# EXHIBIT A

Case nos. 6:20-cv-00634 and 6:20-cv-00636

# Demaray LLC v Intel Corp.
# Demaray LLC v Samsung Electronics Co. Ltd., et al.

## *Markman* Hearing

August 17, 2021

*All docket citations are to docket entries in case no. 6:20-cv-00634

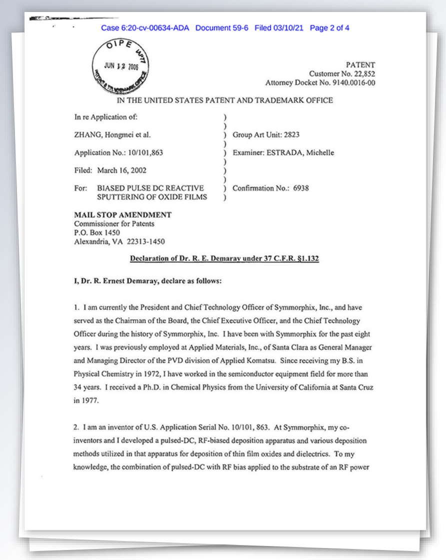
1) “pulsed DC power” / “pulsed DC power supply”
2) “narrow band rejection filter”
3) “preamble” / “insulating substrate”
4) “metallic mode” / “poison mode”
5) “reconditioning the target”
6) “substantially constant”

# “pulsed DC power”

’657 Patent, Claim 1

’276 Patent, Claims 1 and 6

# Patentee’s Claimed Invention



Case 6:20-cv-00634-ADA Document 59-6 Filed 03/10/21 Page 2 of 4

OIPE
JUN 12 2006

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
ZHANG, Hongmei et al. ) Group Art Unit: 2823
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
Filed: March 16, 2002 )
For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS ) Confirmation No.: 6938

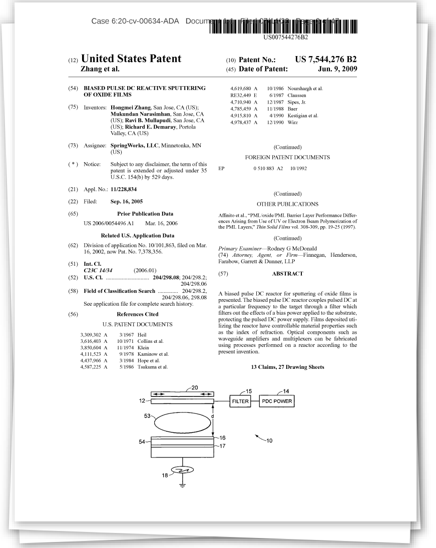
**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**Declaration of Dr. R. E. Demaray under 37 C.F.R. §1.132**

**I, Dr. R. Ernest Demaray, declare as follows:**

1. I am currently the President and Chief Technology Officer of Symmorphix, Inc., and have served as the Chairman of the Board, the Chief Executive Officer, and the Chief Technology Officer during the history of Symmorphix, Inc. I have been with Symmorphix for the past eight years. I was previously employed at Applied Materials, Inc., of Santa Clara as General Manager and Managing Director of the PVD division of Applied Komatsu. Since receiving my B.S. in Physical Chemistry in 1972, I have worked in the semiconductor equipment field for more than 34 years. I received a Ph.D. in Chemical Physics from the University of California at Santa Cruz in 1977.

2. I am an inventor of U.S. Application Serial No. 10/101, 863. At Symmorphix, my co-inventors and I developed a pulsed-DC, RF-biased deposition apparatus and various deposition methods utilized in that apparatus for deposition of thin film oxides and dielectrics. To my knowledge, the combination of pulsed-DC with RF bias applied to the substrate of an RF power



Case 6:20-cv-00634-ADA Docum

US007544276B2

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

(10) **Patent No.: US 7,544,276 B2**
(45) **Date of Patent: Jun. 9, 2009**

(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**

(75) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Mukundan Narasimhan**, San Jose, CA (US); **Ravi B. Mullapudi**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

(73) Assignee: **SpringWorks, LLC**, Minnetonka, MN (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 529 days.

(21) Appl. No.: **11/228,834**

(22) Filed: **Sep. 16, 2005**

(65) **Prior Publication Data**

US 2006/0054496 A1 Mar. 16, 2006

**Related U.S. Application Data**

(62) Division of application No. 10/101,863, filed on Mar. 16, 2002, now Pat. No. 7,378,356.

(51) **Int. Cl.**
*C23C 14/34* (2006.01)

(52) **U.S. Cl.** .............................. **204/298.08**; 204/298.2; 204/298.06

(58) **Field of Classification Search** ............. 204/298.2, 204/298.06, 298.08
See application file for complete search history.

(56) **References Cited**

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| | | | |
|---|---|---|---|
| 3,309,302 | A | 3/1967 | Heil |
| 3,616,403 | A | 10/1971 | Collins et al. |
| 3,850,604 | A | 11/1974 | Klein |
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| RE32,449 | E | 6/1987 | Claussen |
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| 4,978,437 | A | 12/1990 | Wirz |

(Continued)

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EP 0 510 883 A2 10/1992

(Continued)

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Affinito et al., “PML/oxide/PML Barrier Layer Performance Differences Arising from Use of UV or Electron Beam Polymerization of the PML Layers,” *Thin Solid Films* vol. 308-309, pp. 19-25 (1997).

(Continued)

*Primary Examiner*—Rodney G McDonald
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

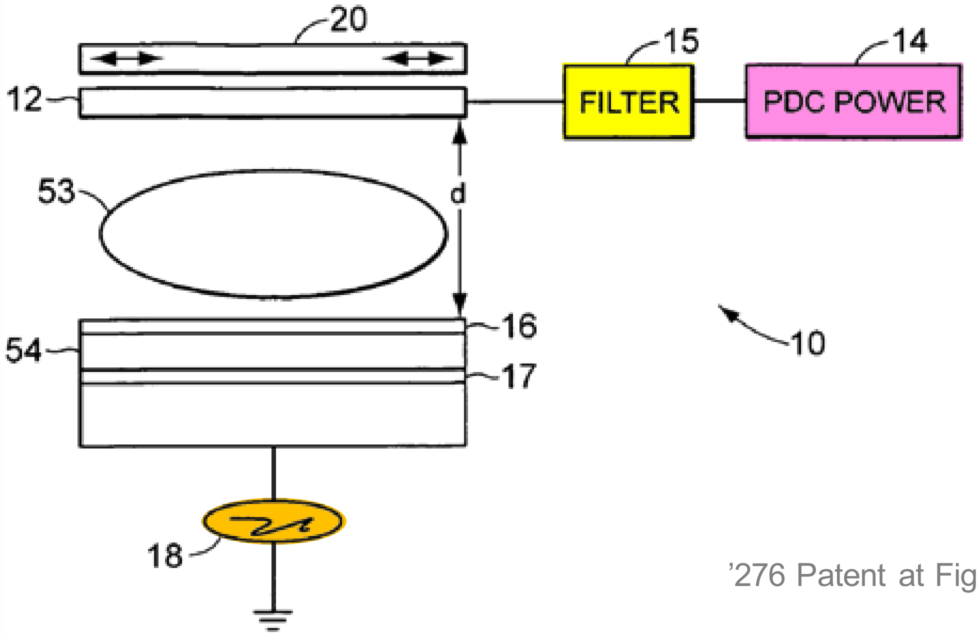
(57) **ABSTRACT**

A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present invention.

**13 Claims, 27 Drawing Sheets**

4. My co-inventors and I developed the band-rejection filter described in the specification and claimed in U.S. Application Serial No. 10/101, 863 to overcome the problem of catastrophic failure of the pulsed-DC power supply output electrometer circuit during operation. We discovered that a band-rejection filter, which is a filter that passes all of the frequencies of the square wave power supply except within a narrow band centered on the RF frequency of the RF bias, protected the pulsed-DC power supply from the RF energy while not distorting the pulses generated by the pulsed-DC power supply applied to the target.

Dkt. 59-6 (06/07/2006 Dr. Demaray Declaration), ¶ 4



’276 Patent at Fig. 1A

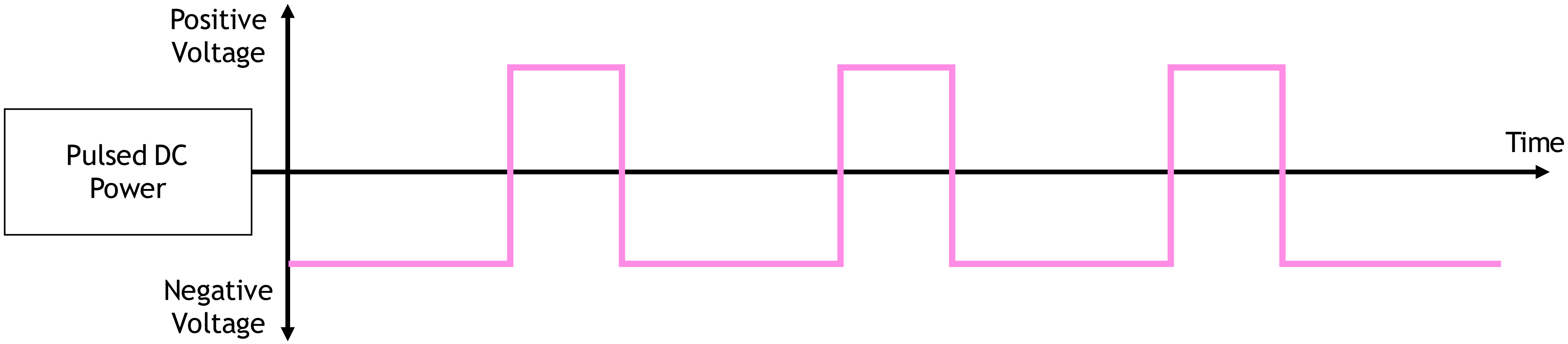
# “pulsed DC power”

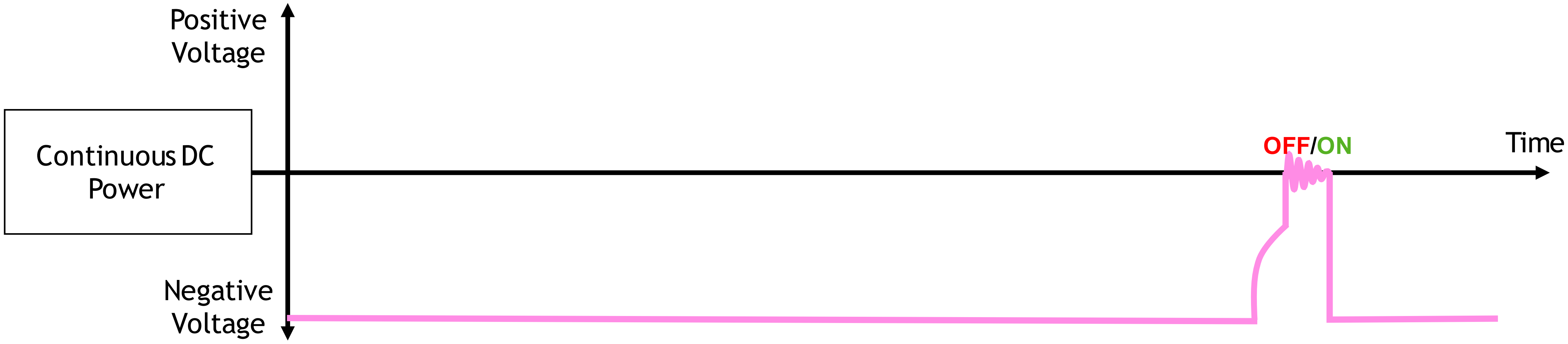
| Claim Term | Tentative Construction |
|---|---|
| “**pulsed** DC power” (’657 patent, claim 1) | “direct current power that **oscillates between positive and negative voltages**” |
| “**pulsed** DC power supply” (’276 patent, claims 1, 6) | “supply for providing **pulsed** DC power” |

**Fine-Tuned Dispute:** does the Court’s construction, which requires “oscillat[ing] between positive and negative voltages” encompass continuous DC power with arc suppression?

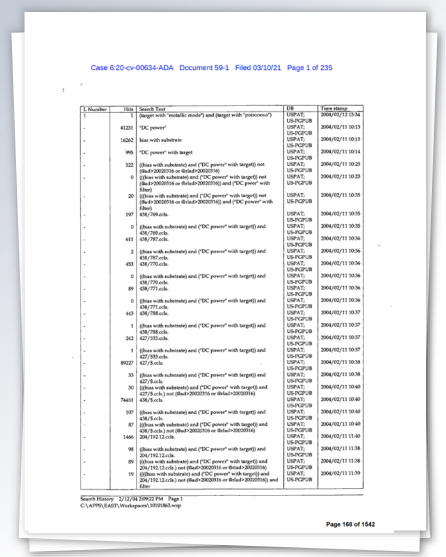
**Fine-Tuned Construction #1:** “direct current power that oscillates between **predetermined** positive and negative voltages”

# "pulsed DC power" vs. continuous DC power



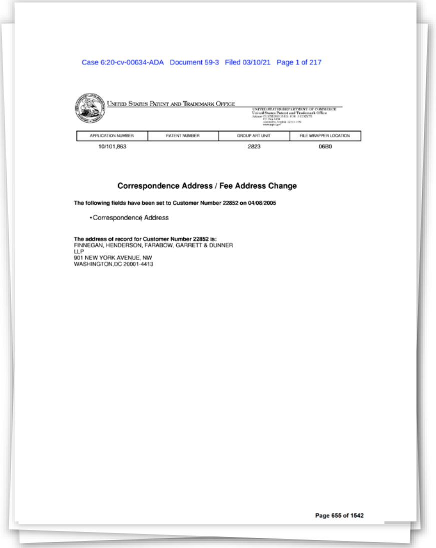


# Demaray: DC Power Supply is "NOT a Pulsed DC Power Supply"



| L Number | Hits | Search Text | DB | Time stamp |
|---|---|---|---|---|
| 1 | 1 | (target with "metallic mode") and (target with "poisonous") | USPAT;<br>US-PGPUB | 2004/02/12 13:34 |
| - | 41231 | "DC power" | USPAT;<br>US-PGPUB | 2004/02/11 10:13 |
| - | 16262 | bias with substrate | USPAT;<br>US-PGPUB | 2004/02/11 10:13 |
| - | 995 | "DC power" with target | USPAT;<br>US-PGPUB | 2004/02/11 10:14 |
| - | 322 | ((bias with substrate) and ("DC power" with target)) not (@ad>20020316 or @rlad>20020316) | USPAT;<br>US-PGPUB | 2004/02/11 10:23 |
| - | 0 | (((bias with substrate) and ("DC power" with target)) not (@ad>20020316 or @rlad>20020316)) and ("DC pwer" with filter) | USPAT;<br>US-PGPUB | 2004/02/11 10:23 |
| - | 20 | (((bias with substrate) and ("DC power" with target)) not (@ad>20020316 or @rlad>20020316)) and ("DC power" with filter) | USPAT;<br>US-PGPUB | 2004/02/11 10:35 |
| - | 197 | 438/769.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:35 |
| - | 0 | ((bias with substrate) and ("DC power" with target)) and 438/769.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:35 |
| - | 611 | 438/787.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:36 |
| - | 2 | ((bias with substrate) and ("DC power" with target)) and 438/787.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:36 |
| - | 453 | 438/770.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:36 |
| - | 0 | ((bias with substrate) and ("DC power" with target)) and 438/770.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:36 |
| - | 89 | 438/771.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:36 |
| - | 0 | ((bias with substrate) and ("DC power" with target)) and 438/771.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:36 |
| - | 443 | 438/788.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:37 |
| - | 1 | ((bias with substrate) and ("DC power" with target)) and 438/788.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:37 |
| - | 242 | 427/533.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:37 |
| - | 1 | ((bias with substrate) and ("DC power" with target)) and 427/533.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:37 |
| - | 89227 | 427/$.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:38 |
| - | 33 | ((bias with substrate) and ("DC power" with target)) and 427/$.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:38 |
| - | 30 | (((bias with substrate) and ("DC power" with target)) and 427/$.ccls.) not (@ad>20020316 or @rlad>20020316) | USPAT;<br>US-PGPUB | 2004/02/11 10:40 |
| - | 74451 | 438/$.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:40 |
| - | 107 | ((bias with substrate) and ("DC power" with target)) and 438/$.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 10:40 |
| - | 87 | (((bias with substrate) and ("DC power" with target)) and 438/$.ccls.) not (@ad>20020316 or @rlad>20020316) | USPAT;<br>US-PGPUB | 2004/02/11 10:40 |
| - | 1466 | 204/192.12.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 11:40 |
| - | 98 | ((bias with substrate) and ("DC power" with target)) and 204/192.12.ccls. | USPAT;<br>US-PGPUB | 2004/02/11 11:38 |
| - | 89 | (((bias with substrate) and ("DC power" with target)) and 204/192.12.ccls.) not (@ad>20020316 or @rlad>20020316) | USPAT;<br>US-PGPUB | 2004/02/11 11:38 |
| - | 19 | ((((bias with substrate) and ("DC power" with target)) and 204/192.12.ccls.) not (@ad>20020316 or @rlad>20020316)) and filter | USPAT;<br>US-PGPUB | 2004/02/11 11:39 |

Search History 2/12/04 2:09:22 PM Page 1
C:\APPS\EAST\Workspaces\10101863.wsp



UNITED STATES PATENT AND TRADEMARK OFFICE

| APPLICATION NUMBER | PATENT NUMBER | GROUP ART UNIT | FILE WRAPPER LOCATION |
|---|---|---|---|
| 10/101,863 |  | 2823 | 06B0 |

**Correspondence Address / Fee Address Change**

**The following fields have been set to Customer Number 22852 on 04/08/2005**

- Correspondence Address

**The address of record for Customer Number 22852 is:**
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER
LLP
901 NEW YORK AVENUE, NW
WASHINGTON,DC 20001-4413

## Jun. 10, 2005: Patentee's Response

power supply (Col. 6, lines 32-37)." (OA, page 5). However, Le utilizes a pulsed DC power supply and not a DC power supply. Therefore, utilizing a filter provided for a DC power supply is not obvious and may not be necessary in the system taught by Le because of the lack of a bias.

Dkt. 59-1 ('356 patent FH, 07/23/2004 Applicant's Response), at 193

Fukui teaches a deposition chamber where an RF power supply is coupled to the target through a matching circuit and a second RF power supply is coupled to the substrate through a second matching circuit. (*See, e.g.*, Fukui, col. 6, lines 19-41). The matching circuits are configured so that reflected waves back to the power supplies are eliminated. *Id.* Further, a DC power supply (NOT a pulsed DC power supply) is coupled to the target through a low-pass filter.

. . .

technologies is great. The use of a DC bias power supply to bias the target in an RF PVD system does not, in any way, imply a pulsed DC PVD system, as is claimed in claims 1 and 20.

Dkt. 59-3 ('356 patent FH, 06/10/2005 Applicant's Response), at 666, 668

# Tentative Construction Effectively Removes "Pulsed" from Claims

| Claim Term | Court's Tentative Construction |
|---|---|
| "**pulsed DC power**" ('657 patent, claim 1) | "**direct current power** that **oscillates between positive and negative voltages**" |

**'657 Patent, Claim 1**

1. A method for depositing a film on an insulating substrate, comprising:

…

~~that oscillates between positive and negative voltages~~

providing **~~pulsed~~ DC power** to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;

…

# Tentative Construction Effectively Removes "Pulsed" from Claims

| Claim Term | Court's Tentative Construction |
|---|---|
| "**pulsed DC power**" ('657 patent, claim 1) | "**direct current power** that **oscillates between positive and negative voltages**" |

## Unasserted Parent: '356 Patent, Claim 1

1. A method of depositing an insulating oxide film on a substrate, comprising:

…

~~that **oscillates between positive and negative voltages**~~

applying **~~pulsed~~ DC power** ^ to the target such that a voltage on the target oscillates between positive and negative voltages…

…

# Tentative Construction Effectively Removes "Pulsed" from Claims

| Claim Term | Court's Tentative Construction |
|---|---|
| "**pulsed DC power**" ('657 patent, claim 1) | "**direct current power** that **oscillates between positive and negative voltages**" |
| "**pulsed DC power** supply" ('276 patent, claims 1, 6) | "supply for providing **pulsed DC power**" |

## '276 Patent, Claim 1

1. A reactor according to the present invention, comprising:

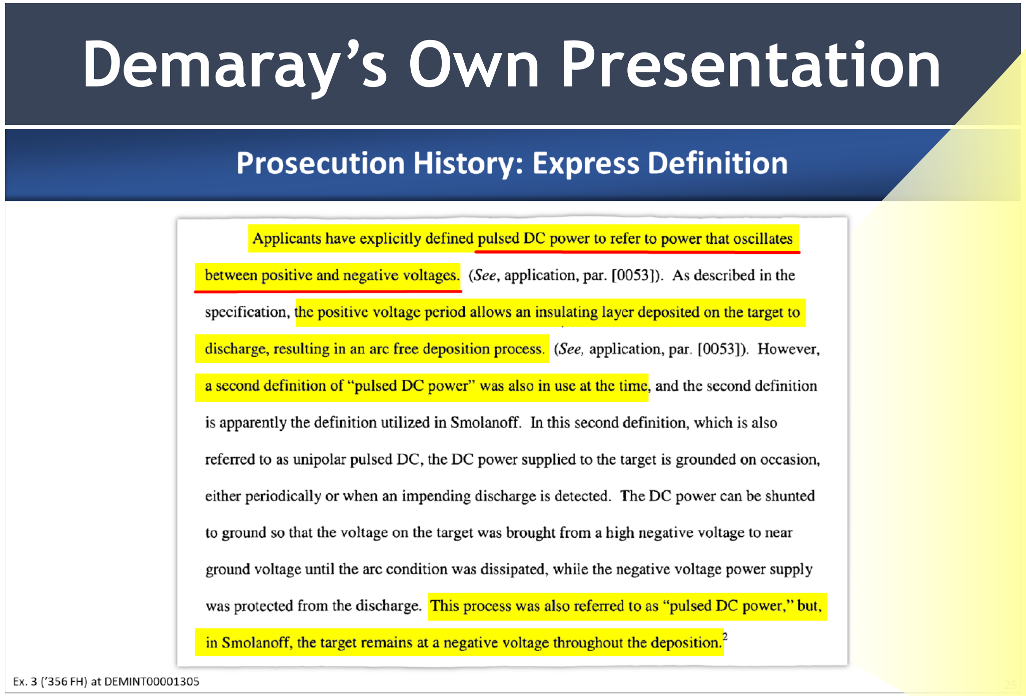
…

~~that **oscillates between positive and negative voltages**~~

the **~~pulsed~~ DC power supply** providing alternating negative and positive voltages to the target;

…

# Demaray's "Express Definition" of "pulsed DC power"

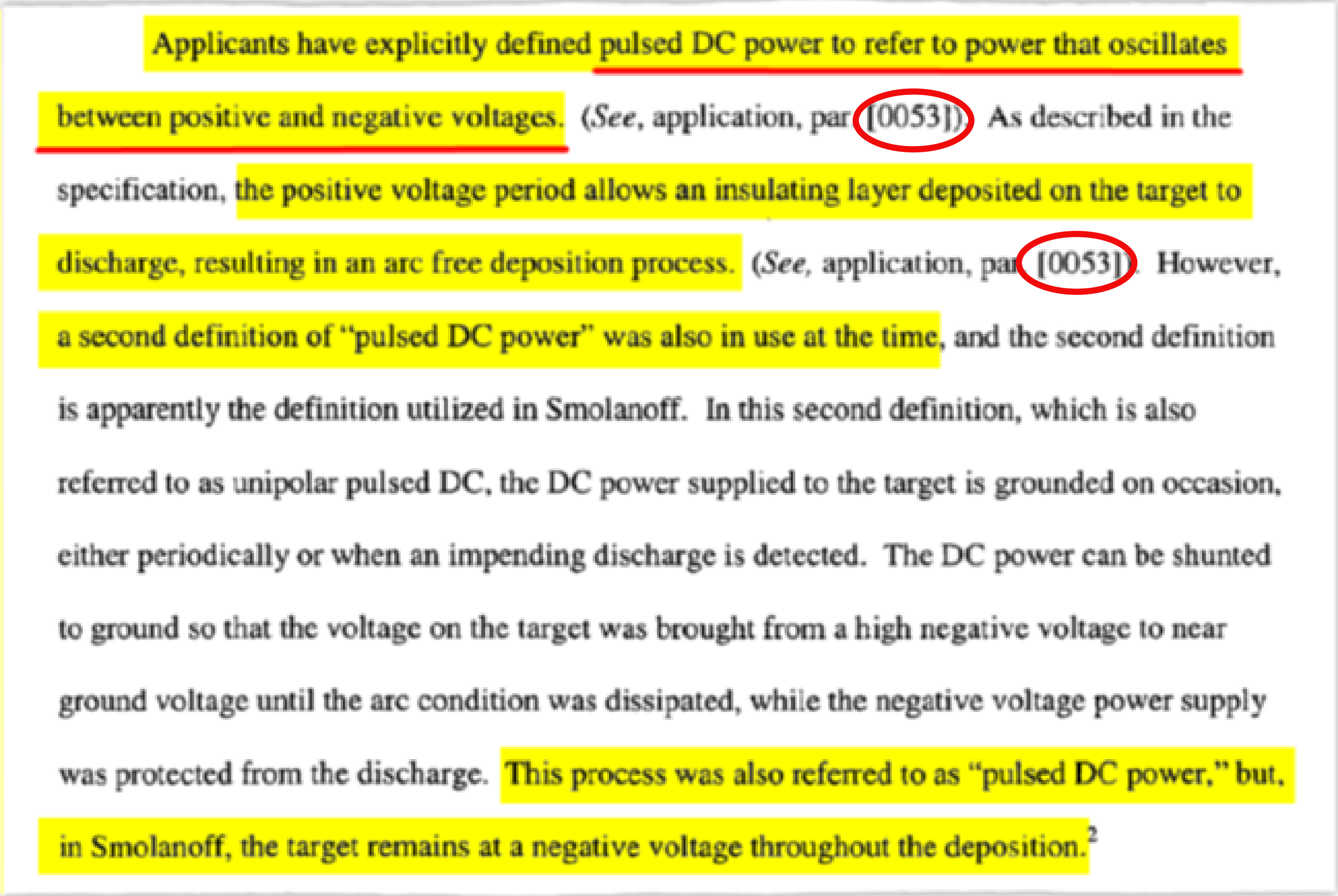


## Demaray's Own Presentation

### Prosecution History: Express Definition

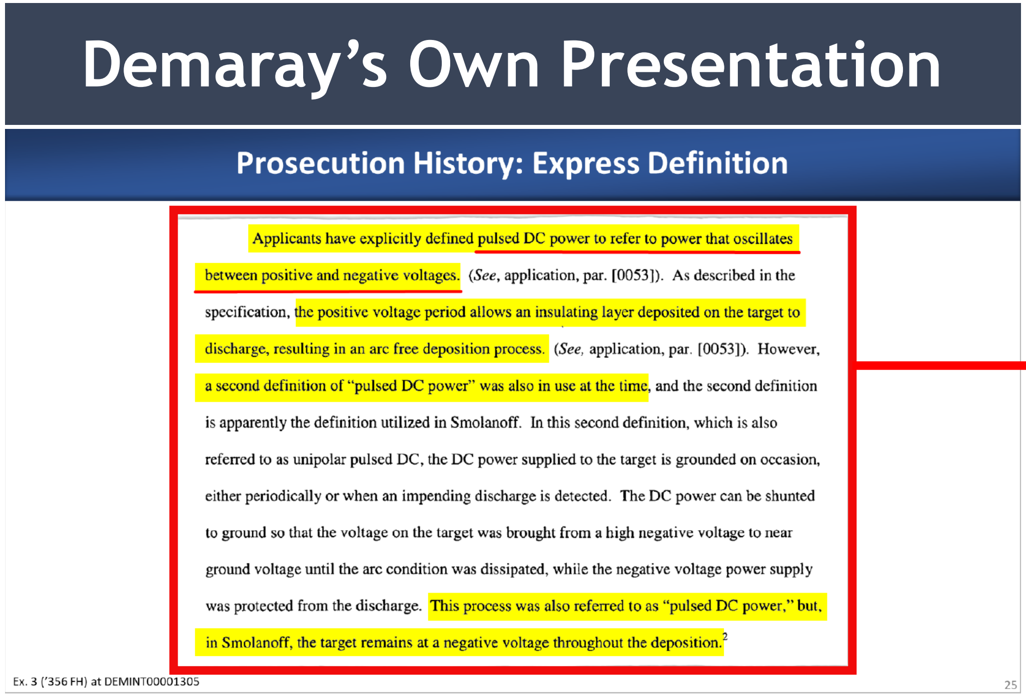
Applicants have explicitly defined pulsed DC power to refer to power that oscillates between positive and negative voltages. (*See*, application, par. [0053]). As described in the specification, the positive voltage period allows an insulating layer deposited on the target to discharge, resulting in an arc free deposition process. (*See*, application, par. [0053]). However, a second definition of "pulsed DC power" was also in use at the time, and the second definition is apparently the definition utilized in Smolanoff. In this second definition, which is also referred to as unipolar pulsed DC, the DC power supplied to the target is grounded on occasion, either periodically or when an impending discharge is detected. The DC power can be shunted to ground so that the voltage on the target was brought from a high negative voltage to near ground voltage until the arc condition was dissipated, while the negative voltage power supply was protected from the discharge. This process was also referred to as "pulsed DC power," but, in Smolanoff, the target remains at a negative voltage throughout the deposition.[2]

Ex. 3 ('356 FH) at DEMINT00001305



Applicants have explicitly defined pulsed DC power to refer to power that oscillates between positive and negative voltages. (*See*, application, par. [0053]). As described in the specification, the positive voltage period allows an insulating layer deposited on the target to discharge, resulting in an arc free deposition process. (*See*, application, par. [0053]). However, a second definition of "pulsed DC power" was also in use at the time, and the second definition is apparently the definition utilized in Smolanoff. In this second definition, which is also referred to as unipolar pulsed DC, the DC power supplied to the target is grounded on occasion, either periodically or when an impending discharge is detected. The DC power can be shunted to ground so that the voltage on the target was brought from a high negative voltage to near ground voltage until the arc condition was dissipated, while the negative voltage power supply was protected from the discharge. This process was also referred to as "pulsed DC power," but, in Smolanoff, the target remains at a negative voltage throughout the deposition.[2]

# FH Shows Added Limitation: NOT "Express Definition" of Pulsed DC



## Demaray's Own Presentation

### Prosecution History: Express Definition

Applicants have explicitly defined pulsed DC power to refer to power that oscillates between positive and negative voltages. (*See*, application, par. [0053]). As described in the specification, the positive voltage period allows an insulating layer deposited on the target to discharge, resulting in an arc free deposition process. (*See*, application, par. [0053]). However, a second definition of "pulsed DC power" was also in use at the time, and the second definition is apparently the definition utilized in Smolanoff. In this second definition, which is also referred to as unipolar pulsed DC, the DC power supplied to the target is grounded on occasion, either periodically or when an impending discharge is detected. The DC power can be shunted to ground so that the voltage on the target was brought from a high negative voltage to near ground voltage until the arc condition was dissipated, while the negative voltage power supply was protected from the discharge. This process was also referred to as "pulsed DC power," but, in Smolanoff, the target remains at a negative voltage throughout the deposition.[2]

Ex. 3 ('356 FH) at DEMINT00001305

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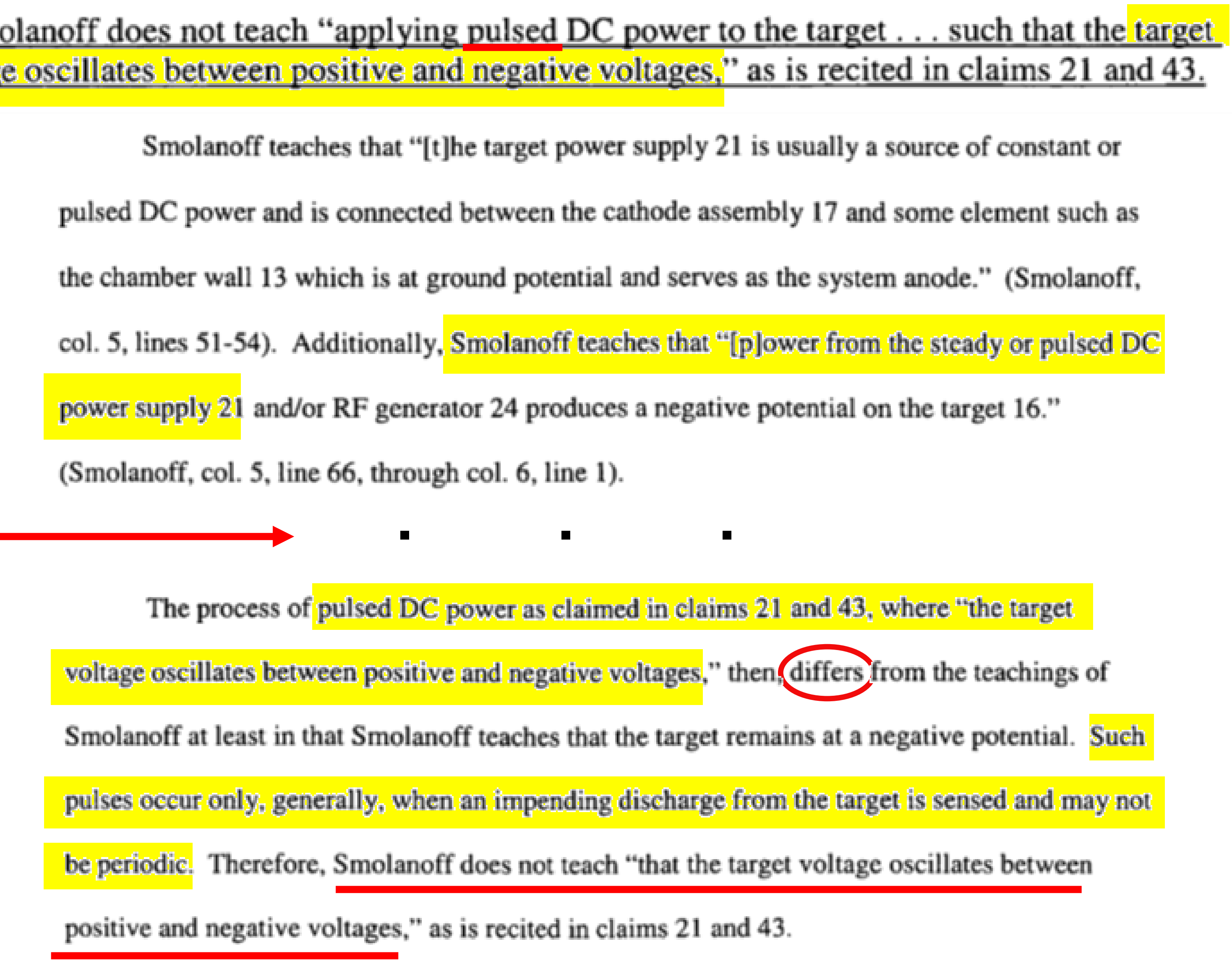


I. Smolanoff does not teach "applying pulsed DC power to the target . . . such that the target voltage oscillates between positive and negative voltages," as is recited in claims 21 and 43.

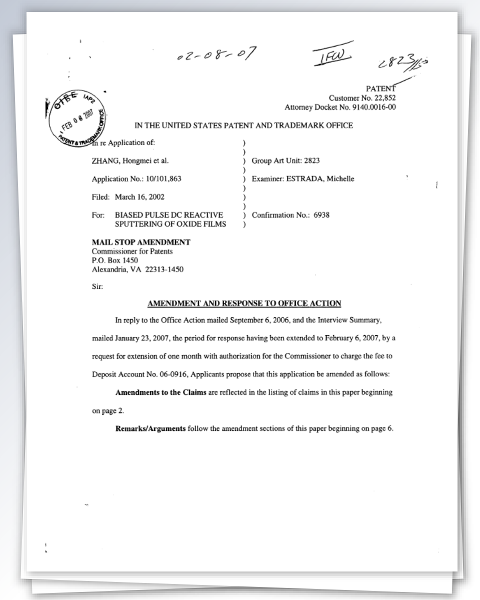
Smolanoff teaches that "[t]he target power supply 21 is usually a source of constant or pulsed DC power and is connected between the cathode assembly 17 and some element such as the chamber wall 13 which is at ground potential and serves as the system anode." (Smolanoff, col. 5, lines 51-54). Additionally, Smolanoff teaches that "[p]ower from the steady or pulsed DC power supply 21 and/or RF generator 24 produces a negative potential on the target 16." (Smolanoff, col. 5, line 66, through col. 6, line 1).

. . .

The process of pulsed DC power as claimed in claims 21 and 43, where "the target voltage oscillates between positive and negative voltages," then, differs from the teachings of Smolanoff at least in that Smolanoff teaches that the target remains at a negative potential. Such pulses occur only, generally, when an impending discharge from the target is sensed and may not be periodic. Therefore, Smolanoff does not teach "that the target voltage oscillates between positive and negative voltages," as is recited in claims 21 and 43.

Dkt. 59-5 ('356 File History, 02/06/07 Amendment), 1304-1306

# Oscillating Voltages Added to Overcome Smolanoff's Pulsed DC Power



02-08-07 IFW 2823

OIPE IAP2 FEB 0 6 2007 PATENT & TRADEMARK OFFICE

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
ZHANG, Hongmei et al. ) Group Art Unit: 2823
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
Filed: March 16, 2002 )
For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS ) Confirmation No.: 6938

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

**AMENDMENT AND RESPONSE TO OFFICE ACTION**

In reply to the Office Action mailed September 6, 2006, and the Interview Summary, mailed January 23, 2007, the period for response having been extended to February 6, 2007, by a request for extension of one month with authorization for the Commissioner to charge the fee to Deposit Account No. 06-0916, Applicants propose that this application be amended as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 6.

21. (Currently amended): A method of depositing [[a]] an oxide film on a substrate, comprising:

conditioning a target;

preparing the substrate;

adjusting an RF bias power to the substrate;

setting a process gas flow; and

applying pulsed DC power to the target through a filter such that the target voltage oscillates between positive and negative voltages to create a plasma and deposit the oxide film,

43. (Currently amended): A method of depositing [[a]] an oxide film on a substrate, comprising:

preparing the substrate;

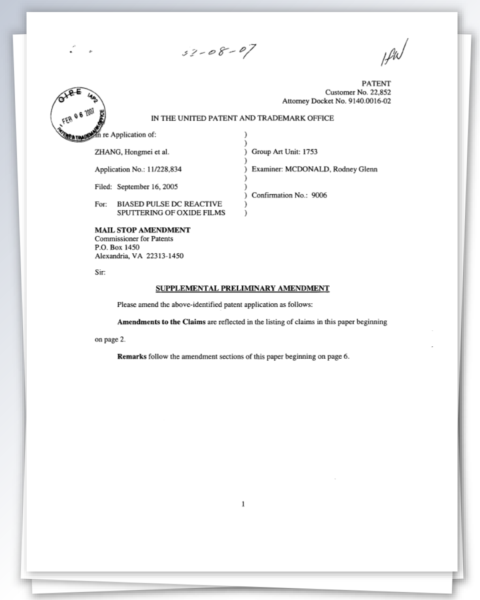
adjusting an RF bias power to the substrate;

setting a process gas flow; and

applying pulsed DC power to a target through a band rejection filter at a frequency of the bias power such that the target voltage oscillates between positive and negative voltages and an oxide film is deposited on the substrate.

Dkt. 59-5 ('356 File History, 02/06/07 Amendment), 1297-98

# Alternating Voltages Added to Overcome Smolianoff's Pulsed DC Power



02-08-07

IFW

OIPE IAP2
FEB 06 2007
PATENT & TRADEMARK OFFICE

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-02

IN THE UNITED PATENT AND TRADEMARK OFFICE

| | |
|---|---|
| In re Application of: | |
| ZHANG, Hongmei et al. | Group Art Unit: 1753 |
| Application No.: 11/228,834 | Examiner: MCDONALD, Rodney Glenn |
| Filed: September 16, 2005 | Confirmation No.: 9006 |
| For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS | |

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

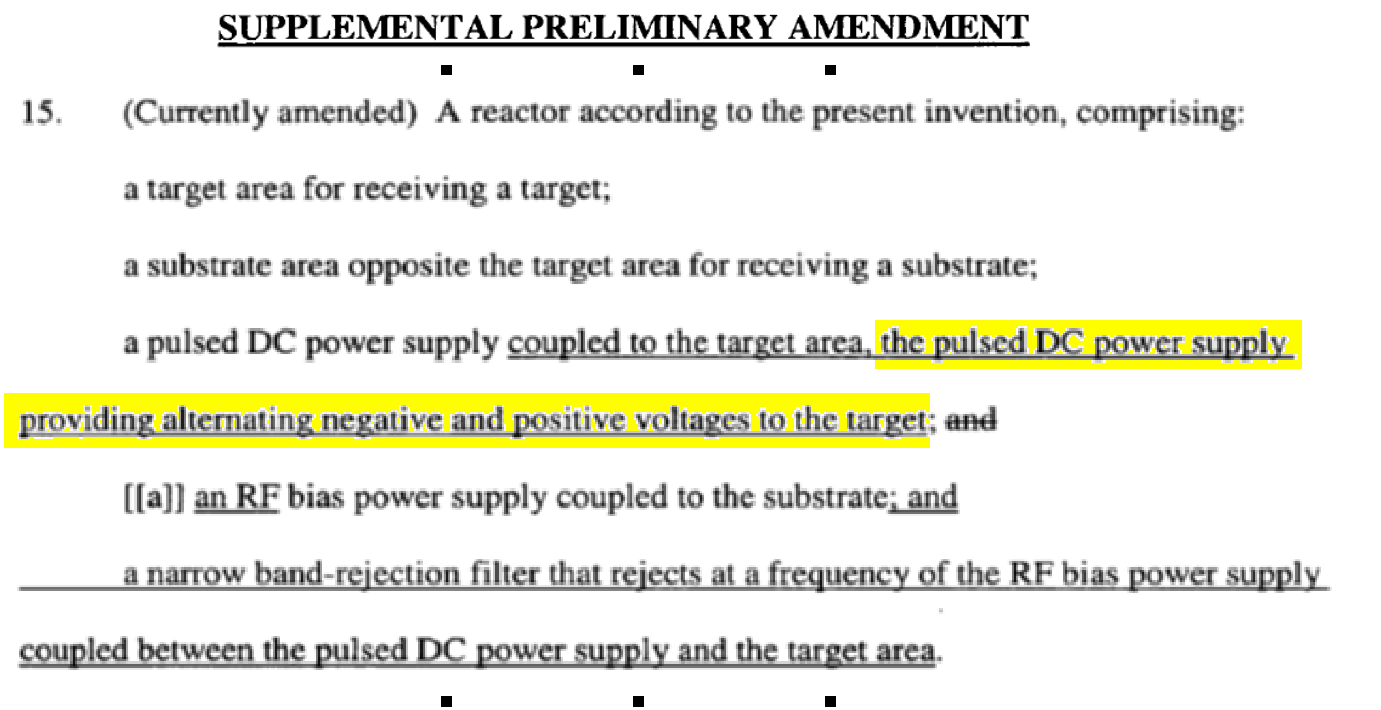
SUPPLEMENTAL PRELIMINARY AMENDMENT

Please amend the above-identified patent application as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks** follow the amendment sections of this paper beginning on page 6.

1



SUPPLEMENTAL PRELIMINARY AMENDMENT

■ ■ ■

15. (Currently amended) A reactor according to the present invention, comprising:

a target area for receiving a target;

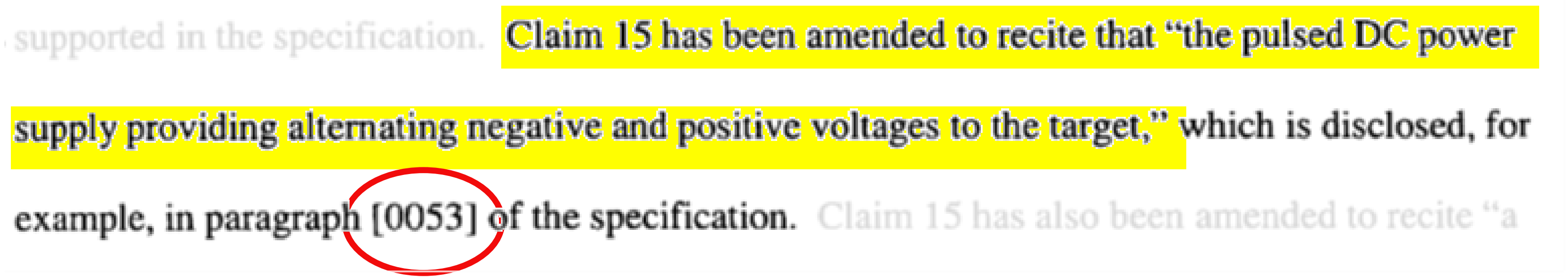
a substrate area opposite the target area for receiving a substrate;

a pulsed DC power supply coupled to the target area, the pulsed DC power supply providing alternating negative and positive voltages to the target; ~~and~~

[[a]] an RF bias power supply coupled to the substrate; and

a narrow band-rejection filter that rejects at a frequency of the RF bias power supply coupled between the pulsed DC power supply and the target area.

