

(12) **United States Patent**
Baretz et al.

(10) **Patent No.:** **US 6,600,175 B1**
 (45) **Date of Patent:** ***Jul. 29, 2003**

(54) **SOLID STATE WHITE LIGHT EMITTER AND DISPLAY USING SAME**

JP 5-152609 * 6/1993 257/98

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(*) Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1212 days.

(21) Appl. No.: **08/621,937**

(22) Filed: **Mar. 26, 1996**

(51) **Int. Cl.**⁷ **H01L 33/00**

(52) **U.S. Cl.** **257/100; 257/88; 257/98; 257/99**

(58) **Field of Search** **257/88, 98, 99, 257/100**

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,593,055	A	*	7/1971	Geusic	.....	257/98
3,763,405	A	*	10/1973	Mitsuhata	.....	257/98
3,932,881	A	*	1/1976	Mita	.....	257/98
4,992,704	A		2/1991	Stinson	.....	315/312
5,126,214	A	*	6/1992	Tokailin	.....	257/99
5,208,462	A	*	5/1993	O'Conner	.....	257/98
5,405,709	A		4/1995	Littman et al.	.....	428/690
5,583,349	A	*	12/1996	Norman	.....	257/88
5,660,461	A	*	8/1997	Ignatius	.....	257/88

FOREIGN PATENT DOCUMENTS

JP	60170194	9/1985
JP	04289691	10/1992

OTHER PUBLICATIONS

Sato, Y. et al, "Full-Color Fluorescent Display Devices Using a Near-UV Light Emitting Diode", *Jpn. J. Appl. Phys.* vol. 35 (1996) pp. L 838-L839.

J.I. Pankove and E.R. Levin, "Scanning Electron Microscopy Studies of GaN" *J. Appl. Phys.* vol. 46, (1975), pp. 1647-1652.

I. Akasaki, et al., "Photoluminescence of Mg-doped p-type GaN and Electroluminescence of GaN p-n Junction LED" *J. Lumin.*, vol. 48-49, (1991) pp. 666-670.

H. Amano et al., UV and Blue Electroluminescence from Al.GaN:Mg/GaN LED treated with Low-Energy Electron Beam Irradiation (LEEBI), *Inst. Phys. Conf. Ser.* vol. 106, (1990), pp. 725-730.

Munch et al, "Silicon Carbide Light-Emitting Diodes with Epitaxial Junctions" *Solid State Electronics*, vol. 19, (1976) p. 871.

Zhang Jin Chao et al., White Light Emitting Glasses, *Journal of Solid State Chemistry*, 93, 17-29 (1991), pp. 17-29.

(List continued on next page.)

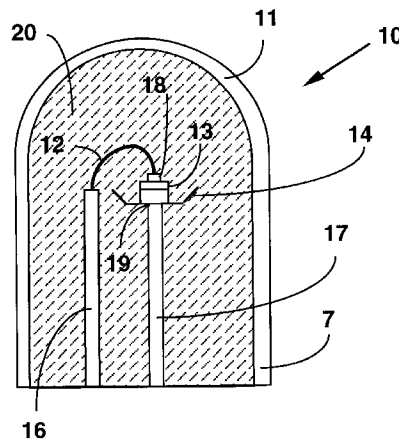
Primary Examiner—Jerome Jackson

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(57) **ABSTRACT**

A light emitting assembly comprising a solid state device coupleable with a power supply constructed and arranged to power the solid state device to emit from the solid state device a first, relatively shorter wavelength radiation, and a down-converting luminophoric medium arranged in receiving relationship to said first, relatively shorter wavelength radiation, and which in exposure to said first, relatively shorter wavelength radiation, is excited to responsively emit second, relatively longer wavelength radiation. In a specific embodiment, monochromatic blue or UV light output from a light-emitting diode is down-converted to white light by packaging the diode with fluorescent organic and/or inorganic fluorescers and phosphors in a polymeric matrix.

26 Claims, 3 Drawing Sheets



OTHER PUBLICATIONS

Shosaku Tanaka, et al., Bright White-Light Electroluminescence Based on Nonradiative Energy Transfer in Ce- and Eu-doped SrS Thin Films, *Appl. Phys. Lett.* 51 (21), Nov. 23, 1987, pp. 1661-1663.

M. Berggren et al., White Light From an Electroluminescent Diode Made From poly[3(4-octylphenyl)-2,2'-bithiophene] and an Oxadiazole Derivatives, *J. Appl. Phys.* 76 (11), Dec. 1, 1994, pp. 7530-7534.

J. Kido et al., White Light-Emitting Organic Electroluminescent Devices Using the poly(N-vinylcarbazole) Emitter Layer Doped with Three Fluorescent Dyes, *Appl. Phys. Lett.*, 64 (7) Feb. 14, 1994, pp. 815-817.

