UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
90/010,940	05/06/2010	6600175	1300-000044/US/RXA	4549

23448 7590 05/24/2012

Hultquist IP
P.O. Box 14329
RESEARCH TRIANGLE PARK, NC 27709

EXAMINER

ART UNIT	PAPER NUMBER

DATE MAILED: 05/24/2012

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

DO NOT USE IN PALM PRINTER

(THIRD PARTY REQUESTER'S CORRESPONDENCE ADDRESS)

HARNESS, DICKEY & PIERCE, P.L.C.

P.O. BOX 828

BLOOMFIELD HILLS, MI 48303

EX PARTE REEXAMINATION COMMUNICATION TRANSMITTAL FORM

REEXAMINATION CONTROL NO. 90/010,940.

PATENT NO. 6600175.

ART UNIT 3992.

Enclosed is a copy of the latest communication from the United States Patent and Trademark Office in the above identified *ex parte* reexamination proceeding (37 CFR 1.550(f)).

Where this copy is supplied after the reply by requester, 37 CFR 1.535, or the time for filing a reply has passed, no submission on behalf of the *ex parte* reexamination requester will be acknowledged or considered (37 CFR 1.550(g)).

PTOL-465 (Rev.07-04)

Office Action in Ex Parte Reexamination	**Control No.** 90/010,940	**Patent Under Reexamination** 6600175
	Examiner ERIK KIELIN	**Art Unit** 3992

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

a☒ Responsive to the communication(s) filed on *26 March 2012* . b☒ This action is made FINAL.
c☐ A statement under 37 CFR 1.530 has not been received from the patent owner.

A shortened statutory period for response to this action is set to expire 2 month(s) from the mailing date of this letter.
Failure to respond within the period for response will result in termination of the proceeding and issuance of an *ex parte* reexamination certificate in accordance with this action. 37 CFR 1.550(d). **EXTENSIONS OF TIME ARE GOVERNED BY 37 CFR 1.550(c).**
If the period for response specified above is less than thirty (30) days, a response within the statutory minimum of thirty (30) days will be considered timely.

Part I THE FOLLOWING ATTACHMENT(S) ARE PART OF THIS ACTION:

1. ☐ Notice of References Cited by Examiner, PTO-892.
2. ☒ Information Disclosure Statement, PTO/SB/08.
3. ☐ Interview Summary, PTO-474.
4. ☐ _____.

Part II SUMMARY OF ACTION

1a. ☒ Claims *1-5,11-13,21-24 and 26-188* are subject to reexamination.
1b. ☒ Claims *6-10,14-20 and 25* are not subject to reexamination.
2. ☐ Claims _____ have been canceled in the present reexamination proceeding.
3. ☐ Claims _____ are patentable and/or confirmed.
4. ☒ Claims *1-5,11-13,21-24 and 26-188* are rejected.
5. ☐ Claims _____ are objected to.
6. ☐ The drawings, filed on _____ are acceptable.
7. ☐ The proposed drawing correction, filed on _____ has been (7a)☐ approved (7b)☐ disapproved.
8. ☐ Acknowledgment is made of the priority claim under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All b)☐ Some* c)☐ None of the certified copies have

    1☐ been received.

    2☐ not been received.

    3☐ been filed in Application No. _____ .

    4☐ been filed in reexamination Control No. _____.

    5☐ been received by the International Bureau in PCT application No. _____.

    * See the attached detailed Office action for a list of the certified copies not received.

9. ☐ Since the proceeding appears to be in condition for issuance of an *ex parte* reexamination certificate except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte* Quayle, 1935 C.D. 11, 453 O.G. 213.

10. ☐ Other: _____

cc: Requester (if third party requester)

DETAILED ACTION

This action is on the claims for which a substantial new question of patentability has been requested and determined to exist; that is claims 1-5, 11-13, 21-24, and 26 of US 6,600,175 to Bruce Baretz and Michael Tischler (the '175 patent, hereafter) and proposed new claims 27-61 submitted in the Amendment dated 5/3/2011 and Proposed new claims 62-188 submitted in the Amendment dated 3/26/2012.

Since requester did not request reexamination of claims 6-10, 14-20, and 25, and did not assert the existence of a substantial new question of patentability (SNQ) for said claims, they will not be reexamined. See MPEP 2243.

This action responds to Patentee's submissions of 2/13/2012 (IDS), 2/29/2012 (IDS), 3/26/2012 (Amendment and Remarks), and 4/4/2012 (IDS).

Table of Contents

I. Information Disclosure Statement 8
II. Claim Status 8
III. The References 8
IV. Claim Rejections - 35 USC § 112 10
  A. Proposed new claims 62-99, 149-171, 178, 187, and 188 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. 10
V. Claim Rejections - 35 USC § 102 and 35 USC § 103 14
  A. Statute 14
    1. 35 USC 102 14
    2. 35 USC 103 15
  B. Comment regarding new claims 62-99, 149-171, 178, 187, and 188 15
  C. Stevenson as a base reference 15
    1. Claims 1, 5, 12, 13, 21, 22, 26, 27, 31-33, 41, 45-47, 55, 59-61, 172, 176, and 178 are rejected under 35 U.S.C. 102(b) as being anticipated over Stevenson, as evidenced by the CRC Handbook. 15
    2. Claims 1, 5, 12, 13, 21, 22, 26, 27, 31-33, 41, 45-47, 55, 59-61, 172, 176, and 178 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of any of Pinnow, Menda, and Admitted Prior Art (APA). 25
    3. Claims 1, 3-5, 12, 13, 21, 22, 26, 62, 63, 69-72, 74, 76-79, 100, 101, 106-110, 112, 114-116, 118, 124-126, 128, 130-132, 134, 137, 140-142, 145-147, 172, 176, and 178 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Nakamura. 31

4. Claims 187 and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Tadatsu. 42

5. Claims 63-65, 68, 70-73, 101-103, 106, 108-111, 119-121, 124, 126, 127, 135-137, 140, 142, 143, 187 and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Nakamura as applied to claims 62, 100, 118, and 134, above, and further in view of Tadatsu. 45

6. Claims 63, 66-72, 74, 101, 104-110, 112, 121-126, 128, 137-142, 162-166 and 168-171 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Nakamura as applied to claims 62, 100, 118, and 134, above, and further in view of Tabuchi. 49

7. Claims 5, 11-13, 21, 22, 26, 172, and 176 is rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Edmond........ 57

8. Claims 2 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of (1) Stevenson in view of **Imamura**, (2) Stevenson in view of any of Pinnow, Menda, and APA, and further in view of **Imamaura**, (3) Stevenson in view of Pinnow, Nakamura, and **Imamura**, and (4) Stevenson in view of Pinnow, Edmond and **Imamura**........ 59

9. Claims 1, 5, 12, 13, 21, 22, 26-28, 30-33, 41, 42, 44-47, 55, 56, 58-61, 172, 173, 176-178, 187, and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of **Tadatsu** or, in the alternative, over Stevenson in view of APA and **Tadatsu**........ 61

10. Claims 28-30, 42-44, 56-58, 173, and 177 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of **Tabuchi** or, in the alternative, over Stevenson in view of APA and **Tabuchi**. 64

11. Claims 3, 34, 38-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA and Nakamura. 67

12. Claims 62, 75, 100, and 113 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA, Wanmaker, and Nakamura........ 72

13. Claims 3, 34, 35, 37-40, and 179 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA and Nakamura and further in view of Tadatsu. 76

14. Claims 35-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA and Nakamura and further in view of Tabuchi. 78

15. Claims 79, 80, 116-118, 129, 132-134, 144, 147, 148, 162, and 167 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA, Wanmaker, and Nakamura and further in view of Tabuchi and Martic. 78

D. Tabuchi as a base reference 82

1. Claims 1, 5, 22, 26, 172, 173, 176, and 177 are rejected under 35 U.S.C. 102(b) as being anticipated by Tabuchi, as evidenced by the CRC Handbook. 82

2. Claims 1, 5, 22, 26, 27-32, 41-46, 55-60, 172, 173, 176, and 177 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Admitted Prior Art (APA). 87

3. Claims 1, 5, 22, 26, 172, 173, 176, 177, and 187 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow. 90

4. Claims 2 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of (1) Tabuchi in view of Stevenson and Imamura, (2) Tabuchi in view of APA, Stevenson, and Imamaura, and (3) Tabuchi in view of Pinnow, Stevenson, and Imamura. 92

5. Claims 3, 4, and 34-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA and Nakamura... 94

6. Claims 62, 63, 66-69, 74-80, 100, 101, 104-107, 110, 112-117, 162, and 164-171 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA, Wanmaker, and Nakamura.. 98

7. Claims 118, 121-126, 128-134, 137-142, and 144-148 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA, Wanmaker, Nakamura, and Martic.. 105

8. Claims 34, 35, 37-40 and 179 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA and Nakamura as applied to claims 3, 4, 34, and 38-40, above, and further in view of Tadatsu. 110

9. Claims 3-5, 12, 13, 21, 22, 26, 62, 63, 66-72, 74, 76-79, 100, 101, 104-110, 112, 114-116, 118, 121-126, 128, 130-132, 134, 137-142, 145-147, 162-166, 168-172, 178, 187, and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow and Nakamura. 111

10. Claims 64, 65, 73, 102, 103, 111, 119, 120, 127, 135, 136, and 143 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow and Nakamura as applied to claims 62, 72, 100, 110, 118, 126, 134, and 142, above, and further in view of Tadatsu. 126

11. Claims 5, 11-13, 22, 26, 172, 173, 187, and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow and Edmond............ 129

E. Menda as a base reference 131

1. Claims 1, 3, 5, 22, and 26 are rejected under 35 U.S.C. 102(b) as being anticipated by Menda, as evidenced by any of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER.. 131

2. Claims 2, 23, 24, 180, 181, and 186 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda, as evidenced by any of Penguin, Fundamentals of Photonics, Morkoç, Abe, and Tadatomo, and in view of Imamura. 144

3. Claims 1, 3, and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of any of Fundamentals of Photonics, Morkoç, Abe, and Tadatomo.... 147

4. Claims 21, 22, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of Tadatomo. 153

5. Claims 2, 23, 24, 180, 181, and 186 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of any of Fundamentals of Photonics, Morkoç, Abe, and Tadatomo and further in view of Imamura. 154

6. Claims 4 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of Morkoç. 157

7. Claims 48 and 52-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of either of Morkoç and Tadatomo, as applied to claim 24 above, and further in view of Uehara or, in the alternative, over Menda in view of Imamura and either of Morkoç and Tadatomo, as applied to claim 24, above, and further in view of Uehara. 158

8. Claims 49-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of Uehara and either of Morkoç and Tadatomo as applied to claim 48, above, and further in view of Abe or, in the alternative, over Menda in view of Imamura, Uehara, and either of Morkoç and Tadatomo as applied to claim 48, above, and further in view of Abe. 162

F. Abe as a base reference 165

1. Claims 3, 4, and 34-37 are rejected under 35 U.S.C. 102(e) as being anticipated by Abe. 165

2. Claims 1, 2, 5, 23, 27-30, 41-44, 172, and 173 are rejected under 35 U.S.C. 102(e) as being anticipated by Abe, as evidenced by LEDLASER. 167

3. Claims 22, 26, 55-58, 176, and 177 are rejected under 35 U.S.C. 102(e) as being anticipated by Abe, as evidenced by LEDLASER and M-H Encyclopedia. 170

4. Claims 11-13, 31-33, 38-40, 45-47, 59-63, 68, 69, 72, 74-80, 100, 101, 106, 107, 110, 112, 113-117, 162, 164, 166, 167-171, and 178 are rejected under 35 U.S.C. 103(a) as being unpatentable over Abe, as evidenced by LEDLASER, in view of Morkoç. 172

G. Lenko as a base reference (The liquid crystal display claims) 178

1. Claims 24, 48, 52-54, 81, 82, 94-98, 174, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, as evidenced by the CRC Handbook. 179

2. Claims 24, 48, 52-54, 81, 82, 94-98, 174, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson in view of any of Pinnow, Menda, and Admitted Prior Art (APA). 184

3. Claims 81, 82, 95-98, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, Pinnow, and Nakamura. 185

4. Claims 83, 84, 87, 89-92, 149-152, 155, 157, 158, 160, and 161 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, Pinnow, Nakamura, and **Tadatsu**. 185

5. Claims 85-88, 91, 93, 149, 152-157, and 175 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, Pinnow, Nakamura, and **Tabuchi**. 187

6. Claims 49 and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of either (1) Stevenson and **Tadatsu**, or (2) Stevenson, APA, and **Tadatsu** 189

7. Claims 49-51 and 175 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of either (1) Stevenson and **Tabuchi**, or (2) Stevenson, APA, and **Tabuchi**............................ 190

8. Claims 81, 82, 94-98, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker and Nakamura 191

9. Claim 99 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker, Nakamura, and **Tabuchi** 192

10. Claims 149 and 159 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker, Nakamura, **Tabuchi and Martic**... 192

11. Claims 24 and 48-53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi and APA.. 193

12. Claims 52-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, and Nakamura.. 195

13. Claims 81, 82, 85-88, and 93-99 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, Wanmaker, and Nakamura. 196

14. Claims 89-91, 149, 152-157, and 159-161 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, Wanmaker, Nakamura, and Martic.................................... 198

15. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi and APA.......... 200

16. Claims 81, 82, 85-91, 93, and 95-98 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, Pinnow, and Nakamura.. 202

17. Claims 83, 84, 89-92, 149-152, 155, 157, 158, 160, and 161 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, Pinnow, Nakamura, and Tadatsu........................... 203

VI. Response to Arguments.. 205

A. Patentee's general arguments directed to Menda 205

1. Patentee and Stringfellow merely speculate that Menda is related to large area displays... 205

2. Patentee and Stringfellow unnecessarily limit the disclosure in Menda 207

3. Menda's alternative sources of radiation, e.g. X-ray, β-ray, γ-rays do not negate the explicit disclosure of "solid ultraviolet light emitting element having a structure of a pn junction, MOS junction or the like".. 208

4. The '175 patent uses commercially available GaN-based LEDs that Patentee and Stringfellow argues would not work.. 209

5. Examiner never even hinted that Menda failed to implicitly disclose single-die semiconductor LEDs 211

6. Each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER tells that it is known to those of ordinary skill that UV light-emitting pn junctions include single-die semiconductor LEDs 212

7. Imamura uses an array of LED as a backlight for an LCD, so those of ordinary skill knew very well at the time of Menda that LEDs were a sufficient light source for back lights 213

8. Specific rejections relying on Menda as a base reference 213

B. Patentee's general arguments directed to Stevenson 214

1. Patentee and Stringfellow fail to acknowledge that Stevenson's GaN-based LED emits light in the same spectral region as the commercially available LED disclosed in the Baretz Declaration and in the '175 patent 214

2. A single white light LED was known by the time of Stevenson, Tabuchi, and Tadatsu 217

3. Patentee does not know what is legally meant by "teaching away" 219

C. Rejections over Abe and the Declarations filed under 37 CFR 1.131 220

1. The facts in *In re Hostettler* and *In re Spiller* and *Ex parte Goddard* do not apply to the facts in these proceedings 220

2. The fourth Baretz, fourth Tischler, and third Elliot Declarations are ineffective in swearing behind Abe 222

3. Specific rejection relying on Abe as a base reference 229

D. Secondary Considerations 230

1. No evidence of long-felt need 230

2. There is no evidence of failure of others, especially since Stevenson, Tabuchi, and Abe anticipate the claimed device 232

3. There is no evidence of unexpected results 232

4. Commercial success and the third Brandes Declaration 233

5. The third Brandes Declaration fails to provide evidence of commercial success 235

Conclusion 240

THE REST OF THIS PAGE IS INTENTIONALLY LEFT BLANK.

I. Information Disclosure Statement

MPEP 2256 states in pertinent part,

> Where patents, publications, and other such items of information are submitted by a party (Patent Owner or Requester) in compliance with the requirements of the rules, the requisite degree of consideration to be given to such information will be normally **limited by the degree to which the party filing the information citation has explained the content and relevance of the information**. The initials of the examiner placed adjacent to the citations on the form PTO /SB /08A and 08B or its equivalent, without an indication to the contrary in the record, do not signify that the information has been considered by the examiner any further than to the extent noted above.

(Emphasis added.)

In concert with MPEP 2256, unless otherwise indicated, the references submitted in the IDS filed 2/13/2012, 2/29/2012, and 4/4/2012 have been considered only to the extent that the submitting party has "explained the content and relevance".

II. Claim Status

(1) Original claims subject to reexamination: 1-5, 11-13, 21-24, and 26

(2) Claims not subject to reexamination: 6-10, 14-20, and 25

(3) Canceled claims: none

(4) Claims newly proposed: 27-188

(5) Claims literally amended: 1, 5, 11, 12, 21, and 24

(6) Claims effectively amended: 2 and 8-23

(7) Claims active: 1-5, 11-13, 21-24, and 26-188

III. The References

(1) JP 6-267301 to Kazunori Menda, published 22 September 1994 (Menda, hereafter)

(2) US 5,535,230 to Tadashi Abe, filed 3 January 1995, issued 9 July 1996 (Abe, hereafter)

(3) US 5,283,425 to Masaya Imamura, issued 1 February 1994 (Imamura, hereafter)

(4) Morkoç, et al, "Large-band-gap SIC, III-V nitride, and II-VI ZnSe-based semiconductor device technologies", *J. Appl. Phys. 76(3)*, 1; March 17, 1994; Illinois University (Morkoç, hereafter)

(5) *McGraw-Hill Encyclopedia of Science & Technology*, 6th Edition, Vol. 9, pg. 582 and Vol. 10, pp. 60-63; Copyright 1987 (M-H Encyclopedia, hereafter)

(6) *McGraw-Hill Dictionary of Scientific and Technical Terms*, 3rd Edition, pp. 912, 1446; Copyright 1984 (M-H Dictionary, hereafter)

(7) *The Penguin Dictionary of Electronics*, 3rd edition, pp. 315, 437-438, 509-510, copyright 1979, 1988, and 1998 (Penguin, hereafter)

(8) "LEDs and Laser Diodes", Electus Distribution, copyright 2001, available at URL: http://www.jaycar.com.au/images_uploaded/ledlaser.pdf (LEDLASER, hereafter)

(9) US 4,772,885 to Uehara et al., issued 20 September 1988 (Uehara, hereafter)

(10) JP 3-24692 to Kentaro Fujii, published 14 March 1991 (Fujii, hereafter)

(11) US 5,770,887 to Tadatomo et al., filed 11 October 1994 (Tadatomo, hereafter)

(12) Saleh and Teich, Fundamentals of Photonics, New York: John Wiley & Sons, 1991, pp. 592-594 (Fundamentals of Photonics, hereafter)

(13) US 3,819,974 to Stevenson et al., issued 25 June 1974 (Stevenson, hereafter)

(14) US 3,691,482 to Pinnow et al., issued 12 September 1972 (Pinnow, hereafter)

(15) JP 5-152609 to Tadatsu et al., published 18 June 1993 (Tadatsu, hereafter)

(16) JP 50-79379 to Sei-ichi Tabuchi, published 24 November 1973 (Tabuchi, hereafter)

(17) CRC Handbook, 63rd Ed., (1983) p. E-201 (CRC Handbook, hereafter)

(18) US 4,918,497 to John Edmond, issued 17 April 1990 (Edmond, hereafter)

(19) US 3,793,046 to Wanmaker et al., issued 19 February 1974 (Wanmaker, hereafter)

(20) US 3,743,833 to Martic et al., issued 3 July 1973 (Martic, hereafter)

(21) Lumogen® F Violet 570 Data Sheet; available at the BASF Chemical Company website URL, http://worldaccount.basf.com/wa/EU~en_GB/Catalog/Pigments/doc4/BASF/PRD/30

048274/.pdf?title=Technical%20Datasheet&asset_type=pds/pdf&language=EN&urn=urn:documentum:eCommerce_sol_EU:09007bb280021e27.pdf

The '175 patent was filed 26 March 1996. Each of Menda, Morkoç, M-H Encyclopedia, M-H Dictionary, Uehara, Fujii, Fundamentals of Photonics, Stevenson, Pinnow, Tadatsu, Tabuchi, and Edmond, were issued or published more than one year before the '175 patent's priority date; thus each qualifies as prior art under 35 USC 102(b).

Abe and Tadatomo were filed before the filing of the application that became the '175 patent; thus, Abe and Tadatomo qualify as prior art under 35 USC 102(e). As will be discussed below, Patentee's Declarations are ineffective to overcome Abe as prior art.

Penguin, LEDLASER, and CRC Handbook are used only for purposes of definition or evidence and therefore need not qualify as prior art.

IV. Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

A. Proposed new claims 62-99, 149-171, 178, 187, and 188 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement.

The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Each of claims 62, 81, 149, 162, 178, 187, and 188 requires a primary radiation consisting of **blue** light from a GaN-based LED to be converted by phosphors to a secondary radiation composed of lower energy (longer wavelength) visible white light, wherein the secondary radiation alone --without contribution from the **blue primary** radiation-- produces white light. As claimed this reads:

(1) Claims 62, 81, 162 and 178:

> *at least one single-die gallium nitride based semiconductor* ***blue light-emitting*** *diode (LED) ... said* ***primary radiation*** *being a relatively shorter wavelength* ***blue*** *light radiation; and*

> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to* ***said primary radiation,*** *is excited to responsively emit a* ***secondary,*** *relatively* ***longer wavelength,*** *polychromatic radiation,* ***with separate wavelengths of said polychromatic radiation mixing*** *to produce a* ***white*** *light output*

(2) Claim 149:

> *at least one single-die gallium nitride based semiconductor* ***blue light-emitting*** *diode (LED) coupleable with a power supply to emit a* ***primary blue light radiation*** *...*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to* ***said primary radiation*** *responsively emits a* ***secondary,*** *relatively* ***longer wavelength,*** *polychromatic radiation, with* ***separate wavelengths of said polychromatic radiation mixing*** *to produce a* ***white*** *light output,*

(5) Claim 187:

> *a light-emitting diode operative to emit* ***blue*** *or ultraviolet* ***radiation,*** *packaged with luminophoric medium in a polymeric matrix, wherein the* ***luminophoric medium absorbs blue*** *or ultraviolet radiation from the light-emitting diode and* ***down converts same*** *to a broad spectrum of frequencies producing* ***polychromatic white light,***

The first reason these claims are not enabled is that the '175 patent does not enable down-converting solely **blue** light (i.e. the primary radiation) to white light. The claim language requires the secondary or down-converted radiation **alone** to make up all of the colors that mix to produce the white light; therefore, blue light from the LED cannot be included in producing white light. However, blue light is one of the primary colors needed to produce white light. Because the LED's blue light cannot contribute to the white light output by the secondary radiation, said secondary radiation lacks the blue light wavelengths needed to produce white light. Therefore, the claims are not enabled.

The second reason the claims are not enabled comes from evidence in the '175 patent itself. As will be shown below, the '175 patent shows that the **blue** light (primary radiation) is either (1) **not** absorbed by at least one of the phosphors in the luminophoric medium needed to produce white light, or (2) is **not down-converted**, as required by the claims. In this regard, the '175 patent indicates that a commercially available blue light-emitting LED, having an emission max at 450 nm, can be used with commercially available phosphors to produce white light:

> In one embodiment, LED 13 comprises a leaded, **gallium nitride based LED** which exhibits **blue light emission** with an emission maximum at approximately **450 nm** with a **FWHM of approximately 65 nm**. Such a

> device is available commercially from Toyoda Gosei Co. Ltd. (Nishikasugai, Japan; see U.S. Pat. No. 5,369,289) or as Nichia Product No. NLPB520, NLPB300, etc. from Nichia Chemical Industries, Ltd. (Shin-Nihonkaikan Bldg. 3-7-18, Tokyo, 0108 Japan; see Japanese Patent Application 4-321,280). The down-converting material in this embodiment comprises a **blue fluorescer** (**Lumogen® F Violet 570**--substituted napthalenetetracarboxylic diimide), a green-yellow fluorescer (Lumogen® F Yellow 083--substituted perylenetetracarboxylic diimide) and a red fluorescer (Lumogen® F Red 300--substituted perylenetetracarboxylic diimide). A composition comprising such blue, green-yellow, and red fluorescent materials, all organic based, as incorporated in an insulating epoxy polymer, is available commercially from Pacific Polytech (Pacific Polytech, Incorporated, 15 Commercial Blvd., Novato, Calif. 94949-6135).

(the '175 patent, col. 9, lines 10-29; emphasis added)

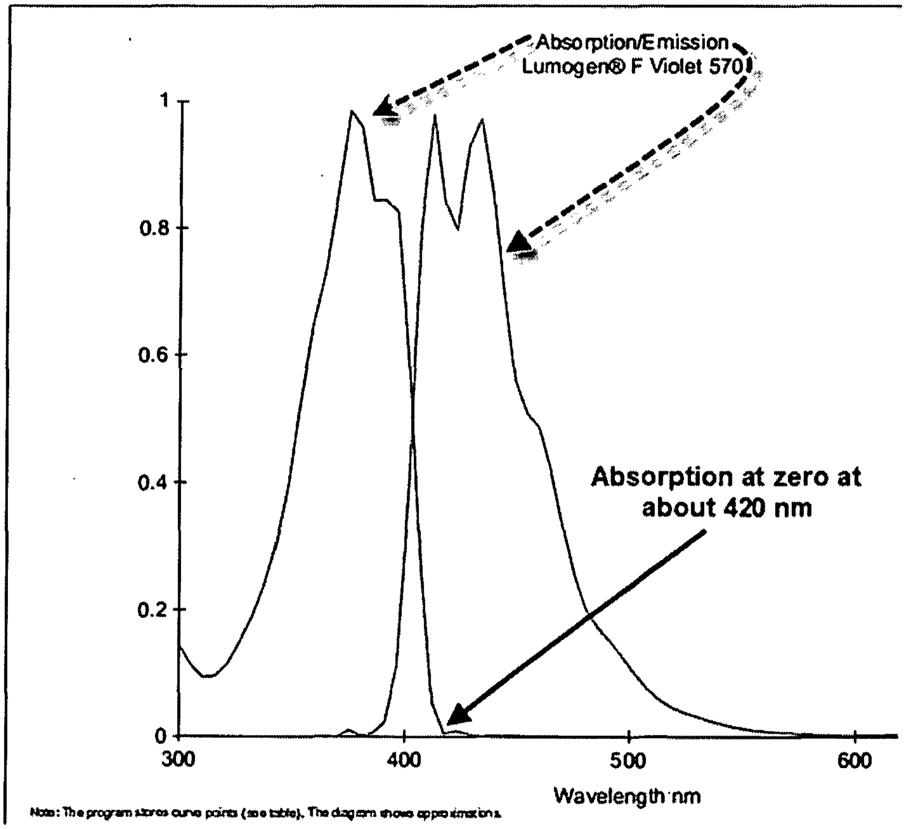
As indicated in the fourth Baretz Declaration (dated 3/26/2012), given the FWHM of about 65 nm (Baretz says "70 nm"), Baretz concluded that the Nichia LED emits in a range of about 380 nm to 520 nm (fourth Baretz Declaration, dated 3/26/2012, ¶ 18), thereby including ultraviolet and violet light as well that for which Baretz used phosphors absorbing over this **entire** wavelength range (*id.*) --not just the blue. However, the claims require the **blue** light primary radiation, **alone**, be converted to all of the wavelengths of light that produce the white light. The blue range of the spectrum is 424 nm to 491.2 nm, as evidenced by the CRC Handbook (table reproduced below):

WAVE LENGTHS OF VARIOUS RADIATIONS

	Angstroms
Cosmic rays	0.0005
Gamma rays	0.005–1.40
X-rays	0.1–100
Ultra violet, below	4000
Limit of sun's U.V. at earth's surface	2920
Visible spectrum	4000–7000
Violet, representative, 4100, limits	4000–4240
Blue, representative, 4700, limits	4240–4912
Green, representative, 5200, limits	4912–5750
Maximum visibility	5560
Yellow, representative, 5800, limits	5750–5850
Orange, representative, 6000, limits	5850–6470
Red, representative, 6500, limits	6470–7000
Infra red, greater than	7000
Hertzian waves, beyond	2.20 × 10^6

(CRC Handbook, 63rd Ed., p. E-201)

As indicated in the '175 patent, above, Luminogen® F Violet 570 is the phosphor cited in the '175 patent, above, for converting light from the Nichia GaN-LED to blue light. However, as will be shown below, Luminogen® F Violet 570 does **not** absorb blue light, as required by the claims. In this regard, the absorption and emission spectra (reproduced below) from the data sheet of Luminogen® F Violet 570 (available at the BASF Chemical Company website and attached to this action) shows that this phosphor absorbs virtually no radiation having a wavelength shorter than about 420 nm, which is **outside** the wavelength range of **blue** light (i.e. below 424 nm, which is violet light, not blue light). Thus, **given the claims as written,** the claims are not enabled for **down-converting blue radiation** using the phosphor since said blue light is **not absorbed** by the very phosphor (Luminogen® F Violet 570) that the '175 patent indicates is responsible for producing the blue light.



(from BASF Chemical Company)

As shown in the emission spectrum above and as evidenced by the fourth Baretz's Declaration (3/26/2012 ¶ 18), the emission spectra of Luminogen® F Violet 570 and Nichia GaN, blue LED appears to have the **same** emission wavelength range of 380-420 nm. By contrast, the claims require the blue radiation emission from the LED to be **down**-converted (in terms of energy i.e. to longer wavelengths). The equal emission spectra do not appear to allow the claimed **down conversion** of

blue light by at least one of the phosphors used in the '175 patent to produce the blue light portion of the secondary radiation that contributes to the white light, as required by the claims.

Further in this regard, without claiming which phosphors are capable of actually down-converting the **blue** primary radiation to some visible color of light that contributes to the white light produced solely by the secondary radiation, the proposed new and proposed amended claims are not enabled in scope with the disclosure in the '175 specification for failing provide which phosphors are capable of said down-conversion of the claimed **blue** light to blue light of a longer wavelength, which does not appear to be a down-conversion at all.

In summary, if the blue light from the LED is not absorbed by the phosphor (e.g. Luminogen® F Violet 570), then there can be no down-converted radiation from said phosphor to contribute to the blue portion of the secondary radiation that makes the white light, contrary to the claims. In addition, since the blue light is not absorbed by the phosphor, Luminogen® F Violet 570, at least some of the blue light contributing to the white light comes from the LED rather than from the secondary, down-converted radiation, since the phosphor is not absorbing the **blue** radiation from the LED, contrary to the claims.

The remaining claims listed above, depend form one of the independent claims either directly or indirectly and therefore are not enabled for the same reasons as discussed above.

V. Claim Rejections - 35 USC § 102 and 35 USC § 103

A. Statute

1. 35 USC 102

The following is a quotation of the appropriate paragraphs of **35 U.S.C. 102** that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the

> international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. 35 USC 103

The following is a quotation of **35 U.S.C. 103(a)** which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

B. Comment regarding new claims 62-99, 149-171, 178, 187, and 188

Based on the rejection under 35 USC 112(1) above, the rejections over prior art of proposed new claims 62-99, 149-171, 178, 187, and 188 are made to the extent these claims may be deemed enabled. Examiner respectfully maintains that the claims are not enabled, **as written**.

C. Stevenson as a base reference

1. Claims 1, 5, 12, 13, 21, 22, 26, 27, 31-33, 41, 45-47, 55, 59-61, 172, 176, and 178 are rejected under 35 U.S.C. 102(b) as being anticipated over Stevenson, as evidenced by the CRC Handbook.

Proposed amended claim 1 reads,

> ***[1]*** *1. A light emitting device, comprising:*
>
> ***[2]*** *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation* ***[3]*** *which is the same for each single-die semiconductor LED present in the device,* ***[4]*** *said primary radiation being a relatively shorter wavelength radiation outside the visible white light spectrum; and*
>
> ***[5]*** *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum, with said radiation of said multiplicity of wavelengths mixing to produce a white light output,* ***[6]*** *wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Feature [1]: ***1. A light emitting device***

Stevenson's Fig. 3 (reproduced below) shows a light emitting device, specifically a GaN-based light-emitting diode (Stevenson, title: "Gallium Nitride Metal-Semiconductor Junction Light Emitting Diode").

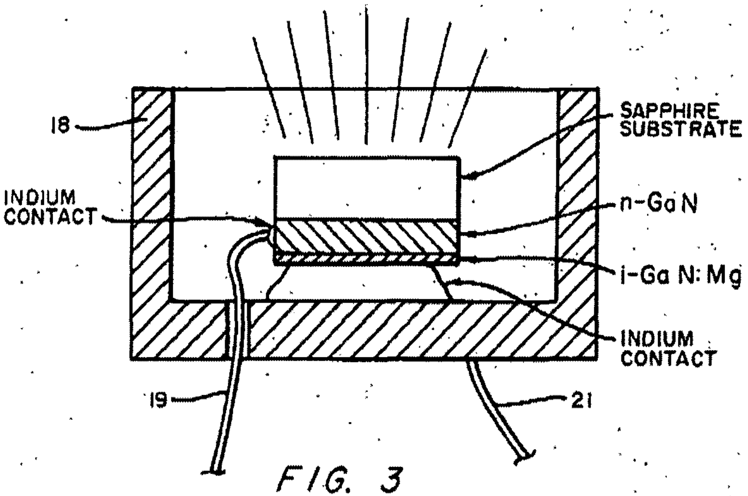


FIG. 3

(Stevenson, Fig. 3)

Feature [2]: *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation*

Stevenson's Fig. 3 shows a *single-die semiconductor LED* where the semiconductor includes GaN. Fig. 3 also shows that leads **19** and **21** that couple the LED to a power supply. In this regard, Stevenson states,

> Referring to FIG. 1, the steps of forming a junction **gallium nitride light emitting diode** are illustrated. A **wafer** or slice of single crystal flame-fusion-grown **sapphire** may be used as the **substrate 11**. A layer of highly n-type **gallium nitride 12** is formed on one surface of the wafer...

(Stevenson, col. 1, lines 58-64; emphasis added)

> After the formation of the slice shown in FIG. 1C, the slice is **cut up** or **diced** to form devices of predetermined size.

(Stevenson, col. 2, lines 29-31; emphasis added)

(This passage is provided because Patentee has previously alleged that a "die" must be cut from a larger wafer --a point with which Examiner disagrees. Patentee cannot argue that Stevenson fails to meet its interpretation of a "*single-die*" because each LED die is cut from a larger wafer.)

The *primary radiation* emitted by the GaN-based LED is shown in Stevenson's Fig. 4 (reproduced below).

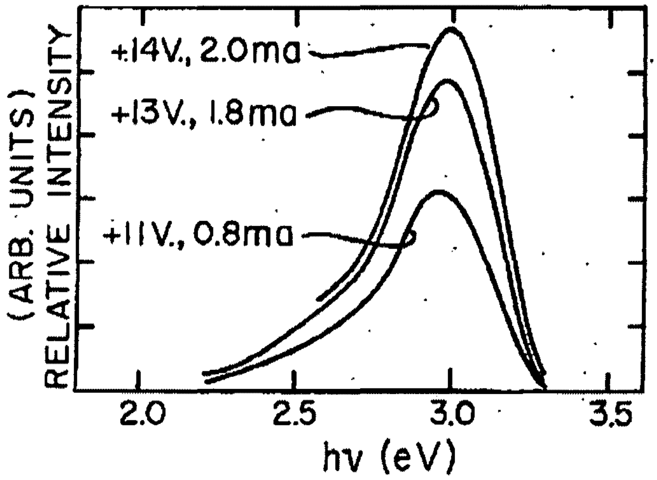


FIG. 4

(Stevenson, Fig. 4)

The range of light energy emitted range from about 2.5 eV to about 3.25 eV. Given that the relations below, the energy can be converted to wavelength.

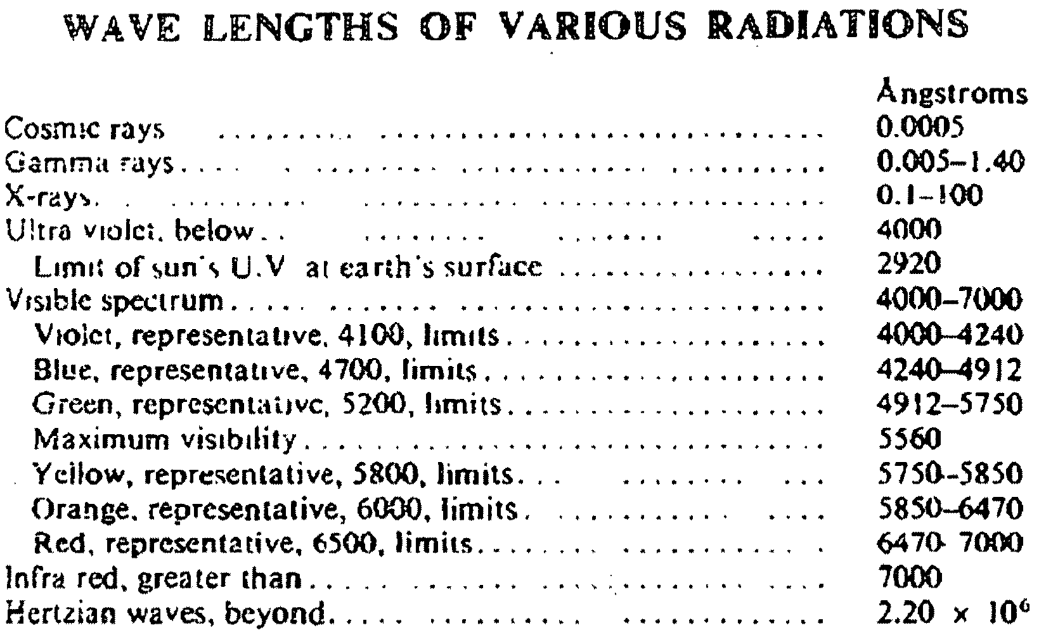
$$E = Hv = Hc/\lambda = (4.13566733\times10\text{-}15 \text{ eV}\cdot\text{s})(299792458 \text{ m/s}) / \lambda$$

$$E \text{ (in eV)} \approx 1240 \text{ eV}\cdot\text{nm} / \lambda \text{ (in nm)}$$

Therefore,

$$\lambda \text{ (in nm)} \approx 1240 \text{ eV}\cdot\text{nm} / E \text{ (in eV)}$$

Using the above relation, the range of wavelengths emitted by Stevenson's GaN-based LED is about 496 nm (4960 Å) to 381 nm (3810 Å). The page from the CRC Handbook (reproduced below) shows that the light emitted ranges from blue to ultraviolet.



WAVE LENGTHS OF VARIOUS RADIATIONS

	Angstroms
Cosmic rays	0.0005
Gamma rays	0.005–1.40
X-rays	0.1–100
Ultra violet, below	4000
Limit of sun's U.V at earth's surface	2920
Visible spectrum	4000–7000
Violet, representative, 4100, limits	4000–4240
Blue, representative, 4700, limits	4240–4912
Green, representative, 5200, limits	4912–5750
Maximum visibility	5560
Yellow, representative, 5800, limits	5750–5850
Orange, representative, 6000, limits	5850–6470
Red, representative, 6500, limits	6470–7000
Infra red, greater than	7000
Hertzian waves, beyond	2.20×10^6

(CRC Handbook, 63rd Ed., p. E-201)

The peak emission is violet (424 nm to 400 nm), but significant emission is both blue (491 nm to 424 nm) and ultraviolet (less than 4000 Å or 400 nm). Therefore, Stevenson's LED emits light outside the visible spectrum. This is entirely consistent with that which Patentee regards as the invention. In this regard, the '175 patent states,

> **Gallium nitride and its alloys** can emit in the spectral range covering the **blue and ultraviolet** extending from wavelengths of **200 nanometers to approximately 650 nanometers**.

(the '175 patent, col. 10, lines 30-33; emphasis added)

Thus, Patentee acknowledges that the range of light emitted by the GaN-based LEDs is a continuum and includes more than a single wavelength or color.

In addition, in all of the declarations of Bruce Baretz (first listed inventor of this patent) indicate that the GaN die emits UV or blue light. (See, e.g. the third Baretz Declaration submitted 3/26/2016 which states,

> 12. The Exhibit B memorandum of July 30, 1994 identifies the subject matter thereof as "REFERENCE: White Light Light Emitting Diodes (LED)" referring to the white light LED invention that I and Bruce H. Baretz had conceived prior to the date of such memorandum. The memorandum states as follows:
>
> "Duncan -

> Enclosed are some samples of the Lumogen dyes already cast into PMMA sheets. These dyes may be useful, when incorporated into polycarbonate LED lenses, to attenuate and shift the light emission from **UV or Blue (assuming [sic] a GaN die)** to either a green, yellow, or red emission, or some combination of these emissions. An appropriate combination would, in theory, generate white light.
>
> I will see if I can get some information on purchasing these Lumogen dyes already mixed into polycarbonate.
>
> Bruce Baretz"

(Third Baretz Declaration, submitted 3/26/2012, p. 7, ¶ 12; emphasis added)

> **Feature [3]:** *which is the same for each single-die semiconductor LED present in the device*

As discussed above, Stevenson includes one or an array of the same GaN-based LEDs:

> By use of different phosphors, all the primary colors may be developed from this **same basic device**. An **array** of such devices may be used for color display systems; for example, a solid state TV screen.

(Stevenson, col. 4, lines 5-7; emphasis added)

Therefore, the primary light is the same for each LED.

> **Feature [4]:** *said primary radiation being a relatively shorter wavelength radiation outside the visible white light spectrum*

As indicated above, Stevenson's GaN-based LED emits ultraviolet (UV) light (i.e. below 400 nm wavelength) which is necessarily outside the *visible white light spectrum*, and is entirely within the meaning of the '175 patent.

> **Feature [5]:** *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum, with said radiation of said multiplicity of wavelengths mixing to produce a white light output,*

Stevenson discloses a down-converting luminophoric medium including organic and inorganic phosphors to convert the blue-to-UV emitted radiation from the GaN-based LED into visible light to be used for, *inter alia*, color displays and TV's:

> Thus, it is seen that there has been provided an improved **light emitting diode** capable of emitting light in the violet **region** of the spectrum. This device may be used as a source of violet light for applications where this spectral range is appropriate. This **light may be converted to lower**

> **frequencies (lower energy)** with good conversion efficiency using **organic and inorganic phosphors**. Such a conversion is appropriate not only to develop **different colors** for aesthetic purposes, but also to produce light in a spectral range of greater sensitivity for the human eye. By use of **different phosphors, all the primary colors may be developed from this same basic device.** An **array** of such devices may be used for **color display systems; for example, a solid state TV screen**.

(Stevenson, paragraph bridging cols. 3-4; emphasis added)

Each of the primary colors is necessarily within the visible white light spectrum, again as evidenced by the CRC Handbook, above; therefore the phosphors for each primary colors *responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum.*

White light is implicit since a TV must produce white light to properly produce images; therefore, *said radiation of said multiplicity of wavelengths mixing to produce a white light output.*

> **Feature [6]:** <u>wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output</u>.

It is implicit that each of Stevenson's individual LEDs is capable of producing white light because one of ordinary skill would clearly recognize that the combination of phosphors for the primary colors produces white light and a single LED would be better than separate LED for each primary color, especially since the same GaN-based LED is used. It is also implicit because white is one of the "different colors" of light composed of a mixture of all of the primary colors.

This is all of the features of claim 1.

Proposed amended **claim 5** reads,

> *5. A light-emitting device, comprising:*
>
> *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, **is excited to** responsively emit a secondary, **relatively longer wavelength, polychromatic** radiation, with **separate wavelengths** of said **polychromatic** radiation mixing to produce a white light output<u>, each of the at least one single-die semiconductor light-emitting diode in interaction</u> <u>with</u>*

> *luminophoric medium receiving its primary radiation produces white light output.*

Claim 5 is distinct from claim 1 in that (1) the primary radiation is not required to include radiation outside the visible white light spectrum; (2) the down-converting is required to yield longer wavelengths than that of the primary radiation; and (3) separate wavelengths are required to be produced.

With regard to **difference (1)**, claim 5 is broader in this respect; thus, Stevenson discloses the claimed LED for the reasons indicated in conjunction with claim 1.

With regard to **differences (2) and (3)**, as discussed in rejecting claim 1 above, Stevenson discloses that the blue-to-UV light is down-converted (in terms of energy) to visible light by phosphor (PL) materials, which implicitly includes white light --especially since Stevenson discusses TV's which must have white light. Visible light includes white light which is necessarily polychromatic, as evidenced by the CRC Handbook (i.e. visible light includes a combination of the wavelengths from 700 to 400 nm). Because Stevenson discloses that the phosphors can be used to produce the visible light of "different colors", which includes white light, those of ordinary skill in the art would recognize that the phosphors to which Stevenson refers include those producing white light.

This is all of the features of claim 5.

Proposed amended **claim 12** and **claim 13** read,

> *12. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device is on a substrate in a multilayer device structure, and wherein said substrate comprises a material selected from the group consisting of* ***sapphire****, SiC, and InGaAIN.*
>
> *13. A light-emitting device according to claim 12, wherein said multilayer device structure includes layers selected from the group consisting of silicon carbide, aluminum nitride,* ***gallium nitride****, gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys.*

Stevenson's Figs. 2 and 3 show that the *gallium nitride* (GaN) *based* LED is multilayered, including an n-GaN layer **12**, an i-GaN layer **13** and an indium contact layer **17**, all formed on a sapphire substrate **11**.

Proposed amended **claim 21** and **claim 22** read,

> *21. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die, two-lead gallium nitride based blue light semiconductor LED.*

> *22. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die two-lead semiconductor LED.*

As noted above in rejecting claim 1, Stevenson discloses a GaN-based LED (Stevenson, Fig. 3) that emits blue-to-UV light (Stevenson, Fig. 4). Fig. 3 also shows the two leads **19**, **21** (Stevenson, col. 2, line 51) and therefore reads-on the features of claims 21 and 22.

Claim 26 reads,

> *26. A light-emission device, comprising*
>
> *a single-die, two-lead semiconductor light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light.*

This claim is significantly broader than claim 22 above. Stevenson discloses each of the features of this claim for the reasons discussed in rejecting claims 1, 5, and 22 above.

Proposed new **claims 27, 41, and 55** read,

> *27. The light emitting device of claim 1, wherein the luminophoric medium comprises an inorganic luminophor.*
>
> *41. The light emitting device of claim 5, wherein the luminophoric medium comprises an inorganic luminophor.*
>
> *55. The light emitting device of claim 26, wherein the luminophoric medium comprises an inorganic luminophor.*

As already indicated above, Stevenson states that the luminophor can be organic or inorganic:

> This light may be converted to lower frequencies (lower energy) with good conversion efficiency using organic and **inorganic phosphors**.

(Stevenson, col. 3, lines 28-31; emphasis added)

The mixing of specifically inorganic phosphors is also taught by APA, as discussed in detail above.

Proposed new **claims 31-33, 45-47, and 59-61** read,

> *31. The light emitting device of claim 27, wherein each said LED comprises material selected from the group consisting of **gallium nitride and its alloys.***
>
> *32. The light emitting device of claim 27, wherein each said LED comprises **gallium nitride.***
>
> *33. The light emitting device of claim 27, wherein each said LED comprises **gallium nitride alloy.***
>
> *45. The light-emitting device of claim 41, wherein each said LED comprises material selected from the group consisting of **gallium nitride and its alloys.***
>
> *46. The light-emitting device of claim 41, wherein each said LED comprises **gallium nitride.***
>
> *47. The light-emitting device of claim 41, wherein each said LED comprises **gallium nitride alloy.***
>
> *59. The light-emission device of claim 55, wherein the light-emitting diode comprises material selected from the group consisting of **gallium nitride and its alloys.***
>
> *60. The light-emission device of claim 55, wherein the light-emitting diode comprises **gallium nitride.***
>
> *61. The light-emission device of claim 55, wherein the light-emitting diode comprises **gallium nitride alloy.***

As indicated above, Stevenson's Figs. 2 and 3 show that the *gallium nitride* (GaN) *based* LED is multilayered, including an n-GaN layer **12**, an i-GaN layer **13** and an indium contact layer **17**, all formed on a sapphire substrate **11**. The term "n-GaN" is undoped or pure; therefore; Stevenson's LED includes gallium nitride:

> A layer of highly n-type gallium nitride **12** is formed on one surface of the wafer **11** by transporting gallium as its gaseous monochloride and introducing nitrogen into the growth zone in the form of ammonia, both at an elevated temperature (approximately 900°-950°C.) whereby there is epitaxially grown the **GaN layer 12**.

(Stevenson, col. 1, lines 61-67; emphasis added)

The i-GaN is made by alloying with magnesium (Mg); therefore, Stevenson's LED includes GaN alloys:

> The dopant atoms compensate the normally n-type growth to form a substantially intrinsic **GaN:Mg layer 13**. The layer **13** forms an i-n junction

> 14 with the layer 12. The **magnesium** is added by placing magnesium in a graphite crucible and maintaining it at approximately 710°C while passing thereover nitrogen gas. This transports the elemental **magnesium** atoms into the growth zone where they deposit as an impurity or dopant with the gallium nitride to form the intrinsic **GaN:Mg region 13**.

(Stevenson, col. 2, lines 10-19; emphasis added)

Proposed new **claims 172 and 176** read,

> *172. The light-emitting device of claim 5, wherein the secondary, relatively longer wavelength, polychromatic radiation comprises a broad spectrum of frequencies.*
>
> *176. The light-emission device of claim 26, wherein radiation down-converted by the recipient down-converting luminophoric medium comprises a broad spectrum of frequencies.*

As noted above, visible light including each of the primary colors is a broad spectrum of frequencies, as evidenced by the CRC Handbook. Therefore, the secondary, down-converted radiation emitted from Stevenson's light emitting device includes *a broad spectrum of frequencies*.

Proposed new **claim 178** reads,

> *178. A light-emitting device, comprising:*
>
> *a single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary radiation, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output.*

Patentee indicates that claim 178 is claim 5 with the exception that the terminology "at least one" has been removed and that the LED is now limited to a GaN-based blue-light emitting diode (Patentee's Remarks dated 3/26/2012, p. 63). For the same reasons as indicated above, Stevenson anticipates this claim because the LED is a GaN-based LED that emits-blue-to-UV light and therefore emits blue light.

2. Claims 1, 5, 12, 13, 21, 22, 26, 27, 31-33, 41, 45-47, 55, 59-61, 172, 176, and 178 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of any of Pinnow, Menda, and Admitted Prior Art (APA).

The prior art of Stevenson, as explained above, is believed to disclose each of the features of claims 1, 5, 12, 13, 21, 22, 26, 27, 31-33, 41, 45-47, 55, 59-61, 172, 176, and 178.

However, if it is believed that Stevenson does not explicitly disclose that the luminophoric medium includes all of the phosphors for each primary color such that white light is produced by *each* of the GaN-based LEDs --as required by the proposed amended feature of claims 1, 5, 26, and proposed new claim 178, above-- then this may be a difference between Stevenson and claims 1, 5, 26, and 178. As claimed,

> *wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output. (claim 1)*
>
> *each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output. (claim 5)*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light. (claim 26)*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output (claim 178)*

Any of Pinnow, Menda, and APA renders this feature obvious for the reasons indicated below.

Pinnow, like Stevenson, teaches a display wherein an argon laser (instead of an LED) is used to produce the primary visible or UV light that is down-converted by a **mixture of phosphors** into visible, secondary light of longer wavelength light which explicitly includes white light:

> A single color display is produced by projection using a scanning laser beam operating in the **visible** or **ultraviolet** and a photoluminescent screen which emits in the visible. **Combinations of phosphors** may be employed to simulate **white** or desired colors.

(Pinnow, abstract)

Pinnow's Fig. 3 shows the display device including the laser **10** and one example of a phosphor screen **15**. The primary light from the laser **10** is down-converted by phosphor screen **15** to produce visible light. Importantly, Pinnow teaches that phosphors for each primary color can be mixed together in a **resin** to produce **white** light:

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is absorbed on a colloid which may take the form of gell [sic] fibers or particles of high molecular weight polymers.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of **homogeneous phosphor screens**. These may be present as **self-supporting members** or as **coatings**, and they may be made up on **one or any combination of colorants required to produce the desired balance**.

(Pinnow, col. 2, lines 15-20; emphasis added)

> A black and **white** display can be achieved by scanning a monochromatic laser beam on a viewing screen that is **coated with an appropriate blend of phosphors** and direct scattering materials such as powdered MgO or talc. For example, a combination of scattered light from a **blue argon-ion laser beam (4,880 A.)** [i.e. **visible** light] and blue-to-red converted light from either of the Rhodamine dye phosphors can produce a **white** appearance since a straight line connecting these primaries on the chromaticity diagram passes very near to illuminant C.
>
> A combination of **more than two primaries** can also be used to produce **white**. As an example, a **Cd-He laser** beam which illuminates a correctly proportioned mixture of MgO and dye phosphors 3,484 A. and 3,485 A. [i.e. **ultraviolet** light] can be used to achieve a white appearance. Alternately, MgO may be replaced by pyrelene-containing materials or 7-diethyl amino, 4-methyl coumarin-containing materials (blue-to-blue and ultraviolet-to-blue converting phosphor, respectively, to completely eliminate speckle).
>
> Regardless of how many phosphors are used, it is apparent from the chromaticity diagram that a necessary condition for achieving a true white is that the illuminating laser beam have a **wavelength of approximately 4,950 A. or shorter**. Otherwise, it is impossible to include illuminant C within a polygon whose primaries are the source and any combination of longer wavelengths that can be achieved by down-conversion of frequency. Fortunately, the argon-ion laser satisfies this necessary condition.

(Pinnow, col. 3, lines 24-55; emphasis added)

(It is noted that Pinnow uses "A." for "angstrom", which is properly, instead, Å.)

It is important to note in the final paragraph from Pinnow excerpted above, Pinnow tells those of ordinary skill that **any primary radiation can be used so long as its wavelength is 4950 Å (495 nm) or shorter**, providing examples of both **blue** and **UV** light sources for the primary light that is down-converted into visible light. Stevenson's GaN-based LED meets this criteria, as discussed above. Stevenson's GaN-based LED emits blue-to-UV light from about 496 nm (4960 Å) to 381 nm (3810 Å). Therefore, those of ordinary skill using the phosphor mixtures taught by Pinnow have a certain expectation of success. Pinnow shows that the results of illuminating the phosphor mixture with UV light or blue light (i.e. shorter than 4950 Å) produces entirely predictable results in making white light of any shade desired.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Pinnow's phosphor mixtures, made as coating on a screen or as a self-standing screen (Pinnow, *id.*) as the phosphor mixture in Stevenson, in order to produce a white display. Because Stevenson wishes to produce color displays such as TVs but is silent as to the phosphors needed to do this, one of ordinary skill would use known material known to work for the intended purpose.

Thus, Stevenson modified to ensure a mixture of phosphors is used, ensures that *each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium* [phosphor mixture] *receiving its primary radiation produces white light output*, as newly claimed in proposed amended claim 1, and as similarly claimed in claims 5, 26, and 178.

Similar to both Stevenson and Pinnow, Menda is drawn to a display device. Like both Stevenson and Pinnow, Menda teaches that the backlight for the display is white light produced by using a source of UV light (which may be a solid state pn junction or MOS junction) to produce the primary UV light that is down-converted by phosphors into visible, secondary light is white light. In this regard, Menda states,

> In the above embodiment, an organic PL element has been realized using a ZnO ultraviolet light emitting element having a schottky junction structure. Likewise, the green light emitting organic PL element can also be realized by using a **solid ultraviolet light emitting element** having a structure of a **pn junction, MOS** [Metal-Oxide-**Semiconductor**] **junction** or the like. Further, light having colors other than green can also be emitted by changing the type of the organic coloring matter doped into the PL luminescent layer 22. Further, the amount of luminescence from the PL luminescent layer 22 can be regulated by regulating the amount of voltage or current applied to the ultraviolet light emitting element.

(Menda translation, ¶ [0018], p. 6, lines 1-11; emphasis added)

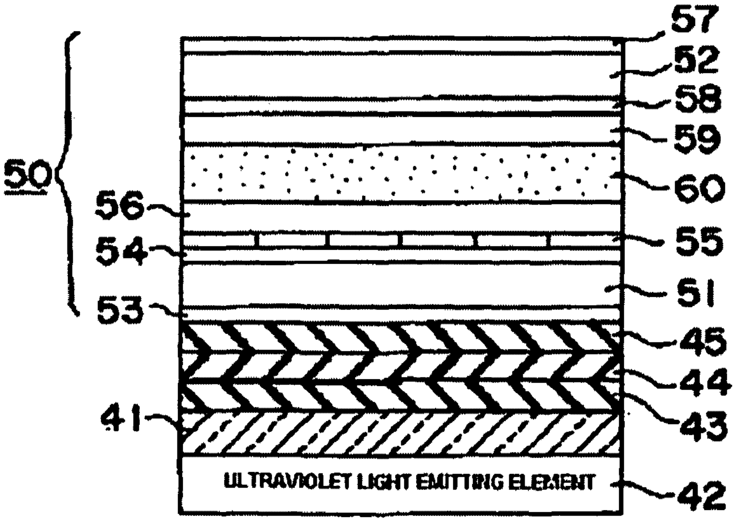
> [0021] **Fig. 4** shows an example in which a PL [PhotoLuminescent] element according to the present invention has been applied to a backlight of a **liquid crystal display**. In the drawing, numeral **41** designates a glass substrate

> transparent to ultraviolet light. An **ultraviolet light emitting element 42 as described in the first embodiment** is provided on one side of the glass substrate **41**. Further, a **blue** PL luminescent layer **43**, a **green** PL luminescent layer **44**, and a **red** PL luminescent layer **45** as described in the second embodiment are stacked on the other side of the glass substrate **41**.
>
> [0022] As shown in the drawing, a **liquid crystal display device 50** is stacked on the PL luminescent element having the above construction. ...
>
> [0023] In the above embodiment, individual PL luminescent layers **43** to **45** of three primary colors are **excited by ultraviolet light emitted from the ultraviolet light emitting element 42** and emit respective lights, and these **three primary colors are mixed together** to provide a **<u>white</u> light**. The **white light** thus obtained is applied as a backlight of the liquid crystal display device **50** through the first glass substrate **51**. Also in this embodiment, a deterioration in the PL luminescent layers **43** to **45** can be avoided, and the service life of the PL luminescent layers **43** to **45** can be prolonged.