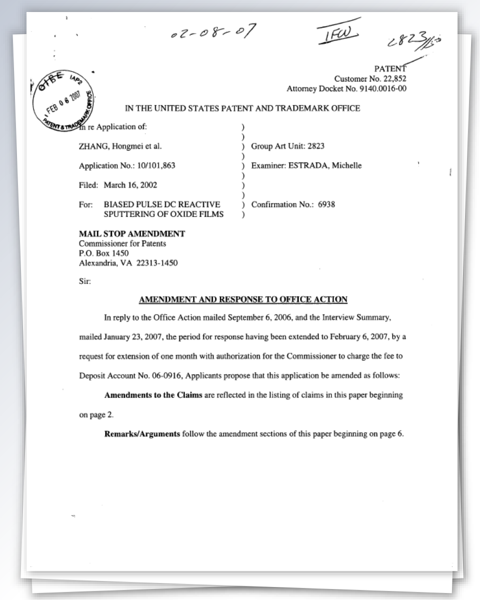
■ ■ ■



supported in the specification. Claim 15 has been amended to recite that "the pulsed DC power supply providing alternating negative and positive voltages to the target," which is disclosed, for example, in paragraph [0053] of the specification. Claim 15 has also been amended to recite "a

Dkt. 60, Feb. 6, 2007 Amendment ('276 patent app., 322-23, 325 )

# Alternating Voltages Added to Overcome Smolanoff's Pulsed DC Power



02-08-07 IFW 2823

OIPE IAP2
FEB 06 2007
PATENT & TRADEMARK OFFICE

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | |
|---|---|
| In re Application of: | |
| ZHANG, Hongmei et al. | Group Art Unit: 2823 |
| Application No.: 10/101,863 | Examiner: ESTRADA, Michelle |
| Filed: March 16, 2002 | |
| For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS | Confirmation No.: 6938 |

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

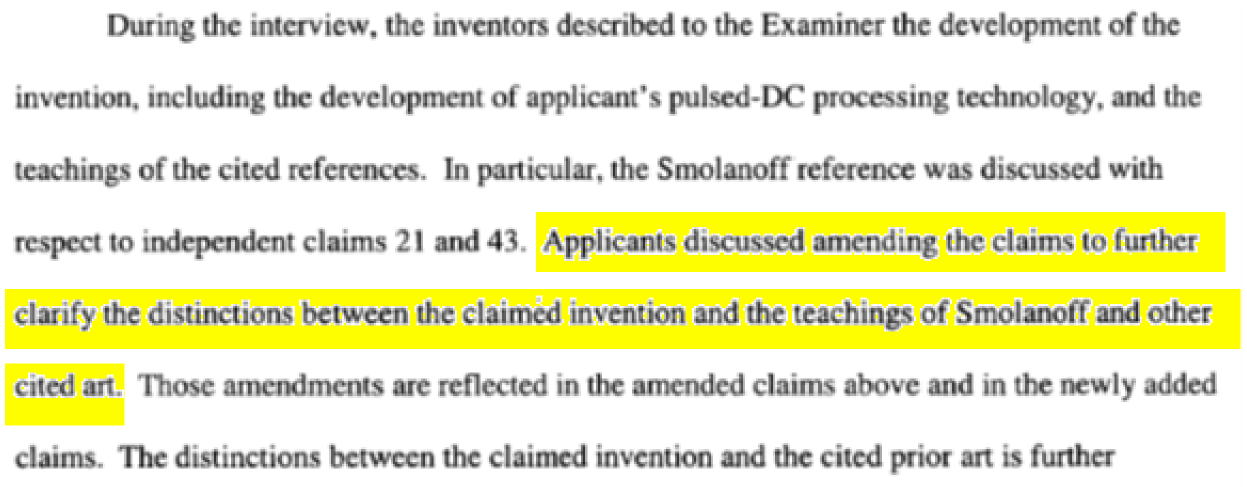
Sir:

**AMENDMENT AND RESPONSE TO OFFICE ACTION**

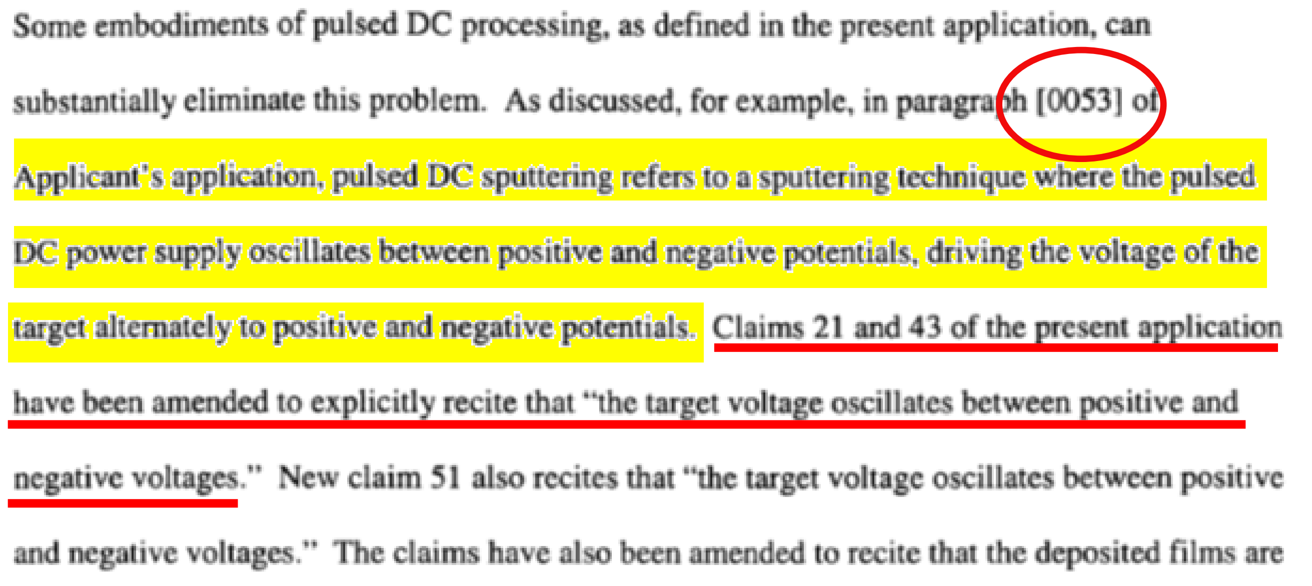
In reply to the Office Action mailed September 6, 2006, and the Interview Summary, mailed January 23, 2007, the period for response having been extended to February 6, 2007, by a request for extension of one month with authorization for the Commissioner to charge the fee to Deposit Account No. 06-0916, Applicants propose that this application be amended as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 6.



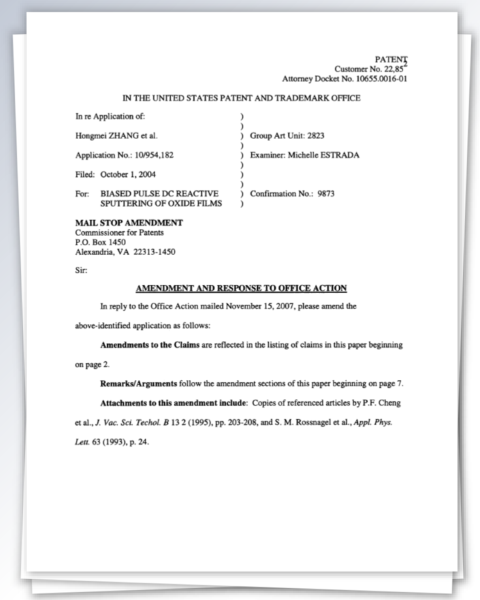
During the interview, the inventors described to the Examiner the development of the invention, including the development of applicant's pulsed-DC processing technology, and the teachings of the cited references. In particular, the Smolanoff reference was discussed with respect to independent claims 21 and 43. Applicants discussed amending the claims to further clarify the distinctions between the claimed invention and the teachings of Smolanoff and other cited art. Those amendments are reflected in the amended claims above and in the newly added claims. The distinctions between the claimed invention and the cited prior art is further



Some embodiments of pulsed DC processing, as defined in the present application, can substantially eliminate this problem. As discussed, for example, in paragraph [0053] of Applicant's application, pulsed DC sputtering refers to a sputtering technique where the pulsed DC power supply oscillates between positive and negative potentials, driving the voltage of the target alternately to positive and negative potentials. Claims 21 and 43 of the present application have been amended to explicitly recite that "the target voltage oscillates between positive and negative voltages." New claim 51 also recites that "the target voltage oscillates between positive and negative voltages." The claims have also been amended to recite that the deposited films are

Dkt. 59-5 ('356 File History, part 6/7), 1301, 1302

# Alternating Voltages Added to Overcome Smolanoff's Pulsed DC Power



PATENT
Customer No. 22,852
Attorney Docket No. 10655.0016-01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
Hongmei ZHANG et al.
Application No.: 10/954,182
Filed: October 1, 2004
For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS

Group Art Unit: 2823
Examiner: Michelle ESTRADA
Confirmation No.: 9873

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

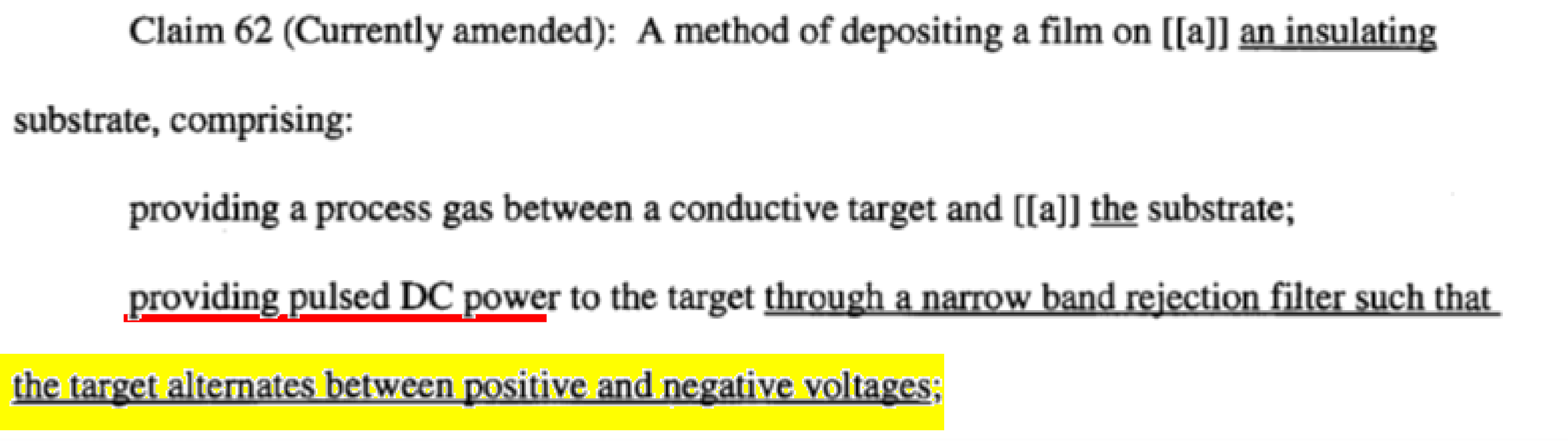
**AMENDMENT AND RESPONSE TO OFFICE ACTION**

In reply to the Office Action mailed November 15, 2007, please amend the above-identified application as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 7.

**Attachments to this amendment include**: Copies of referenced articles by P.F. Cheng et al., *J. Vac. Sci. Techol. B* 13 2 (1995), pp. 203-208, and S. M. Rossnagel et al., *Appl. Phys. Lett.* 63 (1993), p. 24.

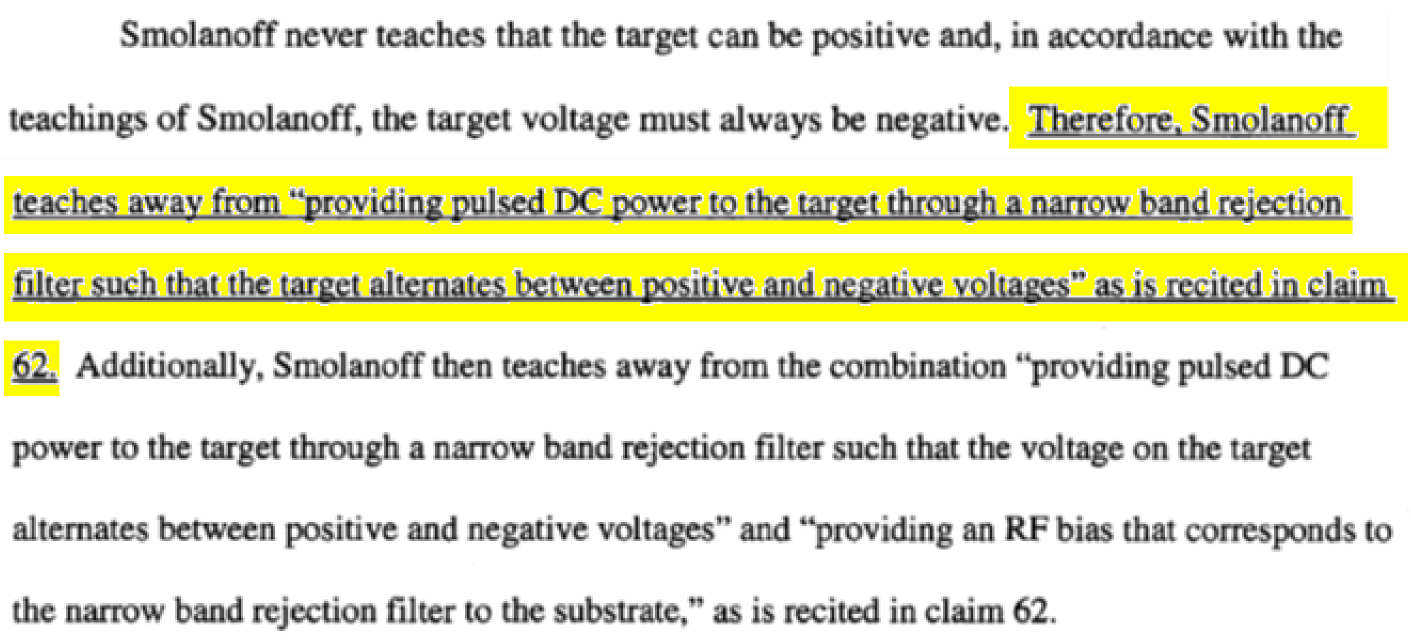


Claim 62 (Currently amended): A method of depositing a film on [[a]] an insulating substrate, comprising:

providing a process gas between a conductive target and [[a]] the substrate;

providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;

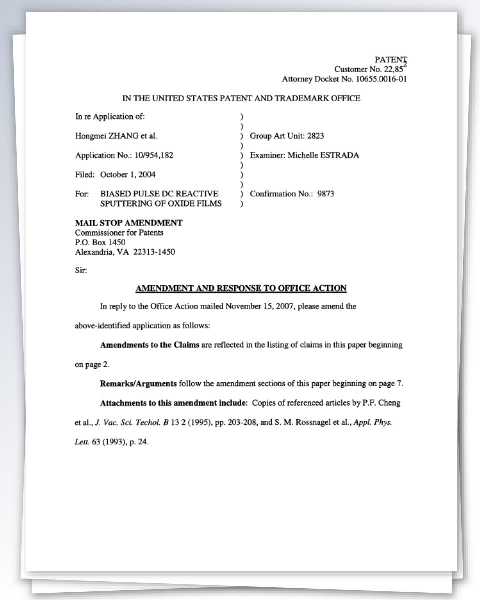
. . .



Smolanoff never teaches that the target can be positive and, in accordance with the teachings of Smolanoff, the target voltage must always be negative. Therefore, Smolanoff teaches away from "providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages" as is recited in claim 62. Additionally, Smolanoff then teaches away from the combination "providing pulsed DC power to the target through a narrow band rejection filter such that the voltage on the target alternates between positive and negative voltages" and "providing an RF bias that corresponds to the narrow band rejection filter to the substrate," as is recited in claim 62.

Dkt. 60-5, Dec. 18, 2007 Amendment ('657 patent app.), 972-73, 976-77

# Alternating Voltages Added to Overcome Smolanoff's Pulsed DC Power



PATENT
Customer No. 22,852
Attorney Docket No. 10655.0016-01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
)
Hongmei ZHANG et al. ) Group Art Unit: 2823
)
Application No.: 10/954,182 ) Examiner: Michelle ESTRADA
)
Filed: October 1, 2004 )
)
For: BIASED PULSE DC REACTIVE ) Confirmation No.: 9873
SPUTTERING OF OXIDE FILMS )

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

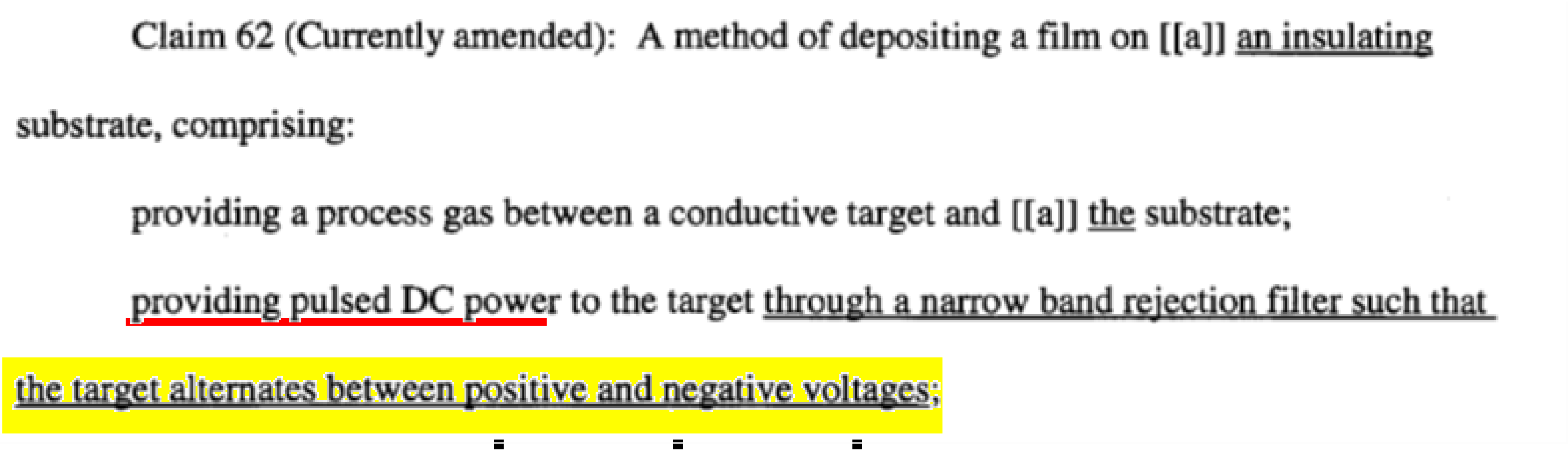
**AMENDMENT AND RESPONSE TO OFFICE ACTION**

In reply to the Office Action mailed November 15, 2007, please amend the above-identified application as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 7.

**Attachments to this amendment include**: Copies of referenced articles by P.F. Cheng et al., *J. Vac. Sci. Techol. B* 13 2 (1995), pp. 203-208, and S. M. Rossnagel et al., *Appl. Phys. Lett.* 63 (1993), p. 24.

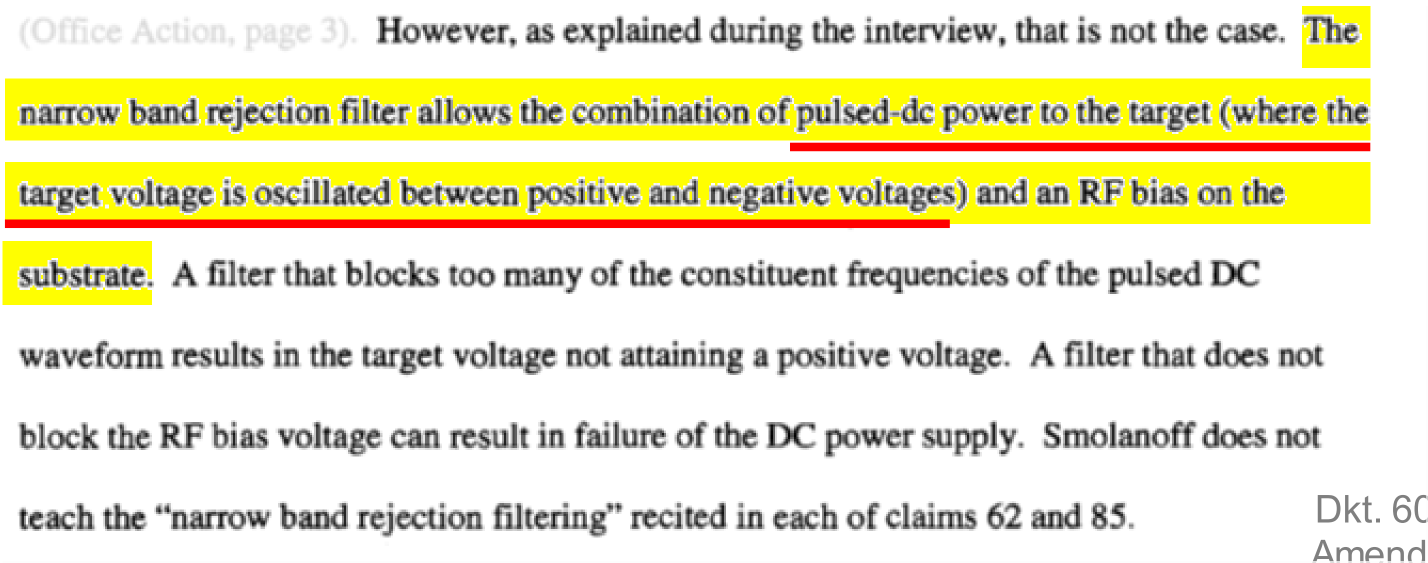


Claim 62 (Currently amended): A method of depositing a film on [[a]] an insulating substrate, comprising:

providing a process gas between a conductive target and [[a]] the substrate;

providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;

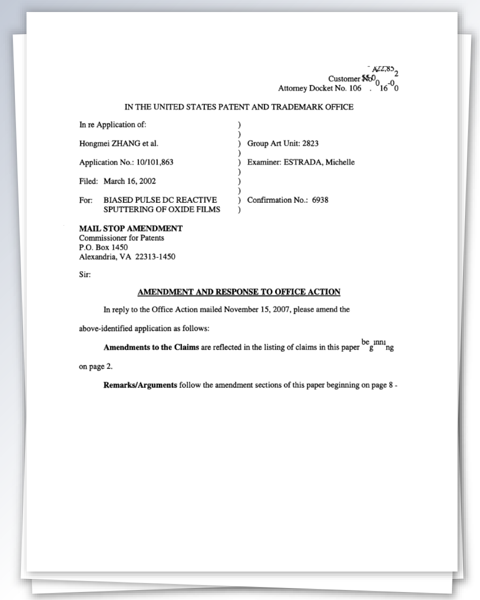
\- - -



(Office Action, page 3). However, as explained during the interview, that is not the case. The narrow band rejection filter allows the combination of pulsed-dc power to the target (where the target voltage is oscillated between positive and negative voltages) and an RF bias on the substrate. A filter that blocks too many of the constituent frequencies of the pulsed DC waveform results in the target voltage not attaining a positive voltage. A filter that does not block the RF bias voltage can result in failure of the DC power supply. Smolanoff does not teach the "narrow band rejection filtering" recited in each of claims 62 and 85.

Dkt. 60-5, Dec. 18, 2007 Amendment ('657 patent app.), 972-73, 979,

# Patentee Again Distinguishes from DC Power Supply



A22,852
Customer No. 0
Attorney Docket No. 106 . 16-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | |
|---|---|
| In re Application of: | ) |
| Hongmei ZHANG et al. | ) Group Art Unit: 2823 |
| Application No.: 10/101,863 | ) Examiner: ESTRADA, Michelle |
| Filed: March 16, 2002 | ) |
| For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS | ) Confirmation No.: 6938 |

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

**AMENDMENT AND RESPONSE TO OFFICE ACTION**

In reply to the Office Action mailed November 15, 2007, please amend the above-identified application as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

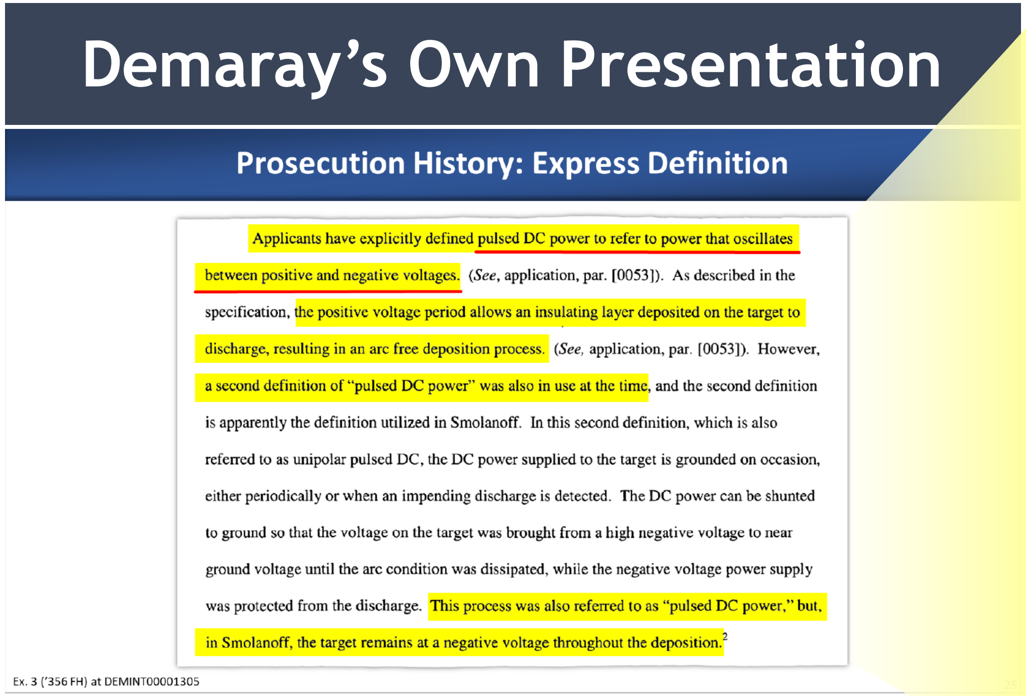
**Remarks/Arguments** follow the amendment sections of this paper beginning on page 8 -

RF bias applied to the substrate, as is recited in claims 21, 43, and 51. Additionally, Fu does not teach the elements for which it is relied or itself teach the combination of pulsed-DC power and RF bias recited in the claims.

Fu teaches high density, magnetic field enhanced ionized metal vapor deposition of conducting films. (*See* Fu, abstract). Fu, however, teaches utilization of a DC power supply (Fu, col. 1, lines 30-32) in combination with an RF bias applied to the substrate (Fu, col. 2, lines 36-41). Therefore, Fu fails to teach "adjusting an RF bias power to the substrate" in combination with "applying pulsed DC power to the target such that a voltage on the target oscillates between positive and negative voltages to create a plasma and deposit the oxide film" as is recited in

Dkt. 60-5 (Dec. 18, 2007
Amendment ('657 patent app.), 977,

# Demaray Disclaimed DC Power with Arc Suppression

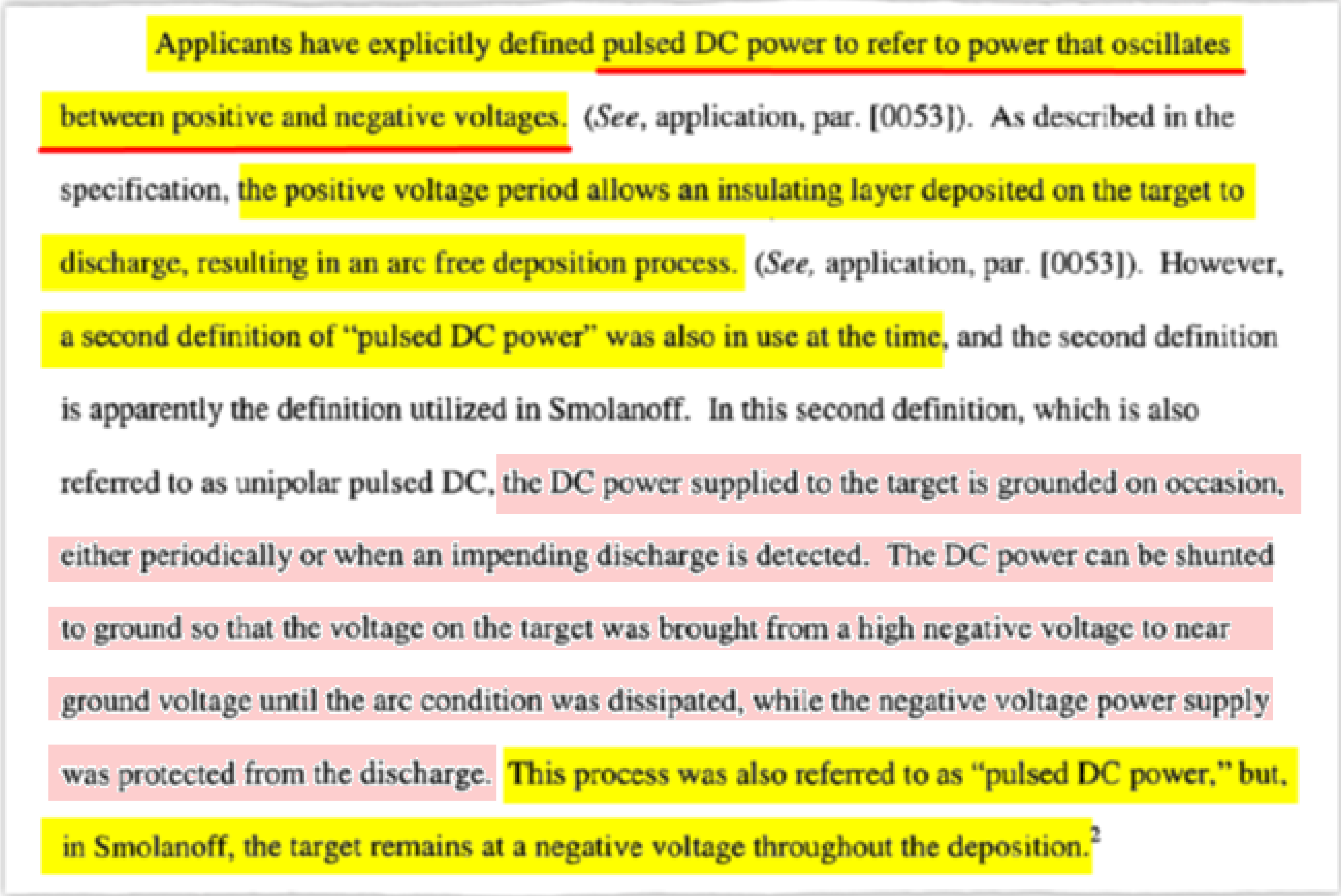


## Demaray's Own Presentation

### Prosecution History: Express Definition

Applicants have explicitly defined pulsed DC power to refer to power that oscillates between positive and negative voltages. (*See*, application, par. [0053]). As described in the specification, the positive voltage period allows an insulating layer deposited on the target to discharge, resulting in an arc free deposition process. (*See*, application, par. [0053]). However, a second definition of "pulsed DC power" was also in use at the time, and the second definition is apparently the definition utilized in Smolanoff. In this second definition, which is also referred to as unipolar pulsed DC, the DC power supplied to the target is grounded on occasion, either periodically or when an impending discharge is detected. The DC power can be shunted to ground so that the voltage on the target was brought from a high negative voltage to near ground voltage until the arc condition was dissipated, while the negative voltage power supply was protected from the discharge. This process was also referred to as "pulsed DC power," but, in Smolanoff, the target remains at a negative voltage throughout the deposition.[2]

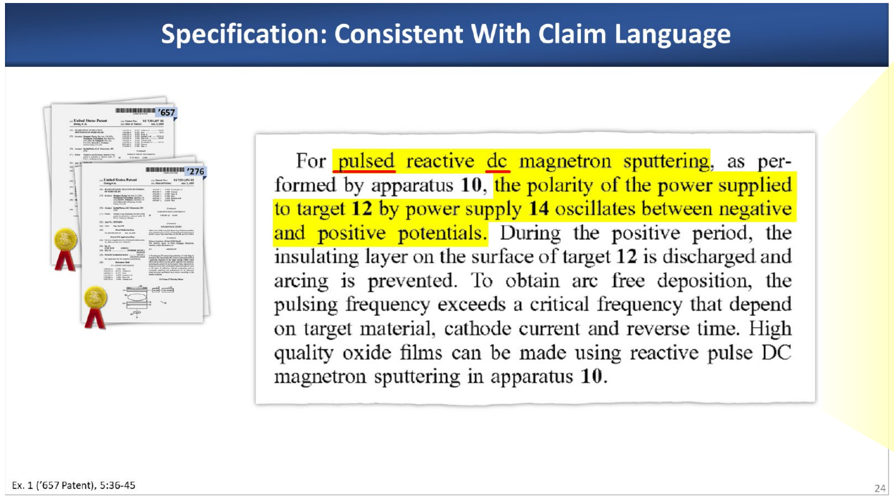
Ex. 3 ('356 FH) at DEMINT00001305



Applicants have explicitly defined pulsed DC power to refer to power that oscillates between positive and negative voltages. (*See*, application, par. [0053]). As described in the specification, the positive voltage period allows an insulating layer deposited on the target to discharge, resulting in an arc free deposition process. (*See*, application, par. [0053]). However, a second definition of "pulsed DC power" was also in use at the time, and the second definition is apparently the definition utilized in Smolanoff. In this second definition, which is also referred to as unipolar pulsed DC, the DC power supplied to the target is grounded on occasion, either periodically or when an impending discharge is detected. The DC power can be shunted to ground so that the voltage on the target was brought from a high negative voltage to near ground voltage until the arc condition was dissipated, while the negative voltage power supply was protected from the discharge. This process was also referred to as "pulsed DC power," but, in Smolanoff, the target remains at a negative voltage throughout the deposition.[2]

# Demaray Relies on Support for Limitation Already Added

## Demaray's Own Presentation



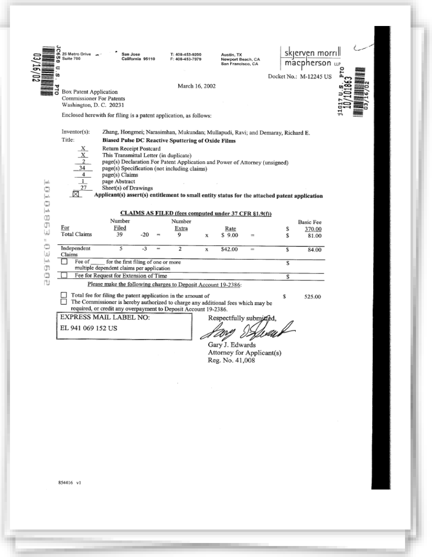
**Specification: Consistent With Claim Language**

For pulsed reactive dc magnetron sputtering, as performed by apparatus 10, the polarity of the power supplied to target 12 by power supply 14 oscillates between negative and positive potentials. During the positive period, the insulating layer on the surface of target 12 is discharged and arcing is prevented. To obtain arc free deposition, the pulsing frequency exceeds a critical frequency that depend on target material, cathode current and reverse time. High quality oxide films can be made using reactive pulse DC magnetron sputtering in apparatus 10.

Ex. 1 ('657 Patent), 5:36-45

24

For pulsed reactive dc magnetron sputtering, as performed by apparatus 10, the polarity of the power supplied to target 12 by power supply 14 oscillates between negative and positive potentials. During the positive period, the insulating layer on the surface of target 12 is discharged and arcing is prevented. To obtain arc free deposition, the pulsing frequency exceeds a critical frequency that depend on target material, cathode current and reverse time. High quality oxide films can be made using reactive pulse DC magnetron sputtering in apparatus 10.



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Newport Beach, CA
San Francisco, CA

skjerven morrill
macpherson LLP

Docket No.: M-12245 US

JC658 U.S. PTO
03/16/02

J1017 U.S. PTO
10/101863
03/16/02

March 16, 2002

Box Patent Application
Commissioner For Patents
Washington, D. C. 20231

Enclosed herewith for filing is a patent application, as follows:

Inventor(s): Zhang, Hongmei; Narasimhan, Mukundan; Mullapudi, Ravi; and Demaray, Richard E.
Title: **Biased Pulse DC Reactive Sputtering of Oxide Films**

X Return Receipt Postcard
X This Transmittal Letter (in duplicate)
2 page(s) Declaration For Patent Application and Power of Attorney (unsigned)
34 page(s) Specification (not including claims)
4 page(s) Claims
1 page Abstract
27 Sheet(s) of Drawings
☒ **Applicant(s) assert(s) entitlement to small entity status for the attached patent application**

**CLAIMS AS FILED (fees computed under 37 CFR §1.9(f))**

| For | Number Filed | | | Number Extra | | Rate | | | Basic Fee |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | $ | 370.00 |
| Total Claims | 39 | -20 | = | 9 | x | $ 9.00 | = | $ | 81.00 |
| Independent Claims | 5 | -3 | = | 2 | x | $42.00 | = | $ | 84.00 |
| ☐ Fee of _____ for the first filing of one or more multiple dependent claims per application | | | | | | | | $ | |
| ☐ Fee for Request for Extension of Time | | | | | | | | $ | |

Please make the following charges to Deposit Account 19-2386:

☐ Total fee for filing the patent application in the amount of $ 525.00
☐ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account 19-2386.

EXPRESS MAIL LABEL NO:
EL 941 069 152 US

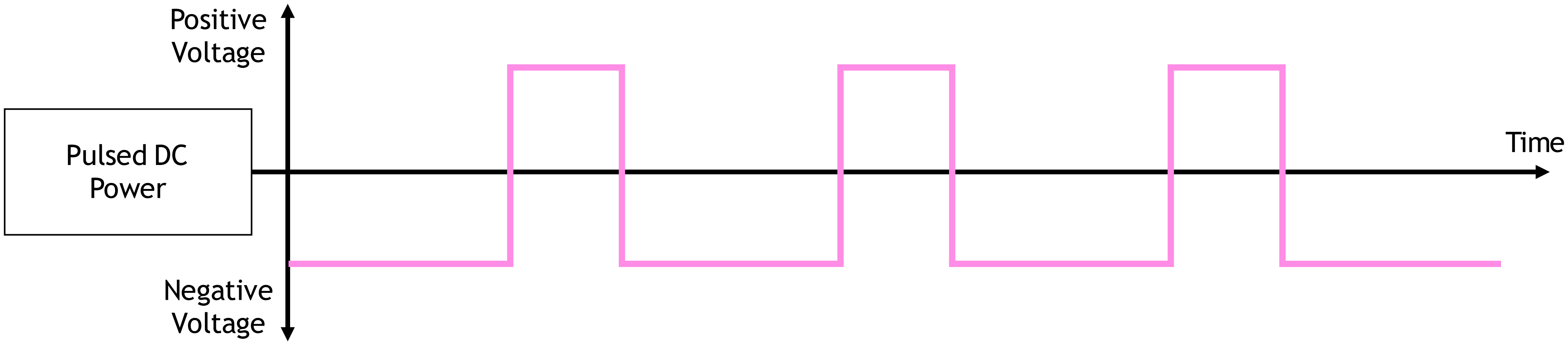
Respectfully submitted,
Gary J Edwards
Gary J. Edwards
Attorney for Applicant(s)
Reg. No. 41,008

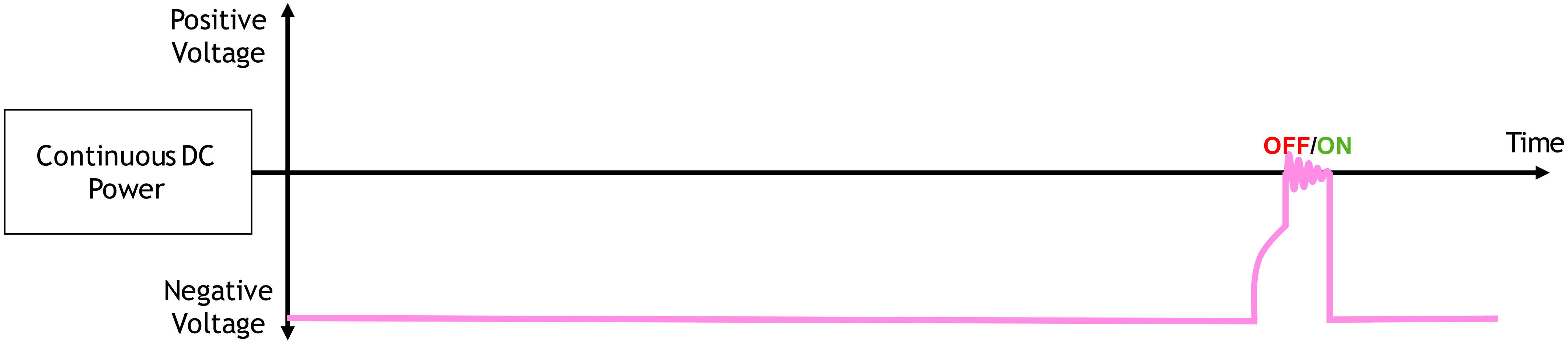
**[0053]**

~~[0051]~~ For pulsed reactive dc magnetron sputtering, as performed by apparatus 10, the polarity of the power supplied to target 12 by power supply 14 oscillates between negative and positive potentials. During the positive period, the insulating layer on the surface of target 12 is discharged and arcing is prevented. To obtain arc free deposition, the pulsing frequency exceeds a critical frequency that depend on target material, cathode current and reverse time. High quality oxide films can be made using reactive pulse DC magnetron sputtering in apparatus 10.

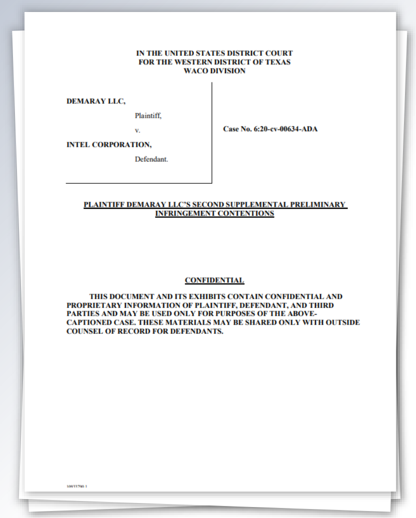
Dkt. 59-5 ('356 File History, 9)

# “pulsed DC power” vs. continuous DC power





# Demaray Attempts To Capture DC with Arc **Suppression** (Not Pulsed DC for Arc **Prevention**)



IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

**DEMARAY LLC,**
Plaintiff,
v.
**INTEL CORPORATION,**
Defendant.

**Case No. 6:20-cv-00634-ADA**

**PLAINTIFF DEMARAY LLC'S SECOND SUPPLEMENTAL PRELIMINARY INFRINGEMENT CONTENTIONS**

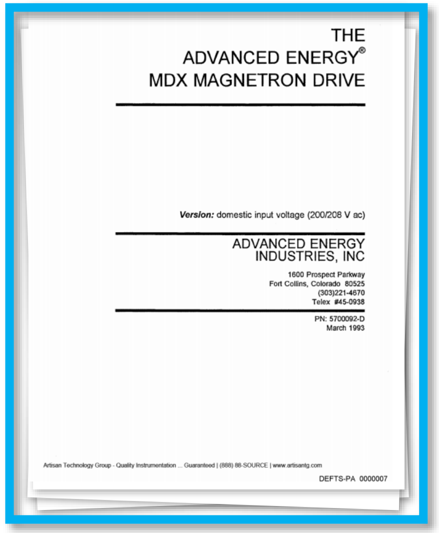
**CONFIDENTIAL**

**THIS DOCUMENT AND ITS EXHIBITS CONTAIN CONFIDENTIAL AND PROPRIETARY INFORMATION OF PLAINTIFF, DEFENDANT, AND THIRD PARTIES AND MAY BE USED ONLY FOR PURPOSES OF THE ABOVE-CAPTIONED CASE. THESE MATERIALS MAY BE SHARED ONLY WITH OUTSIDE COUNSEL OF RECORD FOR DEFENDANTS.**

## Infringement Contentions

As another example, the Advanced Energy Pinnacle III DC power source manual describes very similar arc suppression using pulses of DC power. See, e.g., AMAT-DEM_0000447 ("*When an arc of less than 50 µs occurs, the stored energy of the arc-out circuit is channeled into the arc and the voltage is reversed, the cunent passes through zero, and the arc is extinguished. Thus, the Pinnacle III unit configured with the arc-out circuitry can extinguish an arc and restore process voltage in approximately 50 µs.* This is very similar to the arc-out circuitry of the Advanced Energy Pinnacle II, MDX, and MDX-L power supplies."); *see also*

04/15/2021 Plaintiff's Second Supplemental Infringement Contentions (Intel), Exhibit A Claim Chart at 40



THE
ADVANCED ENERGY®
MDX MAGNETRON DRIVE

***Version:*** domestic input voltage (200/208 V ac)

ADVANCED ENERGY
INDUSTRIES, INC

1600 Prospect Parkway
Fort Collins, Colorado 80525
(303)221-4670
Telex #45-0938

PN: 5700092-D
March 1993

Artisan Technology Group - Quality Instrumentation ... Guaranteed | (888) 88-SOURCE | www.artisantg.com

DEFTS-PA 0000007

## Advanced Energy MDX Conventional DC Power Supply Manual (1993)

### Arc-suppression Circuitry

ARC-OUT™ provides multilevel suppression and quenching of different types of arcs. An added advantage is that ARC-OUT reduces target burn-in time and material loss. This feature also prevents energy from being dumped into hot spots by sensing a drop in impedance and immediately shutting the power off. Start-up after an arc is controlled so that the hot spots cool before power is reapplied, thus preventing repeated arcing.