N. El Jouhar et al., White Light Generation Using Fluorescent Glasses Activated by Ce³⁺, Tb³⁺ and Mn²⁺ Ions, *J. De Physique IV, Colloque C2, supplement au j. de Physique III*, vol. 2, Oct. 1992, pp. 257-260.

* cited by examiner

FIGURE 1

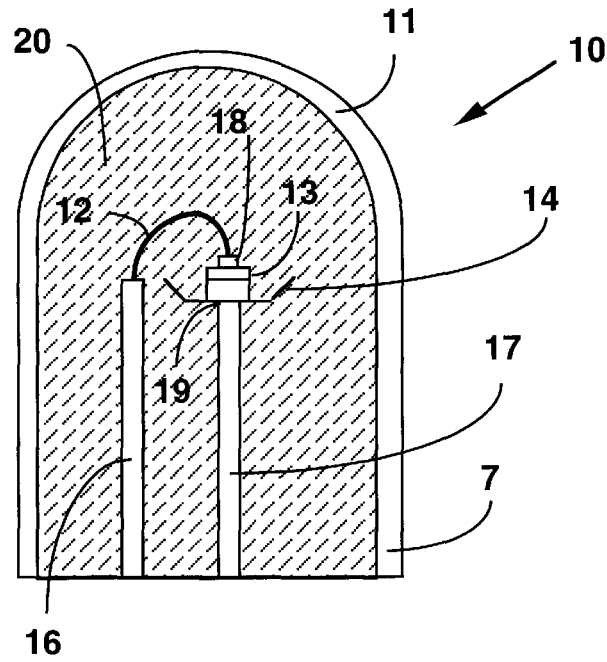


FIGURE 2