(Menda translation, p. 7; emphasis added)

Menda's Fig. 4 (reproduced below) shows the UV light emitting element **42** and the photoluminescent (PL) layers **43, 44, 45**, one for each of the primary colors specifically a liquid crystal display having a backlight (Menda translation, p. 7, ¶ [0021]).

[Fig 4]



(Menda, Fig. 4)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Menda's three PL layers **43, 44, 45** on UV-transparent glass **41** as the phosphor set-up in Stevenson, in order to produce a white display. Because Stevenson wishes to produce color displays such as TVs but is silent as to the phosphors needed to do this, one of ordinary skill would use known materials known to work for the intended purpose.

Because each of Stevenson's GaN-based LEDs would pass through all of the PL layers, each LED would produce white light. Thus, Stevenson modified according to Menda to use Menda's phosphor layers **43, 44, 45**, on UV-transparent glass **41**, ensures that *each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output*, as newly claimed in proposed amended claim 1, and as similarly claimed in claims 5, 26, and 178.

Finally, the '175 patent is replete with admitted prior art indicating that it was well known to mix together phosphors, one for each of the primary colors, to produce white light output. For example, the '175 patent states,

> It is well known that so-called **fluorescent lamps provide white light** illumination. In a fluorescent lamp, the Hg vapor in the vacuum tube is excited by an electrical discharge. The excited Hg atoms emit light, **primarily in the ultraviolet region** (e.g., 254 nm, 313 nm, 354 nm), which is absorbed by the **inorganic phosphors coating the inside walls of the tube**. The phosphors then emit light. These inorganic phosphors are designed as such to offer white light emission by "down-converting" (i.e., transforming a higher frequency, shorter wavelength form of energy to a lower frequency, longer wavelength form of energy) the ultraviolet emissions of the excited states of atomic Hg into a **broad spectrum** of emitted light which appears as **white** to the observer. **However, these light emitting devices are not solid-state**, ...

(the '175 patent, col. 3, lines 40-53; emphasis added)

Thus, the '175 teaches that the missing part is **not** the mixed phosphors but is, instead, the solid-state light emitting devices, e.g. LEDs. **But** Stevenson --20 years earlier-- already did this. Stevenson exchanged the UV light from electrically-excited Hg vapor with a **solid-state** GaN-based LED and used phosphors --just as in a fluorescent bulb-- to down-convert the blue-to-UV light to any other color and white light (Stevenson, paragraph bridging cols. 3-4, excerpt above).

The '175 patent discusses other mixed, inorganic phosphor systems that produce white light and then acknowledges the following:

> While the devices in the above examples vary in concept and construction, they demonstrate the utilization of **red, green and blue fluorescent materials**, all inorganic in composition, which when excited by **photons** or electron beams, can release multiple wavelengths of **secondary light emission** (luminescence of either fluorescent or phosphorescent character) to exhibit **white light** to the observer. This is generally true, even if microscopic domains of discrete colored light emission can be observed on the Lambertian surface of the light emitting device.

(the '175 patent, col. 4, lines 32-41; emphasis added)

The '175 patent admits that it is known in the art to mix phosphors together to produce white light from a **single** primary source of light. Again, all that is lacking is the LED, but Stevenson teaches this as well as explicitly stating to use organic or inorganic phosphors to produce visible light. Thus the only think purported to be inventive in the '175 patent, the LED, was known 20 years before the '175 patent. Everything else, i.e. the phosphors is old and notoriously well known.

Another example of single white-light-emitting device discussed in the '175 patent's APA is the "thin film organic electroluminescent cell":

> **White light emission** from thin film organic electroluminescent cells based on poly(vinylcarbazole PVK) thin films on ITO-coated glass has also been recently reported. ... It is well known that the excited carbazole moiety within the polymer aggregates in the excited state leads to **blue excimer emission**, in the absence of quenchers or dopants. In the example of the organic Mg:Ag:Alq:TAZ:doped PVK:ITO:Glass electroluminescent device, the quenchers of excimeric emission, are the **dopants blue emitting** 1,1,4,4-tetraphenylbuta-1,3-diene (TPB), **green emitting** 7-diethylamino-3-(2'benzothiazoyl)coumarin (Coumarin-6), and **red emitting** dicyanomethylene-2-methyl-6-p-dimethylaminostyryl-4H-pyran (DCM-1).

(the '175 patent, col. 5, lines 21-44; emphasis added)

Thus, the primary "blue excimer emission" is converted into each of the primary color by dopants that are **mixed** together to produce white light by the same cell.

The '175 patent also acknowledges that others have produced white light using LEDs by mixing wavelengths of light from **three different** LEDs, each one producing a separate "primary" color:

> Given the desirability of white light displays (e.g., commercial bank "time and temperature" message boards, stadium scoreboards), considerable effort has been expended to produce white light LEDs. Although the recent availability of the blue LED makes a full color, and by extension a white light display realizable, conventionally it has been considered that such a display would require multiple LEDs. The **multiple** LEDs would be then incorporated into complicated and expensive LED modules to obtain the required broad band illumination necessary to provide white light. Even if a discrete LED lamp were constructed that provides white illumination (as opposed to the utilization of a **multitude** of **single die, single color discrete LED lamps in a module or sub-assembly**), the current state of the art requires the utilization of multiple LED dies and typically at least four electrical leads to power these dies. U.S. Pat. No. 4,992,704 issued to Stinson teaches a variable color light emitting diode having a unitary housing of clear molded solid epoxy supporting **three LED dies characterized as producing color hues of red, green and blue**, respectively. There have been some recent introductions of commercial "full-color" LED lamps, that are essentially **discrete lamps** which afford a means of producing white light. All currently available examples of

> such lamps contain a minimum of three LED dies (or chips)--**one red, one green and one blue**, encapsulated in a single epoxy package.
>
> (the '175 patent, col. 2, lines 25-50; emphasis added)

What the '175 patent does **not**, however, acknowledge is that Stevenson --**20 years before** the '175 patent-- already produced colored or white light by down-converting blue-to-UV light from the **same** GaN-based LED (rather than three separate LEDs, one emitting each primary color) by using organic or inorganic phosphors (Stevenson, paragraph bridging cols. 3-4; excerpt above).

All that Stevenson **may** not disclose is whether or not the phosphors are mixed together to produce white light. Given the APA discussed above, one would be hard-pressed to believe that it would escape the mind of the routineer in the lighting arts to mix the phosphors together to produce white light. Nonetheless, even if it is not implicit in Stevenson alone to mix the phosphors to produce white light, given the ample evidence in the '175 patent's APA for the desire to produce white light from a **single** light-emitting device by mixing phosphors together, (e.g. fluorescent bulbs, EL devices, *supra*), it would have been entirely obvious to one of ordinary skill at the time of the invention to mix together the phosphors in Stevenson to produce white light output from each single GaN-based LED because the '175 patent's APA admits that this is both highly desired and notoriously well known. In addition, one **benefit** would be to produce white light from a **single** LED rather than from **multiple** LEDs, thereby making the cost of white light less expensive, as clearly indicated by the APA.

Thus, Stevenson modified according to APA to use known phosphor mixtures ensures that *each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output*, as newly claimed in proposed amended claim 1, and as similarly claimed in claims 5, 26, and 178.

3. Claims 1, 3-5, 12, 13, 21, 22, 26, 62, 63, 69-72, 74, 76-79, 100, 101, 106-110, 112, 114-116, 118, 124-126, 128, 130-132, 134, 137, 140-142, 145-147, 172, 176, and 178 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Nakamura.

The prior art of Stevenson, as explained above, is believed to disclose each of the features of claims 1, 5, 12, 13, 21, 22, 26, 172, 176, and 178.

To the extent it is believed that claims 1 and 26 (and their dependent claims) exclude light outside the visible spectrum --a point to which Examiner disagrees-- and because Stevenson indicates that the GaN-based LED emits light "in a violet region of the spectrum" --albeit including emission wavelengths running from blue-to-UV (Stevenson, Fig. 4; col. 3, lines 24-26)-- then this may be a difference between claims 1 and 26, and Stevenson. To the extent it is believed that claims 21 and 178 exclude light other than blue light, then this may be a difference between claims 21 and 178, and Stevenson. Note, however, just as the commercially available GaN-based LED from Nichia used in the '175 patent (col. 9, lines 10-18) emits a significant amount of both UV and violet light, Patentee cannot argue that the LED emits **only** light the visible spectrum, as this would contradict the '175 patent and the inventor Bartez's Declaration dated 3/26/2012, paragraph 18, which shows the Nichia LED emits light from UV to blue, just as does Stevenson's.

Nakamura teaches GaN-based LEDs and lasers that emit both blue and UV light. (In fact, one LED indicated as suitable in the '175 invention is a GaN LED from Nichia Chemicals, to which Nakamura is assigned. See the '175 patent, col. 9, lines 10-18. Thus, Patentee admits to using known GaN-based LED for the instant invention.)

First, Nakamura indicates that GaN-based LED emitting light outside the visible white light spectrum are known in the art:

> **Jpn. Pat. Appln. KOKAI Publication No. 4-68579** discloses a double-heterostructure having a p-type **GaInN** clad layer formed on an oxygen-doped, n-type **GaInN** light-emitting layer. ... The emission wavelength of the light-emitting device having this double-heterostructure is **365 to 406 nm**.

(Nakamura, col. 2, lines 7-14; emphasis added)

UV light is light less than 400 nm as evidenced by the CRC Handbook, *supra*.

In regard to its LEDs and lasers, Nakamura states the following:

> The semiconductor device of the present invention includes a **light-emitting diode (LED)** and **a laser diode (LD)**.

(Nakamura, col. 4, lines 9-11)

> It is still another object of the present invention to provide an **ultraviolet to red light-emitting device** having a wavelength in the region of **365 to 620 nm**.

(Nakamura, col. 2, lines 30-33; emphasis added)

> FIG. 12 shows a structure of a **laser diode 40** having a double-heterostructure of the present invention.
>
> The **laser diode 40** has a double-heterostructure constituted by an impurity-doped **$In_xGa_{1-x}N$ active layer 18** described above in detail in association with the light-emitting diode, and two clad layers sandwiching the active layer **18**, i.e., an n-type gallium nitride-based compound semiconductor layer **16** and a p-type gallium nitride-based compound semiconductor layer **20**, as described above. A buffer layer **14** described above in detail is formed on a substrate **12** described above in detail. An n-type gallium nitride layer **42** is formed on the buffer layer **14**, providing a contact layer for an n-electrode described below.

(Nakamura, col. 11, line 61 to col. 12, line 6; emphasis added)

Nakamura shows that the wavelength of the LED or LD can be controlled by controlling the dopant:

> In the light-emitting device of the present invention, when the value of x in $In_xGa_{1-x}N$ of the light-emitting layer is close to 0, the device emits **ultraviolet** light. When the value of x increases, the emission falls in the longer-wavelength region. When the value of x is close to 1, the device emits red light. When the value of x is in the range of $0<x<0.5$, the light-emitting device of the present invention emits **blue** to yellow light in the wavelength range of **450** to 550 nm.

(Nakamura, col. 4, lines 52-59; emphasis added)

Nakamura provides numerous examples of LEDs emitting blue light (Examples 1-28 at cols. 13-20) including an emission **peak** value at, *inter alia*, 400 nm (Nakamura, col. 14, lines 64-65) at 405 nm (*id.*, claim 18, line 67), 430 nm (*id.*, col. 14, lines 51-52), and 480 nm (*id.*, col. 13, lines 40-42).

The peak emission wavelength at 400 nm and 405 nm show that the LEDs of these examples emit primarily **ultraviolet** light, as evidenced by the CRC Handbook. Similarly, those LEDS having peak emission at 430 nm and 480 nm emit primarily **blue** light.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute Stevenson's GaN-based LED with either the known UV light emitting or blue light emitting LED GaN-based LED disclosed in Nakamura (inventive or already known). This can be seen as simple substitution of one known element (Stevenson's GaN-based LED) for another known element (Nakamura's GaN-based LED) to obtain predictable results (as evidenced by Pinnow) and is one of the rationales identified by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___,___, 82 USPQ2d 1385, 1395-97 (2007). (See MPEP 2143, Rationale B.)

Both Stevenson's and Nakamura's LED emit light in the same general region of the spectrum and are GaN-based, so the material is essentially the same. Nonetheless, it is the wavelength of light emitted that counts, and Pinnow teaches that the wavelength of light need only be shorter than 495 nm (4950 Å) to be effective to be converted by the mixture of phosphors to white light.

In regard to the predictability, as already noted above, Pinnow teaches that any wavelength of primary radiation can be down-converted by the mixture of phosphors to produce white light so long as the wavelength is less than 4950 Å (495 nm):

> Regardless of how many phosphors are used, it is apparent from the chromaticity diagram that a necessary condition for achieving a true white is

> that the illuminating laser beam have a **wavelength of approximately 4,950 A. or shorter**. Otherwise, it is impossible to include illuminant C within a polygon whose primaries are the source and any combination of longer wavelengths that can be achieved by down-conversion of frequency. Fortunately, the argon-ion laser satisfies this necessary condition.

(Pinnow, col. 3, lines 24-55; emphasis added)

(It is noted that Pinnow uses "A." for "angstrom", which is properly, instead, Å.)

Thus, Pinnow teaches those of ordinary skill that shifting the peak maximum of the LED in Stevenson from violet to either blue (slightly longer wavelength) or ultraviolet (slightly shorter wavelength), by using one of Nakamura's GaN-based LED (inventive or known) would yield entirely predictable results of white light emission with the down-converting phosphor mixture. The predictability results from using Nakamura's LEDs that emit light (UV or blue) having a wavelength of less than 4950 Å (495 nm).

This is all of the features of claims 1, 21, 26, and 178.

Claims 3 and 4 read,

> *3. A light-emitting device, comprising:*
>
> *a semiconductor **laser** coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the **visible** light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*
>
> *4. A light-emitting device according to claim 3, wherein said semiconductor laser includes an active material selected from the group consisting of III-V alloys and II-VI alloys.*

Claim 3 is distinguished from claim 1 in that (1) a *semiconductor **laser*** is required versus a *single-die semiconductor LED*; (2) the primary radiation is required to be outside the **visible** light spectrum, as opposed to outside the visible **white** light spectrum; and (3) the wording associated with the luminophoric medium.

Each of these features has been addressed above. Nakamura discloses a GaN-based laser diode **40** (Fig. 12) capable of producing either blue or UV light, UV light being outside the visible white light spectrum. The GaN-based LED and LD are made from GaN alloys, such as $In_xGa_{1-x}N$ (i.e. a *III-V alloys*), as required by claim 4. In addition, Pinnow teaches that UV **laser** light or blue **laser** light is down converted by a mixture of phosphors to produce white light. Therefore, those of ordinary skill in the art know that substituting Stevenson's GaN-based LED with Nakamura's GaN-based laser diode will yield the same predictable result of white light by the phosphor mixture, for the same reasons as discussed above. In other words, it is the wavelength of light not whether or not the device emits incoherent or coherent light.

The reason for using Nakamura's GaN-based laser diode in place of Stevenson's GaN-based LED is the same as for claims 1 and 26, discussed above.

Further regarding **claim 5**, there is no requirement that the light be outside the visible white light spectrum, but substituting Stevenson LED with those of Nakamura would still read on claim 5 because the secondary radiation emitted by the phosphor mixture of Stevenson/Pinnow would be white light.

Further regarding **claims 12 and 13**, Nakamura, like Stevenson, fabricates the LED on sapphire substrates (Nakamura, col. 12, line 42) and the LEDs are multilayered (Nakamura's Figs. 1, 11, 12), so substitution of Stevenson's GaN LED with those in Nakamura, still reads on the features of claims 12 and 13.

Further regarding proposed amended **claim 21 and claim 22**, both Stevenson and Nakamura disclose that the LED have two leads. Thus again, substitution of Stevenson's GaN LED with those in Nakamura, still reads on the features of proposed amended claim 21 and claim 22.

Further regarding proposed new **claims 172 and 176**, because Pinnow teaches plural phopshors making white light, the secondary, down-converted radiation of the Stevenson/Nakamura/Pinnow light-emitting device has a *broad spectrum of frequencies*.

Further regard proposed new **claim 178**, because Pinnow teaches plural phopshors making white light, the secondary, down-converted radiation of the Stevenson/Nakamura/Pinnow light-emitting device emits white light from the blue or UV LED, as explained above.

Proposed new **claim 62** reads,

> *62. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is*

> *excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the light-emitting device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged* ***about*** *the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being* ***contiguous to*** *the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in* ***laterally spaced relationship to said side surface;***
>
> *(iv) the luminophoric medium being dispersed* ***in polymer or glass****; and*
>
> *(v) the luminophoric medium being* ***on polymer or glass.***

Claim 62 is coextensive with claim 5, as indicated by Patentee (Remarks dated 3/26/2012, pp. 28-29). Claim 62 is distinguished from claim 5 in (1) the LED is required to be a blue-light-emitting GaN-based LED and (2) the one or more *compatible characteristics*. The substitution of Stevenson's blue-to-UV-light-emitting GaN-based LED with Nakamura's blue-light-emitting GaN-based LEDs was discussed above and is obvious for the same reasons. The luminophoric medium (phosphor mixture of Pinnow) is necessarily *about* the LED; otherwise, it would not interact with the primary radiation. In addition, Pinnow teaches that the phosphor mixture meets either of iv and v:

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution [i.e. a polymer] which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is absorbed on a colloid which may take the form of gell [sic] fibers or particles of high molecular weight polymers.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of **homogeneous** **phosphor screens**. These may be present as **self-supporting members** or as

> <u>**coatings**</u>, and they may be made up on **one or any combination of colorants required to produce the desired balance.**

(Pinnow, col. 2, lines 15-20; emphasis added)

Proposed new claims 63, 68-72, and 74 read,

> <u>*63. The light-emitting device of claim 62, comprising the luminophoric medium being arranged **about** the single-die light-emitting diode.*</u>
>
> <u>*68. The light-emitting device of claim 62, comprising the single-die light-emitting diode being arranged to **directly impinge primary radiation** on the luminophoric medium.*</u>
>
> <u>*69. The light-emitting device of claim 62, comprising the single-die light-emitting diode and luminophoric medium being arranged **without intermediate material therebetween.***</u>
>
> <u>*70. The light-emitting device of claim 62, comprising the luminophoric medium being **dispersed in polymer** or glass.*</u>
>
> <u>*71. The light-emitting device of claim 70, comprising the luminophoric medium being **dispersed in polymer about** the single-die light-emitting diode.*</u>
>
> <u>*72. The light-emitting device of claim 70, comprising the luminophoric medium being in a **homogeneous** composition.*</u>
>
> <u>*74. The light-emitting device of claim 62, comprising the luminophoric medium being **on polymer** or glass.*</u>

As discussed above, Pinnow teaches that the phosphor can be a coating on a screen or can be homogeneously dispersed in a resin (i.e. polymer) to make a screen. The screen is in spaced relationship to the primary source of radiation without intermediate material therebetween and the primary radiation directly impinges the screen and therefore the phosphor mixtures that produce white light in response to the primary radiation.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to orient Pinnow's phosphor mixture screens (whether coatings or dispersed within the screen) without material and to allow direct impingement by Stevenson/Nakamura's LED, as a matter of design choice. In other words, it is common sense to place the phosphor mixture to make the most advantageous use of the primary radiation, as shown in Pinnow.

Proposed new **claims 76-78** read,

> *76. The light-emitting device of claim 62, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *77. The light-emitting device of claim 62, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *78. The light-emitting device of claim 62, wherein the at least one single-die gallium nitride based semiconductor blue light-emitting diode comprises only one single-die gallium nitride based semiconductor blue light-emitting diode.*

As indicated above, Nakamura teaches GaN and its alloys make the blue-light-emitting LEDs; thus, modification of Stevenson to use Nakamura's LEDs already includes the features of these claims.

Proposed new **claim 79** reads,

> *79. The light-emitting device of claim 62, comprising a light-emitting diode lamp.*

Stevenson's or Stevenson modified according to Nakamura includes a single LED and therefore includes a lamp.

Proposed new **claim 100** reads,

> *100. A light-emission device, comprising*
>
> *a single-die, two-lead **gallium nitride based** semiconductor **blue** light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the light-emission device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged **about** the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being **contiguous to** the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in **laterally spaced relationship to said side surface**;*
>
> *(iv) the luminophoric medium being dispersed **in polymer or glass**; and*

(v) the luminophoric medium being ***on polymer or glass.***

Claim 100 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 40-41). Claim 100 differs from claim 26 in the same ways that claim 62 is distinguished from claim 5. Therefore claim 100 is obvious for the same additional reasons as indicated above in conjunction with claim 62.

Proposed **new claims 101, 106-110, and 112** read,

> *101. The light-emission device of claim 100, comprising the luminophoric medium being arranged* ***about*** *the single-die light-emitting diode.*
>
> *106. The light-emission device of claim 100, comprising the single-die light-emitting diode being arranged to* ***directly impinge*** *primary radiation on the luminophoric medium.*
>
> *107. The light-emission device of claim 100, comprising the single-die light-emitting diode and luminophoric medium being arranged* ***without intermediate material*** *therebetween.*
>
> *108. The light-emission device of claim 100, comprising the luminophoric medium being* ***dispersed in*** *polymer or glass.*
>
> *109. The light-emission device of claim 108, comprising the luminophoric medium being* ***dispersed in polymer about*** *the single-die light-emitting diode.*
>
> *110. The light-emission device of claim 100, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*
>
> *112. The light-emission device of claim 100, comprising the luminophoric medium being* ***on*** *polymer or glass.*

Each of the above features was discussed above in conjunction with claims 63, 68-72, and 74 and applies here.

Proposed **new claims 114-116** read,

> *114. The light-emission device of claim 100, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *115. The light-emission device of claim 100, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *116. The light-emission device of claim 100, comprising a light-emitting diode lamp.*

Each of the above features was discussed above in conjunction with claims 76-79 and applies here.

Proposed new **claim 118** reads,

> *118. A light-emission device, comprising*
>
> *a single-die, two-lead **gallium nitride based** semiconductor **blue** light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the luminophoric medium is **dispersed in a polymer that is on or about** the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*

Claim 118 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, p. 45). Claim 118 differs from claim 26 in the same ways that claim 100 is distinguished from claim 26, except the *compatible characteristics* are as highlighted in bold. As noted above, Pinnow teaches these features and the combination remains obvious for the same reasons as indicated above.

Proposed new **claims 124-126 and 128** read,

> *124. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode being arranged to **directly impinge** radiation on the polymer.*
>
> *125. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode and polymer being arranged **without intermediate material therebetween**.*
>
> *126. The light-emission device of claim 118, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *128. The light-emission device of claim 118, comprising the luminophoric medium being **on** polymer or glass.*

Each of the above features was discussed above in conjunction with claims 63, 68-72, and 74 and applies here.

Proposed new **claims 130-132** read,

> *130. The light-emission device of claim 118, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*

> *131. The light-emission device of claim 118, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *132. The light-emission device of claim 118, comprising a light-emitting diode lamp.*

Each of the above features was discussed above in conjunction with claims 76-79 and applies here.

Proposed new **claim 134** reads,

> *134. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the luminophoric medium is **dispersed in a polymer that is on or about** the single-die gallium nitride based semiconductor blue light-emitting diode.*

Each of the features of this claim has been discussed in conjunction with claims 5, 62, and 118, above and applies here.

Proposed new **claims 137 and 140-142** read,

> *137. The light-emitting device of claim 134, comprising the luminophoric medium **dispersed in a polymer that is about** the single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *140. The light-emitting device of claim 134, comprising the single-die light-emitting diode being arranged to **directly impinge** radiation on the polymer.*

> *141. The light-emitting device of claim 134, comprising the single-die light-emitting diode and polymer being arranged **without intermediate material therebetween**.*
>
> *142. The light-emitting device of claim 134, comprising the luminophoric medium being in a **homogeneous** composition.*

Each of the above features was discussed above in conjunction with claims 63, 68-72, and 74 and applies here.

Proposed new **claims 145-147** read,

> *145. The light-emitting device of claim 134, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *146. The light-emitting device of claim 134, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *147. The light-emission device of claim 134, comprising a light-emitting diode lamp.*

Each of the above features was discussed above in conjunction with claims 76-79 and applies here.

4. Claims 187 and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Tadatsu.

Proposed new **claims 187 and 188** read,

> *187. A light emitting device comprising a light-emitting diode operative to emit **blue or ultraviolet** radiation, **packaged with luminophoric medium in a polymeric matrix**, wherein the luminophoric medium absorbs blue or ultraviolet radiation from the light-emitting diode and down converts same to a broad spectrum of frequencies producing polychromatic white light, wherein the light-emitting diode is a single-die, two-lead semiconductor light-emitting diode.*
>
> *188. The light-emitting device of claim 187, wherein the light-emitting diode is operative to emit **blue** light.*

Claims 187 and 188 are distinguished from claim 26 in (1) specifying the radiation emitted from the LED as being blue or UV and (2) the luminophoric medium being in a polymeric matrix. As discussed above, Stevenson's Fig. 4 shows that the GaN-based LED emits blue-to-UV light and therefore reads on these claims.

With regard to distinction (1), Stevenson discloses that the LED emits from blue to UV light as evidenced by Stevenson's Fig. 4, as was discussed above in the rejection over Stevenson.

With regard to distinction (2), also as noted above in the rejection over Stevenson in view of any of Pinnow, Menda, and APA, Pinnow teaches that the phosphors can be dispersed in an organic resin, which is a polymeric matrix:

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is absorbed on a colloid which may take the form of gell [sic] fibers or particles of high molecular weight polymers.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of **homogeneous phosphor screens**. These may be present as **self-supporting members** or as **coatings**, and they may be made up on **one or any combination of colorants required to produce the desired balance**.

(Pinnow, col. 2, lines 15-20; emphasis added)

Thus, Pinnow teaches that phosphors are packaged in a polymeric matrix.

In addition, Tadatsu discloses a packaged LED **11** wherein a primary radiation is down-converted by a luminophor **5** to a longer wavelength, and is therefore in the same field of endeavor as is Stevenson. Tadatsu also desires producing white light. In this regard, Tadatsu states,

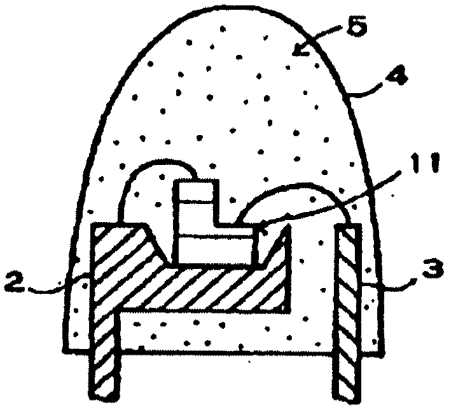
> [Constitution] A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a **resin mold**, wherein said **light emitting device is made of gallium nitride related compound semiconductors** which are expressed with a general formula of $Ga_xAl_{1-x}N$ (where $0 \leq x \leq 1$), and further wherein a **fluorescent dye or pigment**, which is **excited with emission light from said gallium nitride related compound semiconductors** and which **emits fluorescent light**, is **added to said resin mold**.

(Tadatsu translation, p. 1)

Tadatsu's Fig. 2 (reproduced below) shows the packaged LED has two leads **2, 3** and a housing member ("resin mold" **4**) within which the luminophor ("fluorescent dye" **5**) is dispersed. Tadatsu also indicates that the luminophor can be organic or inorganic:

> [0003] Ordinarily, a resin with a large index of refraction and a high transparency is selected for the resin mold 4, so that the emission light from the light emitting device is efficiently emitted to the air. In other cases, an **inorganic or organic pigment is mixed as a coloring agent in the resin mold 4** in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its **emission color turns into white.**

(Tadatsu translation ¶ [0003]; emphasis added)



(Tadatsu, Fig. 2)

Thus Tadatsu discloses that the light-emitting diode **11** is *packaged with luminophoric medium in a polymeric matrix*, as required by claims 187 and 188.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to put Stevenson/Pinnow's phosphor mixture in the resin housing member, and to package Stevenson's GaN-based blue LED as in Tadatsu because Stevenson is silent as to where the phosphors should be oriented relative to the LED, such that one of ordinary skill would use a known packaging method that achieves the correct relative orientation to allow the light emitted from the LED to interact with the luminophor, such as that orientation taught in Tadatsu.

In addition, it is noted that Tadatsu teaches that it is desired in the lighting arts to produce **white** light from a **single** LED by down-converting the LED's primary radiation using phosphors (i.e. dyes and pigments excited by the primary radiation from the LED) to produce a mixture of wavelengths that mix to produce white light (*id.*). So even if it is believed that Stevenson and Pinnow somehow fail to produce sufficient information to those of ordinary skill in the lighting arts to mix the phosphors of Pinnow --that are already mixed together to produce white light in black and white luminescent display screens-- then Tadatsu provides even more evidence that those of ordinary skill in the art desire white light from a **single LED** by using phosphors, and would therefore ensure that Stevenson's mixture of phosphors produces white light.

5. Claims 63-65, 68, 70-73, 101-103, 106, 108-111, 119-121, 124, 126, 127, 135-137, 140, 142, 143, 187 and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Nakamura as applied to claims 62, 100, 118, and 134, above, and further in view of Tadatsu.

The prior art of Stevenson in view of Pinnow and Nakamura, as explained above in the previous rejection, teaches each of the features of claims 62, 100, 118, and 134.

Proposed new **claims 63-65, 68, and 70-73** read,

> *63. The light-emitting device of claim 62, comprising the luminophoric medium being arranged **about** the single-die light-emitting diode.*
>
> *64. The light-emitting device of claim 62, comprising the luminophoric medium being **contiguous to** the single-die light-emitting diode.*
>
> *65. The light-emitting device of claim 64, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being **contiguous to the side die surface**.*
>
> *68. The light-emitting device of claim 62, comprising the single-die light-emitting diode being arranged to **directly impinge** primary radiation on the luminophoric medium.*
>
> *70. The light-emitting device of claim 62, comprising the luminophoric medium being **dispersed in** polymer or glass.*
>
> *71. The light-emitting device of claim 70, comprising the luminophoric medium being **dispersed in polymer about** the single-die light-emitting diode.*
>
> *72. The light-emitting device of claim 70, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *73. The light-emitting device of claim 72, wherein the **homogeneous** composition is **contiguous to** the single die light-emitting diode.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches the features of claim 62. The **homogenous mixture of phosphors dispersed in a polymer or resin** that produce white light in response to blue light primary radiation is taught by Pinnow, as discussed above.

None of Stevenson, Pinnow, and Nakamura teaches the luminophoric medium being *contiguous to*, or *contiguous to a side surface*, or of the LED.

As indicated above, Tadatsu discloses a packaged LED **11** wherein a primary radiation is down-converted by a luminophor **5** to a longer wavelength, and is therefore in the same field of endeavor as is Stevenson. Tadatsu also desires producing white light. In this regard, Tadatsu states,

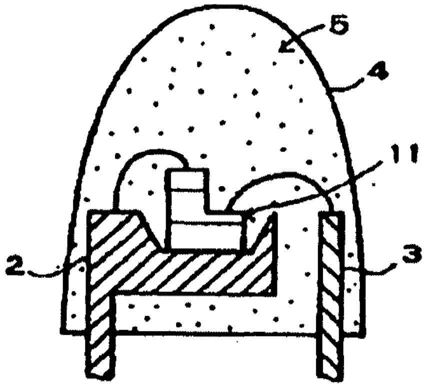
> [Constitution] A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a **resin mold**, wherein said **light emitting device is made of gallium nitride related compound semiconductors** which are expressed with a general formula of $Ga_xAl_{1-x}N$ (where $0 \leq x \leq 1$), and further wherein a **fluorescent dye or pigment**, which is **excited with emission light from said gallium nitride related compound semiconductors** and which **emits fluorescent light**, is **added to said resin mold**.

(Tadatsu translation, p. 1)

Tadatsu's Fig. 2 (reproduced below) shows the packaged LED has two leads **2, 3** and a housing member ("resin mold" **4**) within which the luminophor ("fluorescent dye" **5**) is dispersed. Tadatsu also indicates that the luminophor can be organic or inorganic:

> [0003] Ordinarily, a resin with a large index of refraction and a high transparency is selected for the resin mold 4, so that the emission light from the light emitting device is efficiently emitted to the air. In other cases, an **inorganic or organic pigment is mixed as a coloring agent in the resin mold 4** in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its **emission color turns into white**.

(Tadatsu translation ¶ [0003]; emphasis added)



(Tadatsu, Fig. 2)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to put Stevenson/Pinnow's phosphor mixture in the resin housing member, and to package Stevenson/Nakamura's GaN-based blue LED as in Tadatsu because Stevenson is silent as to where the phosphors should be oriented relative to the LED, such that one of ordinary skill would use a known packaging method that achieves the correct relative orientation to allow the light emitted from the LED to interact with the luminophor, such as that orientation taught in Tadatsu.

So packaged, Pinnow's phosphor mixture is *homgenously dispersed* in Tadatsu's *polymer* or resin mold **4** around Stevenson/Nakamura's GaN-based blue LED. The resulting device has a *luminophoric medium* (phosphor mixture) that is *about*, is *contiguous to the LED on all sides*, and is *directly impinged by the primary radiation* from the GaN-based blue LED, as required by claims 63-65, 68, and 70-73.

Proposed new **claims 101-103, 106, and 108-111** read,

> *101. The light-emission device of claim 100, comprising the luminophoric medium being arranged **about** the single-die light-emitting diode.*
>
> *102. The light-emission device of claim 100, comprising the luminophoric medium being **contiguous to** the single-die light-emitting diode.*
>
> *103. The light-emission device of claim 102, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being **contiguous to the side die surface**.*
>
> *106. The light-emission device of claim 100, comprising the single-die light-emitting diode being arranged to **directly impinge** primary radiation on the luminophoric medium.*
>
> *108. The light-emission device of claim 100, comprising the luminophoric medium being **dispersed in** polymer or glass.*
>
> *109. The light-emission device of claim 108, comprising the luminophoric medium being **dispersed in polymer about** the single-die light-emitting diode.*
>
> *110. The light-emission device of claim 100, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *111. The light-emission device of claim 110, wherein the **homogeneous** composition is **contiguous to** the single-die light-emitting diode.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches all of the features of claim 100. Each of the features of claims 101-103, 106, and 108-111 was discussed in conjunction with claims 63-65, 68, and 70-73 which applies here.

Proposed new **claims 119-121, 124, 126, and 127** read,

> *119. The light-emission device of claim 118, comprising the luminophoric medium* ***dispersed in a polymer that is on*** *the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*
>
> *120. The light-emission device of claim 119, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the* ***polymer is contiguous to the die side surface****.*
>
> *121. The light-emission device of claim 118, comprising the luminophoric medium* ***dispersed in a polymer that is about*** *the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*
>
> *124. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode being arranged to* ***directly impinge*** *radiation on the polymer.*
>
> *126. The light-emission device of claim 118, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*
>
> *127. The light-emission device of claim 126, wherein the* ***homogeneous*** *composition is* ***contiguous to*** *the single-die light-emitting diode.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches all of the features of claim 118. Each of the features of claims 119-121, 124, 126, and 127 was discussed in conjunction with claims 63-65, 68, and 70-73 which applies here.

Proposed new claims **135-137, 140, 142, and 143** read,

> *135. The light-emitting device of claim 134, comprising the luminophoric medium* ***dispersed in a polymer that is on*** *the single-die gallium nitride based semiconductor blue light- emitting diode.*
>
> *136. The light-emitting device of claim 135, comprising the single-die gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the* ***polymer is contiguous to the die side surface****.*
>
> *137. The light-emitting device of claim 134, comprising the luminophoric medium* ***dispersed in a polymer that is about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *140. The light-emitting device of claim 134, comprising the single-die light-emitting diode being arranged to* ***directly impinge*** *radiation on the polymer.*

> *142. The light-emitting device of claim 134, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *143. The light-emitting device of claim 142, wherein the **homogeneous** composition is **contiguous to** the single-die light-emitting diode.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches all of the features of claim 134. Each of the features of claims 135-137, 140, 142, and 143 was discussed in conjunction with claims 63-65, 68, and 70-73 which applies here.

Regarding **claims 187 and 188**, to the extent it is believed that claim 187 excludes violet light emission by reciting "blue or ultraviolet", then this may be a difference between claims 187 and 188, and Stevenson. Note, however, just as the commercially available GaN-based LED from Nichia used in the '175 patent (col. 9, lines 10-18) emits a significant amount of both UV and violet light, Patentee cannot argue that the LED emits **only** blue or UV light, as this would contradict the '175 patent and the inventor Bartez's Declaration dated 3/26/2012, paragraph 18, which shows the Nichia LED emits light from UV to blue, just as does Stevenson's.

Nakamura is applied as above, to show that it would be obvious to substitute Stevenson's GaN-based LED with Nakamura's GaN-based LED which emits blue light. Thus, Stevenson in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claims 187 and 188.

> 6. Claims 63, 66-72, 74, 101, 104-110, 112, 121-126, 128, 137-142, 162-166 and 168-171 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Nakamura as applied to claims 62, 100, 118, and 134, above, and further in view of Tabuchi.

The prior art of Stevenson in view of Pinnow and Nakamura, as explained above in the previous rejection, teaches each of the features of claims 62, 100, 118, and 134.

Proposed new claims 63, 66-72, and 74 read,

> *63. The light-emitting device of claim 62, comprising the luminophoric medium being arranged **about** the single-die light-emitting diode.*
>
> *66. The light-emitting device of claim 62, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being in **laterally spaced relationship to said side die surface**.*
>
> *67. The light-emitting device of claim 66, wherein the luminophoric medium is in **laterally spaced facing relationship to said side die surface**.*

> *68. The light-emitting device of claim 62, comprising the single-die light-emitting diode being arranged to **directly impinge** primary radiation on the luminophoric medium.*
>
> *69. The light-emitting device of claim 62, comprising the single-die light-emitting diode and luminophoric medium being arranged **without intermediate material** therebetween.*
>
> *70. The light-emitting device of claim 62, comprising the luminophoric medium being **dispersed in** polymer or glass.*
>
> *71. The light-emitting device of claim 70, comprising the luminophoric medium being **dispersed in polymer about** the single-die light-emitting diode.*
>
> *72. The light-emitting device of claim 70, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *74. The light-emitting device of claim 62, comprising the luminophoric medium being **on** polymer or glass.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches the features of claim 62. The **homogenous mixture of phosphors dispersed in a polymer or resin** that produce white light in response to blue light primary radiation is taught by Pinnow:

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution [i.e. a polymer] which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is **absorbed on a colloid** which may take the form of gell [sic] fibers or particles of high molecular weight **polymers**.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of **homogeneous** **phosphor screens**. These may be present as **self-supporting members** or as **coatings**, and they may be made up on **one or any combination of colorants required to produce the desired balance**.

(Pinnow, col. 2, lines 15-20; emphasis added)

Thus, the phosphors may be dispersed in a polymer whether the polymer is coated made into a coating or formed into a "self-supporting member".

None of Stevenson, Pinnow, and Nakamura teaches the luminophoric medium being *laterally spaced relationship to said side die surface* (claim 66), or *laterally spaced facing relationship to said side die surface* (claim 67).

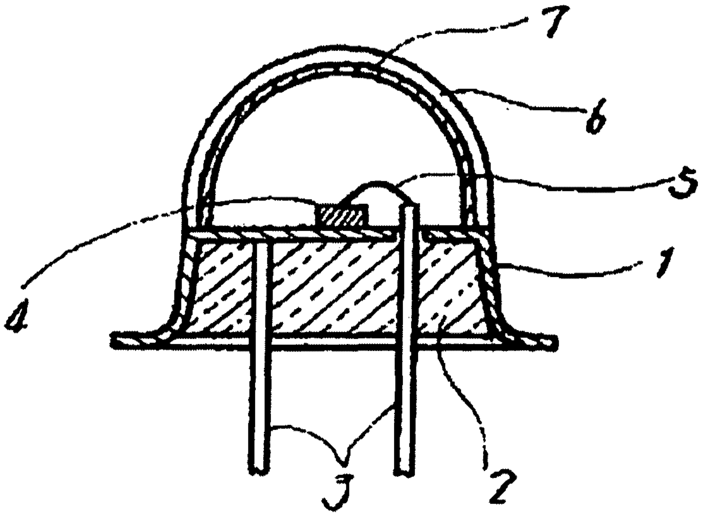
Tabuchi's Fig. 1 (reproduced below) shows a LED **4** in a housing including transparent cover **6** having a phosphor film **7** coated thereon to convert the primary radiation (UV or IR) from said LED **4** into visible light. In this regard, Tabuchi states,

> Figure 1 depicts a **light emitting semiconductor apparatus** of an example of the present utility model invention. In the example, the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A **light emitting semiconductor device 4** is conductively connected to stem 1. A transparent cover 6 according to the present utility model invention is fixed on stem 1. **A phosphor layer 7** is provided by applying **a binding agent** in which a phosphor to convert the radiation from light emitting semiconductor device **4** to visible light **is dispersed on the inner surface of transparent cover 6**. **Transparent cover 6** is made of a material such as **glass** or **an epoxy resin** is preferably fixed to stem 1 so that it can also function as a cap for hermetic sealing.
>
> In the light emitting apparatus of the present utility model invention, **phosphor layer 7 converts** infrared or **UV** emitted from **light emitting semiconductor device 4** to **visible light** which is radiated in random directions. Therefore, the light emitting semiconductor apparatus can produce an emission with a uniform intensity over a large area. Further, the light emitting semiconductor apparatus utilizes a relatively small quantity of phosphor and hence, is inexpensive.

(Tabuchi translation, pp. 3-4; emphasis added)

> A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)



(Tabuchi, Fig. 1)

As shown in Tabuchi's Fig. 1 above, the phosphor is (1) *about* the LED (claim 63) *without intermediate material* between the phosphor **7** and the LED **4** (claim 69), (2) is *laterally spaced relationship to said side die surface* (claim 66), (3) is *laterally spaced facing relationship to said side die surface* (claim 67). It is also evident that the phosphor **7** is *directly impinged* by the primary radiation from the LED **4** (claim 68).

Because Tabuchi uses a binder to make the phosphor coating and because Pinnow teaches the phosphor mixture is homogeneously dispersed in a resin to make the phosphor coatings, Pinnow's phosphor mixtures oriented on the walls of Tabuchi's cover would result in the features of claims 70-72 and 74 above.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to put Stevenson's or Stevenson/Pinnow's inorganic phosphors in a film on the surface of a housing member (Tabuchi), and to package Stevenson/Nakamura's GaN-based LED as in Tabuchi because Stevenson/Nakamura is silent as to where the phosphors should be oriented relative to the LED, such that one of ordinary skill would use a known packaging method that achieves the correct relative orientation to allow the light emitted from the LED to interact with the luminophor, such as that orientation taught in Tabuchi.

Thus, Stevenson/Pinnow/Nakamura's light-emitting device modified to locate Pinnow's mixture of phosphors as in Tabuchi renders obvious the features of claims 63, 66-72, and 74.

Proposed new **claims 101, 104-110, and 112** read,

> *101. The light-emission device of claim 100, comprising the luminophoric medium being arranged* ***about*** *the single-die light-emitting diode.*

> *104. The light-emission device of claim 100, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being in* ***laterally spaced relationship to said side die surface.***
>
> *105. The light-emission device of claim 104, wherein the luminophoric medium is in* ***laterally spaced facing relationship to said side die surface.***
>
> *106. The light-emission device of claim 100, comprising the single-die light-emitting diode being arranged to* ***directly impinge*** *primary radiation on the luminophoric medium.*
>
> *107. The light-emission device of claim 100, comprising the single-die light-emitting diode and luminophoric medium being arranged* ***without intermediate material therebetween.***
>
> *108. The light-emission device of claim 100, comprising the luminophoric medium being* ***dispersed in*** *polymer or glass.*
>
> *109. The light-emission device of claim 108, comprising the luminophoric medium being* ***dispersed in polymer about*** *the single-die light-emitting diode.*
>
> *110. The light-emission device of claim 100, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*
>
> *112. The light-emission device of claim 100, comprising the luminophoric medium being* ***on*** *polymer or glass.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches all of the features of claim 100. Each of the features of claims 101, 104-110, and 112 was discussed in conjunction with claims 63, 66-72, and 74 which applies here.

Proposed new **claims 121-126 and 128** read,

> *121. The light-emission device of claim 118, comprising the luminophoric medium* ***dispersed in a polymer*** *that is* ***about*** *the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*
>
> *122. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is in* ***laterally spaced relationship to said side die surface.***
>
> *123. The light-emission device of claim 122, wherein the polymer is in* ***laterally spaced facing relationship to said side die surface.***

> *124. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode being arranged to* ***directly impinge*** *radiation on the polymer.*

> *125. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode and polymer being arranged* ***without intermediate material therebetween****.*

> *126. The light-emission device of claim 118, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*

> *128. The light-emission device of claim 118, comprising the luminophoric medium being* ***on*** *polymer or glass.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches all of the features of claim 118. Each of the features of claims 121-126 and 128 was discussed in conjunction with claims 63, 66-72, and 74 which applies here.

Proposed new **claims 137-142** read,

> *137. The light-emitting device of claim 134, comprising the luminophoric medium* ***dispersed in a polymer*** *that is* ***about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*

> *138. The light-emitting device of claim 134, comprising the single-die gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is in* ***laterally spaced relationship to said side die surface****.*

> *139. The light-emitting device of claim 138, wherein the polymer is in* ***laterally spaced facing relationship to said side die surface.***

> *140. The light-emitting device of claim 134, comprising the single-die light-emitting diode being arranged to* ***directly impinge*** *radiation on the polymer.*

> *141. The light-emitting device of claim 134, comprising the single-die light-emitting diode and polymer being arranged* ***without intermediate material therebetween****.*

> *142. The light-emitting device of claim 134, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*

As noted above in the previous rejection, Stevenson in view of Pinnow and Nakamura teaches all of the features of claim 134. Each of the features of claims 137-142 was discussed in conjunction with claims 63, 66-72, and 74 which applies here.

Proposed new **claim 162** reads,

> *162. A light-emitting device, comprising:*
>
> *at least one single-die* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein said at least one single-die gallium nitride based semiconductor blue light-emitting diode is* ***in a housing comprising a light-transmissive wall member in spaced relationship*** *to said at least one single-die gallium nitride based semiconductor blue light-emitting diode,*
>
> *and* ***wherein said luminophoric medium is dispersed in or on said light-transmissive wall member.***

Claim 162 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 58-59). Claim 162 differs from claim 5 in requiring the LED be a GaN-based blue-light-emitting LED and the orientation of the luminophoric medium in or on a light-transmissive wall member.

As noted above in the rejection of claim 5 over Stevenson in view of Pinnow and Nakamura, the GaN-based LED is obvious. As noted above in this rejection of claims 63, 66-72, and 74, the light-transmissive wall member **6** having a phosphor coating **7** thereon in spaced relationship to the LED **4** is obvious over Tabuchi. Thus, all of the additional features of claim 162 are obvious for the reasons already discussed above.

Proposed new **claim 163** reads,

> *163. The light-emitting device of claim 162, wherein said luminophoric medium is* ***dispersed in said light-transmissive wall member.***

Although Tabuchi does not teach that the phosphor **7** can be *dispersed in* the wall member **6**, Pinnow teaches that a phosphor mixture dispersed in organic resin (i.e. polymer) can be used to make a self-supporting member. Again Pinnow states,

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution [i.e. a polymer] which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is **absorbed on a colloid** which may take the form of gell [sic] fibers or particles of high molecular weight **polymers**.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of <u>**homogeneous**</u> **phosphor screens**. These may be present as <u>**self-supporting members**</u> or as <u>**coatings**</u>, and they may be made up on **one or any combination of colorants required to produce the desired balance**.

(Pinnow, col. 2, lines 15-20; emphasis added)

Thus, the phosphors may be dispersed in a polymer whether the polymer is coated made into a coating or formed into a "self-supporting member".

It would have been obvious to one of ordinary skill in the art, at the time of the invention to form Pinnow's phosphor mixture into a self-supporting member in the form of Tabuchi's wall member **6** because Pinnow teaches that the phosphor mixture functions for the same purpose whether it is in the form of a coating or a self-supporting member (*id.*). As such, Pinnow tells those of ordinary skill that it is a matter of design choice to form the phosphor mixture in resin as a self-supporting member or as a coating. Therefore, one of ordinary skill can see the Tabuchi's phosphor coating **7** on the wall member **6** can be consolidated into a self-supporting member having the phosphor dispersed therein.

This "design choice" is substantially rationale B: simple substitution of one known element for another (MPEP 2143). Pinnow proves the predictability because Pinnow teaches that both forms of the phosphor mixture in resin (coating or self-supporting member) function to down-convert blue or UV primary radiation into polychromatic secondary radiation that mixes to produce white light.

This is all of the features of claim 163.

Proposed new **claims 164-166** read,

> <u>*164. The light-emitting device of claim 162, wherein said luminophoric medium is* ***dispersed on*** *said light-transmissive wall member.*</u>

> *165. The light-emitting device of claim 162, wherein the light-transmissive wall member comprises* ***polymer****.*
>
> *166. The light-emitting device of claim 162, wherein the light-transmissive wall member comprises* ***glass****.*

Again Tabuchi states that the housing member **6** onto which the phosphor **7** is dispersed can be made from glass or epoxy resin (i.e. polymer):

> Transparent cover 6 is made of a material such as **glass** or an **epoxy resin**...

(Tabuchi translation, pp. 3-4; emphasis added)

Proposed new **claims 168 and 169** read,

> *168. The light-emitting device of claim 162, wherein the single-die light-emitting diode comprises* ***gallium nitride and its alloys****.*
>
> *169. The light-emitting device of claim 162, wherein the single-die light-emitting diode comprises at least one of* ***gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride****.*

Again, Nakamura teaches GaN-based LED and the use of Nakamura's GaN-based, blue-light-emitting LED in place of Stevenson's GaN-based blue-to-UV LED is obvious for the reasons indicated above in the rejection over Stevenson in view of Pinnow and Nakamura, which applies here.

Proposed new **claims 170 and 171** read,

> *170. The light-emitting device of claim 162, wherein the at least one single-die gallium nitride based semiconductor blue light-emitting diode comprises* ***only one*** *single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *171. The light-emitting device of claim 162, comprising a light-emitting diode* ***lamp****.*

Stevenson, Nakamura, and Tabuchi each teach only one single LED which renders claims 170 and 171 obvious.

7. Claims 5, 11-13, 21, 22, 26, 172, and 176 is rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of Pinnow and Edmond.

The prior art of Stevenson, as explained above, is believed to disclose each of the features of claim 5, 12, 13, 21, 22, 26, 172, and 176.

Stevenson does not teach an LED made on a SiC substrate (claims 11 and 12) or from including specifically SiC LED structure layers (claim 12 and 13).

Edmond discloses LEDs made on a SiC substrate having a multilayered device structure, wherein the layers include SiC, said SiC-based LEDs have peak maximum at several ranges in the blue wavelength spectrum:

> The present invention comprises a light emitting diode formed in silicon carbide and that emits **visible light** having a wavelength of between about **475-480 nanometers**, or between about **455-460 nanometers**, or between about **424-428 nanometers**. The diode comprises a **substrate of alpha silicon carbide** having a first conductivity type and a **first epitaxial layer of alpha silicon carbide** upon the substrate having the same conductivity type as the substrate. A **second epitaxial layer of alpha silicon carbide** is upon the first epitaxial layer, has the opposite conductivity type from the first layer, and **forms a p-n junction** with the first epitaxial layer.

(Edmond, abstract; emphasis added)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute Stevenson's GaN-based LED with the SiC-based LED disclosed in Edmond. This can be seen as simple substitution of one known element (Stevenson's GaN-based LED) for another known element (Edmond's SiC-based LED) to obtain predictable results (as evidenced by Pinnow) and is one of the rationales identified by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___,___, 82 USPQ2d 1385, 1395-97 (2007). (See MPEP 2143, Rationale B.)

Both Stevenson's and Edmond's LEDs emit light in the same general region of the spectrum, so even though the materials from which the LED are made are different, it is the wavelength of light emitted that counts, and Pinnow teaches that the wavelength of light need only be shorter than 495 nm (4950 Å) to be effective to be converted by the mixture of phosphors to white light. Thus, in regard to the predictability, as already noted above, Pinnow teaches that any wavelength of primary radiation can be down-converted by the mixture of phosphors to produce white light so long as the wavelength is less than 4950 Å (495 nm):

> Regardless of how many phosphors are used, it is apparent from the chromaticity diagram that a necessary condition for achieving a true white is that the illuminating laser beam have a **wavelength of approximately 4,950 A. or shorter**. Otherwise, it is impossible to include illuminant C within a polygon whose primaries are the source and any combination of longer wavelengths that can be achieved by down-conversion of frequency. Fortunately, the argon-ion laser satisfies this necessary condition.

(Pinnow, col. 3, lines 24-55; emphasis added)

(It is noted that Pinnow uses "A." for "angstrom", which is properly, instead, Å.)

Thus, Pinnow teaches those of ordinary skill that shifting the peak maximum of the LED in Stevenson slightly from 413 nm (violet) to any of the wavelengths of Edmond's SiC LED, e.g. 424-428 nm, would yield entirely predictable results of white light emission with the down-converting phosphor mixture. The predictability results from using LEDs that emit light having a wavelength of less than 4950 Å (495 nm), specifically blue light in the case of Edmond.

Stevenson modified by Edmond to use Edmond's SiC LEDs therefore teaches each of the features of claims 5, 11-13, 21, 22, and 26, as follows.

Regarding **claim 5**, there is no requirement that the light be outside the visible white light spectrum, but substituting Stevenson LED with those of Edmond would still read on claim 5 because the secondary radiation emitted by the phosphor mixture of Stevenson/Pinnow would be white light.

Proposed amended **claims 11 and 12 and claim 13** read,

> *11. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device <u>is on</u> a substrate <u>in</u> a multilayer device structure, and wherein said substrate comprises **silicon carbide**.*
>
> *12. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device <u>is on</u> a substrate <u>in</u> a multilayer device structure, and wherein said substrate comprises a material selected from the group consisting of sapphire, **SiC**, and InGaAIN.*
>
> *13. A light-emitting device according to claim 12, wherein said multilayer device structure includes layers selected from the group consisting of **silicon carbide**, aluminum nitride, gallium nitride, gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys.*

As shown in Edmond's abstract, above, and Edmond's Figs. 1-8, the substrate is SiC and the device layers include SiC.

Further regarding proposed new **claims 172 and 176**, because Pinnow teaches plural phopshors making white light, the secondary, down-converted radiation of the Stevenson/Edmond/Pinnow light-emitting device has a *broad spectrum of frequencies*.

<u>8. Claims 2 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of (1) Stevenson in view of **Imamura**, (2) Stevenson in view of any of Pinnow, Menda, and APA, and further in view of **Imamaura**, (3) Stevenson in view of Pinnow, Nakamura, and **Imamura**, and (4) Stevenson in view of Pinnow, Edmond and **Imamura**.</u>

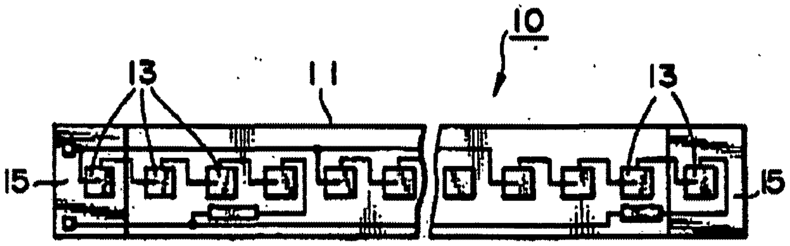
Claims 2 and 23 read,

> *2. A light-emitting device according to claim 1, comprising a **two-lead array** of single-die semiconductor LEDs.*
>
> *23. A light-emitting device according to claim 5, comprising a **two-lead array** of single-die semiconductor LEDs.*

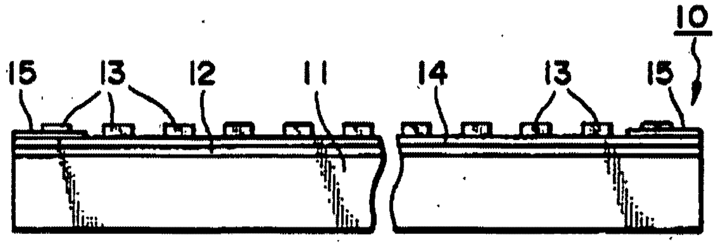
The prior art of any of (1) Stevenson, (2) Stevenson in view of any of Pinnow, Menda, and APA, (3) Stevenson in view of Pinnow and Nakamura, and (4) Stevenson in view of Pinnow and Edmond, as explained above, discloses each of the features of claim 1 and 5.

Stevenson does not explicitly disclose a two-lead **array** of single-die LEDs. However, Stevenson does disclose using an array of LED to produce a display (Stevenson, col. 4, lines 5-7).