Dkt. 61-2 (The Advanced Energy MDX Magnetron Drive (1993)) at 18

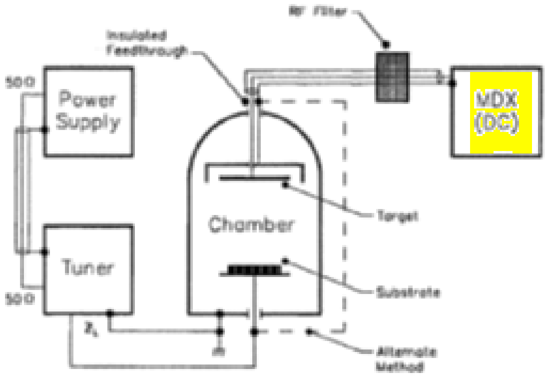


*Figure 1- 5. Typical configuration for dc sputtering with RF bias.*

# Demaray's Intrinsic Record Confirms Difference: Pulsed DC vs. Continuous DC

## Demaray's Own Presentation

### Intrinsic Record: Pulses At Arc Detection Known

Ex. 16 at DEFTS-PA_0003062

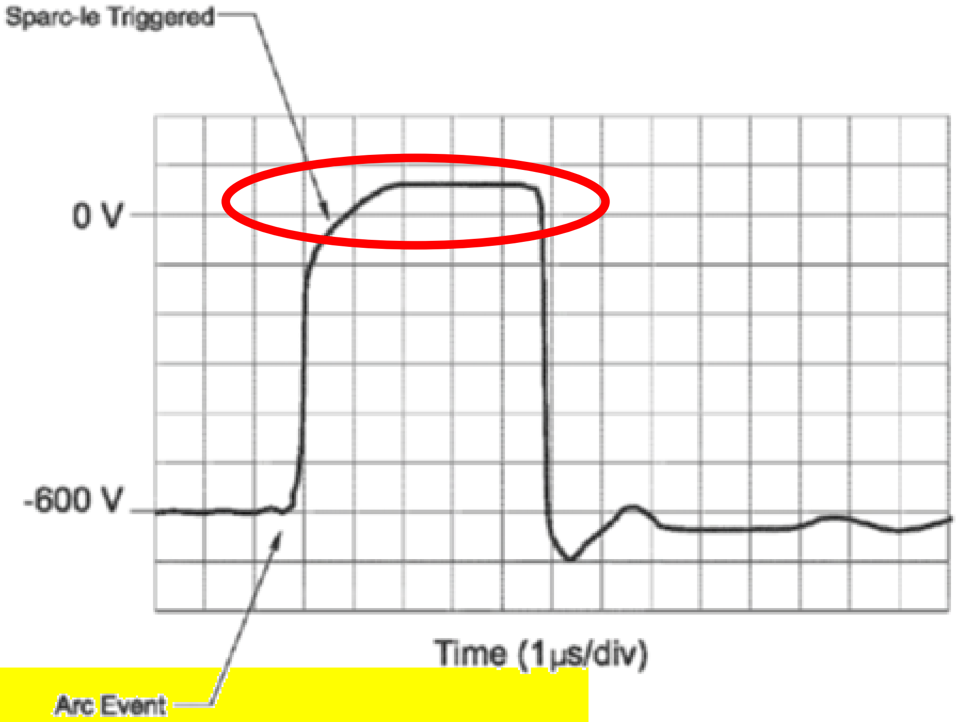
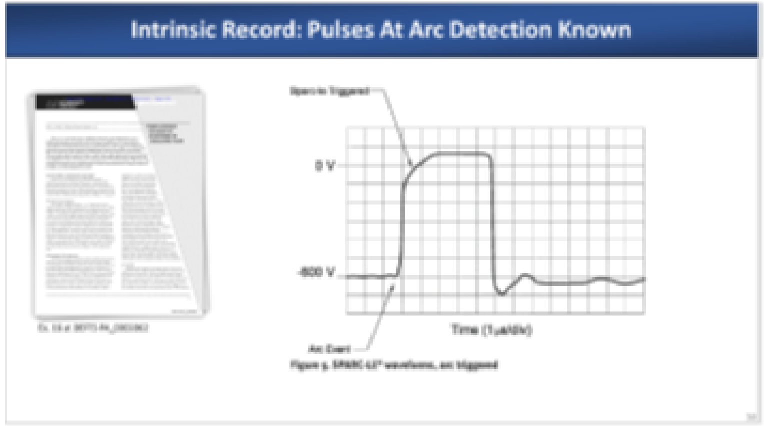


Figure 5. SPARC-LE® waveforms, arc triggered

# Demaray's Intrinsic Record Confirms Difference: Pulsed DC vs. Continuous DC

## Demaray's Own Presentation



Intrinsic Record: Pulses At Arc Detection Known

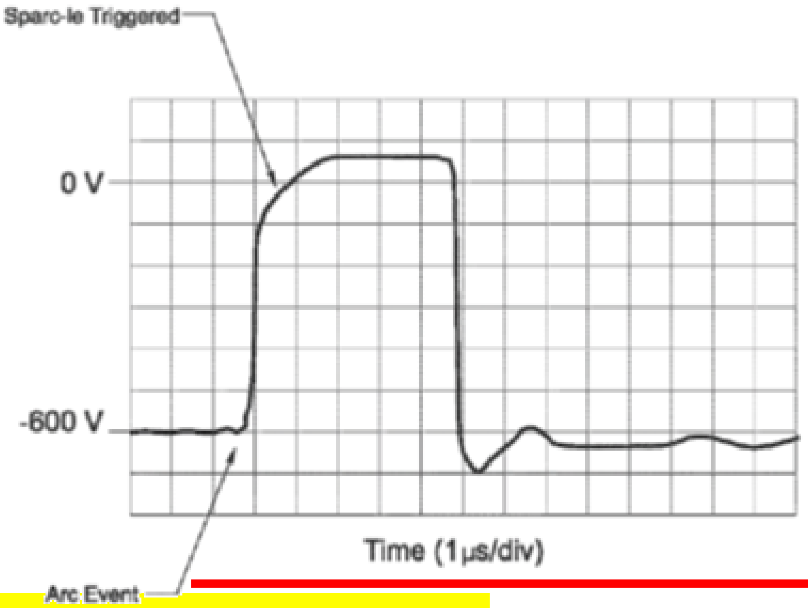


Figure 5. SPARC-LE® waveforms, arc triggered

*Pulsed DC approaches*

For the thin insulating layers formed on the target during reactive sputtering, however, there is no need to resort to radio-frequency power. Depending upon the dielectric constant of the reaction product and the current density of the arriving ions, the layers can be kept discharged with relatively low frequencies. If the layers are kept discharged, arcing can be prevented altogether. For $Al_2O_3$, a discharge rate of only 20 kHz is sufficient to prevent dielectric breakdown for current densities of up to 103 A/m$^3$, and it can be shown that the rate required to prevent breakdown is not dependent upon the film thickness [5]. This fact has been taken advantage of in the use of a number of approaches to reactive sputtering.

Meanwhile, an arc detect circuit, (D), sends a signal to close the switch when an arc is sensed. This has the effect of removing the electrons from the arc and quenching it. The voltage waveform for this case is shown in Figure 5 on page 7.

"Bipolar pulsed dc" supplies are also available that contain reversal-switching for a dc supply. These units apply the full output voltage of the dc portion of the power supply to the plasma, in either a positive or negative polarity. The positive and negative pulse widths are adjustable over a considerable range (from a few ms up to ½ s) and variable off-times are available between the pulses. Provided the positive pulse is kept

Dkt. 46-19 (Ex. 16)

# Demaray's Intrinsic Record Confirms Difference: Pulsed DC vs. Continuous DC

## Demaray's Own Presentation

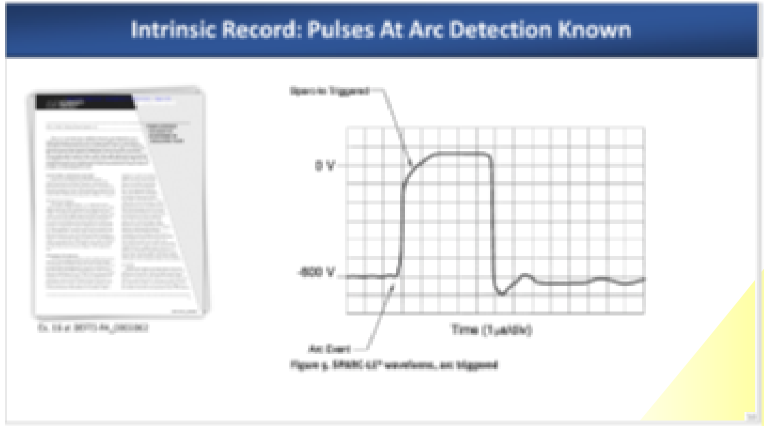

Intrinsic Record: Pulses At Arc Detection Known

Figure 5. SPARC-LE® waveforms, arc triggered


ADVANCED ENERGY®

WHITEPAPER

POWER SYSTEMS FOR REACTIVE SPUTTERING OF INSULATING FILMS

Dr. R.A. Scholl, Advanced Energy Industries, Inc.

DEFTS-PA_0003056

Ex. 16 at DEFTS-PA_0003062

Considerable success has been achieved by an approach that forcibly reverses the target voltage to a few tens of volts higher than the plasma potential [5,9]. This device, Advanced Energy's Sparc-le® unit, for which patents are pending, has a basic schematic diagram as shown in Figure 2 on page 6.

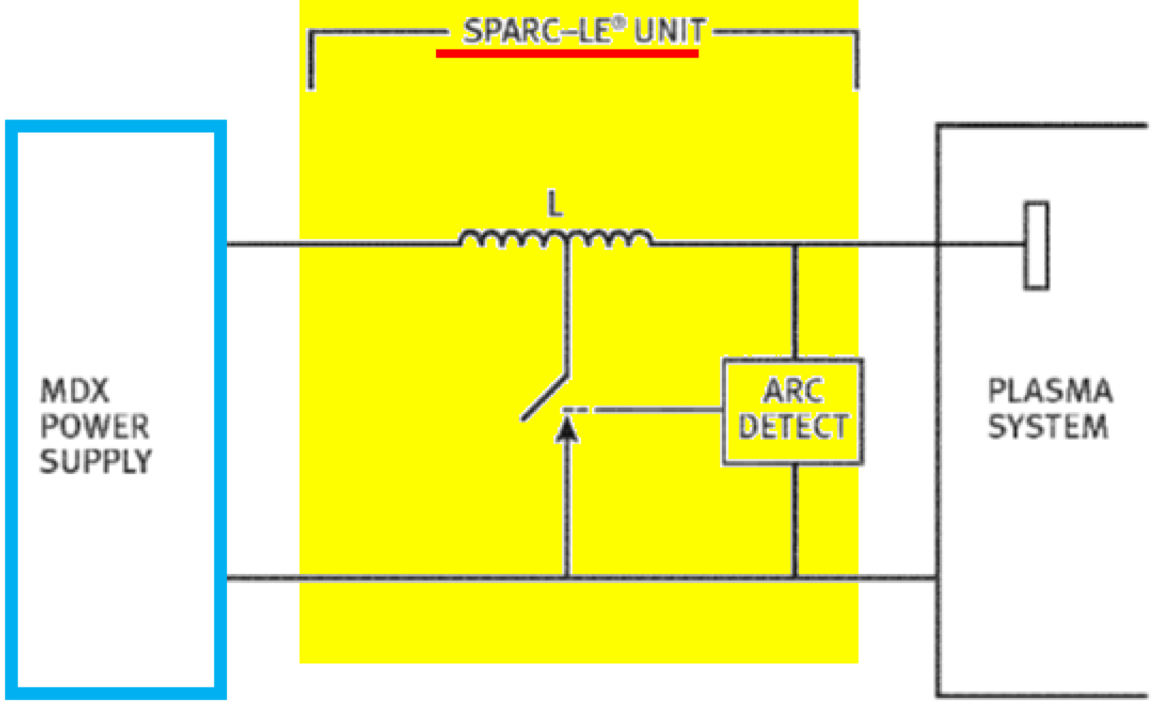
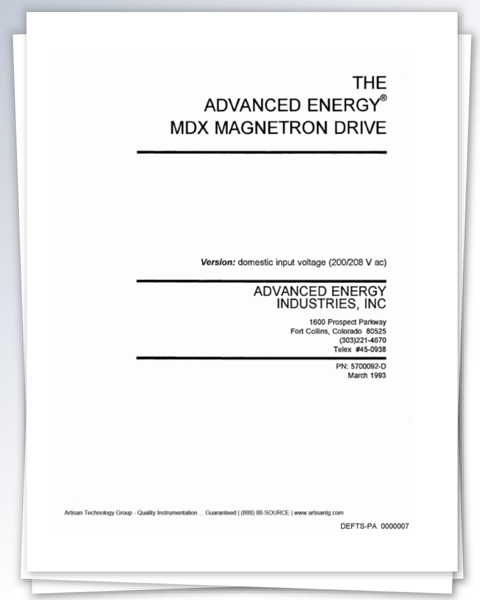


Figure 2. SPARC-LE® unit simplified schematic

Dkt. 46-19 (Ex. 16)

# Conventional DC Sputtering with RF Bias (1993)



THE
ADVANCED ENERGY®
MDX MAGNETRON DRIVE

***Version:*** domestic input voltage (200/208 V ac)

ADVANCED ENERGY
INDUSTRIES, INC
1600 Prospect Parkway
Fort Collins, Colorado 80525
(303)221-4670
Telex #45-0938

PN: 5700092-D
March 1993

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DEFTS-PA 0000007

PN: 5700092-D
March 1993

## DC Sputtering with RF Bias

In this application (see the illustration on the next page), proper installation of the RF generator and tuner is critical to proper operation of the system. Proper installation includes good, solid, RF grounding and dc installation.

An RF filter must be placed between the dc output and the chamber because 13.56 MHz can damage the typical dc magnetron power supply. There is no

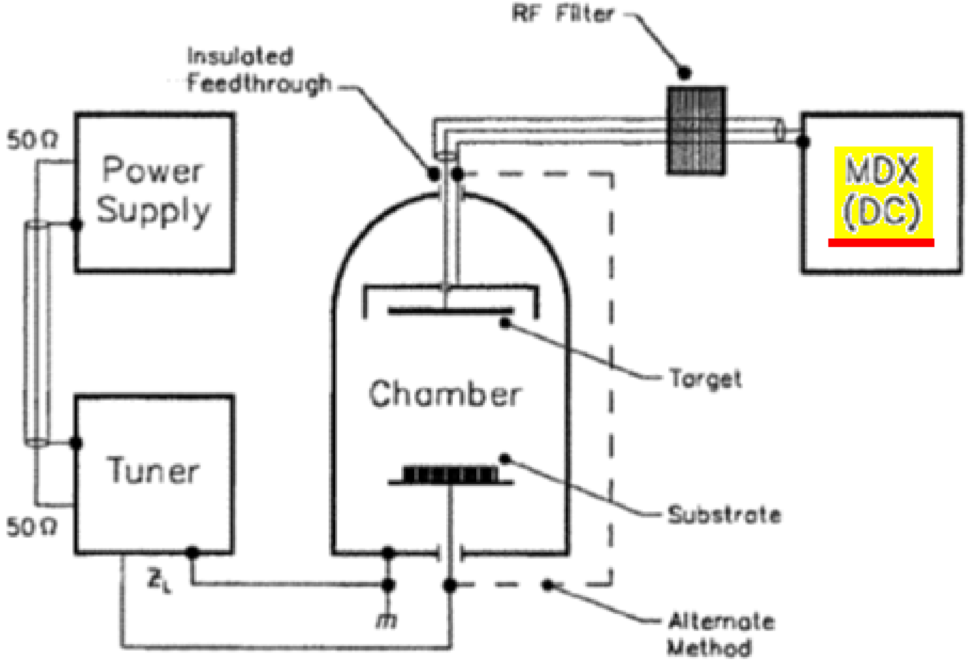
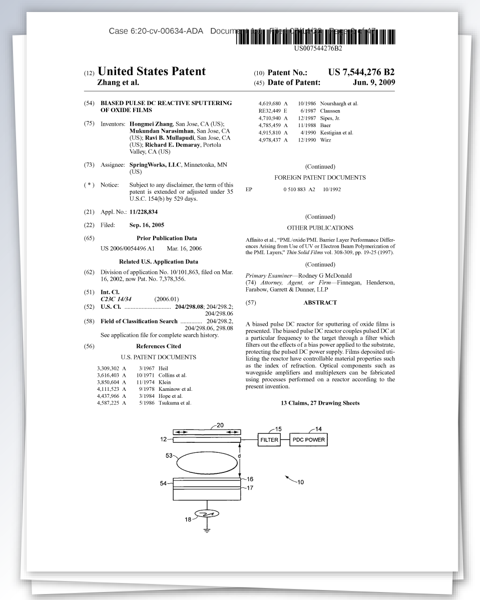


*Figure 1- 5. Typical configuration for dc sputtering with RF bias.*

Dkt. 61-2 (The Advanced Energy MDX Magnetron Drive (1993)) at 24-25

# "Pulsed DC Power" Should Not Capture Conventional Systems / Processes Denigrated by the Patentee



Case 6:20-cv-00634-ADA Document 1-1 Filed 07/14/20 Page 9 of 47

US007544276B2

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

(10) **Patent No.: US 7,544,276 B2**
(45) **Date of Patent: Jun. 9, 2009**

(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**

(75) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Mukundan Narasimhan**, San Jose, CA (US); **Ravi B. Mullapudi**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

(73) Assignee: **SpringWorks, LLC**, Minnetonka, MN (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 529 days.

(21) Appl. No.: **11/228,834**

(22) Filed: **Sep. 16, 2005**

(65) **Prior Publication Data**

US 2006/0054496 A1 Mar. 16, 2006

**Related U.S. Application Data**

(62) Division of application No. 10/101,863, filed on Mar. 16, 2002, now Pat. No. 7,378,356.

(51) **Int. Cl.**
*C23C 14/34* (2006.01)

(52) **U.S. Cl.** .............................. **204/298.08**; 204/298.2; 204/298.06

(58) **Field of Classification Search** ............. 204/298.2, 204/298.06, 298.08
See application file for complete search history.

(56) **References Cited**

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| | | | |
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Affinito et al., "PML/oxide/PML Barrier Layer Performance Differences Arising from Use of UV or Electron Beam Polymerization of the PML Layers," *Thin Solid Films* vol. 308-309, pp. 19-25 (1997).

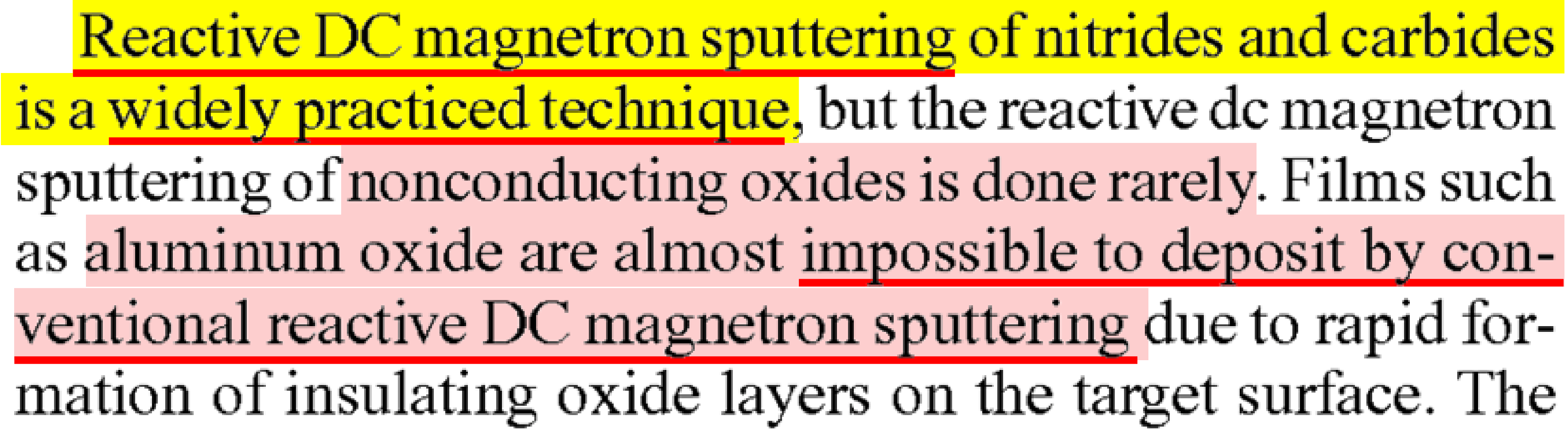
(Continued)

*Primary Examiner*—Rodney G McDonald
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

(57) **ABSTRACT**

A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present invention.

**13 Claims, 27 Drawing Sheets**



Reactive DC magnetron sputtering of nitrides and carbides is a widely practiced technique, but the reactive dc magnetron sputtering of nonconducting oxides is done rarely. Films such as aluminum oxide are almost impossible to deposit by conventional reactive DC magnetron sputtering due to rapid formation of insulating oxide layers on the target surface. The

'276 Patent, 4:44-49

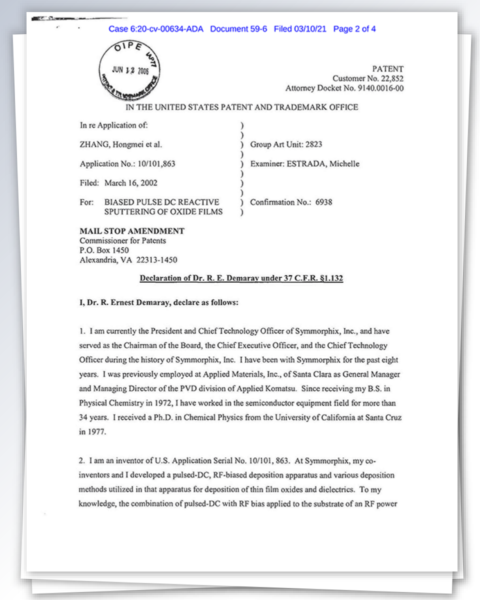
# “pulsed DC power”

| Claim Term | Tentative Construction |
|---|---|
| “**pulsed** DC power” (’657 patent, claim 1) | “direct current power **that oscillates between positive and negative voltages**” |
| “**pulsed** DC power supply” (’276 patent, claims 1, 6) | “supply for providing **pulsed** DC power” |

**Fine-Tuned Construction #1:** “direct current power **that oscillates between <u>predetermined</u> positive and negative voltages**”

**Fine-Tuned Construction #2:** “direct current power **in a square wave form**”

# Patentee Defines "pulsed DC" as Square Wave



PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
)
ZHANG, Hongmei et al. ) Group Art Unit: 2823
)
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
)
Filed: March 16, 2002 )
)
For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS ) Confirmation No.: 6938
)

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

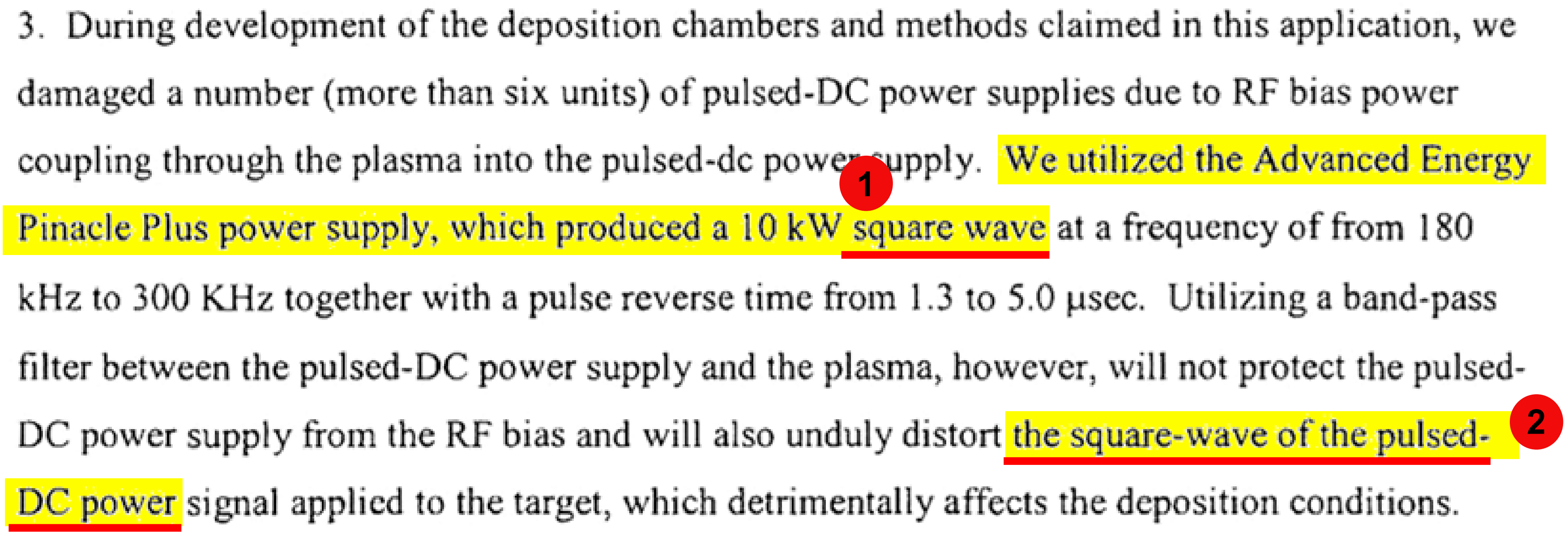
**Declaration of Dr. R. E. Demaray under 37 C.F.R. §1.132**

**I, Dr. R. Ernest Demaray, declare as follows:**

1. I am currently the President and Chief Technology Officer of Symmorphix, Inc., and have served as the Chairman of the Board, the Chief Executive Officer, and the Chief Technology Officer during the history of Symmorphix, Inc. I have been with Symmorphix for the past eight years. I was previously employed at Applied Materials, Inc., of Santa Clara as General Manager and Managing Director of the PVD division of Applied Komatsu. Since receiving my B.S. in Physical Chemistry in 1972, I have worked in the semiconductor equipment field for more than 34 years. I received a Ph.D. in Chemical Physics from the University of California at Santa Cruz in 1977.

2. I am an inventor of U.S. Application Serial No. 10/101, 863. At Symmorphix, my co-inventors and I developed a pulsed-DC, RF-biased deposition apparatus and various deposition methods utilized in that apparatus for deposition of thin film oxides and dielectrics. To my knowledge, the combination of pulsed-DC with RF bias applied to the substrate of an RF power

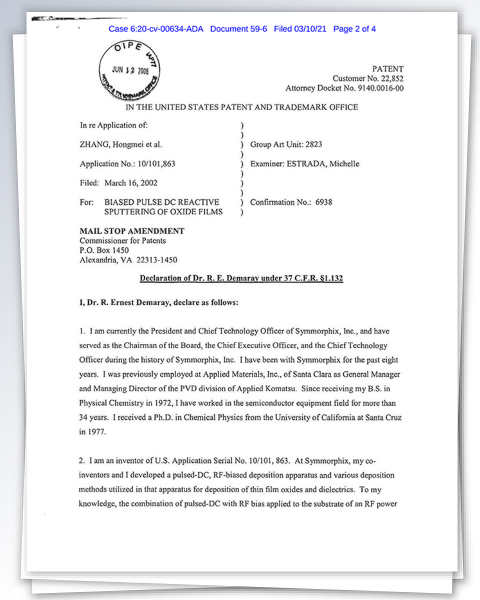
## Jun. 7, 2006: Dr. Demaray's Sworn Declaration



3. During development of the deposition chambers and methods claimed in this application, we damaged a number (more than six units) of pulsed-DC power supplies due to RF bias power coupling through the plasma into the pulsed-dc power supply. We utilized the Advanced Energy Pinacle Plus power supply, which produced a 10 kW ① square wave at a frequency of from 180 kHz to 300 KHz together with a pulse reverse time from 1.3 to 5.0 μsec. Utilizing a band-pass filter between the pulsed-DC power supply and the plasma, however, will not protect the pulsed-DC power supply from the RF bias and will also unduly distort the square-wave of the pulsed-DC power ② signal applied to the target, which detrimentally affects the deposition conditions.

Dkt. 59-6 (06/07/2006 Dr. Demaray Declaration), ¶ 3
*also at* Dkt. 59-5 ('356 File History, part 6/7), 1134 (¶ 3)

# Patentee Defines "pulsed DC" as Square Wave



Case 6:20-cv-00634-ADA Document 59-6 Filed 03/10/21 Page 2 of 4

OIPE
JUN 12 2006

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
ZHANG, Hongmei et al. ) Group Art Unit: 2823
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
Filed: March 16, 2002 )
For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS ) Confirmation No.: 6938

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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2. I am an inventor of U.S. Application Serial No. 10/101, 863. At Symmorphix, my co-inventors and I developed a pulsed-DC, RF-biased deposition apparatus and various deposition methods utilized in that apparatus for deposition of thin film oxides and dielectrics. To my knowledge, the combination of pulsed-DC with RF bias applied to the substrate of an RF power

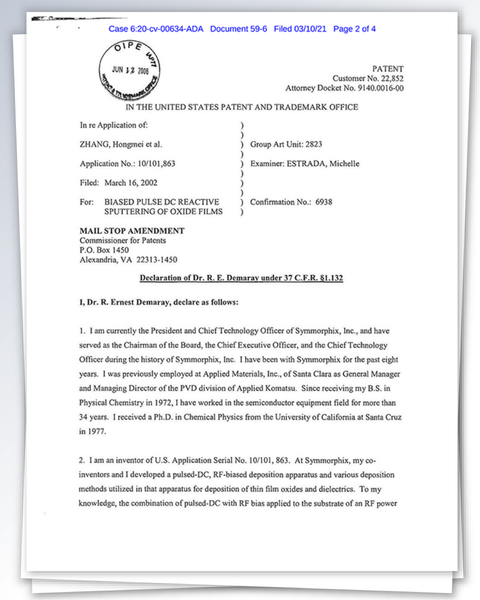
## Jun. 7, 2006: Dr. Demaray's Sworn Declaration

4. My co-inventors and I developed the band-rejection filter described in the specification and claimed in U.S. Application Serial No. 10/101, 863 to overcome the problem of catastrophic failure of the pulsed-DC power supply output electrometer circuit during operation. We discovered that a band-rejection filter, which is a filter that passes all of the frequencies of the square wave power supply except within a narrow band centered on the RF frequency of the RF bias, protected the pulsed-DC power supply from the RF energy while not distorting the pulses generated by the pulsed-DC power supply applied to the target.

3

Dkt. 59-6 (06/07/2006 Dr. Demaray Declaration), ¶ 4
*also at* Dkt. 59-5 ('356 File History, part 6/7), 1134 (¶ 4)

# Patentee Defines "pulsed DC" as Square Wave



Case 6:20-cv-00634-ADA Document 59-6 Filed 03/10/21 Page 2 of 4

OIPE
JUN 12 2006

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:
ZHANG, Hongmei et al. ) Group Art Unit: 2823
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
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Alexandria, VA 22313-1450

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**I, Dr. R. Ernest Demaray, declare as follows:**

1. I am currently the President and Chief Technology Officer of Symmorphix, Inc., and have served as the Chairman of the Board, the Chief Executive Officer, and the Chief Technology Officer during the history of Symmorphix, Inc. I have been with Symmorphix for the past eight years. I was previously employed at Applied Materials, Inc., of Santa Clara as General Manager and Managing Director of the PVD division of Applied Komatsu. Since receiving my B.S. in Physical Chemistry in 1972, I have worked in the semiconductor equipment field for more than 34 years. I received a Ph.D. in Chemical Physics from the University of California at Santa Cruz in 1977.

2. I am an inventor of U.S. Application Serial No. 10/101, 863. At Symmorphix, my co-inventors and I developed a pulsed-DC, RF-biased deposition apparatus and various deposition methods utilized in that apparatus for deposition of thin film oxides and dielectrics. To my knowledge, the combination of pulsed-DC with RF bias applied to the substrate of an RF power

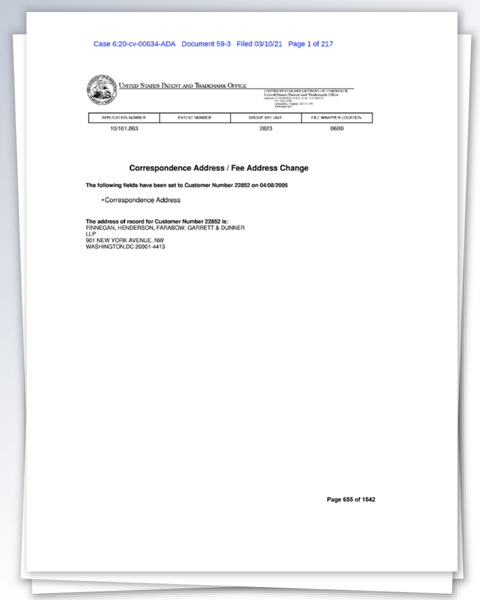
## Jun. 7, 2006: Dr. Demaray's Sworn Declaration

8. Fukui describes a band-pass filter (specifically a low pass filter) coupled between the pulsed-dc power supply and the filter. Again, a band-pass filter does not protect the pulsed-DC power supply, as is required, and will distort the pulsed-DC square wave. Further, Fukui indicates that "[t]he band-pass filter 27 serves to adjust the circuit impedance to have an infinite value so that no RF waves are superposed on a dc power from the dc power supply 28." (Fukui, col. 6, lines 33-36). This is quite the opposite of what occurs in our applications, where the RF signal is superimposed on the pulsed DC power signal in the plasma, to which the substrate is exposed. Therefore, Fukui does not teach a band-rejection filter at the frequency of the RF bias.

④

Dkt. 59-6 (Dr. Demaray Declaration), ¶ 8;
*also at* Dkt. 59-5 ('356 File History, part 6/7), 1135 (¶ 8)

# “pulsed DC power” *Square Wave* Argued to Overcome Rejection



Case 6:20-cv-00634-ADA Document 59-3 Filed 03/10/21 Page 1 of 217

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

| APPLICATION NUMBER | PATENT NUMBER | GROUP ART UNIT | FILE WRAPPER LOCATION |
|---|---|---|---|
| 10/101,863 | | 2823 | 0680 |

Correspondence Address / Fee Address Change

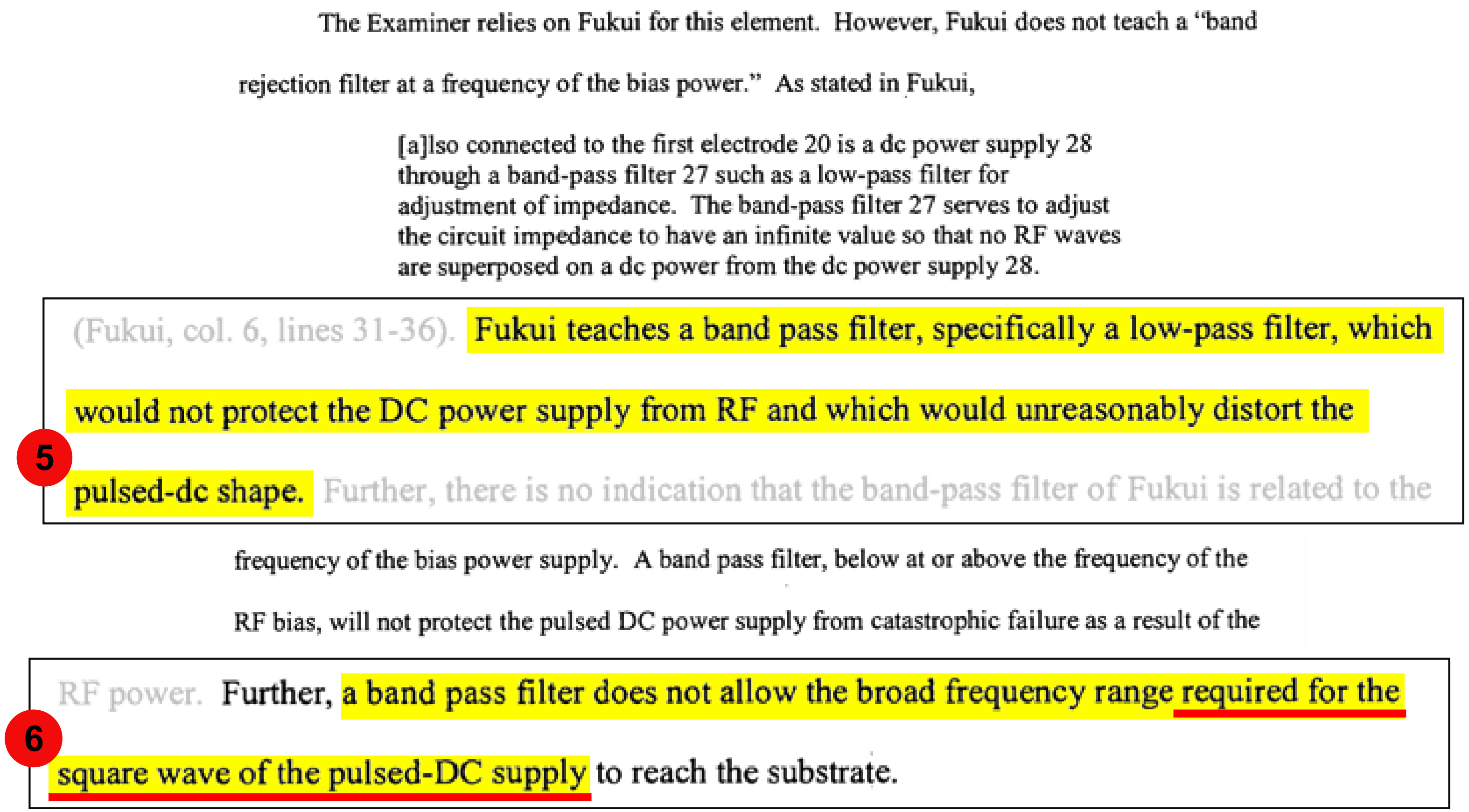
The following fields have been set to Customer Number 22852 on 04/08/2005

- Correspondence Address

The address of record for Customer Number 22852 is:
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER
LLP
901 NEW YORK AVENUE, NW
WASHINGTON,DC 20001-4413

Page 655 of 1542

## Jun. 12, 2006: Patentee’s Response



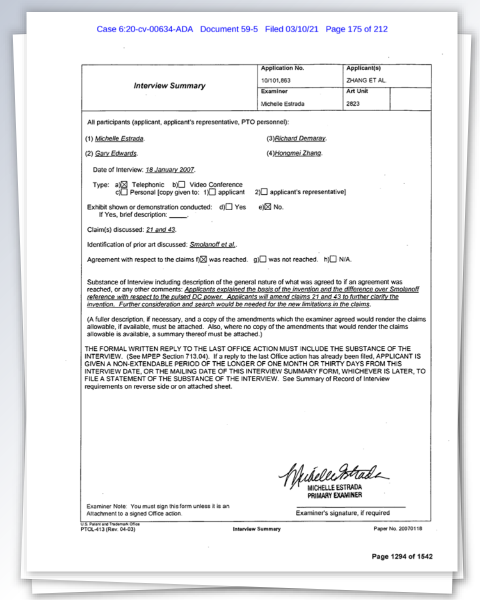
The Examiner relies on Fukui for this element. However, Fukui does not teach a “band rejection filter at a frequency of the bias power.” As stated in Fukui,

> [a]lso connected to the first electrode 20 is a dc power supply 28 through a band-pass filter 27 such as a low-pass filter for adjustment of impedance. The band-pass filter 27 serves to adjust the circuit impedance to have an infinite value so that no RF waves are superposed on a dc power from the dc power supply 28.

(Fukui, col. 6, lines 31-36). Fukui teaches a band pass filter, specifically a low-pass filter, which would not protect the DC power supply from RF and which would unreasonably distort the pulsed-dc shape. Further, there is no indication that the band-pass filter of Fukui is related to the frequency of the bias power supply. A band pass filter, below at or above the frequency of the RF bias, will not protect the pulsed DC power supply from catastrophic failure as a result of the RF power. Further, a band pass filter does not allow the broad frequency range required for the square wave of the pulsed-DC supply to reach the substrate.

Dkt. 59-5 (’356 File History, part 6/7), 1131

# Patentee Defines "pulsed DC" as Square Wave



Case 6:20-cv-00634-ADA Document 59-5 Filed 03/10/21 Page 175 of 212

| Interview Summary | Application No.<br>10/101,863 | Applicant(s)<br>ZHANG ET AL. | |
|---|---|---|---|
| | Examiner<br>Michelle Estrada | Art Unit<br>2823 | |

All participants (applicant, applicant's representative, PTO personnel):

(1) *Michelle Estrada*. (3)*Richard Demaray*.

(2) *Gary Edwards*. (4)*Hongmei Zhang*.

Date of Interview: *18 January 2007*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: *21 and 43*.

Identification of prior art discussed: *Smolanoff et al.*.

Agreement with respect to the claims f)☒ was reached. g)☐ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *Applicants explained the basis of the invention and the difference over Smolanoff reference with respect to the pulsed DC power. Applicants will amend claims 21 and 43 to further clarify the invention. Further consideration and search would be needed for the new limitations in the claims*.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN A NON-EXTENDABLE PERIOD OF THE LONGER OF ONE MONTH OR THIRTY DAYS FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.

MICHELLE ESTRADA
PRIMARY EXAMINER

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Examiner's signature, if required

U.S. Patent and Trademark Office
PTOL-413 (Rev. 04-03) **Interview Summary** Paper No. 20070118

**Page 1294 of 1542**

## Jan. 23, 2007: Interview with Patent Office

When explaining the "**basis of the invention**," the Patentee emphasized the "pulsed DC" square wave form:

All participants (applicant, applicant's representative, PTO personnel):

(1) *Michelle Estrada*. (3)*Richard Demaray*.

(2) *Gary Edwards*. (4)*Hongmei Zhang*.

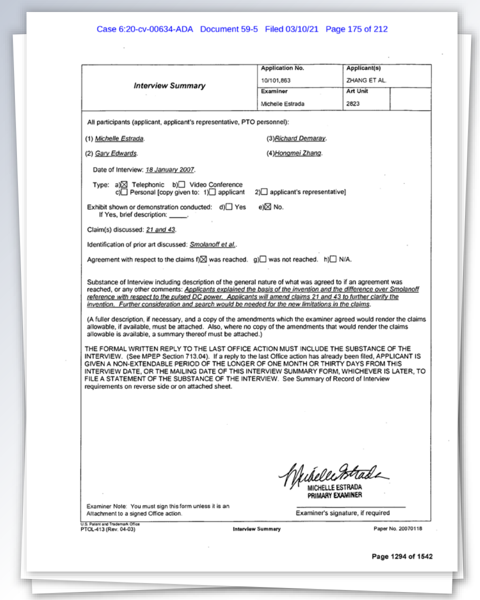
Named inventors

…

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *Applicants explained the basis of the invention and the difference over Smolanoff reference with respect to the pulsed DC power. Applicants will amend claims 21 and 43 to further clarify the invention. Further consideration and search would be needed for the new limitations in the claims*.

Dkt. 59-5 ('356 File History, part 6/7, 01/23/2007 Interview Summary), 1294

# Patentee Defines "pulsed DC" as Square Wave



| **Interview Summary** | **Application No.**<br>10/101,863 | **Applicant(s)**<br>ZHANG ET AL. | |
|---|---|---|---|
| | **Examiner**<br>Michelle Estrada | **Art Unit**<br>2823 | |

All participants (applicant, applicant's representative, PTO personnel):

(1) *Michelle Estrada*. (3)*Richard Demaray*.

(2) *Gary Edwards*. (4)*Hongmei Zhang*.

Date of Interview: *18 January 2007*.

Type: a)☒ Telephonic b)☐ Video Conference
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☐ Yes e)☒ No.
If Yes, brief description: _____.

Claim(s) discussed: *21 and 43*.

Identification of prior art discussed: *Smolanoff et al.*.

Agreement with respect to the claims f)☒ was reached. g)☐ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: *Applicants explained the basis of the invention and the difference over Smolanoff reference with respect to the pulsed DC power. Applicants will amend claims 21 and 43 to further clarify the invention. Further consideration and search would be needed for the new limitations in the claims*.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

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Michelle Estrada
MICHELLE ESTRADA
PRIMARY EXAMINER

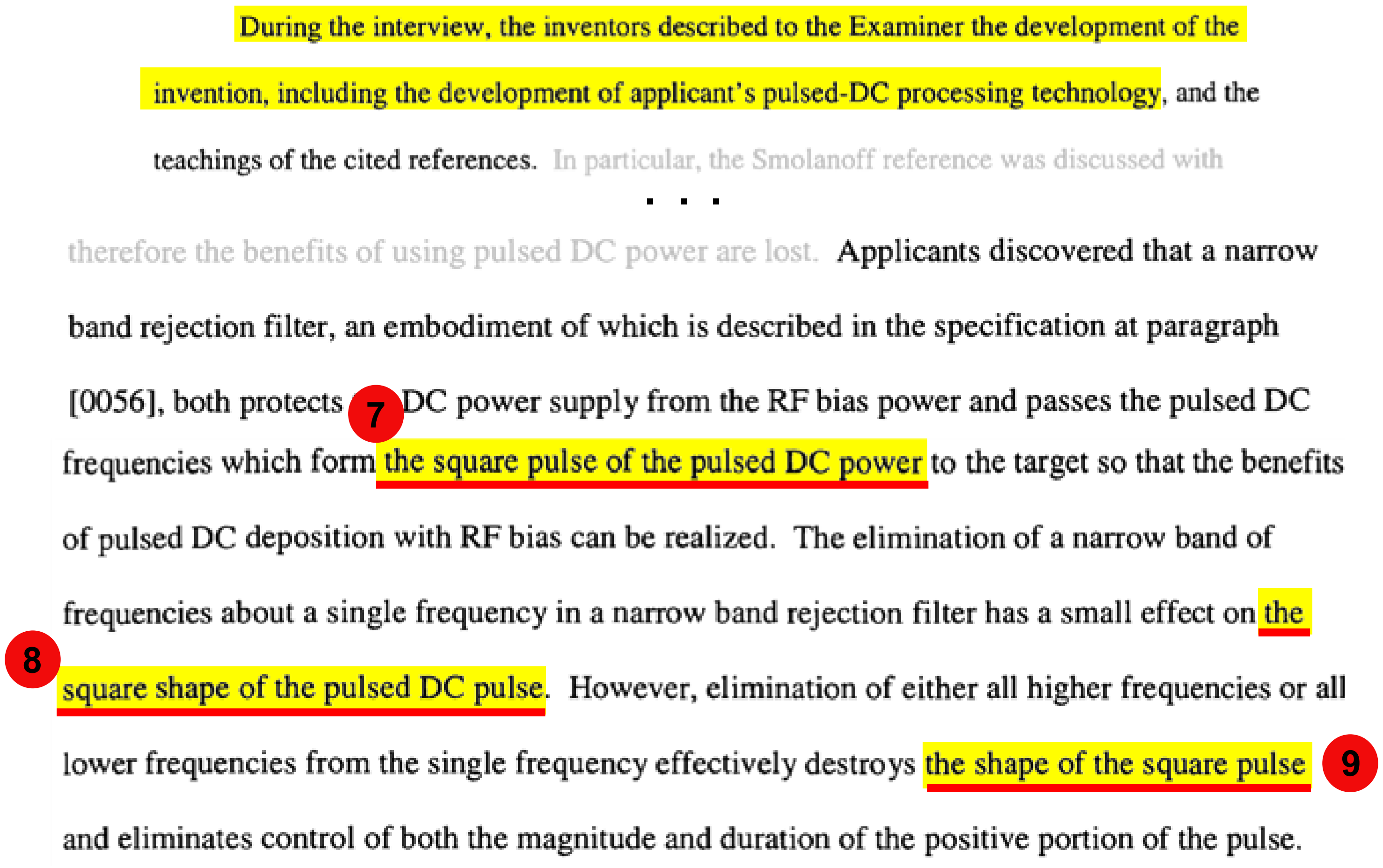
Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Examiner's signature, if required

U.S. Patent and Trademark Office
PTOL-413 (Rev. 04-03) **Interview Summary** Paper No. 20070118

**Page 1294 of 1542**

## Feb. 6, 2007: Patentee's Summary of the Same Interview



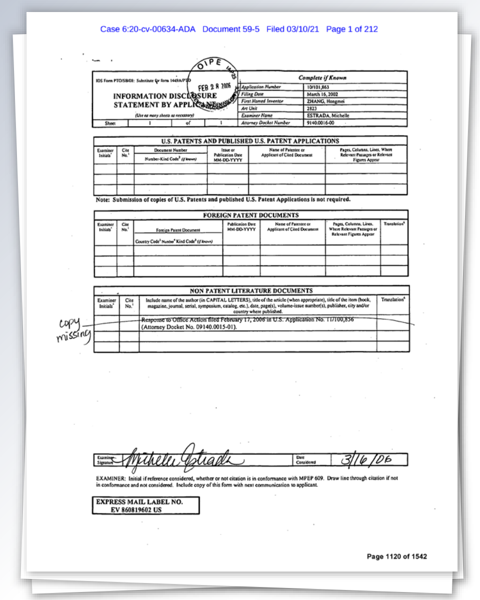
During the interview, the inventors described to the Examiner the development of the invention, including the development of applicant's pulsed-DC processing technology, and the teachings of the cited references. In particular, the Smolanoff reference was discussed with

. . .

therefore the benefits of using pulsed DC power are lost. Applicants discovered that a narrow band rejection filter, an embodiment of which is described in the specification at paragraph [0056], both protects ⑦ DC power supply from the RF bias power and passes the pulsed DC frequencies which form the square pulse of the pulsed DC power to the target so that the benefits of pulsed DC deposition with RF bias can be realized. The elimination of a narrow band of frequencies about a single frequency in a narrow band rejection filter has a small effect on the ⑧ square shape of the pulsed DC pulse. However, elimination of either all higher frequencies or all lower frequencies from the single frequency effectively destroys the shape of the square pulse ⑨ and eliminates control of both the magnitude and duration of the positive portion of the pulse.