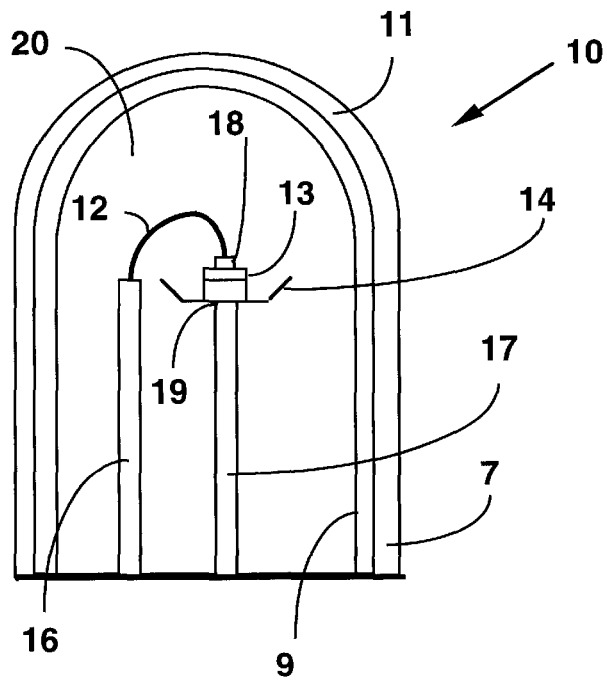


FIGURE 3

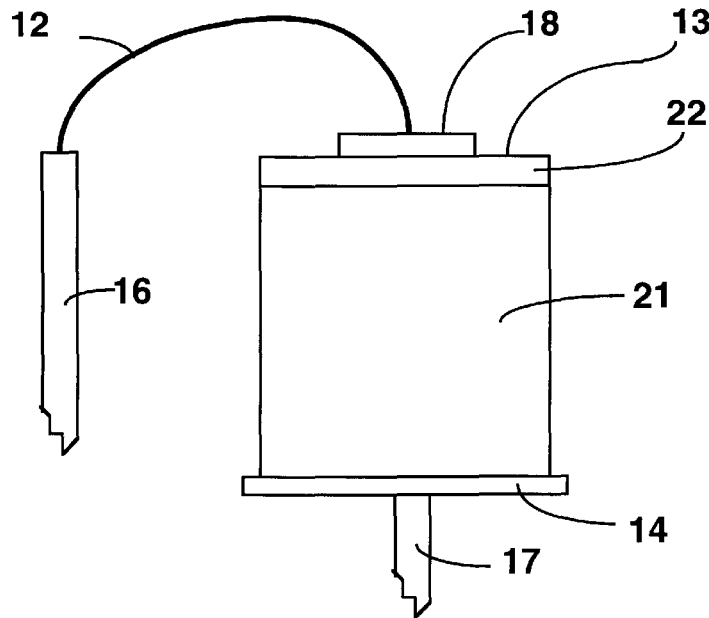


FIGURE 4

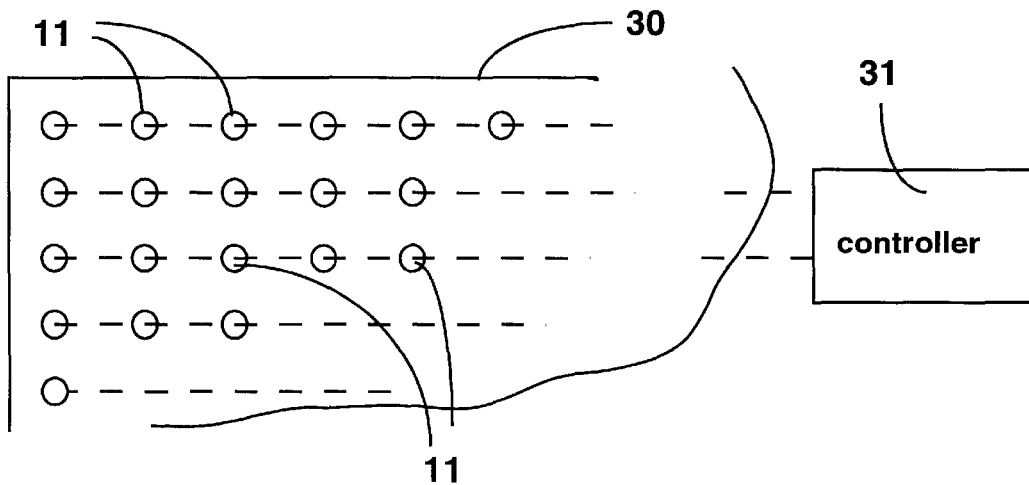


FIGURE 5

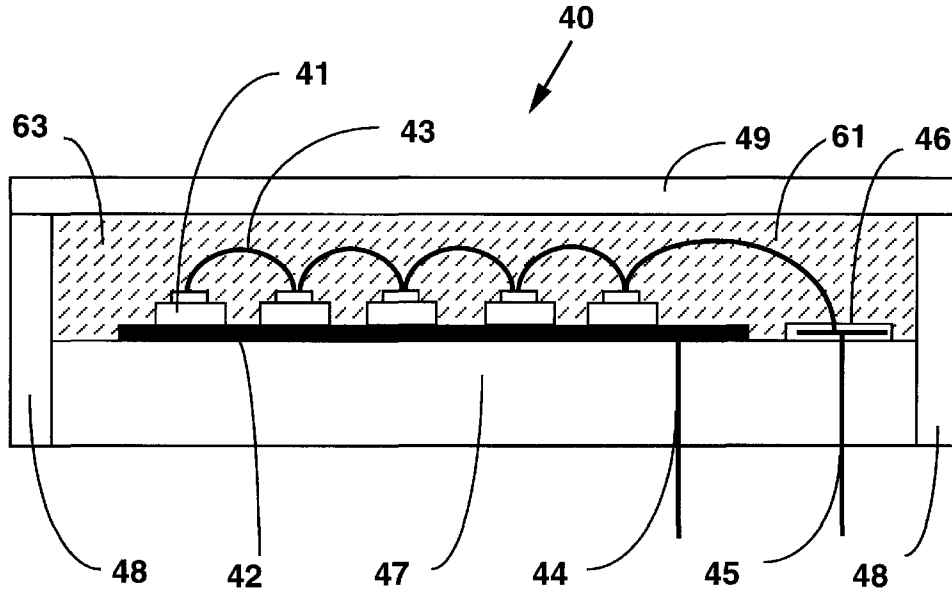
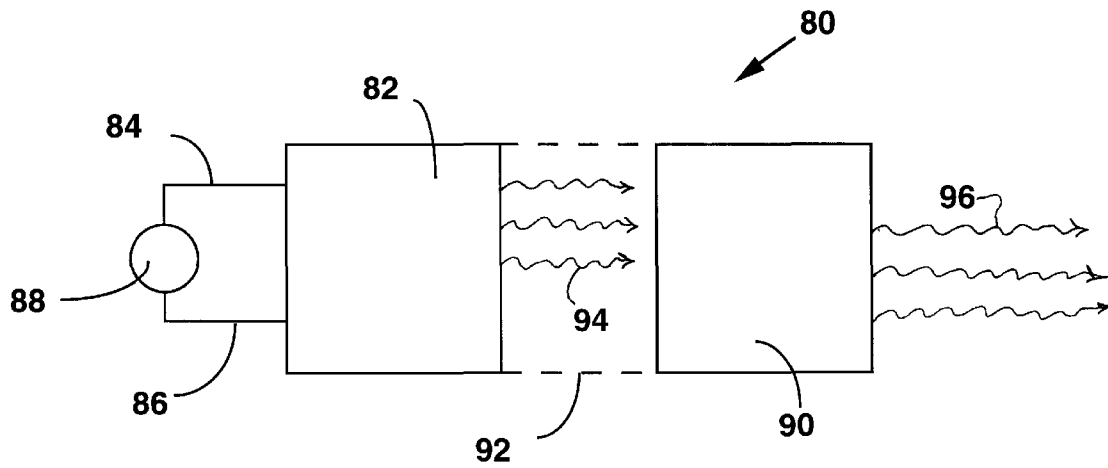


FIGURE 6



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