Imamura's Figs. 4 and 5 (reproduced below) shows the top and side views of an light array **10** made from an array of single-die semiconductor LEDs **13** on a substrate **15** (Imamura, col. 3, lines 16-36).



(Imamura, Fig. 4)



(Imamura, Fig. 5)

The array **10** can be used as a backlight for a liquid crystal display, such as shown in Fig. 8 (Imamura, col. 4, lines 59-61). Each LED die **13** has two leads that connect to the array's two leads, made from the gold-plated copper pattern **12** shown in the side view of right side of Fig. 5 and in the top view as the horizontal lines running across the top and bottom of the substrate **15** that connect the array of LEDs **13**. As also shown in Fig. 4, each of the array's two leads ends in a terminal. Thus, Imamura teaches *a **two-lead array** of single-die semiconductor LEDs.*

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Imamura's two-lead array configuration of plural identical LEDs -- therefore *emitting identical radiation*-- for Stevenson's array of LED, because Stevenson is silent as to how an array of LED would be wired for a display, such that one of ordinary skill would follow known ways of assembling an array such as taught by Imamura (Imamura, col. 3, lines 37-60).

9. Claims 1, 5, 12, 13, 21, 22, 26-28, 30-33, 41, 42, 44-47, 55, 56, 58-61, 172, 173, 176-178, 187, and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of **Tadatsu** or, in the alternative, over Stevenson in view of APA and **Tadatsu**

Proposed new claims 28, 30, 42, 44, 56, and 58 read,

> *28. The light emitting device of claim 27, wherein the inorganic luminophor is dispersed **on or in** a housing member.*
>
> *30. The light emitting device of claim 27, wherein the inorganic luminophor is **within** a housing member.*
>
> *42. The light-emitting device of claim 41, wherein the inorganic luminophor is dispersed **on or in** a housing member.*
>
> *44. The light-emitting device of claim 41, wherein the inorganic luminophor is **within** a housing member.*
>
> *56. The light-emission device of claim 55, wherein the inorganic luminophor is dispersed **on or in** a housing member.*
>
> *58. The light-emission device of claim 55, wherein the inorganic luminophor is **within** a housing member.*

The prior art of Stevenson, or Stevenson in view of APA, as explained above, discloses each of the features of claims 1, 5, 12, 13, 21, 22, 26, 27, 31-33, 41, 45-47, 55, 59-61, 172, 176, and 178.

Stevenson does not indicate where the inorganic phosphors should be located and thus does not teach luminophors in or within a housing member.

Tadatsu discloses a package LED **11** wherein a primary radiation is down-converted by a luminophor **5** to a longer wavelength, and is therefore in the same field of endeavor as is Stevenson. Tadatsu also desires producing white light. In this regard, Tadatsu states,

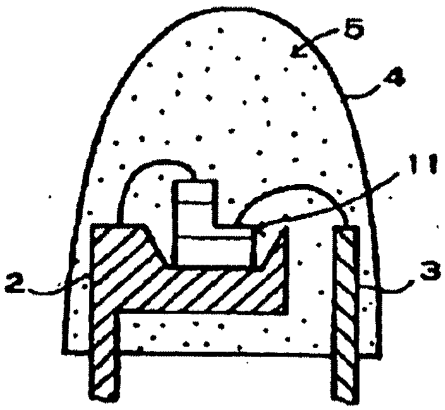
> [Constitution] A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a **resin mold**, wherein said **light emitting device is made of gallium nitride related compound semiconductors** which are expressed with a general formula of $Ga_xAl_{1-x}N$ (where $0 \leq x \leq 1$), and further wherein a **fluorescent dye or pigment**, which is **excited with emission light from said gallium nitride related compound semiconductors** and which **emits fluorescent light**, is **added to said resin mold**.

(Tadatsu translation, p. 1)

Tadatsu's Fig. 2 (reproduced below) shows the packaged LED have two leads **2, 3** and a housing member ("resin mold" **4**) within which the luminophor ("fluorescent dye" **5**) is dispersed. Tadatsu also indicates that the luminophor can be organic or inorganic:

> [0003] Ordinarily, a resin with a large index of refraction and a high transparency is selected for the resin mold 4, so that the emission light from the light emitting device is efficiently emitted to the air. In other cases, an **inorganic or organic pigment is mixed as a coloring agent in the resin mold 4** in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its **emission color turns into white**.

(Tadatsu translation ¶ [0003]; emphasis added)



(Tadatsu, Fig. 2)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to put Stevenson's or Stevenson/APA's inorganic phosphors in the resin housing member, and to package Stevenson's GaN-based LED as in Tadatsu because Stevenson is silent as to where the phosphors should be oriented relative to the LED, such that one of ordinary skill would use a known packaging method that achieves the correct relative orientation to allow the light emitted from the LED to interact with the luminophor, such as that orientation taught in Tadatsu.

Proposed new **claims 173 and 177** read,

> *173. The light-emitting device of claim 5, wherein the single-die semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*
>
> *177. The light-emission device of claim 26, wherein the single-die, two-lead semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*

As noted above, it would be obvious to package Stevenson's two-lead LED as in Tadatsu; so packaged, the LED would be *on a support* (Tadatsu lead **2**) *in an interior volume of a light-transmissive enclosure* (Tadatsu, molded resin **4**).

Proposed new **claims 187 and 188** read,

> *187. A light emitting device comprising a light-emitting diode operative to emit **blue or ultraviolet** radiation, **packaged with luminophoric medium in a polymeric matrix**, wherein the luminophoric medium absorbs blue or ultraviolet radiation from the light-emitting diode and down converts same to a broad spectrum of frequencies producing polychromatic white light, wherein the light-emitting diode is a single-die, two-lead semiconductor light-emitting diode.*
>
> *188. The light-emitting device of claim 187, wherein the light-emitting diode is operative to emit **blue** light.*

As noted above, Tadatsu teaches dispersing the phosphor in the resin mold, thus Stevenson's LED packaged according to Tadatsu would include the phosphors in a polymeric matrix whether Stevenson's or APA's phosphors are used.

Claims 1, 5, 12, 13, 21, 22, 26, 27, 31-33, 41, 45-47, 55, 59-61, 172, 176, 178, 187, and 188 are rejected here, again, with the addition of Tadatsu, to provide even more reasons to mix the phosphors to produce white light. Tadatsu teaches that it is desired in the lighting arts to produce **white** light from a **single LED** by down-converting the LED's primary radiation using phosphors (i.e. dyes and pigments excited by the primary radiation from the LED) to produce a mixture of wavelengths that mix to produce white light (*id.*). So even if it is believed that Stevenson and APA somehow fail to produce sufficient information to those of ordinary skill in the lighting arts to mix the phosphors of APA --that are already mixed together to produce white light in fluorescent light bulbs and in EL cells-- then Tadatsu provides even more evidence that those of ordinary skill in the art desire white light from a **single LED** by using phosphors, and would therefore ensure that Stevenson's mixture of phosphors produce white light.

> 10. Claims 28-30, 42-44, 56-58, 173, and 177 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of **Tabuchi** or, in the alternative, over Stevenson in view of APA and **Tabuchi**.

Proposed new claims 28-30, 42-44, and 56-58 read,

> *28. The light emitting device of claim 27, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *29. The light emitting device of claim 27, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *30. The light emitting device of claim 27, wherein the inorganic luminophor is* ***within*** *a housing member.*
>
> *42. The light-emitting device of claim 41, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *43. The light emitting device of claim 41, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *44. The light-emitting device of claim 41, wherein the inorganic luminophor is* ***within*** *a housing member.*
>
> *56. The light-emission device of claim 55, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *57. The light emitting device of claim 55, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *58. The light-emission device of claim 55, wherein the inorganic luminophor is* ***within*** *a housing member.*

The prior art of Stevenson or, in the alternative, Stevenson in view of APA, as explained above, discloses each of the features of claims 1, 27, 5, 41, 26, and 55.

Stevenson does not indicate where the inorganic phosphors should be located and thus does not teach luminophors (1) *on or in a housing member*, (2) *in a film on a surface of a housing member*, or (3) *within a housing member*.

As noted above, APA teaches that it is notoriously well known in the lighting arts to place a mixture of inorganic phosphors in a coating on the surface of a housing member, e.g. a fluorescent light bulb, to produce white light:

> It is well known that so-called **fluorescent lamps provide white light** illumination. In a fluorescent lamp, the Hg vapor in the vacuum tube is excited by an electrical discharge. The excited Hg atoms emit light, **primarily in the ultraviolet region** (e.g., 254 nm, 313 nm, 354 nm), which is absorbed by the **inorganic phosphors coating the inside walls of the tube**. The phosphors then emit light. These inorganic phosphors are designed as such to offer white light emission by "down-converting" (i.e., transforming a higher frequency, shorter wavelength form of energy to a lower frequency, longer wavelength form of energy) the ultraviolet emissions of the excited states of atomic Hg into a **broad spectrum** of emitted light which appears as **white** to the observer.

(the '175 patent, col. 3, lines 40-52; emphasis added)

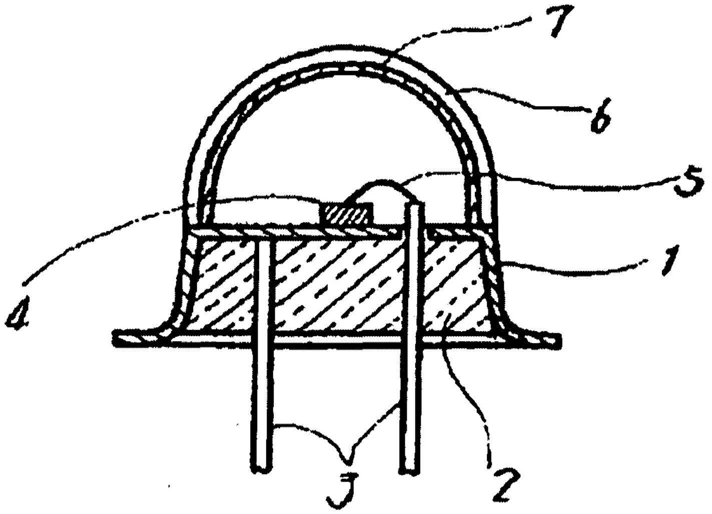
Tabuchi's Fig. 1 (reproduced below) shows a LED **4** in a housing including transparent cover **6** having a phosphor film **7** coated thereon to convert the primary radiation (UV or IR) from said LED **4** into visible light. In this regard, Tabuchi states,

> Figure 1 depicts a **light emitting semiconductor apparatus** of an example of the present utility model invention. In the example, the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A **light emitting semiconductor device 4** is conductively connected to stem 1. A transparent cover 6 according to the present utility model invention is fixed on stem 1. **A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6**. Transparent cover 6 is made of a material such as **glass** or an **epoxy** resin is preferably fixed to stem 1 so that it can also function as a cap for hermetic sealing.
>
> In the light emitting apparatus of the present utility model invention, **phosphor layer 7 converts** infrared or **UV** emitted from **light emitting semiconductor device 4** to **visible light** which is radiated in random directions. Therefore, the light emitting semiconductor apparatus can produce an emission with a uniform intensity over a large area. Further, the light emitting semiconductor apparatus utilizes a relatively small quantity of phosphor and hence, is inexpensive.

(Tabuchi translation, pp. 3-4; emphasis added)

> A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)



(Tabuchi, Fig. 1)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to put Stevenson's or Stevenson/APA's inorganic phosphors in a film on the surface of a housing member (Tabuchi), and to package Stevenson's GaN-based LED as in Tabuchi because Stevenson is silent as to where the phosphors should be oriented relative to the LED, such that one of ordinary skill would use a known packaging method that achieves the correct relative orientation to allow the light emitted from the LED to interact with the luminophor, such as that orientation taught in Tabuchi.

Thus, Stevenson/APA modified to locate APA's mixture of phosphors as in Tabuchi teaches the phosphor mixture located (1) ***on or in*** *a housing member*, (2) *in a film on a surface of a housing member*, or (3) ***within*** *a housing member.*

Proposed new **claims 173 and 177** reads,

> *173. The light-emitting device of claim 5, wherein the single-die semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*
>
> *177. The light-emission device of claim 26, wherein the single-die, two-lead semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*

As noted above, it would be obvious to package Stevenson's two-lead LED as in Tabuchi, so packaged, the LED would be is *on a support* (Tabuchi "stem" **1**) *in an interior volume of a light-transmissive enclosure* (Tabuchi, "transparent cover" **6**).

11. Claims 3, 34, 38-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA and Nakamura.

Claim 3 reads,

> *3. A light-emitting device, comprising:*
>
> *a semiconductor* ***laser*** *coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the* ***visible*** *light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*

Claim 3 is distinguished from claim 1 in that (1) a *semiconductor* ***laser*** is required versus a *single-die semiconductor LED*; (2) the primary radiation is required to be outside the **visible** light spectrum, as opposed to outside the visible **white** light spectrum; and (3) the wording associated with the luminophoric medium.

With regard to **differences (1) and (2)**, Stevenson does not teach a semiconductor laser that produces primary radiation outside the visible spectrum. Stevenson does, however, teach a GaN-based LED producing blue-to-UV light and therefore produces light (i.e. the UV light) outside the visible light spectrum (Stevenson, Fig. 4).

As discussed above, in the rejection over Stevenson in view of Pinnow and Nakamura, the substitution of any of Nakamura's LEDs or LDs for Stevenson's LED is obvious. Again, Nakamura teaches GaN-based LEDs and lasers that emit both blue and UV light. (In fact, one LED indicated as suitable in the '175 invention is a GaN LED from Nichia Chemicals, to which Nakamura is assigned. See the '175 patent, col. 9, lines 10-18. Thus, Patentee admits to using known GaN-based LED for the instant invention.)

First, Nakamura indicates that GaN-based LED emitting light *outside the visible white light spectrum* are known in the art:

> **Jpn. Pat. Appln. KOKAI Publication No. 4-68579** discloses a double-heterostructure having a p-type **GaInN** clad layer formed on an oxygen-doped, n-type **GaInN** light-emitting layer. ... The emission wavelength of the light-emitting device having this double-heterostructure is **365 to 406 nm**.

(Nakamura, col. 2, lines 7-14; emphasis added)

UV light is light less than 400 nm as evidenced by the CRC Handbook, *supra*.

In regard to its LEDs and lasers, Nakamura states the following:

> The semiconductor device of the present invention includes a **light-emitting diode (LED)** and **a laser diode (LD)**.

(Nakamura, col. 4, lines 9-11)

> It is still another object of the present invention to provide an **ultraviolet to red light-emitting device** having a wavelength in the region of **365 to 620 nm**.

(Nakamura, col. 2, lines 30-33; emphasis added)

> FIG. 12 shows a structure of a **laser diode 40** having a double-heterostructure of the present invention.
>
> The **laser diode 40** has a double-heterostructure constituted by an impurity-doped **$In_xGa_{1-x}N$ active layer 18** described above in detail in association with the light-emitting diode, and two clad layers sandwiching the active layer **18**, i.e., an n-type gallium nitride-based compound semiconductor layer **16** and a p-type gallium nitride-based compound semiconductor layer **20**, as described above. A buffer layer **14** described above in detail is formed on a substrate **12** described above in detail. An n-type gallium nitride layer **42** is formed on the buffer layer **14**, providing a contact layer for an n-electrode described below.

(Nakamura, col. 11, line 61 to col. 12, line 6; emphasis added)

Nakamura shows that the wavelength of the LED or LD can be controlled by controlling the dopant:

> In the light-emitting device of the present invention, when the value of x in $In_xGa_{1-x}N$ of the light-emitting layer is close to 0, the device emits **ultraviolet** light. When the value of x increases, the emission falls in the longer-wavelength region. When the value of x is close to 1, the device emits red light. When the value of x is in the range of $0<x<0.5$, the light-emitting device of the present invention emits **blue** to yellow light in the wavelength range of **450** to 550 nm.

(Nakamura, col. 4, lines 52-59; emphasis added)

Nakamura provides numerous examples of LEDs emitting blue light (Examples 1-28 at cols. 13-20) including an emission **peak** value at, *inter alia*, 400 nm (Nakamura, col. 14, lines 64-65) at 405 nm (*id.*, claim 18, line 67), 430 nm (*id.*, col. 14, lines 51-52), and 480 nm (*id.*, col. 13, lines 40-42).

The peak emission wavelength at 400 nm and 405 nm show that the LEDs of these examples emit primarily **ultraviolet** light, as evidenced by the CRC Handbook. Similarly, those LEDS having peak emission at 430 nm and 480 nm emit primarily **blue** light.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute Stevenson's GaN-based LED with the UV light emitting LED GaN-based laser diodes disclosed in Nakamura. This can be seen as simple substitution of one known element (Stevenson's GaN-based LED) for another known element (Nakamura's GaN-based laser diode) to obtain predictable results and is one of the rationales identified by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___,___, 82 USPQ2d 1385, 1395-97 (2007). (See MPEP 2143, Rationale B.)

The results are predictable because both Stevenson's and Nakamura's LED and LD emit light in the same general region of the spectrum and are GaN-based, so the LED and LD materials are essentially the same. As will be discussed below, because the phosphor mixture disclosed in APA emit white light in response to UV radiation and Nakamura's LDs emit light in the UV wavelength range, the results of using Nakamura's LD in Stevenson's device and APA's phosphor mixtures yield predictable results, i.e. the production of white light.

With regard to **difference (3)**, the luminophoric mixture: As noted above, in the rejection over Stevenson in view of any of Pinnow, Menda, and APA, it is obvious to use APA's inorganic or organic phosphor mixtures as Stevenson's inorganic or organic phosphor mixtures to produce white light using Stevenson's GaN-based LED. To repeat, the '175 patent is replete with admitted prior art indicating that it was well known to mix together phosphors, one for each of the primary colors, to produce white light output. For example, the '175 patent states,

> It is well known that so-called **fluorescent lamps provide white light** illumination. In a fluorescent lamp, the Hg vapor in the vacuum tube is excited by an electrical discharge. The excited Hg atoms emit light, **primarily in the ultraviolet region** (e.g., 254 nm, 313 nm, 354 nm), which is absorbed by the **inorganic phosphors coating the inside walls of the tube**. The phosphors then emit light. These inorganic phosphors are designed as such to offer white light emission by "down-converting" (i.e., transforming a higher frequency, shorter wavelength form of energy to a lower frequency, longer wavelength form of energy) the ultraviolet emissions of the excited states of atomic Hg into a **broad spectrum** of emitted light which appears as **white** to the observer. **However, these light emitting devices are not solid-state**, ...

(the '175 patent, col. 3, lines 40-53; emphasis added)

Thus, the '175 teaches that the missing part is **not** the mixed phosphors but is, instead, the solid-state light emitting devices, e.g. LEDs. **But** Stevenson --20 years earlier-- already did this. Stevenson exchanged the UV light from electrically-excited Hg vapor with a **solid-state** GaN-based LED and used phosphors --just as in a fluorescent bulb-- to down-convert the blue-to-UV light to any other color and white light (Stevenson, paragraph bridging cols. 3-4, excerpt above).

The '175 patent discusses other known mixed, inorganic phosphor systems that produce white light and then acknowledges the following:

> While the devices in the above examples vary in concept and construction, they demonstrate the utilization of **red, green and blue fluorescent materials**, all **inorganic** in composition, which when excited by **photons** or electron beams, can release multiple wavelengths of **secondary light emission** (luminescence of either fluorescent or phosphorescent character) to exhibit **white light** to the observer. This is generally true, even if microscopic domains of discrete colored light emission can be observed on the Lambertian surface of the light emitting device.

(the '175 patent, col. 4, lines 32-41; emphasis added)

The '175 patent admits that it is known in the art to mix phosphors together to produce white light from a **single** source of light. Again, all that is lacking is the LED, but Stevenson teaches this as well as explicitly stating to use organic or inorganic phosphors to produce visible light. Thus the only think purported to be inventive in the '175 patent, the LED, was known 20 years before the '175 patent. Everything else, i.e. the phosphors is old and notoriously well known.

Another example of single white-light-emitting device discussed in the '175 patent's APA is the "thin film organic electroluminescent cell":

> **White light emission** from thin film organic electroluminescent cells based on poly(vinylcarbazole PVK) thin films on ITO-coated glass has also been recently reported. ... It is well known that the excited carbazole moiety within the polymer aggregates in the excited state leads to **blue excimer emission**, in the absence of quenchers or dopants. In the example of the organic Mg:Ag:Alq:TAZ:doped PVK:ITO:Glass electroluminescent device, the quenchers of excimeric emission, are the **dopants blue emitting** 1,1,4,4-tetraphenylbuta-1,3-diene (TPB), **green emitting** 7-diethylamino-3-(2'benzothiazoyl)coumarin (Coumarin-6), and **red emitting** dicyanomethylene-2-methyl-6-p-dimethylaminostyryl-4H-pyran (DCM-1).

(the '175 patent, col. 5, lines 21-44; emphasis added)

Thus, the primary "blue excimer emission" is converted into each of the primary color by dopants that are **mixed** together to produce white light by the same cell.

The '175 patent also acknowledges that others have produced white light using LEDs by mixing wavelengths of light from **three separate** LEDs, each one producing a different "primary" color:

> Given the **desirability of white light displays** (e.g., commercial bank "time and temperature" message boards, stadium scoreboards), **considerable effort has been expended to produce white light LEDs**. Although the recent availability of the blue LED makes a full color, and by extension a white light display realizable, conventionally it has been considered that such a display would require multiple LEDs. The **multiple** LEDs would be then

> incorporated into complicated and expensive LED modules to obtain the required broad band illumination necessary to provide white light. Even if a discrete LED lamp were constructed that provides white illumination (as opposed to the utilization of a **multitude** of **single die, single color discrete LED lamps in a module or sub-assembly**), the current state of the art requires the utilization of multiple LED dies and typically at least four electrical leads to power these dies. U.S. Pat. No. 4,992,704 issued to Stinson teaches a variable color light emitting diode having a unitary housing of clear molded solid epoxy supporting **three LED dies characterized as producing color hues of red, green and blue**, respectively. There have been some recent introductions of commercial "full-color" LED lamps, that are essentially **discrete lamps** which afford a means of producing white light. All currently available examples of such lamps contain a minimum of three LED dies (or chips)--**one red, one green and one blue**, encapsulated in a single epoxy package.

(the '175 patent, col. 2, lines 25-50; emphasis added)

What the '175 patent does **not**, however, acknowledge is that Stevenson --**20 years before** the '175 patent-- already produced colored or white light by down-converting blue-to-UV light from the **same** GaN-based LED (rather than three separate LEDs, one emitting each primary color) by using organic or inorganic phosphors (Stevenson, paragraph bridging cols. 3-4; excerpt above).

All that Stevenson **may** not disclose is whether or not the phosphors are mixed together to produce white light. Given the APA discussed above, one would be hard-pressed to believe that it would escape the mind of the routineer in the lighting arts to mix the phosphors together to produce white light. Nonetheless, even if it is not implicit in Stevenson alone to mix the phosphors to produce white light, given the ample evidence in the '175 patent's APA for the desire to produce white light from a **single** light-emitting device by mixing phosphors together, (e.g. fluorescent bulbs, EL devices, *supra*), it would have been entirely obvious to one of ordinary skill at the time of the invention to mix together the phosphors in Stevenson to produce white light output from each single GaN-based LED because the '175 patent's APA admits that this is both highly desired and notoriously well known. In addition, one **benefit** would be to produce white light from a **single** LED rather than from **multiple** LEDs, thereby making the cost of white light less expensive, as clearly indicated by the APA.

Proposed new **claims 34 and 38-40** read,

> *34. The light-emitting device of claim 3, wherein the luminophoric medium comprises an **inorganic** luminophor.*
>
> *38. The light-emitting device of claim 34, wherein the semiconductor laser comprises material selected from the group consisting of **gallium nitride and its alloys.***

> *39. The light-emitting device of claim 34, wherein the semiconductor laser comprises **gallium nitride**.*
>
> *40. The light-emitting device of claim 34, wherein the semiconductor laser comprises **gallium nitride alloy**.*

As noted above, APA discloses a mixture of inorganic phosphors (*luminophoric medium*) and the use of APA's phosphor mixture as Stevenson's phosphor is obvious for the reasons indicated above.

Nakamura discloses each of the features of claims 38-40. Therefore, Stevenson modified to use Nakamura's UV laser, includes GaN and/or its alloys.

12. Claims 62, 75, 100, and 113 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA, Wanmaker, and Nakamura.

Proposed new **claim 62** reads,

> *62. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the light-emitting device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged **about** the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being **contiguous to** the single-die light-emitting diode;*

> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in* ***laterally spaced relationship to said side surface;***
>
> *(iv) the luminophoric medium being dispersed* ***in polymer or glass;*** *and*
>
> *(v) the luminophoric medium being* ***on polymer or glass.***

Claim 62 is coextensive with claim 5, as indicated by Patentee (Remarks dated 3/26/2012, pp. 28-29). Claim 62 is distinguished from claim 5 in (1) the LED is required to be a blue-light-emitting GaN-based LED, and (2) the one or more *compatible characteristics*. The substitution of Stevenson's blue-to-UV-light-emitting GaN-based LED with Nakamura's blue-light-emitting GaN-based LEDs is obvious for the reasons discussed above. The luminophoric medium (phosphor mixture of APA) is necessarily *about* the LED; otherwise, it would not interact with the primary radiation.

Proposed new **claim 75** reads,

> *75. The light-emitting device of claim 62, wherein the luminophoric medium comprises* ***inorganic*** *luminophoric material.*

Recall that Stevenson discloses that organic or inorganic phosphors can be used to make each of the primary colors from the blue-to-UV light emitting GaN-based LED:

> Thus, it is seen that there has been provided an improved **light emitting diode** capable of emitting light in the violet **region** of the spectrum. This device may be used as a source of violet light for applications where this spectral range is appropriate. This **light may be converted to lower frequencies (lower energy)** with good conversion efficiency using **organic and inorganic phosphors**. Such a conversion is appropriate not only to develop different colors for aesthetic purposes, but also to produce light in a spectral range of greater sensitivity for the human eye. By use of **different phosphors, all the primary colors may be developed from this same basic device.** An **array** of such devices may be used for **color display systems; for example, a solid state TV screen**.

(Stevenson, paragraph bridging cols. 3-4; emphasis added)

Again, as noted above in the rejection over Stevenson as evidenced by the CRC Handbook, Stevenson's Fig. 4 shows that there is significant emission in the blue wavelength range of the spectrum by the GaN-based LED that can be used in conjunction with **in**organic phosphors to produce each of the primary colors. Thus, one of ordinary skill has a reasonable expectation of success in substituting Stevenson's GaN-based LED with Nakamura's blue-light-emitting LED, even when **in**organic phosphors are used.

In addition, as noted above, APA teaches that it is known in the art to use inorganic phosphor mixtures coated on a glass housing to convert primary radiation from electrically excited Hg (mercury) vapor, as in fluorescent bulbs:

> It is well known that so-called **fluorescent lamps provide white light** illumination. In a fluorescent lamp, the Hg vapor in the vacuum tube is excited by an electrical discharge. The excited **Hg atoms emit light, primarily in the ultraviolet region** (e.g., 254 nm, 313 nm, 354 nm), which is absorbed by the **inorganic phosphors coating the inside walls of the tube**. The phosphors then emit light. These inorganic phosphors are designed as such to offer white light emission by "down-converting" (i.e., transforming a higher frequency, shorter wavelength form of energy to a lower frequency, longer wavelength form of energy) the **ultraviolet** emissions of the excited states of atomic Hg into a **broad spectrum** of emitted light which appears as **white** to the observer. **However, these light emitting devices are not solid-state**, ...

(the '175 patent, col. 3, lines 40-53; emphasis added)

The '175 patent is not entirely accurate as to the emission of Hg vapor that is converted to visible light. Rather, the '175 patent fails to acknowledge that, in fact, such high intensity **blue** light is emitted by the Hg vapor that the phosphor coatings include inorganic compounds that absorb and convert, not just the UV wavelengths, but also the **blue** wavelengths to longer wavelength visible light, so that the blue does not overwhelm the emitted light. In this regard, Wanmaker states,

> To obtain a satisfactory rendition of the colours of articles irradiated by a fluorescent lamp it is necessary to **suppress the intensity of the blue mercury lines emitted by the mercury vapour discharge** at wave lengths of **405 and 436 nm**.
>
> To what extent this suppression is to be effected is dependent on the desired quality of the colour rendition and on the desired colour temperature of the lamp. An **attenuation of the said blue mercury lines** can be obtained if the wall of the lamp is provided with a layer which includes a light yellow coloured **red luminescing material which absorbs at least a part of the blue mercury radiation**. The **emitted radiation of this luminescent material provides a desired contribution in the red part of the spectrum** of the radiation emitted by the lamp. This known step is described in United Kingdom patent specification 737,828. **Magnesium arsenate** activated by **quadrivalent manganese** is used in practice as a **blue absorbing red luminescing material**. Furthermore the lamp includes a second luminescent layer which is provided on the absorption layer and which comprises **one or more luminescent materials** with which it is possible to achieve the desired spectral distribution of the radiation emitted by the lamp.

(Wanmaker, col. 1, lines 18-22; emphasis added)

Wanmaker goes on to improve upon the prior art phosphors with other phosphors that also convert the mercury blue lines to longer wavelength visible light.

Wanmaker is important here because it shows that those of ordinary skill in the art knew in 1974 --20 years before the '175 patent-- how to choose **in**organic phosphor mixtures that down-convert **blue** light to visible white light --such as that produced by Nakamura's GaN-based LEDs emitting light in the **blue** region of the spectrum. Thus, Wanmaker provides evidence of success and predictable results in using APA's or Wanmaker's mixture of **in**organic phosphors along with Nakamura's GaN-based, blue-light emitting LED in place of Stevenson's GaN-based LED.

This is all of the features of claim 75.

Proposed new **claim 100** reads,

> *100. A light-emission device, comprising*
>
> *a single-die, two-lead **gallium nitride based** semiconductor **blue** light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the light-emission device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged **about** the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being **contiguous to** the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in **laterally spaced relationship to said side surface**;*
>
> *(iv) the luminophoric medium being dispersed **in polymer or glass**; and*
>
> *(v) the luminophoric medium being **on polymer or glass**.*

Claim 100 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 40-41). Claim 100 differs from claim 26 in the same ways that claim 62 is distinguished from claim 5. Therefore claim 100 is obvious for the same additional reasons as indicated above in conjunction with claim 62.

Proposed new **claim 113** reads,

> *113. The light-emitting device of claim 100, wherein the luminophoric medium comprises **inorganic** luminophoric material.*

See discussion above directed to claim 75 which applies here.

13. Claims 3, 34, 35, 37-40, and 179 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA and Nakamura and further in view of Tadatsu.

Proposed new claims 35, 37, and 179 read,

> *35. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *37. The light-emitting device of claim 34, wherein the inorganic luminophor is* ***within*** *a housing member.*
>
> *179. The light-emitting device of claim 3, wherein the luminophoric medium is* ***contiguous to*** *said semiconductor laser.*

The prior art of Stevenson in view of APA and Nakamura, as explained above, discloses each of the features of claims 3, 34, and 38-40.

Stevenson does not indicate where the inorganic phosphors should be located and thus does not teach luminophoric medium on, in, or within a housing member, or is contiguous to the LED or laser diode.

Tadatsu discloses a package LED **11** wherein a primary radiation is down-converted by a luminophor **5** to a longer wavelength, and is therefore in the same field of endeavor as is Stevenson. Tadatsu also desires producing **white light**. In this regard, Tadatsu states,

> [Constitution] A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a **resin mold**, wherein said **light emitting device is made of gallium nitride related compound semiconductors** which are expressed with a general formula of $Ga_xAl_{1-x}N$ (where $0 \leq x \leq 1$), and further wherein a **fluorescent dye or pigment**, which is **excited with emission light from said gallium nitride related compound semiconductors** and which **emits fluorescent light**, is **added to said resin mold**.

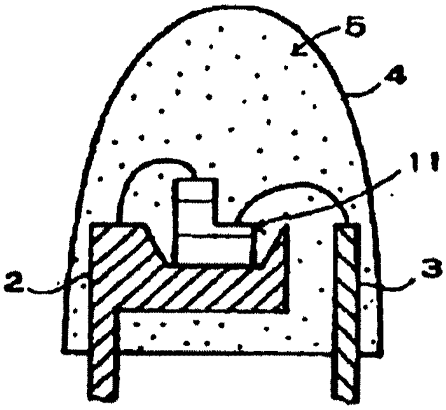
(Tadatsu translation, p. 1)

Tadatsu's Fig. 2 (reproduced below) shows the packaged LED have two leads **2, 3** and a housing member ("resin mold" **4**) within which the luminophor ("fluorescent dye" **5**) is dispersed. Tadatsu also indicates that the luminophor can be organic or inorganic:

> [0003] Ordinarily, a resin with a large index of refraction and a high transparency is selected for the resin mold 4, so that the emission light from the light emitting device is efficiently emitted to the air. In other cases, an **inorganic or organic pigment is mixed as a coloring agent in the resin**

> **mold 4** in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its **emission color turns into white**.

(Tadatsu translation ¶ [0003]; emphasis added)



(Tadatsu, Fig. 2)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to put Stevenson's or Stevenson/APA's inorganic phosphors in the resin housing member, and to package Stevenson/Nakamura's GaN-based laser as in Tadatsu because Stevenson/Nakamura is silent as to where the phosphors should be oriented relative to the LD, such that one of ordinary skill would use a known packaging method that achieves the correct relative orientation to allow the light emitted from the LD to interact with the luminophor, such as that orientation taught in Tadatsu. So oriented, the luminophoric medium is in and within a housing member, and is contiguous to Stevenson/Nakamura's laser, as taught by Tadatsu.

Claims 3, 34, and 38-40 are rejected here, again, with the addition of Tadatsu, to provide even more reasons to mix the phosphors. Tadatsu teaches that it is desired in the lighting arts to produce **white** light from a **single** LED by down-converting the LED's primary radiation using phosphors (i.e. dyes and pigments exicted by the primary radiation from the LED) to produce a mixture of wavelengths that mix to produce white light (*id.*). So even if it is believed that Stevenson and APA somehow fail to produce sufficient information to those of ordinary skill in the lighting arts to mix the phosphors of APA --that are already mixed together to produce white light-- then Tadatsu provides even more evidence that those of ordinary skill in the art desire white light from a **single** LED.

14. Claims 35-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA and Nakamura and further in view of Tabuchi.

Proposed new claim 36 reads,

> *35. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *36. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *37. The light-emitting device of claim 34, wherein the inorganic luminophor is* ***within*** *a housing member.*

The prior art of Stevenson in view of APA and Nakamura, as explained above, discloses each of the features of claims 3 and 34.

Tabuchi is applied as above in the rejection over Stevenson in view of APA and Tabuchi to show that is would have been obvious to those of ordinary skill in the art, at the time of the invention, to package the laser diode of Stevenson/Nakamura as in Tabuchi and thereby to have APA's mixture of phosphors located (1) ***on or in*** *a housing member*, (2) ***in a film on a surface*** *of a housing member*, or (3) ***within*** *a housing member*.

15. Claims 79, 80, 116-118, 129, 132-134, 144, 147, 148, 162, and 167 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stevenson in view of APA, Wanmaker, and Nakamura and further in view of Tabuchi and Martic.

Proposed new **claims 118 and 129** read,

> *118. A light-emission device, comprising*
>
> *a single-die, two-lead* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the luminophoric medium is* ***dispersed in a polymer that is on or about*** *the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*
>
> *129. The light-emission device of claim 118, wherein the luminophoric medium comprises* ***inorganic*** *luminophoric material.*

Claim 118 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, p. 45). The ***GaN-based blue LED*** and the luminophoric medium made from a mixture of ***inorganic*** phosphors was discussed above in the rejection over Stevenson in view of APA, Wanmaker, and Nakamura which applies equally to claim 118.

Thus the only difference is that there is no indication that the phosphoric mixture of APA or Wanmaker is *dispersed in a polymer that is on or about* the GaN-based LED.

As noted above, Tabuchi teaches the phosphor **7** is coated on the wall of the transparent cover **6**:

> A **phosphor layer 7** is provided by applying a **binding agent in which a phosphor** to convert the radiation from light emitting semiconductor device 4 to visible light is **dispersed on the inner surface of transparent cover 6**. Transparent cover 6 is made of a material such as **glass** or an **epoxy** resin is preferably fixed to stem 1 so that it can also function as a cap for hermetic sealing.

(Tabuchi translation, pp. 3-4; emphasis added)

Although Tabuchi does not indicate the identity of the binder, Martic teaches that it has long been known (since 1973) to use organic resins (i.e. polymers) as binding agents specifically for inorganic phosphors in the manufacture of luminescent screens:

> In still another aspect, this invention relates to screens comprising **inorganic phosphors** wherein the **binding agent** for said phosphors comprises a **polyurethane elastomer** alone or in combination with an **alkyl methacrylate resin** in various ratio ranges.

(Martic, col. 1, lines 10-14; emphasis added)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to disperse APA or Wanmaker's inorganic phosphors in the polymeric binding agent of Martic to make the phosphor layer **7** in Tabuchi, because Tabuchi is silent as to the binding agent for the phosphor, such that one of ordinary skill would use known binders specifically used for inorganic phosphors that must emit light.

This is all of the additional features of claims 118 and 129.

Proposed new **claims 134 and 144** read,

> *134. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*

> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the luminophoric medium is* ***dispersed in a polymer that is on or about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *144. The light-emitting device of claim 134, wherein the luminophoric medium comprises* ***inorganic*** *luminophoric material.*

Each of the additional features of these claims, highlighted in bold has been discussed above.

Proposed new **claims 162 and 167** read,

> *162. A light-emitting device, comprising:*
>
> *at least one single-die* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein said at least one single-die gallium nitride based semiconductor blue light-emitting diode is* ***in a housing comprising a light-transmissive wall member in spaced relationship*** *to said at least one single-die gallium nitride based semiconductor blue light-emitting diode,*
>
> *and* ***wherein said luminophoric medium is dispersed in or on said light-transmissive wall member****.*

> *167. The light-emitting device of claim 162, wherein the luminophoric medium comprises **inorganic** luminophoric material.*

Each of the additional features of these claims, highlighted in bold has been discussed above. Tabuchi's cover **6** is called a "transparent cover **6**" so it is necessarily a *housing comprising a light-transmissive wall member in spaced relationship* to the LED. The phosphor layer **7** is dispersed on transparent cover **6**.

Proposed new **claims 79, 80, 116, 117, 132, 133, 147, and 148** read,

> *79. The light-emitting device of claim 62, comprising a light-emitting diode lamp.*
>
> *80. The light-emitting device of claim 79, wherein the light-emitting diode lamp comprises the at least one single-die gallium nitride based semiconductor blue light-emitting diode and **inorganic** luminophoric material within an **enclosure** comprising material that is light-transmissive of said white light output.*
>
> *116. The light-emission device of claim 100, comprising a light-emitting diode lamp.*
>
> *117. The light-emission device of claim 116, wherein the light-emitting diode lamp comprises the single-die gallium nitride based semiconductor blue light-emitting diode and **inorganic** luminophoric material within an **enclosure** comprising material that is light- transmissive of said white light.*
>
> *132. The light-emission device of claim 118, comprising a light-emitting diode lamp.*
>
> *133. The light-emission device of claim 132, wherein the light-emitting diode lamp comprises the single-die gallium nitride based semiconductor blue light-emitting diode and **inorganic** luminophoric material within an **enclosure** comprising material that is light- transmissive of said white light.*
>
> *147. The light-emission device of claim 134, comprising a light-emitting diode lamp.*
>
> *148. The light-emission device of claim 147, wherein the light-emitting diode lamp comprises the single-die gallium nitride based semiconductor blue light-emitting diode and **inorganic** luminophoric material within an **enclosure** comprising material that is light-transmissive of said white light output.*

Regarding claims 79, 116, 132, and 147, the device of Stevenson as modified by the other references includes a single LED package which is therefore a lamp.

Regarding claims 80, 117, 133, and 147, as discussed above, Tabuchi teaches that the LED lamp includes an enclosure having a transparent cover **6** with the phosphor coating **7** on the interior surface thereof. Because the transparent cover **6** is transparent, it is *light-transmissive of said white light output*.

D. Tabuchi as a base reference

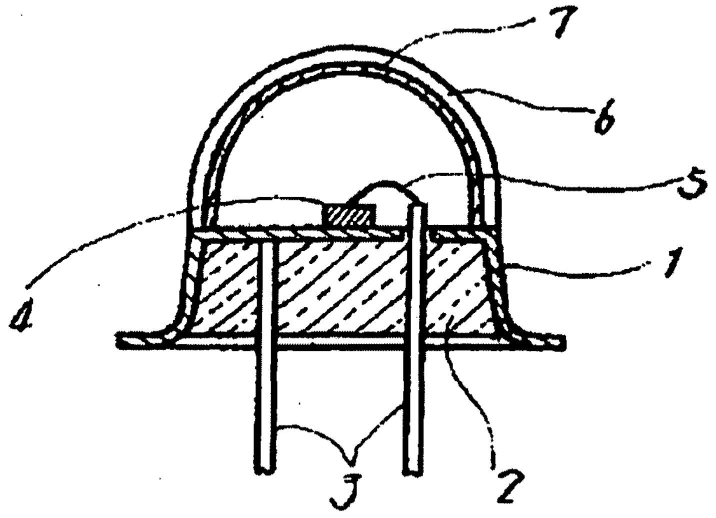
1. Claims 1, 5, 22, 26, 172, 173, 176, and 177 are rejected under 35 U.S.C. 102(b) as being anticipated by Tabuchi, as evidenced by the CRC Handbook.

Proposed amended claim 1 reads,

> ***[1]*** *1. A light emitting device, comprising:*
>
> ***[2]*** *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation* ***[3]*** *which is the same for each single-die semiconductor LED present in the device,* ***[4]*** *said primary radiation being a relatively shorter wavelength radiation outside the visible white light spectrum; and*
>
> ***[5]*** *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum, with said radiation of said multiplicity of wavelengths mixing to produce a white light output, [6] wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Feature [1]: *1. A light emitting device*

Tabuchi's Fig. 1 (reproduced below) shows a LED **4**, which can be a GaN-based LED, in a housing including transparent cover **6** having a phosphor film **7** coated thereon to convert the primary radiation (UV or IR) from said LED **4** into visible light. Visible light includes white light. The LED includes two leads **3** for powering the LED.



(Tabuchi, Fig. 1)

In regard to the embodiment shown in Fig. 1, Tabuchi states,

> Figure 1 depicts a **light emitting semiconductor apparatus** of an example of the present utility model invention. In the example, the present utility model invention is applied to a light emitting semiconductor apparatus which employs a so-called TO-5 stem. Figure 1, glass 2 fixes leads 3 in a TO-5 metal stem 1. A **light emitting semiconductor device 4** is conductively connected to stem 1. A transparent cover 6 according to the present utility model invention is fixed on stem 1. **A phosphor layer 7 is provided by applying a binding agent in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is dispersed on the inner surface of transparent cover 6**. Transparent cover 6 is made of a material such as **glass** or an **epoxy** resin is preferably fixed to stem 1 so that it can also function as a cap for hermetic sealing.
>
> In the light emitting apparatus of the present utility model invention, **phosphor layer 7 converts** infrared or **UV** emitted from **light emitting semiconductor device 4** to **visible light** which is radiated in random directions. Therefore, the light emitting semiconductor apparatus can produce an emission with a uniform intensity over a large area. Further, the light emitting semiconductor apparatus utilizes a relatively small quantity of phosphor and hence, is inexpensive.

(Tabuchi translation, pp. 3-4; emphasis added)

> A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)

> **Feature [2]:** *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation*

Tabuchi's Fig. 1 above shows a *single-die semiconductor LED* **4** where the semiconductor includes GaN when UV light is the primary light (*id.*). Fig. 1 also shows that leads **3** that couple the LED to a power supply (*id.*).

> **Feature [3]:** *which is the same for each single-die semiconductor LED present in the device*

Only one LED is required by the claim. Therefore, the primary light is the same for each LED.

> **Feature [4]:** *said primary radiation being a relatively shorter wavelength radiation outside the visible white light spectrum*

Ultraviolet (UV) light (i.e. below 400 nm wavelength) is necessarily outside the *visible white light spectrum*, as admitted in the '175 patent.

> **Feature [5]:** *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum, with said radiation of said multiplicity of wavelengths mixing to produce a white light output*,

Tabuchi discloses a down-converting luminophoric medium (phosphor film **7**, which can be "an **ordinary** UV-visible light conversion phosphor") for converting UV light from the GaN-based LED into visible light:

> A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)

Visible light is 4000 Å to 7000 Å that inherently includes *a multiplicity of wavelengths*, again as evidenced by the CRC Handbook, above; therefore the "ordinary UV-visible light conversion phosphor" *responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum*.

> **Feature [6]:** <u>wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output</u>.

It is implicit that each of Tabuchi's individual LEDs is capable of producing white light because one of ordinary skill would recognize that visible light made by "an **ordinary** UV-visible light conversion phosphor" includes white light.

This is all of the features of proposed amended claim 1.

Proposed amended **claim 5** reads,

> *5. A light-emitting device, comprising:*
>
> *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation,* ***is excited to*** *responsively emit a secondary,* ***relatively longer wavelength, polychromatic*** *radiation, with* ***separate wavelengths*** *of said* ***polychromatic*** *radiation mixing to produce a white light output, each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Claim 5 is distinct from claim 1 in that (1) the primary radiation is not required to include radiation outside the visible white light spectrum; (2) the down-converting is required to yield longer wavelengths than that of the primary radiation; and (3) separate wavelengths are required to be produced.

With regard to **difference (1)**, claim 5 is broader in this respect; thus, Tabuchi discloses the claimed LED for the reasons indicated in conjunction with claim 1.

With regard to **differences (2) and (3)**, as discussed in rejecting claim 1 above, Tabuchi discloses that the light is down-converted (in terms of energy) to visible light by any "ordinary UV-visible light conversion phosphor". Visible light includes white light which is necessarily polychromatic, as evidenced by the CRC Handbook (i.e. visible light includes a combination of the wavelengths from 700 to 400 nm). Because Tabuchi discloses that any "ordinary UV-**visible** light conversion phosphor" can be used to produce the visible light, which includes white light, those of ordinary skill in the art would recognize that the phosphors to which Tabuchi refers include those producing white light.

This is all of the features of claim 5.

Claim 22 reads,

> *22. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die two-lead semiconductor LED.*

As noted above in rejecting claim 1, Tabuchi discloses a GaN-based LED having two leads **3** (Tabuchi translation, p. 5; Fig. 1).

Claim 26 reads,

> *26. A light-emission device, comprising*
>
> *a single-die, two-lead semiconductor light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light.*

This claim is significantly broader than claim 22 above. Tabuchi discloses each of the features of this claim for the reasons discussed in rejecting claims 1, 5, and 22 above.

Proposed new **claims 172 and 176** read,

> *172. The light-emitting device of claim 5, wherein the secondary, relatively longer wavelength, polychromatic radiation comprises a broad spectrum of frequencies.*
>
> *176. The light-emission device of claim 26, wherein radiation down-converted by the recipient down-converting luminophoric medium comprises a broad spectrum of frequencies.*

As noted above, visible light includes a broad spectrum of frequencies, as evidenced by the CRC Handbook. Therefore, Tabuchi's the secondary, down-converted radiation emitted from Tabuchi's light emitting device includes *a broad spectrum of frequencies*.

Proposed new **claims 173 and 177** read,

> *173. The light-emitting device of claim 5, wherein the single-die semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*
>
> *177. The light-emission device of claim 26, wherein the single-die, two-lead semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*

Tabuchi's Fig. 1, above shows that the *single-die, two-lead* ***3*** *semiconductor light-emitting diode* ***4*** *is on a support* ***1*** *in an interior volume of a light-transmissive enclosure* **6**.

2. Claims 1, 5, 22, 26, 27-32, 41-46, 55-60, 172, 173, 176, and 177 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Admitted Prior Art (APA).

The prior art of Tabuchi, as explained above, is believed to disclose each of the features of claims 1, 5, 22, 26, 172, 173, 176, and 177. If it is believed by Patentee, however, that Tabuchi does not include *white light*, then this may be a difference between Tabuchi and claims 1, 5, 22, 26, 172, 173, 176, and 177.

As noted above, Tabuchi discloses that any "**ordinary** UV-visible light conversion phosphor" can be used to produce the visible light (Tabuchi translation, p. 5; emphasis added).

APA teaches fluorescent light bulbs use ordinary UV-visible light conversion phosphors for producing white light and that such phosphors are inorganic:

> It is well known that so-called **fluorescent lamps provide white light** illumination. In a fluorescent lamp, the Hg vapor in the vacuum tube is excited by an electrical discharge. The excited Hg atoms emit light, **primarily in the ultraviolet region** (e.g., 254 nm, 313 nm, 354 nm), which is absorbed by the **inorganic phosphors coating the inside walls of the tube**. The phosphors then emit light. These inorganic phosphors are designed as such to offer white light emission by "down-converting" (i.e., transforming a higher frequency, shorter wavelength form of energy to a lower frequency, longer wavelength form of energy) the ultraviolet emissions of the excited states of atomic Hg into a **broad spectrum** of emitted light which appears as **white** to the observer. **However, these light emitting devices are not solid-state**, ...

(the '175 patent, col. 3, lines 40-53; emphasis added)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use APA's inorganic phosphor in Tabuchi because Tabuchi explicitly suggests using any "**ordinary** UV-visible light conversion phosphor" and because APA teaches such an ordinary phosphor for producing white light from UV light.

Further regarding proposed new **claims 172 and 176** reads, as noted above, visible light includes a broad spectrum of frequencies, as evidenced by the CRC Handbook. Therefore, the secondary, down-converted radiation emitted from Tabuchi/APA's light emitting device includes *a broad spectrum of frequencies*, noting that APA teaches plural phosphors that necessarily emit plural wavelengths of light.

Proposed new **claims 27, 41, and 55** read,

> *27. The light emitting device of claim 1, wherein the luminophoric medium comprises an* ***inorganic*** *luminophor.*
>
> *41. The light emitting device of claim 5, wherein the luminophoric medium comprises an* ***inorganic*** *luminophor.*
>
> *55. The light emitting device of claim 26, wherein the luminophoric medium comprises an* ***inorganic*** *luminophor.*

As just noted, APA teaches that the phosphor is inorganic.

Proposed new claims 28-30, 42-44, and 56-58 read,

> *28. The light emitting device of claim 27, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *29. The light emitting device of claim 27, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *30. The light emitting device of claim 27, wherein the inorganic luminophor is* ***within*** *a housing member.*
>
> *42. The light emitting device of claim 41, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *43. The light emitting device of claim 41, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *44. The light emitting device of claim 41, wherein the inorganic luminophor is* ***within*** *a housing member.*
>
> *56. The light emitting device of claim 55, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *57. The light emitting device of claim 55, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *58. The light emitting device of claim 55, wherein the inorganic luminophor is* ***within*** *a housing member.*

Tabuchi's Fig. 1, above, shows that the phosphor layer **7** is in a film on the inside surface of the transparent cover **6**:

> A **phosphor layer 7** is provided by applying a **binding agent** in which a phosphor to convert the radiation from light emitting semiconductor device 4 to visible light is **dispersed on the inner surface of transparent cover 6**.

> Transparent cover 6 is made of a material such as **glass** or an **epoxy resin** is preferably fixed to stem 1 so that it can also function as a cap for hermetic sealing.

(Tabuchi translation, p. 3, last full ¶; emphasis added)

Thus, Tabuchi discloses phosphor **7** is located *on, in, within,* and *in a film on a surface*, of a housing member **6**.

This is also entirely consistent with the APA phosphor which is a coating on the inside of the light bulb housing.

Proposed new **claims 31, 32, 45, 46, 59, and 60** read,

> *31. The light emitting device of claim 27, wherein each said LED comprises material selected from the group consisting of **gallium nitride and its alloys**.*
>
> *32. The light emitting device of claim 27, wherein each said LED comprises **gallium nitride**.*
>
> *45. The light-emitting device of claim 41, wherein each said LED comprises material selected from the group consisting of **gallium nitride and its alloys**.*
>
> *46. The light-emitting device of claim 41, wherein each said LED comprises **gallium nitride**.*
>
> *59. The light-emission device of claim 55, wherein the light-emitting diode comprises material selected from the group consisting of **gallium nitride and its alloys**.*
>
> *60. The light-emission device of claim 55, wherein the light-emitting diode comprises **gallium nitride**.*

As noted above, Tabuchi indicates that the LED is GaN when UV light is used as the primary radiation:

> A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)

<u>3. Claims 1, 5, 22, 26, 172, 173, 176, 177, and 187 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow.</u>

The prior art of Tabuchi, as explained above, is believed to disclose each of the features of claims 1, 5, 22, 26, 172, 173, 176, and 177. If it is believed by Patentee, however, that Tabuchi does not include *white light*, then this may be a difference between Tabuchi and claims 1, 5, 22, 26, 172, 173, 176, and 177.

As noted above, Tabuchi discloses that any "**ordinary** UV-visible light conversion phosphor" can be used to produce the visible light (Tabuchi translation, p. 5; emphasis added).

> *<u>wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output</u>. (claim 1)*
>
> *<u>each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output</u>. (claim 5)*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light. (claim 26)*

Pinnow teaches a display wherein a laser (instead of an LED) is used to produce primary **visible or UV** light that is down-converted by a **mixture of phosphors** into visible, secondary light of longer wavelength light which explicitly includes white light:

> A single color display is produced by projection using a scanning laser beam operating in the **visible** or **ultraviolet** and a photoluminescent screen which emits in the visible. **Combinations of phosphors** may be employed to simulate **white** or desired colors.

(Pinnow, abstract)

Pinnow's Fig. 3 shows the light emitting device (a display) including the laser **10** and one example of a phosphor screen **15**. The primary light from the laser **10** is down-converted by phosphor screen **15** to produce visible light. Importantly, Pinnow teaches that phosphors for each primary color can be mixed together in a **resin** to produce **white** light:

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is absorbed on a colloid which may take the form of gell [sic] fibers or particles of high molecular weight polymers.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of **homogeneous phosphor screens**. These may be present as **self-supporting members** or as **coatings**, and they may be made up on **one or any combination of colorants required to produce the desired balance**.

(Pinnow, col. 2, lines 15-20; emphasis added)

> A black and **white** display can be achieved by scanning a monochromatic laser beam on a viewing screen that is **coated with an appropriate blend of phosphors** and direct scattering materials such as powdered MgO or talc. For example, a combination of scattered light from a **blue argon-ion laser beam (4,880 A.)** [i.e. **visible** light] and blue-to-red converted light from either of the Rhodamine dye phosphors can produce a **white** appearance since a straight line connecting these primaries on the chromaticity diagram passes very near to illuminant C.
>
> A combination of **more than two primaries** can also be used to produce **white**. As an example, a **Cd-He laser** beam which illuminates a correctly proportioned mixture of MgO and dye phosphors 3,484 A. and 3,485 A. [i.e. **ultraviolet** light] can be used to achieve a white appearance. Alternately, MgO may be replaced by pyrelene-containing materials or 7-diethyl amino, 4-methyl coumarin-containing materials (blue-to-blue and ultraviolet-to-blue converting phosphor, respectively, to completely eliminate speckle).
>
> Regardless of how many phosphors are used, it is apparent from the chromaticity diagram that a necessary condition for achieving a true white is that the illuminating laser beam have a **wavelength of approximately 4,950 A. or shorter**. Otherwise, it is impossible to include illuminant C within a polygon whose primaries are the source and any combination of longer wavelengths that can be achieved by down-conversion of frequency. Fortunately, the argon-ion laser satisfies this necessary condition.

(Pinnow, col. 3, lines 24-55; emphasis added)

(It is noted that Pinnow uses "A." for "angstrom", which is properly, instead, Å.)

It is important to note in the final paragraph from Pinnow excerpted above, Pinnow tells those of ordinary skill that **any primary radiation can be used so long as its wavelength is 4950 Å (495 nm) or shorter**, providing examples of both **blue** and **UV** light sources for the primary light that is down-converted into visible light. Tabuchi's GaN-based LED meets this criteria, as discussed above. Tabuchi's GaN-based LED emits UV light. Therefore, those of ordinary skill using the phosphor mixtures taught by Pinnow have a certain expectation of success. Pinnow shows that the results of illuminating the phosphor mixture with UV light or blue light (i.e. shorter than 4950 Å) produces entirely predictable results in making white light of any shade desired.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Pinnow's phosphor mixtures, made as coating or self-standing elements (Pinnow, col. 2, lines 15-20) as the phosphor mixture in Tabuchi, in order to produce a visible white light. Because Tabuchi is silent as to the specific "ordinary UV-visible light conversion phosphor" needed to produce visible light, one of ordinary skill would use known materials known to work for the intended purpose, such as that taught in Pinnow.

Thus, Tabuchi modified to ensure a mixture of phosphors is used, ensures that *each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium* [phosphor mixture] *receiving its primary radiation produces white light output*, as newly claimed in proposed amended claim 1, and as similarly claimed in claims 5 and 26.

Proposed new **claim 187** reads,

> *187. A light emitting device comprising a light-emitting diode operative to emit **blue or ultraviolet** radiation, **packaged with luminophoric medium in a polymeric matrix**, wherein the luminophoric medium absorbs blue or ultraviolet radiation from the light-emitting diode and down converts same to a broad spectrum of frequencies producing polychromatic white light, wherein the light-emitting diode is a single-die, two-lead semiconductor light-emitting diode.*

Claim 187 is distinguished from claim 26 in (1) specifying the radiation emitted from the LED as being UV.