Dkt. 59-5 ('356 File History, part 6/7, 02/06/2007 Applicant's Response), 1301-03

# “Benefits” Not “Realized” Without Square Wave of “pulsed DC power”



IDS Form PTO/SB/08: Substitute for form 1449A/PTO

OIPE
FEB 28 2006

INFORMATION DISCLOSURE
STATEMENT BY APPLICANT
(Use as many sheets as necessary)

| Complete if Known | |
|---|---|
| Application Number | 10/101,863 |
| Filing Date | March 16, 2002 |
| First Named Inventor | ZHANG, Hongmei |
| Art Unit | 2823 |
| Examiner Name | ESTRADA, Michelle |
| Attorney Docket Number | 9140.0016-00 |

Sheet 1 of 1

U.S. PATENTS AND PUBLISHED U.S. PATENT APPLICATIONS

| Examiner Initials* | Cite No.¹ | Document Number<br>Number-Kind Code² (if known) | Issue or Publication Date MM-DD-YYYY | Name of Patentee or Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear |
|---|---|---|---|---|---|
| | | | | | |
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Note: Submission of copies of U.S. Patents and published U.S. Patent Applications is not required.

FOREIGN PATENT DOCUMENTS

| Examiner Initials* | Cite No.¹ | Foreign Patent Document<br>Country Code³ Number⁴ Kind Code⁵ (if known) | Publication Date MM-DD-YYYY | Name of Patentee or Applicant of Cited Document | Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear | Translation⁶ |
|---|---|---|---|---|---|---|
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NON PATENT LITERATURE DOCUMENTS

| Examiner Initials* | Cite No.¹ | Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published. | Translation⁶ |
|---|---|---|---|
| copy missing | | ~~Response to Office Action filed February 17, 2006 in U.S. Application No. 11/100,856~~<br>(Attorney Docket No. 09140.0015-01). | |
| | | | |
| | | | |

Examiner Signature: Michelle Estrada | Date Considered: 3/16/06

EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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EV 860819602 US

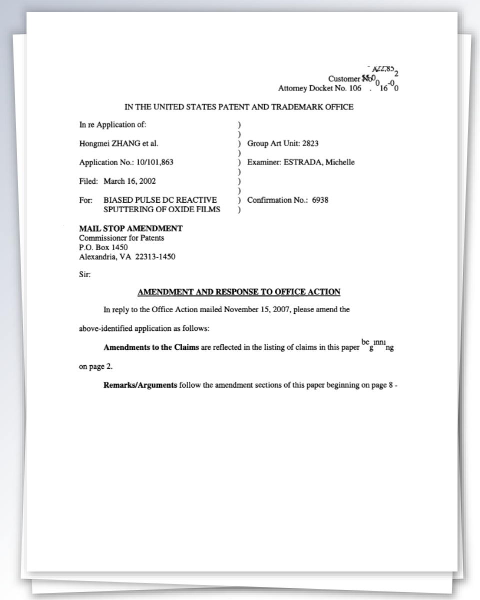
## Feb. 6, 2007: Patentee’s Response

Although it is true that “the filter is going to work at certain frequencies,” as suggested by the Examiner, the recited “band rejection filter” works at the frequency of the RF bias supply and blocks only a narrow band of frequencies around the frequency of the RF bias supply. This allows the square wave pulse of the DC power, which is formed of all frequencies both higher and lower than the biased frequency, to be transmitted through the filter to the target. Otherwise, the pulse that would reach the target is distorted so that the benefits of the pulsed DC power are not realized. Therefore, utilization of a band rejection filter at the frequency of the bias power is neither taught nor obvious from the teachings of Smolanoff. Furthermore, use of a band rejection filter at the frequency of the bias power places a distinct limitation on the claim.

10

Dkt. 59-5 (’356 File History, part 6/7, 02/06/2007 Applicant’s Response), 1307

# “Benefits” Not “Realized” Without Square Wave of “pulsed DC power”



A22,85 2
Customer No. 0
Attorney Docket No. 106 . 16-0 0

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
)
Hongmei ZHANG et al. ) Group Art Unit: 2823
)
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
)
Filed: March 16, 2002 )
)
For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS ) Confirmation No.: 6938
)

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

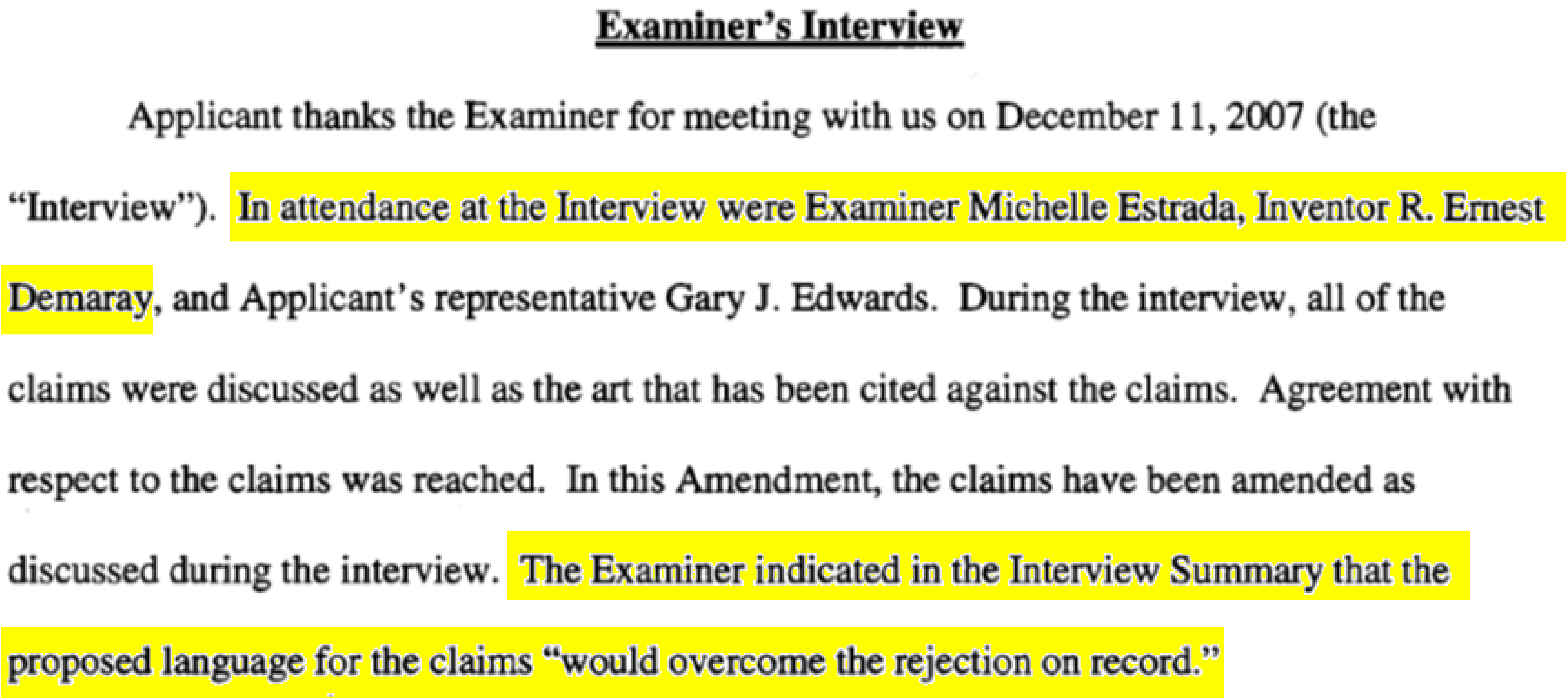
**AMENDMENT AND RESPONSE TO OFFICE ACTION**

In reply to the Office Action mailed November 15, 2007, please amend the above-identified application as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 8 -

## Dec. 11, 2007: Another Interview With Patent Office

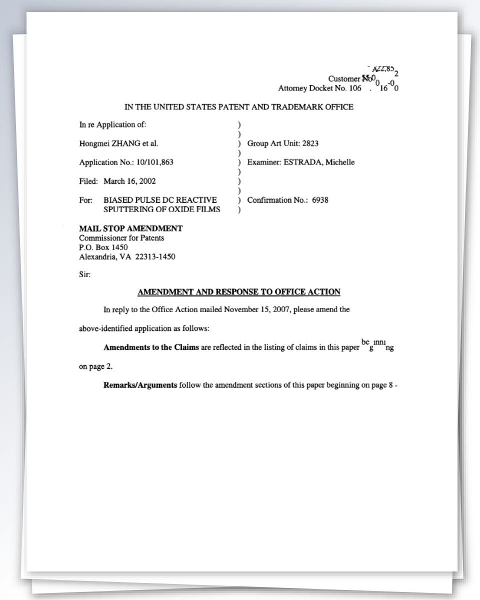


**Examiner’s Interview**

Applicant thanks the Examiner for meeting with us on December 11, 2007 (the “Interview”). In attendance at the Interview were Examiner Michelle Estrada, Inventor R. Ernest Demaray, and Applicant’s representative Gary J. Edwards. During the interview, all of the claims were discussed as well as the art that has been cited against the claims. Agreement with respect to the claims was reached. In this Amendment, the claims have been amended as discussed during the interview. The Examiner indicated in the Interview Summary that the proposed language for the claims “would overcome the rejection on record.”

Dkt. 59-5 (’356 File History, 012/18/2007 Applicant’s Response), 1454
Dkt. 60-5 (’657 File History, 12/18/2007 Applicant’s Response), 975

# Patentee Defines "pulsed DC" as Square Wave



22,852
Customer No.
Attorney Docket No. 106 . 16-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | |
|---|---|
| In re Application of: | |
| Hongmei ZHANG et al. | Group Art Unit: 2823 |
| Application No.: 10/101,863 | Examiner: ESTRADA, Michelle |
| Filed: March 16, 2002 | |
| For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS | Confirmation No.: 6938 |

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 8 -

## Dec. 18, 2007: Patentee's Response

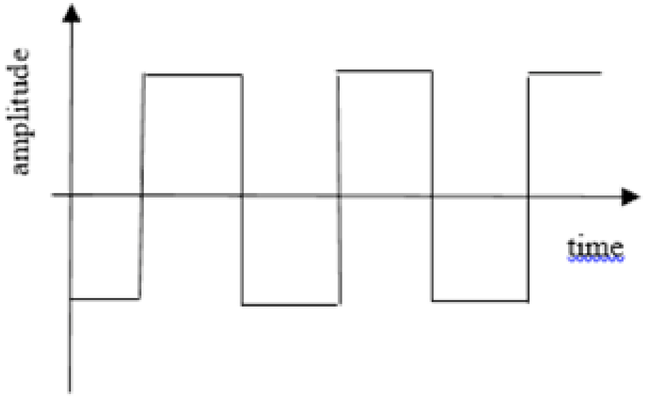
Interview, that is not the case. The filter allows the combination of pulsed-DC power to the target (where the target voltage is oscillated between positive and negative voltages) and an RF bias on the substrate. A filter that blocks too many of the constituent frequencies of the pulsed

⑪ DC waveform results in the target voltage not attaining a positive voltage. A filter that does not block the RF bias voltage can result in failure of the DC power supply. Smolanoff does not teach the "narrow band rejection filtering" recited in each of claims 21, 43, and 51.

Dkt. 59-5 ('356 File History, 012/18/2007 Applicant's Response), 1456-57

# Dr. Glew Agrees that Pulsed DC Power Has a "Square Wave" Form

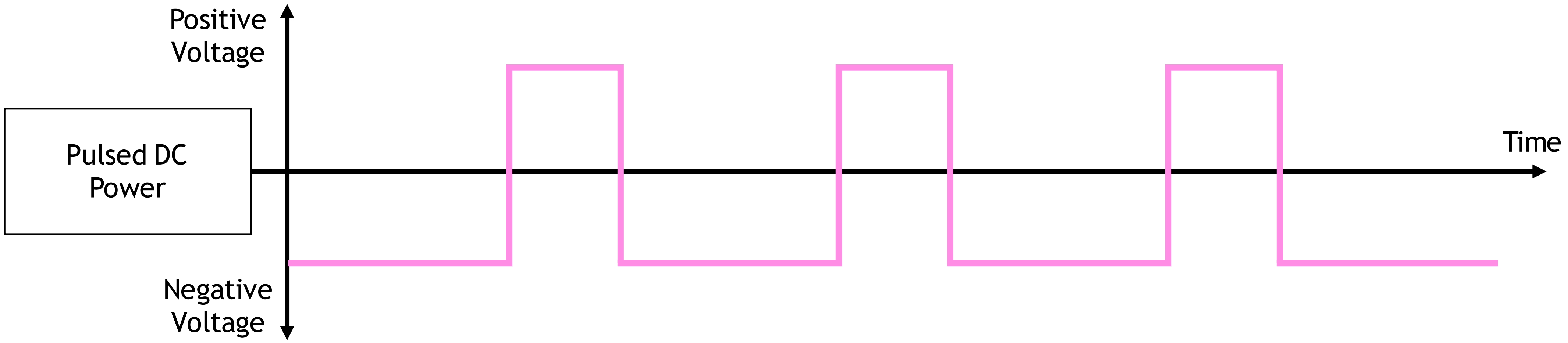
43. DC (direct current) has a unidirectional flow of electrical charge (by contrast, AC (alternating current) takes sinusoidal form). Pulsed DC power can go from positive (or negative) to zero. Alternatively, pulsed DC power can go from positive or negative passing through zero. In the claims, in order to provide both positive and negative voltage to help reduce arcing, the pulse would have to pass through zero. See, e.g., '657 Patent at 5:30-39. Pulsed DC power passing through zero could thus roughly approximate the following schematic waveform:



This schematic waveform is often called a "square wave." As practiced in the industry, however, "pulsed DC power" is not restricted to power in the form of a square wave.

Dkt. 46–1 at ¶43

# Square Wave Disclosures Support Either Fine-Tuned Constructions



**Fine-Tuned Construction #1:** “direct current power **that oscillates between predetermined positive and negative voltages**”

**Fine-Tuned Construction #2:** “direct current power **in a square wave form**”

# “narrow band rejection filter”

’657 Patent, Claim 1

’276 Patent, Claims 1 and 6

# "narrow band rejection filter" (NBRF)

| Demaray's Proposal | Defendants' Proposal |
|---|---|
| Plain and ordinary meaning, or<br>"filter which rejects a narrow band of frequencies" | "filter which rejects a narrow band of frequencies (but passes [substantially] all frequencies outside of the narrow band)" |

**<u>Court's Tentative Construction</u>**: Plain and ordinary meaning

# “narrow band rejection filter” (NBRF) Fine-Tuned Dispute

**Court’s Tentative Construction**: Plain and ordinary meaning

**The dispute fine-tuned**: is the plain and ordinary meaning of NBRF:

(1) a “filter that passes all of the frequencies of the power supply except within a narrow band”

**OR**

(2) a “filter which rejects a narrow band of frequencies but that is also engineered to do other things as well (such as reject at frequencies outside the narrow band)”

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

**DURING PROSECUTION**

**06/07/2006**
**Dr. Demaray's Declaration**

06/12/2006
Applicant's Response

02/06/2007
Applicant's Response

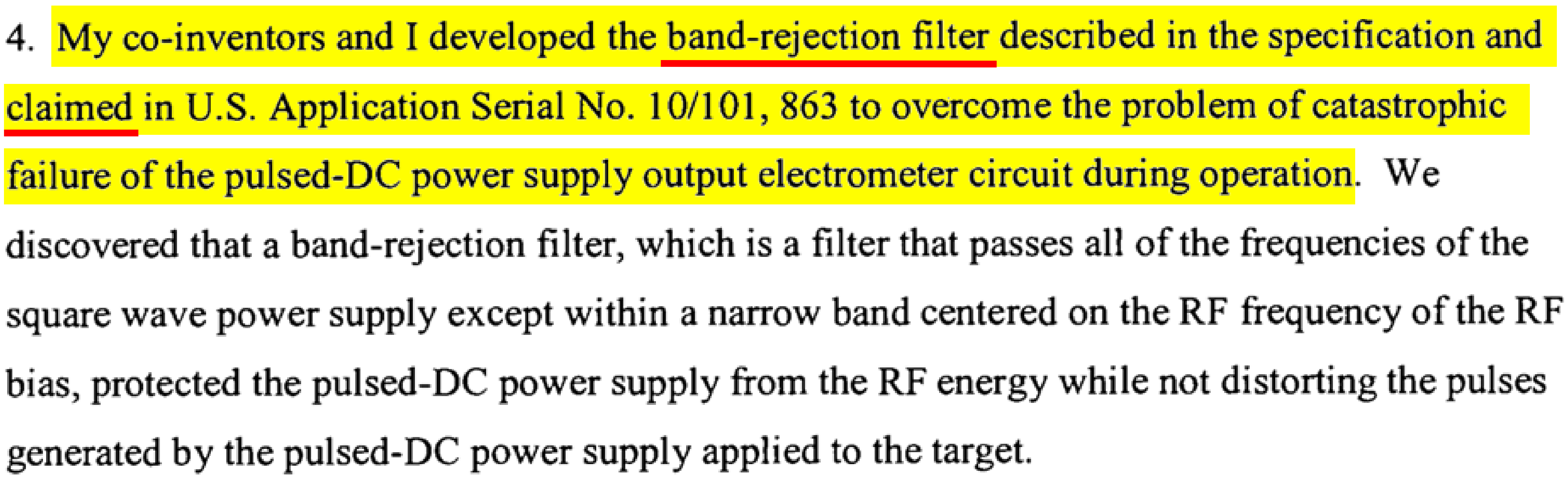
10/02/2007
Applicant's Response

01/08/2021
Proposed Claim Construction

01/15/2021
Disclosure of Extrinsic Evidence

01/22/2021
Revised Constructions

02/16/2021
IPR Preliminary Response



4. My co-inventors and I developed the band-rejection filter described in the specification and claimed in U.S. Application Serial No. 10/101, 863 to overcome the problem of catastrophic failure of the pulsed-DC power supply output electrometer circuit during operation. We discovered that a band-rejection filter, which is a filter that passes all of the frequencies of the square wave power supply except within a narrow band centered on the RF frequency of the RF bias, protected the pulsed-DC power supply from the RF energy while not distorting the pulses generated by the pulsed-DC power supply applied to the target.

Dkt. 59-6 (Declaration), ¶ 4

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

**DURING PROSECUTION**

**06/07/2006**
**Dr. Demaray's**
**Declaration**

06/12/2006
Applicant's
Response

02/06/2007
Applicant's
Response

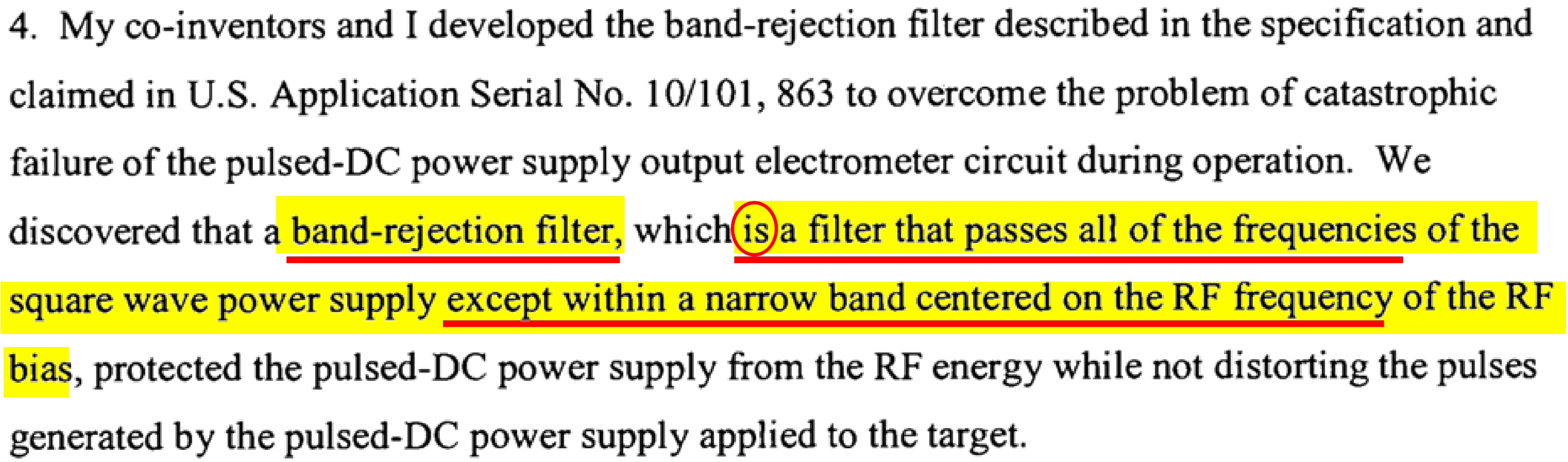
10/02/2007
Applicant's
Response

01/08/2021
Proposed Claim
Construction

01/15/2021
Disclosure of
Extrinsic Evidence

01/22/2021
Revised
Constructions

02/16/2021
IPR Preliminary
Response



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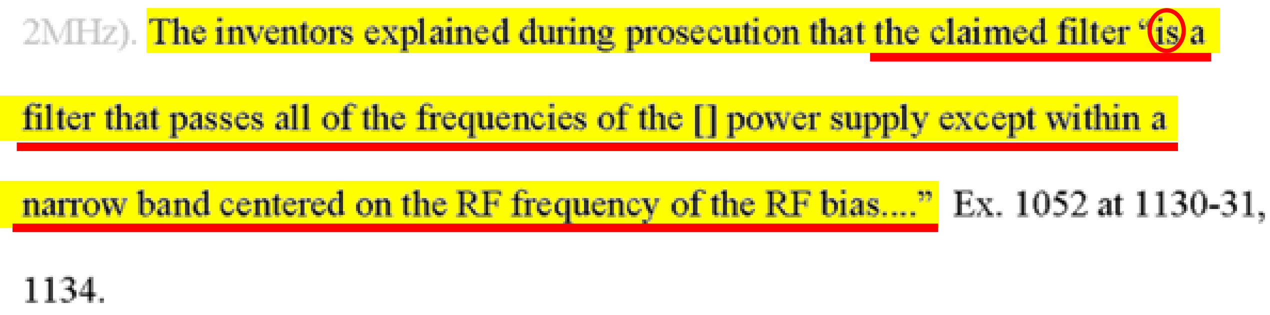
Dkt. 59-6 (Declaration), ¶ 4

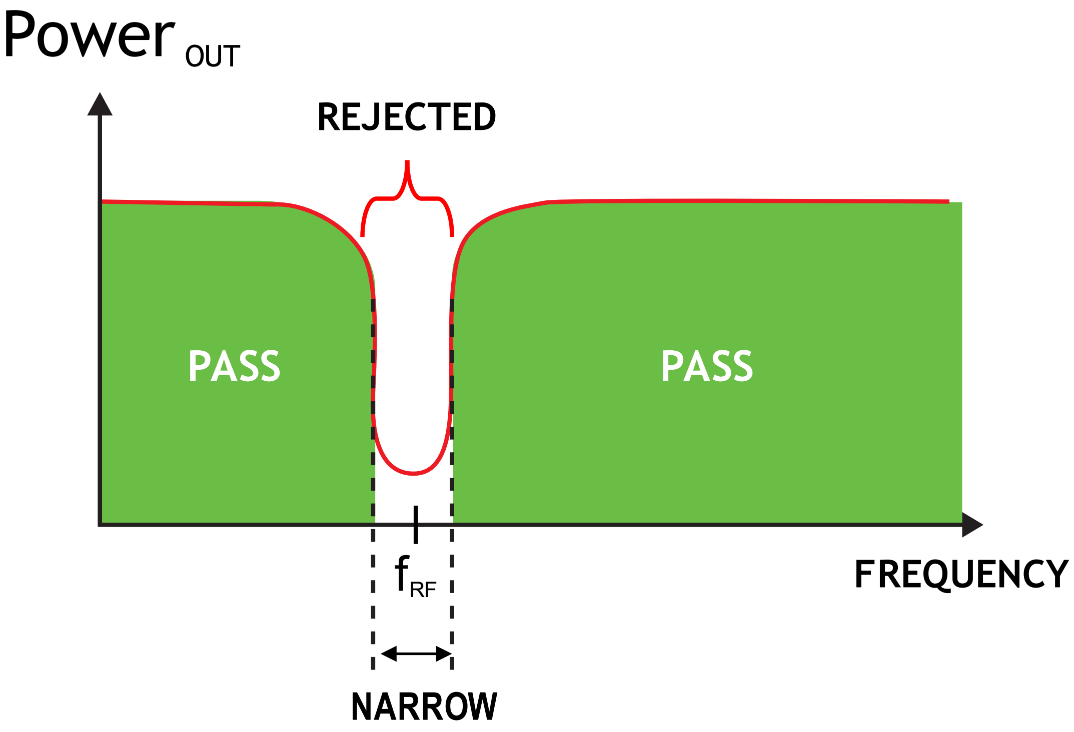
# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

## Demaray's Definition



2MHz). The inventors explained during prosecution that the claimed filter "is a filter that passes all of the frequencies of the [] power supply except within a narrow band centered on the RF frequency of the RF bias...." Ex. 1052 at 1130-31, 1134.

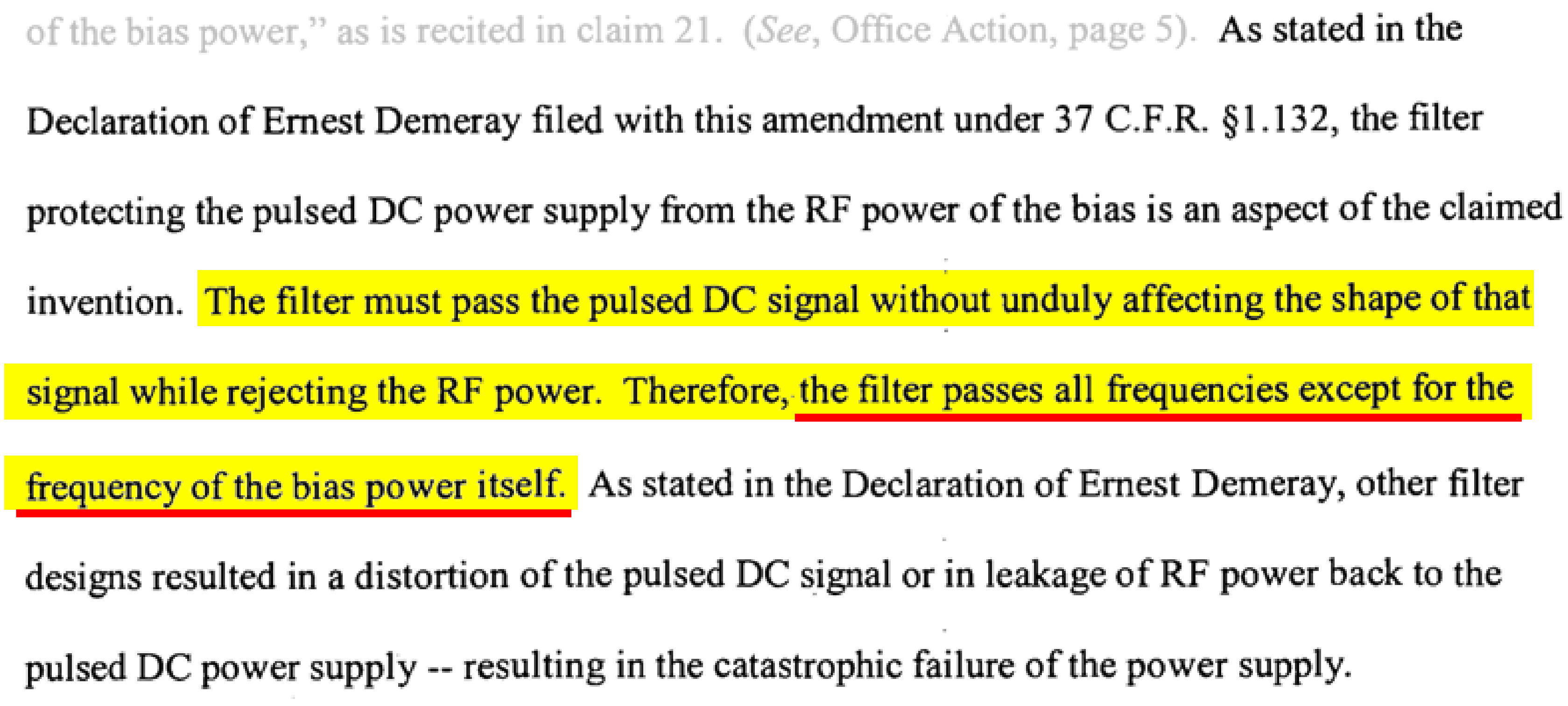
Dkt. 58-3 (IPR2021-00103, 02/16/2021 Demaray's Preliminary Response), 24



# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

**DURING PROSECUTION**

- 06/07/2006 Dr. Demaray's Declaration
- **06/12/2006 Applicant's Response**
- 02/06/2007 Applicant's Response
- 10/02/2007 Applicant's Response
- 01/08/2021 Proposed Claim Construction
- 01/15/2021 Disclosure of Extrinsic Evidence
- 01/22/2021 Revised Constructions
- 02/16/2021 IPR Preliminary Response



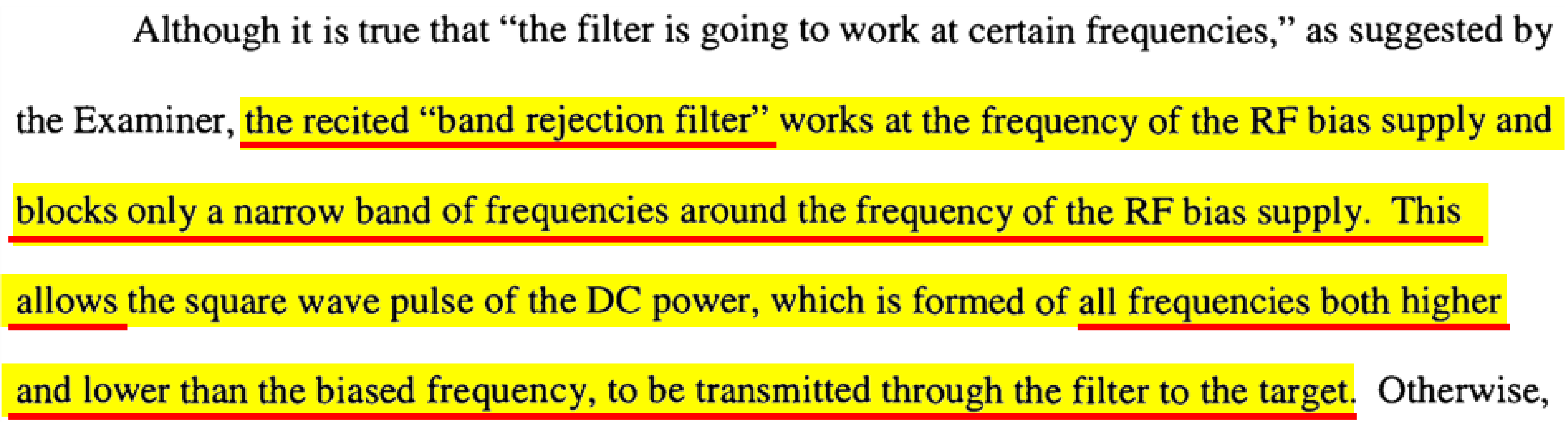
of the bias power," as is recited in claim 21. (*See*, Office Action, page 5). As stated in the Declaration of Ernest Demeray filed with this amendment under 37 C.F.R. §1.132, the filter protecting the pulsed DC power supply from the RF power of the bias is an aspect of the claimed invention. The filter must pass the pulsed DC signal without unduly affecting the shape of that signal while rejecting the RF power. Therefore, the filter passes all frequencies except for the frequency of the bias power itself. As stated in the Declaration of Ernest Demeray, other filter designs resulted in a distortion of the pulsed DC signal or in leakage of RF power back to the pulsed DC power supply -- resulting in the catastrophic failure of the power supply.

Dkt. 59-5 ('356 File History, part 6/7), 1130-31

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

**DURING PROSECUTION**

- 06/07/2006 Dr. Demaray's Declaration
- 06/12/2006 Applicant's Response
- **02/06/2007 Applicant's Response**
- 10/02/2007 Applicant's Response
- 01/08/2021 Proposed Claim Construction
- 01/15/2021 Disclosure of Extrinsic Evidence
- 01/22/2021 Revised Constructions
- 02/16/2021 IPR Preliminary Response



Although it is true that "the filter is going to work at certain frequencies," as suggested by the Examiner, the recited "band rejection filter" works at the frequency of the RF bias supply and blocks only a narrow band of frequencies around the frequency of the RF bias supply. This allows the square wave pulse of the DC power, which is formed of all frequencies both higher and lower than the biased frequency, to be transmitted through the filter to the target. Otherwise,

Dkt. 59 ('356 File History, part 7/7), 1307

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

**DURING PROSECUTION**

06/07/2006
Dr. Demaray's
Declaration

06/12/2006
Applicant's
Response

02/06/2007
Applicant's
Response

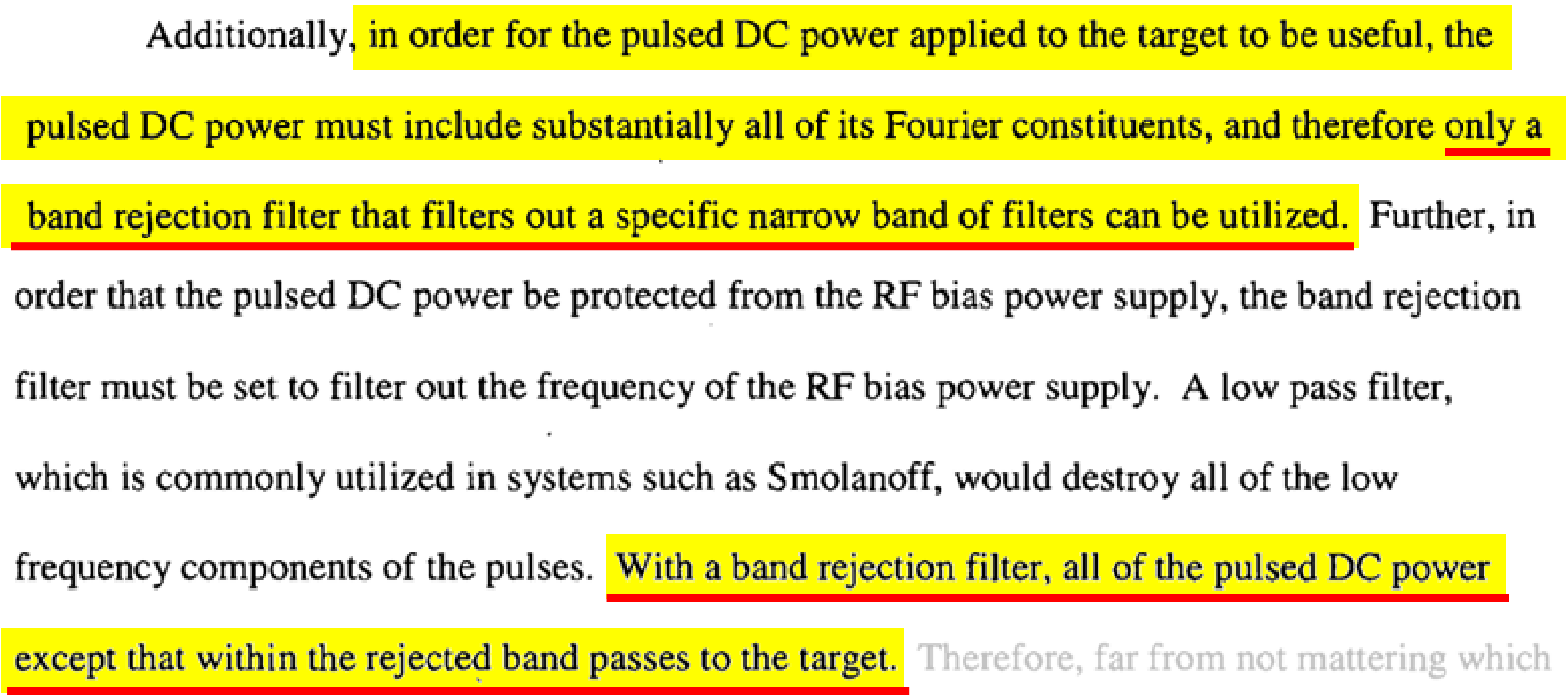
**10/02/2007**
**Applicant's**
**Response**

01/08/2021
Proposed Claim
Construction

01/15/2021
Disclosure of
Extrinsic Evidence

01/22/2021
Revised
Constructions

02/16/2021
IPR Preliminary
Response



Additionally, in order for the pulsed DC power applied to the target to be useful, the pulsed DC power must include substantially all of its Fourier constituents, and therefore only a band rejection filter that filters out a specific narrow band of filters can be utilized. Further, in order that the pulsed DC power be protected from the RF bias power supply, the band rejection filter must be set to filter out the frequency of the RF bias power supply. A low pass filter, which is commonly utilized in systems such as Smolanoff, would destroy all of the low frequency components of the pulses. With a band rejection filter, all of the pulsed DC power except that within the rejected band passes to the target. Therefore, far from not mattering which

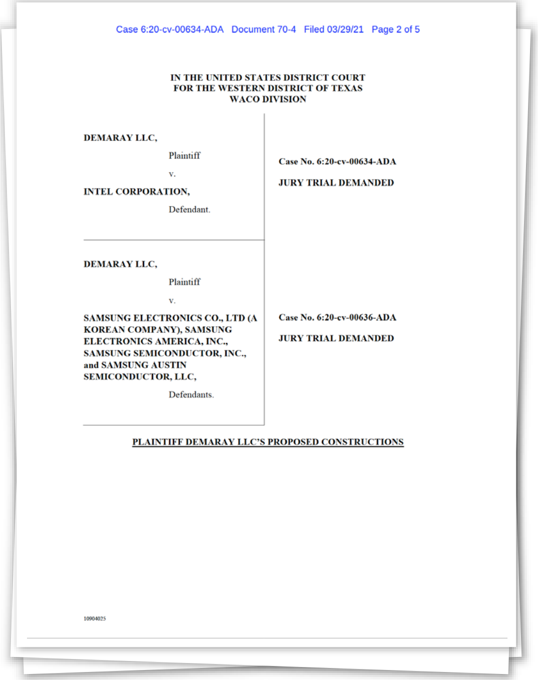
Dkt. 59 ('356 File History, part 7/7), 1386-87

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

IN THIS LITIGATION

- 06/07/2006 Dr. Demaray's Declaration
- 06/12/2006 Applicant's Response
- 02/06/2007 Applicant's Response
- 10/02/2007 Applicant's Response
- **01/08/2021 Proposed Claim Construction**
- 01/15/2021 Disclosure of Extrinsic Evidence
- 01/22/2021 Revised Constructions
- 02/16/2021 IPR Preliminary Response

Demaray acknowledged that the NBRF "passes all of the frequencies … except within a narrow band"



Case 6:20-cv-00634-ADA Document 70-4 Filed 03/29/21 Page 2 of 5

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

DEMARAY LLC,
Plaintiff
v.
INTEL CORPORATION,
Defendant.

Case No. 6:20-cv-00634-ADA
JURY TRIAL DEMANDED

DEMARAY LLC,
Plaintiff
v.
SAMSUNG ELECTRONICS CO., LTD (A KOREAN COMPANY), SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR, LLC,
Defendants.

Case No. 6:20-cv-00636-ADA
JURY TRIAL DEMANDED

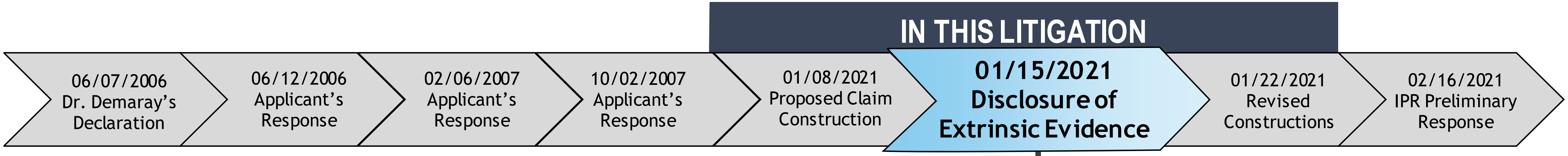
PLAINTIFF DEMARAY LLC'S PROPOSED CONSTRUCTIONS

10904025

| | |
|---|---|
| "narrow band-rejection filter" | Plain and ordinary meaning<br>or<br>"filter that passes all of the frequencies of the power supply except within a narrow band" |

Dkt. 70-4 (Demaray's Proposed Constructions), 3

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band



IN THIS LITIGATION

06/07/2006
Dr. Demaray's
Declaration

06/12/2006
Applicant's
Response

02/06/2007
Applicant's
Response

10/02/2007
Applicant's
Response

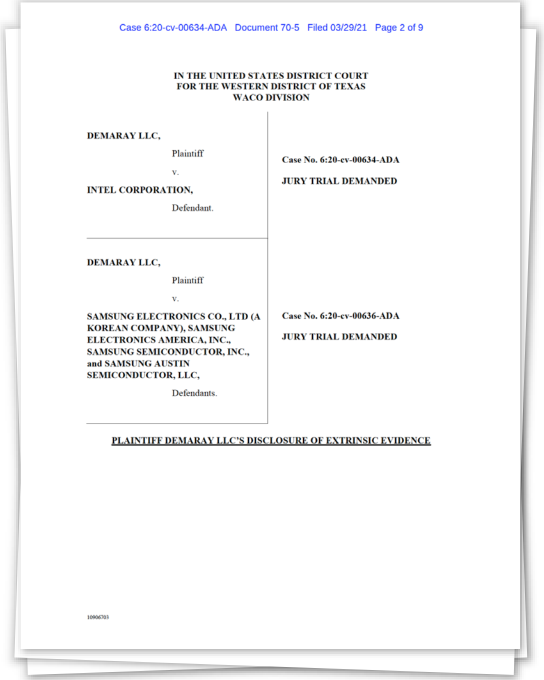
01/08/2021
Proposed Claim
Construction

**01/15/2021**
**Disclosure of**
**Extrinsic Evidence**

01/22/2021
Revised
Constructions

02/16/2021
IPR Preliminary
Response

Demaray reiterated that the NBRF "passes all of the frequencies … except within a narrow band"



Case 6:20-cv-00634-ADA Document 70-5 Filed 03/29/21 Page 2 of 9

**IN THE UNITED STATES DISTRICT COURT**
**FOR THE WESTERN DISTRICT OF TEXAS**
**WACO DIVISION**

| | |
|---|---|
| **DEMARAY LLC,**<br>Plaintiff<br>v.<br>**INTEL CORPORATION,**<br>Defendant. | **Case No. 6:20-cv-00634-ADA**<br>**JURY TRIAL DEMANDED** |
| **DEMARAY LLC,**<br>Plaintiff<br>v.<br>**SAMSUNG ELECTRONICS CO., LTD (A KOREAN COMPANY), SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR, LLC,**<br>Defendants. | **Case No. 6:20-cv-00636-ADA**<br>**JURY TRIAL DEMANDED** |

**PLAINTIFF DEMARAY LLC'S DISCLOSURE OF EXTRINSIC EVIDENCE**

10906703

| | |
|---|---|
| "narrow band-rejection filter" | Plain and ordinary meaning<br>or<br>"filter that passes all of the frequencies of the power supply except within a narrow band" |

Dkt. 70-5 (01/15/2021 Demaray's Disclosure of Extrinsic Evidence), 4

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

IN THIS LITIGATION

06/07/2006
Dr. Demaray's Declaration

06/12/2006
Applicant's Response

02/06/2007
Applicant's Response

10/02/2007
Applicant's Response

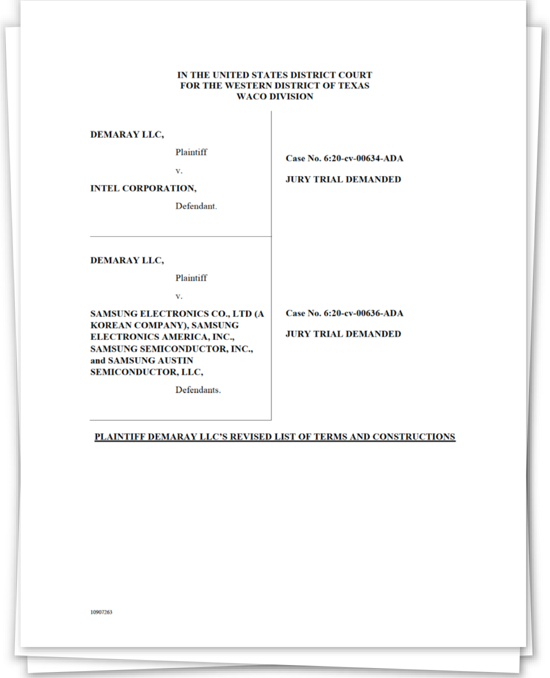
01/08/2021
Proposed Claim Construction

01/15/2021
Disclosure of Extrinsic Evidence

**01/22/2021**
**Revised Constructions**

02/16/2021
IPR Preliminary Response

Demaray abandoned its prior position that the NBRF "passes all of the frequencies … except within a narrow band"



IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
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JURY TRIAL DEMANDED

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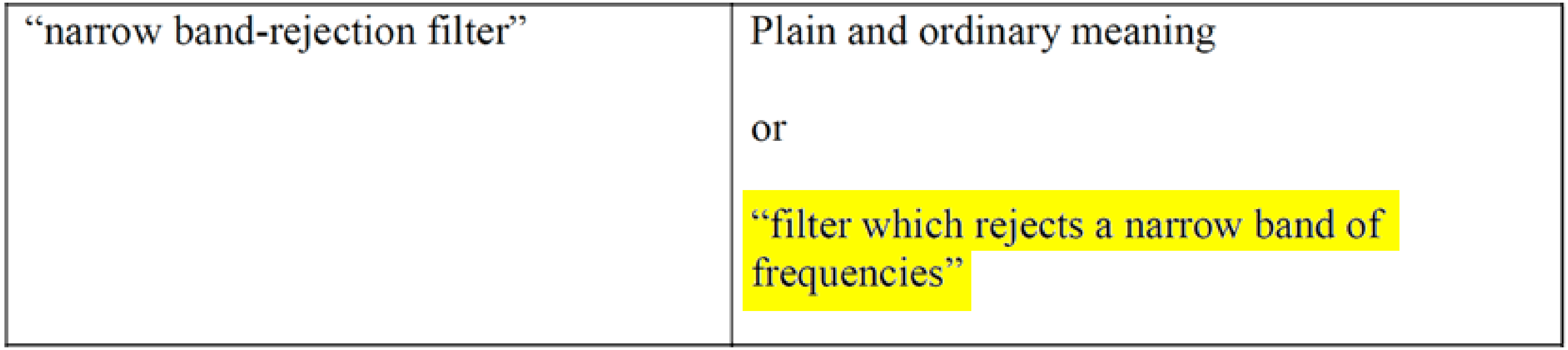
SAMSUNG ELECTRONICS CO., LTD (A KOREAN COMPANY), SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR, LLC,
Defendants.

Case No. 6:20-cv-00636-ADA
JURY TRIAL DEMANDED

PLAINTIFF DEMARAY LLC'S REVISED LIST OF TERMS AND CONSTRUCTIONS

10907263



| | |
|---|---|
| "narrow band-rejection filter" | Plain and ordinary meaning<br>or<br>"filter which rejects a narrow band of frequencies" |

(01/22/2021 Demaray's Revised Constructions), 3;
Dkt. 76 (Joint Claim Construction Statement), 2

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

06/07/2006
Dr. Demaray's
Declaration

06/12/2006
Applicant's
Response

02/06/2007
Applicant's
Response

10/02/2007
Applicant's
Response

01/08/2021
Proposed Claim
Construction

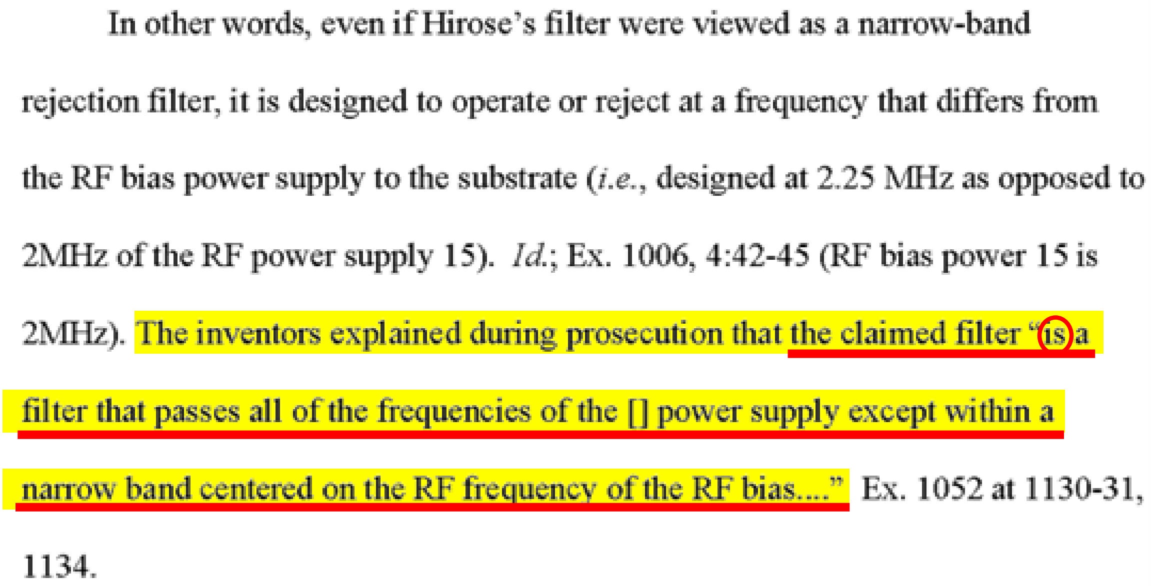
01/15/2021
Disclosure of
Extrinsic Evidence

01/22/2021
Revised
Constructions

**BEFORE THE PTAB**

**02/16/2021**
**IPR Preliminary**
**Response**

Demaray once again argued that the claimed filter "passes all of the frequencies … except within a narrow band centered on the RF frequency of the RF bias"



In other words, even if Hirose's filter were viewed as a narrow-band rejection filter, it is designed to operate or reject at a frequency that differs from the RF bias power supply to the substrate (*i.e.*, designed at 2.25 MHz as opposed to 2MHz of the RF power supply 15). *Id.*; Ex. 1006, 4:42-45 (RF bias power 15 is 2MHz). The inventors explained during prosecution that the claimed filter "is a filter that passes all of the frequencies of the [] power supply except within a narrow band centered on the RF frequency of the RF bias...." Ex. 1052 at 1130-31, 1134.

Dkt. 58-3 (IPR2021-00103, 02/16/2021 Demaray's Preliminary Response), 24

# Demaray Has Repeatedly Defined NBRF (Just Like Defendants) As Passing All Frequencies Outside the Narrow Band

**DURING PROSECUTION**

- 06/07/2006 Dr. Demaray's Declaration
- 06/12/2006 Applicant's Response
- 02/06/2007 Applicant's Response
- 10/02/2007 Applicant's Response

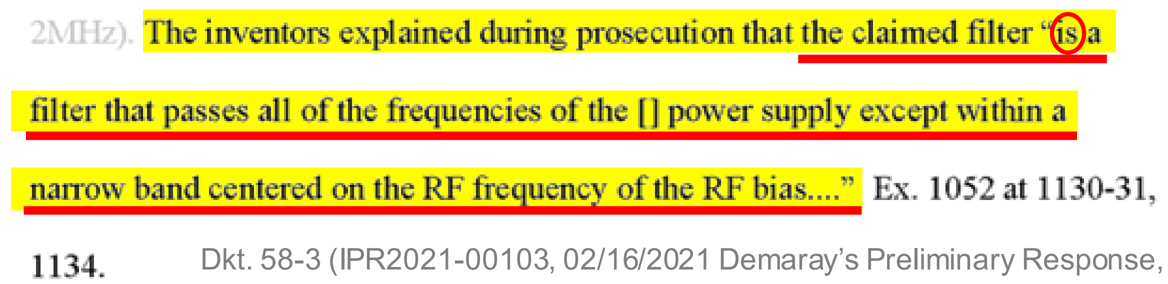
**IN THIS LITIGATION**

- 01/08/2021 Proposed Claim Construction
- 01/15/2021 Disclosure of Extrinsic Evidence
- **01/22/2021 Revised Constructions**

**AT THE PTAB**

- 02/16/2021 IPR Preliminary Response

## Demaray's Definition



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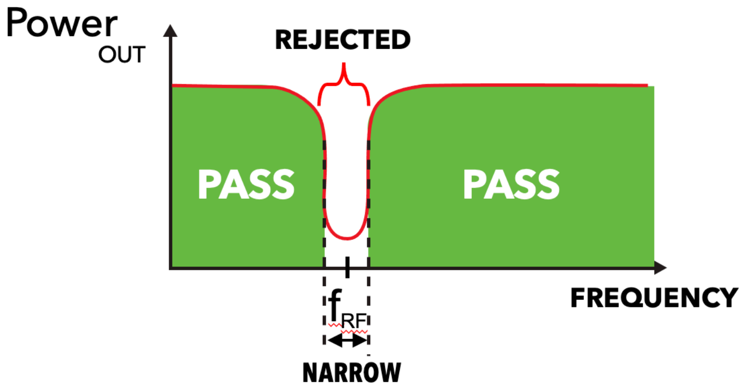
Dkt. 58-3 (IPR2021-00103, 02/16/2021 Demaray's Preliminary Response, *citing* to **06/07/2006 Demaray Declaration**), 24



## Demaray's Litigation Proposal

Plain and ordinary meaning, or

"filter which rejects a narrow band of frequencies"

(01/22/2021 Demaray's Revised Constructions), 3;
Dkt. 76 (Joint Claim Construction Statement), 2

# Why Did Demaray Change its Proposal to Leave Open That the Narrow Band Rejection Filter Can Reject Other Frequencies?

DURING PROSECUTION

- 06/07/2006 Dr. Demaray's Declaration
- 06/12/2006 Applicant's Response
- 02/06/2007 Applicant's Response
- 10/02/2007 Applicant's Response

IN THIS LITIGATION

- 01/08/2021 Proposed Claim Construction
- **01/15/2021 Non-Party Applied Doc Production**
- **01/22/2021 Revised Constructions**

AT THE PTAB

- 02/16/2021 IPR Preliminary Response

Exhibit #
Miller 11
02/09/21 - MP

APPLIED MATERIALS®

FOR PART QUALIFICATION & CONTROL REQUIREMENTS, REFERENCE PQC ADDENDUM DOCUMENT FOR THIS ITEM REVISION. PART SPECIFICATION IS INCOMPLETE WITHOUT PQC ADDENDUM

| | |
|---|---|
| Part Number | **0190-41240** |
| Revision | **05** |
| Title | [redacted] |
| ECO Releasing this Rev. | **3026888** |
| Original Document Author | **Ken Smyth/Wenwen Liu** |

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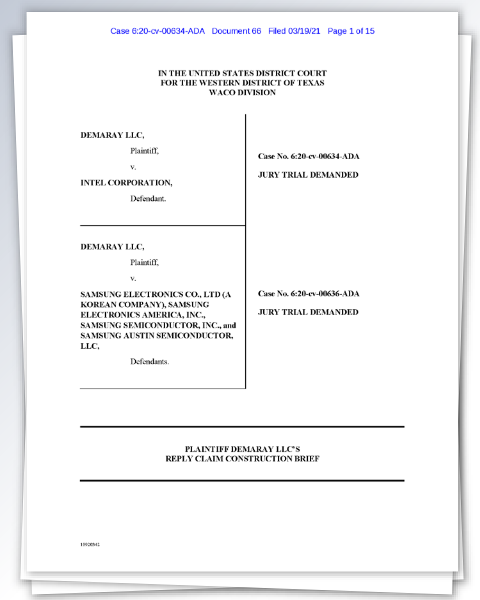
## Demaray's Litigation Proposal

Plain and ordinary meaning, or

"filter which rejects a narrow band of frequencies"

(01/22/2021 Demaray's Revised Constructions), 3;
Dkt. 76 (Joint Claim Construction Statement), 2

# Demaray's New Arguments in Litigation



Case 6:20-cv-00634-ADA Document 66 Filed 03/19/21 Page 1 of 15

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

DEMARAY LLC,
Plaintiff,
v.
INTEL CORPORATION,
Defendant.

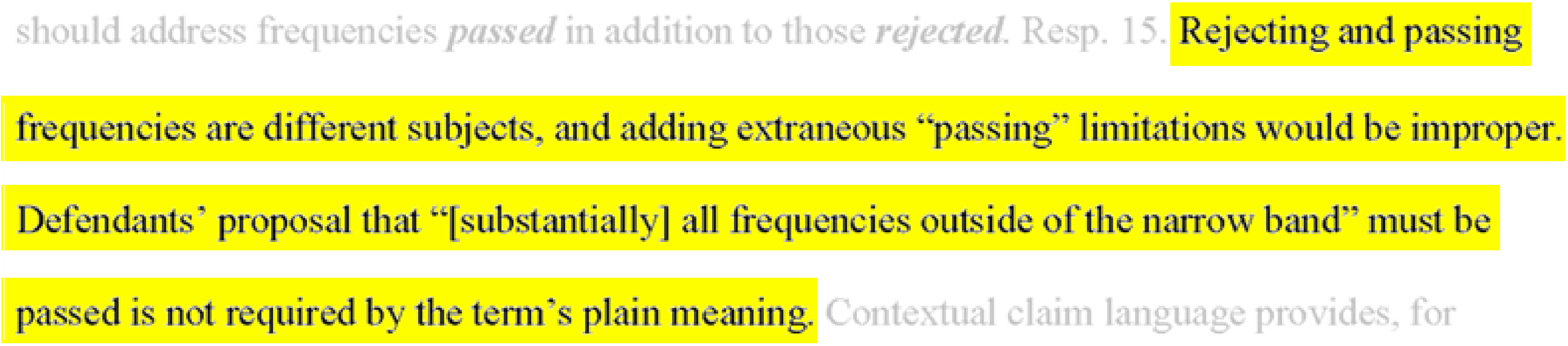
Case No. 6:20-cv-00634-ADA
JURY TRIAL DEMANDED

DEMARAY LLC,
Plaintiff,
v.
SAMSUNG ELECTRONICS CO., LTD (A KOREAN COMPANY), SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR, LLC,
Defendants.

Case No. 6:20-cv-00636-ADA
JURY TRIAL DEMANDED

PLAINTIFF DEMARAY LLC'S
REPLY CLAIM CONSTRUCTION BRIEF

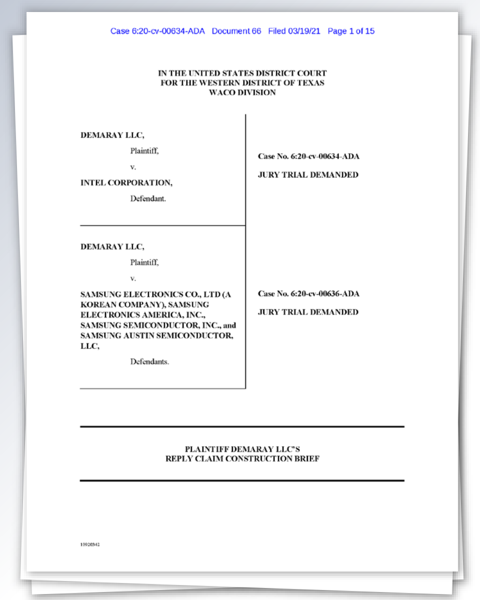
## Demaray's Litigation Argument



should address frequencies *passed* in addition to those *rejected*. Resp. 15. Rejecting and passing frequencies are different subjects, and adding extraneous "passing" limitations would be improper. Defendants' proposal that "[substantially] all frequencies outside of the narrow band" must be passed is not required by the term's plain meaning. Contextual claim language provides, for

Dkt. 66 (03/19/2021 Demaray's Reply Br.), 7-8

# Demaray's New Arguments in Litigation Contradict Its Own Expert



Case 6:20-cv-00634-ADA Document 66 Filed 03/19/21 Page 1 of 15

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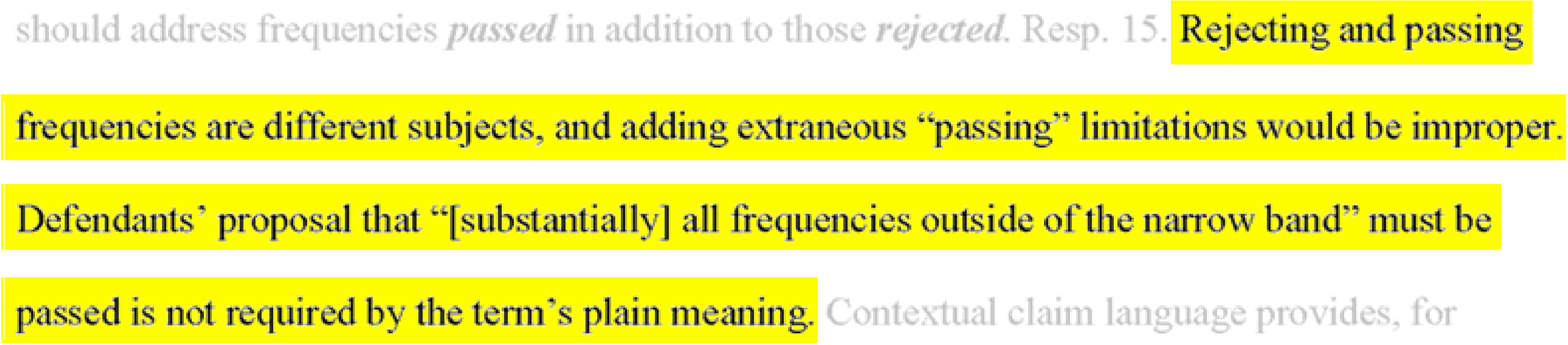
**Case No. 6:20-cv-00636-ADA**

**JURY TRIAL DEMANDED**

**PLAINTIFF DEMARAY LLC'S
REPLY CLAIM CONSTRUCTION BRIEF**

10920342

## Demaray's Litigation Argument



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Dkt. 66 (03/19/2021 Demaray's Reply Br.), 7-8

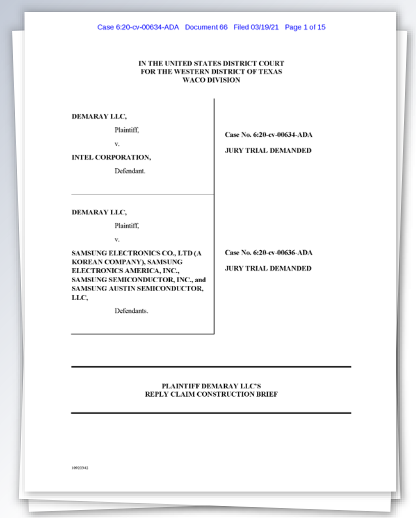
## Demaray's Expert

Q. And what would a POSITA then understand in terms of what that narrow band rejection filter passes? How would a POSITA describe or understand that?

A. What it doesn't filter, it passes. That which is not filtered is passed. You know, given—given the limitations of any circuit not being perfect.

Dkt. 58-7 (03/02/2021 Dr. Glew Depo. Tr.), 252:12-20

# Demaray's New Arguments in Litigation Contradict the Plain Meaning



Case 6:20-cv-00634-ADA Document 66 Filed 03/19/21 Page 1 of 15

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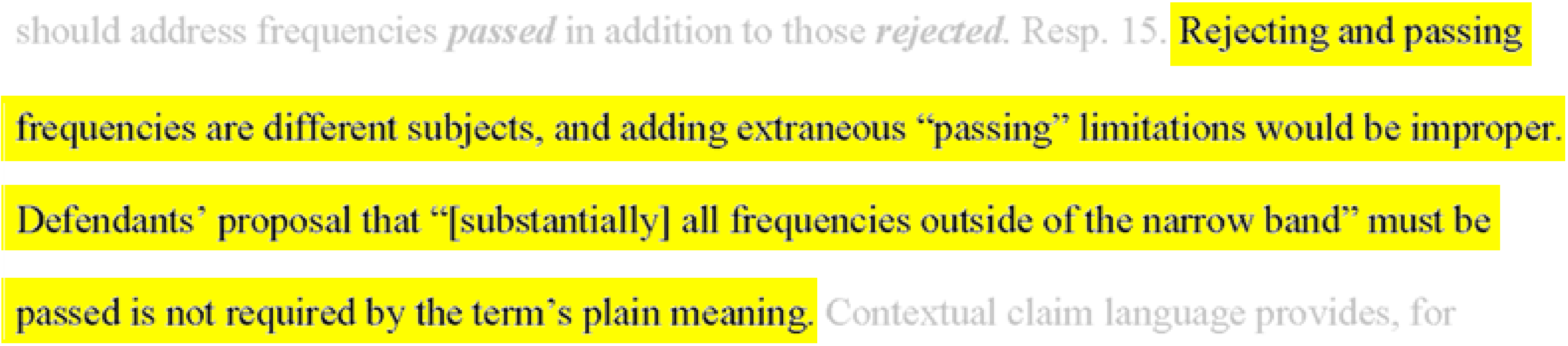
JURY TRIAL DEMANDED

PLAINTIFF DEMARAY LLC'S
REPLY CLAIM CONSTRUCTION BRIEF

10920342

## Demaray's Litigation Argument



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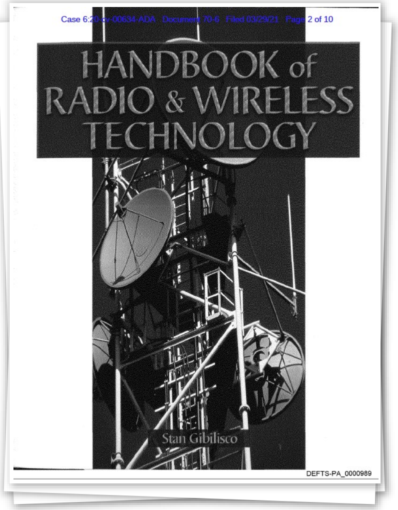
Dkt. 66 (03/19/2021 Demaray's Reply Br.), 7-8



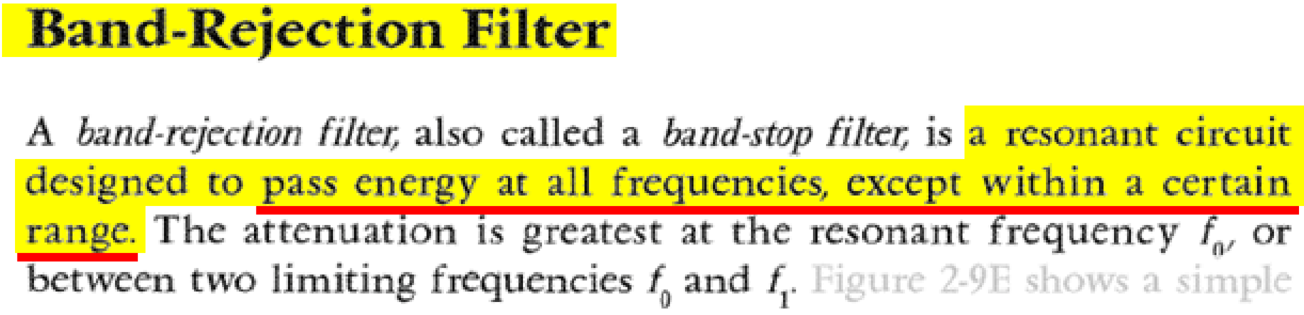
Case 6:20-cv-00634-ADA Document 70-6 Filed 03/29/21 Page 2 of 10

HANDBOOK of
RADIO & WIRELESS
TECHNOLOGY

Stan Gibilisco

DEFTS-PA_0000989

## Plain Meaning

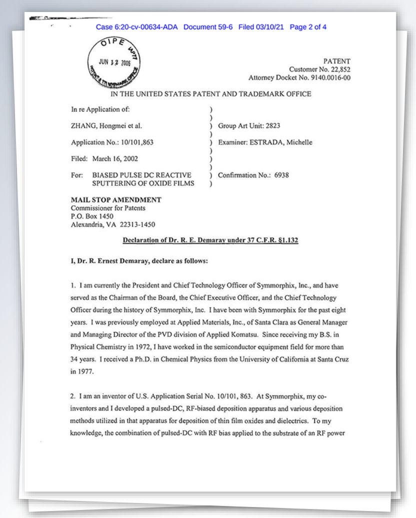


**Band-Rejection Filter**

A *band-rejection filter*, also called a *band-stop filter*, is a resonant circuit designed to pass energy at all frequencies, except within a certain range. The attenuation is greatest at the resonant frequency $f_0$, or between two limiting frequencies $f_0$ and $f_1$. Figure 2-9E shows a simple

Dkt. 70-6 (Handbook of Radio and Wireless Technology (1999)), 63

# Demaray Cannot Sue Based on Filters it Disclaimed in Prosecution History



Case 6:20-cv-00634-ADA Document 59-6 Filed 03/10/21 Page 2 of 4

OIPE JUN 12 2006

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | |
|---|---|
| In re Application of: | |
| ZHANG, Hongmei et al. | Group Art Unit: 2823 |
| Application No.: 10/101,863 | Examiner: ESTRADA, Michelle |
| Filed: March 16, 2002 | |
| For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS | Confirmation No.: 6938 |

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**Declaration of Dr. R. E. Demaray under 37 C.F.R. §1.132**

**I, Dr. R. Ernest Demaray, declare as follows:**

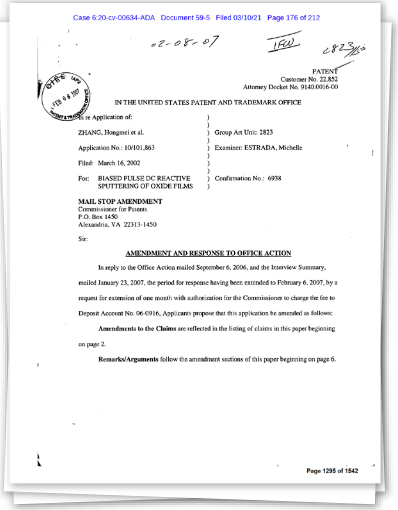
1. I am currently the President and Chief Technology Officer of Symmorphix, Inc., and have served as the Chairman of the Board, the Chief Executive Officer, and the Chief Technology Officer during the history of Symmorphix, Inc. I have been with Symmorphix for the past eight years. I was previously employed at Applied Materials, Inc., of Santa Clara as General Manager and Managing Director of the PVD division of Applied Komatsu. Since receiving my B.S. in Physical Chemistry in 1972, I have worked in the semiconductor equipment field for more than 34 years. I received a Ph.D. in Chemical Physics from the University of California at Santa Cruz in 1977.

2. I am an inventor of U.S. Application Serial No. 10/101, 863. At Symmorphix, my co-inventors and I developed a pulsed-DC, RF-biased deposition apparatus and various deposition methods utilized in that apparatus for deposition of thin film oxides and dielectrics. To my knowledge, the combination of pulsed-DC with RF bias applied to the substrate of an RF power

Disclaimed filter

> kHz to 300 KHz together with a pulse reverse time from 1.3 to 5.0 µsec. Utilizing a band-pass filter between the pulsed-DC power supply and the plasma, however, ① will not protect the pulsed-DC power supply from the RF bias and ② will also unduly distort the square-wave of the pulsed-DC power signal applied to the target, which detrimentally affects the deposition conditions.

Dkt. 59-6 (06/07/2006 Dr. Demaray Declaration), ¶ 3



Case 6:20-cv-00634-ADA Document 59-5 Filed 03/10/21 Page 176 of 212

02-08-07 IFW 2823

OIPE IAP2 FEB 06 2007

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

| | |
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**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

**AMENDMENT AND RESPONSE TO OFFICE ACTION**

In reply to the Office Action mailed September 6, 2006, and the Interview Summary, mailed January 23, 2007, the period for response having been extended to February 6, 2007, by a request for extension of one month with authorization for the Commissioner to charge the fee to Deposit Account No. 06-0916, Applicants propose that this application be amended as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 6.

Page 1295 of 1542

Disclaimed filters

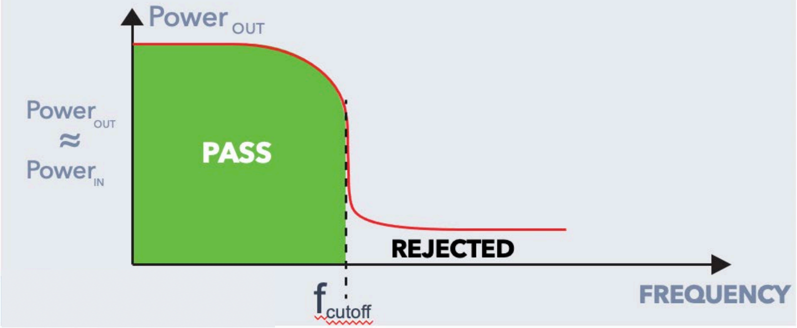
> supply due to transmission of the RF power into the pulsed DC power supply. However, a conventional high or low pass filter blocks a portion of the pulsed DC frequency to the target and therefore the benefits of using pulsed DC power are lost. Applicants discovered that a narrow

Dkt. 59-5 ('356 File History, part 6/7, 02/06/2007 Applicant's Response), 1302

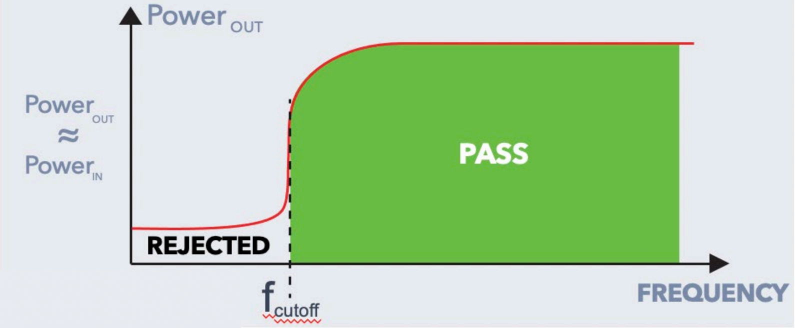
# Demaray Cannot Sue Based on Filters it Disclaimed in Prosecution History

## Disclaimed Filters

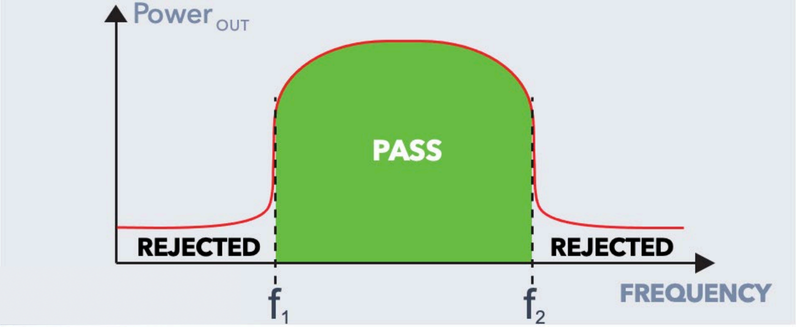
Low Pass Filter



High Pass Filter



Band Pass Filter

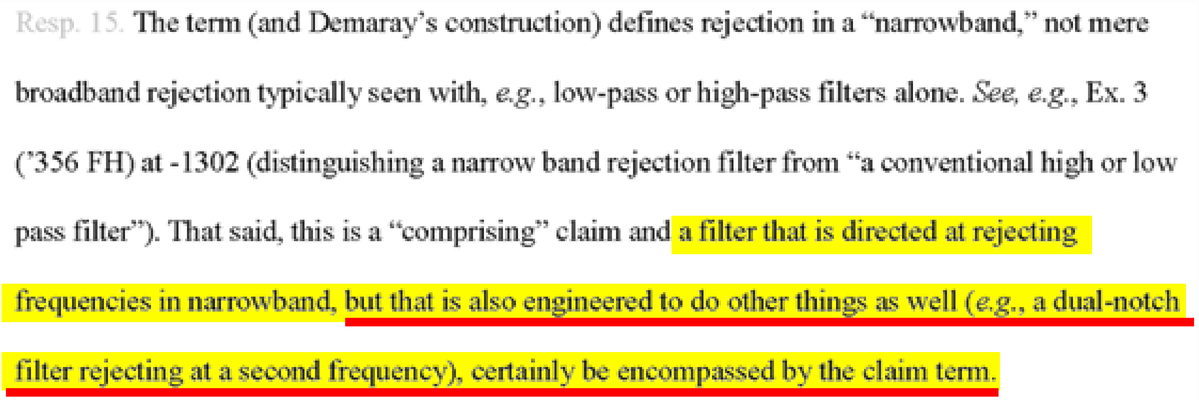


> “A patentee may not state during prosecution that the claims do not cover a particular device and then change position and later sue a party who makes that same device for infringement.”

*Spring Window Fashions LP v. Novo Industries, L.P.*, 323 F.3d 989, 995 (Fed. Cir. 2003)

# Demaray's POM Interpretation of NBRF Rejects Frequencies Outside the Narrow Band

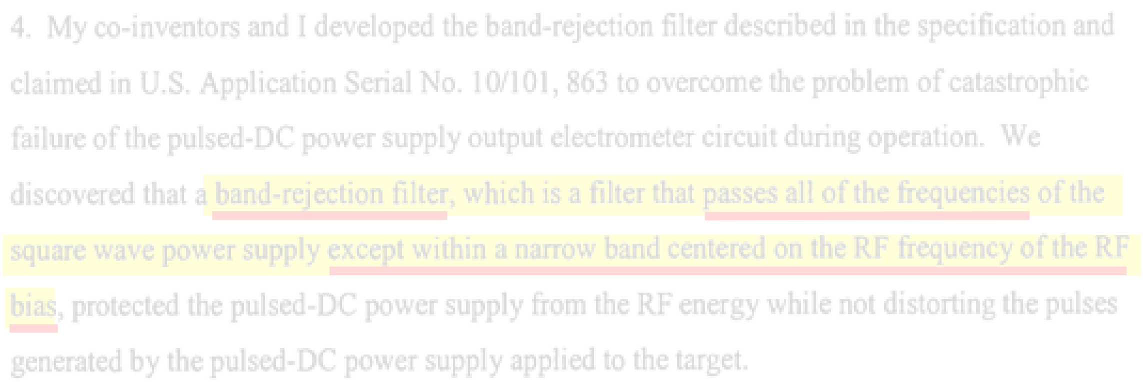
## Demaray's Litigation Argument



Resp. 15. The term (and Demaray's construction) defines rejection in a "narrowband," not mere broadband rejection typically seen with, *e.g.*, low-pass or high-pass filters alone. *See, e.g.*, Ex. 3 ('356 FH) at -1302 (distinguishing a narrow band rejection filter from "a conventional high or low pass filter"). That said, this is a "comprising" claim and a filter that is directed at rejecting frequencies in narrowband, but that is also engineered to do other things as well (*e.g.*, a dual-notch filter rejecting at a second frequency), certainly be encompassed by the claim term.

Dkt. 66 (03/19/2021 Demaray's Reply), 9

## Demaray's Statements During Prosecution

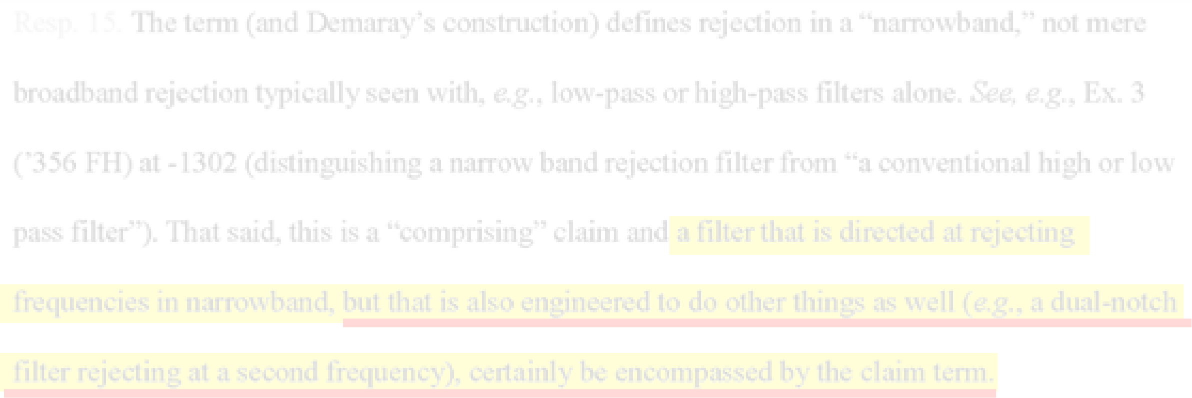


4. My co-inventors and I developed the band-rejection filter described in the specification and claimed in U.S. Application Serial No. 10/101, 863 to overcome the problem of catastrophic failure of the pulsed-DC power supply output electrometer circuit during operation. We discovered that a band-rejection filter, which is a filter that passes all of the frequencies of the square wave power supply except within a narrow band centered on the RF frequency of the RF bias, protected the pulsed-DC power supply from the RF energy while not distorting the pulses generated by the pulsed-DC power supply applied to the target.

Dkt. 59-6 (06/07/2006 Dr. Demaray's Declaration) at ¶ 4; *see also*
Dkt. 59-5 (06/12/2006 Applicant's Response), 1130-1131;
Dkt. 59-6 (02/06/2007 Applicant's Response), 1307;
Dkt. 59 (10/02/2007 Applicant's Response), 1386-87;
Dkt. 70-4 (01/08/2021 Demaray's Proposed Constructions), 3;
Dkt. 70 (01/15/2021 Demaray's Disclosure of Extrinsic Evidence), 4;
Dkt. 58-3 (02/16/2021 Demaray's IPR Preliminary Response), 24

# Demaray’s POM Interpretation of NBRF Rejects Frequencies Outside the Narrow Band

## Demaray’s Litigation Argument



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Dkt. 66 (03/19/2021 Demaray’s Reply), 9

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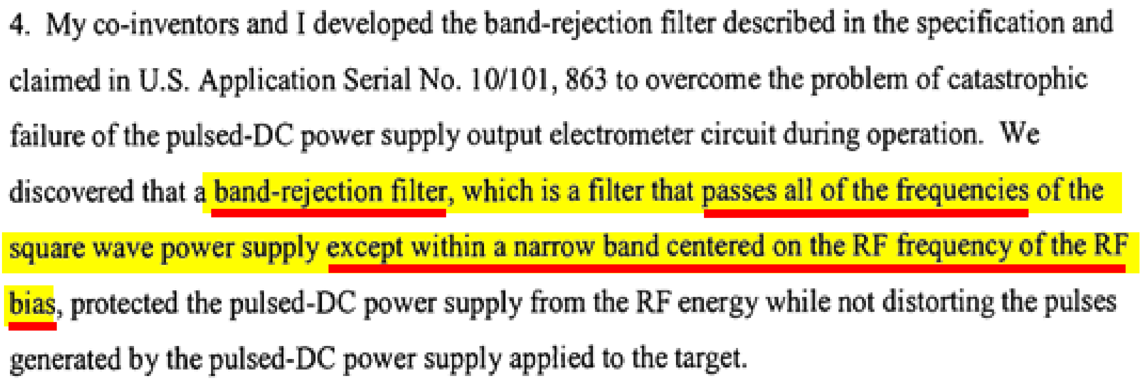

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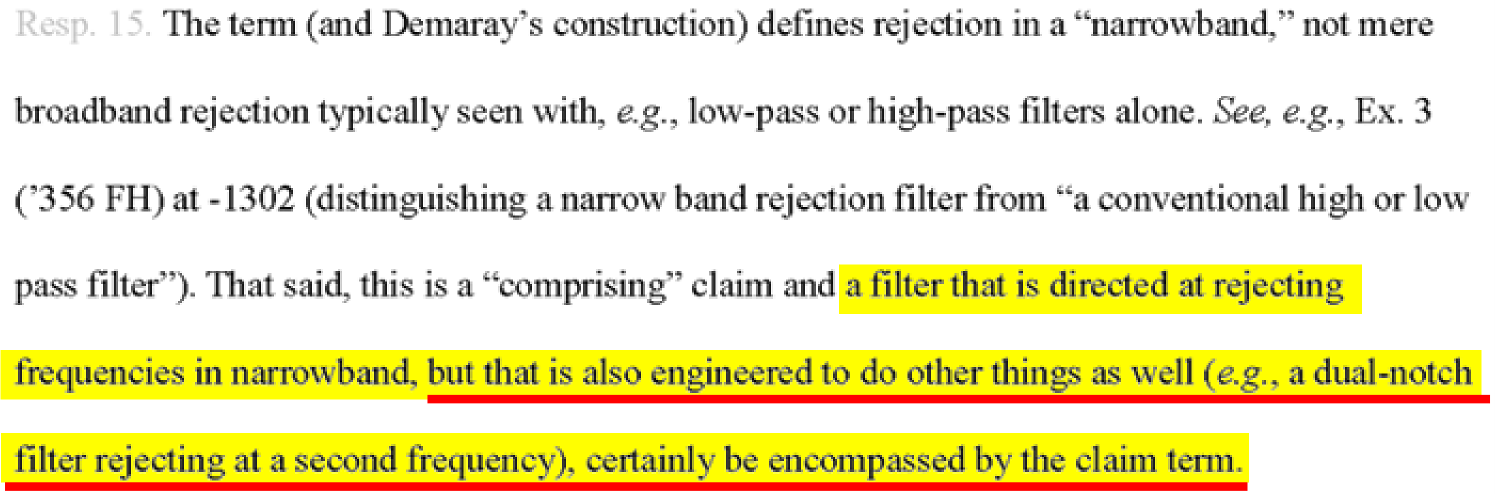
Dkt. 59-5 (06/12/2006 Applicant’s Response), 1130-1131;
Dkt. 59-6 (02/06/2007 Applicant’s Response), 1307;
Dkt. 59 (10/02/2007 Applicant’s Response), 1386-87;
Dkt. 70-4 (01/08/2021 Demaray’s Proposed Constructions), 3;
Dkt. 70 (01/15/2021 Demaray’s Disclosure of Extrinsic Evidence), 4;
Dkt. 58-3 (02/16/2021 Demaray’s IPR Preliminary Response), 24

# Demaray's POM Interpretation of NBRF Rejects Frequencies Outside the Narrow Band



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Dkt. 66 (03/19/2021 Demaray's Reply), 9

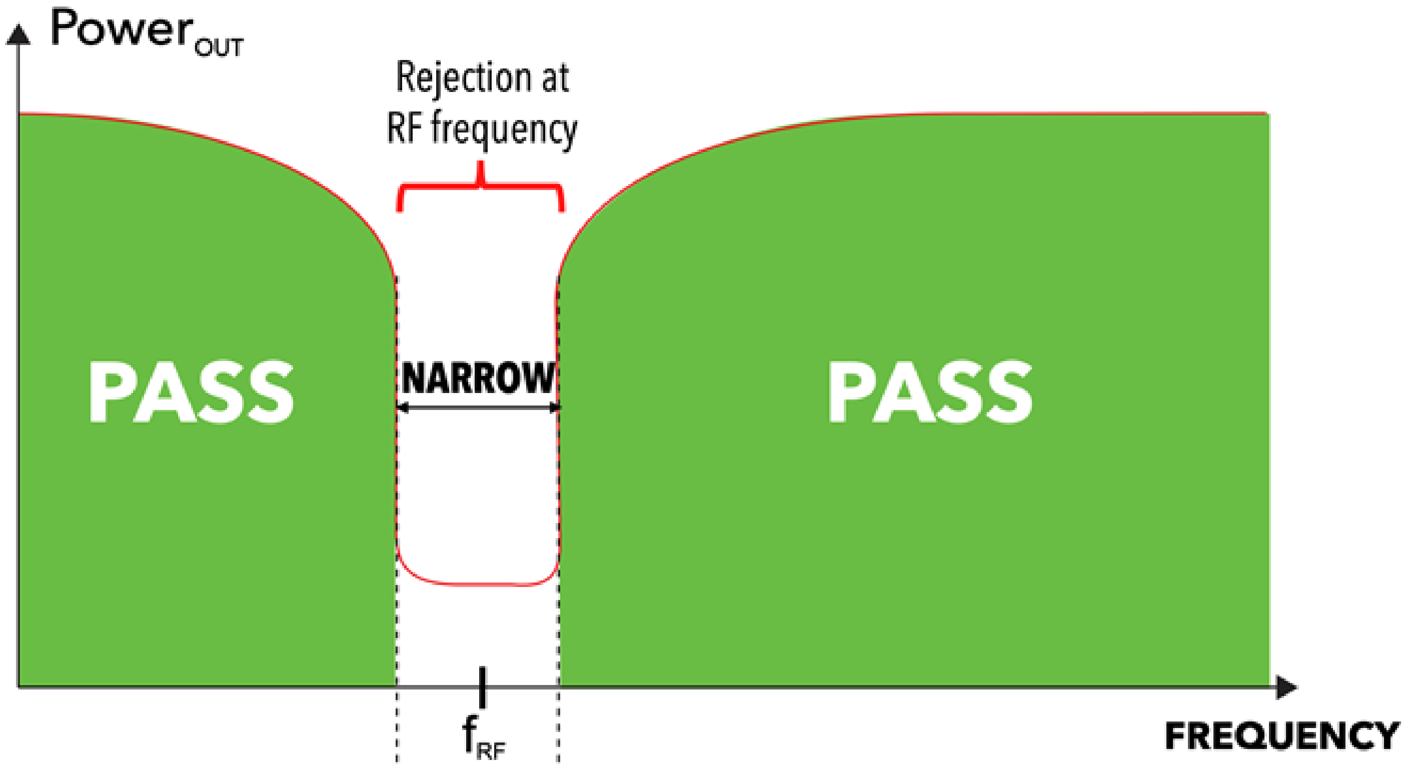
## Demaray's Proposal

~~Plain and ordinary meaning,~~ or

"filter which rejects a narrow band of frequencies but that is also engineered to do other things as well (such as reject at frequencies outside the narrow band)"