With regard to distinction (1), as discussed above, Tabuchi states that the GaN-based LED emits UV light and therefore reads on these claims.

With regard to distinction (2), as noted above, Tabuchi indicates that the phosphors are dispersed in a "binder":

Also as noted above, Pinnow teaches that the luminophoric medium is also homogeneously dispersed in a binder, i.e. an organic resin, from which coatings or self-supporting structures are made (Pinnow, paragraph bridging cols. 1-3; col. 2, lines 15-20). Thus, the phosphor coating of Pinnow including the mixture of phosphors that produce white light can be applied as the phosphor coating in Tabuchi. So done, Tabuchi's LED includes *a light-emitting diode operative to emit* **...** ***ultraviolet*** *radiation,* ***packaged with luminophoric medium in a polymeric matrix***, as required by claim 187.

4. Claims 2 and 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over any of (1) Tabuchi in view of Stevenson and Imamura, (2) Tabuchi in view

of APA, Stevenson, and Imamaura, and (3) Tabuchi in view of Pinnow, Stevenson, and Imamura.

Claims 2 and 23 read,

> *2. A light-emitting device according to claim 1, comprising a **two-lead array** of single-die semiconductor LEDs.*
>
> *23. A light-emitting device according to claim 5, comprising a **two-lead array** of single-die semiconductor LEDs.*

The prior art of any of (1) Tabuchi, (2) Tabuchi in view of APA, and (3) Tabuchi in view of Pinnow, as explained above, discloses each of the features of claim 1 and 5.

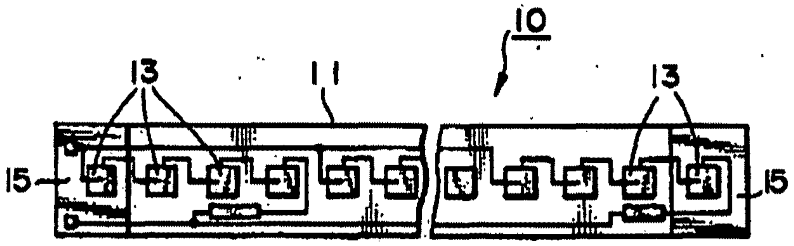
Tabuchi does not explicitly disclose a two-lead **array** of single-die LEDs.

As explained in detail above, Stevenson's and Tabuchi's light emitting devices produce light in the same way, wherein a GaN-based LED down-converts the primary radiation from said LED into secondary visible light, using phosphors. In addition, Stevenson teaches using an array of LEDs to produce a display (Stevenson, col. 4, lines 5-7).

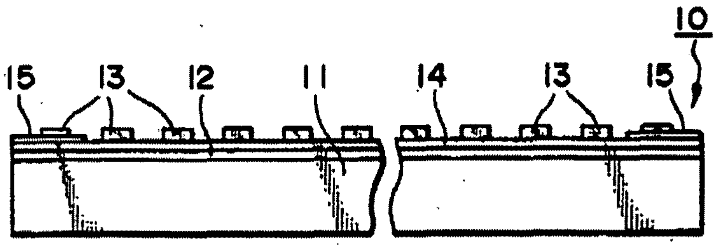
It would have been obvious to one of ordinary skill in the art, at the time of the invention to use an array of Tabuchi's or Tabuchi/APA's, or Tabuchi/Pinnow's LED, as taught by Stevenson, in order to make a display, because Stevenson suggests using an array to make a display. In other words, Stevenson provides a reason to make an array of LED, specifically to make a display.

Then the only difference is that --even though Tabuchi and Stevenson both teach that each LED has two leads-- there is no teaching that the array has two leads.

Imamura's Figs. 4 and 5 (reproduced below) shows the top and side views of an light array **10** made from an array of single-die semiconductor LEDs **13** on a substrate **15** (Imamura, col. 3, lines 16-36).



(Imamura, Fig. 4)



(Imamura, Fig. 5)

The array **10** can be used as a backlight for a liquid crystal display, such as shown in Fig. 8 (Imamura, col. 4, lines 59-61). Each LED die **13** has two leads that connect to the array's two leads, made from the gold-plated copper pattern **12** shown in the side view of right side of Fig. 5 and in the top view as the horizontal lines running across the top and bottom of the substrate **15** that connect the array of LEDs **13**. As also shown in Fig. 4, each of the array's two leads ends in a terminal. Thus, Imamura teaches *a **two-lead array** of single-die semiconductor LEDs.*

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Imamura's two-lead array configuration of plural identical LEDs of Tabuchi, or Tabuchi/APA, or Tabuchi/Pinnow --therefore *emitting identical radiation*-- because Stevenson is silent as to how an array of LED would be wired for a display, such that one of ordinary skill would follow known ways of assembling an array such as taught by Imamura (Imamura, col. 3, lines 37-60).

5. Claims 3, 4, and 34-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA and Nakamura.

Claim 3 reads,

> *3. A light-emitting device, comprising:*
>
> *a semiconductor **laser** coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the **visible** light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*

Claim 3 is distinguished from claim 1 in that (1) a *semiconductor **laser*** is required versus a *single-die semiconductor LED*; (2) the primary radiation is required to be outside the **visible** light spectrum, as opposed to outside the visible **white** light spectrum; and (3) the wording associated with the luminophoric medium.

As discussed above in the rejection of claim 1 over Tabuchi in view of APA, Tabuchi in view of APA teaches all of the features of claim 3 except for the semiconductor laser. Instead, Tabuchi uses a GaN-based LED to produce the primary radiation.

With regard to **differences (1) and (2)** between claim 3 and claim 1, Tabuchi does not teach a semiconductor **laser** that produces primary radiation outside the visible spectrum. Tabuchi does, however, teach a GaN-based LED producing UV light which is outside the visible light spectrum:

> A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)

Nakamura teaches GaN-based LEDs and laser diodes (LDs) that emit both blue and UV light. (In fact, one LED indicated as suitable in the '175 invention is a GaN LED from Nichia Chemicals, to which Nakamura is assigned. See the '175 patent, col. 9, lines 10-18. Thus, Patentee admits to using known GaN-based LED for the instant invention.)

Nakamura indicates that GaN-based LED emitting light *outside the visible white light spectrum* are known in the art:

> **Jpn. Pat. Appln. KOKAI Publication No. 4-68579** discloses a double-heterostructure having a p-type **GaInN** clad layer formed on an oxygen-doped, n-type **GaInN** light-emitting layer. ... The emission wavelength of the light-emitting device having this double-heterostructure is **365 to 406 nm**.

(Nakamura, col. 2, lines 7-14; emphasis added)

UV light is light less than 400 nm as evidenced by the CRC Handbook, *supra*.

In regard to its LEDs and lasers, Nakamura states the following:

> The semiconductor device of the present invention includes a **light-emitting diode (LED)** and **a laser diode (LD)**.

(Nakamura, col. 4, lines 9-11)

> It is still another object of the present invention to provide an **ultraviolet to red light-emitting device** having a wavelength in the region of **365 to 620 nm**.

(Nakamura, col. 2, lines 30-33; emphasis added)

> FIG. 12 shows a structure of a **laser diode 40** having a double-heterostructure of the present invention.
>
> The **laser diode 40** has a double-heterostructure constituted by an impurity-doped **$In_xGa_{1-x}N$ active layer 18** described above in detail in association with the light-emitting diode, and two clad layers sandwiching the active layer **18**, i.e., an n-type gallium nitride-based compound semiconductor layer **16** and a p-type gallium nitride-based compound semiconductor layer **20**, as described above. A buffer layer **14** described above in detail is formed on a substrate **12** described above in detail. An n-type gallium nitride layer **42** is formed on the buffer layer **14**, providing a contact layer for an n-electrode described below.

(Nakamura, col. 11, line 61 to col. 12, line 6; emphasis added)

Nakamura shows that the wavelength of the LED or LD can be controlled by controlling the dopant:

> In the light-emitting device of the present invention, when the value of x in $In_xGa_{1-x}N$ of the light-emitting layer is close to 0, the device emits **ultraviolet** light. When the value of x increases, the emission falls in the longer-wavelength region. When the value of x is close to 1, the device emits red light. When the value of x is in the range of $0<x<0.5$, the light-emitting device of the present invention emits **blue** to yellow light in the wavelength range of **450** to 550 nm.

(Nakamura, col. 4, lines 52-59; emphasis added)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute Tabuchi's UV-light-emitting GaN-based LED with Nakamura's UV-light-emitting GaN-based **LD**. This can be seen as simple substitution of one known element (Tabuchi's GaN-based LED) for another known element (Nakamura's GaN-based LD) to obtain predictable results and is one of the rationales identified by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___,___, 82 USPQ2d 1385, 1395-97 (2007). (See MPEP 2143, Rationale B.)

The results are predictable because both Tabuchi's LED and Nakamura's LED and LD emit light in the same general region of the spectrum and are GaN-based, so the LED and LD materials are essentially the same. As will be discussed below, because the phosphor mixture disclosed in APA emits white light in response to UV radiation and Nakamura's LDs emits UV light, the results of using Nakamura's LD in place of Tabuchi's LED along with APA's phosphor mixtures yield predictable results, i.e. the production of white light.

Claim 4 and proposed new **claims 38-40** read,

> *4. A light-emitting device according to claim 3, wherein said semiconductor laser includes an active material selected from the group consisting of III-V alloys and II-VI alloys.*
>
> *38. The light-emitting device of claim 34, wherein the semiconductor laser comprises material selected from the group consisting of* ***gallium nitride and its alloys****.*
>
> *39. The light-emitting device of claim 34, wherein the semiconductor laser comprises* ***gallium nitride****.*
>
> *40. The light-emitting device of claim 34, wherein the semiconductor laser comprises* ***gallium nitride alloy****.*

Nakamura's LED and LD are made from GaN-based semiconductor material which is a *group III-V alloy*. In particular, when producing UV light, the value of x in $In_xGa_{1-x}N$ approaches zero, the device emits ultraviolet light.

> In the light-emitting device of the present invention, when the value of x in $In_xGa_{1-x}N$ of the light-emitting layer is close to 0, the device emits **ultraviolet** light. When the value of x increases, the emission falls in the longer-wavelength region. When the value of x is close to 1, the device emits red light. When the value of x is in the range of $0<x<0.5$, the light-emitting device of the present invention emits **blue** to yellow light in the wavelength range of **450** to 550 nm.

(Nakamura, col. 4, lines 52-59; emphasis added)

Thus, Nakamura includes LDs wherein GaN and InGaN are used. Substitution of Tabuchi's GaN LED with Nakamura's LDs is the same as discussed above in conjunction with claim 3.

Proposed new **claims 34-37** read,

> *34. The light-emitting device of claim 3, wherein the luminophoric medium comprises an* ***inorganic*** *luminophor.*
>
> *35. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed* ***on or in*** *a housing member.*
>
> *36. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed* ***in a film on a surface*** *of a housing member.*
>
> *37. The light-emitting device of claim 34, wherein the inorganic luminophor is* ***within*** *a housing member.*

As discussed above in rejecting claims 27-30 over Tabuchi in view of APA inorganic phosphor mixture is obvious and the location of the phosphor **7** on, in, and within the housing member **6** in a film is disclosed in Tabuchi (Tabuchi, Fig. 1).

6. Claims 62, 63, 66-69, 74-80, 100, 101, 104-107, 110, 112-117, 162, and 164-171 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA, Wanmaker, and Nakamura.

Proposed new **claims 62 and 75** read,

> *62. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the light-emitting device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged **about** the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being **contiguous to** the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in **laterally spaced relationship to said side surface**;*
>
> *(iv) the luminophoric medium being dispersed **in polymer or glass**; and*
>
> *(v) the luminophoric medium being **on polymer or glass**.*

> *75. The light-emitting device of claim 62, wherein the luminophoric medium comprises **inorganic** luminophoric material.*

Claim 62 is coextensive with claim 5, as indicated by Patentee (Remarks dated 3/26/2012, pp. 28-29). Claim 62 is distinguished from claim 5 in (1) the LED is required to be a blue-light-emitting GaN-based LED and (2) the one or more *compatible characteristics*. The substitution of Tabuchi's UV-light-emitting GaN-based LED with Nakamura's blue-light-emitting GaN-based LEDs was discussed above and is obvious for the same reasons. Tabuchi's Fig. 1 shows the luminophoric medium (phosphor 7) is (i) *about* the LED, (iii) laterally spaced from the side surface of the LED, and (v) on polymer or glass, as Tabuchi's transparent cover 6 is made from plastic or glass.

In addition, Tabuchi indicates that "an ordinary UV-visible light conversion phosphor" can be used to down convert the light from the LED to the visible light (Tabuchi translation, p. 4).

APA teaches that it is known in the art to use **inorganic** phosphor mixtures coated on a glass housing to convert primary radiation from electrically excited Hg (mercury) vapor, as in fluorescent bulbs:

> It is well known that so-called **fluorescent lamps provide white light** illumination. In a fluorescent lamp, the Hg vapor in the vacuum tube is excited by an electrical discharge. The excited **Hg atoms emit light, primarily in the ultraviolet region** (e.g., 254 nm, 313 nm, 354 nm), which is absorbed by the **inorganic phosphors coating the inside walls of the tube**. The phosphors then emit light. These inorganic phosphors are designed as such to offer white light emission by "down-converting" (i.e., transforming a higher frequency, shorter wavelength form of energy to a lower frequency, longer wavelength form of energy) the **ultraviolet** emissions of the excited states of atomic Hg into a **broad spectrum** of emitted light which appears as **white** to the observer. **However, these light emitting devices are not solid-state**, ...

(the '175 patent, col. 3, lines 40-53; emphasis added)

The '175 patent is not entirely accurate as to the emission of Hg vapor that is converted to visible light. Rather, the '175 patent fails to acknowledge that, in fact, such high intensity **blue** light is emitted by the Hg vapor that the phosphor coatings include inorganic compounds that absorb and convert, not just the UV wavelengths, but also the **blue** wavelengths to longer wavelength visible light, so that the blue does not overwhelm the emitted light. In this regard, Wanmaker states,

> To obtain a satisfactory rendition of the colours of articles irradiated by a fluorescent lamp it is necessary to **suppress the intensity of the blue mercury lines emitted by the mercury vapour discharge** at wave lengths of **405 and 436 nm**.

> To what extent this suppression is to be effected is dependent on the desired quality of the colour rendition and on the desired colour temperature of the lamp. An **attenuation of the said blue mercury lines** can be obtained if the wall of the lamp is provided with a layer which includes a light yellow coloured **red luminescing material which absorbs at least a part of the blue mercury radiation**. The **emitted radiation of this luminescent material provides a desired contribution in the red part of the spectrum** of the radiation emitted by the lamp. This known step is described in United Kingdom patent specification 737,828. **Magnesium arsenate** activated by **quadrivalent manganese** is used in practice as a **blue absorbing red luminescing material**. Furthermore the lamp includes a second luminescent layer which is provided on the absorption layer and which comprises **one or more luminescent materials** with which it is possible to achieve the desired spectral distribution of the radiation emitted by the lamp.

(Wanmaker, col. 1, lines 18-22; emphasis added)

Wanmaker goes on to improve upon the prior art phosphors with other phosphors that also convert the mercury blue lines to longer wavelength visible light.

Wanmaker is important here because it shows that those of ordinary skill in the art knew in 1974 --20 years before the '175 patent-- how to choose **in**organic phosphor mixtures that down-convert **blue** light to visible white light --such as that produced by Nakamura's GaN-based LEDs emitting light in the **blue** region of the spectrum. Thus, Wanmaker provides evidence of success and predictable results in using APA's or Wanmaker's mixture of **in**organic phosphors along with Nakamura's GaN-based, blue-light emitting LED in place of Stevenson's GaN-based LED.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use APA's or Wanmaker's inorganic phosphor mixture to produce white light because Tabuchi indicates that any UV-visible light conversion phosphor can be used to make white light, and APA and Wanmaker teach known phosphors mixtures that produce white light from, *inter alia*, blue light, such that there is predictable results using said phosphor mixtures with Nakamura's GaN-based LED in place of Tabuchi's GaN LED.

This is all of the features of claims 62 and 75.

Proposed new **claims 63, 66-69, 74, and 80** read,

> *63. The light-emitting device of claim 62, comprising the luminophoric medium being arranged* ***about*** *the single-die light-emitting diode.*
>
> *66. The light-emitting device of claim 62, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being in* ***laterally spaced relationship to said side die surface****.*

> *67. The light-emitting device of claim 66, wherein the luminophoric medium is in **laterally spaced facing relationship to said side die surface.***
>
> *68. The light-emitting device of claim 62, comprising the single-die light-emitting diode being arranged to **directly impinge primary radiation** on the luminophoric medium.*
>
> *69. The light-emitting device of claim 62, comprising the single-die light-emitting diode and luminophoric medium being arranged **without intermediate material therebetween.***
>
> *74. The light-emitting device of claim 62, comprising the luminophoric medium being **on** polymer or glass.*
>
> *80. The light-emitting device of claim 79, wherein the light-emitting diode lamp comprises the at least one single-die gallium nitride based semiconductor blue light-emitting diode and **inorganic** luminophoric material **within an enclosure** comprising material that is light-transmissive of said white light output.*

APA and Wanmaker teach that the phosphor can be homogeneously dispersed to make a coating, and Tabuchi discloses that the phosphor **7** is homogenously dispersed in binder to make a coating on the transparent cover **6**, said cover being made from polymer or glass. The transparent cover forms an *enclosure* around the LED **4** and phosphor **7**.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use APA's or Wanmaker's phosphor mixture as Tabuchi's "ordinary UV-visible light conversion phosphor" layer **7** for the reasons indicated above. So placed, the orientation shown in Tabuchi's Fig. 1 discloses each of the features of claims 63, 66-69, 74, and 80.

Proposed new **claims 76-78** read,

> *76. The light-emitting device of claim 62, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *77. The light-emitting device of claim 62, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *78. The light-emitting device of claim 62, wherein the at least one single-die gallium nitride based semiconductor blue light-emitting diode comprises only one single-die gallium nitride based semiconductor blue light-emitting diode.*

As indicated above, Nakamura teaches GaN and its alloys make the blue-light-emitting LEDs; thus, modification of Tabuchi to use Nakamura's LEDs already includes the features of these claims.

Proposed new **claim 79** reads,

> *79. The light-emitting device of claim 62, comprising a light-emitting diode lamp.*

Tabuchi alone or as modified according to Nakamura includes a single LED and therefore includes a lamp.

Proposed new **claims 100 and 113** read,

> *100. A light-emission device, comprising*
>
> *a single-die, two-lead **gallium nitride based** semiconductor **blue** light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the light-emission device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged **about** the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being **contiguous to** the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in **laterally spaced relationship to said side surface**;*
>
> *(iv) the luminophoric medium being dispersed **in polymer or glass**; and*
>
> *(v) the luminophoric medium being **on polymer or glass**.*
>
> *113. The light-emission device of claim 100, wherein the luminophoric medium comprises **inorganic** luminophoric material.*

Claim 100 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 40-41). Claim 100 differs from claim 26 in the same ways that claim 62 is distinguished from claim 5. Therefore claim 100 is obvious for the same additional reasons as indicated above in conjunction with claim 62.

This is all of the features of claims 100 and 113.

Proposed **new claims 101, 104-107, 110, 112, and 117** read,

> *101. The light-emission device of claim 100, comprising the luminophoric medium being arranged* ***about*** *the single-die light-emitting diode.*
>
> *104. The light-emission device of claim 100, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being in* ***laterally spaced relationship to said side die surface****.*
>
> *105. The light-emission device of claim 104, wherein the luminophoric medium is in* ***laterally spaced facing relationship to said side die surface****.*
>
> *106. The light-emission device of claim 100, comprising the single-die light-emitting diode being arranged to* ***directly impinge*** *primary radiation on the luminophoric medium.*
>
> *107. The light-emission device of claim 100, comprising the single-die light-emitting diode and luminophoric medium being arranged* ***without intermediate material*** *therebetween.*
>
> *110. The light-emission device of claim 100, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*
>
> *112. The light-emission device of claim 100, comprising the luminophoric medium being* ***on*** *polymer or glass.*
>
> *117. The light-emission device of claim 116, wherein the light-emitting diode lamp comprises the single-die gallium nitride based semiconductor blue light-emitting diode and* ***inorganic*** *luminophoric material* ***within an enclosure*** *comprising material that is light-transmissive of said white light.*

Each of the above features was discussed above in conjunction with claims 63, 66-69, and 74 and applies here.

Proposed **new claims 114-116** read,

> *114. The light-emission device of claim 100, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *115. The light-emission device of claim 100, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *116. The light-emission device of claim 100, comprising a light-emitting diode lamp.*

Each of the above features was discussed above in conjunction with claims 76-79 and applies here.

Proposed new **claims 162 and 167** read,

> *162. A light-emitting device, comprising:*
>
> *at least one single-die* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein said at least one single-die gallium nitride based semiconductor blue light-emitting diode is* ***in a housing comprising a light-transmissive wall member in spaced relationship*** *to said at least one single-die gallium nitride based semiconductor blue light-emitting diode,*
>
> *and* ***wherein said luminophoric medium is dispersed in or on said light-transmissive wall member****.*
>
> *167. The light-emitting device of claim 162, wherein the luminophoric medium comprises* ***inorganic*** *luminophoric material.*

Claim 162 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 58-59). Claim 162 differs from claim 5 in requiring the LED be a GaN-based blue-light-emitting LED and the orientation of the luminophoric medium in or on a light-transmissive wall member.

As noted above in this rejection, the substitution of Tabuchi's GaN-based LED with Nakamura's GaN-based LED is obvious. Also as noted above in conjunction with claims 63, 66-72, and 74, the light-transmissive wall member **6** having a phosphor coating **7** thereon in spaced relationship to the LED **4** is taught by Tabuchi. Thus, all of the additional features of claim 162 are obvious for the reasons already discussed above.

Proposed new **claims 164-166** read,

> *164. The light-emitting device of claim 162, wherein said luminophoric medium is **dispersed on** said light-transmissive wall member.*
>
> *165. The light-emitting device of claim 162, wherein the light-transmissive wall member comprises **polymer**.*
>
> *166. The light-emitting device of claim 162, wherein the light-transmissive wall member comprises **glass**.*

Again, Tabuchi states that the housing member **6** onto which the phosphor **7** is dispersed can be made from glass or epoxy resin (i.e. polymer):

> Transparent cover 6 is made of a material such as **glass** or an **epoxy resin**...

(Tabuchi translation, pp. 3-4; emphasis added)

Proposed new **claims 168 and 169** read,

> *168. The light-emitting device of claim 162, wherein the single-die light-emitting diode comprises **gallium nitride and its alloys**.*
>
> *169. The light-emitting device of claim 162, wherein the single-die light-emitting diode comprises at least one of **gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride**.*

Again, Nakamura teaches GaN-based LED and the use of Nakamura's GaN-based, blue-light-emitting LED in place of Tabuchi's GaN-based LED is obvious for the reasons indicated above, which applies here.

Proposed new **claims 170 and 171** read,

> *170. The light-emitting device of claim 162, wherein the at least one single-die gallium nitride based semiconductor blue light-emitting diode comprises **only one** single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *171. The light-emitting device of claim 162, comprising a light-emitting diode **lamp**.*

Tabuchi teaches only one single LED which renders claims 170 and 171 obvious.

7. Claims 118, 121-126, 128-134, 137-142, and 144-148 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA, Wanmaker, Nakamura, and Martic.

Proposed new **claims 118 and 129** read,

> *118. A light-emission device, comprising*
>
> *a single-die, two-lead **gallium nitride based** semiconductor **blue** light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the luminophoric medium is **dispersed in a polymer that is on or about** the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*
>
> *129. The light-emission device of claim 118, wherein the luminophoric medium comprises **inorganic** luminophoric material.*

Claim 118 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, p. 45). The ***GaN-based blue LED*** and the luminophoric medium made from a mixture of ***inorganic*** phosphors was discussed above in the rejection over Tabuchi in view of APA, Wanmaker, and Nakamura which applies equally to claim 118.

Thus the only difference is that there is no indication that the phosphoric mixture of APA or Wanmaker is *dispersed in a polymer that is on or about* the GaN-based LED.

As noted above, Tabuchi teaches the phosphor **7** is coated on the wall of the transparent cover **6**:

> A **phosphor layer 7** is provided by applying a **binding agent in which a phosphor** to convert the radiation from light emitting semiconductor device 4 to visible light is **dispersed on the inner surface of transparent cover 6**. Transparent cover 6 is made of a material such as **glass** or an **epoxy** resin is preferably fixed to stem 1 so that it can also function as a cap for hermetic sealing.

(Tabuchi translation, pp. 3-4; emphasis added)

Although Tabuchi does not indicate the identity of the binder, Martic teaches that it has long been known (since 1973) to use organic resins (i.e. polymers) as binding agents specifically for inorganic phosphors in the manufacture of luminescent screens:

> In still another aspect, this invention relates to screens comprising **inorganic phosphors** wherein the **binding agent** for said phosphors comprises a **polyurethane elastomer** alone or in combination with an **alkyl methacrylate resin** in various ratio ranges.

(Martic, col. 1, lines 10-14; emphasis added)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to disperse APA or Wanmaker's inorganic phosphors in the polymeric binding agent of Martic to make the phosphor layer **7** in Tabuchi, because Tabuchi is silent as to the binding agent for the phosphor, such that one of ordinary skill would use known binders specifically used for inorganic phosphors that must emit light.

This is all of the additional features of claims 118 and 129.

Proposed new **claims 121-126, 128, 132, and 133** read,

> *121. The light-emission device of claim 118, comprising the luminophoric medium **dispersed in a polymer that is about** the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*
>
> *122. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is in **laterally spaced relationship to said side die surface**.*
>
> *123. The light-emission device of claim 122, wherein the polymer is in **laterally spaced facing relationship to said side die surface**.*
>
> *124. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode being arranged to **directly impinge** radiation on the polymer.*
>
> *125. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode and polymer being arranged **without intermediate material therebetween**.*
>
> *126. The light-emission device of claim 118, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *128. The light-emission device of claim 118, comprising the luminophoric medium being **on** polymer or glass.*
>
> *132. The light-emission device of claim 118, comprising a light-emitting diode lamp.*
>
> *133. The light-emission device of claim 132, wherein the light-emitting diode lamp comprises the single-die gallium nitride based semiconductor blue light-emitting diode and **inorganic** luminophoric material **within an enclosure** comprising material that is **light-transmissive of said white light**.*

Each of the above features was discussed above in conjunction with the rejection of claims 62, 63, 66-69, 74-80 over Tabuchi in view of APA, Wanmaker and Nakamura, above, and applies here.

Proposed new **claims 130-131** read,

> *130. The light-emission device of claim 118, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *131. The light-emission device of claim 118, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*

Each of the above features was discussed above in the rejection of claims 76-79 over Tabuchi in view of APA, Wanmaker and Nakamura, above, and applies here.

Proposed new **claims 134 and 144** read,

> *134. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the luminophoric medium is **dispersed in a polymer that is on or about** the single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *144. The light-emitting device of claim 134, wherein the luminophoric medium comprises **inorganic** luminophoric material.*

Each of the features of this claim has been discussed in conjunction with claims 5 (Tabuchi in view of APA), 62 (Tabuchi in view of APA, Wanmaker and Nakamura), and 118 and 129, above and applies here.

Proposed new **claims 137-142, 147, and 148** read,

> *137. The light-emitting device of claim 134, comprising the luminophoric medium **dispersed in a polymer that is about** the single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *138. The light-emitting device of claim 134, comprising the single-die gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is in **laterally spaced relationship to said side die surface.***
>
> *139. The light-emitting device of claim 138, wherein the polymer is in **laterally spaced facing relationship to said side die surface.***
>
> *140. The light-emitting device of claim 134, comprising the single-die light-emitting diode being arranged to **directly impinge** radiation on the polymer.*
>
> *141. The light-emitting device of claim 134, comprising the single-die light-emitting diode and polymer being arranged **without intermediate material therebetween.***
>
> *142. The light-emitting device of claim 134, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *147. The light-emission device of claim 134, comprising a light-emitting diode lamp.*
>
> *148. The light-emission device of claim 147, wherein the light-emitting diode lamp comprises the single-die gallium nitride based semiconductor blue light-emitting diode and **inorganic** luminophoric material within an **enclosure** comprising material that is **light-transmissive of said white light output.***

Each of the above features was discussed above in conjunction with the rejection of claims 63, 66-69, 74, 79, 80, and 162 over Tabuchi in view of APA, Wanmaker and Nakamura, above, and applies here.

Proposed new **claims 145 and 146** read,

> *145. The light-emitting device of claim 134, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *146. The light-emitting device of claim 134, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*

Each of the above features was discussed above in the rejection of claims 76-78 over Tabuchi in view of APA, Wanmaker and Nakamura, above, and applies here.

8. Claims 34, 35, 37-40 and 179 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of APA and Nakamura as applied to claims 3, 4, 34, and 38-40, above, and further in view of Tadatsu.

Again, proposed new claims 34, 35, 37, and 179 read,

> *34. The light-emitting device of claim 3, wherein the luminophoric medium comprises an **inorganic** luminophor.*
>
> *35. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed **on or in** a housing member.*
>
> *37. The light-emitting device of claim 34, wherein the inorganic luminophor is **within** a housing member.*
>
> *179. The light-emitting device of claim 3, wherein the luminophoric medium is **contiguous to** said semiconductor laser.*

The prior art of Tabuchi in view of APA and Nakamura, as explained above, discloses each of the features of claims 3, 4, 34, and 38-40.

Tadatsu teaches an alternative location for the phosphors. Tadatsu discloses a packaged LED **11** wherein a primary radiation is down-converted by a luminophor **5** to a longer wavelength, and is therefore in the same field of endeavor as is Tabuchi. Tadatsu also desires producing **white** light from a single LED. In this regard, Tadatsu states,

> [Constitution] A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a **resin mold**, wherein said **light emitting device is made of gallium nitride related compound semiconductors** which are expressed with a general formula of $Ga_xAl_{1-x}N$ (where $0 \le x \le 1$), and further wherein a **fluorescent dye or pigment**, which is **excited with emission light from said gallium nitride related compound semiconductors** and which **emits fluorescent light**, is **added to said resin mold**.

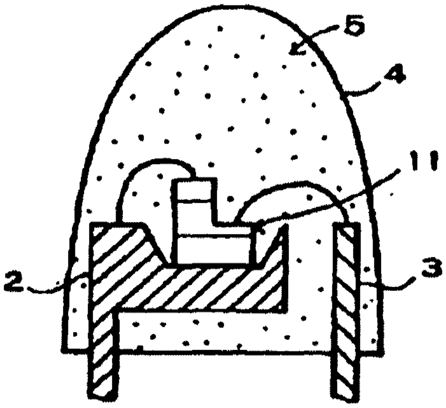
(Tadatsu translation, p. 1)

Tadatsu's Fig. 2 (reproduced below) shows the packaged LED have two leads **2, 3** and a housing member ("resin mold" **4**) within which the luminophor ("fluorescent dye" **5**) is dispersed. Tadatsu also indicates that the luminophor can be organic or inorganic:

> [0003] Ordinarily, a resin with a large index of refraction and a high transparency is selected for the resin mold 4, so that the emission light from the light emitting device is efficiently emitted to the air. In other cases, an **inorganic or organic pigment is mixed as a coloring agent in the resin mold 4** in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a

> green light emitting device having GaP semiconductor materials, its **emission color turns into white**.

(Tadatsu translation ¶ [0003]; emphasis added)



(Tadatsu, Fig. 2)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute the phosphor location used in Tabuchi with that location in Tadatsu because it is substitution of known equivalents to produce predictable results, as proven by Tadatsu. So modified, the luminophoric medium is in or within a housing member and is contiguous with the laser diode of Tabuchi/Nakamura.

Evidence of predictable results comes from Tadatsu. Tadatsu shows that dispersing the phosphor in a resin molded cap allows the primary radiation from the LED to be converted by the phosphor to secondary radiation and that the wavelengths mix are capable of mixing to produce white light. Thus, APA's inorganic phosphors in the resin housing member of Tadatsu would predictable produce white light when Tabuchi/Nakamura's GaN-based laser is packaged as in Tadatsu.

<u>9. Claims 3-5, 12, 13, 21, 22, 26, 62, 63, 66-72, 74, 76-79, 100, 101, 104-110, 112, 114-116, 118, 121-126, 128, 130-132, 134, 137-142, 145-147, 162-166, 168-172, 178, 187, and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow and Nakamura.</u>

The prior art of Tabuchi in view of Pinnow, as explained above, discloses each of the features of claim 5, 22, 26, 172, and 187.

Claim 3 reads,

> *3. A light-emitting device, comprising:*

> *a semiconductor **laser** coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the **visible** light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*

Claim 3 is distinguished from claim 1 in that (1) a *semiconductor **laser*** is required versus a *single-die semiconductor LED*; (2) the primary radiation is required to be outside the **visible** light spectrum, as opposed to outside the visible **white** light spectrum; and (3) the wording associated with the luminophoric medium.

With regard to **differences (1) and (2)**, Tabuchi does not teach a semiconductor **laser** that produces primary radiation outside the visible spectrum. Tabuchi does, however, teach a GaN-based LED producing UV light which is outside the visible light spectrum:

> A light emitting semiconductor apparatus of the present utility model invention is not limited to the structures and materials illustrated in the above examples. For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)

Nakamura teaches GaN-based LEDs and laser diodes (LDs) that emit both blue and UV light. (In fact, one LED indicated as suitable in the '175 invention is a GaN LED from Nichia Chemicals, to which Nakamura is assigned. See the '175 patent, col. 9, lines 10-18. Thus, Patentee admits to using known GaN-based LED for the instant invention.)

Nakamura indicates that GaN-based LED emitting light *outside the visible white light spectrum* are known in the art:

> **Jpn. Pat. Appln. KOKAI Publication No. 4-68579** discloses a double-heterostructure having a p-type **GaInN** clad layer formed on an oxygen-doped, n-type **GaInN** light-emitting layer. ... The emission wavelength of the light-emitting device having this double-heterostructure is **365 to 406 nm**.

(Nakamura, col. 2, lines 7-14; emphasis added)

UV light is light less than 400 nm as evidenced by the CRC Handbook, *supra*.

In regard to its LEDs and lasers, Nakamura states the following:

> The semiconductor device of the present invention includes a **light-emitting diode (LED)** and **a laser diode (LD)**.

(Nakamura, col. 4, lines 9-11)

> It is still another object of the present invention to provide an **ultraviolet to red light-emitting device** having a wavelength in the region of **365 to 620 nm**.

(Nakamura, col. 2, lines 30-33; emphasis added)

> FIG. 12 shows a structure of a **laser diode 40** having a double-heterostructure of the present invention.
>
> The **laser diode 40** has a double-heterostructure constituted by an impurity-doped **$In_xGa_{1-x}N$ active layer 18** described above in detail in association with the light-emitting diode, and two clad layers sandwiching the active layer **18**, i.e., an n-type gallium nitride-based compound semiconductor layer **16** and a p-type gallium nitride-based compound semiconductor layer **20**, as described above. A buffer layer **14** described above in detail is formed on a substrate **12** described above in detail. An n-type gallium nitride layer **42** is formed on the buffer layer **14**, providing a contact layer for an n-electrode described below.

(Nakamura, col. 11, line 61 to col. 12, line 6; emphasis added)

Nakamura shows that the wavelength of the LED or LD can be controlled by controlling the dopant:

> In the light-emitting device of the present invention, when the value of x in $In_xGa_{1-x}N$ of the light-emitting layer is close to 0, the device emits **ultraviolet** light. When the value of x increases, the emission falls in the longer-wavelength region. When the value of x is close to 1, the device emits red light. When the value of x is in the range of $0<x<0.5$, the light-emitting device of the present invention emits **blue** to yellow light in the wavelength range of **450** to 550 nm.

(Nakamura, col. 4, lines 52-59; emphasis added)

Nakamura provides numerous examples of LEDs emitting blue light (Examples 1-28 at cols. 13-20) including an emission **peak** value at, *inter alia*, 400 nm (Nakamura, col. 14, lines 64-65) at 405 nm (*id.*, claim 18, line 67), 430 nm (*id.*, col. 14, lines 51-52), and 480 nm (*id.*, col. 13, lines 40-42).

The peak emission wavelength at 400 nm and 405 nm show that the LEDs of these examples emit primarily **ultraviolet** light, as evidenced by the CRC Handbook. Similarly, those LEDS having peak emission at 430 nm and 480 nm emit primarily **blue** light.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute Tabuchi's GaN-based LED with either a UV-light-emitting GaN-based **LDs** (claim 3) or a blue- or UV-light-emitting GaN-based **LEDs** (claim 5) disclosed in Nakamura. This can be seen as simple substitution of one known element (Tabuchi's GaN-based LED) for another known element (Nakamura's GaN-based LED or LD) to obtain predictable results and is one of the rationales identified by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___,___, 82 USPQ2d 1385, 1395-97 (2007). (See MPEP 2143, Rationale B.)

The results are predictable because both Tabuchi's and Nakamura's LED and LD emit light in the same general region of the spectrum and are GaN-based, so the LED and LD materials are essentially the same. In addition, Pinnow teaches that the wavelength of light need only be shorter than 495 nm (4950 Å) to be effective to be converted by the mixture of phosphors to white light. Moreover, Pinnow uses both blue and UV laser light, thereby indicating that it is the wavelength of light and not whether the primary radiation is coherent or incoherent that matters.

In regard to the predictability, as already noted above, Pinnow teaches that any wavelength of primary radiation can be down-converted by the mixture of phosphors to produce white light so long as the wavelength is less than 4950 Å (495 nm):

> Regardless of how many phosphors are used, it is apparent from the chromaticity diagram that a necessary condition for achieving a true white is that the illuminating laser beam have a **wavelength of approximately 4,950 A. or shorter**. Otherwise, it is impossible to include illuminant C within a polygon whose primaries are the source and any combination of longer wavelengths that can be achieved by down-conversion of frequency. Fortunately, the argon-ion laser satisfies this necessary condition.

(Pinnow, col. 3, lines 24-55; emphasis added)

(It is noted that Pinnow uses "A." for "angstrom", which is properly, instead, Å.)

Thus, Pinnow teaches those of ordinary skill that shifting the peak maximum of the LED in Tabuchi from UV to blue (slightly longer wavelength), by using one of Nakamura's GaN-based LD or LED (inventive or known) would yield entirely predictable results of white light emission with the down-converting phosphor mixture. The predictability results from using Nakamura's LEDs that emit light (UV or blue) having a wavelength of less than 4950 Å (495 nm).

Claim 4 reads,

> *4. A light-emitting device according to claim 3, wherein said semiconductor laser includes an active material selected from the group consisting of III-V alloys and II-VI alloys.*

Nakamura's LED and LD are made from InGaN which is a *group III-V alloy*. Thus, substitution of Tabuchi's LED with Nakamura's LD, as discussed above, results in the laser including *group III-V alloy*.

Regarding **claim 5**, there is no requirement that the **primary** radiation is outside the visible white light spectrum, but substituting Tabuchi's GaN-based LED that emit either blue light or UV light with Nakamura's GaN-based LED still teaches all of the features of claim 5 because the **secondary** radiation emitted by the phosphor mixture of Tabuchi/Pinnow would be still white light, as evidenced by Pinnow.

Regarding **claims 12 and 13**, Nakamura, like Stevenson, fabricates the LED on sapphire substrates (Nakamura, col. 12, line 42) and the LEDs are multilayered (Nakamura's Figs. 1, 11, 12), so substitution of Tabuchi's GaN LED with the GaN-based LEDs in Nakamura, still reads on the features of claims 12 and 13.

Proposed amended **claim 21** reads,

> *21. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die, two-lead gallium nitride based **blue** light semiconductor LED.*

Both Tabuchi and Nakamura disclose that the LEDs have two leads. Substitution of Tabuchi's UV-light-emitting GaN LED with Nakamura's blue-light-emitting GaN-based LED is obvious for the reasons expressed above.

Regarding **claim 22**, both Tabuchi and Nakamura disclose that the LEDs have two leads. Thus again, substitution of Tabuchi's GaN LED with those in Nakamura, still teaches the features of claim 22.

Regarding **claim 26**, substitution of Tabuchi's GaN LED with those in Nakamura, still teaches the features of claim 26.

Regarding **claim 172**, substitution of Tabuchi's GaN LED with those in Nakamura, still results in the secondary, down-converted radiation having a broad spectrum of frequencies, because white light is produced, as evidenced by Pinnow.

Proposed new **claim 62** reads,

> *62. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least*

> *one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the light-emitting device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged **about** the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being **contiguous to** the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in **laterally spaced relationship to said side surface**;*
>
> *(iv) the luminophoric medium being dispersed **in polymer or glass**; and*
>
> *(v) the luminophoric medium being **on polymer or glass**.*

Claim 62 is coextensive with claim 5, as indicated by Patentee (Remarks dated 3/26/2012, pp. 28-29). Claim 62 is distinguished from claim 5 in (1) the LED is required to be a blue-light-emitting GaN-based LED and (2) the one or more *compatible characteristics*. The substitution of Tabuchi's UV-light-emitting GaN-based LED with Nakamura's blue-light-emitting GaN-based LEDs was discussed above and is obvious for the same reasons. Tabuchi's Fig. 1 shows the luminophoric medium (phosphor 7) is (i) *about* the LED, (iii) laterally spaced from the side surface of the LED, and (v) on polymer or glass, as Tabuchi's transparent cover 6 is made from plastic or glass.

In addition, Pinnow teaches that the phosphor mixture meets either of iv and v:

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution [i.e. a polymer] which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is absorbed on a colloid which may take the form of gell [sic] fibers or particles of high molecular weight polymers.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of **homogeneous phosphor screens**. These may be present as **self-supporting members** or as

> **coatings**, and they may be made up on **one or any combination of colorants required to produce the desired balance.**

(Pinnow, col. 2, lines 15-20; emphasis added)

Proposed new claims 63, 66-72, and 74 read,

> *63. The light-emitting device of claim 62, comprising the luminophoric medium being arranged **about** the single-die light-emitting diode.*
>
> *66. The light-emitting device of claim 62, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being in **laterally spaced relationship to said side die surface.***
>
> *67. The light-emitting device of claim 66, wherein the luminophoric medium is in **laterally spaced facing relationship to said side die surface.***
>
> *68. The light-emitting device of claim 62, comprising the single-die light-emitting diode being arranged to **directly impinge primary radiation** on the luminophoric medium.*
>
> *69. The light-emitting device of claim 62, comprising the single-die light-emitting diode and luminophoric medium being arranged **without intermediate material therebetween.***
>
> *70. The light-emitting device of claim 62, comprising the luminophoric medium being **dispersed in polymer** or glass.*
>
> *71. The light-emitting device of claim 70, comprising the luminophoric medium being **dispersed in polymer about** the single-die light-emitting diode.*
>
> *72. The light-emitting device of claim 70, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *74. The light-emitting device of claim 62, comprising the luminophoric medium being **on** polymer or glass.*

As discussed above, Pinnow teaches that the phosphor can be homogeneously dispersed in a resin (i.e. polymer) to make a coating or self-supporting member, and Tabuchi discloses that the phosphor **7** is a coating on the transparent cover **6** which can be made of polymer or glass.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Pinnow's phosphor mixture as Tabuchi's any "ordinary UV-visible light conversion phosphor" layer **7** for the reasons indicated above. So places, the orientation shown in Tabuchi's Fig. 1 discloses each of the features of claims 63, 66-72, and 74.

Proposed new **claims 76-78** read,

> *76. The light-emitting device of claim 62, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *77. The light-emitting device of claim 62, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *78. The light-emitting device of claim 62, wherein the at least one single-die gallium nitride based semiconductor blue light-emitting diode comprises only one single-die gallium nitride based semiconductor blue light-emitting diode.*

As indicated above, Nakamura teaches GaN and its alloys make the blue-light-emitting LEDs; thus, modification of Tabuchi to use Nakamura's LEDs already includes the features of these claims.

Proposed new **claim 79** reads,

> *79. The light-emitting device of claim 62, comprising a light-emitting diode lamp.*

Tabuchi alone or as modified according to Nakamura includes a single LED and therefore includes a lamp.

Proposed new **claim 100** reads,

> *100. A light-emission device, comprising*
>
> *a single-die, two-lead* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the light-emission device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged* ***about*** *the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being* ***contiguous to*** *the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in* ***laterally spaced relationship to said side surface;***

> *(iv) the luminophoric medium being dispersed **in polymer or glass**; and*
>
> *(v) the luminophoric medium being **on polymer or glass**.*

Claim 100 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 40-41). Claim 100 differs from claim 26 in the same ways that claim 62 is distinguished from claim 5. Therefore claim 100 is obvious for the same additional reasons as indicated above in conjunction with claim 62.

Proposed **new claims 101, 104-110, and 112** read,

> *101. The light-emission device of claim 100, comprising the luminophoric medium being arranged **about** the single-die light-emitting diode.*
>
> *104. The light-emission device of claim 100, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being in **laterally spaced relationship to said side die surface**.*
>
> *105. The light-emission device of claim 104, wherein the luminophoric medium is in **laterally spaced facing relationship to said side die surface**.*
>
> *106. The light-emission device of claim 100, comprising the single-die light-emitting diode being arranged to **directly impinge** primary radiation on the luminophoric medium.*
>
> *107. The light-emission device of claim 100, comprising the single-die light-emitting diode and luminophoric medium being arranged **without intermediate material** therebetween.*
>
> *108. The light-emission device of claim 100, comprising the luminophoric medium being **dispersed in** polymer or glass.*
>
> *109. The light-emission device of claim 108, comprising the luminophoric medium being **dispersed in polymer about** the single-die light-emitting diode.*
>
> *110. The light-emission device of claim 100, comprising the luminophoric medium being in a **homogeneous** composition.*
>
> *112. The light-emission device of claim 100, comprising the luminophoric medium being **on** polymer or glass.*

Each of the above features was discussed above in conjunction with claims 63, 66-72, and 74 and applies here.

Proposed **new claims 114-116** read,

> *114. The light-emission device of claim 100, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *115. The light-emission device of claim 100, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *116. The light-emission device of claim 100, comprising a light-emitting diode lamp.*

Each of the above features was discussed above in conjunction with claims 76-79 and applies here.

Proposed new **claim 118** reads,

> *118. A light-emission device, comprising*
>
> *a single-die, two-lead* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the luminophoric medium is* ***dispersed in a polymer that is on or about*** *the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*

Claim 118 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, p. 45). Claim 118 differs from claim 26 in the same ways that claim 100 is distinguished from claim 26, except the *compatible characteristics* are as highlighted in bold. As noted above, Pinnow teaches these features and the combination remains obvious for the same reasons as indicated above.

Proposed new **claims 121-126 and 128** read,

> *121. The light-emission device of claim 118, comprising the luminophoric medium* ***dispersed in a polymer that is about*** *the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*
>
> *122. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is in* ***laterally spaced relationship to said side die surface****.*
>
> *123. The light-emission device of claim 122, wherein the polymer is in* ***laterally spaced facing relationship to said side die surface.***

> *124. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode being arranged to* ***directly impinge*** *radiation on the polymer.*
>
> *125. The light-emission device of claim 118, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode and polymer being arranged* ***without intermediate material therebetween****.*
>
> *126. The light-emission device of claim 118, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*
>
> *128. The light-emission device of claim 118, comprising the luminophoric medium being* ***on*** *polymer or glass.*

Each of the above features was discussed above in conjunction with claims 63, 66-72, and 74 and applies here.

Proposed new **claims 130-132** read,

> *130. The light-emission device of claim 118, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *131. The light-emission device of claim 118, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *132. The light-emission device of claim 118, comprising a light-emitting diode lamp.*

Each of the above features was discussed above in conjunction with claims 76-79 and applies here.

Proposed new **claim 134** reads,

> *134. A light-emitting device, comprising:*
>
> *at least one single-die* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*

> *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the luminophoric medium is* ***dispersed in a polymer that is on or about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*

Each of the features of this claim has been discussed in conjunction with claims 5, 62, and 118, above and applies here.

Proposed new **claims 137-142** read,

> *137. The light-emitting device of claim 134, comprising the luminophoric medium* ***dispersed in a polymer that is about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *138. The light-emitting device of claim 134, comprising the single-die gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the polymer is in* ***laterally spaced relationship to said side die surface****.*
>
> *139. The light-emitting device of claim 138, wherein the polymer is in* ***laterally spaced facing relationship to said side die surface****.*
>
> *140. The light-emitting device of claim 134, comprising the single-die light-emitting diode being arranged to* ***directly impinge*** *radiation on the polymer.*
>
> *141. The light-emitting device of claim 134, comprising the single-die light-emitting diode and polymer being arranged* ***without intermediate material therebetween****.*
>
> *142. The light-emitting device of claim 134, comprising the luminophoric medium being in a* ***homogeneous*** *composition.*

Each of the above features was discussed above in conjunction with claims 63, 66-72, and 74 and applies here.

Proposed new **claims 145-147** read,

> *145. The light-emitting device of claim 134, wherein the single-die light-emitting diode comprises gallium nitride and its alloys.*
>
> *146. The light-emitting device of claim 134, wherein the single-die light-emitting diode comprises at least one of gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*

> *147. The light-emission device of claim 134, comprising a light-emitting diode lamp.*

Each of the above features was discussed above in conjunction with claims 76-79 and applies here.

Proposed new **claim 162** reads,

> *162. A light-emitting device, comprising:*
>
> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein said at least one single-die gallium nitride based semiconductor blue light-emitting diode is **in a housing comprising a light-transmissive wall member in spaced relationship** to said at least one single-die gallium nitride based semiconductor blue light-emitting diode,*
>
> *and **wherein said luminophoric medium is dispersed in or on said light-transmissive wall member**.*

Claim 162 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 58-59). Claim 162 differs from claim 5 in requiring the LED be a GaN-based blue-light-emitting LED and the orientation of the luminophoric medium in or on a light-transmissive wall member.

As noted above in this rejection, the substitution of Tabuchi's GaN-based LED with Nakamura's GaN-based LED is obvious. Also as noted above in conjunction with claims 63, 66-72, and 74, the light-transmissive wall member **6** having a phosphor coating **7** thereon in spaced relationship to the LED **4** is taught by Tabuchi. Thus, all of the additional features of claim 162 are obvious for the reasons already discussed above.

Proposed new **claim 163** reads,

> *163. The light-emitting device of claim 162, wherein said luminophoric medium is* ***dispersed in said light-transmissive wall member.***

Although Tabuchi does not teach that the phosphor **7** can be *dispersed in* the wall member **6**, Pinnow teaches that a phosphor mixture dispersed in organic resin (i.e. polymer) can be used to make a self-supporting member. Again Pinnow states,

> In this description, use will be made of the term "colorant" or "organic colorant." It is to be understood that this term includes photoluminescent organic dyes and pigments. **Pigments** are particularly useful and may be formed by **dissolving a dye in an organic resin solution [i.e. a polymer] which is subsequently condensed**. It is known that luminescent efficiency in certain cases may be enhanced if the dye is **absorbed on a colloid** which may take the form of gell [sic] fibers or particles of high molecular weight **polymers**.

(Pinnow, paragraph bridging cols. 1-3; emphasis added)

> The invention is broadly premised on the use of such organic colorants. Monochromatic displays result from use of **homogeneous phosphor screens**. These may be present as **self-supporting members** or as **coatings**, and they may be made up on **one or any combination of colorants required to produce the desired balance**.

(Pinnow, col. 2, lines 15-20; emphasis added)

Thus, the phosphors may be dispersed in a polymer whether the polymer is coated made into a coating or formed into a "self-supporting member".

It would have been obvious to one of ordinary skill in the art, at the time of the invention to form Pinnow's phosphor mixture into a self-supporting member in the form of Tabuchi's wall member **6** because Pinnow teaches that the phosphor mixture functions for the same purpose whether it is in the form of a coating or a self-supporting member (*id.*). As such, Pinnow tells those of ordinary skill that it is a matter of design choice to form the phosphor mixture in resin as a self-supporting member or as a coating. Therefore, one of ordinary skill can see the Tabuchi's phosphor coating **7** on the wall member **6** can be consolidated into a self-supporting member having the phosphor dispersed therein.

This "design choice" is substantially rationale B: simple substitution of one known element for another (MPEP 2143). Pinnow proves the predictability because Pinnow teaches that both forms of the phosphor mixture in resin (coating or self-supporting member) function to down-convert blue or UV primary radiation into polychromatic secondary radiation that mixes to produce white light.

This is all of the features of claim 163.

Proposed new **claims 164-166** read,

> *164. The light-emitting device of claim 162, wherein said luminophoric medium is **dispersed on** said light-transmissive wall member.*
>
> *165. The light-emitting device of claim 162, wherein the light-transmissive wall member comprises **polymer**.*
>
> *166. The light-emitting device of claim 162, wherein the light-transmissive wall member comprises **glass**.*

Again, Tabuchi states that the housing member **6** onto which the phosphor **7** is dispersed can be made from glass or epoxy resin (i.e. polymer):

> Transparent cover 6 is made of a material such as **glass** or an **epoxy resin**...

(Tabuchi translation, pp. 3-4; emphasis added)

Proposed new **claims 168 and 169** read,

> *168. The light-emitting device of claim 162, wherein the single-die light-emitting diode comprises **gallium nitride and its alloys**.*
>
> *169. The light-emitting device of claim 162, wherein the single-die light-emitting diode comprises at least one of **gallium nitride, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.***

Again, Nakamura teaches GaN-based LED and the use of Nakamura's GaN-based, blue-light-emitting LED in place of Tabuchi's GaN-based LED is obvious for the reasons indicated above, which applies here.

Proposed new **claims 170 and 171** read,

> *170. The light-emitting device of claim 162, wherein the at least one single-die gallium nitride based semiconductor blue light-emitting diode comprises **only one** single-die gallium nitride based semiconductor blue light-emitting diode.*
>
> *171. The light-emitting device of claim 162, comprising a light-emitting diode **lamp.***

Tabuchi teaches only one single LED which renders claims 170 and 171 obvious.

Proposed new **claim 178** reads,

> *178. A light-emitting device, comprising:*
>
> *a single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary radiation, said*

> *primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output.*

Patentee indicates that claim 178 is claim 5 with the exception that the terminology "at least one" has been removed and that the LED is now limited to a GaN-based blue-light emitting diode (Patentee's Remarks dated 3/26/2012, p. 63). For the same reasons as indicated above, it would be obvious to use Nakamura's blue GaN-based LED in place of Tabuchi's UV GaN-based LED. This is all of the features of claim 178.

Regarding **claim 187**, substitution of Tabuchi's GaN LED with those in Nakamura, still results in the secondary, down-converted radiation having a broad spectrum of frequencies, because white light is produced, as evidenced by Pinnow.

Proposed new **claim 188** reads,

> *188. The light-emitting device of claim 187, wherein the light-emitting diode is operative to emit* ***blue*** *light.*

Nakamura discloses blue-light-emitting LED, so this claim is obvious for the same reasons as claims, 1, 5, 26, 178, and 187, as discussed above.

10. Claims 64, 65, 73, 102, 103, 111, 119, 120, 127, 135, 136, and 143 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow and Nakamura as applied to claims 62, 72, 100, 110, 118, 126, 134, and 142, above, and further in view of Tadatsu.

Again, proposed new claims 64, 65, 73, 102, 103, 111, 119, 120, 127, 135, 136, and 143 read,

> *64. The light-emitting device of claim 62, comprising the luminophoric medium being* ***contiguous to*** *the single-die light-emitting diode.*
>
> *65. The light-emitting device of claim 64, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being* ***contiguous to the side die surface.***
>
> *73. The light-emitting device of claim 72, wherein the* ***homogeneous*** *composition is* ***contiguous to*** *the single die light-emitting diode.*

*102. The light-emission device of claim 100, comprising the luminophoric medium being **contiguous to** the single-die light-emitting diode.*

*103. The light-emission device of claim 102, comprising the single-die light-emitting diode comprising side die surface, and the luminophoric medium being **contiguous to the side die surface**.*

*111. The light-emission device of claim 110, wherein the **homogeneous** composition is **contiguous to** the single-die light-emitting diode.*

*119. The light-emission device of claim 118, comprising the luminophoric medium **dispersed in a polymer that is on** the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode.*

*120. The light-emission device of claim 119, comprising the single-die, two-lead gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the **polymer is contiguous to the die side surface.***

*127. The light-emission device of claim 126, wherein the **homogeneous** composition is **contiguous to** the single-die light-emitting diode.*

*135. The light-emitting device of claim 134, comprising the luminophoric medium **dispersed in a polymer that is on** the single-die gallium nitride based semiconductor blue light- emitting diode.*

*136. The light-emitting device of claim 135, comprising the single-die gallium nitride based semiconductor blue light-emitting diode comprising die side surface, and wherein the **polymer is contiguous to the die side surface**.*

*143. The light-emitting device of claim 142, wherein the homogeneous composition is **contiguous to** the single-die light-emitting diode.*

The prior art of Tabuchi in view of Pinnow and Nakamura, as explained above, discloses each of the features of claims 62, 72, 100, 110, 118, 126, 134, and 142.