# Demaray’s POM Interpretation of NBRF Rejects Frequencies Outside the Narrow Band

| Demaray’s Original Proposal | Demaray’s POM Interpretation |
|---|---|
| “filter that passes all of the frequencies of the power supply except within a narrow band” | “filter which rejects a narrow band of frequencies but that is also engineered to do other things as well (such as reject at frequencies outside the narrow band)” |



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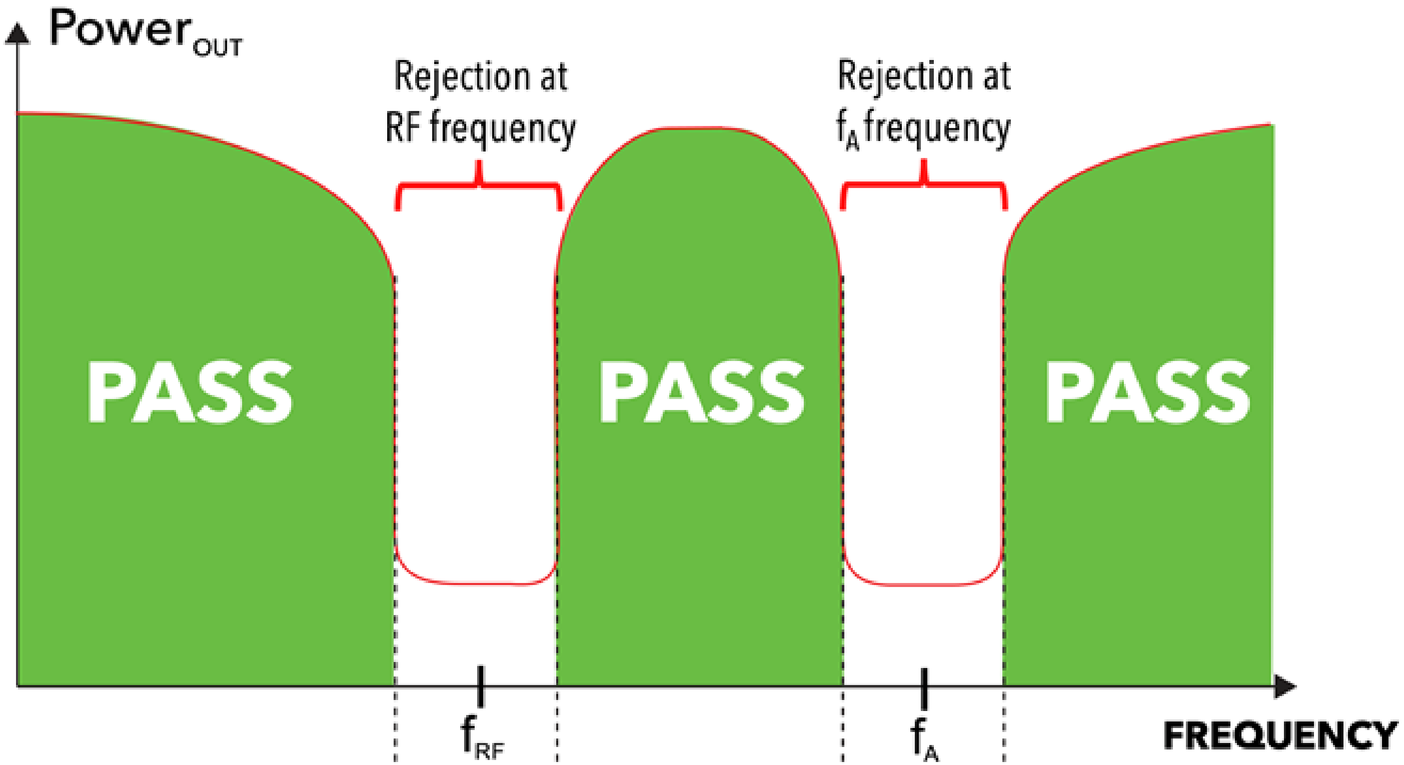

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|---|---|
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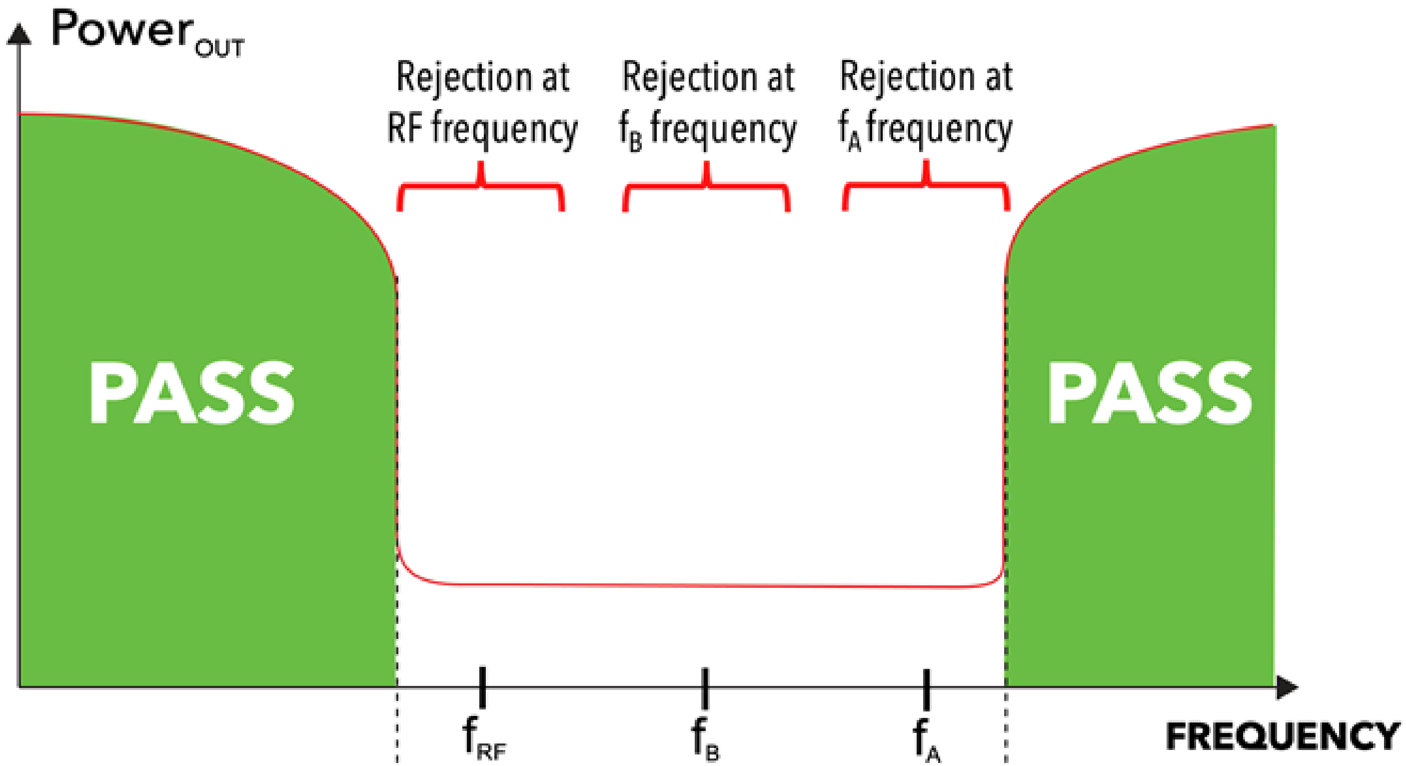

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|---|---|
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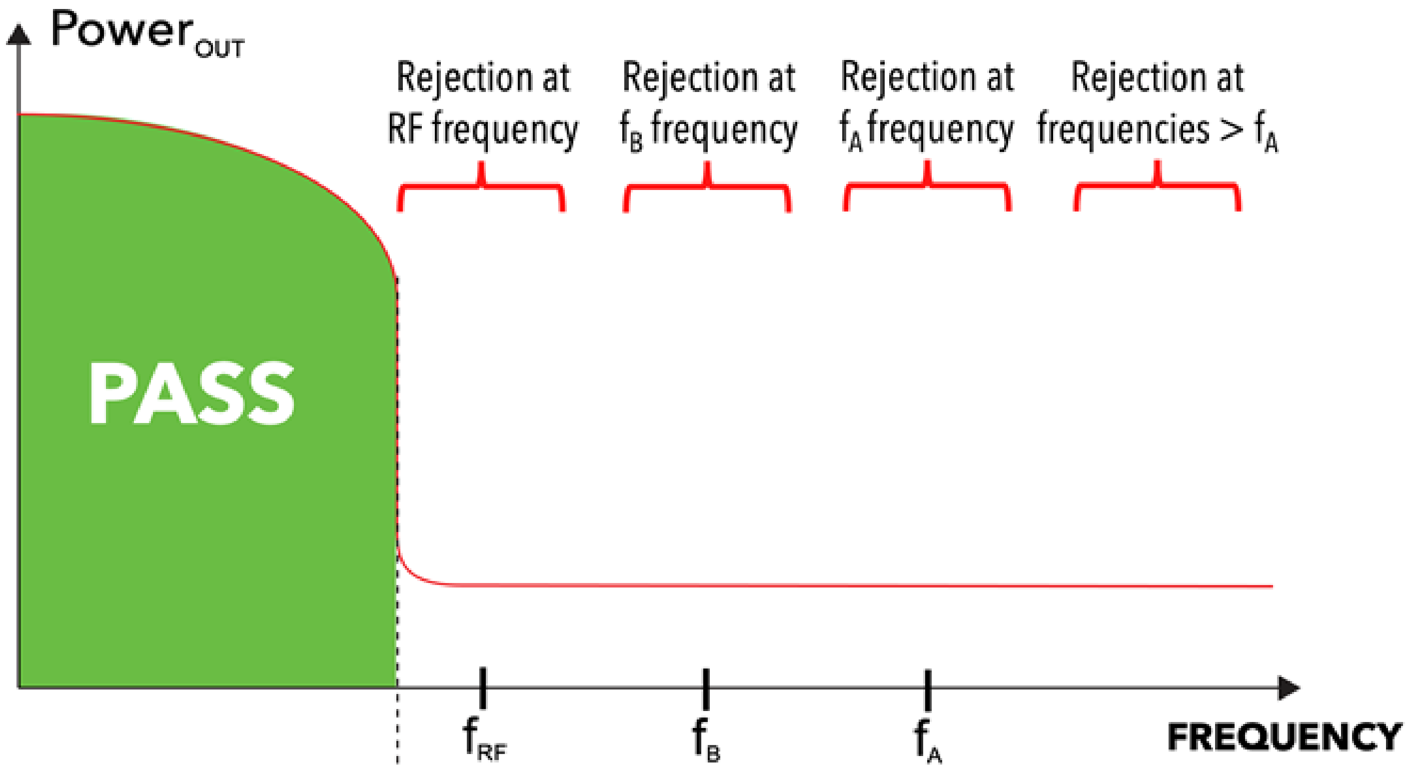
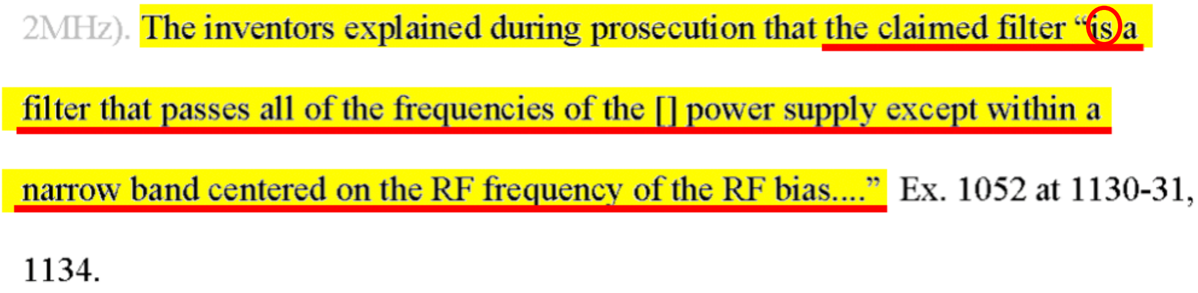


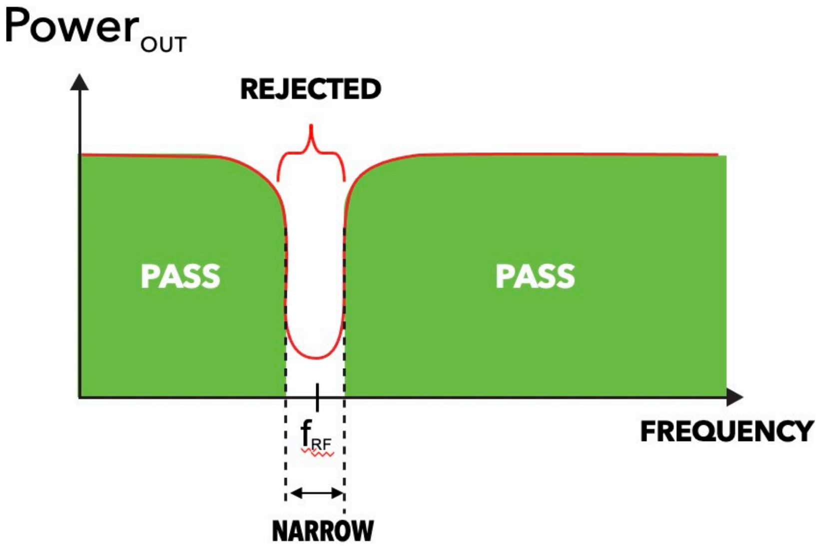
# Demaray's POM Interpretation of NBRF Seeks to Recapture Disclaimed Filters

## Demaray's Definition


2MHz). The inventors explained during prosecution that the claimed filter "is a filter that passes all of the frequencies of the [] power supply except within a narrow band centered on the RF frequency of the RF bias...." Ex. 1052 at 1130-31, 1134.

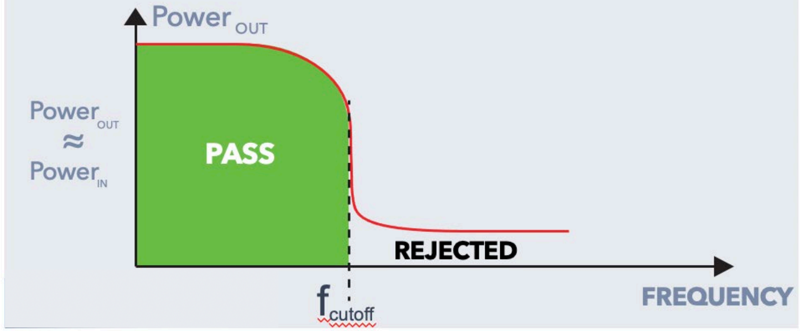
Dkt. 58-3 (IPR2021-00103, 02/16/2021 Demaray's Preliminary Response), 24

## Claimed NBRF

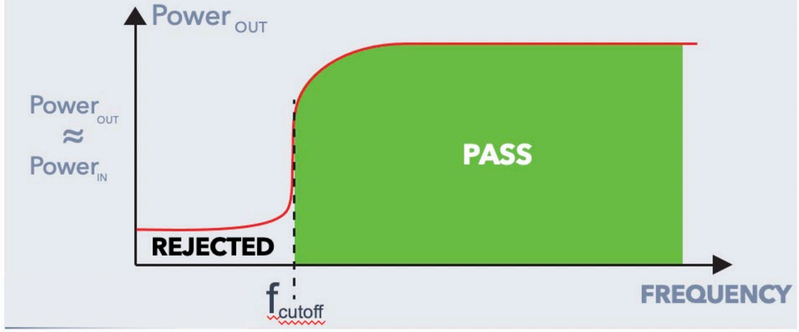


## Disclaimed Filters

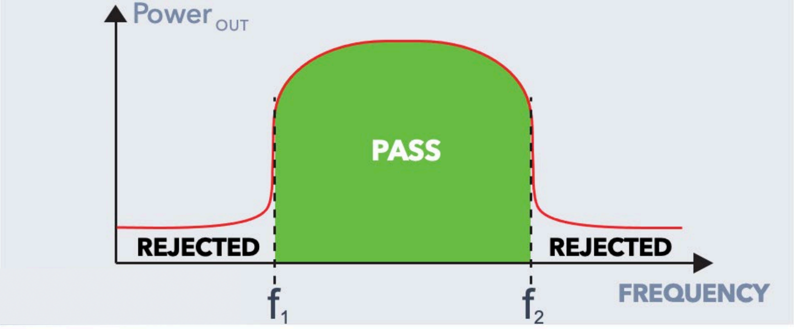
### Low Pass Filter



### High Pass Filter

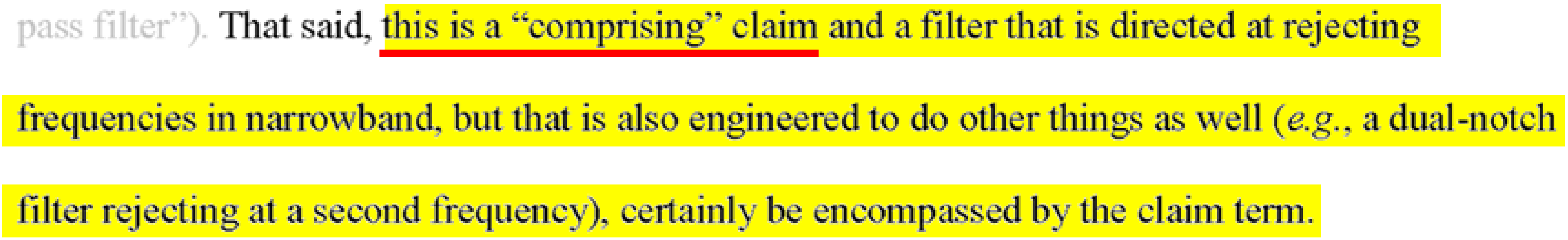


### Band Pass Filter



# Demaray's POM Interpretation of NBRF Rejects Frequencies Outside the Narrow Band

## Demaray's alleged basis for broadening the claim limitation is contrary to law



pass filter"). That said, this is a "comprising" claim and a filter that is directed at rejecting frequencies in narrowband, but that is also engineered to do other things as well (*e.g.*, a dual-notch filter rejecting at a second frequency), certainly be encompassed by the claim term.

Dkt. 66 (03/19/2021 Demaray's Reply), 9

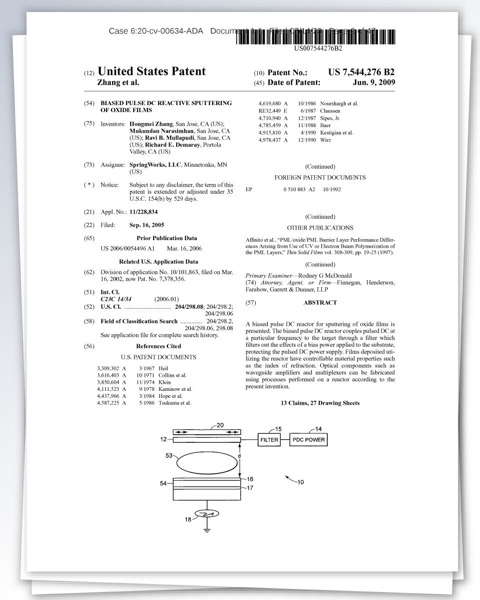
> "Comprising, while permitting additional elements not required by a claim, does not remove the limitations that are present."

*Power Mosfet Techs. L.L.C. v. Siemens AG*, 378 F.3d 1396, 1409 (Fed. Cir. 2004) (internal quotes omitted)

> "[C]omprising is not a weasel word with which to abrogate claim limitations."

*Dippin' Dots, Inc. v. Mosey*, 476 F.3d 1337, 1343 (Fed. Cir. 2007) (internal quotes omitted)

# NBRF Must Pass All Frequencies Outside the Narrow Band to Not Distort the Shape of the “pulsed DC power”



Case 6:20-cv-00634-ADA Docum

US007544276B2

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

(10) **Patent No.: US 7,544,276 B2**
(45) **Date of Patent: Jun. 9, 2009**

(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**

(75) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Mukundan Narasimhan**, San Jose, CA (US); **Ravi B. Mullapudi**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

(73) Assignee: **SpringWorks, LLC**, Minnetonka, MN (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 529 days.

(21) Appl. No.: **11/228,834**

(22) Filed: **Sep. 16, 2005**

(65) **Prior Publication Data**

US 2006/0054496 A1 Mar. 16, 2006

**Related U.S. Application Data**

(62) Division of application No. 10/101,863, filed on Mar. 16, 2002, now Pat. No. 7,378,356.

(51) **Int. Cl.**
*C23C 14/34* (2006.01)

(52) **U.S. Cl.** .............................. **204/298.08**; 204/298.2; 204/298.06

(58) **Field of Classification Search** ............. 204/298.2, 204/298.06, 298.08
See application file for complete search history.

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(Continued)

*Primary Examiner*—Rodney G McDonald
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

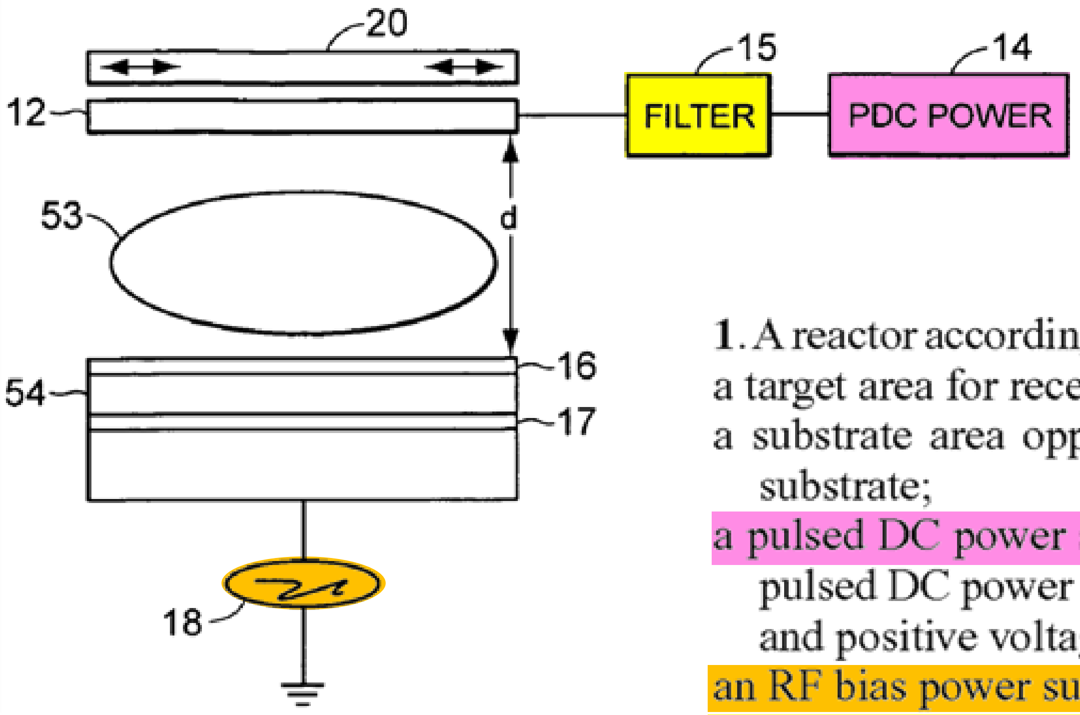
(57) **ABSTRACT**

A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present invention.

**13 Claims, 27 Drawing Sheets**

’276 Patent at Fig. 1A, Claim 1

## Three Key Interrelated Elements of Alleged Invention

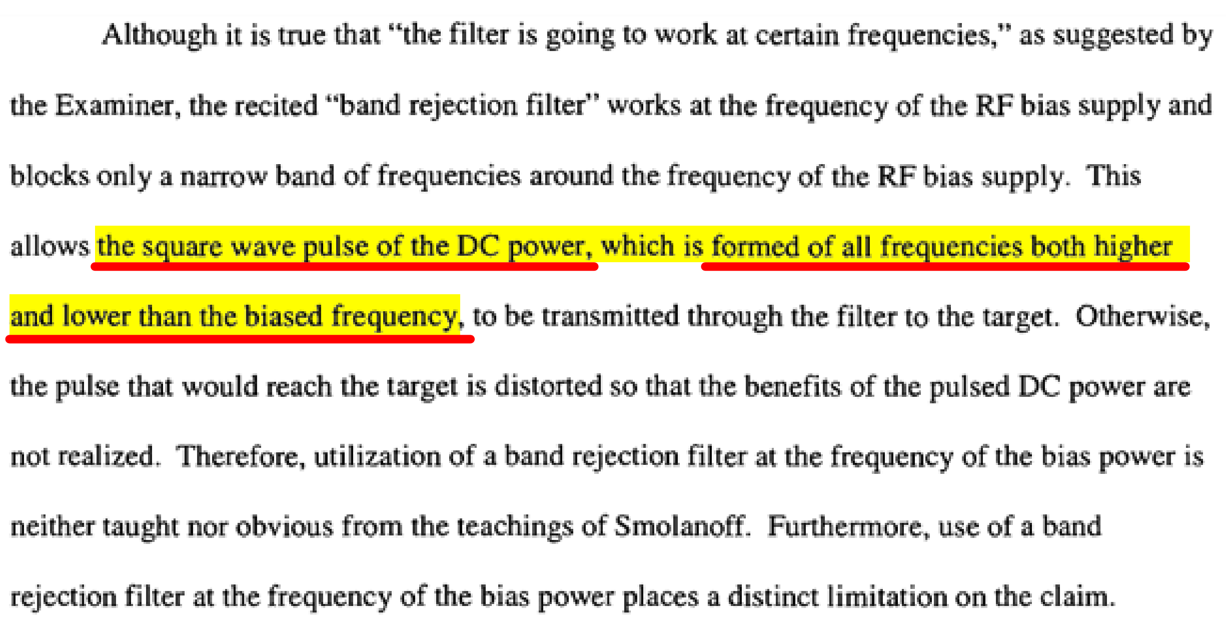


1. A reactor according to the present invention, comprising:
a target area for receiving a target;
a substrate area opposite the target area for receiving a substrate;
a pulsed DC power supply coupled to the target area, the pulsed DC power supply providing alternating negative and positive voltages to the target;
an RF bias power supply coupled to the substrate; and
a narrow band-rejection filter that rejects at a frequency of the RE bias power supply coupled between the pulsed DC power supply and the target area.

’276 Patent at Claim 1, Fig. 1A

# NBRF Must Pass All Frequencies Outside the Narrow Band to Not Distort the Shape of the “pulsed DC power”

## Applicant’s Response

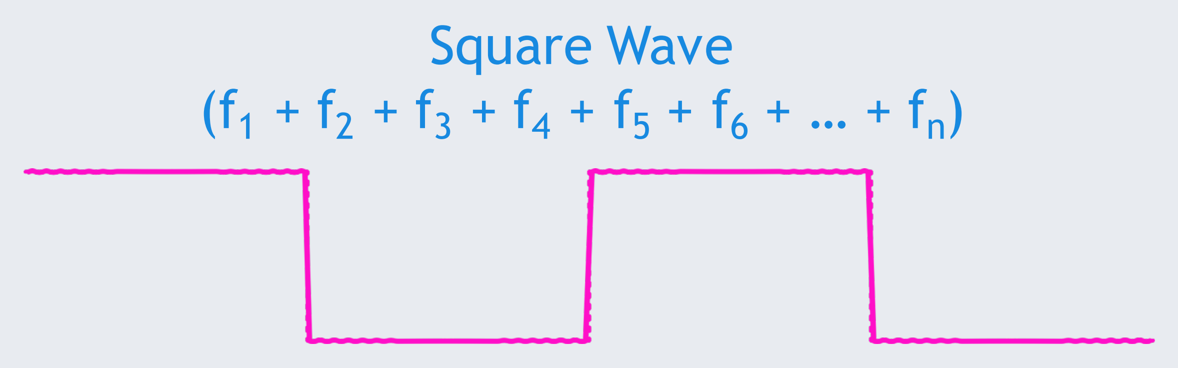


Although it is true that “the filter is going to work at certain frequencies,” as suggested by the Examiner, the recited “band rejection filter” works at the frequency of the RF bias supply and blocks only a narrow band of frequencies around the frequency of the RF bias supply. This allows the square wave pulse of the DC power, which is formed of all frequencies both higher and lower than the biased frequency, to be transmitted through the filter to the target. Otherwise, the pulse that would reach the target is distorted so that the benefits of the pulsed DC power are not realized. Therefore, utilization of a band rejection filter at the frequency of the bias power is neither taught nor obvious from the teachings of Smolanoff. Furthermore, use of a band rejection filter at the frequency of the bias power places a distinct limitation on the claim.

Dkt. 59-5 (’356 File History, part 6/7, Applicant’s Response), 1307

## Given that:

a. The pulse wave is “formed of all frequencies both higher and lower than the [RF] bias[] frequency”

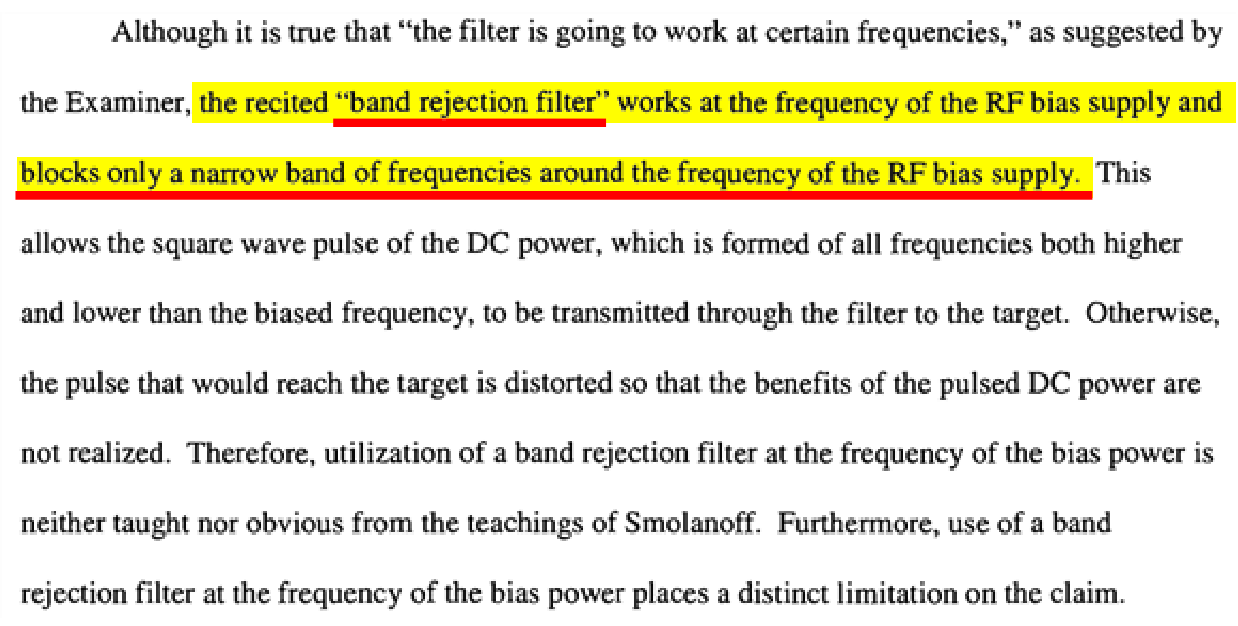


Square Wave

$(f_1 + f_2 + f_3 + f_4 + f_5 + f_6 + \ldots + f_n)$

# NBRF Must Pass All Frequencies Outside the Narrow Band to Not Distort the Shape of the “pulsed DC power”

## Applicant’s Response



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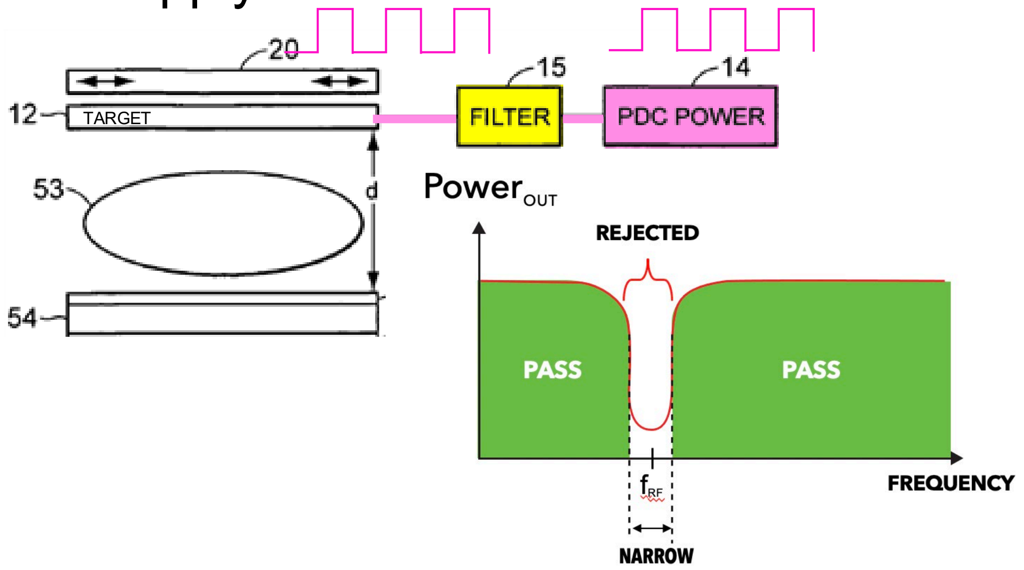
Dkt. 59-5 (’356 File History, part 6/7, Applicant’s Response), 1307

Given that:

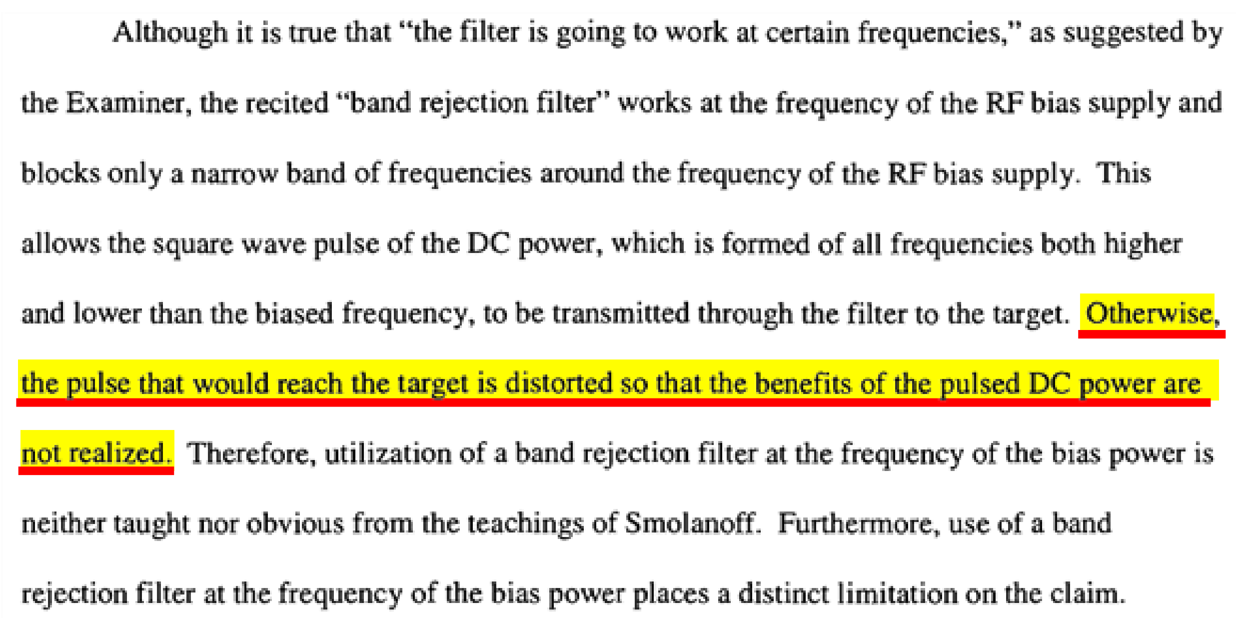
a. The pulse wave is “formed of all frequencies both higher and lower than the [RF] bias[] frequency”

b. The NBRF “blocks only a narrow band of frequencies around the frequency of the RF bias supply”



# NBRF Must Pass All Frequencies Outside the Narrow Band to Not Distort the Shape of the “pulsed DC power”

## Applicant’s Response



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Dkt. 59-5 (’356 File History, part 6/7, Applicant’s Response), 1307

Given that:

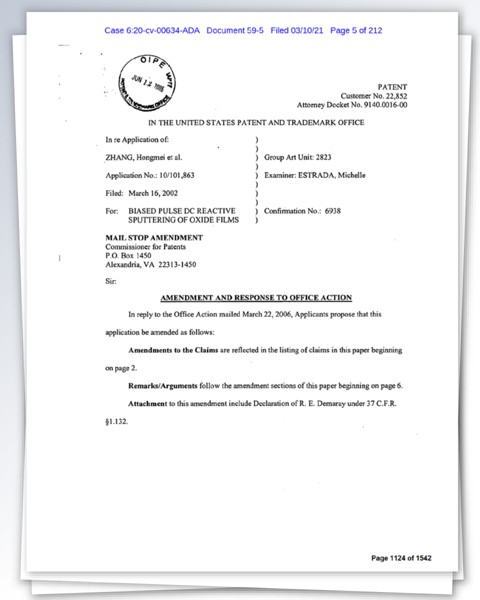
a. The pulse wave is “formed of all frequencies both higher and lower than the [RF] bias[] frequency”

b. The NBRF “blocks only a narrow band of frequencies around the frequency of the RF bias supply”

The result is:

c. The pulsed DC is **not** “distorted so that the **benefits** of the pulsed DC power are [] **realized**”

# NBRF Must Pass All Frequencies Outside the Narrow Band to Not Distort the Shape of the “pulsed DC power”



OIPE
JUN 12 2006

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
ZHANG, Hongmei et al. ) Group Art Unit: 2823
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
Filed: March 16, 2002 )
For: BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS ) Confirmation No.: 6938

**MAIL STOP AMENDMENT**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

**AMENDMENT AND RESPONSE TO OFFICE ACTION**

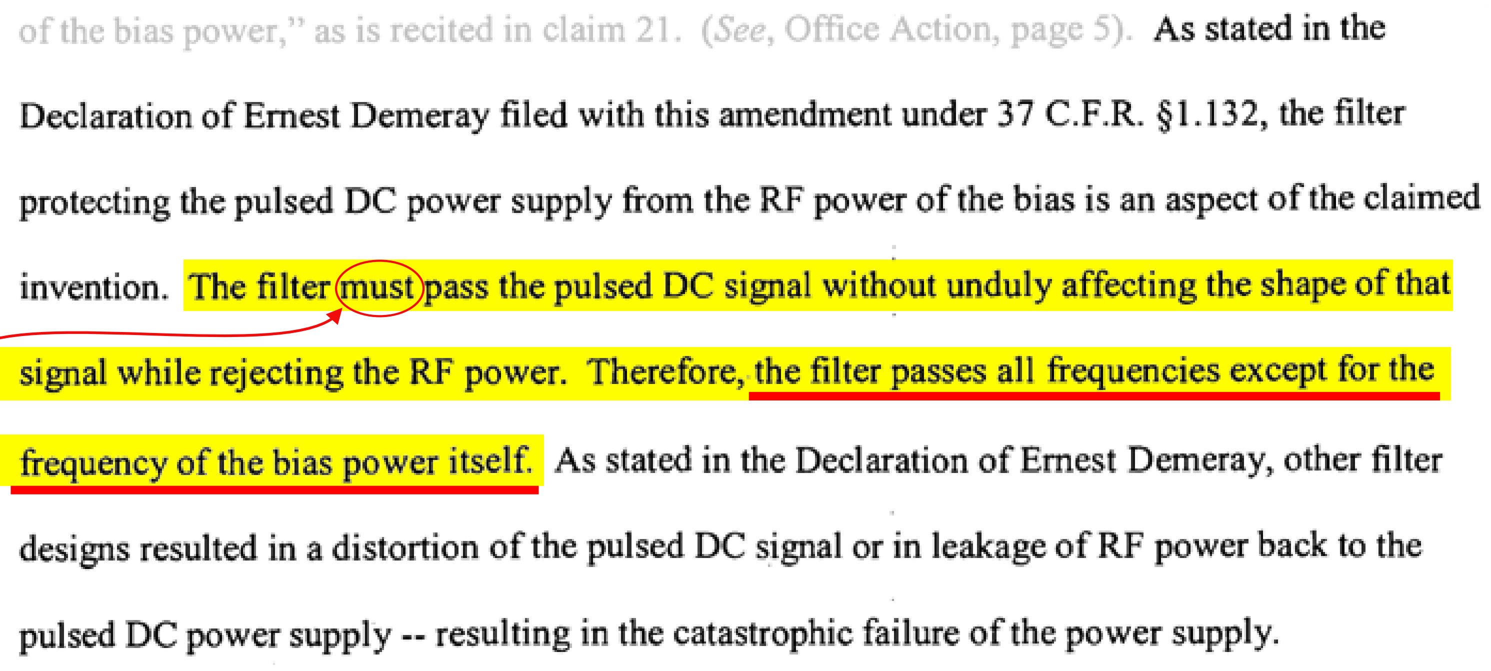
In reply to the Office Action mailed March 22, 2006, Applicants propose that this application be amended as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 6.

**Attachment** to this amendment include Declaration of R. E. Demaray under 37 C.F.R. §1.132.

## Applicant’s Response

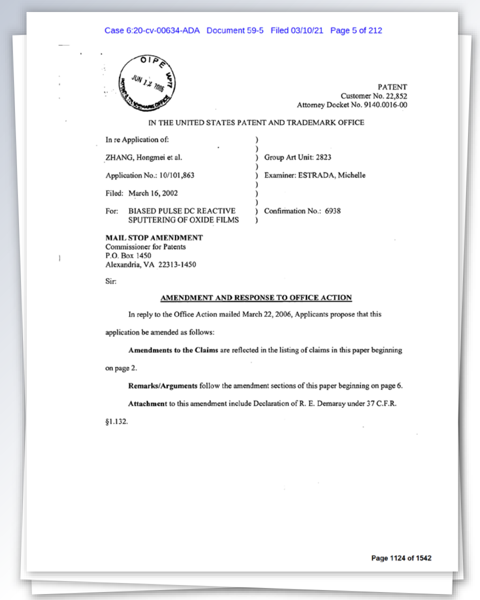


of the bias power,” as is recited in claim 21. (*See*, Office Action, page 5). As stated in the Declaration of Ernest Demeray filed with this amendment under 37 C.F.R. §1.132, the filter protecting the pulsed DC power supply from the RF power of the bias is an aspect of the claimed invention. The filter must pass the pulsed DC signal without unduly affecting the shape of that signal while rejecting the RF power. Therefore, the filter passes all frequencies except for the frequency of the bias power itself. As stated in the Declaration of Ernest Demeray, other filter designs resulted in a distortion of the pulsed DC signal or in leakage of RF power back to the pulsed DC power supply -- resulting in the catastrophic failure of the power supply.

Dkt. 59-5 (’356 File History, part 6/7, 06/12/2006 Applicant’s Response), 1130-31

Passing all frequencies outside the narrow band is a “must”

# NBRF Must Pass All Frequencies Outside the Narrow Band to Not Distort the Shape of the “pulsed DC power”



OIPE JUN 12 2006

PATENT
Customer No. 22,852
Attorney Docket No. 9140.0016-00

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: )
ZHANG, Hongmei et al. ) Group Art Unit: 2823
Application No.: 10/101,863 ) Examiner: ESTRADA, Michelle
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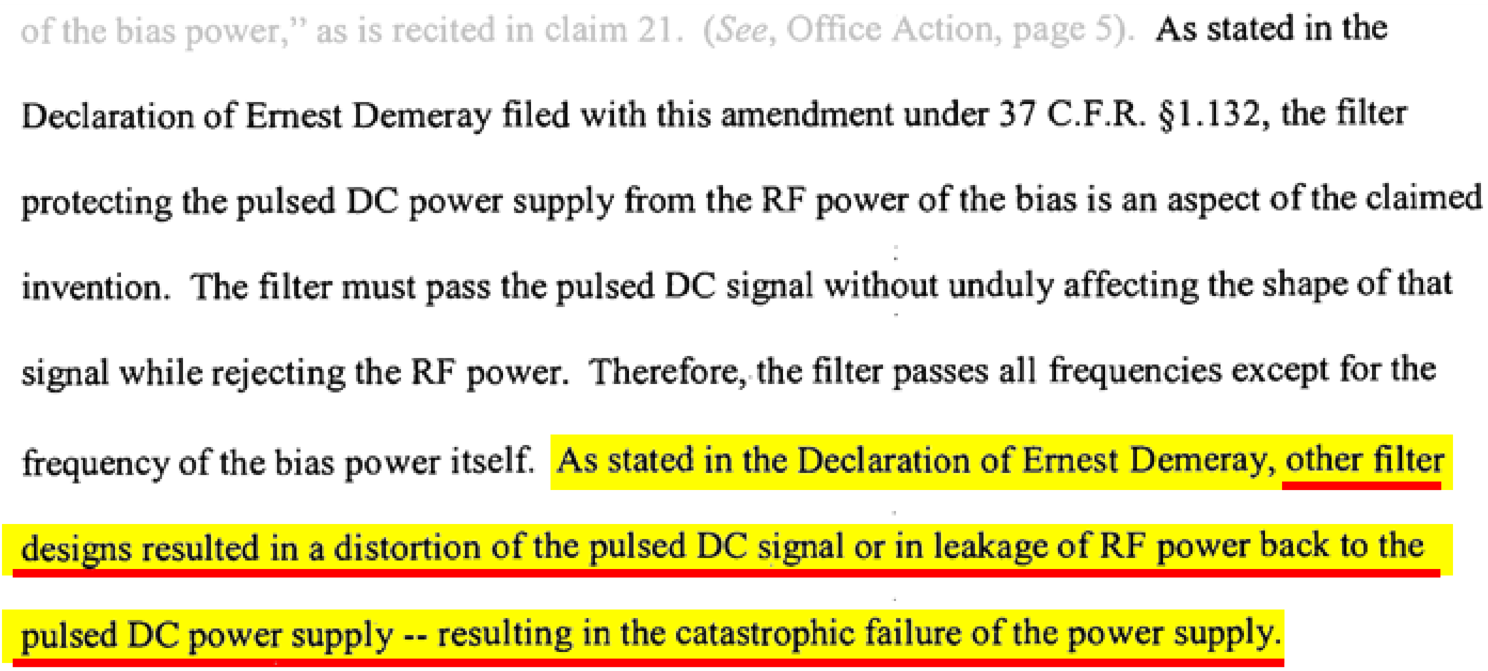

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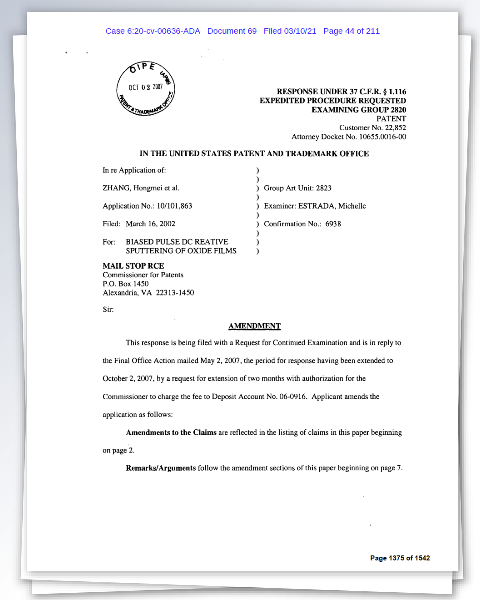
Dkt. 59-5 (’356 File History, part 6/7, 06/12/2006 Applicant’s Response), 1130-31

# NBRF Must Pass All Frequencies Outside the Narrow Band to Not Distort the Shape of the “pulsed DC power”



Case 6:20-cv-00636-ADA Document 69 Filed 03/10/21 Page 44 of 211

OIPE
OCT 0 2 2007

**RESPONSE UNDER 37 C.F.R. § 1.116**
**EXPEDITED PROCEDURE REQUESTED**
**EXAMINING GROUP 2820**
PATENT
Customer No. 22,852
Attorney Docket No. 10655.0016-00

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

| | |
|---|---|
| In re Application of: | ) |
| ZHANG, Hongmei et al. | ) Group Art Unit: 2823 |
| Application No.: 10/101,863 | ) Examiner: ESTRADA, Michelle |
| Filed: March 16, 2002 | ) Confirmation No.: 6938 |
| For: BIASED PULSE DC REATIVE SPUTTERING OF OXIDE FILMS | ) |

**MAIL STOP RCE**
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

**AMENDMENT**

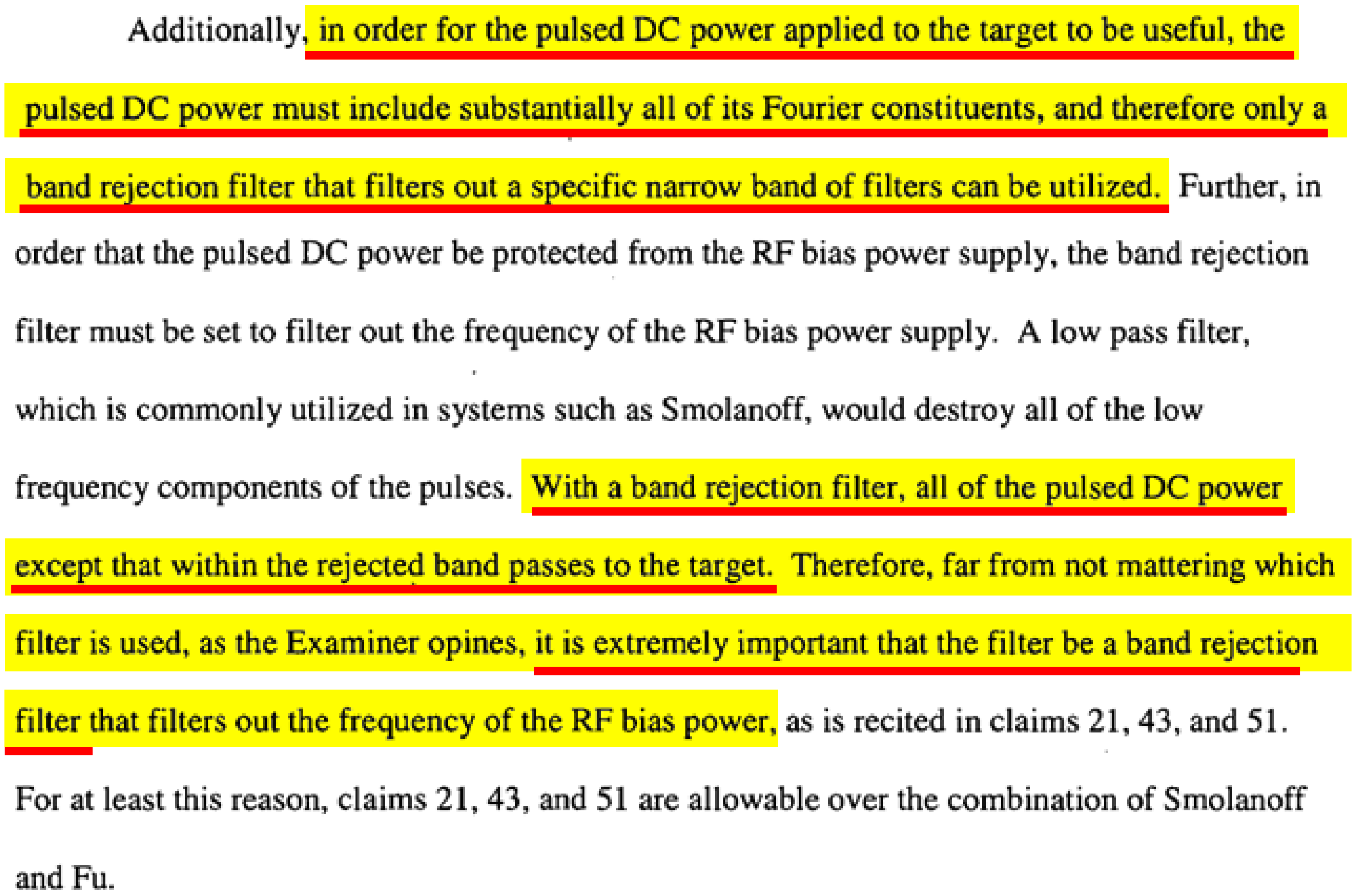
This response is being filed with a Request for Continued Examination and is in reply to the Final Office Action mailed May 2, 2007, the period for response having been extended to October 2, 2007, by a request for extension of two months with authorization for the Commissioner to charge the fee to Deposit Account No. 06-0916. Applicant amends the application as follows:

**Amendments to the Claims** are reflected in the listing of claims in this paper beginning on page 2.

**Remarks/Arguments** follow the amendment sections of this paper beginning on page 7.

Page 1375 of 1542

## Applicant’s Response

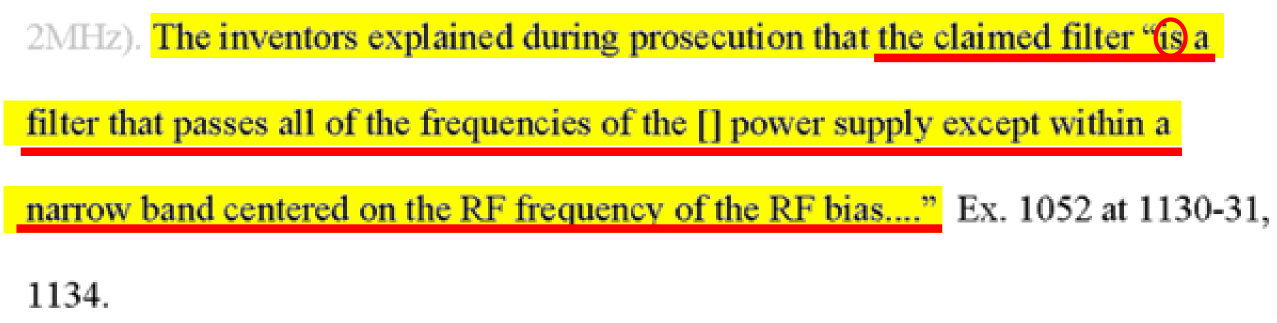


Additionally, in order for the pulsed DC power applied to the target to be useful, the pulsed DC power must include substantially all of its Fourier constituents, and therefore only a band rejection filter that filters out a specific narrow band of filters can be utilized. Further, in order that the pulsed DC power be protected from the RF bias power supply, the band rejection filter must be set to filter out the frequency of the RF bias power supply. A low pass filter, which is commonly utilized in systems such as Smolanoff, would destroy all of the low frequency components of the pulses. With a band rejection filter, all of the pulsed DC power except that within the rejected band passes to the target. Therefore, far from not mattering which filter is used, as the Examiner opines, it is extremely important that the filter be a band rejection filter that filters out the frequency of the RF bias power, as is recited in claims 21, 43, and 51. For at least this reason, claims 21, 43, and 51 are allowable over the combination of Smolanoff and Fu.

Dkt. 59 (’356 File History, part 7/7, 10/02/2007 Applicant’s Response), 1386-87

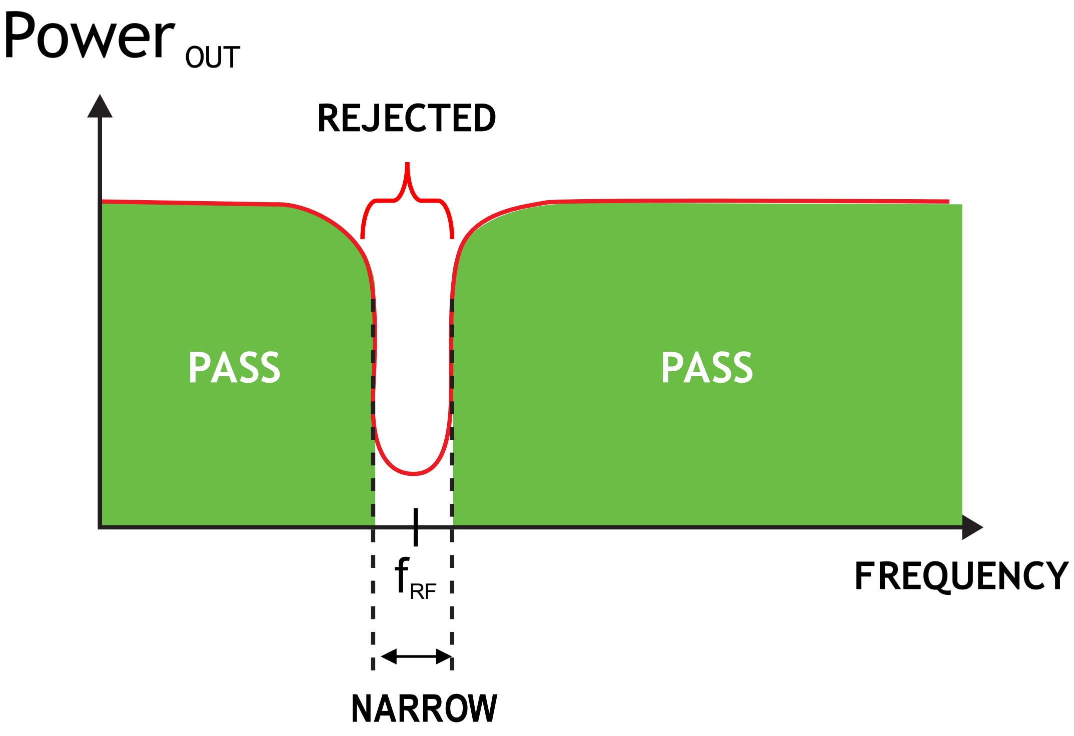
# NBRF Defined to Pass All Frequencies Outside the Narrow Band

## Demaray's Definition



2MHz). The inventors explained during prosecution that the claimed filter "is a filter that passes all of the frequencies of the [] power supply except within a narrow band centered on the RF frequency of the RF bias...." Ex. 1052 at 1130-31, 1134.

Dkt. 58-3 (IPR2021-00103, 02/16/2021 Demaray's Preliminary Response), *citing* **to 06/07/06 Demaray Declaration** , 24



# “A method of depositing a film on an insulating substrate, comprising”

’657 Patent, Claim 1 Preamble

# The Meaning of "substrate"

| Limitation | Court's Preliminary Construction | Demaray's Proposal |
|---|---|---|
| "substrate" | Plain-and-ordinary meaning, which includes, but is not limited to a wafer coated with an insulator | Plain and ordinary meaning<br>OR<br>"***material that provides the surface on which something is deposited or inscribed***, ***for example a silicon wafer used to manufacture integrated circuits***" |

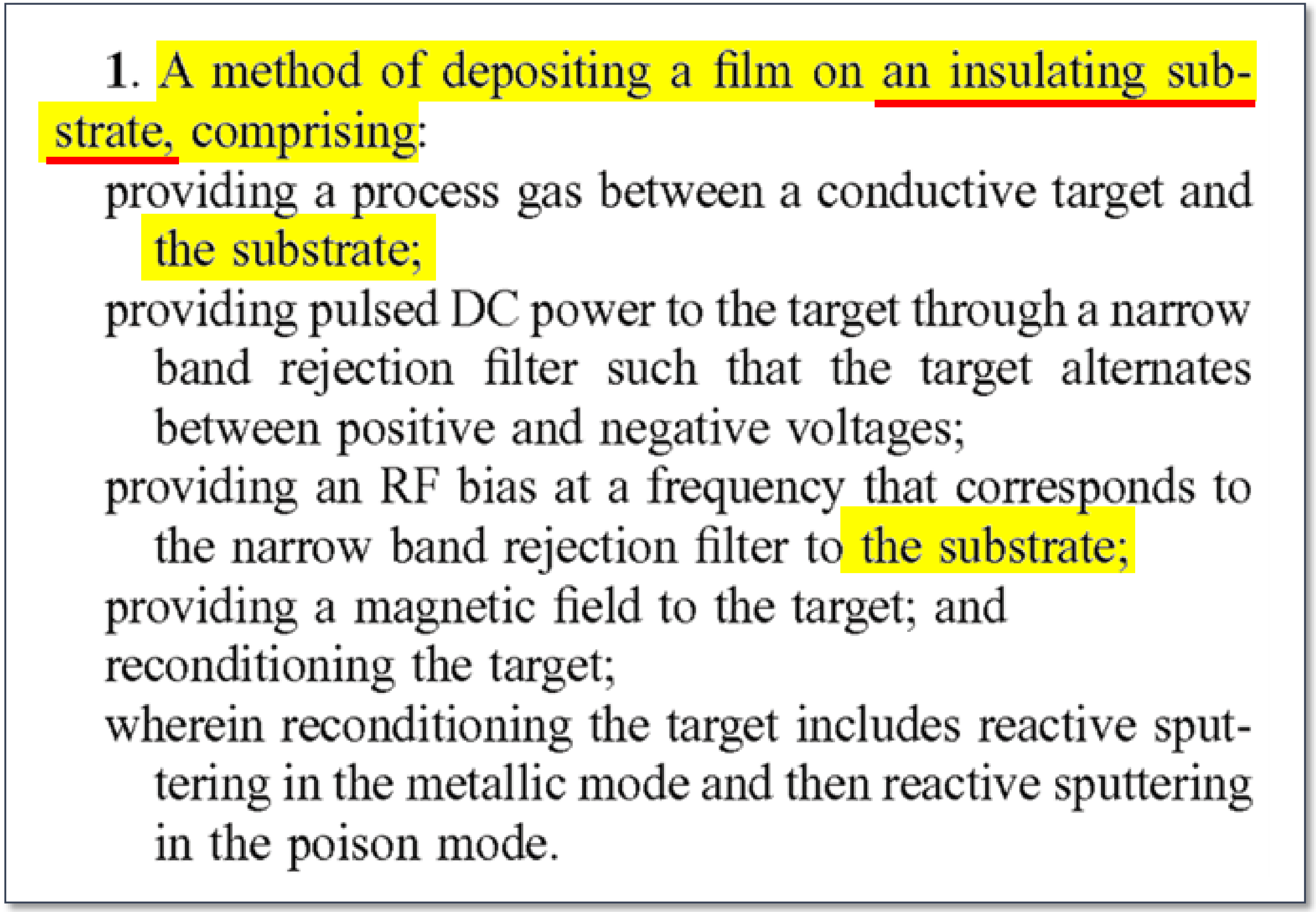
# Fine-Tuned Dispute: The Meaning of "substrate"

**Court's Tentative Construction**: Plain and ordinary meaning, which includes, but is not limited to a wafer coated with an insulator

**The dispute fine-tuned**: Can the plain and ordinary meaning of "substrate" as used in the claimed "insulating substrate" be any "material that provides the surface on which something is deposited or inscribed"?

In other words, can an "insulating substrate" be any type of substrate having one thin film that is insulating?

# Asserted Claim Requires "an insulating substrate"



1. A method of depositing a film on an insulating substrate, comprising:

providing a process gas between a conductive target and the substrate;

providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;

providing an RF bias at a frequency that corresponds to the narrow band rejection filter to the substrate;

providing a magnetic field to the target; and

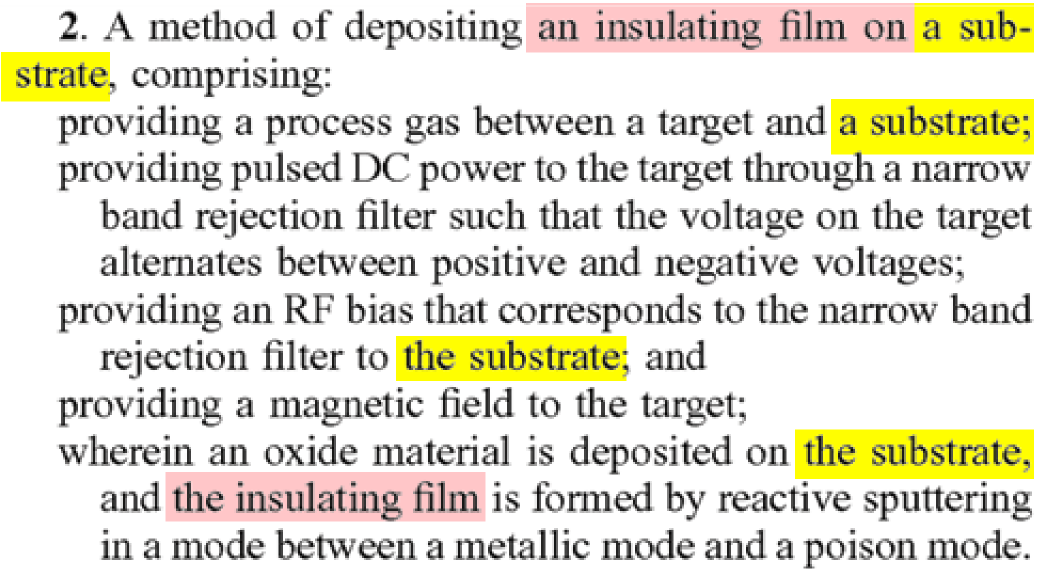
reconditioning the target;

wherein reconditioning the target includes reactive sputtering in the metallic mode and then reactive sputtering in the poison mode.

'657 Patent, Claim 1

# Non-Asserted Claim Requires Any Type of "substrate"

"an *insulating film* on a substrate"



**2.** A method of depositing an insulating film on a substrate, comprising:

providing a process gas between a target and a substrate;

providing pulsed DC power to the target through a narrow band rejection filter such that the voltage on the target alternates between positive and negative voltages;

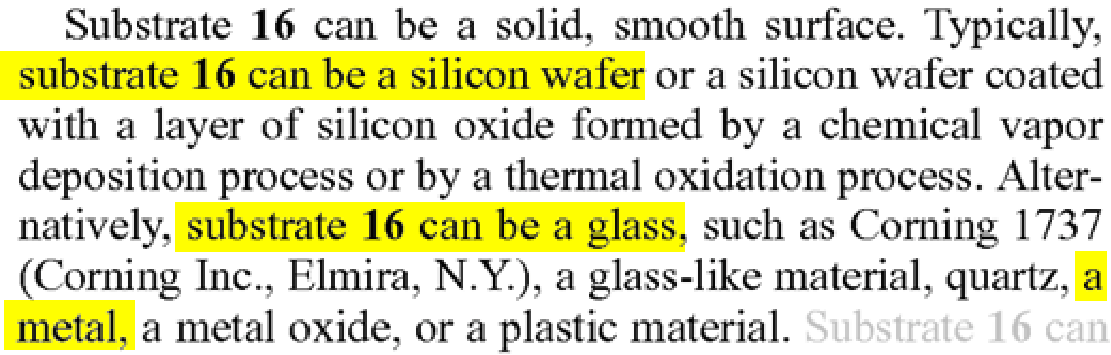
providing an RF bias that corresponds to the narrow band rejection filter to the substrate; and

providing a magnetic field to the target;

wherein an oxide material is deposited on the substrate, and the insulating film is formed by reactive sputtering in a mode between a metallic mode and a poison mode.

'657 Patent, Claim 2

## [Any Type of] Substrate



Substrate **16** can be a solid, smooth surface. Typically, substrate **16** can be a silicon wafer or a silicon wafer coated with a layer of silicon oxide formed by a chemical vapor deposition process or by a thermal oxidation process. Alternatively, substrate **16** can be a glass, such as Corning 1737 (Corning Inc., Elmira, N.Y.), a glass-like material, quartz, a metal, a metal oxide, or a plastic material. Substrate **16** can

'657 Patent, 7:62-8:1

silicon substrate

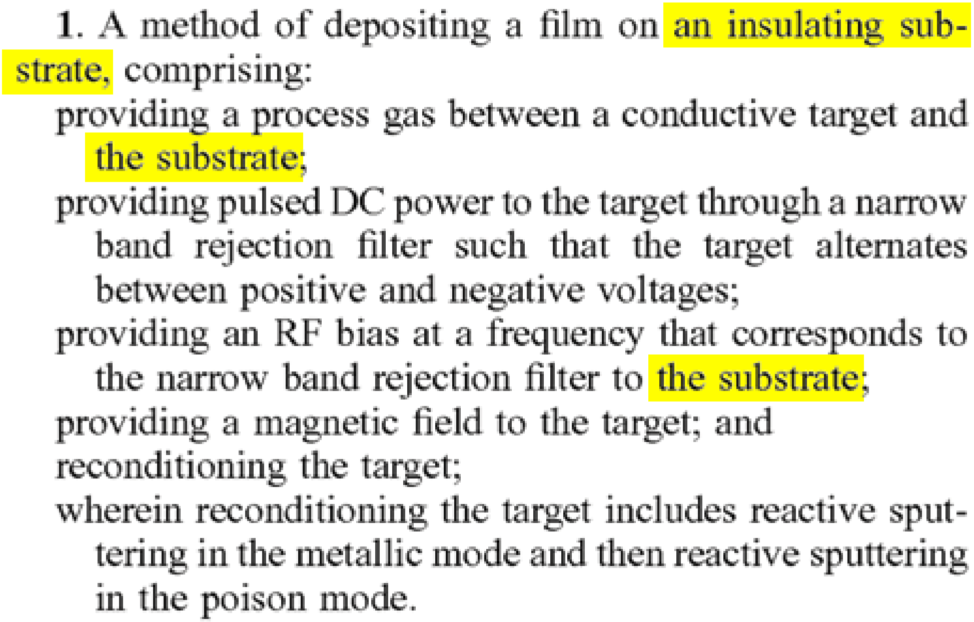
glass substrate

metal substrate

# Asserted Claim Requires "an insulating substrate"—Not Any Type of "substrate"

## Asserted Claim

"an *insulating substrate*"

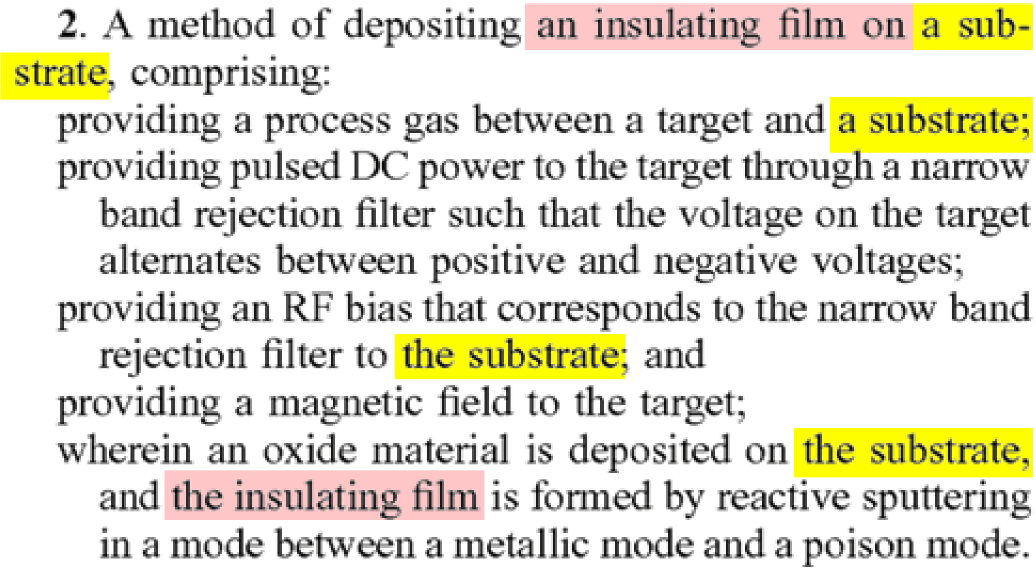


1. A method of depositing a film on an insulating substrate, comprising:
providing a process gas between a conductive target and the substrate;
providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;
providing an RF bias at a frequency that corresponds to the narrow band rejection filter to the substrate;
providing a magnetic field to the target; and
reconditioning the target;
wherein reconditioning the target includes reactive sputtering in the metallic mode and then reactive sputtering in the poison mode.

'657 Patent, Claim 1

## Non-Asserted Claim

"an *insulating film* on a substrate"



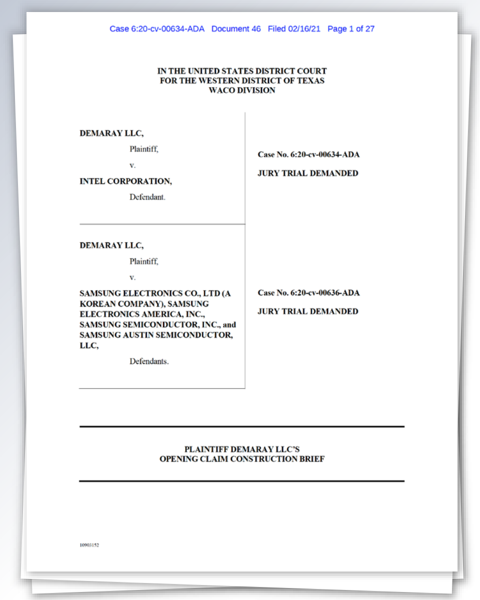
2. A method of depositing an insulating film on a substrate, comprising:
providing a process gas between a target and a substrate;
providing pulsed DC power to the target through a narrow band rejection filter such that the voltage on the target alternates between positive and negative voltages;
providing an RF bias that corresponds to the narrow band rejection filter to the substrate; and
providing a magnetic field to the target;
wherein an oxide material is deposited on the substrate, and the insulating film is formed by reactive sputtering in a mode between a metallic mode and a poison mode.

'657 Patent, Claim 2

> "In the absence of any evidence to the contrary, ***we must presume that the use of these different terms in the claims connotes different meanings.***"

*CAE Screenplates Inc. v. Heinrich Fiedler GmbH & Co. KG*, 224 F.3d 1308, 1317 (Fed. Cir. 2000)

# Demaray Replaces “insulating substrate” With Any Type of “substrate”



Case 6:20-cv-00634-ADA Document 46 Filed 02/16/21 Page 1 of 27

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

DEMARAY LLC,
Plaintiff,
v.
INTEL CORPORATION,
Defendant.

Case No. 6:20-cv-00634-ADA
JURY TRIAL DEMANDED

DEMARAY LLC,
Plaintiff,
v.
SAMSUNG ELECTRONICS CO., LTD (A KOREAN COMPANY), SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR, LLC,
Defendants.

Case No. 6:20-cv-00636-ADA
JURY TRIAL DEMANDED

PLAINTIFF DEMARAY LLC’S
OPENING CLAIM CONSTRUCTION BRIEF

Defendants’ position disregards the patents’ teaching that the claimed methods can be used with “any type” of substrate. Ex. 1, 2:61–62. Defendants’ position also contradicts numerous

Dkt. 46 (Demaray’s Opening Brief), 6

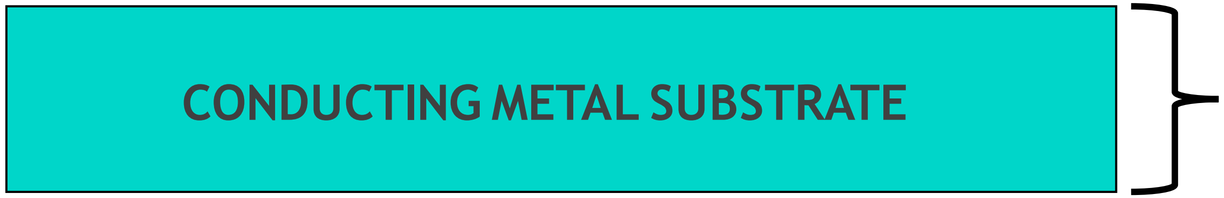
# Demaray’s POM of “substrate”: Improperly Allows “insulating substrate” to Encompass Any Type of “Substrate” Having One Insulating Layer of Material

**“insulating [Court’s construction of ‘substrate’]”**

**insulating [plain and ordinary meaning, which includes, but is not limited to a wafer coated with an insulator]**

**INSERTING DEMARAY’S POM:**

**insulating [*material that provides the surface on which something is deposited or inscribed*, which includes, but is not limited to a wafer coated with an insulator]**

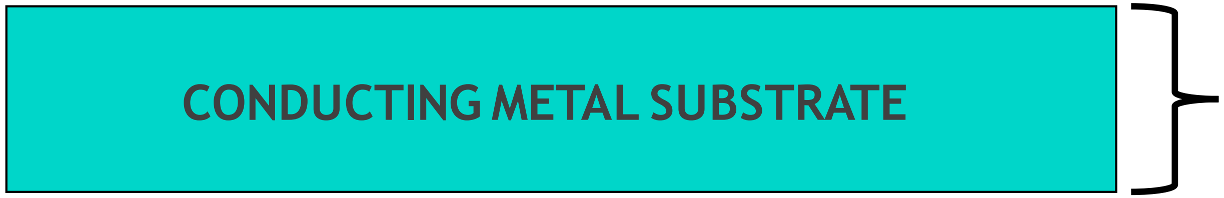


Parties agree this is a “substrate”

# Demaray's POM of "substrate": Improperly Allows "insulating substrate" to Encompass Any Type of "Substrate" Having One Insulating Layer of Material

"insulating [Demaray's 'substrate' POM]"

**insulating [*material that provides the surface on which something is deposited or inscribed*, which includes, but is not limited to a wafer coated with an insulator]**

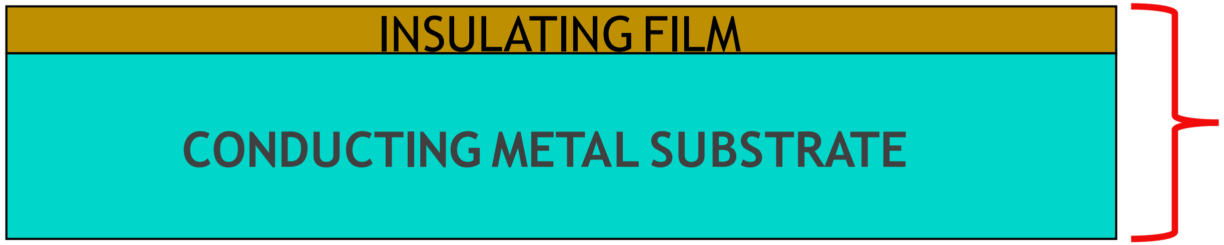


Parties agree this is a "substrate"

# Demaray's POM of "substrate": Improperly Allows "insulating substrate" to Encompass Any Type of "Substrate" Having One Insulating Layer of Material

**"insulating [Demaray's 'substrate' POM]"**

**insulating [*material that provides the surface on which something is deposited or inscribed*, which includes, but is not limited to a wafer coated with an insulator]**



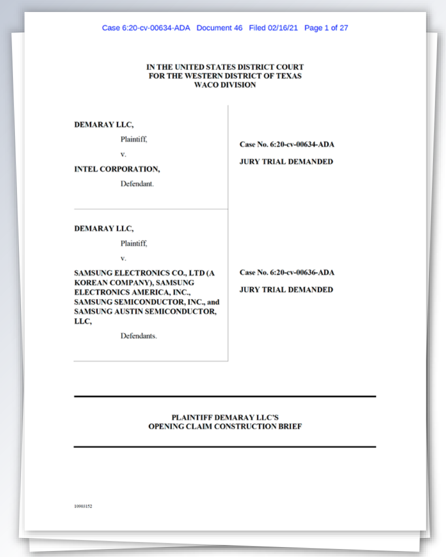
insulating substrate *according to Demaray*

# Demaray's POM of "substrate": Improperly Allows "insulating substrate" to Encompass Any Type of "Substrate" Having One Insulating Layer of Material

| "insulating [Demaray's 'substrate' POM]" |
|---|
| **insulating [*<u>material that provides the surface on which something is deposited or inscribed</u>*, which includes, but is not limited to a wafer coated with an insulator]** |

insulating substrate *according to Demaray*

# Demaray Replaces “insulating substrate” With Any Type of “substrate”


Case 6:20-cv-00634-ADA Document 46 Filed 02/16/21 Page 1 of 27

IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
WACO DIVISION

**DEMARAY LLC,**
Plaintiff,
v.
**INTEL CORPORATION,**
Defendant.

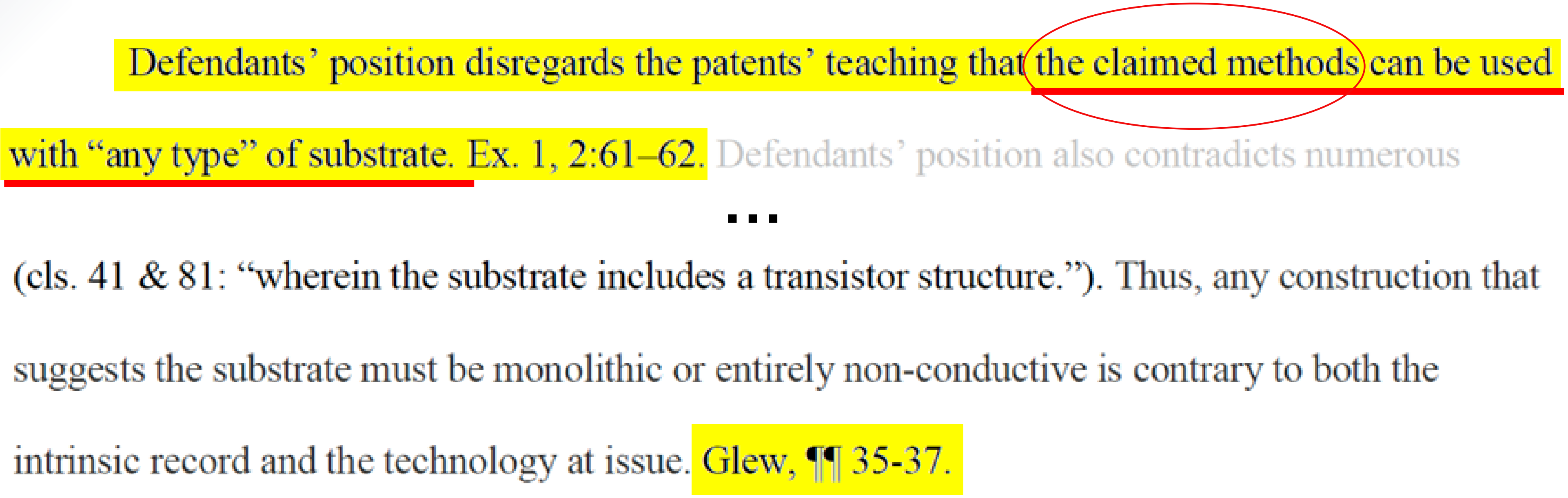
**Case No. 6:20-cv-00634-ADA**
**JURY TRIAL DEMANDED**

**DEMARAY LLC,**
Plaintiff,
v.
**SAMSUNG ELECTRONICS CO., LTD (A KOREAN COMPANY), SAMSUNG ELECTRONICS AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG AUSTIN SEMICONDUCTOR, LLC,**
Defendants.

**Case No. 6:20-cv-00636-ADA**
**JURY TRIAL DEMANDED**

**PLAINTIFF DEMARAY LLC’S**
**OPENING CLAIM CONSTRUCTION BRIEF**

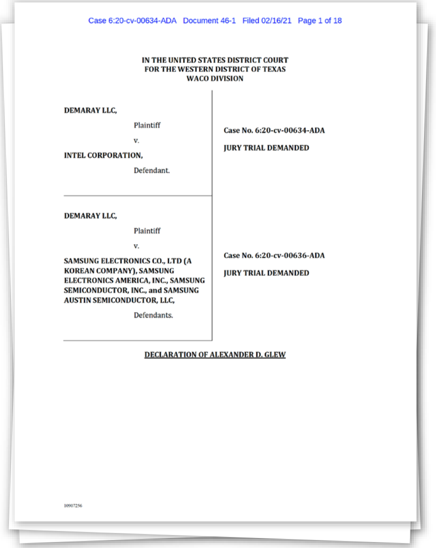
10903152


Defendants’ position disregards the patents’ teaching that the claimed methods can be used with “any type” of substrate. Ex. 1, 2:61–62. Defendants’ position also contradicts numerous

. . .

(cls. 41 & 81: “wherein the substrate includes a transistor structure.”). Thus, any construction that suggests the substrate must be monolithic or entirely non-conductive is contrary to both the intrinsic record and the technology at issue. Glew, ¶¶ 35-37.

Dkt. 46 (Demaray’s Opening Brief), 6


Case 6:20-cv-00634-ADA Document 46-1 Filed 02/16/21 Page 1 of 18

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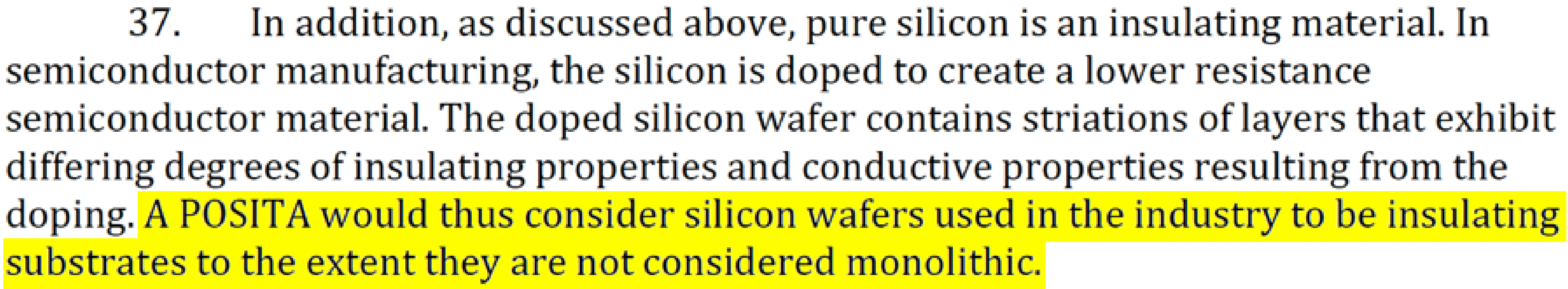
**Case No. 6:20-cv-00636-ADA**
**JURY TRIAL DEMANDED**

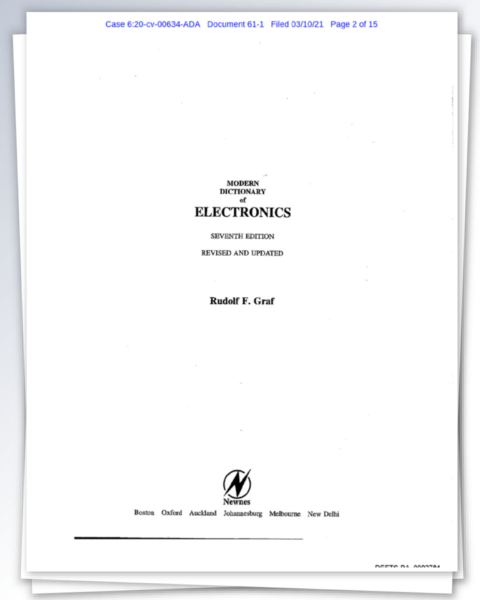
**DECLARATION OF ALEXANDER D. GLEW**

10907256


37. In addition, as discussed above, pure silicon is an insulating material. In semiconductor manufacturing, the silicon is doped to create a lower resistance semiconductor material. The doped silicon wafer contains striations of layers that exhibit differing degrees of insulating properties and conductive properties resulting from the doping. A POSITA would thus consider silicon wafers used in the industry to be insulating substrates to the extent they are not considered monolithic.

Dkt. 46–1 (Glew Declaration), ¶ 37

# Silicon is a Semiconducting Material



Case 6:20-cv-00634-ADA Document 61-1 Filed 03/10/21 Page 2 of 15

MODERN
DICTIONARY
of
ELECTRONICS

SEVENTH EDITION

REVISED AND UPDATED

Rudolf F. Graf

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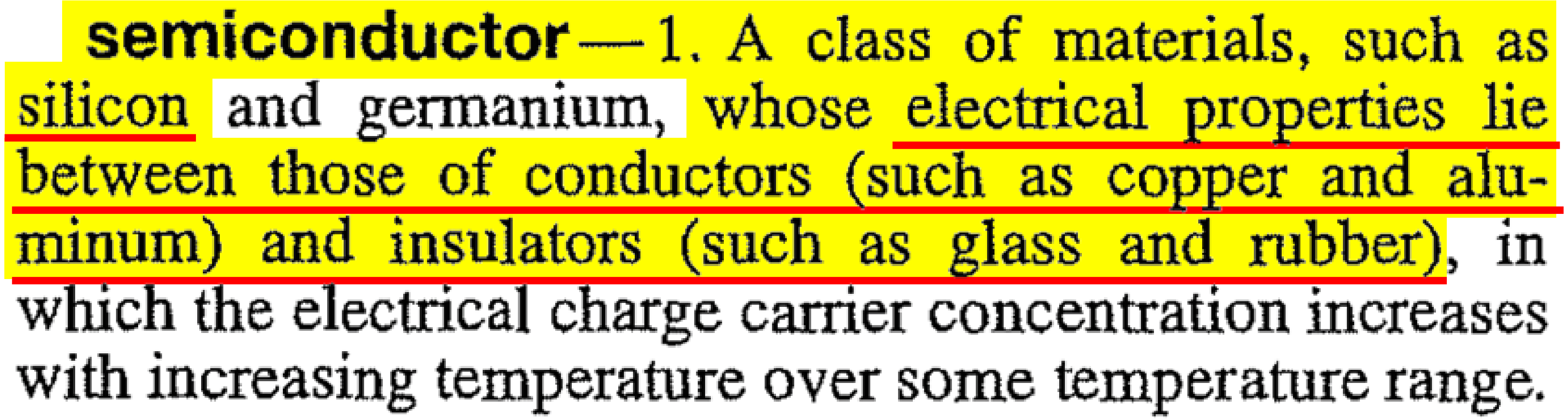
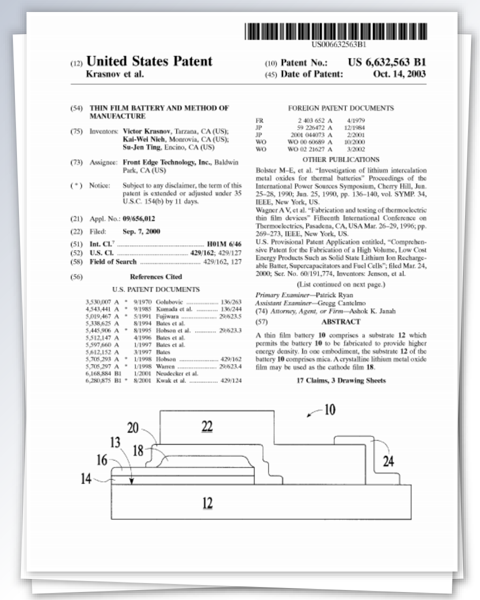
Boston Oxford Auckland Johannesburg Melbourne New Delhi



**semiconductor**—1. A class of materials, such as silicon and germanium, whose electrical properties lie between those of conductors (such as copper and aluminum) and insulators (such as glass and rubber), in which the electrical charge carrier concentration increases with increasing temperature over some temperature range.

Dkt. 61-1 (Modern Dictionary of Electronics (1999)), 2796.

# Substrates Can Be Insulating, Semiconducting, or Conducting



US006632563B1

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

(10) **Patent No.:** **US 6,632,563 B1**
(45) **Date of Patent:** **Oct. 14, 2003**

(54) **THIN FILM BATTERY AND METHOD OF MANUFACTURE**

(75) Inventors: **Victor Krasnov**, Tarzana, CA (US); **Kai-Wei Nieh**, Monrovia, CA (US); **Su-Jen Ting**, Encino, CA (US)

(73) Assignee: **Front Edge Technology, Inc.**, Baldwin Park, CA (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 11 days.

(21) Appl. No.: **09/656,012**

(22) Filed: **Sep. 7, 2000**

(51) **Int. Cl.$^7$** ........ **H01M 6/46**
(52) **U.S. Cl.** ........ **429/162**; 429/127
(58) **Field of Search** ........ 429/162, 127

(56) **References Cited**

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Wagner A V, et al. "Fabrication and testing of thermoelectric thin film devices" Fifteenth International Conference on Thermoelectrics, Pasadena, CA, USA Mar. 26–29, 1996; pp. 269–273, IEEE, New York, US.

U.S. Provisional Patent Application entitled, "Comprehensive Patent for the Fabrication of a High Volume, Low Cost Energy Products Such as Solid State Lithium Ion Rechargeable Batter, Supercapacitators and Fuel Cells"; filed Mar. 24, 2000; Ser. No. 60/191,774, Inventors: Jenson, et al.

(List continued on next page.)