Tadatsu teaches an alternative location for the phosphors. Tadatsu discloses a packaged LED **11** wherein a primary radiation is down-converted by a luminophor **5** to a longer wavelength, and is therefore in the same field of endeavor as is Tabuchi. Tadatsu also desires producing **white** light from a single LED. In this regard, Tadatsu states,

> [Constitution] A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a **resin mold**, wherein said **light emitting device is made of gallium nitride related compound semiconductors** which are expressed with a general formula of $Ga_xAl_{1-x}N$ (where $0\leq x\leq 1$), and further wherein a **fluorescent dye or pigment**, which

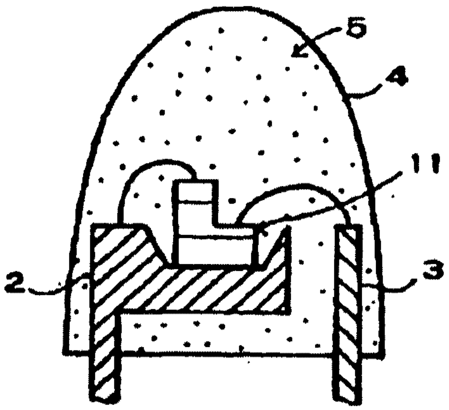
> is **excited with emission light from said gallium nitride related compound semiconductors** and which **emits fluorescent light**, is **added to said resin mold**.

(Tadatsu translation, p. 1)

Tadatsu's Fig. 2 (reproduced below) shows the packaged LED have two leads **2, 3** and a housing member ("resin mold" **4**) within which the luminophor ("fluorescent dye" **5**) is dispersed. Tadatsu also indicates that the luminophor can be organic or inorganic:

> [0003] Ordinarily, a resin with a large index of refraction and a high transparency is selected for the resin mold 4, so that the emission light from the light emitting device is efficiently emitted to the air. In other cases, an **inorganic or organic pigment is mixed as a coloring agent in the resin mold 4** in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its **emission color turns into white**.

(Tadatsu translation ¶ [0003]; emphasis added)



(Tadatsu, Fig. 2)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute the phosphor location used in Tabuchi with that location in Tadatsu because it is substitution of known equivalents to produce predictable results, as proven by Tadatsu. So modified, the luminophoric medium is in or within a housing member and is contiguous with the LED of Tabuchi/Nakamura.

Evidence of predictable results comes from Tadatsu. Tadatsu shows that dispersing the phosphor in a resin molded cap that is contiguous with all sides of the LED allows the primary radiation from the LED to be converted by the phosphor to secondary radiation and that the wavelengths mix are capable of mixing to produce white light. Thus, APA's inorganic phosphors in the resin housing member of

Tadatsu would predictable produce white light when Tabuchi/Nakamura's GaN-based laser is packaged as in Tadatsu.

11. Claims 5, 11-13, 22, 26, 172, 173, 187, and 188 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tabuchi in view of Pinnow and Edmond.

The prior art of Tabuchi in view of Pinnow, as explained above, is believed to disclose each of the features of claim 5, 12, 13, 22, 26, 172, 173, and 187.

Tabuchi does not teach a LED made on a SiC substrate (claims 11 and 12) or from including specifically SiC LED structure layers (claim 12 and 13).

Edmond discloses LEDs made on a SiC substrate having a multilayered device structure, wherein the layers include SiC, said SiC-based LEDs have peak maximum at several ranges in the blue wavelength spectrum:

> The present invention comprises a light emitting diode formed in silicon carbide and that emits **visible light** having a wavelength of between about **475-480 nanometers**, or between about **455-460 nanometers**, or between about **424-428 nanometers**. The diode comprises a **substrate of alpha silicon carbide** having a first conductivity type and a **first epitaxial layer of alpha silicon carbide** upon the substrate having the same conductivity type as the substrate. A **second epitaxial layer of alpha silicon carbide** is upon the first epitaxial layer, has the opposite conductivity type from the first layer, and **forms a p-n junction** with the first epitaxial layer.

(Edmond, abstract; emphasis added)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to substitute Tabuchi's GaN-based LED with the SiC-based LED disclosed in Edmond. This can be seen as simple substitution of one known element (Tabuchi's GaN-based LED) for another known element (Edmond's SiC-based LED) to obtain predictable results (as evidenced by Pinnow) and is one of the rationales identified by the Supreme Court in *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___,___, 82 USPQ2d 1385, 1395-97 (2007). (See MPEP 2143, Rationale B.)

Both Tabuchi's and Edmond's LEDs emit light in the same general region of the spectrum (i.e. UV light), so even though the materials from which the LED are made are different, it is the wavelength of light emitted that counts, and Pinnow teaches that the wavelength of light need only be shorter than 495 nm (4950 Å) to be effective to be converted by the mixture of phosphors to white light.

In regard to the predictability, as already noted above, Pinnow teaches that any wavelength of primary radiation can be down-converted by the mixture of phosphors to produce white light so long as the wavelength is less than 4950 Å (495 nm):

> Regardless of how many phosphors are used, it is apparent from the chromaticity diagram that a necessary condition for achieving a true white is that the illuminating laser beam have a **wavelength of approximately 4,950 A. or shorter**. Otherwise, it is impossible to include illuminant C within a polygon whose primaries are the source and any combination of longer wavelengths that can be achieved by down-conversion of frequency. Fortunately, the argon-ion laser satisfies this necessary condition.

(Pinnow, col. 3, lines 24-55; emphasis added)

(It is noted that Pinnow uses "A." for "angstrom", which is properly, instead, Å.)

Because Tabuchi's and Edmond's LED emit light in the same general region of the emission spectrum, blue-to-UV light, substituting a UV-light-emitting GaN-based LED with a blue-light-emitting SiC-based LED would yield predictable results in producing emission of white light with the down-converting phosphor mixture. The predictability results from using LEDs that emit light having a wavelength of less than 4950 Å (495 nm), as evidenced by Pinnow.

Tabuchi modified by Edmond to use Edmond's SiC LEDs therefore teaches each of the features of claims 5 and 11-13 as follows.

Regarding **claim 5**, there is no requirement that the light be outside the visible white light spectrum, but substituting Tabuchi's LED with those of Edmond would still read on claim 5 because the secondary radiation emitted by the phosphor mixture of Tabuchi/Pinnow would be white light.

Proposed amended **claims 11 and 12 and claim 13** read,

> *11. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device <u>is on</u> a substrate <u>in</u> a multilayer device structure, and wherein said substrate comprises **silicon carbide**.*
>
> *12. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device <u>is on</u> a substrate <u>in</u> a multilayer device structure, and wherein said substrate comprises a material selected from the group consisting of sapphire, **SiC**, and InGaAIN.*
>
> *13. A light-emitting device according to claim 12, wherein said multilayer device structure includes layers selected from the group consisting of **silicon carbide**, aluminum nitride, gallium nitride, gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys.*

As shown in Edmond's abstract, above, and Edmond's Figs. 1-8, the substrate is SiC and the device layers include SiC.

The features of claims 22, 172, and 173 have been discussed above in conjunction with the rejection over Tabuchi in view of Pinnow and are not changed by the addition of Edmond.

Claims 26, 187, and 188 are obvious for the same reasons as discussed above in conjunction with claims 5 and 11-13 in that Edmond teaches a SiC **blue**-light-emitting LED, and the use of Edmond's LED in place of Tabuchi's is obvious.

E. Menda as a base reference

1. Claims 1, 3, 5, 22, and 26 are rejected under 35 U.S.C. 102(b) as being anticipated by Menda, as evidenced by any of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER.

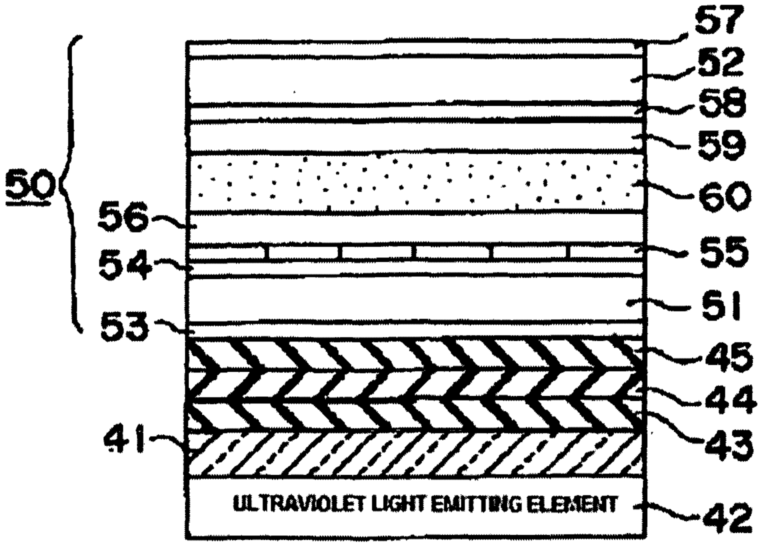
Proposed amended claim 1 reads,

> ***[1]*** *1. A light emitting device, comprising:*
>
> ***[2]*** *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation* ***[3]*** *which is the same for each single-die semiconductor LED present in the device,* ***[4]*** *said primary radiation being a relatively shorter wavelength radiation outside the visible white light spectrum; and*
>
> ***[5]*** *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum, with said radiation of said multiplicity of wavelengths mixing to produce a white light output, **[6]** wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Feature [1]: *1. A light emitting device*

Menda's Fig. 4 (reproduced below) shows a light emitting device, specifically a liquid crystal display (Menda translation, p. 7, ¶ [0021]).

[Fig 4]



(Menda, Fig. 4)

Feature [2]: *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation*

Menda states,

> In the above embodiment, an organic PL element has been realized using a ZnO ultraviolet light emitting element having a schottky junction structure. Likewise, the green light emitting organic PL element can also be realized by using a **solid ultraviolet light emitting element** having a structure of a **pn junction**, **MOS** [Metal-Oxide-**Semiconductor**] **junction** or the like. Further, light having colors other than green can also be emitted by changing the type of the organic coloring matter doped into the PL luminescent layer 22. Further, the amount of luminescence from the PL luminescent layer 22 can be regulated by regulating the amount of voltage or current applied to the ultraviolet light emitting element.

(Menda translation, ¶ [0018], p. 6, lines 1-11; emphasis added)

In addition, with regard to Fig. 4 (above), Menda states,

Menda states,

> [0021] **Fig. 4** shows an example in which a PL [PhotoLuminescent] element according to the present invention has been applied to a backlight of a **liquid crystal display**. In the drawing, numeral **41** designates a glass substrate transparent to ultraviolet light. An **ultraviolet light emitting element 42**

> **as described in the first embodiment** is provided on one side of the glass substrate **41**. Further, a **blue** PL luminescent layer **43**, a **green** PL luminescent layer **44**, and a **red** PL luminescent layer **45** as described in the second embodiment are stacked on the other side of the glass substrate **41**.
>
> [0022] As shown in the drawing, a **liquid crystal display device 50** is stacked on the PL luminescent element having the above construction. ...
>
> [0023] In the above embodiment, individual PL luminescent layers **43** to **45** of three primary colors are **excited by ultraviolet light emitted from the ultraviolet light emitting element 42** and emit respective lights, and these **three primary colors are mixed together** to provide a **white light**. The **white light** thus obtained is applied as a backlight of the liquid crystal display device **50** through the first glass substrate **51**. Also in this embodiment, a deterioration in the PL luminescent layers **43** to **45** can be avoided, and the service life of the PL luminescent layers **43** to **45** can be prolonged.

(Menda translation, p. 7; emphasis added)

The request fails to provide evidentiary support or sufficient explanation that a light-emitting pn junction **implicitly includes** a single-die semiconductor LED (light emitting diode). Accordingly, any of Penguin, Morkoç, Abe, and Tadatomo has been provided.

First, by definition, a "pn junction" is necessarily formed from semiconductor materials:

> **pn-junction** The region at which two **semiconductors** of opposite polarity meet, i.e. at which p-type and n-type semiconductor meet. ...

(Penguin, p. 437; emphasis added)

Thus, Menda's pn junction is necessarily a *semiconductor*. Note also that the term "MOS" in Menda is an acronym for Metal-Oxide-**Semiconductor**, thereby placing one of ordinary skill squarely in the mindset of light-emtting **semiconductor** materials.

Because the pn junction produces UV light, it is necessarily a *semiconductor light-emitting* element, albeit not necessarily a *diode*. However, each of Penguin, Morkoç, Abe, and Tadatomo teaches that one of ordinary skill knows very well that a light-emitting **pn junction** implicitly includes a light-emitting **diode**, thereby providing evidence that Menda's "solid **ultraviolet light emitting element** having a **structure of a pn junction**, MOS junction or the like" (Menda, *id.*) implicitly includes the light-emitting ***diode***.

Penguin's definition of "light emitting diode (LED)" includes the light-emitting, pn junction:

> **light-emitting diode** (LED) A **p-n junction** diode that **emits light** as a result of direct radiative recombination of excess electron-hole pairs...

(Penguin, p. 315; 2nd emphasis added)

Given that the elements in Penguin's definition of "pn junction" and "light-emitting diode" are found in Menda's description of the UV light-emitting element, i.e. "solid ultraviolet **light emitting element** having a structure of a **pn junction**, MOS [Metal-Oxide-Semiconductor] junction or the like" (Menda, *id.*), Penguin teaches that those of ordinary skill in the art know that Menda's light-emitting pn junction **implicitly includes** the light-emitting ***diode***.

Because the UV-light-emitting pn junction or UV LED, once produced, is of necessity finite, it is a **die** and therefore reads on *at least one single **die***. Because power is required to produce light ("...the amount of luminescence from the PL luminescent layer 22, [43, 44, 45] can be regulated by regulating the **amount of voltage or current applied** to the ultraviolet light emitting element"; Menda, *id.*) the semiconductor light-emitting device is *coupleable with a power supply to emit a primary radiation*. In order to apply power across the pn junction to produce light, one electrode must be applied to the p-type semiconductor and one electrode must be applied to the n-type semiconductor; thus, Menda's pn junction is a *diode*.

Fundamentals of Photonics similarly indicates that those of ordinary skill knew before 1991 (the copyright date of the book) --that is two years before the foreign filing of Menda-- that light-emitting semiconductor **pn junctions** at least included light-emiting **diodes**. In this regard, the term "LED" is defined:

> A **light-emitting diode (LED)** is a forward-biased **p-n junction** fabricated from a direct-gap **semiconductor** material that emits light via injection electroluminescence...

(Fundamentals of Photonics, p. 593; emphasis added)

Fundamentals of Photonics goes on to state that the both LEDs and semiconductor lasers are of "small size" and are used in displays:

> **Semiconductor** photons sources, in the form of both **LEDs** and injection **lasers**, serve as highly efficient electronic-to-photonic transducers. They are convenient because they are readily modulated by controlling the injected current. Their **small size**, high efficiency, high reliability, and compatibility with electronic systems are important factors in their successful use in many applications. These include lamp indicators; **display devices**; scanning, reading, and printing systems; fiber optic communication systems; and optical data storage systems such as compact-disc players.

(Fundamentals of Photonics, paragraph bridging pp. 593-594; emphasis added)

Thus, those of ordinary skill in the art also knew that **small**-sized LEDs and semiconductor lasers were used to make **display devices**, just as in Menda, i.e. the LCD. Therefore, Fundamentals of Photonics provides evidence that those of ordinary skill in the art knew before 1991, when the book was published (that is two years before Menda) that the small-sized LEDs and semiconductor lasers were already know for use to make display devices.

With regard to semiconductor lasers, Fundamentals of Photonics states

> 16.2 SEMICONDUCTOR LASER AMPLIFIERS
>
> The principle underlying the operation of a **semiconductor laser** amplifier is the same as that for other laser amplifiers: the creation of a population inversion that renders stimulated emission more prevalent than absorption. The population inversion is usually achieved by electric current injection in a **p-n junction diode**; a forward bias voltage causes carrier pairs to be injected into the junction region, where they recombine by means of stimulated emission.

(Fundamentals of Photonics, p. 609; emphasis added)

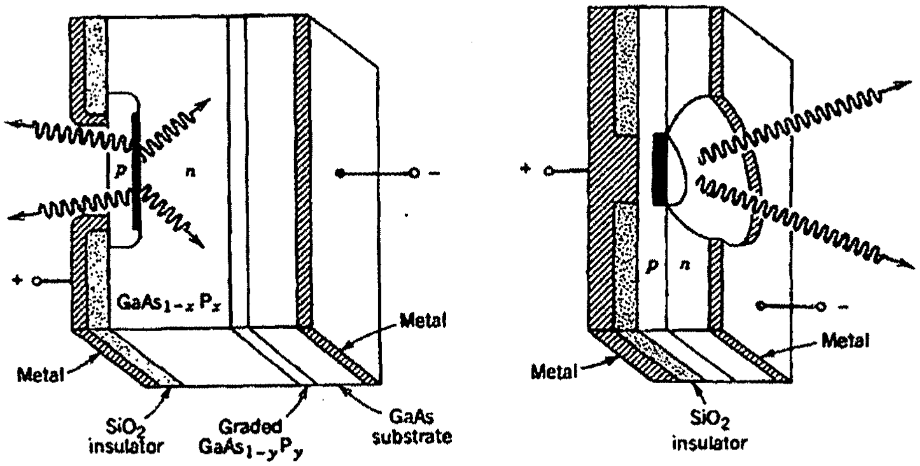
Thus, Fundamentals of Photonics shows that those of ordinary skill in the art know that semiconductor lasers are a form of pn junction and by extension that a light-emitting pn junction, such as Menda's, suggests semiconductor lasers as well as LEDs.

In addition, Fundamentals of Photonics states that the basic structure of the LED and semiconductor laser are the same:

> ***Device Structures***
>
> **LEDs** may be constructed either in surface-emitting or edge-emitting configurations (fig. 16.1-10). The surface-emitting LED emits light from a face of the device that is parallel to the junction plane. Light emitted from the opposite face is absorbed by the substrate and lost or, preferably, reflected from a metallic contact (which is possible if a transparent substrate is used). The edge-emitting LED emits light from the edge of the junction region. The latter structure has usually been used for **diode lasers** as well, although surface-emitting **laser diodes** (SELDs) are being increasingly used. Surface emitting LEDs are generally more efficient than edge-emitting LEDs. Heterostructure LEDs, with configurations such as those described in Sec. 16.2C, provide superior performance.

(Fundamentals of Photonics, p. 606; emphasis added)

Furthermore, figures 16.1-11(a) and (b) (reproduced below) of Fundamentals of Photonics shows the LEDs are known to be implemented as *single dies*.



(a) (b)

Figure 16.1-11 (*a*) A flat-diode-configuration $GaAs_{1-x}P_x$ LED. (*b*) A Burrus-type LED.

(Fundamentals of Photonics, p. 607; emphasis added)

Based on the foregoing, Fundamentals of Photonics provides evidence that those of ordinary skill in the art would appreciate that Menda's "solid ultraviolet **light emitting element** having a **structure of a pn junction**, MOS junction or the like" (Menda, *id.*) **implicitly includes** a *single-die semiconductor light-emitting* ***diode*** and a *single die semiconductor* ***laser***.

Similarly, **Morkoç** provides evidence that light-emitting **pn junctions** include *single-die semiconductor light-emitting* ***diodes*** *(LEDs)*. In Morkoç's section entitled, "III. GaN-based III-V Nitride Semiconductors" Morkoç explicitly calls the light emitters, "GaN **p-n junction LEDs**" (emphasis added):

> These advances in material quality and processing have allowed researchers to demonstrate and commercialize GaN **p-n junction LEDs** giving rise to optimism of a GaN-based **laser** soon to follow.

(Morkoç, p. 1379, right col. last full sentence; emphasis added)

> The first GaN LED was reported over 20 years ago.[146] Due to the inability at the time to dope GaN p type, these devices were not **conventional p-n junction LEDs**, but rather metal-insulator-semiconductor (MIS) structures. Only recently, when Amano et al.[104] first obtained p-type GaN was the first **p-n junction GaN LED** realized. Soon after, some of these same workers introduced AlGaN as a barrier material.[147]

(Morkoç, p. 1387, right col., 1st full ¶; emphasis added)

The Amano et al. article is dated 1990 which is three years **before** the filing date of Menda. Morkoç also points out that the GaN-based LEDs produce UV light, i.e. light of a wavelength less than 400 nm (Morkoç, p. 1388, Fig. 47 and associated text on p. 1389). Thus, Morkoç shows that those of ordinary skill knew **before** the time of Menda that a GaN-based, UV-light-emitting **diodes** were made from a semiconductor **pn junction before** the time of Menda.

See also Morkoç p. 1386, Fig. 41 and Fig. 43 captions, which also use the language "p-n junction LED" (emphasis added). See also Morkoç at p. 1387, which uses the language "p-n junction LEDs" and "p-n junction GaN LED".

Morkoç's Figs. 49, 52, 56, and 58 each show **single die** semiconductor lasers; thus those of ordinary skill in the art know that semiconductor light emitting devices, including LEDs and lasers are implemented as a ***single die***, as claimed.

Thus, Morkoç teaches that those of ordinary skill in the art know that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, *id.*) **implicitly includes** *at least one single-die semiconductor light-emitting diode (LED).*

In addition to Penguin and Morkoç, **Abe** shows to those of ordinary skill in the art that a UV-light-emitting semiconductor pn junction includes both LEDs and lasers. In discussing the prior art, Abe states,

> In addition, the light source described above includes a **light emitting diode** (which will be referred to as **LED** thereafter) as a display element used in OA (Office Automation) apparatuses and display units. The LED is adapted to **emit light** by applying current to **p-n junction** of a **semiconductor**.

(Abe, col. 1, lines 28-33; emphasis added)

Thus, Abe teaches that it was already known in the art at least by 1994 (the foreign priority date of Abe) that a light-emitting semiconductor pn junction includes light-emitting **diodes**, or LEDs.

Abe also shows that semiconductor lasers are implemented as a "single chip":

> Either of AC and DC power sources may be used as a required power source. In case of using the AC power source, a rectifying device may be incorporated in a lighting circuit, or the **semiconductor laser element** and the lighting circuit may be integrated in a **single chip**.

(Abe, col. 2, lines 45-49; emphasis added)

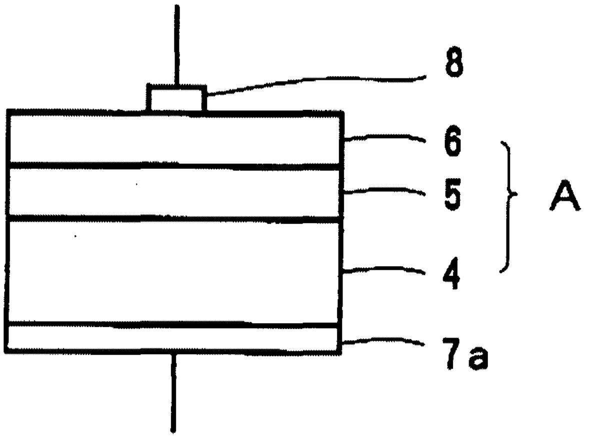
Note that Abe includes the lighting circuit along with the semiconductor laser; thus, Abe also points out here that the lighting circuit and the semiconductor lasers are known to be implemented on separate semiconductor chips (i.e. die).

Abe's Figs. 1(a), 1(b), 4(a)-4(g), 5, 6, 8(a), 8(b), each shows the semiconductor laser element **1** implemented **single die**.

Based on the foregoing, Abe shows that those of ordinary skill in the art would understand that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, *id.*) **implicitly includes** *at least one single-die semiconductor light-emitting diode (LED).*

Finally, **Tadatomo** --a reference provided by Patentee in the IDS submitted 3/2/2011 -- shows that light-emitting **pn junctions** include both light-emitting **diodes** and **lasers**. In this regard, Tadatomo's Fig. 3 (reproduced below) shows a UV-light-emitting **diode** implemented as a **single die**.

Fig. 3



(Tadatomo, Fig. 3)

In regard to Fig. 3, Tadatomo states,

> **FIG. 3** schematically shows the structure of **LED** of a typical semiconductor light emitting element. As shown in the Figure, the **LED** comprises a laminate A (**4, 5, 6**) including the GaN single crystal (n type) produced by the method of the present invention as a substrate **4**, and a **semiconductor layer 5 (n type)** and a **semiconductor layer 6 (p type)**, both being GaN group compound semiconductors, formed thereon, and **electrodes 8 and 7** set on the outermost layers **6** and **4** of the laminate A.

(Tadatomo, col. 8, lines 37-44; emphasis added)

> In **FIG. 3**, the **light emitting part** has a simple two-layer **p-n junction**. The junction of the light emitting part may be **homo-junction** where the same materials are joined, or **hetero-junction** where different materials are joined. Furthermore, the junctional structure of the light emitting part is **not limited to two-layer junction** but may be **multi-layer junction** such as **double-hetero junction, single quantum well, multiple quantum well etc**.

> With such junctional structure of the light emitting part, various **semiconductor light emitting elements** such as **LED** and **LD [Laser Diode]** are obtained.
>
> (Tadatomo, col. 9, lines 8-19; emphasis added)

In addition, Tadatomo states,

> The thick GaN single crystal of superior quality which is produced by the method of the present invention can be suitably used for **semiconductor light emitting elements** such as **light emitting diode (LED)**, **laser diode (LD)** and superluminescence diode, and electron devices. In the electron devices, the use of the GaN single crystal of the present invention as a substrate enables production of LED, LD etc. having the same electrode structure as in the conventional red LED etc. Those which emit blue lights are particularly important. In addition, the efficiency of the light emission of semiconductor light emitting elements by the use of the GaN single crystal of the present invention is advantageously high.
>
> (Tadatomo, col. 8, lines 20-32; emphasis added)

Thus, Tadatomo teaches that those of ordinary skill in the art knew around 1993-1994 (the foreign priority dates of Tadatomo) that light-emitting **pn junctions** include **both** semiconductor light-emitting **diodes** and semiconductor **lasers** implemented as **single dies**. In addition, the electrodes **7, 8** shows that those of ordinary skill know that the light emitting element must have a power source in order to emit radiation (as claimed, "*coupleable with a power supply to emit a primary radiation*").

In summary, each of Penguin, Fundamentals of Photonics, Morkoç, Abe, and Tadatomo provides evidence that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, *id.*) **implicitly includes** *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation*, as claimed.

> **Feature [3]:** *which is the same for each single-die semiconductor LED present in the device*

As discussed above, Menda teaches at least one *single-die LED*, which is all that is required of the claim.

> **Feature [4]:** *said primary radiation being a relatively shorter wavelength radiation outside the visible white light spectrum*

The LED emits ultraviolet (UV) light (i.e. below 400 nm wavelength) which is necessarily outside the *visible white light spectrum* (400 to about 700 nm wavelength).

> **Feature [5]:** *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum, with said radiation of said multiplicity of wavelengths mixing to produce a white light output*

As quoted above from Menda, in regard to the liquid crystal display shown in Fig. 4, Menda states,

> [0021] **Fig. 4** shows an example in which a PL element according to the present invention has been applied to a backlight of a **liquid crystal display**. In the drawing, numeral **41** designates a glass substrate transparent to ultraviolet light. An **ultraviolet light emitting element 42** as described in the first embodiment is provided on one side of the glass substrate **41**. Further, a **blue** PL luminescent layer **43**, a **green** PL luminescent layer **44**, and a **red** PL luminescent layer **45** as described in the second embodiment are stacked on the other side of the glass substrate **41**.
>
> [0022] As shown in the drawing, a **liquid crystal display device 50** is stacked on the PL luminescent element having the above construction. The liquid crystal display device 50 comprises a first glass substrate 51 and a second glass substrate 52. A polarizing plate 53 is stacked on one side of the glass substrate 51. A transparent electrode 54, a color filter 55, and an aligning film 56 are stacked in that order on the other side of the glass substrate 51. Further, a polarizing plate 57 is stacked on one side of the glass substrate 52, and a transparent electrode 58 and an aligning film 59 are stacked in that order on the other side of the glass substrate 52. A liquid crystal material 60 is filled into the two aligning films 56-59 to constitute a liquid crystal display cell.
>
> [0023] In the above embodiment, individual PL luminescent layers **43** to **45** of **three primary colors are excited by ultraviolet light emitted from the ultraviolet light emitting element 42** and emit respective lights, and these **three primary colors are mixed together** to provide a **white light**. The **white light** thus obtained is applied as a backlight of the liquid crystal display device **50** through the first glass substrate **51**. Also in this embodiment, a deterioration in the PL luminescent layers **43** to **45** can be avoided, and the service life of the PL luminescent layers **43** to **45** can be prolonged.

(Menda translation, p. 7; emphasis added)

Fig. 4 shows that Menda's *luminophoric medium* **43, 44, 45** is in *receiving relationship* to the UV light emitting element **42**.

Menda discloses that the UV light is down-converted (in terms of energy) to visible light. UV light has a wavelength of less than 400 nm and visible white light includes wavelengths between 400 to 700 nm. In particular, Menda's luminophoric medium yields light having separate wavelengths of blue **43**, green **44**, and red **45** that mix to produce white light when mixed (*Id.*).

> **Feature [6]:** *wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output*

Because the light source of Menda passes through all three PL layers 43, 44, and 45, *each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output*.

This is all of the features of claim 1.

Claim 3 reads,

> *3. A light-emitting device, comprising:*
>
> *a semiconductor **laser** coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the **visible** light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*

Claim 3 is distinguished from claim 1 in that (1) a *semiconductor **laser*** is required versus a *single-die semiconductor LED*; (2) the primary radiation is required to be outside the **visible** light spectrum, as opposed to outside the visible **white** light spectrum; and (3) the wording associated with the luminophoric medium.

With regard to **difference (1)**, claim 3 requires the LED be a *semiconductor laser*. Menda teaches that the UV-light emitting element can be a "pn junction", as just discussed. Thus, all pn junction, light-emitting devices are implicitly included. Penguin provides additional evidence that light-emitting pn junctions include semiconductor lasers. In this regard, Penguin states,

> **semiconductor laser** *Syn*. diode laser A laser that uses a **p-n junction diode** made from a direct-gap **semiconductor material** such as gallium arsenide, GaAs. ...

(Penguin, p. 509; second emphasis added)

Similarly, as noted above, Morkoç states,

> These advances in material quality and processing have allowed researchers to demonstrate and commercialize GaN **p-n junction LEDs** giving rise to optimism of a GaN-based **laser** soon to follow.

(Morkoç, p. 1379, right col. last full sentence; emphasis added)

Thus Menda's "pn junction" that produces UV light includes both LEDs and semiconductor **lasers** since both are within the scope of "pn junctions", as disclosed by Menda as the "UV light-emitting element" (Menda, ¶ [0018]).

As already indicated above, each of <u>Fundamentals of Photonics</u>, Abe, and Tadatomo teach those of ordinary skill that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]) **implicitly includes** semiconductor **lasers**, as well as LEDs.

Finally, LEDLASER indicates that those of ordinary skill in the art know that a semiconductor laser is simply a specialized form of p-n junction diode:

> **Laser diodes** (also called 'injection lasers') are in effect a specialised form of **LED**. Just like a **LED**, they're a form of **P-N junction diode** with a thin depletion layer where electrons and holes collide to create light photons, when the diode is forward biased. ...
>
> In other words, they end up 'in sync' and forming continuous-wave **coherent radiation**.

(LEDLASER, p. 2, right col.; emphasis added)

Thus, LEDLASER shows that those of ordinary skill in the art know that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]) **implicitly includes** semiconductor lasers, as well as LEDs because the laser is just the specialized form of the pn junction LED.

With regard to **difference (2)**, as noted above in discussing claim 1, UV light is outside the visible spectrum.

With regard to **difference (3)**, the difference is in wording only and is not distinct from claim 1. In other words, there is no difference between *polychromatic radiation* and *a multiplicity of wavelengths*, as it applies to mixing to produce white light.

Thus, Menda discloses all of the features of claim 3.

Claim 5 reads,

> *5. A light-emitting device, comprising:*
>
> *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*

> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, **is excited to** responsively emit a secondary, **relatively longer wavelength, polychromatic** radiation, with **separate wavelengths** of said **polychromatic** radiation mixing to produce a white light output, each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output..*

Claim 5 is distinct from claim 1 in that (1) the primary radiation is not required to be outside the visible white light spectrum; (2) the down-converting is required to yield longer wavelengths than that of the primary radiation; and (3) separate wavelengths are required to be produced.

With regard to **difference (1)**, claim 5 is broader in this respect; thus, Menda discloses the claimed LED for the reasons indicated in conjunction with claim 1.

With regard to **differences (2) and (3)**, as discussed in rejecting claim 1 above, Menda discloses that the UV light is down-converted (in terms of energy) to visible light. UV light has a wavelength of less than 400 nm and visible white light includes wavelengths between 400 to 700 nm. In particular, Menda's luminophoric medium yields light having separate wavelengths of blue **43**, green **44**, and red **45** that mix to produce white light when mixed (Menda translation, ¶¶ [0021]-[0023], *supra*).

This is all of the features of claim 5.

Claims 22 and 26 read,

> *22. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die **two-lead** semiconductor LED.*
>
> *26. A light-emission device, comprising*
>
> *a single-die, **two-lead** semiconductor light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light.*

Independent claim 26 is broader than all of the other independent claims except for the feature that the LED has two leads. Thus, Menda, as discussed above, discloses each of the features of claim 26 and claims 21 and 22 except for explicitly indicating the number of leads of the UV light-emitting element **42**.

As noted above, the UV light-emitting element **42** can be a pn junction and thereby includes single-die semiconductor LED and semiconductor lasers, as evidenced by any of Penguin, Morkoç, Abe, and Tadatomo.

Tadatomo's Figs. 3, 4, 5, and 6 each show that those of ordinary skill know that a light-emitting pn junction implemented as a LED or LD has ***two leads***, one attached to each electrode **7** and **8** for each of the p-type and n-type semiconductor of the pn junction.

Thus, Tadamoto provides evidence that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS [Metal-Oxide-**Semiconductor**] junction or the like" (Menda, ¶ [0018]) **implicitly includes** *two leads*, as required by each of claims 22 and 26.

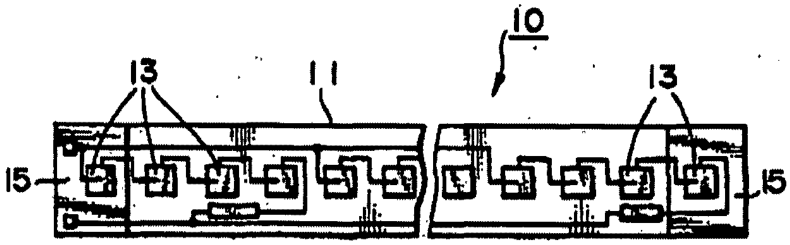
> <u>2. Claims 2, 23, 24, 180, 181, and 186 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda, as evidenced by any of Penguin, Fundamentals of Photonics, Morkoç, Abe, and Tadatomo, and in view of Imamura.</u>

Claims 2 and 23 read,

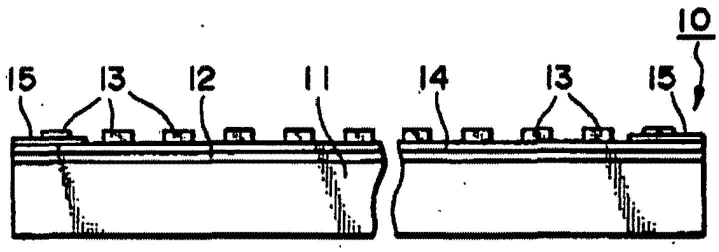
> *2. A light-emitting device according to claim 1, comprising a **two-lead array** of single-die semiconductor LEDs.*
>
> *23. A light-emitting device according to claim 5, comprising a **two-lead array** of single-die semiconductor LEDs.*

The prior art of Menda, as evidenced by any of Penguin, <u>Fundamentals of Photonics</u>, Morkoç, Abe, and Tadatomo, as explained above, discloses each of the claimed features of claims 1 and 5. Menda does not explicitly disclose a two-lead array of single-die LEDs.

Imamura's Figs. 4 and 5 (reproduced below) shows the top and side views of an light array **10** may from an array of single-die semiconductor LEDs **13** on a substrate **15** (Imamura, col. 3, lines 16-36).



(Imamura, Fig. 4)



(Imamura, Fig. 5)

The array **10** can be used as a backlight for a liquid crystal display, such as shown in Fig. 8 (Imamura, col. 4, lines 59-61). Each LED die **13** has two leads that connect to the array's two leads, made from the gold-plated copper pattern **12** shown in the side view of right side of Fig. 5 and in the top view as the horizontal lines running across the top and bottom of the substrate **15** that connect the array of LEDs **13**. As also shown in Fig. 4, each of the array's two leads ends in a terminal. Thus, Imamura teaches *a **two-lead array** of single-die semiconductor LEDs*.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Imamura's two-lead array configuration of plural identical UV LEDs --therefore *emitting identical UV radiation*-- for Menda's UV light emitting element **42**, in order to enable making a uniformly lit, larger, liquid crystal display than could be made from a single UV LED, as taught by Imamura (Imamura, col. 3, lines 37-60).

Proposed amended **claim 24** reads,

> *24. A liquid crystal display, including:*
>
> *a backlight member including a **multiplicity of light-emitting devices**, each light-emitting device comprising:*
>
> > *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Claim 24 is distinct from claim 5 in that (1) a liquid crystal display is claimed as opposed to just a light emitting device, and (2) a multiplicity of light-emitting devices is required to make a backlight for the LCD.

Imamura is applied as above.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Imamura's array configuration of plural **identical** UV LEDs --therefore *emitting identical UV radiation*-- for Menda's UV light emitting element **42**, in order to enable making a uniformly lit, larger, liquid crystal display than could be made from a single UV LED, as taught by Imamura (Imamura, col. 3, lines 37-60).

Further in this regard, the courts have held that mere duplication of parts has no patentable significance unless a new or unexpected result is produced. See *In re Harza*, 274 F.2d 669, 124 USPQ 378 (CCPA 1960). Thus, it would have been obvious to use more than one UV LED to increase the brightness or increase the size of the display.

Proposed new **claims 180 and 181** read,

> *180. The liquid crystal display of claim 24, wherein said multiplicity of light-emitting devices comprises an array of single-die semiconductor light-emitting diodes.*
>
> *181. The liquid crystal display of claim 180, wherein said array comprises a regular pattern.*

Imamura calls the LED array a "LED array substrate **10**" (Imamura, e.g. at col. 3, line 19) which is shown to be a rectangle, in Fig. 4. In addition, Imamura states,

> A plurality of **LED array substrates 32** are mounted in the interior of a cover **33** to provide a **back-light 34** for illuminating a **liquid crystal display** panel **30** and are supplied with a power through a connector **31**.

(Imamura, col. 4, lines 65-68; emphasis added)

Thus the array can be may whatever size is required for the LCD.

Proposed new **claim 186** reads,

> *186. The liquid crystal display of claim 24, comprising a **full-color** liquid crystal display.*

Menda discloses a full-color LCD display. Menda's Fig. 4 shows the color filter **55** used to produce each of the different colors required for each pixel of the display (Menda translation, ¶ [0022]). In addition, Menda explicitly states that the LCDs are "full color" (Menda translation, ¶ [0019], 1st sentence).

3. Claims 1, 3, and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of any of Fundamentals of Photonics, Morkoç, Abe, and Tadatomo.

The prior art of Menda, as evidenced by any of Penguin, Fundamentals of Photonics, Morkoç, Abe, and Tadatomo, as explained above, is believed to discloses each of the features of claims 1, 3, and 5. If, however, it is believed by Patentee that any of Penguin, Fundamentals of Photonics, Morkoç, Abe, and Tadatomo does not provide sufficient evidence that Menda's UV-light emitting pn junction **implicitly includes** a *single-die semiconductor LED* or a *semiconductor laser*, then any of Morkoç, Fundamentals of Photonics, Abe, and Tadatomo at least renders this obvious.

As noted above, **Fundamentals of Photonics** indicates that those of ordinary skill knew before 1991 (the copyright date of the book) --that is two years before the foreign filing of Menda-- that light-emitting semiconductor **pn junctions** at least included light-emiting **diodes** and semiconductor **lasers**. In this regard, the term "LED" is defined:

> A **light-emitting diode (LED)** is a forward-biased **p-n junction** fabricated from a direct-gap **semiconductor** material that emits light via injection electroluminescence...

(Fundamentals of Photonics, p. 593; emphasis added)

Fundamentals of Photonics goes on to state that the both LEDs and semiconductor lasers are of "small size" and are used in displays:

> **Semiconductor** photons sources, in the form of both **LEDs** and injection **lasers**, serve as highly efficient electronic-to-photonic transducers. They are convenient because they are readily modulated by controlling the injected current. Their **small size**, high efficiency, high reliability, and compatibility with electronic systems are important factors in their successful use in many applications. These include lamp indicators; **display devices**; scanning, reading, and printing systems; fiber optic communication systems; and optical data storage systems such as compact-disc players.

(Fundamentals of Photonics, paragraph bridging pp. 593-594; emphasis added)

Thus, those of ordinary skill in the art also knew that **small**-sized LEDs and semiconductor lasers were used to make **display devices**, just as in Menda, i.e. the LCD. Therefore, Fundamentals of Photonics provides evidence that those of ordinary skill in the art knew before 1991, when the book was published (that is two years before Menda) that the small-sized LEDs and semiconductor lasers were already know for use to make display devices.

With regard to semiconductor lasers, Fundamentals of Photonics states

> 16.2 SEMICONDUCTOR LASER AMPLIFIERS
>
> The principle underlying the operation of a **semiconductor laser** amplifier is the same as that for other laser amplifiers: the creation of a population inversion that renders stimulated emission more prevalent than absorption. The population inversion is usually achieved by electric current injection in a **p-n junction diode**; a forward bias voltage causes carrier pairs to be injected into the junction region, where they recombine by means of stimulated emission.

(Fundamentals of Photonics, p. 609; emphasis added)

Thus, Fundamentals of Photonics shows that those of ordinary skill in the art know that semiconductor lasers are a form of pn junction and by extension that a light-emitting pn junction, such as Menda's, suggests semiconductor lasers as well as LEDs.

In addition, Fundamentals of Photonics states that the basic structure of the LED and semiconductor laser are the same:

> ***Device Structures***
>
> **LEDs** may be constructed either in surface-emitting or edge-emitting configurations (fig. 16.1-10). The surface-emitting LED emits light from a face of the device that is parallel to the junction plane. Light emitted from the opposite face is absorbed by the substrate and lost or, preferably, reflected from a metallic contact (which is possible if a transparent substrate is used). The edge-emitting LED emits light from the edge of the junction region. The latter structure has usually been used for **diode lasers** as well, although surface-emitting **laser diodes** (SELDs) are being increasingly used. Surface emitting LEDs are generally more efficient than edge-emitting LEDs. Heterostructure LEDs, with configurations such as those described in Sec. 16.2C, provide superior performance.

(Fundamentals of Photonics, p. 606; emphasis added)

Furthermore, figures 16.1-11(a) and (b) (reproduced below) of Fundamentals of Photonics shows the LEDs are known to be implemented as *single dies*.

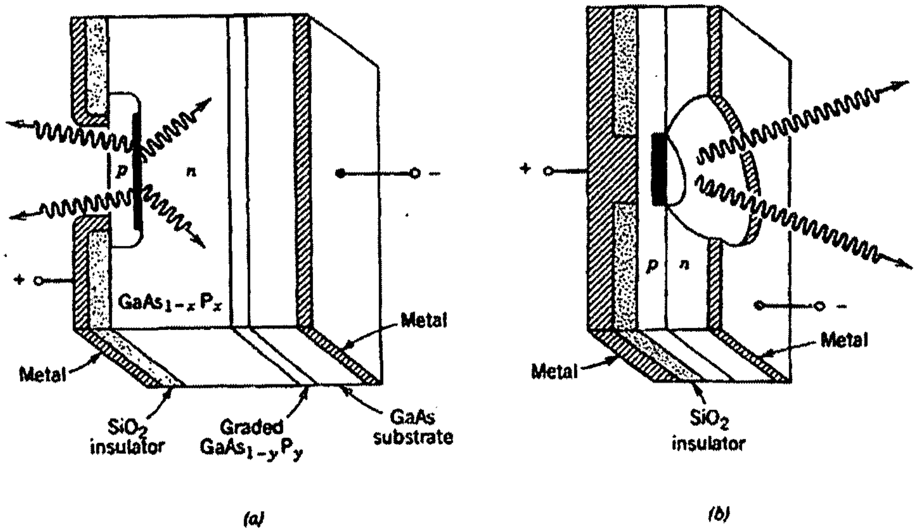


Figure 16.1-11 (*a*) A flat-diode-configuration $GaAs_{1-x}P_x$ LED. (*b*) A Burrus-type LED.

(Fundamentals of Photonics, p. 607; emphasis added)

Based on the foregoing, Fundamentals of Photonics provides evidence that those of ordinary skill in the art would appreciate that Menda's "solid ultraviolet **light emitting element** having a **structure of a pn junction**, MOS junction or the like" (Menda, *id.*) **implicitly includes** a *single-die semiconductor light-emitting* ***diode*** and a *single die semiconductor* ***laser***.

Because Menda explicitly suggests making the UV light emitting element **42** of the liquid crystal **display** as a "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]), and because Fundamentals of Photonics states that the semiconductor LEDs and lasers are known to be used in "**display devices**", it would have been obvious to one of ordinary skill in the art, at the time of the invention to use known light-emitting pn junctions, such as those disclosed in Fundamentals of Photonics, which are *single-die semiconductor LEDs* and *semiconductor lasers*.

As noted above, **Morkoç** provides evidence that light-emitting **pn junctions** include *single-die semiconductor light-emitting* ***diodes*** *(LEDs)*. In Morkoç's section entitled, "III. GaN-based III-V Nitride Semiconductors" Morkoç explicitly calls the light emitters, "GaN **p-n junction LEDs**" (emphasis added):

> These advances in material quality and processing have allowed researchers to demonstrate and commercialize GaN **p-n junction LEDs** giving rise to optimism of a GaN-based **laser** soon to follow.

(Morkoç, p. 1379, right col. last full sentence; emphasis added)

> The first GaN LED was reported over 20 years ago.[146] Due to the inability at the time to dope GaN p type, these devices were not **conventional p-n junction LEDs**, but rather metal-insulator-semiconductor (MIS) structures. Only recently, when Amano et al.[104] first obtained p-type GaN was the first **p-n junction GaN LED** realized. Soon after, some of these same workers introduced AlGaN as a barrier material.[147]

(Morkoç, p. 1387, right col., 1st full ¶; emphasis added)

The Amano et al. article cited in Morkoç is dated 1990 which is three years **before** the filing date of Menda.

Morkoç also points out that the GaN-based LEDs produce UV light, i.e. light of a wavelength less than 400 nm (Morkoç, p. 1388, Fig. 47 and associated text on p. 1389). Thus, Morkoç shows that those of ordinary skill knew **before** the time of Menda that a GaN-based, UV-light-emitting **diodes** were made from a semiconductor pn junction **before** the time of Menda.

See also Morkoç p. 1386, Fig. 41 and Fig. 43 captions, which also use the language "p-n junction LED" (emphasis added). See also Morkoç at p. 1387, which uses the language "p-n junction LEDs" and "p-n junction GaN LED".

Morkoç's Figs. 49, 52, 56, and 58 each show **single die** semiconductor lasers; thus those of ordinary skill in the art know that semiconductor light emitting devices, including LEDs and lasers are implemented as a ***single die***, as claimed.

Similarly, as noted above, Morkoç states,

> These advances in material quality and processing have allowed researchers to demonstrate and commercialize **GaN p-n junction LEDs** giving rise to optimism of a **GaN-based laser** soon to follow.

(Morkoç, p. 1379, right col. last full sentence; emphasis added)

Thus, Morkoç teaches that those of ordinary skill in the art know that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]) can be *at least one single-die semiconductor light-emitting diode (LED)* or *semiconductor lasers*.

Because Menda explicitly suggests making the UV light emitting element **42** as a "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]), it would have been obvious to one of ordinary skill in the art, at the time of the invention to use known UV-light-emitting pn junctions, such as those disclosed in Morkoç which include single-die semiconductor GaN-based LEDs and semiconductor lasers.

As also noted above, **Abe** shows to those of ordinary skill in the art that a UV-light-emitting semiconductor pn junction includes both LEDs and lasers. In discussing the prior art, Abe states,

> In addition, the light source described above includes a **light emitting diode** (which will be referred to as **LED** thereafter) as a display element used in OA (Office Automation) apparatuses and display units. The LED is adapted to **emit light** by applying current to **p-n junction** of a **semiconductor**.

(Abe, col. 1, lines 28-33; emphasis added)

Thus, Abe teaches that it was already known in the art at least by 1994 (the foreign priority date of Abe) that a light-emitting semiconductor pn junction includes light-emitting **diodes**, or LEDs.

Abe also shows that semiconductor lasers are implemented as a "single chip":

> Either of AC and DC power sources may be used as a required power source. In case of using the AC power source, a rectifying device may be incorporated in a lighting circuit, or the **semiconductor laser element** and the lighting circuit may be integrated in a **single chip**.

(Abe, col. 2, lines 45-49; emphasis added)

Note that Abe includes the lighting circuit along with the semiconductor laser; thus, Abe also points out here that the lighting circuit and the semiconductor lasers are known to be implemented on separate semiconductor chips (i.e. die).

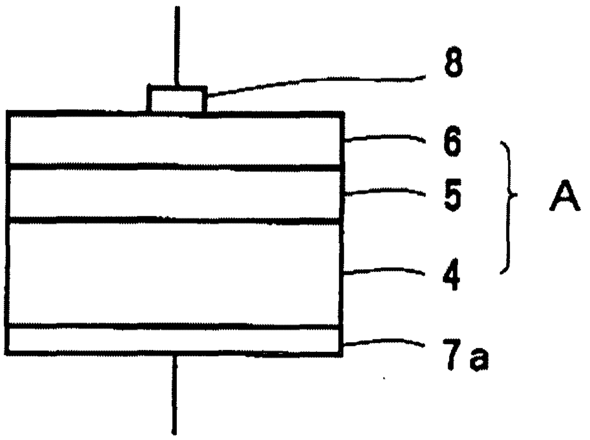
Abe's Figs. 1(a), 1(b), 4(a)-4(g), 5, 6, 8(a), 8(b), each shows the UV-light emitting semiconductor laser element **1** implemented **single die**.

Based on the foregoing, Abe shows that those of ordinary skill in the art would understand that Menda's "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]) can be *at least one single-die semiconductor light-emitting diode (LED)* or *semiconductor laser*.

Because Menda explicitly suggests making the UV light emitting element **42** as a "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, *id.*), it would have been obvious to one of ordinary skill in the art, at the time of the invention to use known UV-light-emitting pn junctions, such as those disclosed in Abe which are single-die semiconductor LEDs and semiconductor lasers.

Finally, **Tadatomo** --a reference provided by Patentee in the IDS submitted 3/2/2011 -- shows that light-emitting **pn junctions** include both light-emitting **diodes** and **lasers**. In this regard, Tadatomo's Fig. 3 (reproduced below) shows a UV-light-emitting **diode** implemented as a **single die**.

Fig. 3



(Tadatomo, Fig. 3)

In regard to Fig. 3, Tadatomo states,

> **FIG. 3** schematically shows the structure of **LED** of a typical semiconductor light emitting element. As shown in the Figure, the **LED** comprises a laminate A (**4, 5, 6**) including the GaN single crystal (n type) produced by the method of the present invention as a substrate **4**, and a **semiconductor layer 5 (n type)** and a **semiconductor layer 6 (p type)**, both being GaN group compound semiconductors, formed thereon, and **electrodes 8 and 7** set on the outermost layers **6** and **4** of the laminate A.

(Tadatomo, col. 8, lines 37-44; emphasis added)

> In **FIG. 3**, the **light emitting part** has a simple two-layer **p-n junction**. The junction of the light emitting part may be **homo-junction** where the same materials are joined, or **hetero-junction** where different materials are joined. Furthermore, the junctional structure of the light emitting part is **not limited to two-layer junction** but may be **multi-layer junction** such as **double-hetero junction, single quantum well, multiple quantum well etc.**
>
> With such junctional structure of the light emitting part, various **semiconductor light emitting elements** such as **LED** and **LD [Laser Diode]** are obtained.

(Tadatomo, col. 9, lines 8-19; emphasis added)

In addition, Tadatomo states,

> The thick **GaN** single crystal of superior quality which is produced by the method of the present invention can be suitably used for **semiconductor light emitting elements** such as **light emitting diode (LED), laser diode**

> **(LD)** and superluminescence diode, and electron devices. In the electron devices, the use of the GaN single crystal of the present invention as a substrate enables production of LED, LD etc. having the same electrode structure as in the conventional red LED etc. Those which emit blue lights are particularly important. In addition, the efficiency of the light emission of semiconductor light emitting elements by the use of the GaN single crystal of the present invention is advantageously high.

(Tadatomo, col. 8, lines 20-32; emphasis added)

Thus, Tadatomo teaches that those of ordinary skill in the art knew around 1993-1994 (the foreign priority dates of Tadatomo) that light-emitting **pn junctions** include **both** semiconductor light-emitting **diodes** and semiconductor **lasers** implemented as **single dies**. In addition, the electrodes **7, 8** shows that those of ordinary skill know that the light emitting element must have a power source in order to emit radiation (as claimed, "*coupleable with a power supply to emit a primary radiation*").

Because Menda explicitly suggests making the UV light emitting element **42** as a "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]), it would have been obvious to one of ordinary skill in the art, at the time of the invention to use known UV-light-emitting pn junctions, such as those disclosed in Tadatomo, which are single-die semiconductor GaN-based LEDs and semiconductor lasers.

Based on the foregoing, even if Menda does not **implicitly include** the UV light-emitting pn junction is a *single-die semiconductor LED* or a *semiconductor laser*, then each of Morkoç, Abe, and Tadatomo at least makes this obvious, as indicated above. Again, given that Menda explicitly states the UV light emitting element **42** may be implemented as a "solid ultraviolet light emitting element having a **structure of a pn junction**, MOS junction or the like" (Menda translation, ¶ [0018]), it would have been obvious to those of ordinary skill in the art to use known pn junction, UV-light-emitting diodes and/or lasers disclosed in any of Morkoç, Abe, and Tadatomo, which are *single-die semiconductor LEDs* (claims 1 and 5) and/or *semiconductor lasers* (claim 3).

This is all of the features of claims 1, 3, and 5.

<u>4. Claims 21, 22, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of Tadatomo.</u>

Proposed amended **claim 21** and **claim 22** reads,

> *21. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a <u>single-die,</u> two-lead <u>gallium nitride based blue light</u> semiconductor LED.*

> *22. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die two-lead semiconductor LED.*

Menda does not teach that the LEDs have two leads.

As noted above in the previous rejection of claim 5, Menda in view of either of Tadatomo teaches that the GaN-based LEDs have two leads Tadatomo (Fig. 3); therefore, the modification of Menda by Tadatomo, as discussed above, results in a GaN-based LEDs having two leads.

Using Tadatomo's GaN-based LED as Menda's UV light source would have been obvious to one of ordinary skill in the art at the time of the invention for the same reasons as indicated in the previous rejection with regard to Tadatomo.

Claim 26 reads,

> *26. A light-emission device, comprising*
>
> *a single-die, two-lead semiconductor light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light.*

This claim is significantly broader than claim 22 above. Menda in view of either of Abe and Tadatomo teaches each of the features of this claim for the reasons discussed in rejecting claims 1, 5, and 22 above.

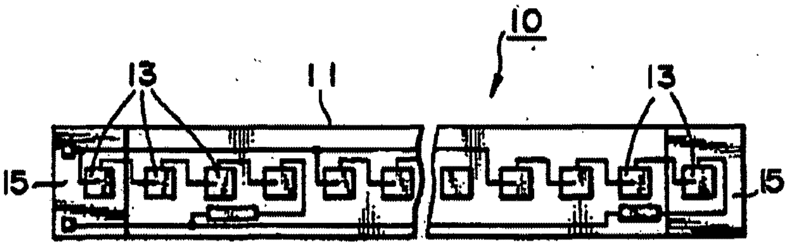
<u>5. Claims 2, 23, 24, 180, 181, and 186 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of any of Fundamentals of Photonics, Morkoç, Abe, and Tadatomo and further in view of Imamura.</u>

Claims 2 and 23 read,

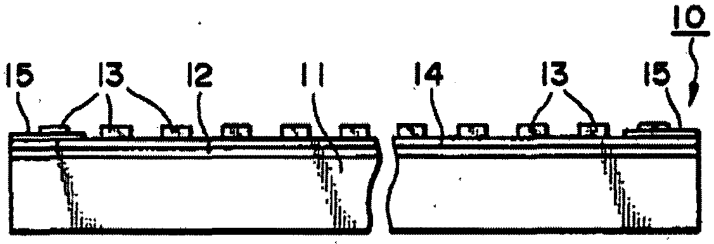
> *2. A light-emitting device according to claim 1, comprising a **two-lead array** of single-die semiconductor LEDs.*
>
> *23. A light-emitting device according to claim 5, comprising a **two-lead array** of single-die semiconductor LEDs.*

The prior art of Menda in view of any of <u>Fundamentals of Photonics,</u> Morkoç, Abe, and Tadatomo, as explained above, discloses each of the claimed features of claims 1 and 5. Menda does not explicitly disclose a two-lead **array** of single-die LEDs.

Imamura's Figs. 4 and 5 (reproduced below) shows the top and side views of an light array **10** may from an array of single-die semiconductor LEDs **13** on a substrate **15** (Imamura, col. 3, lines 16-36).



(Imamura, Fig. 4)



(Imamura, Fig. 5)

The array **10** can be used as a backlight for a liquid crystal display, such as shown in Fig. 8 (Imamura, col. 4, lines 59-61). Each LED die **13** has two leads that connect to the array's two leads, made from the gold-plated copper pattern **12** shown in the side view of right side of Fig. 5 and in the top view as the horizontal lines running across the top and bottom of the substrate **15** that connect the array of LEDs **13**. As also shown in Fig. 4, each of the array's two leads ends in a terminal. Thus, Imamura teaches *a* ***two-lead array*** *of single-die semiconductor LEDs*.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to fashion Menda's UV backlight **42** of pn junction LED as Imamura's two-lead array configuration of plural identical UV LEDs --therefore *emitting identical UV radiation*-- in order to enable making a uniformly lit, larger, liquid crystal display than could be made from a single UV LED, as taught by Imamura (Imamura, col. 3, lines 37-60). Each LED would be that of Morkoç for the reasons indicated above.

Proposed amended **claim 24** reads,

> *24. A liquid crystal display, including:*
>
> *a backlight member including a* ***multiplicity of light-emitting devices,*** *each light-emitting device comprising:*

> *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Claim 24 is distinct from claim 5 in that (1) a liquid crystal display is claimed as opposed to just a light emitting device, and (2) a multiplicity of light-emitting devices is required to make a backlight for the LCD.

Imamura is applied as above.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to fashion Menda's UV backlight **42** of pn junction LED as Imamura's two-lead array configuration of plural identical UV LEDs --therefore *emitting identical UV radiation*-- in order to enable making a uniformly lit, larger, liquid crystal display than could be made from a single UV LED, as taught by Imamura (Imamura, col. 3, lines 37-60). Each LED would be that of Morkoç for the reasons indicated above.

Further in this regard, the courts have held that mere duplication of parts has no patentable significance unless a new or unexpected result is produced. See *In re Harza*, 274 F.2d 669, 124 USPQ 378 (CCPA 1960). Thus, it would have been obvious to use more than one UV LED to increase the brightness or increase the size of the display.

Proposed new **claims 180 and 181** read,

> *180. The liquid crystal display of claim 24, wherein said multiplicity of light-emitting devices comprises an array of single-die semiconductor light-emitting diodes.*
>
> *181. The liquid crystal display of claim 180, wherein said array comprises a regular pattern.*

Imamura calls the LED array a "LED array substrate **10**" (Imamura, e.g. at col. 3, line 19) which is shown to be a rectangle, in Fig. 4. In addition, Imamura states,

> A plurality of **LED array substrates 32** are mounted in the interior of a cover **33** to provide a **back-light 34** for illuminating a **liquid crystal display** panel **30** and are supplied with a power through a connector **31**.
>
> (Imamura, col. 4, lines 65-68; emphasis added)

Thus the array can be may whatever size is required for the LCD.

Proposed new **claim 186** reads,

> *186. The liquid crystal display of claim 24, comprising a **full-color** liquid crystal display.*

Menda discloses a full-color LCD display. Menda's Fig. 4 shows the color filter **55** used to produce each of the different colors required for each pixel of the display (Menda translation, ¶ [0022]). In addition, Menda explicitly states that the LCDs are "full color" (Menda translation, ¶ [0019], 1st sentence).

6. Claims 4 and 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of Morkoç.

Claims 4 and 13 and proposed amended claims 11 and 12 read,

> *4. A light-emitting device according to claim 3, wherein said semiconductor laser includes an active material selected from the group consisting of III-V alloys and II-VI alloys.*
>
> *11. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device is on a substrate in a multilayer device structure, and wherein said substrate comprises silicon carbide.*
>
> *12. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device is on a substrate in a multilayer device structure, and wherein said substrate comprises a material selected from the group consisting of sapphire, SiC, and InGaAIN.*
>
> *13. A light-emitting device according to claim 12, wherein said multilayer device structure includes layers selected from the group consisting of silicon carbide, aluminum nitride, gallium nitride, gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys.*

Menda does not indicate the materials from which the pn junction or substrate are made.

Morkoç teaches UV light-emitting LED and lasers made from III-V materials such as GaN, from II-VI materials such as ZnSe --as required by claim 4-- and from SiC:

> For optical emitters and detectors, **ZnSe**, **SiC**, and **GaN** all have demonstrated operation in the green, blue, or **ultraviolet (UV) spectra**. Blue SiC light-emitting diodes (LEDs) have been on the market for several years, joined recently by **UV** and blue **GaN-based LEDs**. These products should find wide use in full color display and other technologies. ... In laser development, ZnSe leads the way with more sophisticated designs having further improved performance being rapidly demonstrated. If the low damage threshold of ZnSe continues to limit practical laser applications, **GaN** appears poised to become the semiconductor of choice for **short-wavelength lasers** in optical memory and other applications.

(Morkoç, abstract; emphasis added)

Morkoç indicates that GaN has been grown on silicon carbide (SiC) and sapphire (single crystal Al_2O_3) substrates --as required by **claims 11-13**. (See Morkoç, p. 1382, sections entitled, "C. Substrates for nitride epitaxy" and "D. Buffer layers for nitride heteroepitaxy on sapphire". Thus, GaN-based, UV LEDs and lasers can be fabricated on SiC and sapphire substrates --as required by claims 11-13.

LEDs and lasers require a pn junction, the p-type and n-type semiconductor being separate layers. In addition, the semiconductor material from which the pn junction, e.g. GaN, are made must be grown on a substrate, the substrate being an additional layer. This proves that LED and lasers are *multilayered device structures*, --as required by claims 11-13. Not the least of which lasers have quantum wells which are multilayer structures.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Morkoç's materials for Menda's LED because Menda is silent to the details of the pn junction LED, such that one of ordinary skill would use known materials to make the LED, as taught in Morkoç. In this regard, it has been held that the selection of a known material based on its suitability for its intended use is *prima facie* obvious. See *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 1945). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960). (See MPEP 2144.07.) In addition, given that Menda uses a UV-light LED and Morkoç teaches materials for UV-light LEDs, one of ordinary skill has a reasonable expectation of success.

<u>7. Claims 48 and 52-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of either of Morkoç and Tadatomo, as applied to claim 24 above, and further in view of Uehara or, in the alternative, over Menda in view of Imamura and either of Morkoç and Tadatomo, as applied to claim 24, above, and further in view of Uehara.</u>

Proposed new claim 48 reads,

48. The liquid crystal display of claim 24, wherein the luminophoric medium comprises an ***inorganic*** *luminophor.*

The prior art of Menda in view of either of Morkoç and Tadatomo, or Menda in view of Imamura and either of Morkoç and Tadatomo, as explained above, discloses each of the features of claim 24. Menda does not, however, teach that the luminophoric medium comprises an **inorganic** luminophor. Instead, Menda's PL layers **43, 44, 45** are **organic**.

Uehara, like Menda, teaches a backlight for a LCD, wherein UV light is converted to visible light using electroluminescent or fluorescent compounds, one for each of red (R), green (G), and blue (B). The distinction is that Uehara uses **inorganic** compounds. In these regard, Uehara states,

> The **liquid crystal color display** device shown in **FIG. 5** includes the liquid crystal unit **35** as illustrated in FIGS. 1 through 4. ...
>
> A **fluorescent layer 143** positioned below the color filter **141** contains fluorescent materials capable of **emitting fluorescent lights in R, G, B**, respectively. The color filter **141** and the fluorescent layer **143** are supported on the opposite sides of a transparent plate **145** interposed therebetween.
>
> A **lamp 151** serving as an energy source for emitting fluorescent light is disposed below the fluorescent layer **143**. **The lamp 151 and the fluorescent layer 143 jointly serve as a fluorescent light source.**
>
> As shown in **FIG. 6**, when the lamp **151** is energized, **the fluorescent materials in the fluorescent layer 143 are excited to emit lights in R, G, B** in the directions of the arrows ...

(Uehara, col. 7, lines 45-68; emphasis added)

As can be seen in Uehara's Fig. 6 (reproduced below), the lamp **151** emits **UV** electromagnetic radiation; thus, the "fluorescent materials capable of emitting fluorescent lights in R, G, B" (*id.*) convert UV light to visible light of each of the primary colors, which mix to produce white light, just as in Menda.

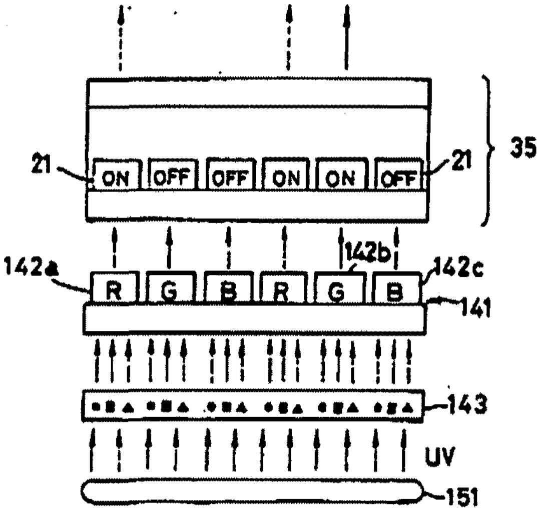
With regard to the **inorganic** materials, Uehara states,

> The EL materials are used principally in the form of powder. Examples of the EL material for emitting red light include Y_2O_2S:Eu (yttrium oxysulfide:europium), Y_2O_2:Eu (yttrium oxide:europium), (Zn Cd) S:Ag (zinc sulfide, cadmium:doped with silver), and GaP:In (gallium phosphide:doped with indium). Examples of the EL material for emitting green light include $ZnSiO_3$ (Mn) (manganese-doped zinc silicate), ZnS:CuAl (zinc sulfide:doped with copper and aluminum), (Zn Cd) S:Cu (zinc sulfide, cadmium:doped with copper), (Zn Cd) S:Ag (zinc sulfide, cadmium:doped with silver) (the amount of CdS is smaller than that of the EL material for emitting red light), and ZnO:Zn (zinc oxide:doped with zinc). Examples of the EL material for emitting blue include ZnS:Ag (zinc sulfide:doped with silver), (ZnS, ZnO):Ag (zinc

> sulfide, zinc oxide:doped with silver), and SnO_2 Eu (tin oxide:doped with europium).

(Uehara, col. 6, lines 36-53)

F I G. 6



(Uehara, Fig. 6)

In addition, Uehara makes clear that the EL materials and fluorescent materials are the same:

> The **fluorescent materials** are used principally in the form of powder, and may be the **same** as the various examples for the **EL materials** given above because the fluorescent and EL materials are only different in their light-emitting mechanism, but are of the same substances.

(Uehara, col. 10, lines 49-54; emphasis added)

The only distinctions between the backlights of Menda and Uehara are (1) the source of UV light, Menda using, *inter alia*, a UV LED and Uehara using a UV lamp, and (2) the materials used to convert the UV light to visible light, Menda using organic materials, and Uehara using inorganic materials.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Uehara's inorganic materials instead of organic materials as a matter of simple substitution of one known element (organic compounds) for another (inorganic compounds) to obtain predictable results (UV light-stimulated emission of visible light).

In this regard, MPEP 2143, states,

> **B. Simple Substitution of One Known Element for Another To Obtain Predictable Results**
>
> To reject a claim based on this rationale, Office personnel must resolve the Graham factual inquiries. Then, Office personnel must articulate the following:
>
> > (1) a finding that the prior art contained a device (method, product, etc.) which differed from the claimed device by the substitution of some components (step, element, etc.) with other components;
> >
> > (2) a finding that the substituted components and their functions were known in the art;
> >
> > (3) a finding that one of ordinary skill in the art could have substituted one known element for another, and the results of the substitution would have been predictable; and
> >
> > (4) whatever additional findings based on the Graham factual inquiries may be necessary, in view of the facts of the case under consideration, to explain a conclusion of obviousness.
>
> (Emphasis in original.)

With regard to (1), as shown above, Menda discloses an LCD which differs from the claimed device only in using organic versus the claimed inorganic luminescent materials.

With regard to (2), as shown above, Uehara teaches that it was known at least by 1988 that **inorganic** luminescent materials, stimulated by UV light to produce visible light can be used as a backlight for a LCD.

With regard to (3), because both Menda and Uehara are directed to making backlights for LCD and because both use UV light-stimulated emission of visible light by luminescent materials, the only difference being that one uses organic and one uses inorganic, the substitution of Menda's organic compounds with Uehara's inorganic compounds, would have produced that same predictable results, i.e. production of the same white light that Menda produced with the organic compounds.

With regard to (4), it is not believed that any addition findings are necessary to explain the conclusion of obviousness.

Proposed new claims 52-54 read,

> *52. The liquid crystal display of claim 48, wherein each said LED comprises material selected from the group consisting of* ***gallium nitride*** *and its alloys.*
>
> *53. The liquid crystal display of claim 48, wherein each said LED comprises* ***gallium nitride****.*

> *54. The light-emission device of claim 48, wherein each said LED comprises* ***gallium nitride alloy.***

As explained above, Morkoç and Tadatomo teach the use of GaN-based semiconductor materials with which LEDs and semiconductor lasers are made. In this regard, Morkoç's section entitled, "III. GaN-based III-V Nitride Semiconductors" Morkoç explicitly calls the light emitters, "GaN p-n junction LEDs":

> These advances in material quality and processing have allowed researchers to demonstrate and commercialize **GaN p-n junction LEDs** giving rise to optimism of a **GaN-based laser** soon to follow.

(Morkoç, p. 1379, right col. last full sentence; emphasis added)

This section discusses LEDs made from GaN and its alloys, e.g. InGaN (p. 1387).

As noted above, Tadatomo indicates that the LED and LD are made from GaN based semiconductor materials (Tadatomo, e.g. Abstract, col. 8, lines 36-44).

The reasons for using Morkoç's or Tadatomo's GaN-based LEDs as Menda's LEDs is the same as indicated above.

8. Claims 49-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Menda in view of Uehara and either of Morkoç and Tadatomo as applied to claim 48, above, and further in view of Abe or, in the alternative, over Menda in view of Imamura, Uehara, and either of Morkoç and Tadatomo as applied to claim 48, above, and further in view of Abe.

Proposed new claims 49-51 read,

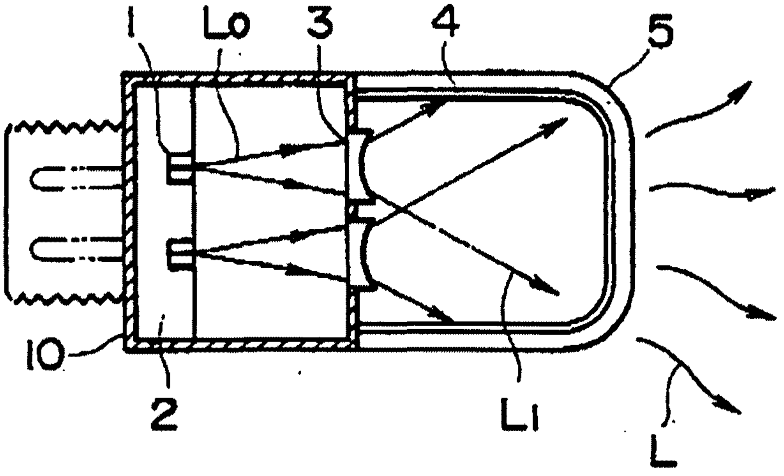
> *49. The liquid crystal display of claim 48, wherein the inorganic luminophor is dispersed on or in a housing member.*
>
> *50. The liquid crystal display of claim 48, wherein the inorganic luminophor is dispersed in a film on a surface of a housing member.*
>
> *51. The liquid crystal display of claim 48, wherein the inorganic luminophor is within a housing member.*

The prior art of Menda in view of Uehara and either of Morkoç and Tadatomo, or Menda in view of Imamura, Uehara, and either of Morkoç and Tadatomo, as explained above, discloses each of the features of claim 48. None of the above references discuss the housing for the LEDs.

Abe's Fig. 1(a) (reproduced below) shows a light-emitting device, including a semiconductor laser elements **1** that emit ultra-violet light that is converted to visible light using "fluophor layer **4**" **formed on the inside housing of the light device**. In regard to Fig. 1(a), Abe states,

> Referring to FIG. 1(a), a plurality of **semiconductor laser elements 1** are buried in or mounted on a heat sink (radiator) **2**, a diffusion lens **3** is arranged in front of each semiconductor laser element **1.** In addition, a **fluophor 4** is provided on the **inside wall surface of a vacuum glass tube 5** charged with argon gas or the like. A laser beam $\mathbf{L_0}$ emitted from each semiconductor laser element **1** is diffused through the diffusion lens **3**, and the **fluorescent material of the fluophor 4** is excited by the diffused light $\mathbf{L_1}$ to obtain **visible** light L.
>
> While the structure of the semiconductor laser element **1** will be described later, the semiconductor laser element generally comprises an active layer (luminous layer) **100**, clad layers **101**, **102**, and a substrate **103** as shown in FIG. 5. The crystal structure having the optimum wavelength for the **conversion into visible light due to the fluophor 4** is selected in the range from the infrared region to the **ultraviolet** region by the oscillation wavelength.

(Abe, col. 4, lines 22-38; emphasis added)



(Abe, Fig. 1(a))

In addition, Abe's Table 1 in column 5 teaches that a laser element **1** can be chosen that emits light in the UV region, specifically the first semiconductor composition in the table (Abe, Table 1, col. 5). The far left side of Fig. 1(a) also shows the two leads for the array of semiconductor laser elements **1** use to apply power.

Abe's Fig. 1(a) also shows the luminophoric medium (called "fluophor **4**", *id.*) that converts the UV light to visible light (*Id.*). Again, Abe states, "The crystal structure having the optimum wavelength for the **conversion into visible light due to the**

fluophor 4 is selected in the range from the infrared region to the **ultraviolet** region by the oscillation wavelength." (*Id.*; emphasis added) Because UV light (<400 nm) has a higher energy and shorter wavelength that visible light (400 nm to 700 nm) wavelengths the UV light is *down-converted* by fluophor **4** with a corresponding increase in wavelength.

Abe's Table 2 (reproduced below) in column 5 teaches several **inorganic** fluorescent compounds used for the fluophor **4** that produce the white light.

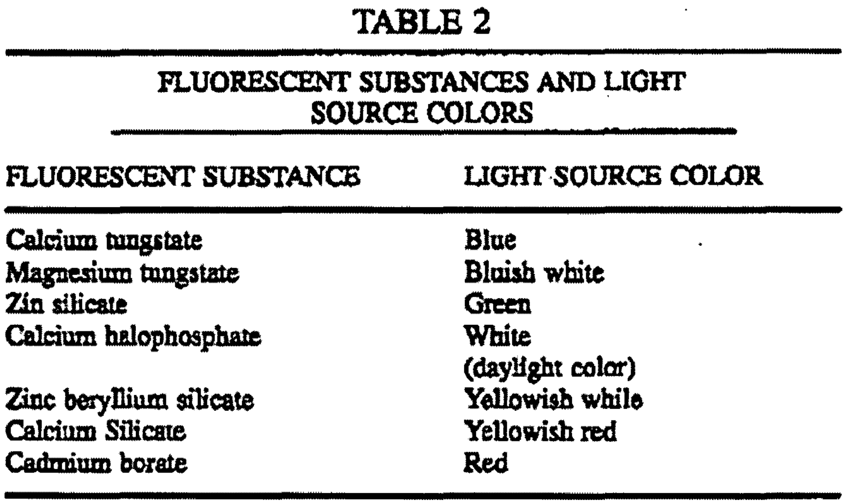


TABLE 2

FLUORESCENT SUBSTANCES AND LIGHT SOURCE COLORS

FLUORESCENT SUBSTANCE	LIGHT SOURCE COLOR
Calcium tungstate	Blue
Magnesium tungstate	Bluish white
Zin silicate	Green
Calcium halophosphate	White (daylight color)
Zinc beryllium silicate	Yellowish while
Calcium Silicate	Yellowish red
Cadmium borate	Red

(Abe, col. 5)

This arrangement is entirely consistent with the location of the fluorescent inorganic compounds in Uehara. In this regard, Uehara states that the fluorescent inorganic compounds may be formed on the outer surface or inner surface of the UV lamp tube, i.e. the lamp **housing**:

> The color filter or the fluorescent layer may be disposed in the liquid crystal unit, and **the fluorescent layer** and the color filter may be disposed on **the outer or inner surface of the tube wall of the lamp**.

(Uehara, col. 9, lines 41-45; emphasis added)

Thus, placing the Uehara's inorganic compounds, like Abe's inorganic compounds, on the inner surface of the LED lamp housing would have a reasonable expectation of success.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to locate the inorganic luminophores within a housing member of the LEDs as a matter of design choice. Because Menda does not limit the location of the luminophores, one of ordinary skill would locate the luminophores according to known methods, such as indicated in Abe.

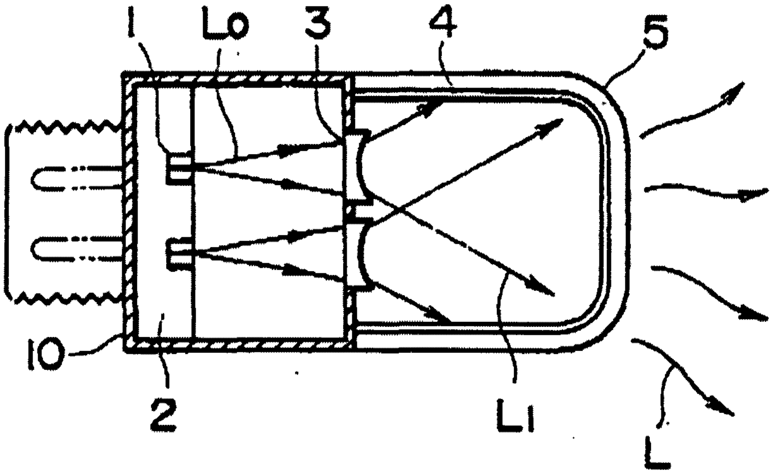
F. Abe as a base reference

1. Claims 3, 4, and 34-37 are rejected under 35 U.S.C. 102(e) as being anticipated by Abe.

Claim 3 reads,

> *3. A light-emitting device, comprising:*
>
> *a semiconductor laser coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the visible light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*

Abe's Fig. 1(a) (reproduced below) shows a light-emitting device, including a semiconductor laser elements **1** that emit ultra-violet light.



(Abe, Fig. 1(a))

In regard to Fig. 1(a), Abe states,

> Referring to FIG. 1(a), a plurality of **semiconductor laser elements 1** are buried in or mounted on a heat sink (radiator) **2**, a diffusion lens **3** is arranged in front of each semiconductor laser element **1**. In addition, a

> **fluophor 4** is provided on the inside wall surface of a vacuum glass tube **5** charged with argon gas or the like. A laser beam **L_0** emitted from each semiconductor laser element **1** is diffused through the diffusion lens **3**, and the **fluorescent material of the fluophor 4** is excited by the diffused light **L_1** to obtain **visible** light L.
>
> While the structure of the semiconductor laser element **1** will be described later, the semiconductor laser element generally comprises an active layer (luminous layer) **100**, clad layers **101**, **102**, and a substrate **103** as shown in FIG. 5. The crystal structure having the optimum wavelength for the **conversion into visible light due to the fluophor 4** is selected in the range from the infrared region to the **ultraviolet** region by the oscillation wavelength.

(Abe, col. 4, lines 22-38; emphasis added)

In addition, Abe's Table 1 in column 5 teaches that a laser element **1** can be chosen that emits light in the UV region, specifically the first semiconductor composition in the table (Abe, Table 1, col. 5). The far left side of Fig. 1(a) also shows the two leads for the array of semiconductor laser elements **1** use to apply power. Thus, Abe's discloses *a semiconductor laser coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the visible light spectrum*.

Abe's Fig. 1(a) also shows the luminophoric medium (called "fluophor **4**", *id.*) *arranged in receiving relationship to said primary radiation*, that down converts the UV light to visible light (*Id.*). Again, Abe states, "The crystal structure having the optimum wavelength for the **conversion into visible light due to the fluophor 4** is selected in the range from the infrared region to the **ultraviolet** region by the oscillation wavelength." (*Id.*; emphasis added) Because UV light (<400 nm) has a higher energy and shorter wavelength that visible light (400 nm to 700 nm) wavelengths the UV light is *down-converted* by fluophor **4** with a corresponding increase in wavelength.

Abe's Table 2 (reproduced below) in column 5 teaches several fluorescent substances used for the fluophor **4** that produce the white light.

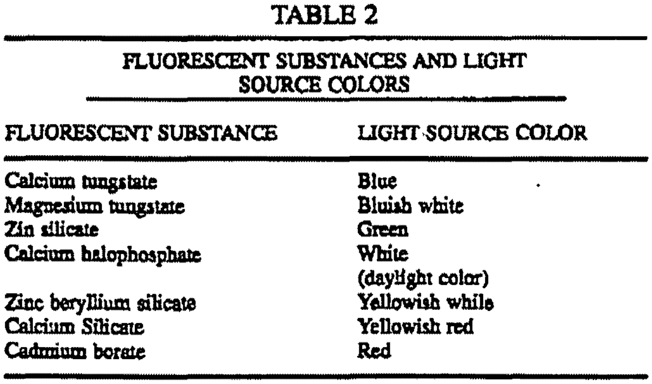


TABLE 2

FLUORESCENT SUBSTANCES AND LIGHT SOURCE COLORS

FLUORESCENT SUBSTANCE	LIGHT SOURCE COLOR
Calcium tungstate	Blue
Magnesium tungstate	Bluish white
Zin silicate	Green
Calcium halophosphate	White (daylight color)
Zinc beryllium silicate	Yellowish while
Calcium Silicate	Yellowish red
Cadmium borate	Red

(Abe, col. 5)

The first, third, and fifth entries each produce white light. (Note that the fifth entry should state "white" instead of "while".) Because white light necessarily requires a mixture of wavelengths of including the primary colors, Abe's *luminophoric medium*, fluophor **4**, necessarily *emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*

This is all of the features of claim 3.

Claim 4 reads,

> *4. A light-emitting device according to claim 3, wherein said semiconductor laser includes an active material selected from the group consisting of III-V alloys and II-VI alloys.*

The first entry in Abe's Table 1 includes active UV light-emitting semiconductor material, ZnSeTe, which is a II-VI semiconductor material and also includes GaP clad layers which are a III-V semiconductor material.

Proposed new claims 34-37 read,

> *34. The light-emitting device of claim 3, wherein the luminophoric medium comprises an inorganic luminophor.*
>
> *35. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed on or in a housing member.*
>
> *36. The light-emitting device of claim 34, wherein the inorganic luminophor is dispersed in a film on a surface of a housing member.*
>
> *37. The light-emitting device of claim 34, wherein the inorganic luminophor is within a housing member.*

As shown above Abe's Table 2, the *luminophoric medium* ***4*** *comprises an inorganic luminophor* because all of the listed "Fluorescent Substances" are inorganic compounds. As shown in Abe's Fig. 1(a), above, the *luminophoric medium* **4** (1) is *dispersed on or in a housing member* **5***, (2)* is *dispersed in a film* **4** *on a surface of a housing member* **5***, or (3)* is *within a housing member* **5**.

2. Claims 1, 2, 5, 23, 27-30, 41-44, 172, and 173 are rejected under 35 U.S.C. 102(e) as being anticipated by Abe, as evidenced by LEDLASER.

Proposed amended claims 1 and 5 read,

> ***1.*** *A light emitting device, comprising:*
>
> *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die semiconductor LED present in the device, said primary radiation being a relatively shorter wavelength radiation outside the visible white light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits radiation at a multiplicity of wavelengths and in the visible white light spectrum, with said radiation of said multiplicity of wavelengths mixing to produce a white light output, wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*
>
> ***5.*** *A light-emitting device, comprising:*
>
> *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

These claims are distinguished from claim 3 essentially in that (1) the light emitter is any LED, not just specifically a laser, (2) the primary radiation is outside the *visible* ***white*** *light spectrum*, as opposed to outside the ***visible*** *light spectrum*, and (3) that each of the LED must produce white light.

With regard to **difference (1)**, a semiconductor laser or "laser diode" is a species of LED, as evidenced by LEDLASER:

> Laser diodes (also called 'injection lasers') are in effect a specialised form of LED. Just like a LED, they're a form of P-N junction diode with a thin depletion layer where electrons and holes collide to create light photons, when the diode is forward biased. ...
>
> In other words, they end up 'in sync' and forming continuous-wave **coherent radiation**.

(LEDLASER, p. 2, right col.; emphasis in original)

Because the claims recite only "LED", the species of LED disclosed in Abe, a laser, reads on the claimed genus, a LED.

With regard to **difference (2)**, UV light is outside visible light and therefore outside of visible white light.

With regard to **difference (3)**, the light emitted by each of the LED **1** passes through the phosphor **4**, therefore, *each of the at least one single-die semiconductor light-emitting diode **1** in interaction with luminophoric medium **4** receiving its primary radiation* $\boldsymbol{L_1}$ *produces white light output **Line***, as newly claimed.

This is all of the additional features of claims 1 and 5.

Claims 2 and 23 read,

> *2. A light-emitting device according to claim 1, comprising a **two-lead array** of single-die semiconductor LEDs.*
>
> *23. A light-emitting device according to claim 5, comprising a **two-lead array** of single-die semiconductor LEDs.*

Abe's Fig. 1(a) shows an array of LEDs **1**, and the array has only two leads (not labeled but shown on the far left side of the figure). In addition, Abe's Fig. 4f shows an array of LEDs **1** having only two leads (not labeled, but shown at the lowermost portion of the figure). (See Abe, col. 7, lies 1-8.)

Proposed new claims 27-30 and 41-44 read,

> *27. The light emitting device of claim 1, wherein the luminophoric medium comprises an inorganic luminophor.*
>
> *28. The light emitting device of claim 27, wherein the inorganic luminophor is dispersed on or in a housing member.*
>
> *29. The light emitting device of claim 27, wherein the inorganic luminophor is dispersed in a film on a surface of a housing member.*
>
> *30. The light emitting device of claim 27, wherein the inorganic luminophor is within a housing member.*
>
> *Claim 41. The light-emitting device of claim 5, wherein the luminophoric medium comprises an inorganic luminophor.*
>
> *Claim 42. The light-emitting device of claim 41, wherein the inorganic luminophor is dispersed on or in a housing member.*

> *43. The light-emitting device of claim 41, wherein the inorganic luminophor is dispersed in a film on a surface of a housing member.*
>
> *44. The light-emitting device of claim 41, wherein the inorganic luminophor is within a housing member.*

These claims recite the same features as claims 34-37. As indicated above in rejection claims 34-37, Abe discloses these features.

Proposed new claims 172 and 173 read,

> *172. The light-emitting device of claim 5, wherein the secondary, relatively longer wavelength, polychromatic radiation comprises a broad spectrum of frequencies.*
>
> *173. The light-emitting device of claim 5, wherein the single-die semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*

Because Abe produces white light, the *radiation down-converted by the recipient down-converting luminophoric medium comprises a broad spectrum of frequencies*.

Abe's Fig. 1(a) shows the LED **1** is on a support **2** in an interior volume of a light-transmissive glass enclosure **5** (col. 4, line 26).

3. Claims 22, 26, 55-58, 176, and 177 are rejected under 35 U.S.C. 102(e) as being anticipated by Abe, as evidenced by LEDLASER and M-H Encyclopedia.

Claims 22 and 26 read,

> *22. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die* ***two-lead*** *semiconductor LED.*
>
> *26. A light-emission device, comprising*
>
> *a single-die,* ***two-lead*** *semiconductor light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light.*

Independent claim 26 is broader than independent claims 1, 3, and 5 except for the feature that the LED has two leads. Thus, Abe, as discussed above, discloses each of the features of claim 26 and claims 21 and 22 except for explicitly indicating the number of leads of the semiconductor laser elements **1**. Each of the laser elements is shown to be a *single die*, as shown in e.g. Figs. 1(a) and 4(f).

M-H Encyclopedia proves that a single LED requires two leads in order to provide power to the p-type and n-type semiconductor. M-H Fig. 1 (p. 61) shows the structure of a typical LED having ohmic contacts to the p- and n-type semiconductor. In this regard, M-H states,

> Ohmic contacts are made by evaporating metallic layers to both n- and p-type materials.
>
> (M-H Encyclopedia, p. 61, left col., 1st full ¶)

That a LED inherently has two leads is further demonstrated by Figs 2(a)-2(c) on p. 62 of M-H Encyclopedia.

In order to provide power to the LED, then a lead is required to each ohmic contact; therefore, a single LED inherently has two leads, and Abe's LED **1** necessarily has two leads, as required by each of claims 21, 22, and 26.

Proposed new claims 55-58 read,

> *55. The light-emission device of claim 26, wherein the luminophoric medium comprises an inorganic luminophor.*
>
> *56. The light emitting device of claim 55, wherein the inorganic luminophor is dispersed on or in a housing member.*
>
> *57. The light emitting device of claim 55, wherein the inorganic luminophor is dispersed in a film on a surface of a housing member.*
>
> *58. The light emitting device of claim 55, wherein the inorganic luminophor is within a housing member.*

These claims recite the same features as claims 34-37. As indicated above in rejection claims 34-37, Abe discloses these features.

Proposed new **claims 176 and 177** read,

> *176. The light-emission device of claim 26, wherein radiation down-converted by the recipient down-converting luminophoric medium comprises a broad spectrum of frequencies.*
>
> *177. The light-emission device of claim 26, wherein the single-die, two-lead semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*

Because Abe produces white light, the *radiation down-converted by the recipient down-converting luminophoric medium comprises a broad spectrum of frequencies.*

Abe's Fig. 1(a) shows the LED **1** is on a support **2** in an interior volume of a light-transmissive glass enclosure **5** (col. 4, line 26).

> <u>4. Claims 11-13, 31-33, 38-40, 45-47, 59-63, 68, 69, 72, 74-80, 100, 101, 106, 107, 110, 112, 113-117, 162, 164, 166, 167-171, and 178 are rejected under 35 U.S.C. 103(a) as being unpatentable over Abe, as evidenced by LEDLASER, in view of Morkoç.</u>

Proposed amended claims 11 and 12, and claim 13 read,

> *11. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device <u>is on</u> a substrate <u>in</u> a multilayer device structure, and wherein said substrate comprises silicon carbide.*
>
> *12. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device <u>is on</u> a substrate <u>in</u> a multilayer device structure, and wherein said substrate comprises a material selected from the group consisting of sapphire, SiC, and InGaAIN.*
>
> *13. A light-emitting device according to claim 12, wherein said multilayer device structure includes layers selected from the group consisting of silicon carbide, aluminum nitride, gallium nitride, gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys.*

Abe discloses that the semiconductor laser (LED) has a multilayered structure, stating,

> While the structure of the semiconductor laser element **1** will be described later, the semiconductor laser element generally comprises an active layer (luminous layer) **100**, clad layers **101**, **102**, and a substrate **103** as shown in FIG. 5.
>
> (Abe, col. 4, lines 31-35)

Thus, Abe's LED **1** is a multilayer structure that includes a substrate. Fig. 5 shows that the substrate **103** is "metal".

Abe does not teach that the substrate is includes *SiC* (claim 11) or includes one of *sapphire, SiC, and InGaAlN* (claim 12), or the multilayer LED *includes layers selected from the group consisting of silicon carbide, aluminum nitride, gallium nitride, gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys* (claim 13).

Morkoç teaches UV light-emitting LED and lasers made from III-V materials such as GaN, from II-VI materials such as ZnSe, and from SiC:

> For optical emitters and detectors, **ZnSe**, **SiC**, and **GaN** all have demonstrated operation in the green, blue, or **ultraviolet (UV) spectra**. Blue SiC light-emitting diodes (LEDs) have been on the market for several years, joined recently by **UV** and blue **GaN-based LEDs**. These products should find wide use in full color display and other technologies. ... In laser development, ZnSe leads the way with more sophisticated designs having further improved performance being rapidly demonstrated. If the low damage threshold of ZnSe continues to limit practical laser applications, **GaN** appears poised to become the semiconductor of choice for **short-wavelength lasers** in optical memory and other applications.

(Morkoç, abstract; emphasis added)

Morkoç indicates that GaN has been grown on silicon carbide (SiC) and sapphire (single crystal Al_2O_3) substrates --as required by claims 11-13. (See Morkoç, p. 1382, sections entitled, "C. Substrates for nitride epitaxy" and "D. Buffer layers for nitride heteroepitaxy on sapphire". Thus, GaN-based, UV LEDs and lasers can be fabricated on SiC and sapphire substrates --as required by claims 11-13.

In addition, Morkoç states that GaN-based LED materials are better than the ZnSe materials used in Abe, specifically for **UV light emission**, stating,

> **III. GaN-BASED III-V NITRIDE SEMICONDUCTORS**
>
> The III-V nitrides have long been viewed as a promising system for optoelectronic applications in the blue and **UV** wavelengths and more recently as a high-power, high- temperature semiconductor with electronic properties potentially superior to SiC; however, progress in the nitrides has been much slower than in SiC and ZnSe, and only recently have practical devices begun to be realized.
>
> While **ZnSe-based laser devices** are **limited** to the visible wavelengths by their relatively smaller band gaps, lasers based on **AlGaN quantum wells (QW) could conceivably operate at energies up to 4 eV**. The **high thermal conductivity** and **superior stability** of the **nitrides** and their **substrates** should eventually allow **higher-power laser operation with less rapid degradation than in ZnSe**.

(Morkoç, p. 1379; emphasis added)

One of the thermally stable substrates to which Morkoç refers is SiC:

> Many different substrates have been tried, and the community has come to favor basal plane sapphire as the substrate of choice; however, substrates such as **SiC**, MgO, and ZnO, which have **superior thermal and lattice matches to the nitrides**, are increasingly available and should become popular in the near future.

(Morkoç, p. 1381, sentence bridging left and right col.; emphasis added)

A laser constructed as per Morkoç would have multiple layers, for example, the quantum wells.

It would have been obvious to one of ordinary skill in the art, at the time of the invention to use Morkoç's GaN-based laser materials grown on a SiC substrate for Abe's semiconductor laser because Morkoç teaches that the "**high thermal conductivity** and **superior stability** of the **nitrides** and their **substrates** should eventually allow **higher-power laser operation with less rapid degradation than in ZnSe**. In other words, Morkoç states that GaN on SiC is better than ZnSe based lasers. Because the GaN-based lasers can be made that emit UV light, there is a very reasonably expectation of success in improving Abe's device, since the GaN lasers are better than the ZnSe lasers used in Abe.

This is all of the features of claims 11-13.

Proposed new claims 31-33 and 38-40 read,

> *31. The light emitting device of claim 27, wherein each said **LED** comprises material selected from the group consisting of **gallium nitride** and its alloys.*
>
> *32. The light emitting device of claim 27, wherein each said **LED** comprises **gallium nitride**.*
>
> *33. The light emitting device of claim 27, wherein each said **LED** comprises **gallium nitride** alloy.*
>
> *38. The light-emitting device of claim 34, wherein the semiconductor **laser** comprises material selected from the group consisting of **gallium nitride** and its alloys.*
>
> *39. The light-emitting device of claim 34, wherein the semiconductor **laser** comprises **gallium nitride**.*
>
> *40. The light-emitting device of claim 34, wherein the semiconductor **laser** comprises **gallium nitride** alloy.*

Proposed new claims 45-47 depend from claim 41 which depends from claim 5, and **proposed new claims 59-61** depend from claim 55 which depends from claim 26. These claims recite the same features as those recited in claims 31-33, above, respectively.

As indicated in detail above, Morkoç teaches that semiconductor LED and semiconductor lasers can be made from GaN-based semiconductors, e.g. the quantum-well layers of a semiconductor laser made from AlGaN (aluminum gallium nitride) which is an "alloy" of GaN. Also as indicated above, LEDLASER proves that a semiconductor laser is a LED. In addition, Morkoç explicitly discusses GaN and GaN-based LED are known (Morkoç, pp. 1386-1388, § K). Finally, as already indicated above, the use of Morkoç's semiconductor materials to make Menda's pn junction LEDs (laser or non-laser) is obvious and need not be repeated.

Proposed new **claim 62** reads,

> *62. A light-emitting device, comprising:*
>
> *at least one single-die* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein the light-emitting device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged* ***about*** *the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being* ***contiguous to*** *the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in* ***laterally spaced relationship to said side surface;***
>
> *(iv) the luminophoric medium being dispersed* ***in polymer or glass****; and*
>
> *(v) the luminophoric medium being* ***on polymer or glass****.*

Claim 62 is coextensive with claim 5, as indicated by Patentee (Remarks dated 3/26/2012, pp. 28-29). Claim 62 is distinguished from claim 5 in (1) the LED is required to be a blue-light-emitting GaN-based LED and (2) the one or more *compatible characteristics*.

With regard to **distinction (1)**, as noted above, the substitution of Abe's laser diode (LD) with Morkoç's GaN-based LEDs or LDs is obvious, and as noted in Abe's Table 1 (col. 5), the primary radiation includes blue light, so the primary radiation being blue is compatible with Abe as well.

With regard to **distinction (2)**, Abe discloses *compatible characteristics* i and v.

This is all of the additional features of claim 62.

It is evident that Abe/ Morkoç also teaches each of the features of claims 63, 68, 69, 72, 74-80.

Proposed new **claim 100** reads,

> *100. A light-emission device, comprising*
>
> *a single-die, two-lead **gallium nitride based** semiconductor **blue** light-emitting diode emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light, wherein the light-emission device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being arranged **about** the single-die light-emitting diode;*
>
> *(ii) the luminophoric medium being **contiguous to** the single-die light-emitting diode;*
>
> *(iii) the single-die light-emitting diode comprising side surface and the luminophoric medium being in **laterally spaced relationship to said side surface**;*
>
> *(iv) the luminophoric medium being dispersed **in polymer or glass**; and*
>
> *(v) the luminophoric medium being **on polymer or glass**.*

Claim 100 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 40-41). Claim 100 differs from claim 26 in the same ways that claim 62 is distinguished from claim 5. Therefore claim 100 is obvious for the same additional reasons as indicated above in conjunction with claim 62.

Note that Abe discloses two-lead array of LED as shown in each of Abe's Figs. 1(a), 4(c), (d), (e), and (f).

It is evident that Abe/ Morkoç also teaches each of the features of claims 101, 106, 107, 110, 112, and 113-117.

Proposed new **claim 162** reads,

> *162. A light-emitting device, comprising:*

> *at least one single-die **gallium nitride based** semiconductor **blue** light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein said at least one single-die gallium nitride based semiconductor blue light-emitting diode is **in a housing comprising a light-transmissive wall member in spaced relationship** to said at least one single-die gallium nitride based semiconductor blue light-emitting diode,*
>
> *and **wherein said luminophoric medium is dispersed in or on said light-transmissive wall member.***

Claim 162 is coextensive with claim 26, as indicated by Patentee (Remarks dated 3/26/2012, pp. 58-59). Claim 162 differs from claim 5 in requiring the LED be a GaN-based blue-light-emitting LED and the orientation of the luminophoric medium in or on a light-transmissive wall member.

Again, as noted above, the substitution of Abe's laser diode (LD) with Morkoç's GaN-based LEDs or LDs is obvious, and as noted in Abe's Table 1 (col. 5), the primary radiation includes blue light, so the primary radiation being blue is compatible with Abe as well.

Abe discloses that the LED is *in a housing comprising a light-transmissive wall member **5** in spaced relationship to said at least one single-die ... semiconductor blue light-emitting diode **1***, and *wherein said luminophoric medium **4** is dispersed in or on said light-transmissive wall member **5***.

This is all of the additional features of claim 162.

It is evident that Abe/ Morkoç also teaches each of the features of claims 164, 166, and 167-171.

Proposed new **claim 178** reads,

> *178. A light-emitting device, comprising:*

> *a single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary radiation, said primary radiation being a relatively shorter wavelength blue light radiation; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation, is excited to responsively emit a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output.*

Patentee indicates that claim 178 is claim 5 with the exception that the terminology "at least one" has been removed and that the LED is now limited to a GaN-based blue-light emitting diode (Patentee's Remarks dated 3/26/2012, p. 63). For the same reasons as indicated above, Stevenson anticipates this claim because the LED is a GaN-based LED that emits-blue-to-UV light and therefore emits blue light.

The "*a single die*" language does not limit the number of LED because the claim uses open-ended language, and Abe as modified by Morkoç teaches a single die GaN-based laser diode and/or LED. All of the other features have been discussed above.

G. Lenko as a base reference (The liquid crystal display claims)

Before delving into the rejections, some introductory remarks are warranted.

The claims rejected in this section can be viewed as combinations including subcombinations of previously rejected claims. The combination claims are drawn to a liquid crystal display (LCD) including the subcombination drawn to the white-light- emitting diodes (LEDs). In this regard, each of independent claims 24, 81, and 149 (as well as their respective dependent claims) is directed to a LCD having a backlight, wherein the LEDs are used as the illumination source for said backlight. For example, the LEDs used in the backlight of claim 24 are those of claim 5.

Each rejection presented in this section is Lenko in view of either of Menda and Pinnow, plus the combination of reference teaching the LEDs, as rejected in the sections above.

Each rejection follows this same basic premise: Lenko discloses a backlight for a liquid crystal display (LCD) using two light-emitting diodes (LEDs) **10** as the source of illumination for said backlight (Lenko, abstract, Fig. 1A). Either Menda or Pinnow is used to show that one of ordinary skill would use white-light-emitting LEDs as Lenko's LEDs **10**. The remaining references relied on in each rejection teach the details of the white-light-emitting LEDs that are used as Lenko's LEDs **10**. These

LED-features have already been discussed above in the previous sections' rejections and will be incorporated by reference, where appropriate.

With the above in mind, the number of references relied on in the rejections and their apparent repetition from the previous sections can be more easily understood. Turning now to the rejections...

1. Claims 24, 48, 52-54, 81, 82, 94-98, 174, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, as evidenced by the CRC Handbook.

Proposed amended claim 24 reads,

> *24. A **liquid crystal display**, including:*
>
> *a **backlight member** including a **multiplicity of light-emitting devices**, each light-emitting device comprising:*
>
> > *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Claim 24 is distinct from claim 5 in that (1) a liquid crystal display (LCD) is claimed as opposed to just a light emitting device, and (2) a multiplicity of light-emitting devices is required to make a backlight member for the LCD.

Lenko discloses a backlight for a LCD:

> A **liquid crystal display** panel having a **backlight** for providing high brightness, uniformity of illumination intensity, high efficiency, and long battery life, and which can be manufactured at a low cost.

(Lenko, Abstract; emphasis added)

Lenko's Figs. 1A and 1B (reproduced below) show the backlight using two, separately packaged LEDs **10**, each having two leads, as the illumination source, and therefore discloses a *multiplicity of light-emitting devices*. In this regard, Lenko states,

> The photoconductor **14** can be made of any appropriate transparent material such as glass or acryl material and in the present embodiment is made of plexiglass in which the **LED's** are mounted and forms an optical coupling to the LCD device. In the present embodiment, reflector **16** is a matted but highly reflecting material such as non-shiny **white paper or green paper to match a green LED**, and is secured by glue or the like to the angled faces of the plexiglass which add to the uniformity in the backlight diffusion. In the exemplary embodiment, reflector **16** is disposed on all surfaces except for light output surface **18**. In a like manner, appropriately colored plastic or paint can be used for reflector **16**.

(Lenko, col. 4, lines 2-16; emphasis added)

Lenko does not teach the details of the light emitting device. However, the details of the light-emitting devices have been discussed in each of the rejections of claim 5 in the previous sections above.

Although Lenko's LED emits green light, Lenko indicates that the LED can match the paper; therefore, Lenko suggests using LEDs that emit white light. Even if Lenko is not considered to suggest LEDs that emit white light, there can be no question that backlights for LCDs that emit white light are desirable in the art, as evidenced by Menda. As discussed in detail in the rejections over Menda, above, Menda teaches a white-light-emitting backlight for an LCD, wherein the white light is made by using a light source that may be a UV-light-emitting LED and down-converting phosphor layers, one for each primary color (Menda, ¶¶ [0018] and [0023]). Of course, it is not relevant in this rejection whether or not Menda uses LEDs to produce white light. **Menda is used here only to show that white-light-emitting backlights for LCD are known and desirable in the LCD art and therefore one of ordinary skill would know to make Lenko's backlight emit white light**.

Alternatively, Pinnow teaches the desire to have a black and white display, thereby requiring a **white** light source which, as discussed in detail above, includes using a UV or blue primary radiation which is down-converted by a phosphor mixture to produce white light (Pinnow, col. 3, lines 24-55). Thus, Lenko's backlight using white-light-emitting LEDs would produce a black-and-white LCD, as taught to be desirable in Pinnow. Like Menda, **Pinnow is used here only to show that black and white displays are desirable; therefore, those of ordinary skill would recognize the desire to make Lenko's backlight emit white light and thus capable of producing a black-and-white display**.

Thus, it would have been obvious to one of ordinary skill in the art, at the time of the invention to use the white-light-emitting LEDs taught by Stevenson as Lenko's LEDs **10**, in order to produce a white backlight that is as taught to be desirable in the display art. The rejection of the claims over Stevenson, as evidenced the CRC Handbook (§ V(C)(1) above) is incorporated herein by reference for teaching the claim features drawn to the claimed *light-emitting devices* (i.e. the subcombination included in the combination that is the LCD) especially the discussion directed to claim 5, since claim 24 is most closely related to claim 5.

This is all of the additional features of claim 24.

Proposed new **claims 48 and 182** read,

> *48. The liquid crystal display of claim 24, wherein the luminophoric medium comprises an* ***inorganic*** *luminophor.*
>
> *182. The liquid crystal display of claim 24, wherein said luminophoric medium comprises* ***inorganic*** *luminophoric material.*

It should be noted that these are duplicate claims as there is no difference between "inorganic luminophor" and "inorganic luminophoric material".

As noted in the rejection of claims over Stevenson, as evidenced by the CRC Handbook, Stevenson discloses that the phosphors can be organic or inorganic (Stevenson, paragraph bridging cols. 3-4). Thus, using Stevenson's LEDs in Lenko results in the LCD having an inorganic luminophor.

Proposed new **claims 52-54 and 183-185** read,

> *52. The liquid crystal display of claim 48, wherein each said LED comprises material selected from the group consisting of* ***gallium nitride and its alloys.***
>
> *53. The liquid crystal display of claim 48, wherein each said LED comprises* ***gallium nitride.***
>
> *54. The light-emission device of claim 48, wherein each said LED comprises* ***gallium nitride alloy.***
>
> *183. The liquid crystal display of claim 182, wherein each single-die semiconductor light-emitting diode comprises a single-die* ***gallium nitride based*** *semiconductor* ***blue*** *light-emitting diode.*
>
> *184. The liquid crystal display of claim 183, wherein each single-die gallium nitride based semiconductor blue light-emitting diode comprises* ***gallium nitride and its alloys.***
>
> *185. The liquid crystal display of claim 183, wherein each single-die gallium nitride based semiconductor* ***blue*** *light-emitting diode comprises at least one of* ***gallium nitride****, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*

As noted in the rejection of claims over Stevenson, as evidenced by the CRC Handbook, Stevenson discloses that the LED is GaN-based including GaN and its alloys; therefore, the above features are taught. For more detail, see the discussion directed to claims 1, 12, 13, 21, and 31-33 in the rejection over Stevenson, as evidenced by the CRC Handbook, above, which is incorporated herein by reference.

Thus, using Stevenson's LEDs in Lenko results in the features of claims 52-54 and 183-185.

Proposed new **claim 174** reads,

> *174. The liquid crystal display of claim 24, wherein the secondary, relatively longer wavelength, polychromatic radiation comprises a broad spectrum of frequencies.*

White light includes a broad spectrum of frequencies; therefore, Stevenson teaches this feature.

Proposed new **claims 81 and 82** read,

> *81. A liquid crystal display, including:*
>
> *a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:*
>
> > *at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
> >
> > *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
> >
> > *and wherein each light-emitting device comprises one or more compatible characteristics selected from the group consisting of:*
> >
> > *(i) the luminophoric medium being* ***arranged about*** *the single-die LED;*

(ii) the luminophoric medium being contiguous to the single-die LED;

(iii) the single-die LED comprising side surface and the luminophoric medium being in laterally spaced relationship to said side surface;

(iv) the luminophoric medium being dispersed in polymer or glass; and

(v) the luminophoric medium being on polymer or glass.

> *82. The liquid crystal display of claim 81, comprising the luminophoric medium being **arranged about** the single-die light-emitting diode.*

Patentee indicates that claim 81 is coextensive with claim 24 (Patentee's Remarks dated 3/26/2012, p. 35). Claim 81 is distinguished from claim 24 in (1) the LED is required to be a blue-light-emitting GaN-based LED and (2) the one or more *compatible characteristics*.

With regard to **distinction (1)**, as already noted above in detail, Stevenson uses a GaN-based LED that emits a primary radiation that includes significant blue light. Just as the commercially available GaN-based LED used in the '175 patent emits a significant about of both UV and violet light, Patentee cannot argue that the LED emits only blue light as this would contradict the '175 patent and the inventor Bartez's Declaration dated 3/26/2012, paragraph 18.

With regard to **distinction (2)**, again as noted in the rejection over Stevenson in view of the CRC Handbook, the luminophor is necessarily *arranged about* the LED; otherwise, the primary radiation could not interact with the phosphor, which would be contrary to the explicit teaching in Stevenson.

These claims are obvious for the same reasons as indicate above with regard to claim 24.

This is all of the additional features of claim 81.

Proposed new **claim 94** reads,

> *94. The liquid crystal display of claim 81, wherein the luminophoric medium comprises **inorganic** luminophoric material.*

Stevenson indicates that the phosphors (*luminophor medium*) can be either organic or inorganic (Stevenson, paragraph bridging cols. 3-4).

Proposed new **claims 95-97** read,

> *95. The liquid crystal display of claim 81, wherein the single-die light-emitting diode comprises **gallium nitride and its alloys**.*

> *96. The liquid crystal display of claim 81, wherein the single-die light-emitting diode comprises at least one of **gallium nitride**, indium gallium nitride, aluminum gallium nitride, and aluminum gallium indium nitride.*
>
> *97. The liquid crystal display of claim 81, wherein the at least one single-die gallium nitride based semiconductor **blue** light-emitting diode comprises **only one single-die gallium nitride** based semiconductor blue light-emitting diode.*

These features were discussed in conjunction with claims 52-54 and 183-185, above; that discussion applies here.

Proposed new **claim 98** reads,

> *98. The liquid crystal display of claim 81, wherein each light-emitting device comprises a light-emitting diode **lamp**.*

Each of Stevenson's LED is a lamp and Lenko's LEDs **10** are each lamps. Thus, the substitution of Lenko's lamps with Stevenson's lamps remain lamps.

2. Claims 24, 48, 52-54, 81, 82, 94-98, 174, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson in view of any of Pinnow, Menda, and Admitted Prior Art (APA).

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, as explained above in the previous rejection, is believed to disclose each of the features of claims 24, 48, 52-54, 81, 82, 94-98, and 182-185. However, if it is believed that Stevenson does not explicitly disclose that the *luminophoric medium* includes phosphors for each primary color such that white light is produced by ***each*** of the GaN-based LEDs --as required by claims 24 and 81 (and their dependent claims), above-- then this may be a difference.

The rejection over Stevenson in view of any of Pinnow, Menda, and APA, (§ V(C)(2) above) shows that it would have been obvious to those of ordinary skill in the art, at the time of the invention, for Stevenson's inorganic or organic phosphors to include a mixture of phosphors for each of the primary color to produce white light, as taught by each of Pinnow, Menda, and APA to be known in the art. The entire discussion of that rejection is incorporated here.

Thus, Lenko's LEDs **10** substituted by the LEDs taught by Stevenson in view of any of Pinnow, Menda, and APA, teaches each of the features of claims 24, 48, 52-54, 81, 82, 94-98, 174, and 182-185.

Further regarding claim 174,

> *174. The liquid crystal display of claim 24, wherein the secondary, relatively longer wavelength, polychromatic radiation comprises a broad spectrum of frequencies.*

White light includes a broad spectrum of frequencies; therefore, Stevenson in view of any of Pinnow, Menda, and APA teaches this feature.

3. Claims 81, 82, 95-98, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, Pinnow, and Nakamura.

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson and any of Pinnow, Menda, and APA, as explained above in the previous rejection, is believed to disclose each of the features of claims 81, 82, 95-98, and 182-185.

To the extent it is believed that claims 81, 82, 95-98, and 182-185 exclude light other than blue light, then this may be difference. Note, however, just as the commercially available GaN-based LED from Nichia used in the '175 patent (col. 9, lines 10-18) emits a significant amount of both UV and violet light that is converted by the phosphors (*luminophoric medium*) to the secondary radiation contributing to the white light, Patentee cannot argue that the LED emits **only** blue light, as this would contradict the '175 patent and the inventor Bartez's Declaration dated 3/26/2012, paragraph 18, which shows the Nichia GaN-based LED emits light from UV to blue, just as does Stevenson's GaN-based LED.

As discussed above in the rejection over Stevenson in view of Pinnow and Nakamura, (1) Pinnow teaches the use of a mixture of phosphors as Stevenson's phosphor, in order to produce white light, and (2) Nakamura teaches GaN-based LEDs and lasers that emit both blue and UV light to substitute Stevenson's GaN-based LED. Again, Pinnow is used **only if** it is believed that Stevenson does not teach that the primary color phosphors can be mixed to produce white light by each LED, and Nakamura is used **only if** it is believed that the claims somehow limit the LED light to blue light, contrary to the '175 patent and to the fourth Baretz Declaration (of 3/26/2012, ¶ 18).

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow and Nakamura, teaches each of the features of claims 81, 82, 95-98, and 182-185.

4. Claims 83, 84, 87, 89-92, 149-152, 155, 157, 158, 160, and 161 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of

Menda and Pinnow, and further in view of Stevenson, Pinnow, Nakamura, and **Tadatsu**.

The prior art of at least one of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, Pinnow, and Nakamura, as explained above, discloses each of the claimed features of claim 81.

Proposed new claims 83, 84, 87, and 89-92 recite the same features as claims 64, 65, 68, and 70-73, respectively. Each of the features of claims 83, 84, 87, 89-92 is addressed in the rejection of claims 64, 65, 68, 70-73 over Stevenson in view of Pinnow, Nakamura, and Tadatsu (§ V(C)(4) above), and is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claims 83, 84, 87, and 89-92.

Proposed new **claim 149** reads,

> *149. A liquid crystal display, including:*
>
> *a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:*
>
> > *at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary blue light radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
> >
> > *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
> >
> > *and wherein the luminophoric medium is* ***dispersed in a polymer that is on or about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*

Claim 149 is distinguished from claim 81 only in that the luminophoric medium is limited to being *dispersed in a polymer that is on or about* the LED, which is a combination of the *compatible characteristics* in claim 81.

As indicated in the rejection over Stevenson in view of Pinnow, Nakamura, and Tadatsu (§ V(C)(4) above and incorporated herein by reference), Tadatsu's Fig. 2 shows a homogenous dispersion of phosphor ("fluorescent dye" **5**) in resin mold **4** (i.e. the claimed *polymer*) that is (1) on, (2) about, and (3) contiguous to all exposed sides of the LED **11**. The LED **11** emits a primary radiation that is down-converted by the phosphor in the polymer resin mold to produce white light, as in Stevenson.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claim 149.

Proposed new claims 150-152, 155, 157, and 158 recite the same features as claims 135-137, 140, 142, and 143, respectively. Each of the features of claims 150-152, 155, 157, and 158, is addressed in the rejection of claims 135-137, 140, 142, and 143 over Stevenson in view of Pinnow, Nakamura, and Tadatsu (§ V(C)(4) above) and is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claim 150-152, 155, 157, and 158.

Proposed new claims 160 and 161 recite the same features as claims 145 and 146, respectively. Each of the features of claims 160 and 161 is addressed in the rejection of claims 145 and 146 over Stevenson in view of Pinnow, and Nakamura (§ V(C)(3) above) and is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claim 160 and 161.

5. Claims 85-88, 91, 93, 149, 152-157, and 175 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, Pinnow, Nakamura, and **Tabuchi**.

The prior art of at least one of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, Pinnow, and Nakamura, as explained above, discloses each of the claimed features of claims 24 and 81.

Proposed new claims 85-88, 91, and 93 recite the same features as claims 66-69, 72, and 74, respectively. Each of the features of claims 85-88, 91, and 93 is therefore addressed in the rejection of claims 66-69, 72, and 74 over Stevenson in view of Pinnow, Nakamura, and Tabuchi (§ V(C)(5) above), and is incorporated herein by reference.

Proposed new claim 175 reads,

> *175. The liquid crystal display of claim 24, wherein in each light-emitting device the single-die semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*

As noted above in the rejection over Stevenson in view of Tabuchi or Stevenson in view of APA and Tabuchi (§ V(C)(9) above), Tabuchi places the LED **4** on a support in a light-transmissive enclosure including transparent cover **6** on which is the phosphor film **7.**

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tabuchi teaches each of the features of claims 85-88, 91, 93, and 175.

Proposed new **claim 149** reads,

> *149. A liquid crystal display, including:*
>
> *a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:*
>
> > *at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary blue light radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
> >
> > *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
> >
> > *and wherein the luminophoric medium is **dispersed in a polymer that is on or about** the single-die gallium nitride based semiconductor blue light-emitting diode.*

Claim 149 is distinguished from claim 81 only in that the luminophoric medium is limited to being *dispersed in a polymer that is on or about* the LED, which is a combination of the *compatible characteristics* in claim 81.

As indicated in the rejection over Stevenson in view of Pinnow, Nakamura, and Tabuchi (§ V(C)(5) above and incorporated herein by reference), Tabuchi's Fig. 1 shows a phosphor layer **7** made from a homogenous dispersion of phosphor in a "**binder**", the phosphor layer **7** deposited on the inside of transparent cover **6**, thereby positioning the phosphor layer **7** (1) about, (2) laterally space from the side surface of, and (3) laterally spaced facing relationship to the LED **4**. The GaN-based LED **4** emits a primary UV radiation that is down-converted by the "an ordinary UV-visible light conversion phosphor" in phosphor layer **7** into white light, as in Stevenson.

Also as indicated in the rejection over Stevenson in view of Pinnow, Nakamura, and Tabuchi (§ V(C)(5) above), Pinnow teaches that the phosphor mixture that produces white light is made by homogeneously dispersing the phosphor mixture in an "organic resin", i.e. a **binder**, such as that used in Tabuchi (Pinnow, col. 2, lines 1-3), which reads on the claimed feature "*dispersed in a polymer*".

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tabuchi teaches each of the features of claim 149.

Proposed new claims 152-157 recite the same features as claims 137-142, respectively. Each of the features of claims 152-157 is addressed in the rejection of claims 137-142 over Stevenson in view of Pinnow, Nakamura, and Tabuchi (§ V(C)(5) above) and is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tabuchi teaches each of the features of claim 152-157.

6. Claims 49 and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of either (1) Stevenson and **Tadatsu**, or (2) Stevenson, APA, and **Tadatsu**

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, or, in the alternative, Lenko in view of either of Menda and Pinnow, and further in view of Stevenson and APA, as explained above in rejections 1 and 2 of this subsection (§ V(G)), teaches each of the features of claim 48.

Proposed new claims 49 and 51 read,

> *49. The liquid crystal display of claim 48, wherein the inorganic luminophor is dispersed on or* ***in*** *a housing member.*

> *51. The liquid crystal display of claim 48, wherein the inorganic luminophor is **within** a housing member.*

These features are the same as claims 28 and 30. Each of the features of claims 49 and 51 was addressed in the rejection of claims 28 and 30 over Stevenson in view of Tadatsu, or Stevenson in view of any of Pinnow, Menda, and APA, and further in view of Tadatsu (§ V(C)(8) above), which is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Tadatsu or Stevenson in view of APA and Tadatsu teaches each of the features of claims 49 and 51.

7. Claims 49-51 and 175 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of either (1) Stevenson and **Tabuchi**, or (2) Stevenson, APA, and **Tabuchi**

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, or, in the alternative, Lenko in view of either of Menda and Pinnow, and further in view of Stevenson and APA, as explained above in rejections 1 and 2 of this subsection (§ V(G)), teaches each of the features of claims 24 and 48.

Proposed new claims 49 and 51 read,

> *49. The liquid crystal display of claim 48, wherein the **inorganic** luminophor is dispersed **on** or in a housing member.*
>
> *50. The liquid crystal display of claim 48, wherein the **inorganic** luminophor is dispersed **in a film** on a surface of a housing member.*
>
> *51. The liquid crystal display of claim 48, wherein the **inorganic** luminophor is **within** a housing member.*

These features are the same as claims 28-30. Each of the features of claims 49-51 was addressed in the rejection of claims 28-30 over Stevenson in view of Tabuchi, or Stevenson in view of APA and Tabuchi (§ V(C)(9) above), and is incorporated herein by reference.

Proposed new claim 175 reads,

> *175. The liquid crystal display of claim 24, wherein in each light-emitting device the single-die semiconductor light-emitting diode is on a support in an interior volume of a light-transmissive enclosure.*

As noted above in the rejection over Stevenson in view of Tabuchi or Stevenson in view of APA and Tabuchi (§ V(C)(9) above), Tabuchi places the LED **4** on a support in a light-transmissive enclosure including transparent cover **6** on which is the phosphor film **7.**

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of Pinnow, Nakamura, and Tabuchi teaches each of the features of claims 85-88, 91, 93, and 175.

8. Claims 81, 82, 94-98, and 182-185 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker and Nakamura

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson and any of Pinnow, Menda, and APA, as explained above in rejection 2 of this subsection (§ V(G)), is believed to disclose each of the features of claims 81, 82, 94-98, and 182-185.

To the extent it is believed that claims 81, 82, 94-98, and 182-185 exclude light other than blue light, then this may be difference. Note, however, just as the commercially available GaN-based LED from Nichia used in the '175 patent (col. 9, lines 10-18) emits a significant amount of both UV and violet light that is converted by the phosphors (*luminophoric medium*) to the secondary radiation contributing to the white light, Patentee cannot argue that the LED emits **only** blue light, as this would contradict the '175 patent and the inventor Bartez's Declaration dated 3/26/2012, paragraph 18, which shows the Nichia GaN-based LED emits light from UV to blue, just as does Stevenson's GaN-based LED.

As discussed above in the rejection over Stevenson in view of APA, Wanmaker, and Nakamura, (§ V(C)(11) above) which is incorporated herein by reference, (1) APA teaches the well-known use of a mixture of inorganic phosphors to produce white light in fluorescent light bulbs for use as Stevenson's phosphor, and Wanmaker shows that the phosphor mixture would work because the Hg vapor used to produce the primary radiation in fluorescent bulbs produces significant blue light that must be converted to longer wavelengths by the phosphor in order to produce true white light, and (2) Nakamura teaches GaN-based LEDs and lasers that emit both blue and UV light to substitute Stevenson's GaN-based LED. Again, APA and Wanmaker are used **only if** it is believed that Stevenson does not teach that the primary color phosphors can be mixed to produce white light by each LED, and Nakamura is used **only if** it is believed that the claims somehow limit the LED light to blue light, contrary to the '175 patent and to the fourth Baretz Declaration (of 3/26/2012, ¶ 18).

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of APA, Wanmaker, and Nakamura, teaches each of the features of claims 81, 82, 94-98, and 182-185.

> 9. Claim 99 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker, Nakamura, and **Tabuchi**

Proposed new claim 99 reads,

> *99. The liquid crystal display of claim 98, wherein the light-emitting diode lamp comprises the at least one single-die gallium nitride based semiconductor blue light-emitting diode and* ***inorganic*** *luminophoric material within an enclosure comprising material that is light-transmissive of said white light output.*

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker and Nakamura, as explained above, discloses each of the features of claim 81 and 98.

As indicated in the rejection over Stevenson in view of APA, Nakamura, and Tabuchi (§ V(C)(13) above) which is incorporated herein by reference, Tabuchi's Fig. 1 shows a phosphor layer **7** made from a homogenous dispersion of phosphor in a "**binder**", the phosphor layer **7** deposited on the inside of transparent cover **6**, thereby positioning the phosphor layer **7** (1) about, (2) laterally space from the side surface of, and (3) laterally spaced facing relationship to the LED **4**. The GaN-based LED **4** emits a primary UV radiation that is down-converted by the "an ordinary UV-visible light conversion phosphor" in phosphor layer **7** into white light, as in Stevenson.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of APA, Wanmaker, Nakamura, and Tabuchi teaches each of the features of claim 99.

> 10. Claims 149 and 159 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker, Nakamura, **Tabuchi and Martic**

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Stevenson, APA, Wanmaker and Nakamura, as explained above, discloses each of the features of claim 81, and claim 149 is distinguished from claim 81 only in the claim 149 requires the luminophoric medium be *dispersed in a polymer that is on or about* the LED.

Proposed new claim 159 reads,

> *159. The liquid crystal display of claim 149, wherein the luminophoric medium comprises inorganic luminophoric material.*

Claim 159 requires the luminophoric medium that is *dispersed in polymer that is on or about* the LED to be **inorganic**.

As indicated in the rejection over Stevenson in view of APA, Wanmaker, Nakamura, Tabuchi, and Martic (§ V(C)(14) above) which and incorporated herein by reference, Tabuchi's Fig. 1 shows a phosphor layer **7** made from a homogenous dispersion of phosphor in a "**binder**", the phosphor layer **7** deposited on the inside of transparent cover **6**, thereby positioning the phosphor layer **7** (1) about, (2) laterally space from the side surface of, and (3) laterally spaced facing relationship to the LED **4**. The GaN-based LED **4** emits a primary UV radiation that is down-converted by the "an ordinary UV-visible light conversion phosphor" in phosphor layer **7** into white light, as in Stevenson.

Also as pointed out in said rejection, although Tabuchi does not indicate the identity of the binder, Martic teaches that it has long been known (since 1973) to use organic resins (i.e. polymers) as binding agents specifically for inorganic phosphors in the manufacture of luminescent screens:

> In still another aspect, this invention relates to screens comprising **inorganic phosphors** wherein the **binding agent** for said phosphors comprises a **polyurethane elastomer** alone or in combination with an **alkyl methacrylate resin** in various ratio ranges.

(Martic, col. 1, lines 10-14; emphasis added)

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Stevenson in view of APA, Wanmaker, Nakamura, Tabuchi, and Martic teaches each of the features of claims 149 and 159.

<u>11. Claims 24 and 48-53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi and APA.</u>

Proposed amended claim 24 reads,

> *24. A **liquid crystal display**, including:*
>
> *a **backlight member** including a **multiplicity of light-emitting devices**, each light-emitting device comprising:*
>
> > *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*

> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output.*

Claim 24 is distinct from claim 5 in that (1) a liquid crystal display (LCD) is claimed as opposed to just a light emitting device, and (2) a multiplicity of light-emitting devices is required to make a backlight member for the LCD.

Lenko discloses a backlight for a LCD:

> A **liquid crystal display** panel having a **backlight** for providing high brightness, uniformity of illumination intensity, high efficiency, and long battery life, and which can be manufactured at a low cost.
>
> (Lenko, Abstract; emphasis added)

Lenko's Figs. 1A and 1B (reproduced below) show the backlight using two, separately packaged LEDs **10**, each having two leads, as the illumination source, and therefore discloses a *multiplicity of light-emitting devices*. In this regard, Lenko states,

> The photoconductor **14** can be made of any appropriate transparent material such as glass or acryl material and in the present embodiment is made of plexiglass in which the **LED's** are mounted and forms an optical coupling to the LCD device. In the present embodiment, reflector **16** is a matted but highly reflecting material such as non-shiny **white paper or green paper to match a green LED**, and is secured by glue or the like to the angled faces of the plexiglass which add to the uniformity in the backlight diffusion. In the exemplary embodiment, reflector **16** is disposed on all surfaces except for light output surface **18**. In a like manner, appropriately colored plastic or paint can be used for reflector **16**.
>
> (Lenko, col. 4, lines 2-16; emphasis added)

Lenko does not teach the details of the light emitting device. However, the details of the light-emitting devices have been discussed in each of the rejections of claim 5 in the previous sections above.

Although Lenko's LED emits green light, Lenko indicates that the LED can match the paper; therefore, Lenko suggests using LEDs that emit white light. Even if Lenko is not considered to suggest LEDs that emit white light, there can be no question that backlights for LCDs that emit white light are desirable in the art, as evidenced by Menda. As discussed in detail in the rejections over Menda, above, Menda teaches a white-light-emitting backlight for an LCD, wherein the white light is made by using a light source that may be a UV-light-emitting LED and down-converting phosphor layers, one for each primary color (Menda, ¶¶ [0018] and [0023]). Of course, it is not relevant in this rejection whether or not Menda uses LEDs to produce white light. **Menda is used here only to show that white-light-emitting backlights for LCD are known and desirable in the LCD art and therefore one of ordinary skill would know to make Lenko's backlight emit white light**.

Alternatively, Pinnow teaches the desire to have a black and white display, thereby requiring a **white** light source which, as discussed in detail above, includes using a UV or blue primary radiation which is down-converted by a phosphor mixture to produce white light (Pinnow, col. 3, lines 24-55). Thus, Lenko's backlight using white-light-emitting LEDs would produce a black-and-white LCD, as taught to be desirable in Pinnow. Like Menda, **Pinnow is used here only to show that black and white displays are desirable; therefore, those of ordinary skill would recognize the desire to make Lenko's backlight emit white light and thus capable of producing a black-and-white display**.

Thus, it would have been obvious to one of ordinary skill in the art, at the time of the invention to use the white-light-emitting LEDs taught by Tabuchi in view of APA as Lenko's LEDs **10**, in order to produce a white backlight that is as taught to be desirable in the display art. The rejection of the claims over Tabuchi in view of APA (§ V(D)(2) above) is incorporated herein by reference for teaching the features drawn to the claimed *light-emitting devices* (i.e. the subcombination included in the combination that is the LCD) especially the discussion directed to claim 5, since claim 24 is most closely related to claim 5.

This is all of the additional features of claim 24.

Proposed new claims 48-53 recite the same features as claims 27-32, respectively. Each of the features of claims 48-53 is addressed in the rejection of claims 27-32 over Tabuchi in view of APA (§ V(D)(2) above) which is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of APA teaches each of the features of claim 48-53.

12. Claims 52-54 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, and Nakamura.

Proposed new claims 52-54 read,

> *52. The liquid crystal display of claim 48, wherein each said LED comprises material selected from the group consisting of* ***gallium nitride*** *and its alloys.*

> *53. The liquid crystal display of claim 48, wherein each said LED comprises* ***gallium nitride.***

> *54. The light-emission device of claim 48, wherein each said LED comprises* ***gallium nitride alloy.***

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi and APA, as explained above in the previous rejection, discloses each of the features of claim 24, 48, 52 and 53.

As discussed in the rejection over Tabuchi in view of APA and Nakamura (§ V(D)(5) above) which is incorporated by reference, it is obvious to substitute Tabuchi's GaN-based LED with Nakamura's GaN-based LEDs or laser diodes. So substituted, each of the features of claims 52-54 is taught.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of APA and Nakamura teaches each of the features of claim 52-54.

13. Claims 81, 82, 85-88, and 93-99 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, Wanmaker, and Nakamura.

Proposed new **claim 81** reads,

> *81. A liquid crystal display, including:*
>
> *a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:*
>
> > *at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
> >
> > *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*

and wherein each light-emitting device comprises one or more compatible characteristics selected from the group consisting of:

(i) the luminophoric medium being ***arranged about*** *the single-die LED;*

(ii) the luminophoric medium being contiguous to the single-die LED;

(iii) the single-die LED comprising side surface and the luminophoric medium being in ***laterally spaced relationship to said side surface;***

(iv) the luminophoric medium being dispersed in polymer or glass; and

(v) the luminophoric medium being ***on polymer or glass.***

Patentee indicates that claim 81 is coextensive with claim 24 (Patentee's Remarks dated 3/26/2012, p. 35). Claim 81 is distinguished from claim 24 in (1) the LED is required to be a blue-light-emitting GaN-based LED and (2) the one or more *compatible characteristics*.

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, and Nakamura, as explained above in the previous rejection, discloses each of the features of claim 24. Thus, each of the features of claim 81 except distinctions (1) and (2), has been discussed above with regard to claim 24.

With regard to **distinction (1)**, as discussed above in the rejection over Tabuchi in view of APA, Wanmaker, and Nakamura, (§ V(D)(6) above), which is incorporated herein by reference, (1) APA teaches the well-known use of a mixture of inorganic phosphors to produce white light in fluorescent light bulbs for use as Tabuchi's "ordinary UV-visible light conversion phosphor", and Wanmaker shows that the phosphor mixture would work because the Hg vapor used to produce the primary radiation in fluorescent bulbs produces significant **blue** light, as well as the UV light, that must be converted to longer wavelengths by the phosphor in order to produce true white light, and (2) Nakamura teaches GaN-based LEDs and lasers that emit both **blue and UV** light to substitute Tabuchi's GaN-based LED. Again, APA and Wanmaker are used **only if** it is believed that Tabuchi does not teach that the "**ordinary** UV-visible light conversion phosphor" is not one producing white light by each LED.

With regard to **distinction (2)**, Tabuchi discloses compatible characteristics i, iii, and v.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of APA, Wanmaker, and Nakamura, teaches each of the features of claim 81.

Proposed new claims 82, 85-88, and 93-99 recite the same features as claims 63, 66-69, and 74-80, respectively. Thus, each of the features of claims 82, 85-88, and

93-99 is addressed in the rejection of claims 63, 66-69, and 74-80 over Tabuchi in view of APA, Wanmaker, and Nakamura (§ V(D)(6) above) which is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of APA, Wanmaker, and Nakamura teaches each of the features of claim 82, 85-88, and 93-99.

14. Claims 89-91, 149, 152-157, and 159-161 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, Wanmaker, Nakamura, and Martic.

Proposed new claims 89-91 read,

> *89. The liquid crystal display of claim 81, comprising the luminophoric medium being **dispersed in polymer** or glass.*
>
> *90. The liquid crystal display of claim 89, comprising the luminophoric medium being **dispersed in polymer about** the single-die light-emitting diode.*
>
> *91. The liquid crystal display of claim 89, comprising the luminophoric medium being in a **homogeneous** composition.*

The prior art of Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, APA, Wanmaker, and Nakamura, as explained above in the previous rejection, discloses each of the features of claim 81.

As discussed above in the rejection over Tabuchi in view of APA, Wanmaker, Nakamura, and Martic (§ V(D)(7) above) which is incorporated herein by reference, although Tabuchi does not indicate the identity of the binder, Martic teaches that it has long been known (since 1973) to use organic resins (i.e. polymers) as binding agents specifically for inorganic phosphors in the manufacture of luminescent screens:

> In still another aspect, this invention relates to screens comprising **inorganic phosphors** wherein the **binding agent** for said phosphors comprises a **polyurethane elastomer** alone or in combination with an **alkyl methacrylate resin** in various ratio ranges.

(Martic, col. 1, lines 10-14; emphasis added)

It would have been obvious to one of ordinary skill in the art, at the time of the invention to disperse APA or Wanmaker's inorganic phosphors in the polymeric binding agent of Martic to make the phosphor layer **7** in Tabuchi, because Tabuchi is silent as to the binding agent for the phosphor, such that one of ordinary skill would use known binders specifically used for inorganic phosphors that must emit light.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of APA, Wanmaker, Nakamura, and Martic teaches each of the features of claims 89-91.

Proposed new **claim 149** reads,

> *149. A liquid crystal display, including:*
>
> *a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:*
>
> > *at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary blue light radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
> >
> > *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
> >
> > *and wherein the luminophoric medium is* ***dispersed in a polymer that is on or about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*

Claim 149 is distinguished from claim 81 only in that the luminophoric medium is limited to being *dispersed in a polymer that is on or about* the LED, which is a combination of the *compatible characteristics* in claim 81. This additional feature was discussed above in addressing claims 89-91 and applies here, as well.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of APA, Wanmaker, Nakamura, and Martic teaches each of the features of claim 149.

Proposed new claims 152-157 and 159-161 recite the same features as claims 137-142 and 144-146, respectively. Thus, each of the features of claims 152-157 and 159-161 is addressed in the rejection of claims 137-142 and 144-146 over Tabuchi in view of APA, Wanmaker, Nakamura, and Martic (§ V(D)(7) above) and is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of APA, Wanmaker, Nakamura, and Martic teaches each of the features of claim 152-157 and 159-161.

<u>15. Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi and APA.</u>

Proposed amended claim 24 reads,

> *24. A* ***liquid crystal display****, including:*
>
> *a* ***backlight member*** *including a* ***multiplicity of light-emitting devices****, each light-emitting device comprising:*
>
> > *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output, <u>wherein each of the at least one single-die semiconductor light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output</u>.*

Claim 24 is distinct from claim 5 in that (1) a liquid crystal display (LCD) is claimed as opposed to just a light emitting device, and (2) a multiplicity of light-emitting devices is required to make a backlight member for the LCD.

Lenko discloses a backlight for a LCD:

> A **liquid crystal display** panel having a **backlight** for providing high brightness, uniformity of illumination intensity, high efficiency, and long battery life, and which can be manufactured at a low cost.

(Lenko, Abstract; emphasis added)

Lenko's Figs. 1A and 1B (reproduced below) show the backlight using two, separately packaged LEDs **10**, each having two leads, as the illumination source, and therefore discloses a *multiplicity of light-emitting devices*. In this regard, Lenko states,

> The photoconductor **14** can be made of any appropriate transparent material such as glass or acryl material and in the present embodiment is made of plexiglass in which the **LED's** are mounted and forms an optical coupling to the LCD device. In the present embodiment, reflector **16** is a matted but highly reflecting material such as non-shiny **white paper or green paper to match a green LED**, and is secured by glue or the like to the angled faces of the plexiglass which add to the uniformity in the backlight diffusion. In the exemplary embodiment, reflector **16** is disposed on all surfaces except for light output surface **18**. In a like manner, appropriately colored plastic or paint can be used for reflector **16**.

(Lenko, col. 4, lines 2-16; emphasis added)

Lenko does not teach the details of the light emitting device. However, the details of the light-emitting devices have been discussed in each of the rejections of claim 5 in the previous sections above.

Although Lenko's LED emits green light, Lenko indicates that the LED can match the paper; therefore, Lenko suggests using LEDs that emit white light. Even if Lenko is not considered to suggest LEDs that emit white light, there can be no question that backlights for LCDs that emit white light are desirable in the art, as evidenced by Menda. As discussed in detail in the rejections over Menda, above, Menda teaches a white-light-emitting backlight for an LCD, wherein the white light is made by using a light source that may be a UV-light-emitting LED and down-converting phosphor layers, one for each primary color (Menda, ¶¶ [0018] and [0023]). Of course, it is not relevant in this rejection whether or not Menda uses LEDs to produce white light. **Menda is used here only to show that white-light-emitting backlights for LCD are known and desirable in the LCD art and therefore one of ordinary skill would know to make Lenko's backlight emit white light**.

Alternatively, Pinnow teaches the desire to have a black and white display, thereby requiring a **white** light source which, as discussed in detail above, includes using a UV or blue primary radiation which is down-converted by a phosphor mixture to produce white light (Pinnow, col. 3, lines 24-55). Thus, Lenko's backlight using white-light-emitting LEDs would produce a black-and-white LCD, as taught to be desirable in Pinnow. Like Menda, **Pinnow is used here only to show that black and white displays are desirable; therefore, those of ordinary skill would recognize the desire to make Lenko's backlight emit white light and thus capable of producing a black-and-white display**.

Thus, it would have been obvious to one of ordinary skill in the art, at the time of the invention to use the white-light-emitting LEDs taught by Tabuchi in view of Pinnow as Lenko's LEDs **10**, in order to produce a white backlight that is as taught to be desirable in the display art. The rejection of the claims over Tabuchi in view of Pinnow (§ V(D)(3) above) is incorporated herein by reference for teaching the features drawn to the claimed *light-emitting devices* (i.e. the subcombination included in the combination that is the LCD) especially the discussion directed to claim 5, since claim 24 is most closely related to claim 5.

This is all of the additional features of claim 24.

> 16. Claims 81, 82, 85-91, 93, and 95-98 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, Pinnow, and Nakamura.

Proposed new **claim 81** reads,

> *81. A liquid crystal display, including:*
>
> *a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:*
>
> *at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength blue light radiation, and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
>
> *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
>
> *and wherein each light-emitting device comprises one or more compatible characteristics selected from the group consisting of:*
>
> *(i) the luminophoric medium being **arranged about** the single-die LED;*
>
> *(ii) the luminophoric medium being contiguous to the single-die LED;*
>
> *(iii) the single-die LED comprising side surface and the luminophoric medium being in **laterally spaced relationship to said side surface**;*
>
> *(iv) the luminophoric medium being dispersed in polymer or glass; and*
>
> *(v) the luminophoric medium being **on polymer or glass**.*

Patentee indicates that claim 81 is coextensive with claim 24 (Patentee's Remarks dated 3/26/2012, p. 35). Claim 81 is distinguished from claim 24 in (1) the LED is required to be a blue-light-emitting GaN-based LED and (2) the one or more *compatible characteristics*.

The prior art of Lenko in view of either of Menda and Pinnow and further in view of Tabuchi and Pinnow, as explained above in the previous rejection, discloses each of the features of claim 24; therefore, all of the features of claim 81 have been discussed except for the distinctions (1) and (2).

With regard to **distinction (1)**, as discussed above in the rejection over Tabuchi in view of Pinnow and Nakamura (§ V(D)(9) above), which is incorporated herein by reference, (1) Pinnow teaches the use of a mixture of phosphors as Tabuchi's "ordinary UV-visible light conversion phosphor", in order to produce white light, and (2) Nakamura teaches GaN-based LEDs and lasers that emit both blue and UV light to substitute Tabuchi's GaN-based LED. Again, Pinnow is used **only if** it is believed that Tabuchi's "ordinary UV-visible light conversion phosphor" does not those phosphors that produce white light, and Nakamura is used **only if** it is believed that the claims somehow limit the LED light to blue light, contrary to the '175 patent and to the fourth Baretz Declaration (of 3/26/2012, ¶ 18).

With regard to **distinction (2)**, Tabuchi discloses compatible characteristics i, iii, and v.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of Pinnow and Nakamura, teaches each of the features of claim 81.

Proposed new claims 82, 85-91, 93, and 95-98 recite the same features as claims 63, 66-72, 74, and 76-79, respectively. Thus, each of the features of claims 82, 85-91, 93, and 95-98 is addressed in the rejection of claims 63, 66-72, 74, and 76-79 over Tabuchi in view of Pinnow and Nakamura (§ V(D)(9) above) which is incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of Pinnow, and Nakamura teaches each of the features of claims 82, 85-91, 93, and 95-98.

17. Claims 83, 84, 89-92, 149-152, 155, 157, 158, 160, and 161 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lenko in view of either of Menda and Pinnow, and further in view of Tabuchi, Pinnow, Nakamura, and Tadatsu.

The prior art of Lenko in view of either of Menda and Pinnow and further in view of Tabuchi, Pinnow, and Nakamura, as explained above in the previous rejection, discloses each of the features of claim 81 from which claims 83, 84, and 89-92 depend.

Proposed new claims 83, 84, and 89-92 recite the same features as claims 64, 65, and 70-73, respectively. Thus, each of the features of claims 83, 84, and 89-92 is addressed in the rejection of claims 64, 65, and 70-73 over Tabuchi in view of Pinnow, and Nakamura (§ V(D)(9) above) and further in view of Tabuchi (§ V(D)(10) above) both of which are incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claims 83, 84, and 89-92.

Proposed new **claim 149** reads,

> *149. A liquid crystal display, including:*
>
> *a backlight member including a multiplicity of light-emitting devices, each light-emitting device comprising:*
>
> > *at least one single-die gallium nitride based semiconductor blue light-emitting diode (LED) coupleable with a power supply to emit a primary blue light radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
> >
> > *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output,*
> >
> > *wherein each of the at least one single-die gallium nitride based semiconductor blue light-emitting diode in interaction with luminophoric medium receiving its primary radiation produces white light output,*
> >
> > *and wherein the luminophoric medium is* ***dispersed in a polymer that is on or about*** *the single-die gallium nitride based semiconductor blue light-emitting diode.*

Claim 149 is distinguished from claim 81 only in that the luminophoric medium is limited to being *dispersed in a polymer that is on or about* the LED, which is a combination of the *compatible characteristics* in claim 81.

As discussed above in the rejection of the claims over Tabuchi in view of Pinnow, Nakamura and further in view of Tadatsu (§ V(D)(11) above) which is incorporated herein by reference, Pinnow teaches that it is obvious to homogenously disperse the phosphor mixture in a polymer (Pinnow, col. 1, line 65 to col. 2, line 25), and Tadatsu also teaches that it is obvious to homogeneously disperse the phosphor **5** in the polymer resin mold **4**. Tadatsu's Fig. 2 also shows that the resin mold **4** holding the phosphor is (1) on and (2) contiguous to the exposed sides of the LED **11**.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claim 149.

Proposed new claims 150-152, 155, 157, 158, 160, and 161 recite the same features as claims 135-137, 140, 142, 143, 145, and 146, respectively. Thus, each of the features of claims 150-152, 155, 157, 158, 160, and 161 is addressed in the rejection of claims 135-137, 140, 142, 143, 145, and 146 over Tabuchi in view of Pinnow, and Nakamura (§ V(D)(9) above) and further in view of Tabuchi (§ V(D)(10) above) both of which are incorporated herein by reference.

Thus, Lenko's LEDs **10** substituted with the LEDs taught by Tabuchi in view of Pinnow, Nakamura, and Tadatsu teaches each of the features of claims 150-152, 155, 157, 158, 160, and 161.

VI. Response to Arguments

Patentee's arguments submitted 3/26/2012 have been considered but are either moot in view of new grounds of rejection or are not persuasive.

A. Patentee's general arguments directed to Menda

Patentee, relying on the latest Stringfellow and Brandes Declarations (also submitted 3/26/2012), continues to argue that Menda's use of "solid **ultraviolet light emitting element** having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]) does not implicitly include single-die semiconductor light-emitting diodes (LEDs) as the UV light source. Examiner respectfully maintains that Patentee's and Stringfellow's arguments fail to persuade given the ample facts of record showing that those of ordinary skill in the art knew at the time of Menda that "solid **ultraviolet light emitting element** having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]) include LEDs, as cited in the rejection. The arguments will be discussed below.

1. Patentee and Stringfellow merely speculate that Menda is related to large area displays

Patentee and Stringfellow state that Menda is drawn to large area displays (Patentee's Remarks dated 3/26/2012, p. 71, last ¶). This argument was already addressed in the Office action dated 11/7/2011. It was then dropped by Patentee in its next response and, for some unknown reason, has been revived. To repeat from the Office action dated 11/7/2011 at pp. 37-38, Examiner respectfully submits that Patentee and Stringfellow are merely speculating and fail to provide a supporting authority for the assertion that Menda must be drawn to a large area display. While this is possible, it is not necessarily the case. A LCD need not be large. For example, watches have LCD displays and are not so large that they could not be illuminated by a single LED. Moreover, Patentee submitted a reference, JP 03-24692 (published 14 March 1991) to Kentaro Fujii, entitled, "**Display** Apparatus" (emphasis added) which proves that it was known before the time of Menda that a **single** LED could be used to make a display. Fujii teaches a single UV-emitting LED **4** making a display by passing the UV electromagnetic (em) radiation through a luminescent layer **2** that converts the UV em radiation to visible light:

> **Luminescence layer 2** becomes a light emitting section which emits fluorescence or phosphorescence when it is irradiated with **ultraviolet light**. Luminescence layer 2 can be formed in an arbitrary shape on the front or back surface side of **display** panel 1 through a printing method and so forth. Further, if one desires to form light blocking layer 3 or a pattern layer on **display** panel 1 in addition to luminescence layer 2, such a layer may be formed through a transcription method at the same time when luminescence layer 2 is formed.
>
> On the back surface of **display** panel 1 where **luminescence layer 2** is formed in such a manner, **LED 4** is arranged. Unlike an ordinary LED, **LED 4 which is employed here emits ultraviolet light**. As **LED 4 which emits ultraviolet light**, the one which emits light having a wavelength region of 400nm or less is used. For example, the ones utilizing **GaN** or ZnS which are group III-IV compounds in the periodic table as a **semiconductor material** may be employed.
>
> [Effects]
>
> LED 4 is arranged in the rear of **display** panel 1 where **luminescence layer 2** is formed thereupon. **Ultraviolet light is irradiated on luminescence layer 2 and thereby light is emitted by luminescence layer 2**. Luminescence layer 2 can be formed in an arbitrary shape. Furthermore, **one can adopt luminescence layer 2 which emits lights of various colors**.

(Fujii translation, pp. 4-5; emphasis added)

Thus, evidence provided by Patentee, itself, proves Patentee's and Stringfellow's argument that a single die is not sufficient to produce a display is quite transparently false.

In response to the above citation to Fujii, Patentee comments that Fujii does not disclose a liquid crystal display or white light (Patentee's Remarks dated 3/26/2012, p. 90). Not surprisingly, Patentee and Stringfellow distract from the salient point for which Fujii --a reference provided by Patentee-- was noted, specifically, that all displays are not so large that a single LED could not be used to illuminate them, as proven by Fujii. Patentee and Stringfellow, in addition to avoiding the salient point, continue to fail to provide factual objective evidence that all liquid crystal displays (LCDs) are of necessity "large", such that they can properly argue that Menda's LCD is necessarily "large" and that, as such, a single LED would be insufficient to illuminate it. Examiner respectfully maintains that Fujii proves that those of ordinary skill in the art clearly know that a single LED is sufficient to illuminate a display of appropriate size, even when the light from the LED is converted by a phosphor to a different wavelength of light.

In addition, it does not matter whether Fujii's display produces white light or light of some other color, as this is entirely irrelevant to the reason Fujii was brought up. Again, Fujii was brought up because Patentee and Stringfellow have made the unsupported allegation that Menda's display is of necessity so large that a single LED could not illuminate it. Nothing Patentee or Stringfellow has stated amount to factual objective evidence that Menda's display is large. Those of ordinary skill in the display art know exceedingly well that liquid crystal displays come in all sizes, from the size of a watch face to the 60-inch LED-backlit LCDs commercially available today, and that as such, Menda is in no manner limited to the size of the LCD display discussed therein. Thus, Menda includes LCDs small enough to be illuminated by a single LED.

Even if Menda's display were too large to be illuminated by a single LED, Stevenson shows that those of ordinary skill in the art were bright enough in 1974 --20 years before Menda and the '175 patent-- to use an **array** of GaN-based LEDs as a light source for a display, which thereby illuminates a larger area than that illuminated by a single LED (Stevenson, paragraph bridging cols. 3-4). In addition, as noted in the rejections above, Imamura teaches the use of an array of LEDs as a backlight for a LCD at the time of Menda (circa 1993). Thus, even if Patentee and Stringfellow were correct in their factually unsupported speculation, those of ordinary skill in the art were bright enough, at the time of Menda, to use an **array** of LEDs sufficient to light a display of a predetermined size, large or small, as evidenced by Stevenson and Imamura.

2. Patentee and Stringfellow unnecessarily limit the disclosure in Menda

From pages 72-75 of Patentee's Remarks, Patentee, relying on the Stringfellow Declaration, tries to limit that which Menda would suggest to those of ordinary skill in the art by "solid **ultraviolet light emitting element** having a **structure of a pn junction**, MOS [Metal Oxide Semiconductor] junction or the like" (Menda, ¶ [0018]). Yet again, Examiner has addressed this argument before and has maintained that Patentee and its declarants fail to provide factual objective evidence that those of ordinary skill somehow did not know that "solid **ultraviolet light emitting element** having a **structure of a pn junction**, MOS junction or the like" (Menda, ¶ [0018]) includes LEDs. Patentee and Stringfellow continue to ignore the evidence contrary to their position.

To repeat from the previous Office action (dated 1/26/2012): First, it is important to note what Menda discloses. In this regard, Menda explicitly indicates the LCD's UV backlight (shown in Fig. 4) can be made from a "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, p. 6, lines 1-11; emphasis added). The acronym "MOS" stands for metal-oxide-**semiconductor**; thus, Menda was clearly aware of **semiconductor** light emitting devices. A "MOS junction" that emits light is a **single-die** semiconductor LED, as evidenced by at least one reference provided by one of the inventors of the instant patent, Bruce Baretz, in the Declaration submitted 5/3/2011. (See Exhibit E: Zanzoni et al., "Measurements of avalanche effects and light emission in advanced Si and SiGe bipolar transistors," section entitled "Introduction".) Given that Menda was well aware of MOS junction LEDs, that is metal-oxide–**semiconductor** junction LEDs, it is **un**reasonable to assume that Menda was somehow excluding **semiconductor** pn junction LEDs when explicitly stating that the "solid ultraviolet light emitting element" can have a structure of "a **pn junction**, **MOS junction** or the like" (Menda translation, p. 6, lines 1-11; emphasis added). The evidence provided in the rejection, i.e. Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER, indicate that pn junctions are made from **semiconductor** materials and that such materials are **single dies or chips**.

The level of ordinary skill can be determined from the references themselves; thus, Menda represents the level of ordinary skill. Menda cannot at the same time be aware of MOS (metal-oxide **semiconductor**) junction LEDs and, at the same time, be unaware of **semiconductor** pn junction LEDs. Plus, each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER shows that which those of ordinary skill in the art knew is meant by pn junction and MOS junction light emitters: they include single-die semiconductor LEDs.

Based on the foregoing, Menda discloses single-die semiconductor LEDs that can be implemented as pn junction or MOS junctions made from semiconductor materials. Examiner respectfully maintains that it is unreasonable, as Patentee and Stringfellow have asserted, to note Menda's disclosure that the LCD's UV backlight (shown in Fig. 4) can be made from a "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, p. 6, lines 1-11; emphasis added), and at the same time suggest that making the pn junction out of a semiconductor material or in the form of a single die, are not at least implicitly disclosed, given the evidence of record, which Patentee and Stringfellow continue to ignore.

3. Menda's alternative sources of radiation, e.g. X-ray, β-ray, γ-rays do not negate the explicit disclosure of "solid ultraviolet light emitting element having a structure of a pn junction, MOS junction or the like"

Patentee, relying on the Stringfellow and Brandes Declarations, discusses Menda's alternative sources of radiation, e.g. X-ray, β-ray, γ-rays, at pages 74-78. Examiner does not know why. The only thing Examiner can think is that, during the last interview on 3/14/2012, Examiner responded that Menda taught several alternative sources of radiation to excite the phosphors to emit white light specifically because Patentee was trying to limit the UV light source in Menda to selected embodiments. That said, Patentee's discussion here is pointless as it (1) fails to negate Menda's explicit disclosure that the UV light source for the LCD backlight can be made from a "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, [0018]; emphasis added), and (2) fails to negate the evidence of record showing that those of ordinary skill in the art knew before the time of Menda that a "UV light-emitting pn junction, MOS junction, or the like" (*id.*) includes single-die semiconductor LEDs, i.e. each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER. In fact, Stevenson shows that it was known in the early **1970's**, twenty years prior to Menda.

4. The '175 patent uses commercially available GaN-based LEDs that Patentee and Stringfellow argues would not work

Patentee, relying on the Stringfellow Declaration, argues that LEDs in the **mid**-1990's would not work as a light source for Menda's display for various failings (Patentee's Remarks dated 3/26/2012, pp. 79-82). Examiner is baffled as to why Patentee and Stringfellow would make such an argument given that the LED disclosed in the '175 patent --and in Inventor Baretz's latest Rule 1.131 Declaration (of 3/26/2012), ¶¶ 9, 13, and 18-- is a **commercially available** LED made in the **early** 1990's, and therefore is one that Stringfellow argues **would not work**. In effect, Stringfellow is arguing that the '175 patent is not enabled for using LEDs that do not work sufficiently well. In this regard, the '175 patent states,

> In one embodiment, **LED 13** comprises a leaded, **gallium nitride based LED** which exhibits blue light emission with an emission maximum at approximately 450 nm with a FWHM of approximately 65 nm. Such a device is **available commercially** from Toyoda Gosei Co. Ltd. (Nishikasugai, Japan; **see U.S. Pat. No. 5,369,289**) or as Nichia Product No. NLPB520, NLPB300, etc. from Nichia Chemical Industries, Ltd. (Shin-Nihonkaikan Bldg. 3-7-18, Tokyo, 0108 Japan; **see Japanese Patent Application 4-321,280**).

(the '175 patent, col. 9, lines 10-18; emphasis added)

A review of the US and JP patent documents shows that these LEDs were invented at least by the filing dates of said documents, which is 31 October **1991** and 19 April **1991**, respectively.

How is it possible that Stringfellow can argue, at length, that LEDs from the **mid**-1990's would not work, when Baretz and Tischler used commercially available LEDs from even earlier, in the **early** 1990's that worked, and Stevenson and Tabuchi used LEDs from the early **1970's** that worked? How can it be that Stringfellow can argue that those of ordinary skill in the art would never use GaN-based LEDs from the mid-1990's when at least the two inventors of the '175 patent, the three inventors of the Stevenson patent, and the inventor Tabuchi (that is six inventors in all), all members of "those of ordinary skill", actually disclosed using **GaN-based** LEDs to generate the primary radiation that is down-converted by known phosphors to produce visible white light. It simply cannot be reasonable to assert, as Stringfellow has done, that six different inventors used GaN-based LED, but that those of ordinary skill in the art would, for some unknown reason, not use them because they allegedly would not work even **after** the time that said six inventors has already successfully used said GaN-based LEDs.

In fact, Stringfellow's speculation is so exceedingly contrary to the evidence of record that it is literally incredible. As amply noted in the rejection over Tabuchi (a 1973 reference) Tabuchi states,

> For example, it goes without saying that a **near UV light emitting devices with GaN** can be employed and that **an ordinary UV-visible light conversion phosphor** can be utilized.

(Tabuchi translation, p. 5; emphasis added)

An "**ordinary** UV-visible light conversion phosphor[s]" at the time of Tabuchi (1973) --not to mention at the time of the '175 patent-- would clearly be any used in, for example, fluorescent light bulbs (as in the '175 patent's APA) and in Pinnow (a 1973 patent) both of which use phosphor **mixtures** to produce **white** light. Therefore, Tabuchi most certainly thought it would work to use a GaN-based LED with an "**ordinary** UV-visible light conversion phosphor[s]" to produce white light, in fact, so much so that Tabuchi filed a patent for it. The same holds true for Stevenson. While Stevenson does not state that the phosphor is "ordinary", Stevenson did not describe any specific phosphor, thereby indicating that it was something notoriously well-known and therefore not in need of explanation. Again, APA and Pinnow taught ordinary phosphors that produce white light were notoriously well known. Thus, the inventors of the Stevenson patent, too, believed it would work to use a GaN-based LED to produce **white** light using known phosphors.

Moreover, if there were problems with the GaN-based LEDs used in the '175 patent, then why didn't Baretz (or Tischler, the other inventor of the '175 patent) say anything at all about said problems or that they expected failure using commercially available GaN-based LEDs? Instead, Baretz and Tischler used **commercially available** GaN-based LEDs and **commercially available** phosphors and it worked just fine. But again, Tabuchi and Stevenson already disclosed this in the early 1970's.

Alternatively, if it was dumb luck that led Baretz and Tischler to use the commercially available LEDs invented in the **early**-1990's, then why should it be considered novel and non-obvious when each of Stevenson and Tabuchi already did the same thing in the **1970's**? Stevenson explicitly discloses using making LED lamps of "different colors" --of which white is one. Stevenson also teaches using an **array** of the GaN-based LED lamps to make a TV display.

Based on the foregoing, it cannot matter what Stringfellow argues about LEDs of the mid-1990's allegedly not working when it was actually disclosed in the 1970's to use an array of GaN-based LED that Stringfellow could only believe would be even more inferior to those of the mid-1990's. Stringfellow's arguments simply cannot negate the explicit suggestion of the art to use an array of GaN-based LED to make a TV display premised on some unsubstantiated opinion that the LEDs of the **mid-1990's** would not work in contradiction to the factual objective evidence that it would work, and did in fact work as also evidenced by the '175 patent. Again, expert opinion does not have weight when it contradicts the facts of record.

Also based on the foregoing, Examiner respectfully maintains that there is nothing persuasive about Stringfellow's arguments that LEDs from the mid-1990's would not have led those of ordinary skill to use GaN-based LEDs as the source of light in Menda's display --especially given Stevenson's explicit suggestion to use an array of GaN-based LEDs for a display in the early-1970's (Stevenson, paragraph bridging cols. 3-4). Inasmuch as Stringfellow's arguments contradict the very '175 patent regarding the effectiveness of LEDs made in the mid-1990's, it simply cannot be considered persuasive to suggest that those of ordinary skill would not have believed that GaN-based LEDs of the 1970's and/or early-1990's would work and would, as a result of said alleged disbelief, be led away from using them in Menda. For these reasons, Patentee's and Stringfellow's arguments are not persuasive.

5. Examiner never even hinted that Menda failed to implicitly disclose single-die semiconductor LEDs

Patentee's Remarks errantly state,

> This disclosure fails to mention any single-die semiconductor LED. (Stringfellow Declaration, ¶35).
>
> Such failing is acknowledged by the January 26, 2012 Office Action, in the statement at page 7 thereof that the originally filed request for Reexamination "fails to provide evidentiary support or sufficient explanation that a light-emitting pn junction implicitly includes a single-die semiconductor LED (light emitting diode)." (Stringfellow Declaration, ¶35).

(Patentee's Remarks, p. 83; emphasis added)

Stringfellow appears to be twisting what the action says by willfully taking that which Examiner stated out of context. Examiner never even hinted that Menda failed to implicitly disclose single-die semiconductor LEDs. The excerpt taken entirely out of context and misinterpreted by Stringfellow, instead, points out that Requester --not Examiner-- failed to provide evidence that Menda's "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, [0018]; emphasis added) **implicitly** includes single-die semiconductor LEDs, which is why the rejection included multiple sources of evidence. In other words, Examiner filled in missing evidence for Requester of implicit or inherent disclosure that is required under MPEP 2112.

Examiner respectfully, but entirely, disagrees with Stringfellow. Examiner maintains that Menda's "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, [0018]; emphasis added) **implicitly** includes single-die semiconductor LEDs, as evidenced by each of

Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER. Yet again, Stringfellow fails to negate the evidence in these references as to that which those of ordinary skill in the art knew about UV light-emitting pn junctions. Simply because Stringfellow turns a blind eye to the vast evidence to the contrary, is not a requirement that Examiner should. Again, opinion does not trump fact, and Stringfellow cannot negate that which each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER tells that it is known to those of ordinary skill: that UV light-emitting pn junctions include single-die semiconductor LEDs. Examiner respectfully maintains that the evidence of record fully supports this position.

6. Each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER tells that it is known to those of ordinary skill that UV light-emitting pn junctions include single-die semiconductor LEDs

Patentee's Remarks at pages 82-88 argues --based on Stringfellow's arguments already discussed above-- that each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER fails to teach that those of ordinary skill in the art that UV light-emitting pn junctions include single-die semiconductor LEDs. Again, Examiner respectfully maintains that Stringfellow is wrong for the reasons discussed above. Again, Stringfellow cannot reasonably argue that because the very LEDs used in the '175 patent would not work, one of ordinary skill would not believe that Menda implicitly discloses using UV light-emitting LEDs. Each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER explain that which is known to those of ordinary skill in the art by "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, [0018]; emphasis added). "Light-emitting pn junction" simply cannot be suggested as excluding single-die semiconductor LEDs. This would contradict each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER. And as discussed above, Stringfellow is wrong about that which those of ordinary skill believed regarding GaN-based LEDs of the mid-1990's, as evidenced by the fact that **six** inventors with ordinary skill in the art --of which two are the inventors of the '175 patent-- actually used said GaN-based LED successfully. It cannot be reasonably argued that **successful** use of GaN-based LED by six members of the ordinarily skilled is somehow a **deterrent**. The facts show that Stringfellow's assertions are wrong and therefore have no merit.

As an aside, Abe, used in the context of evidence, cannot be eliminated by a rule 1.131 declaration. (See Patentee's Remarks, pp. 84-86.) Abe is clearly relevant to the skill in the art around the time of the '175 patent and therefore does not have to be prior art. The very fact that Patentee has to file a declaration in order to try to swear behind Abe shows the relevance Abe has to what those of ordinary skill in the art knew at the time of the '175 patent.

7. Imamura uses an array of LED as a backlight for an LCD, so those of ordinary skill knew very well at the time of Menda that LEDs were a sufficient light source for back lights

Patentee further argues with regard to claim 24, directed to a LCD, that those of ordinary skill would not have believed that GaN-based LEDs of the mid-1990's would provide sufficient light for backlighting a LCD (Patentee's Remarks dated 3/26/2012, pp. 89-90). Examiner respectfully disagrees for all of the reasons presented in the rejection and above. In addition, as pointed out in the rejections, **Imamura teaches using an array of LED as a backlight for a LCD** (Imamura, Fig. 8, col. 4, lines 59-61). So yet again, Stringfellow's opinion contradicts the facts of record and therefore has absolutely no merit.

8. Specific rejections relying on Menda as a base reference

As to the specific rejections relying on Menda as the base reference, Patentee relies primarily on the argument that Menda does not disclose a single-die semiconductor LED (Patentee's Remarks dated 3/26/2012, pp. 97-107) which has already been addressed above.

Importantly, Patentee fails to point out how Menda in view of the other references fails to teach *at least one single-die semiconductor light-emitting diode (LED)*. It is not enough to suggest that Menda, alone, does not anticipate this feature when the other rejections show that the use of single-die semiconductor LEDs as Medna's backlight would be obvious. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

One further comment regarding anticipation by Menda: Patentee argues that an anticipation rejection cannot be made over more than a single reference (Patentee's Remarks, p. 97). Patentee is wrong, and the case law on which Patentee relies is inapplicable here. In this regard, MPEP 2131.01 states,

> ***2131.01 Multiple Reference 35 U.S.C. 102 Rejections***
>
> Normally, only one reference should be used in making a rejection under 35 U.S.C. 102.
>
> However, a 35 U.S.C. 102 rejection over multiple references has been held to be proper when the extra references are cited to:
>
> (A) Prove the primary reference contains an "enabled disclosure;"
>
> (B) Explain the meaning of a term used in the primary reference; or
>
> (C) Show that a characteristic not disclosed in the reference is inherent.

> See paragraphs I-III below for more explanation of each circumstance.

(Emphasis in original.)

Each of Penguin, Fundamentals of Photonics, Morkoç, Abe, Tadatomo and LEDLASER was provided to show that Menda's "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, [0018]; emphasis added) inherently includes LEDs; therefore, the use of multiple references is allowed by item (C) above. While an alternative rejection under 35 USC 103(a) over Menda in view of each of the references was also made, it does not negate that the rejection under 35 USC 102(b) is proper.

Also, a reference used as evidence need not qualify as prior art to be used:

> Also note that the critical date of extrinsic evidence showing a universal fact **need not antedate the filing date**. See MPEP § 2124.

(MPEP 2131.01, last sentence; emphasis added)

Thus, Patentee's suggestion that LEDLASER cannot be used because it does not predate the invention is also wrong.

Patentee further opines that the seven references are somehow needed. This is entirely false. The six reference used to show inherency are to show that a plurality or sources **each** independently show that those of ordinary skill in the art know exceedingly well that UV light emitting pn junctions include single-die semiconductor LEDs. The number is merely for degree, to show that it cannot be reasonably argued that single-die semiconductor LEDs could be omitted as implicit in the light sources included by Menda's "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, [0018]; emphasis added).

The remaining arguments at pages 99-107 are redundant, as just noted above, being premised Patentee's belief that Menda does not include single-die semiconductor LEDs in "solid ultraviolet light emitting element having a structure of a **pn junction**, **MOS junction or the like**" (Menda translation, [0018]; emphasis added). Each of those arguments was already addressed in the previous sections.

B. Patentee's general arguments directed to Stevenson

1. Patentee and Stringfellow fail to acknowledge that Stevenson's GaN-based LED emits light in the same spectral region as the commercially available LED disclosed in the Baretz Declaration and in the '175 patent

As indicated in the rejection over Stevenson, above, Stevenson's GaN-based LED emits light in the blue-to-UV spectral range, as shown in Stevenson's Fig. 4. This is virtually the same as in the example used by inventor Baretz in conceiving of the invention that is the subject of the '175 patent. In the Fourth Baretz Declaration, Baretz states,

> Prior to transmittal of the blue LED product literature, of Exhibit B to ATMI for review by Duncan Brown and Michael Tischler, I had studied such product literature. These documents furnished by Mr. Ogawa indicated a **peak wavelength of 450 nm** for the blue LED products of Nichia. I recall thinking at that time that I wished the peak wavelength of such blue LEDs were hypsochromic to 450 nm, but that **the half-width was specified as 70 nm**, which indicated to me that down-conversion necessary to produce white light would take place with luminescent dyes absorbing between **380 nm and 520 nm**.

(Fourth Baretz Declaration, dated 3/26/2012, p. 9, ¶ 18; emphasis added)

Thus, Baretz admits that the blue LED used to develop the invention and cited in the '175 patent (at col. 9, lines 10-18) emits significant UV light (380-400 nm) and violet light (400-424 nm) as well as blue (424-491.2 nm) and even some green light (491.2-520 nm). (See excerpt from CRC Hanbook, above.) And as pointed out in the rejection under 35 USC 112(1), above, the phosphor used to convert light from said commercially available LED used by Baretz to blue light, Lumogen® F Violet 570, does not absorb light above about 420 nm. Thus, Lumogen® F Violet 570 **requires** violet or ultraviolet light --i.e. less than 420 nm-- in order to produce blue light. Thus, Patentee admits that UV and violet light are necessary to produce the white light.

Similarly, Stevenson's GaN-based LED emits blue-to-UV light. To repeat from the rejection over Stevenson, above, the range of wavelengths emitted by Stevenson's GaN-based LED is about 496 nm (4960 Å) to 381 nm (3810 Å) (Stevenson's Fig. 4) , which **significantly** overlaps the 520 to 380 nm that Baretz admits is emitted from the commercially available GaN-based LED used in the '175 patent. The only difference is a slight shift in the emission peak maximum (blue in the '175 patent and violet in Stevenson). It simply is not a significant difference in the context of the claims of the '175 patent, especially since several of the '175 patent's **original** claims (e.g. independent claims 1 and 3) require the primary radiation to be "**outside** the visible spectrum". By contrast, certain of the proposed **new** claims limit the primary radiation from the LED light that is converted to **blue** light and therefore lack enablement, as indicated above in the rejection under 35 USC 112(1).

The above is important to keep in mind, so that Patentee and Stringfellow do not try to assert that Stevenson's GaN-based LED from 1974 is somehow significantly different from the commercially available LED from 1991 that Baretz used to develop the '175 invention, but that Stringfellow nonetheless disparages as being ineffective for being made prior to 1994 (Patentee's Remarks dated 3/26/2012 pp. 79-82 citing the Stringfellow Declaration at ¶¶ 27-32).

It must be maintained in mind that Stevenson disclosed **exactly the same** concept as the '175 patent: to use a luminophor, such as a phosphor, to down-convert (in terms of energy) primary radiation from a GaN-based LED to visible light, which includes **white** light. First, the level of skill in the art is determined from the references themselves; thus, Stevenson is representative of the level of skill in the art in **1974**. It simply cannot be, as Patentee and Stringfellow suggest, that the inventors of Stevenson were intelligent enough to make a GaN-based LED, and to use inorganic and organic phosphors to down-convert the light from said LED to "develop different colors" among which include the "primary colors" (Stevenson, paragraph bridging cols. 3-4) but, at the same time, that said inventors were simultaneously so **lacking** in intelligence that they would not **mix** the phosphors to produce white light from a single LED --especially since Stevenson suggests making a TV display, which would of necessity require **white** light. Even a high school student taking a basic physics class knows that the primary colors of light mix to produce white light. Based on the facts in Stevenson, Stevenson implicitly suggests using a phosphor capable of producing white light at least as one of the "different colors" (*id.*). Thus, for Patentee and Stringfellow to even suggest that Stevenson fails to disclose white light simply because the term "white" was not explicitly used is contrary to the facts of record and that which was notoriously well known to those of ordinary skill in the art, as evidenced by Pinnow and Patentee's admitted prior art in the '175 patent, boht of which taught that phosphor **mixtures** of primary colors produce white light when excited by blue-to-UV light and that these phosphor mixtures were known (1) since the development of fluorescent light bulbs (the '175 patent, col. 3, lines 40-52) and (2) at least since Pinnow in 1973 (Pinnow, col. 3, lines 24-55). There is no need for Stevenson to explicitly state "white" light is produced by mixing phosphors when it was notoriously well known in the art before the time of Stevenson, as admitted in the '175 patent and in Pinnow to mix phosphors that produce white light. Stevenson said enough to implicitly include white light. In short, Stevenson's patent discloses more to those of ordinary skill in the art than Patentee and Stringfellow wish to acknowledge.

Notably, neither Patentee nor Stringfellow deny that those of ordinary skill in the art at the time of Stevenson, knew about mixing phosphors to produce white light. The reason is that they **cannot** state this as it would contradict the very evidence in the '175 patent's APA indicating that mixed phosphors were known since at least the commercialization of fluorescent light bulbs. In fact, General Electric, although not inventing the fluorescent light bulb, commercialized it beginning in the mid-1930's:

> In 1934, Arthur Compton, a renowned physicist and GE consultant, reported to the GE lamp department on successful experiments with fluorescent lighting at General Electric Co., Ltd. in Great Britain (unrelated to General Electric in the United States). Stimulated by this report, and with all of the key elements available, a team led by George E. Inman built a prototype fluorescent lamp in 1934 at General Electric's Nela Park (Ohio) engineering laboratory. This was not a trivial exercise; as noted by Arthur A. Bright, "A great deal of experimentation had to be done on lamp sizes and shapes,

> cathode construction, gas pressures of both argon and mercury vapor, **colors of fluorescent powders**, methods of attaching them to the inside of the tube, and other details of the lamp and its auxiliaries before the new device was ready for the public."[8]

(http://en.wikipedia.org/wiki/Fluorescent_lamp#cite_note-Bright-7; emphasis added)

The citation, [8], is

> Bright, Jr., Arthur A. (**1949**). *The Electric-Lamp Industry*. MacMillan. Pages 221–223 describe Moore tubes. Pages 369–374 describe neon tube lighting. Page 385 discusses Risler's contributions to fluorescent coatings in the 1920s. **Pages 388–391 discuss the development of the commercial fluorescent at General Electric in the 1930s.**

There can be no question that mixing phosphors for each of the primary colors to produce white light was so well known by the 1970's when Stevenson was filed that there was no need to explicitly state this, especially since Stevenson explicitly states that different colors can be produced, that primary colors can be produced and that a TV can be made all of which imply **white** light output, whether by mixing the phosphors together or by mixing the primary colors after they are produced.

None of the '175 patent, Patentee, or Stringfellow indicates that there is anything mysterious or difficult about the selection of phosphors. In fact, not only did Baretz use commercially available LEDs, but Baretz also used commercially available phosphors (the '175 patent, col. 9, lines 18-29; Fourth Baretz Declaration dated 3/26/2012, ¶¶ 9-11). Thus, no evidence of record suggests that there would be any problem using **known** LEDs and **known** phosphors. What then did Baretz and Tischler achieve that was not already disclosed in each of Stevenson, not to mention Tabuchi? Each of Stevenson and Tabuchi already used GaN-based LEDs and organic or inorganic phosphors to produce visible light that only Patentee and Stringfellow question as somehow excluding white light. It simply cannot be seen as novel and non-obvious to mix the phosphors since this was known exceedingly long before the time of the '175 patent. What exactly then is novel and non-obvious in the '175 patent claims over that which was disclosed in each of Stevenson and Tabuchi?

2. A single white light LED was known by the time of Stevenson, Tabuchi, and Tadatsu

Patentee argues that it was not known how to construct a single LED that would produce white light before 1994, relying on a press release falsely stating that it was "impossible" before 1994:

> The Stevenson et al. reference does not mention or suggest the provision of a single LED that would produce white light, or of backlight illumination of LCD displays. The Stevenson et al. reference was issued on June 25, 1974. At that time, there was no knowledge or awareness that a single white light LED product

> was feasible or of how it could be constructed. To the contrary, it was believed that such a product was not possible. Attached to the Stringfellow Declaration is a copy of a 1997 information release of Franhofer Institute, Freiberg, Germany, (Fraunhofer- Gesellschaft: Research News Special 1997, at http://www.fhg.de/presslmd- e/md1997/sondert2.htm) (copy attached as Exhibit N of the Stringfellow Declaration), which states that
>
> > "three years ago [i.e., in **1994**]...the emission of white light by a single chip LED was still **impossible**."
>
> This information release then goes on to state that
>
> > "This problem was solved by a research team at the Fraunhofer-Institut fur Angewandte Festkorperphysik IAF in Freiberg (Germany) and, at the same time, by their colleagues at Nichia Chemical Industries in Japan. Their innovative idea was to generate white light by luminescence conversion. They combined a blue emitting GaN LED with an organic dye or an inorganic phosphor, emitting at longer wavelengths, to synthesise white light by additive colour mixing."
>
> It is noted that the '175 patent involved in the present Reexamination proceeding has a filing date that is prior to the above-referenced 1997 information release of Franhofer Institute and thereby evidences earlier solution of the problem of single chip LED emission of white light, in relation to the reported research efforts of Fraunhofer-Institut fur Angewandte Festkorperphysik IAF and of Nichia Chemical Industries in Japan. This evidence is consistent with information that Nichia Chemical Industries is a licensee of the '175 patent. (Stringfellow Declaration, ¶41).
>
> Stevenson therefore **teaches away** from the use of a single-die LED and a luminophoric medium to generate a white light output, and therefore, lacks basis for deriving the light-emission devices and displays of the present claimed invention.

(Patentee's Remarks, pp. 92-93; emphasis added)

Examiner respectfully disagrees. This is nothing more than a self-serving advertisement for Nichia and the Franhofer Institute and fails to discuss the work of others, particularly the relevant references used to reject the claims in this patent. For this reason, alone, this press release is irrelevant.

Moreover, the evidence of record in these proceedings shows that the above article is factually wrong. Each of Stevenson (in 1974) and Tabuchi (in 1973), as pointed out in the rejections above, used **exactly** that same method as cited in the article above to make white light: namely down-conversion of light from a GaN-based LED using organic or inorganic phosphors. Therefore, by 1973, it was known **exactly** how to construct the very thing Patentee says was allegedly impossible to construct.

In addition, Tadatsu (published in June 1993 and therefore **before** 1994) discloses a single LED that emits white light. As pointed out in the rejections above, Tadatsu discloses a packaged LED **11** wherein a primary radiation is down-converted by a luminophor **5** to a longer wavelength to produce white light:

> [Constitution] A light emitting diode having a light emitting device on a stem, the light emitting device being surrounded with a **resin mold**, wherein said **light emitting device is made of gallium nitride related compound semiconductors** which are expressed with a general formula of $Ga_xAl_{1-x}N$ (where $0 \leq x \leq 1$), and further wherein a **fluorescent dye or pigment**, which is **excited with emission light from said gallium nitride related compound semiconductors** and which **emits fluorescent light**, is **added to said resin mold**.

(Tadatsu translation, p. 1)

Tadatsu's Fig. 2 (reproduced below) shows the packaged LED has two leads **2, 3** and a housing member ("resin mold" **4**) within which the luminophor ("fluorescent dye" **5**) is dispersed. Tadatsu also indicates that the luminophor can be organic or inorganic:

> [0003] Ordinarily, a resin with a large index of refraction and a high transparency is selected for the resin mold 4, so that the emission light from the light emitting device is efficiently emitted to the air. In other cases, an **inorganic or organic pigment is mixed as a coloring agent in the resin mold 4** in order to convert or correct the emission color of the light emitting device. For instance, when a red pigment is added to a resin mold around a green light emitting device having GaP semiconductor materials, its **emission color turns into white**.

(Tadatsu translation ¶ [0003]; emphasis added)

So the folks at the Fraunhofer Institute and Nichia, upon which Patentee relies, very clearly do **not** know what they are talking with regard to what was known in the art because several others disclosed **single** LEDs that emit **white** light since 1973.

Ultimately, it does not matter what the press release from the Fraunhofer Institute says because it fails to discuss the references cited in this case, and it cannot be presumed that they were aware of these references. The fact that those at the Franhofer Institute fail to discuss the work disclosed in Stevenson, in Tabuchi, in Tadatsu, and in Abe cannot negate that this they disclose the claimed invention.

3. Patentee does not know what is legally meant by "teaching away"

Patentee argues that the above discussed press release from the Fraunhofer Institute somehow constitutes a "teaching away" in Stevenson from white light LEDs:

> Stevenson therefore **teaches away** from the use of a single-die LED and a luminophoric medium to generate a white light output, and therefore, lacks basis

> for deriving the light-emission devices and displays of the present claimed invention.
>
> (Patentee's Remarks dated 3/26/2012, p. 93, 1st ¶; emphasis added)

In addition, Patentee states,

> The Stevenson et al. reference states that different colors can be developed and that by use of different phosphors, all primary colors may be developed from the same basic device, and that an array of such devices may be used for color display systems, for example, a solid state TV screen. Stevenson therefore **teaches away** from the use of a single-die LED and a luminophoric medium to generate a white light output, and therefore lacks basis for deriving the light-emission devices and displays of the present claimed invention. (Stringfellow Declaration, ¶39).
>
> (Patentee's Remarks, dated 3/26/2012, p. 91; emphasis added)

(In fact, Stringfellow's paragraph 39 says nothing of teaching away, so this is Patentee's fabrication.)

MPEP 2123(II) is clear that a teaching away requires criticism, discouragement, or discredit of specific disclosure:

> Disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure or nonpreferred embodiments. *In re Susi*, 440 F.2d 442, 169 USPQ 423 (CCPA 1971).
>
> Furthermore, "[t]he prior art's mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not **criticize, discredit, or otherwise discourage the solution claimed**...." *In re Fulton*, 391 F.3d 1195, 1201, 73 USPQ2d 1141, 1146 (Fed. Cir. 2004).

Stevenson does none of this. Thus, there is no teaching away in Stevenson from white light from a single LED. Rather, white light from the single LED is implicitly included by the indication that "different colors" --of which white is one-- and "primary colors" can be made by the use of inorganic and organic phosphors and by the knowledge of those of ordinary skill in the lighting arts who know exceedingly well, long before 1974, that phosphor mixtures are used to produce white light by down-conversion of blue-to-UV light, as evidence by the '175 patent's admitted prior art and Pinnow, as discussed in the rejections, above.

C. Rejections over Abe and the Declarations filed under 37 CFR 1.131

1. The facts in *In re Hostettler* and *In re Spiller* and *Ex parte Goddard* do not apply to the facts in these proceedings

The facts in *In re Hostettler* and *In re Spiller* do not apply to the facts in these proceedings because the differences between the factual evidence presented in the declarations and claims are neither predictable (*Hostettler*) nor "trivial" (*Spiller*).

Patentee relies on *In re Hostettler* as applying to the Rule 1.131 declarations in these proceedings (Patentee's Remarks, pp. 108-109). *Hostettler* shows that the differences between that the differences between the claims and the embodiment disclosed in the declaration would be expected to those of ordinary skill in the art, i.e. are predictable. As Patentee pointed out, the Court concluded that the functionality of the molecule (monofunctional alcohol or polyfunctional alcohol) would not matter because the catalyst (stannous octoate) acts according to functional group, i.e. the alcohol group C-OH, whether there is a single such function group present in the molecule or many. In other words, the catalyst's behavior was predictable.

Hostettler is not blanket case law that lets Patentee avoid providing evidence of conception commensurate in scope with the claims. In this regard, MPEP 715.02 states,

> Further, a 37 CFR 1.131 affidavit is not insufficient merely because it does not show the identical disclosure of the reference(s) or the identical subject matter involved in the activity relied upon. If the affidavit contains facts showing a completion of the invention **commensurate with the extent of the invention as claimed** is shown in the reference or activity, the affidavit or declaration is sufficient, whether or not it is a showing of the identical disclosure of the reference or the identical subject matter involved in the activity. See *In re Wakefield*, 422 F.2d 897, 164 USPQ 636 (CCPA 1970).
>
> Even if applicant's 37 CFR 1.131 affidavit is **not fully commensurate** with the rejected claim, the applicant can still overcome the rejection by **showing that the differences between the claimed invention and the showing under 37 CFR 1.131 would have been obvious to one of ordinary skill in the art, in view of applicant's 37 CFR 1.131 evidence, prior to the effective date of the reference(s) or the activity**.

(Emphasis added.)

In this case, the differences between the claims and the disclose in the declarations is not commensurate in scope and Patentee fails to show "that the differences between the claimed invention and the showing under 37 CFR 1.131 would have been obvious to one of ordinary skill in the art, in view of applicant's 37 CFR 1.131 evidence, prior to the effective date of the reference(s) or the activity."

Turning now to *Hostettler*, the situation in *Hostettler* does not apply to the facts of this case. First, Patentee fails to show how the facts of *Hostettler* apply here. Second, LEDs are not chemical compounds, as in *Hostettler* and are not undergoing a catalyst-mediated chemical reaction to turn a single LED into a plurality of LEDs used to make a single light-emitting device. Patentee fails to provide factual evidence or otherwise to admit it that mere mention of a **single** LED connotes a single light emitting device composed of **plural** LEDs to those of skill in the art **before** the time of the declaration. Thus, absent such evidence or admission, Patentee cannot rely on its declarations to swear behind Abe.

Patentee also relies on *In re Spiller* as applying to the Rule 1.131 declarations in these proceedings (Patentee's Remarks, pp. 109-110). As pointed out in the excerpt from *Ex parte Goddard* (citing *Spiller*) provided by Patentee, the key in finding the declaration effective is that "the declaration differs in **some trivial way** from what is later claimed" difference (*id.*, p. 110, citing *Spiller*; emphasis added). As will be shown below, the differences between the features disclosed in the declaration and the claims is not trivial. For example, there is no indication anywhere in the Baretz or Tischler Declarations of conception of (1) a **plurality** of semiconductor LEDs in a single light-emitting device, as required in all claims, (2) a semiconductor **laser** (claim 3 and its dependent claims), (3) a **plurality** of semiconductor lasers (claim 3 and its dependent claims), and (4) a liquid crystal display having a backlight made from plural LEDs (claim 24 and its dependent claims). Patentee fails to admit or provide factual objective evidence that the aforementioned differences between the declaration and the claims are trivial, pursuant to *Spiller*. Therefore, *Spiller* does not apply here. If anything, *Spiller* serves to support Examiner's position that the declarations are ineffective to swear behind Abe.

If Patentee is implying (by citing *Spiller*) that the differences between the facts in the declaration and the claims are merely trivial, then this too is improper. Patentee cannot argue, on the one hand, that the differences are trivial in order to gain an earlier conception date and then, on the other hand, argue that the differences are **not** trivial in order to overcome the prior art rejections. Pursuant to *Spiller*, unless Patentee provides evidence or otherwise admits that the differences between the facts in the declaration and the claims are merely trivial, Patentee cannot rely on the declarations to provide evidence of conception of the claimed light-emitting devices.

2. The fourth Baretz, fourth Tischler, and third Elliot Declarations are ineffective in swearing behind Abe

At pages 107-136 of Patentee's Remarks dated 3/26/2012, Patentee relies on the aforementioned declarations of Baretz, Tischler, and Elliot to swear behind the date of Abe, 1/3/95. Patentee's Remarks at pp. 38-55 does little more than quote virtually all of the **fourth** Baretz Declaration (pp. 110-125), the **third** Elliot Declaration (pp. 125-134), and the **fourth** Tischler Declaration (p. 134-136). Accordingly, these declarations will be addressed concurrently with Patentee's Remarks.

The first Elliot Declaration, first Baretz Declaration, and first Tischler Declaration (submitted 11/20/2010), the second Baretz Declaration and second Tischler

Declaration (submitted 5/3/2011), and the third Baretz Declartion, third Tischler Declaration, and second Elliot Declaration submitted on 1/7/2012 have all been addressed previously. (See the Non-Final Rejection dated 3/3/2011 at pages 35-39, the Final Rejection dated 11/7/2011, pp. 60-64 and the Non-Final Rejection date 1/26/2012, pp. 52-59.) The **fourth** Baretz Declartion, **fourth** Tischler Declaration, and **third** Elliot Declaration submitted on 3/26/2012 include the information presented in their previous declarations, and more, so addressing these latest declarations effectively address all of the previous declarations as well.

The **fourth** Baretz Declartion, **fourth** Tischler Declaration, and **third** Elliot Declaration submitted on 3/26/2012 under 37 CFR 1.131 have been considered but are **ineffective** to overcome Abe (US 5,535,230).

a. Baretz's Exhibit A: the fax to Duncan Brown (¶¶ 8-12)

The evidence submitted is insufficient to establish a conception of the **claimed** invention prior to the effective date of Abe. While conception is the mental part of the inventive act, it must be capable of proof, such as by demonstrative evidence or by a complete disclosure to another. Conception is more than a vague idea of how to solve a problem. The requisite means themselves and their interaction must also be comprehended. See *Mergenthaler v. Scudder*, 1897 C.D. 724, 81 O.G. 1417 (D.C. Cir. 1897).

In this case, Abe was filed in the United States on 3 January 1995. All of the evidence provided by the Baretz and Tischler Declarations of conception of the **claimed** invention prior to 3 January 1995 is the fax dated 30 July 1994, stating,

> REFERENCE: White Light Emitting Diodes (LED)
>
> Duncan -
>
> Enclosed are some samples of the Lumogen dyes already cast into PMMA sheets. These dyes may be useful, when incorporated into polycarbonate LED lenses, to attenuate and shift the light emission from UV or Blue (assuming [sic] a GaN die) to either a green, yellow, or red emission, or some combination of these emissions. An appropriate combination would, in theory, generate white light.
>
> I will see if I can get some information on purchasing these Lumogen dyes already mixed into polycarbonate.
>
> Bruce Baretz

(Exhibit 3 of both Baretz and Tischler Declarations submitted 11/20/2010)

(While the document called, "Fax Note" ("Exhibit 5") in each of the Declarations is noted, it was not written until **7** January 1995 which is four days **after** the filing of Abe in the US.)

In this case, all that Baretz has evidence of is producing white light by shifting light from an UV- or blue-light LED to "a green, yellow, or red emission, or some combination of these emissions", something already done by several others, including Stevenson in 1973 and Tabuchi in 1973. By contrast, each of the independent claims includes features not apparently contemplated by the inventors. In this regard, MPEP 2138.04 states,

> Conception has been defined as "the **complete** performance of the mental part of the inventive act" and it is "the formation in the mind of the inventor of a definite and permanent idea of the **complete** and **operative** invention as it is thereafter to be applied in practice...." *Townsend v. Smith*, 36 F.2d 292, 295, 4 USPQ 269, 271 (CCPA 1930). ... Conception has also been defined as a disclosure of an invention which enables one skilled in the art to reduce the invention to a practical form without "exercise of the inventive faculty." *Gunter v. Stream*, 573 F.2d 77, 197 USPQ 482 (CCPA 1978). See also *Coleman v. Dines*, 754 F.2d 353, 224 USPQ 857 (Fed. Cir. 1985) (It is settled that in establishing conception a party must show possession **of every feature recited in the count**, and that every limitation of the count **must have been known to the inventor at the time of the alleged conception. Conception must be proved by corroborating evidence.**)

(Emphasis added.)

The features in each of claims 2, 3, 4, 11-13, 21-24, and 26, **not** apparently contemplated before 3 January 1995, are shown in bold highlight below.

> *2. A light-emitting device according to claim 1, comprising a* ***two-lead array*** *of single-die semiconductor LEDs.*
>
> *3. A light-emitting device, comprising:*
>
> *a* ***semiconductor laser*** *coupleable with a power supply to emit a primary radiation having a relatively shorter wavelength outside the visible light spectrum; and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits polychromatic radiation in the visible light spectrum, with different wavelengths of said polychromatic radiation mixing to produce a white light output.*
>
> *4. A light-emitting device according to claim 3, wherein said* ***semiconductor laser*** *includes an active material selected from the group consisting of* ***III-V alloys*** *and* ***II-VI alloys****.*
>
> *11. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device includes* ***a substrate and a multilayer device structure****, and wherein said substrate comprises silicon carbide.*

> *12. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device includes **a substrate and a multilayer device structure**, and wherein said **substrate comprises a material** selected from the group consisting of **sapphire,** SiC, and **InGaAlN**.*
>
> *13. A light-emitting device according to claim 12, wherein said **multilayer device structure** includes layers selected from the group consisting of silicon carbide, **aluminum nitride**, gallium nitride, **gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys**.*
>
> *21. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single: die, **two-lead** semiconductor LED.*
>
> *22. A light-emitting device according to claim 5, wherein each single-die semiconductor LED present in the device comprises a single-die **two-lead** semiconductor LED.*
>
> *23. A light-emitting device according to claim 5, comprising a **two-lead array of single-die semiconductor LEDs**.*
>
> *24. **A liquid crystal display**, including:*
>
> ***a backlight member including a multiplicity of light-emitting devices**, each light-emitting device comprising:*
>
> *at least one single-die semiconductor light-emitting diode (LED) coupleable with a power supply to emit a primary radiation which is the same for each single-die LED present in the device, said primary radiation being a relatively shorter wavelength radiation, and*
>
> *a down-converting luminophoric medium arranged in receiving relationship to said primary radiation, and which in exposure to said primary radiation responsively emits a secondary, relatively longer wavelength, polychromatic radiation, with separate wavelengths of said polychromatic radiation mixing to produce a white light output.*
>
> *26. A light-emission device, comprising*
>
> *a single-die, **two-lead semiconductor light-emitting diode** emitting radiation; and*
>
> *a recipient down-converting luminophoric medium for down-converting the radiation emitted by the light-emitting diode, to a polychromatic white light.*

With regard to **claims 2, 21-23, and 26**, there is no evidence of conception of the number of leads the diode would have, much less, specifically **two leads** (claims

21, 22, and 26). Nor is there evidence of conception of a ***two-lead*** *array of single-die semiconductor LEDs* (claims 2 and 23).

With regard to **claim 3**, there is no indication of evidence of conception of a *semiconductor* ***laser*** as the primary source of radiation. In this regard, Baretz's Invention Report from January 7, 1995 mentions only the word "lasing" along with a question mark:

> h. Potential for lasing to take place within dome?
>
> (First Baretz Declaration dated 11/20/2010, Exhibit 2, "page 12 of 14")

With regard to **claim 4**, there is no indication of evidence of conception of using any specific semiconductor material (i.e. III-V or II-VI semiconductor materials) to produce a semiconductor **laser** at least because there exists no evidence of conception of the semiconductor **laser**.

With regard to **claims 11 and 12**, there is no evidence of conception of an LED including *a substrate and a multilayer device structure*.

Further in regard to **claims 12 and 13**, there is no evidence of conception of the substrate materials of sapphire and InGaAlN or light-producing layers of *aluminum nitride, gallium phosphide, germanium carbide, indium nitride, and their mixtures and alloys*.

While the **first** Baretz Declaration provided support for using the light-emitting device as a backlight for a LCD (as in claim 24), the evidence of conception was not until June 29, 1995 (first Baretz Declaration, ¶ 12). There is no evidence to support conception prior to that date. Inasmuch as Abe is not used to reject claim 24, the point is moot.

b. Baretz's Exhibit B: the Nichia data sheets and letter to Tomoji Ogawa and the associated discussions with Drs. Tischler and Brown, and Elliot (¶¶ 13-18)

There is nothing in either the letter or the Nichia data sheets or the discussions that makes up for the deficiencies in Exhibit A or the Invention Report for evidence of conception of the **claimed** features discussed above prior to 7 January 1995. Again, 37 CFR 1.131(b) requires "[o]riginal exhibits of drawings or records, or photocopies thereof, must accompany and form part of the affidavit or declaration or their absence must be satisfactorily explained." Discussions with Drs. Tischer and Brown that occurred 17 years before the time of the declarations fails to amount to "[o]riginal exhibits of drawings or records, or photocopies thereof". If Patentee conceived of more than that indicates in Exhibits A and B, at a time before 7 January 1995 when the invention Report was "prepared", it is unclear as to why Patentee cannot provide "[o]riginal exhibits of drawings or records, or photocopies thereof" or satisfactorily explain why Patentee fails to have provided them.

c. Discussions between Drs. Baretz and Elliot and the search report (¶¶ 19-23)

The fourth Baretz Declaration and third Elliot Declaration appear to have the same bullet points indicating as to that which was discussed "prior to December 20, 1994" when the search report was done (Baretz Declaration dated 3/26/2012, ¶ 19).

While Examiner acknowledges that MPEP 715.07 indicates that verbal testimony may be relied on. There is no factual evidence that the conversations took place. Examiner acknowledges the bullet points in the fourth Baretz Declaration dated 3/26/2012, ¶ 19, and the third Elliot Declaration, ¶ 11, attesting to exactly what was discussed **17 years ago**, but these are not "[o]riginal exhibits of drawings or records, or photocopies thereof" and the absence of the originals is not satisfactorily explained. In other words, neither Baretz nor Elliot have corroborating evidence of the conversation. The search report is not corroborating evidence that anything was discussed other than what others did, not Baretz.

Baretz and Elliot previously and presently attempt to provide corroborating evidence that the Invention Report --indicated by Baretz, himself, to be done on 7 January 1995-- was instead completed before 20 December 1994 when the search report of prior art was done (fourth Baretz Declartion, ¶¶ 20-23; third Elliot Declaration, ¶¶ 11-12). With regard to the search report of the prior art, the search report itself fails to provide evidence of the **claimed** invention or when the **claimed** invention was completed. Rather the date of the search report is merely the date Baretz and/or Elliot investigated that which **others** did. In this regard, 37 CFR 1.131(b) states,

> The showing of **facts** shall be such, in character and weight, as to establish reduction to practice prior to the effective date of the reference, or conception of the invention prior to the effective date of the reference coupled with due diligence from prior to said date to a subsequent reduction to practice or to the filing of the application. **Original exhibits of drawings or records,** or photocopies thereof, **must** accompany and form part of the affidavit or declaration **or their absence must be satisfactorily explained**.

(Emphasis added.)

Patentee fails to provide "[o]riginal exhibits of drawings or records, or photocopies thereof" of that which was conceived and/or reduced to practice **before** 7 January 1995, which is the date Baretz, himself, indicated the Invention Report was written. Given the absence of evidence, it is unclear as to why Baretz and/or Elliot have failed to provide a **satisfactory explanation** as to the absence of drawings or records indicating that which was conceived and/or reduced to practice, and by **what date**, as required by 37 CFR 1.131.

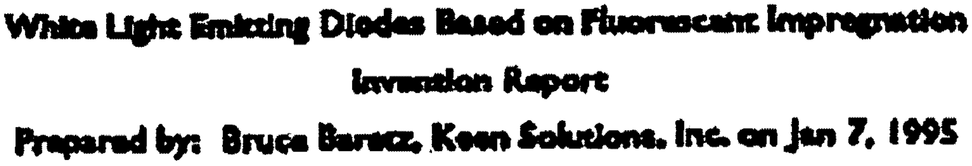
With regard to Baretz's alleged conversation with Dr. Elliot that occurred prior to 20 December **1994** (Baretz Declaration, ¶ 9)(see also, the second Elliot Declaration, submitted 1/7/2012, ¶ 8) during which the contents of the Invention Report were discussed, there is no corroborating evidenced as to that which was discussed and when. In other words, Baretz's and Elliot's recollection of a conversation fails to provide facts as to when and exactly what was discussed. In this regard, MPEP 2138.04 states,

> Conception has been defined as "the **complete** performance of the mental part of the inventive act" and it is "the formation in the mind of the inventor of a definite and permanent idea of the **complete** and **operative** invention as it is thereafter to be applied in practice...." *Townsend v. Smith*, 36 F.2d 292, 295, 4 USPQ 269, 271 (CCPA 1930). ... Conception has also been defined as a disclosure of an invention which enables one skilled in the art to reduce the invention to a practical form without "exercise of the inventive faculty." *Gunter v. Stream*, 573 F.2d 77, 197 USPQ 482 (CCPA 1978). See also *Coleman v. Dines*, 754 F.2d 353, 224 USPQ 857 (Fed. Cir. 1985) (It is settled that in establishing conception a party must show possession **of every feature recited in the count**, and that every limitation of the count **must have been known to the inventor at the time of the alleged conception. Conception must be proved by corroborating evidence.**)

(Emphasis added.)

In addition, given that the alleged conversation happened 16 to 17 years before the recollection indicated in the third Baretz and second Elliot Declaration, it is reasonably viewed with skepticism that every detail of every claimed feature could be recalled with certitude. This point notwithstanding, recollection of a conversation fails to constitute factual evidence of that which was conceived and/or reduced to practice and the date of said conception and/or reduction to practice.

Without "[o]riginal exhibits of drawings or records, or photocopies thereof" (rule 131, *id.*) to support exactly when the conversation occurred and exactly that which was discussed, Examiner respectfully maintains that there exists no factual support for the conception and/or reduction to practice of the invention prior to the date Baretz himself has already attested to having "prepared" the Invention Report, specifically 7 January 1995:



White Light Emitting Diodes Based on Fluorescent Impregnation

Invention Report

Prepared by: Bruce Baretz, Keen Solutions, Inc. on Jan 7, 1995

(first Baretz Declaration submitted 11/20/2010, Exhibit 2)

"White Light Emitting Diodes Based on Fluorescent Impregnation
Invention Report
Prepared by: Bruce Baretz, Keen Solutions, Inc. on Jan 7, 1995,"

(first Baretz Declaration submitted 11/20/2010, ¶ 10)

d. Fourth Tischler Declaration dated 3/26/2012, ¶¶ 6-12

The fourth Tischler Declaration fails to make up for the deficiencies discussed above in the Baretz and Tischler Declarations. In other words, Tischler fails to provide factual evidence that the **claimed features indicated above** were conceived of prior to 7 January 1995.

Based on all of the foregoing, Examiner respectfully maintains that none of the Baretz, Tischler, or Elliot Declarations provides evidence of conception of the above claim features before the priority date of Abe. Accordingly, the rejections of the claims over Abe are maintained.

3. Specific rejection relying on Abe as a base reference

Patentee reiterates that Abe is disqualified based on the fourth Baretz Declaration, third Elliot Declaration, and fourth Tischler Declaration (Patentee's Remarks dated 3/26/2012, pp. 153-158). For the reasons indicated above, Examiner respectfully maintains that the Declarations are ineffective in overcoming Abe.

Patentee further argues,

> It again is pointed out that Abe contains no derivative basis for features specified in the patentees' claims (see previous discussion of Abe as a secondary reference, in the Menda Rejections), including:
>
> - contiguous relationship of a primary emitter and the luminophoric medium;
> - disposing the emitter element in laterally spaced apart facing relationship to luminophoric material; and
> - arrangement of a primary radiation emitter for direct impingement of the primary radiation on luminophoric material or on glass or polymer in which luminophoric material is dispersed.

(Patentee's Remarks dated 3/26/2012, p. 158)

With regard to the last two bulleted features, as indicated in the rejection's Abe does, in fact, disclose each of these features. Abe's Fig. 1(a) very clearly shows that the LED **1** is in laterally spaced facing relationship to the luminophoric medium **4**, and that the primary radiation from said LED **1** directly impinges the luminophoric medium **4**. The fact that the primary radiation passes through a lens **3** does not make the impingement anything less than "direct". Just as in the '175 patent's Fig. 2, the radiation from the LED passes through a medium of some kind (e.g. air) **before** impinging the luminophoric medium because the '175 patent makes no mention of a vacuum.

As to the arguments directed to combinations of Abe directed to LCDs, Abe has never been suggested to anticipate LCDs, nor is Abe presently applied to reject claims directed to LCDs, so it is unclear as to why Patentee makes this argument.

D. Secondary Considerations

Before beginning, note that several claims remain rejected under 35 USC 102. Evidence of secondary considerations, such as unexpected results or commercial success, is irrelevant to rejections under 35 U.S.C. 102 and thus cannot overcome a rejection so based. *In re Wiggins*, 488 F.2d 538, 543, 179 USPQ 421, 425 (CCPA 1973).

1. No evidence of long-felt need

The section entitled, "Long Felt But Unsolved Need", in Patentee's Remarks dated 3/26/2012, pp. 137-139, Patentee argues that the '175 patent resolve long-felt but unsolved need. First, it is axiomatic that if a thing has been successfully done, then it cannot be an "unsolved" need. Stevenson and Tabuchi each successfully solved the problem in exactly the same manner as claimed: using a luminophor (phosphor) to convert blue-to-UV light from a GaN-based LED to white light. That is all that is claimed, and it was succesfully done by others (Stevenson and Tabuchi inventors) 20 years before the time of the '175 patent. Therefore, there is no unsolved problem.

Importantly, there is no showing that others of ordinary skill in the art were working on the problem and if so, for how long. In addition, there is no evidence that if persons skilled in the art who were presumably working on the problem knew of the teachings of the above cited references, e.g. **Stevenson, Tabuchi, Tadatsu, Abe**, they would still be unable to solve the problem. **See MPEP § 716.04**.

Patentee points out the benefits of LEDs over other devices such as "incandescent bulbs, prior art LED RGB arrays, and planar light emission electroluminescent devices" (Patentee's Remarks daed 3/26/2012, p. 137). This is irrelevant to the inquiry of long-felt need. Patentee fails to understand what "long-felt but unsolved need" is. The need must exist in the relevant art. Here it is LED art, not incandescent bulbs, EL devices, or the like.

Patentee states that the claimed subject matter solved a problem that was long standing in the art but fails to point out what the problem is, especially given the success of Stevenson and Tabuchi in doing exactly what was claimed: using a luminophor (phosphor) to convert the blue-to-UV light from a GaN-based LED to white light. That is all that is claimed, and it was successfully done by others (Stevenson and Tabuchi inventors) 20 years before the time of the '175 patent.

Patentee and (Stringfellow) erroneously suggest that Stevenson serves as evidence of long-felt but unsolved need (Patentee's Remarks, pp. 137-138). This is legally erroneous and factually incorrect. Patentee and Stringfellow appear to confuse long-felt need with a mere lack of **commercialization**, but commercialization is not the correct yardstick by which novelty and non-obviousness is measured, disclosure is. Stevenson and Tabuchi need not have commercialized their inventions for the disclosure of their inventions to exist. The fact that the Stevenson and Tabuchi inventions were not **commercialized** does not mean that they were not **disclosed** to the public in the early 1970's, 20 years before the time of the '175 patent.

Patentee (and Stringfellow) again refers to the Fraunhofer press release as somehow suggesting that others tried but failed to make the claimed invention (Patentee's Remarks dated 3/26/2012, paragraph bridging pp. 137-138). Again, as noted above, the Fraunhofer press release is merely a self-serving advertisement. The Fraunhofer press release makes no mention of any of Stevenson, Tabuchi, Tadatsu, and Abe, all of whom made single-die semiconductor LEDs or laser diodes that emit light by bathochromic (shifting to longer wavelength or lower energy) conversion of light from said LED or laser by a luminophor (e.g. phosphor). Again, in this regard, there is no showing in the Fraunhofer press release that others of ordinary skill in the art were working on the problem and if so, for how long. In addition, there is no evidence that if persons skilled in the art who were presumably working on the problem knew of the teachings of the above cited references, e.g. **Stevenson, Tabuchi, Tadatsu, Abe**, they would still be unable to solve the problem. **See MPEP § 716.04**.

Patentee also argues that the "perceived as unsuitable for backlighting, as lacking desired brightness and uniformity for backlighting, and being sufficiently miniscule, with a typical size 0.1 mm^2 (see Stringfellow Declaration, ¶27) that backlighting utilizing such a miniscule LEDs, with associated addressing and interconnection issues, was regarded as unworkable and prohibitively expensive" (Patentee's Remarks dated 3/26/2012, p. 138 (last full ¶). As noted above in addressing Stringfellow's arguments directed at Menda, Stringfellow's opinion in this regard contradicts the facts of record. In addition, the **solution**s to these alleged deficiencies (i.e. brightness, uniformity, etc.) is **claimed relative to the closest prior art,** i.e. Stevenson, Tabuchi, Menda. If the inventors of the '175 patent did something that solved the alleged deficiencies in the light-emitting devices of Stevenson, Tabuchi, Menda, inter alia, to yield the suitable properties, then it must be disclosed and claimed. Notably, Patentee does not argue that it is simply making a single LEDs emit **white** light that was missing (i.e. the long-felt need) in the art. Patentee cannot make that assertion since it was done by Stevenson (1973), Tabuchi (1973), Tadatsu (1991), and Abe (1994).

Simply arguing that the '175 patent solved problems does not mean that the **critical features** that made it suitable for commercialization are claimed. Those critical features may be the very things that distinguish over the invention of others, and therefore **must** be claimed in order to have patentable weight. It is not enough for Patentee to claim the very same things disclosed in the prior art and then simply argue that they solved some problem not solved in the prior art. In other words, the problems Patentee alleges are solved by the '175 patent must be the thing that is not disclosed in the art, and it **must** be claimed. As drafted, the claims recite nothing that is not already notoriously well known in the art, as evidenced by Stevenson, Tabuchi, Tadatsu, and Abe.

2. There is no evidence of failure of others, especially since Stevenson, Tabuchi, and Abe anticipate the claimed device

In the section of Patentee's Remarks dated 3/26/2012, entitled, "Failure of Others", pp. 139-140, Patentee argues that there existed a failure of others to make the claimed device. However, the evidence of record, e.g. Stevenson, Tabuchi, and Abe, shows that others succeeded in making the claimed device long before the time of the '175 patent. **See MPEP § 716.04**.

Patentee argues that pursuits in **other** areas (e.g. **organic** light-emitting elements and electroluminescent panels) somehow equates to failure of others to make the **claimed** device (Patentee's Remarks, p. 139-140), which is instead drawn to using a luminophor (e.g. phosphor) to down-convert light from a GaN-based LED. Patentee entirely fails to provide one shred of evidence that Stevenson, Tabuchi, Tadatsu, and Abe failed to do this. In fact, Stevenson, Tabuchi, and Abe do it in the same way **claimed**.

Absent a showing that others were **working on the same invention** and failed, the argument is irrelevant.

3. There is no evidence of unexpected results

In the section of Patentee's Remarks dated 3/26/2012, entitled, "Failure of Others", pp. 140-141, Patentee argues that there exist unexpected results. However, the results are totally expected as evidenced by each of Stevenson, Tabuchi, Tadatsu, and Abe. In other words, producing white light by using a luminophor (phosphor) to convert blue-to-UV light from a GaN-based LED was known in the art since 1973.

Therefore, Patentee cannot allege unexpected results. If, on the other hand, there was something different about the '175 patent's invention that produced the unexpected results, then it **must** be claimed.

Again, as drafted, the claims recite no feature different from the prior art that produces the alleged unexpected results (e.g. "sufficient brightness", "color uniformity", "high intensity white light"; *id.*). Patentee does not even attempt to point to something that is **claimed** that is the critical feature producing the alleged unexpected results. It is well-settled that the unexpected result must be relative to the closest prior art. Inasmuch as each of Stevenson, Tabuchi, and Abe disclose the same claimed features to produce white light (i.e. a luminophor (phosphor) to convert blue-to-UV light from a GaN-based LED to white light), then the '175 claims **must** include the features that produce the unexpected results in order to distinguish over the prior art.

4. Commercial success and the third Brandes Declaration

a. Fraunhofer press release is not evidence of commercial success of the claimed invention

Patentee argues that the Fraunhofer press release allegedly provides evidence of commercial success for the claimed invention (Patentee's Remarks, pp. 141-142). However, the article is directed to the invention of others, rather than that in the instant invention. As noted above, the Fraunhofer press release's suggestion that the invention was impossible prior to their personal efforts is merely a self-serving advertisement. Also as noted above, each of Stevenson (1973), Tabuchi (1973), Tadatsu (1991) and Abe (1994) has already achieved emission of white light from a single LED and each of Stevenson and Tabuchi (each in 1973) achieved using ordinary phosphors to down convert the blue-to-UV light from GaN-based LEDs to light of any color phosphors would make, which necessarily includes white light since phosphor mixtures that make white light were known at least since 1934 when General Electric commercialized fluorescent light bulbs. In addition, the '175 patent admits that such phosphors were notoriously well known (the '175 patent, e.g. at col. 3, line 40 to col. 4, line 42) and used to down-convert the primary blue-to-UV radiation to white light. Therefore, Examiner respectfully maintains that the Fraunhofer article is not only inaccurate, it contradicts the factual objective evidence that others succeeded in making single-die semiconductor LEDs that emit white light long before Fraunhofer did.

Moreover, Patentee surmises, based on the Fraunhofer press release, that the commercial success is because the device is a single semiconductor LED that emits white light. However, if this is the reason for the commercial success, then it would not overcome the prior art because Stevenson, Tabuchi, Tadatsu, and Abe all produced white light from a single-die semiconductor LED before the time of the '175 patent. Stevenson, Tabuchi, and Abe, as evidenced by the rejections above, all achieved white light production at least to the extent claimed. While Tadatsu produces the white light from the single LED in a manner different from that claimed, it does not negate that Tabuchi's device uses a **single**-die semiconductor LED and a phosphor that down-converts the primary light from the LED to produce **white** light. The distinction between the claims and Tabuchi is only that Tabuchi's device uses light from the LED as well as light from the phosphor to produce white light, while the claims require all of the down-converted light to be sufficient to produce white light. This does not negate that Fraunhofer cannot claim to be the first to do something that several others did very long before those at the Fraunhofer Institute did. And Patentee cannot rely on the success of others as being that which allegedly created commercial success for the **claimed** invention.

b. ZDNet press release is not evidence of commercial success of the claimed invention.

Patentee argues that the ZDNet press release allegedly provides evidence of commercial success for the claimed invention (Patentee's Remarks of 3/2/2012, pp. 142-144). All the ZDNet press release states is that the patents are predominantly owned by Nichia, Toyota Gosei and Cree (Cree being the assignees of the instant patent). This is not evidence of commercial success. Rather it is only an acknowledgement that Cree, *inter alia*, was able to get some patents on the technology; the first of said patents from which several others claim priority is presently under reexamination here.

Patentee further surmises that "[t]he KAIST information [i.e. the ZDNet press release] therefore provides further evidence of the nexus between the claims involved in the present reexamination proceedings, and the commercial success of the patent owner, Cree, Inc. in the field of white light LED technology and products" (*id.*, p. 144). Again, several others (e.g. Stevenson, Tabuchi, and Abe) did the same thing in the same way as claimed.

And again, Patentee alleges that the thing that made their patents commercial success is that they are **single** LEDs the produce **white** light. As will be shown herein below, Patentee changes its tune as to what made the claimed invention commercially successful. As will be discussed below, Patentee has created a laundry list of claim features (e.g. where the phosphor is located relative to the LED) and alleges that each one of those claimed features caused the commercial success, contrary to that which they have twice argued above. If it is the single LEDs producing white light that made the claimed invention successful, then pointing to individual features, such as where the phosphor is located relative to the LED cannot be the thing that made the claimed invention commercially successful. In other words, the reasons conflict with each other. Moreover, Patentee has the burden of proof to show that something other than that shown in each of Stevenson, Tabuchi, and Abe is the thing that made the claims commercially successful. Patentee has not even provided evidence of a cause-effect relationship between any of the claimed features and commercial success, much less showing that the claimed features lacking in each of Stevenson, Tabuchi, and Abe are the reasons for commercial success. Given the each of Stevenson and Tabuchi use phosphors to down-convert blue-to-UV radiation to white light back in 1973 and Tabuchi, in particular, discloses the identical phosphor-LED relative location (compare Tabuchi's Fig. 1 and Abe's Fig. 1(a) to the '175 patent's Fig. 2) the bar is set exceedingly high.

5. The third Brandes Declaration fails to provide evidence of commercial success

Patentee adds another declaration, the third Brandes Declaration (submitted 3/26/2012) onto the second Brandes Declaration for alleged evidence of commercial success. (See Patentee's Remarks submitted 3/26/2012, pp. 144-153.) Consequently, the second and third Brandes Declarations will be addressed in conjunction with Patentee's Remarks.

(Note that the third Brandes Declaration, dated 3/26/2012, deals with three completely different issues the first two of which have been addressed above. The paragraphs drawn to the alleged commercial success begin in the declaration's paragraph 16.)

a. The second Brandes Declaration (1/7/2012) fails to establish a nexus between the claimed invention and evidence of commercial success

First, Patentee and Brandes fail to provide evidence that the **claimed** invention had commercial success as, again, the work of **others** does not provide reasons why the **claimed** invention was perceived as commercially successful. Second, both Patentee and Brandes fail to establish a nexus between the invention **as claimed** and commercial success established because there is no correlational evidence for any **claimed** feature --distinct from the applied prior art of Stevenson, Tabuchi, and Abe-- being that feature generating commercial success for the invention. In this regard, MPEP 716.01(b) states,

> **716.01(b) Nexus Requirement and Evidence of Nonobviousness**
>
> **TO BE OF PROBATIVE VALUE, ANY SECONDARY EVIDENCE MUST BE RELATED TO THE CLAIMED INVENTION (NEXUS REQUIRED)**
>
> The weight attached to evidence of secondary considerations by the examiner will depend upon its relevance to the issue of obviousness and the amount and nature of the evidence. Note the great reliance apparently placed on this type of evidence by the Supreme Court in upholding the patent in *United States v. Adams*, 383 U.S. 39,148 USPQ 479 (1966). To be given substantial weight in the determination of obviousness or nonobviousness, **evidence of secondary considerations must be relevant to the subject matter as claimed**, and therefore the **examiner must determine** whether there is a **nexus between the merits of the claimed invention and the evidence of secondary considerations.** *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 305 n.42, 227 USPQ 657, 673-674 n. 42

> (Fed. Cir. 1985), cert. denied, 475 U.S. 1017 (1986). The term "**nexus**" designates a **factually and legally sufficient connection between the objective evidence of nonobviousness and the claimed invention** so that the evidence is of probative value in the determination of nonobviousness. *Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 7 USPQ2d 1222 (Fed. Cir.), cert. denied, 488 U.S. 956 (1988).

(Emphasis added.)

Patentee first opines with regard to the second Brandes Declaration,

> Enclosed with this Response to the January 26, 2012 Office Action is a further Declaration of George R. Brandes under 37 CFR 1.132, supplementing his Declaration filed January 7, 2012, attesting to **Cree's licensing** of the '175 patent, and the increased commercial importance of the **claimed** single-die LED/luminophoric medium combinations in the form of **increasing sales** of such white LED devices and of consumer products incorporating white LED backlit LCD displays.
>
> As set forth in the prior Declaration of Dr. Brandes filed on January 7, 2012, the '175 patent has been recognized in the optoelectronics and illumination products industry as a **patent claiming a fundamental advance in the field of LED device and display technology**, as evidenced by its involvement as a key intellectual property asset in major commercial technology transactions set forth in such Declaration. As attested by Dr. Brandes, these transactions include **licensing** and **cross-licensing** transactions that evidence the recognition of the '175 patent by major companies in the optoelectronics and illumination products industry, e.g., Nichia, Philips, and Osram, and the royalty-bearing **license** agreements involving the '175 patent with various companies as part of Cree's **remote phosphor** licensing efforts.

(Patentee's Remarks dated 3/26/2012, p. 144; emphasis added)

Paragraph 4 of the second Brandes Declaration (1/7/2012), which is the only relevant paragraph in the second Brandes Declaration, presents licensing of others as evidence of commercial success of the claimed invention. However, licensing alone is insufficient. See *EWP Corp. v. Reliance Universal, Inc.*, 755 F.2d 898, 225 USPQ 20 (Fed. Cir. 1985) (evidence of licensing is a secondary consideration which must be carefully appraised as to its evidentiary value because **licensing programs may succeed for reasons unrelated to the unobviousness of the product or process**, e.g., license is mutually beneficial or less expensive than defending infringement suits). Absent evidence that the licensing is truly at arm's length, the examples of licensing are not persuasive of commercial success.

b. The third Brandes Declaration (3/26/2012) fails to establish a nexus between the claimed invention and evidence of commercial success

Patentee first opines with regard to the third Brandes Declaration,

> As further attested by Dr. Brandes, these transactions and the increased commercial importance of the claimed single-die LED/luminophoric medium combinations reflected by **increasing sales** of such white light LED devices and consumer products incorporating white LED backlit LCD displays, are **evidence of substantial commercial success having nexus to recited features of the claims issued in the '175 patent** and under current examination in the present Reexamination, as shown by the data set out in **Dr. Brandes' current Declaration**, and the accompanying discussion in such Declaration of the commercial success nexus factors, consistent with the requirements of MPEP 716.01(b) ("Nexus Requirement and Evidence of Nonobviousness") that there be a nexus between the merits of the claimed invention and the evidence of secondary considerations. *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 305 n.42, 227 USPQ 657, 673-674 n. 42 (Fed. Cir. 1985), cert. denied, 475 U.S. 1017 (1986).

(Patentee's Remarks, paragraph bridging pp. 144-145; emphasis added)

Increased sales does not, in and of itself, establish a nexus between the **claimed** invention and commercial success. For such a nexus to exist there must be evidence that it was the **claimed** invention that caused the increased sale. Each of Stevenson, Tabuchi, Tadatsu, and Abe, all disclose single-die semiconductor LEDs that emit white light; therefore, it cannot be that merely a single-die semiconductor LED that emits white light as being the thing that generated increased sales because that was the work of **others**, not of the **claimed** invention. In other words, Patentee and Brandes fail to provide that which is different from the claimed invention and that done in the prior art as being the reason for increased sales. Therefore, the data shown in the third Brandes Declaration is irrelevant because it is not shown to be caused by the **claimed** invention rather than be the work of others. In other words, there is no nexus. In this regard, MPEP 716.03(b)(I) states,

> In considering evidence of commercial success, **care should be taken to determine that the commercial success alleged is directly derived from the invention claimed**, in a marketplace where the consumer is free to choose on the basis of objective principles, and that such success is not the result of **heavy promotion or advertising, shift in advertising, consumption by purchasers normally tied to applicant or assignee, or other business events extraneous to the merits of the claimed invention, etc.** *In re Mageli*, 470 F.2d 1380, 176 USPQ 305 (CCPA 1973) (conclusory statements or opinions that **increased sales** were due to the merits of the invention are entitled to little weight); *In re Noznick*, 478 F.2d 1260, 178 USPQ 43 (CCPA 1973).

(Emphasis added.)

Given that Stevenson, Tabuchi, Tadatsu, and Abe all produced single-die semiconductor LEDs that emit white light, the bar is significantly higher for Patentee to establish a nexus between the **claimed** invention and the increased sales. The increased sales of white LEDs may be only because they were finally mass produced.

Turning now to the Brandes data in paragraphs 19-22, and Brandes' conclusions in paragraphs 23 which state,

> 23. I note in this respect that the '175 patent has been licensed to a major manufacturer of consumer products incorporating LED backlit LCD displays **as claimed in the '175 patent**.

(Third Brandes Declaration, p. 12, ¶ 23; emphasis added)

The fact that the '175 patent was licensed does not prove that the increased sales had anything to do with the **claimed** invention. Brandes fails show a correlation between the **claimed** invention and the sales numbers, much less that the licensing of the '175 patent had anything at all to do with it. Correlation does not prove causality. Thus, the mere fact that sales increased does not mean that it was the result of the '175 patent. In fact, Brandes does not even attempt to show a cause-effect relationship between the sales and the invention **as claimed**. Again, *In re Mageli*, 470 F.2d 1380, 176 USPQ 305 (CCPA 1973) holds that **conclusory statements or opinions** that increased sales were due to the merits of the invention are entitled to little weight. In addition, there is no evidence that the increase in sales was not due to other causes.

In paragraphs 24-40 of the third Brandes Declaration (and in Patentee's Remarks dated 3/26/2012, pp. 146-153) which virtually verbatim repeats the Brandes Declaration) Brandes merely makes a laundry list of each of the claim features and provides a blurb as to why the feature is a good thing and then merely opines that each one of said features is somehow independently responsible for the commercial success and that, therefore, a nexus exists. Examiner respectfully disagrees. Simply because a feature may have some **benefit** does not mean that the feature was the **cause** of the commercial success --especially given the fact that others (Stevenson and Tabuchi) used organic and inorganic phosphors to down-convert blue-to-UV radiation from a single GaN-based LEDs to produce white light. In addition, Abe and Tadatsu both use phosphors to down-convert light from a single-die LED to produce white light. In other words, others at least made single-die semiconductor LEDs that emit white light (Stevenson, Tabuchi, Tadatsu, Abe) and some did it in exactly the same manner as claimed (Stevenson and Tabuchi). Therefore, the commercial success **cannot** be due to simply making a single-die semiconductor LED that emits white light. If that were the case, then the commercialization could have started back in 1973. It has to be something other than a single-die semiconductor LED that emits white light and said something else **must be claimed.**

Without a showing of a cause-effect relationship between **each** feature in the laundry list cited in the Brandes Declaration (and repeated in Patentee's Remarks) and proof **for each feature** that it **caused** the increase in sales, then there is no nexus established. In fact, Brandes, is again, merely making conclusory statements and stating opinions for which no evidence of cause-effect relationship has been provided. The conclusory statements and opinions are entitled to little if any weight. As such absolutely no evidence has been provided by Patentee or Brandes that the invention **as claimed** is the cause of the commercial success; therefore, there is no evidence of a nexus.

Conclusion

Patent owner's amendment filed 3/26/2012 or the a reference cited in one of the three IDS filed 2/13/2012, 2/29/2012, or 4/4/2012 after the latest Office action on the merits (mailed 1/26/2012) necessitated the new grounds of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a), which indicates that an action may be made final if it is necessitated by amendment or "based on information submitted in an information disclosure statement". Here, Patentee submitted Stevenson and Tabuchi in the IDS dated 2/13/2012. Stevenson was used to reject claims in an Office action (mailed 10/20/2008) in the continuation application (10/623,198) of the application (08/621,937) that became the instant '175 patent that is presently being reexamined. Tabuchi was used in a rejection of claims in an Office action (mailed 7/14/2011) in the application 12/131,119 which claims priority to the application 08/621,937 that became the instant '175 patent that is presently being reexamined. Because Patentee presented these references after the mailing of the previous Office actions, including the Office action dated 1/26/2012, the new ground of rejection is necessitated by Patentee's providing the Stevenson and Tabuchi reference and/or by the proposed amendments to original claims 1 and 5 from which claims 12, 13, 21, and 22 depend, as well as the proposed new claims 62-188.

A shortened statutory period for response to this action is set to expire two (2) months from the mailing date of this action.

Extensions of time under 37 CFR 1.136(a) do not apply in reexamination proceedings. The provisions of 37 CFR 1.136 apply only to "an applicant" and not to parties in a reexamination proceeding. Further, in 35 U.S.C. 305 and in 37 CFR 1.550(a), it is required that reexamination proceedings "will be conducted with special dispatch within the Office."

Extensions of time in reexamination proceedings are provided for in 37 CFR 1.550(c). A request for extension of time must be filed on or before the day on which a response to this action is due, and it must be accompanied by the petition fee set forth in 37 CFR 1.17(g). The mere filing of a request will not effect any extension of time. An extension of time will be granted only for sufficient cause, and for a reasonable time specified.

The filing of a timely first response to this final rejection will be construed as including a request to extend the shortened statutory period for an additional month, which will be granted even if previous extensions have been granted. In no event, however, will the statutory period for response expire later than SIX MONTHS from the mailing date of the final action. See MPEP § 2265.

All correspondence relating to this *ex parte* reexamination proceeding should be directed as follows:

By **U.S. Postal Service Mail** to:

Mail Stop *Ex Partes* Reexam
ATTN: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

By FAX to: (571) 273-9900
Central Reexamination Unit

By hand to: Customer Service Window
Randolph Building
401 Dulany St.
Alexandria, VA 22314

Registered users of EFS-Web may alternatively submit such correspondence via the electronic filing system EFS-Web, at https://efs.uspto.gov/efile/myportal/efs-registered. EFS-Web offers the benefit of quick submissions to the particular area of the Office that needs to act on the correspondence. Also, EFS-Web submissions are "soft scanned" (i.e. electronically uploaded) directly into the official file for the reexamination proceeding, which offers parties the opportunity to review the content of their submissions after the "soft scanning" process is complete.

Telephone Numbers for reexamination inquiries:

Reexamination	(571) 272-7703
Central Reexam Unit (CRU)	(571) 272-7705
Reexamination Facsimile Transmission No.	(571) 273-9900

Any inquiry concerning this communication should be directed to Erik Kielin at telephone number 571-272-1693.

Signed:

/Erik Kielin/
Primary Patent Examiner
Art Unit 3992

Conferees:

/Leonardo Andujar/
Primary Examiner, Art Unit 3992

MARK J. REINHART
Supervisory Patent Reexamination Specialist
CRU -- Art Unit 3992