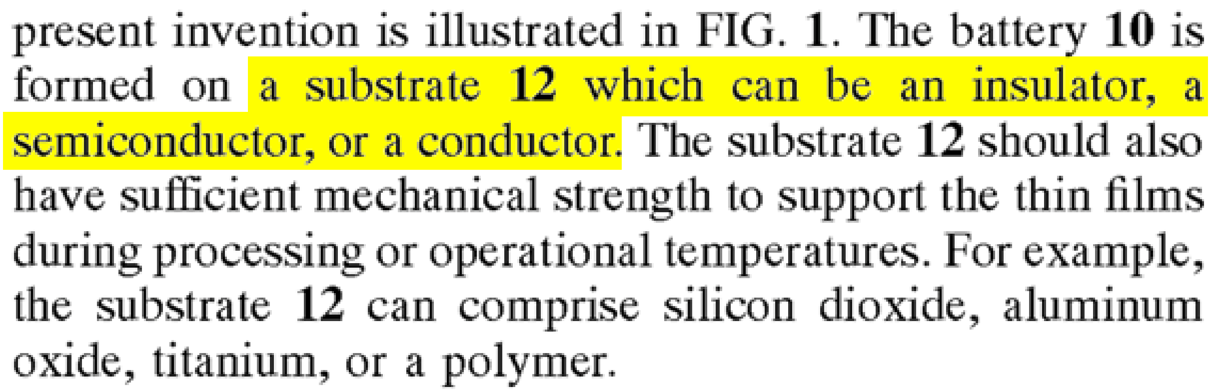
*Primary Examiner*—Patrick Ryan
*Assistant Examiner*—Gregg Cantelmo
(74) *Attorney, Agent, or Firm*—Ashok K. Janah

(57) **ABSTRACT**

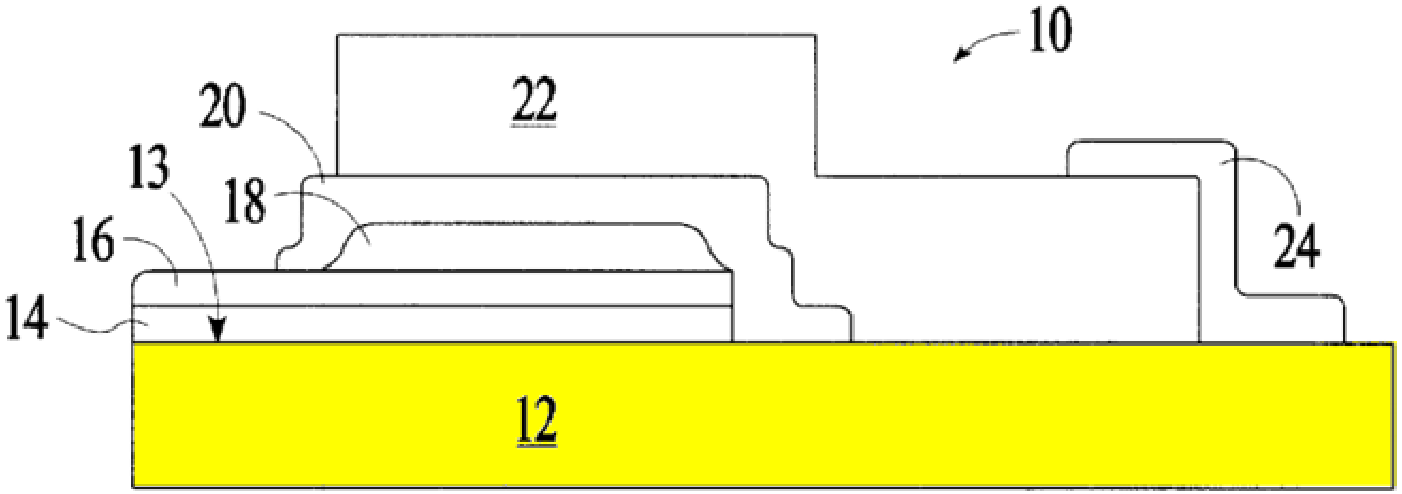
A thin film battery **10** comprises a substrate **12** which permits the battery **10** to be fabricated to provide higher energy density. In one embodiment, the substrate **12** of the battery **10** comprises mica. A crystalline lithium metal oxide film may be used as the cathode film **18**.

**17 Claims, 3 Drawing Sheets**

## Intrinsic Evidence



present invention is illustrated in FIG. **1**. The battery **10** is formed on a substrate **12** which can be an insulator, a semiconductor, or a conductor. The substrate **12** should also have sufficient mechanical strength to support the thin films during processing or operational temperatures. For example, the substrate **12** can comprise silicon dioxide, aluminum oxide, titanium, or a polymer.



U.S. Pat. 6,632,563, 2:46-48, Fig. 1
(cited on face of Patents-in-Suit)

# Demaray's POM of "substrate": Improperly Allows "insulating substrate" to Encompass Any Type of "Substrate" Having One Insulating Layer of Material

**"insulating [Demaray's 'substrate' POM]"**

**insulating [*material that provides the surface on which something is deposited or inscribed*, which includes, but is not limited to a wafer coated with an insulator]**

insulating substrate *according to Demaray*

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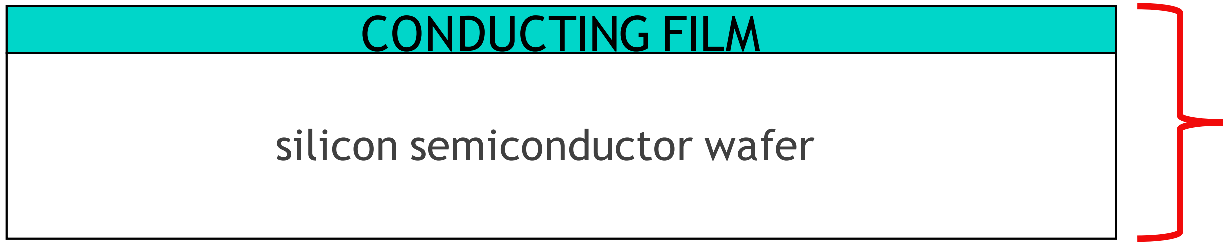

CONDUCTING FILM

silicon semiconductor wafer

insulating substrate
***according to Demaray***

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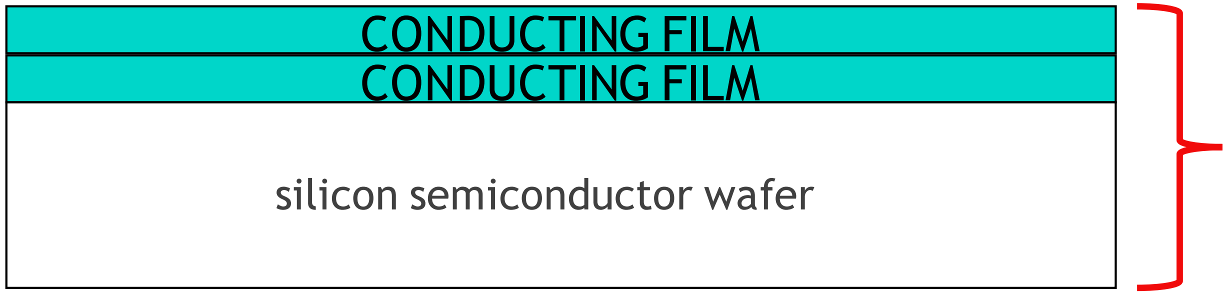

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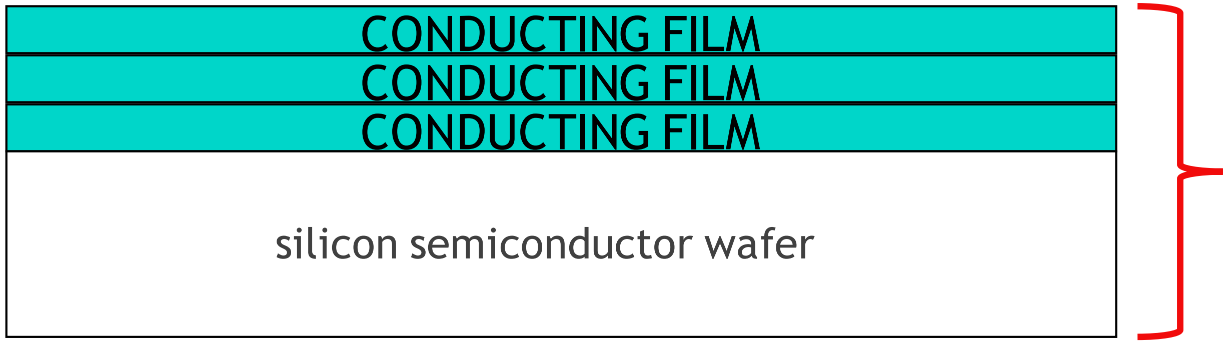
CONDUCTING FILM
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***according to Demaray***

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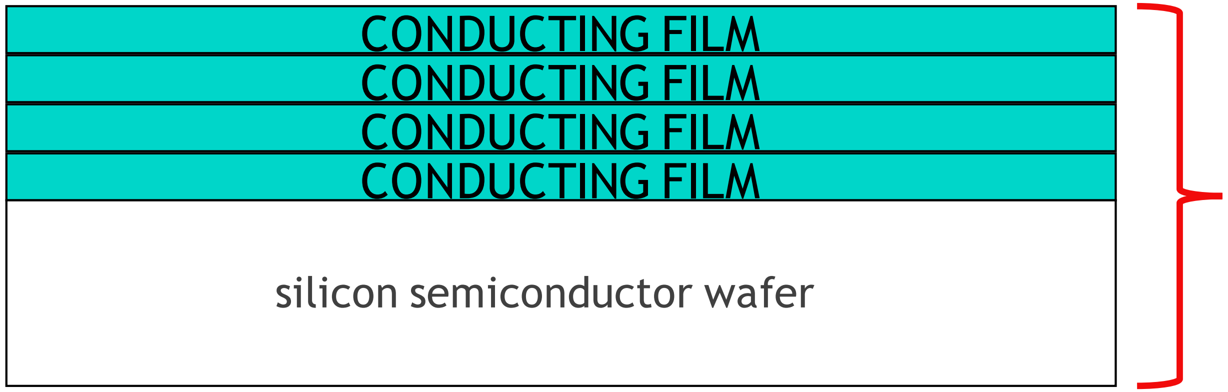

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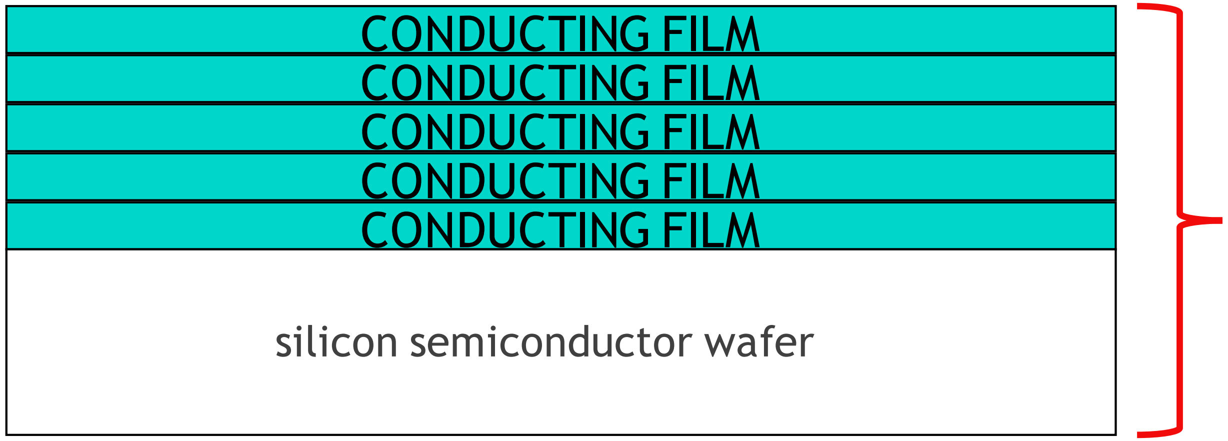

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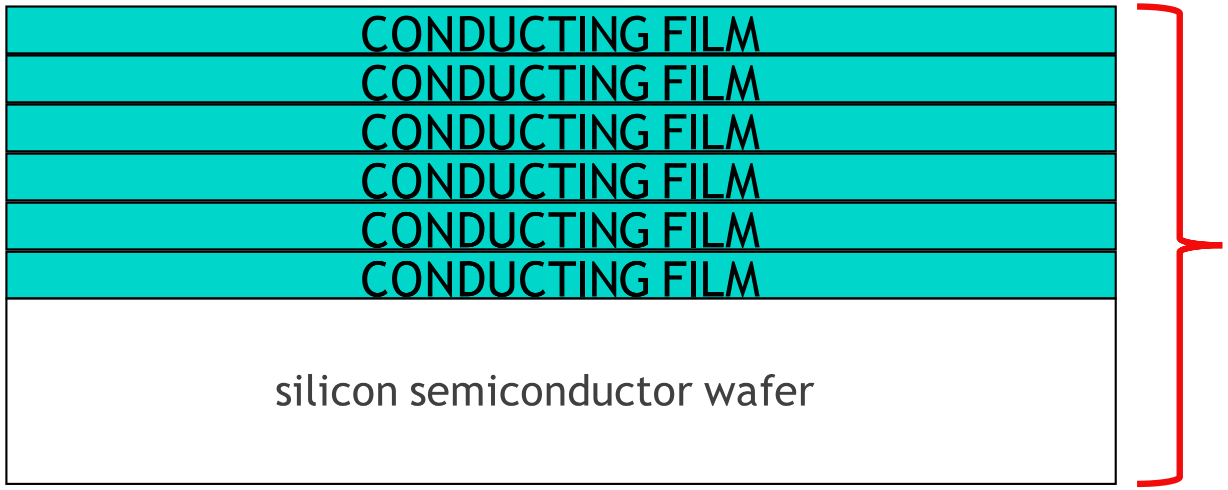

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|---|
| **insulating [*__material that provides the surface on which something is deposited or inscribed__*, which includes, but is not limited to a wafer coated with an insulator]** |

Parties agree this is an "insulating substrate"

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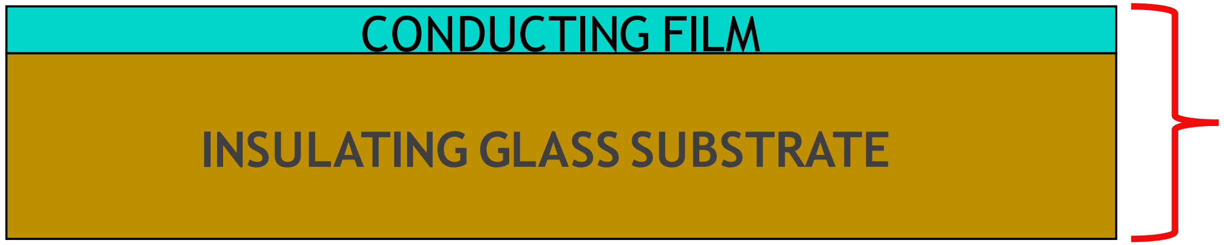

CONDUCTING FILM

INSULATING GLASS SUBSTRATE

insulating substrate *according to Demaray*

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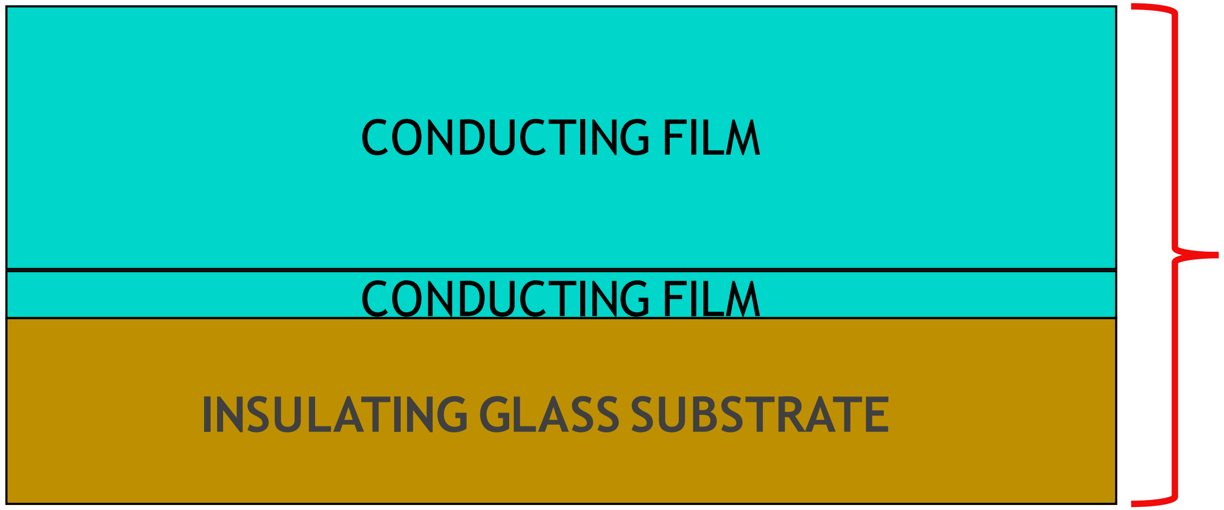

insulating substrate
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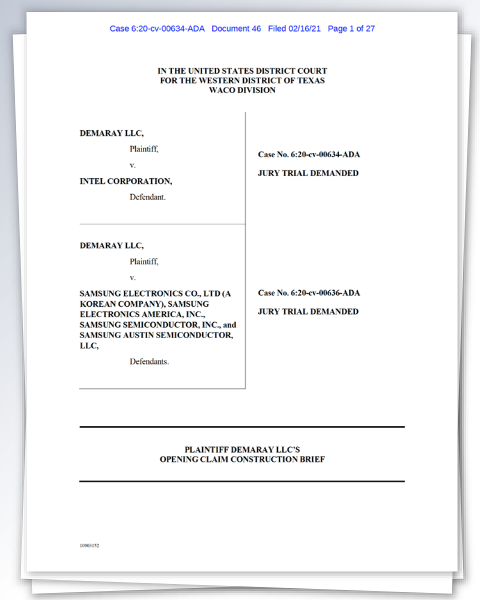
# Demaray Mischaracterizes Claim 1 and the Specification



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**OPENING CLAIM CONSTRUCTION BRIEF**

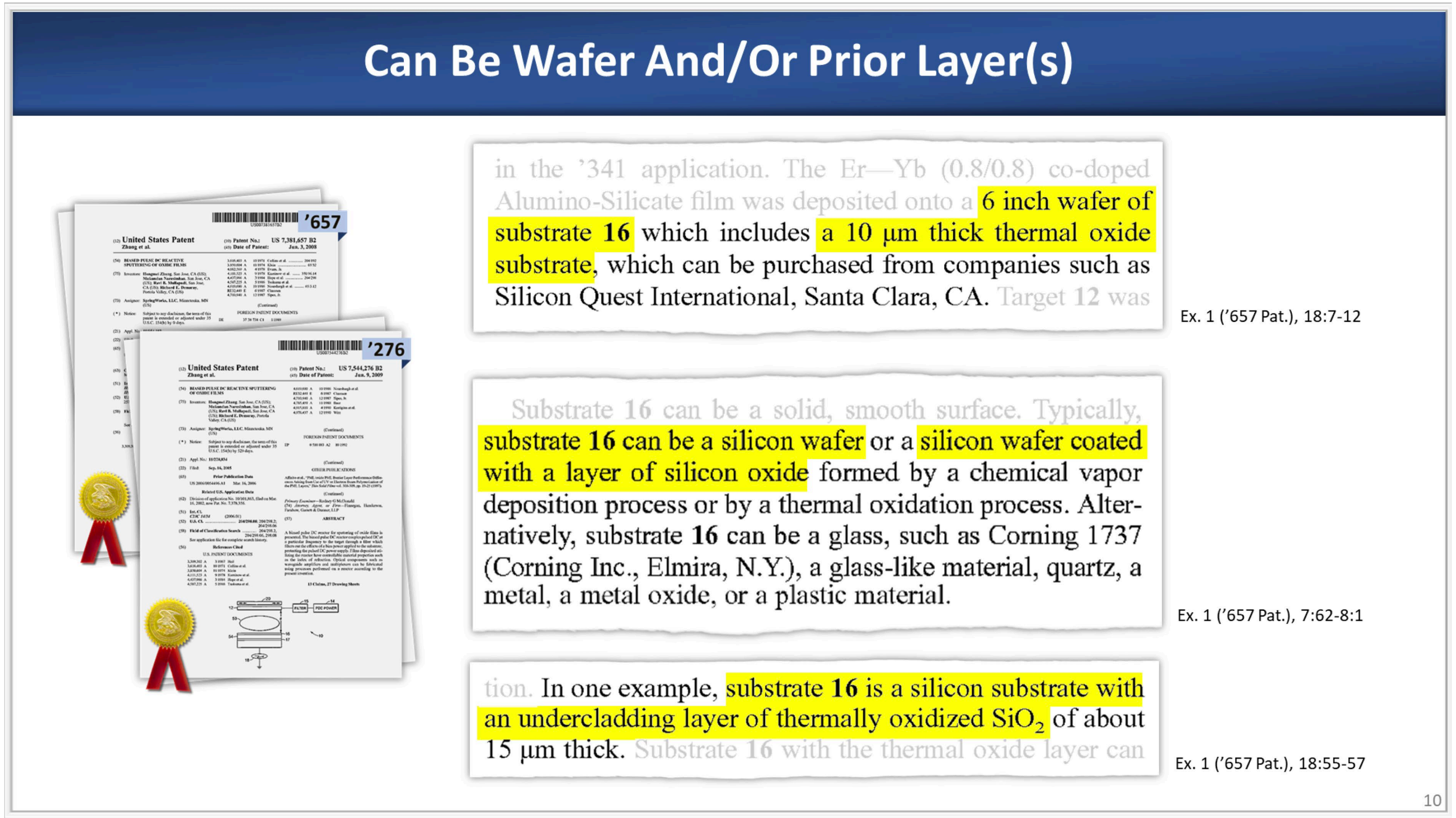
10903152

Defendants' position disregards the patents' teaching that the claimed methods can be used with "any type" of substrate. Ex. 1, 2:61–62. Defendants' position also contradicts numerous preferred embodiments involving substrates that include layers of insulating materials that have been deposited on top of other materials—as well as materials containing conductive elements such as traces and transistors—that are also part of the "substrate." In these preferred

Dkt. 46 (02/16/2021 Demaray's Opening Br.), 6

# Demaray's Citations Support the POM of "substrate" is "base material, including but not limited to a wafer coated with an insulator"

## Demaray's Own Presentation



### Can Be Wafer And/Or Prior Layer(s)

in the '341 application. The Er—Yb (0.8/0.8) co-doped Alumino-Silicate film was deposited onto a 6 inch wafer of substrate **16** which includes a 10 µm thick thermal oxide substrate, which can be purchased from companies such as Silicon Quest International, Santa Clara, CA. Target **12** was

Ex. 1 ('657 Pat.), 18:7-12

Substrate **16** can be a solid, smooth surface. Typically, substrate **16** can be a silicon wafer or a silicon wafer coated with a layer of silicon oxide formed by a chemical vapor deposition process or by a thermal oxidation process. Alternatively, substrate **16** can be a glass, such as Corning 1737 (Corning Inc., Elmira, N.Y.), a glass-like material, quartz, a metal, a metal oxide, or a plastic material.

Ex. 1 ('657 Pat.), 7:62-8:1

tion. In one example, substrate **16** is a silicon substrate with an undercladding layer of thermally oxidized $SiO_2$ of about 15 µm thick. Substrate **16** with the thermal oxide layer can

Ex. 1 ('657 Pat.), 18:55-57

10

Demaray's Presentation, Slide 10

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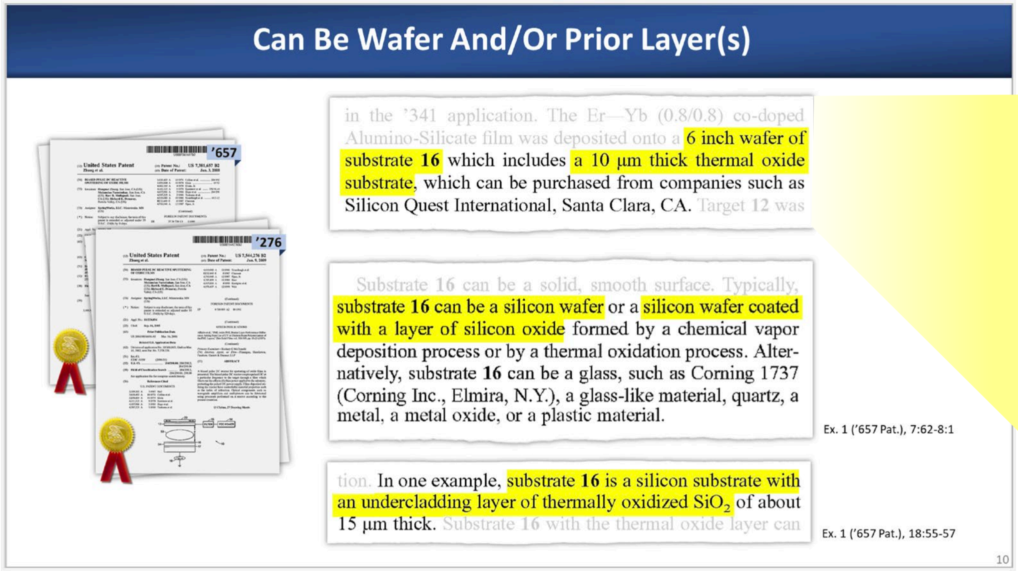

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Ex. 1 ('657 Pat.), 18:55-57

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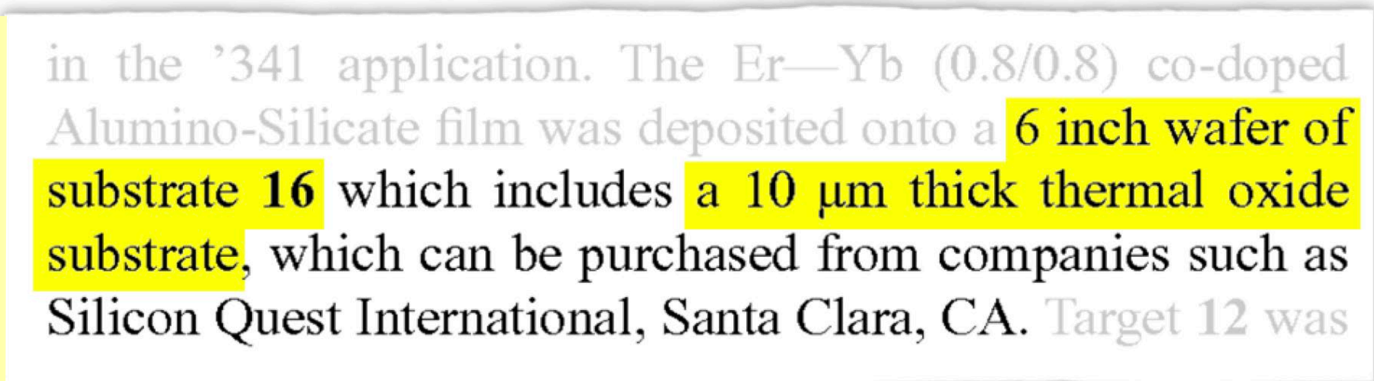
Demaray's Presentation, Slide 10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'657 Patent at 18:7-12

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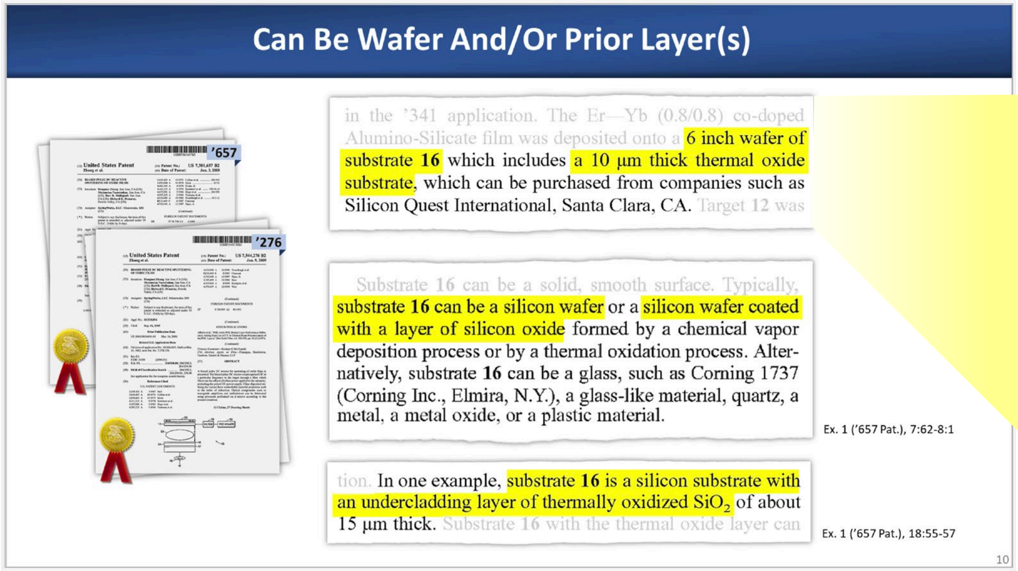

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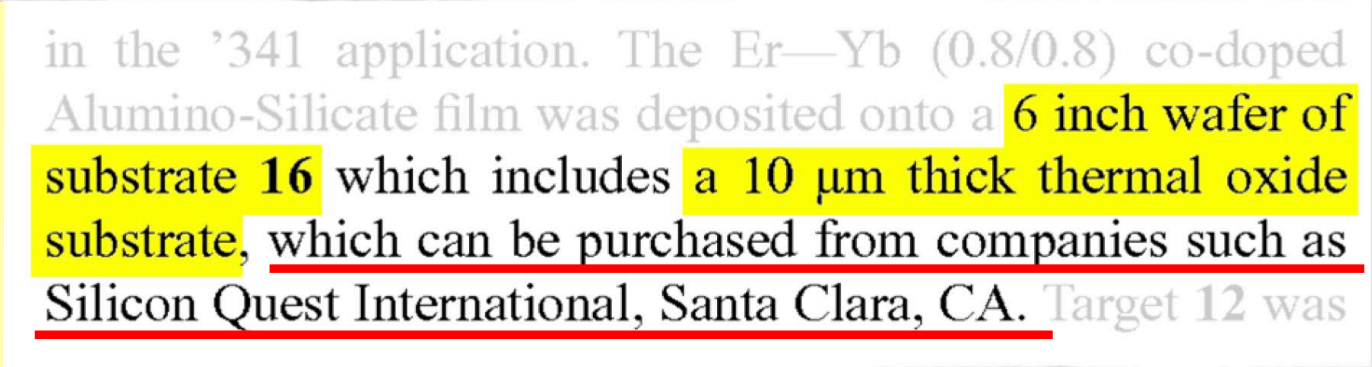
Demaray’s Presentation, Slide 10



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’657 Patent at 18:7-12

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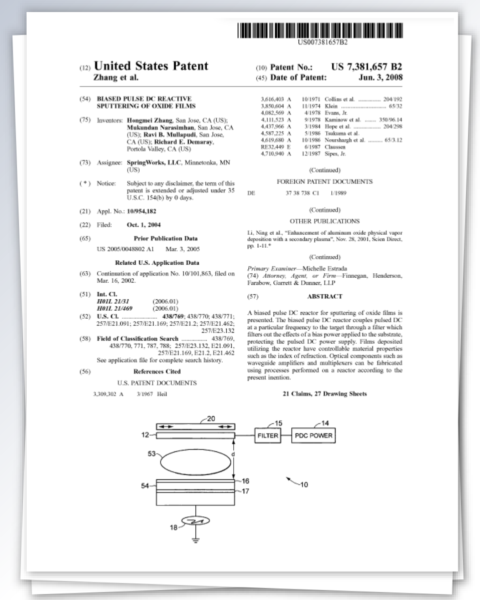
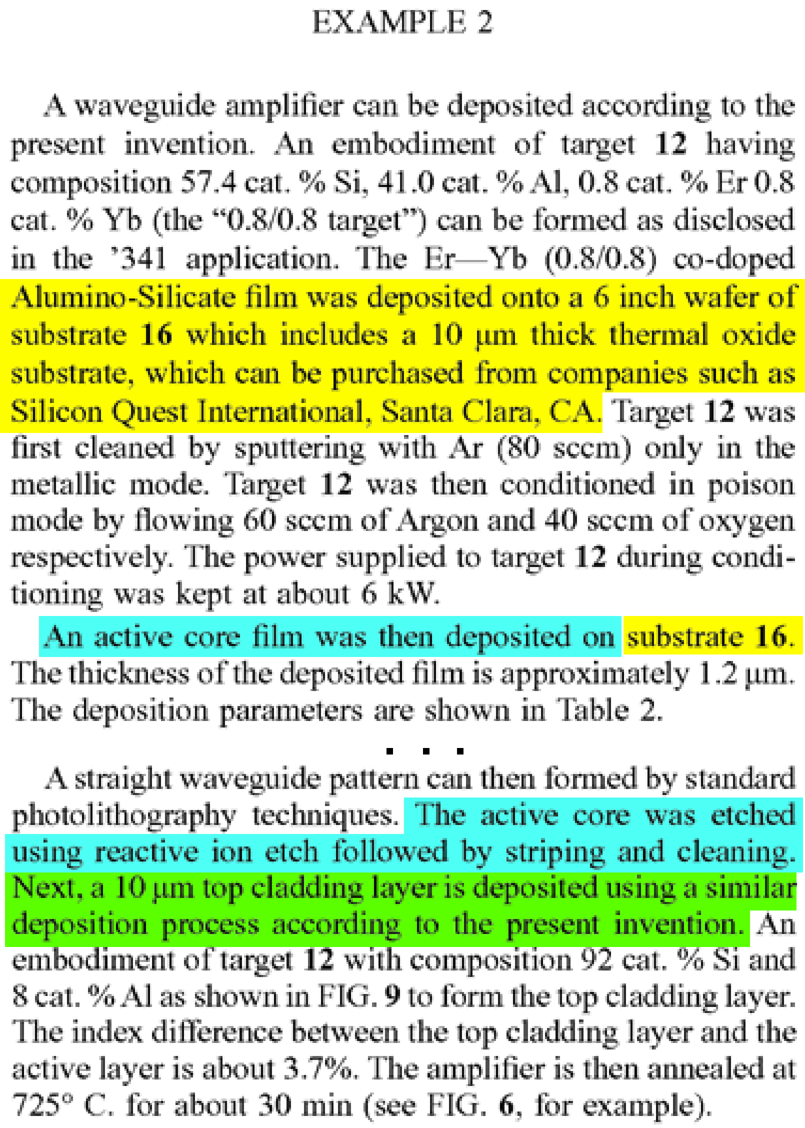




EXAMPLE 2

A waveguide amplifier can be deposited according to the present invention. An embodiment of target **12** having composition 57.4 cat. % Si, 41.0 cat. % Al, 0.8 cat. % Er 0.8 cat. % Yb (the “0.8/0.8 target”) can be formed as disclosed in the ’341 application. The Er—Yb (0.8/0.8) co-doped Alumino-Silicate film was deposited onto a 6 inch wafer of substrate **16** which includes a 10 μm thick thermal oxide substrate, which can be purchased from companies such as Silicon Quest International, Santa Clara, CA. Target **12** was first cleaned by sputtering with Ar (80 sccm) only in the metallic mode. Target **12** was then conditioned in poison mode by flowing 60 sccm of Argon and 40 sccm of oxygen respectively. The power supplied to target **12** during conditioning was kept at about 6 kW.

An active core film was then deposited on substrate **16**. The thickness of the deposited film is approximately 1.2 μm. The deposition parameters are shown in Table 2.

. . .

A straight waveguide pattern can then formed by standard photolithography techniques. The active core was etched using reactive ion etch followed by striping and cleaning. Next, a 10 μm top cladding layer is deposited using a similar deposition process according to the present invention. An embodiment of target **12** with composition 92 cat. % Si and 8 cat. % Al as shown in FIG. **9** to form the top cladding layer. The index difference between the top cladding layer and the active layer is about 3.7%. The amplifier is then annealed at 725° C. for about 30 min (see FIG. **6**, for example).

’657 Patent at 18:1:39

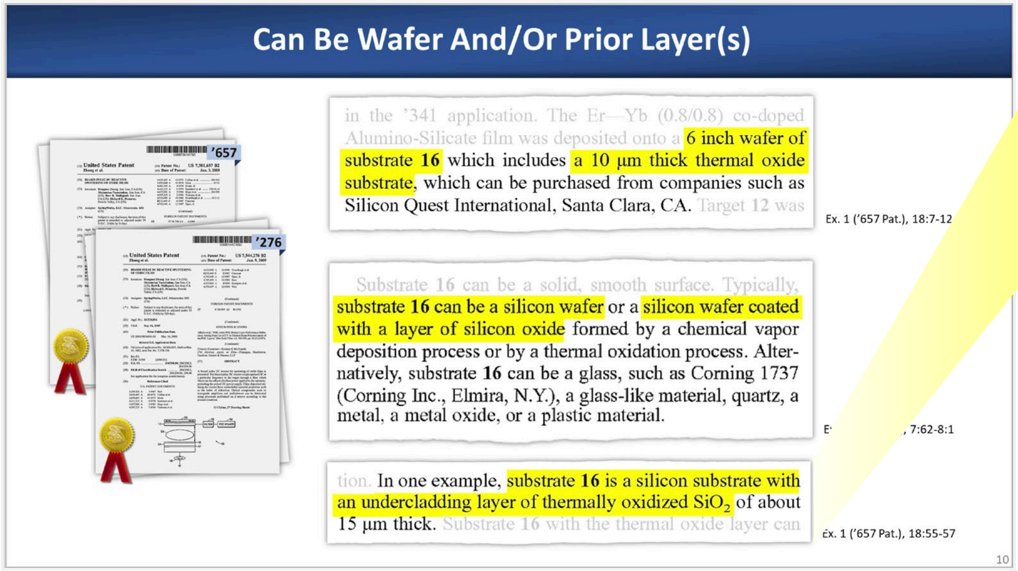
Substrate 16

Active core film deposited

Cladding layer deposited over active core film

# Demaray's Citations Support the POM of "substrate" is "base material, including but not limited to a wafer coated with an insulator"

## Demaray's Own Presentation



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Ex. 1 ('657 Pat.), 18:7-12

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Ex. 1 ('657 Pat.), 18:55-57

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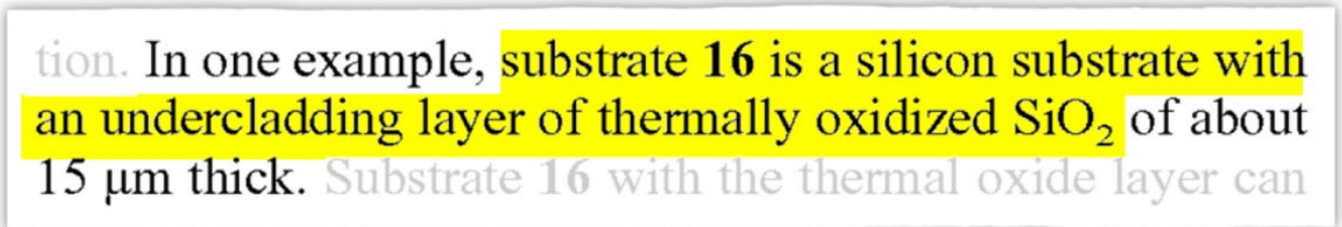
Demaray's Presentation, Slide 10



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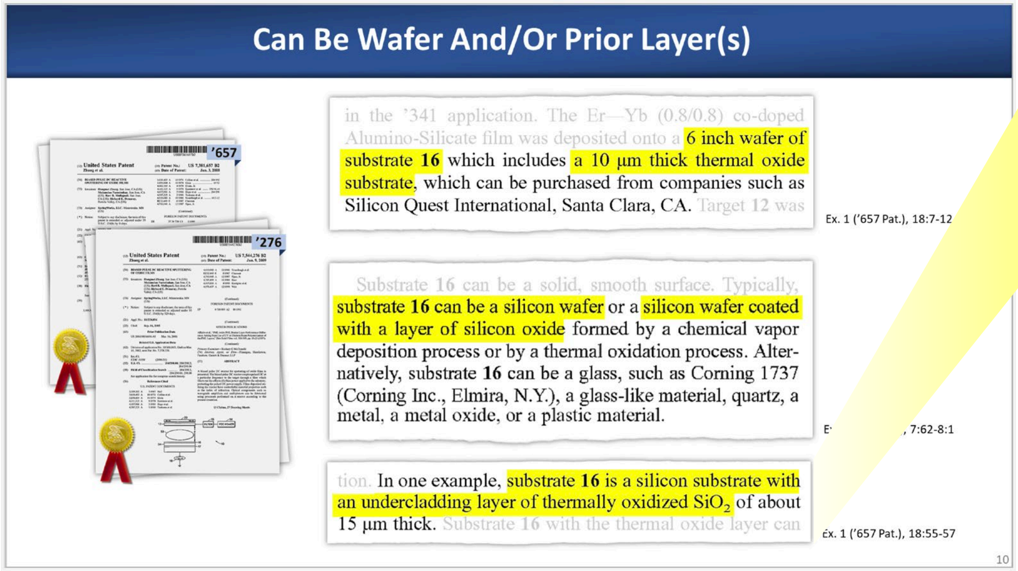
'657 Patent at 18:55-57

# Demaray’s Citations Support the POM of “substrate” is “base material, including but not limited to a wafer coated with an insulator”

## Demaray’s Own Presentation



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E , 7:62-8:1

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Ex. 1 (’657 Pat.), 18:55-57

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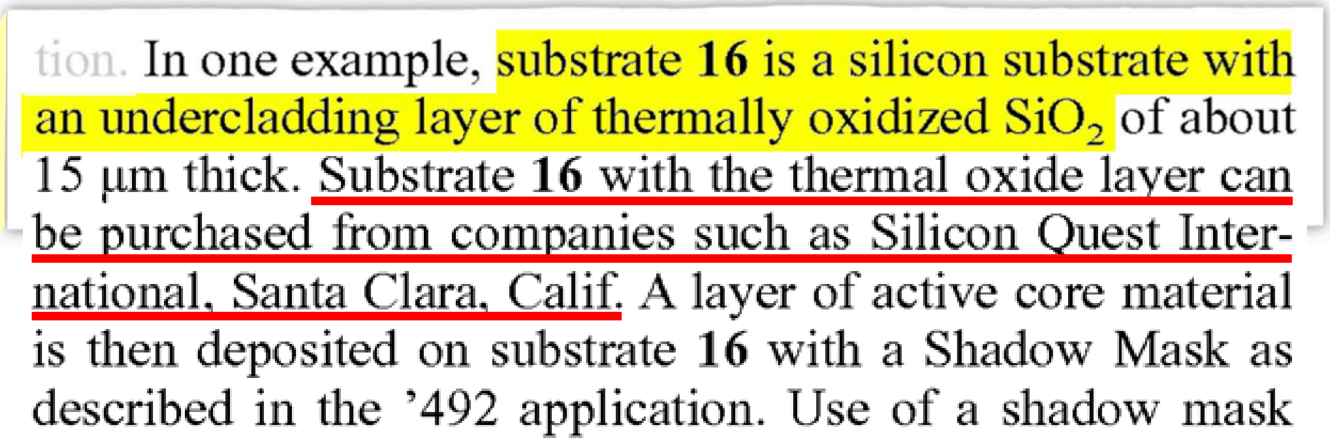
Demaray’s Presentation, Slide 10



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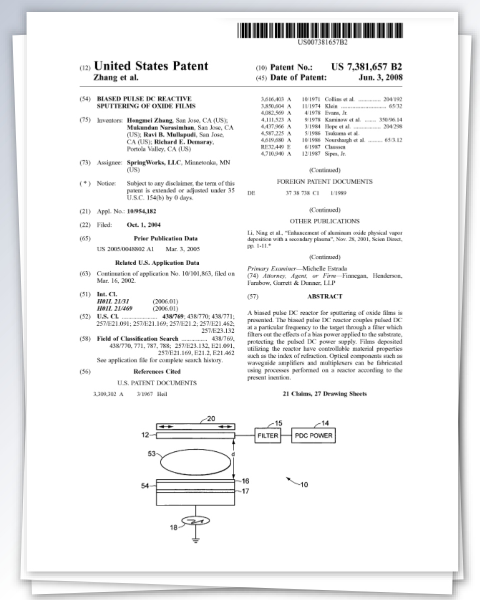
’657 Patent at 18:55-61

# Demaray's Citations Support the POM of "substrate" is "base material, including but not limited to a wafer coated with an insulator"



US007381657B2

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

(10) **Patent No.:** **US 7,381,657 B2**
(45) **Date of Patent:** **Jun. 3, 2008**

(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**

(75) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Mukundan Narasimhan**, San Jose, CA (US); **Ravi B. Mullapudi**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

(73) Assignee: **SpringWorks, LLC**, Minnetonka, MN (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/954,182**

(22) Filed: **Oct. 1, 2004**

(65) **Prior Publication Data**

US 2005/0048802 A1 Mar. 3, 2005

**Related U.S. Application Data**

(63) Continuation of application No. 10/101,863, filed on Mar. 16, 2002.

(51) **Int. Cl.**
***H01L 21/31*** (2006.01)
***H01L 21/469*** (2006.01)

(52) **U.S. Cl.** ...................... **438/769**; 438/770; 438/771; 257/E21.091; 257/E21.169; 257/E21.2; 257/E21.462; 257/E23.132

(58) **Field of Classification Search** ................ 438/769, 438/770, 771, 787, 788; 257/E23.132, E21.091, 257/E21.169, E21.2, E21.462
See application file for complete search history.

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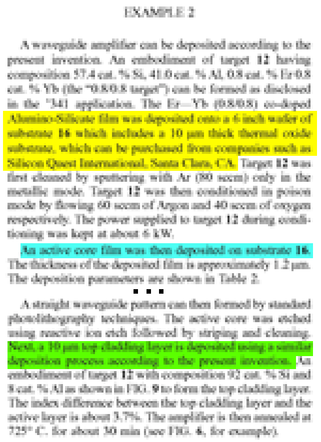
(Continued)

*Primary Examiner*—Michelle Estrada
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

(57) **ABSTRACT**

A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present inention.

**21 Claims, 27 Drawing Sheets**



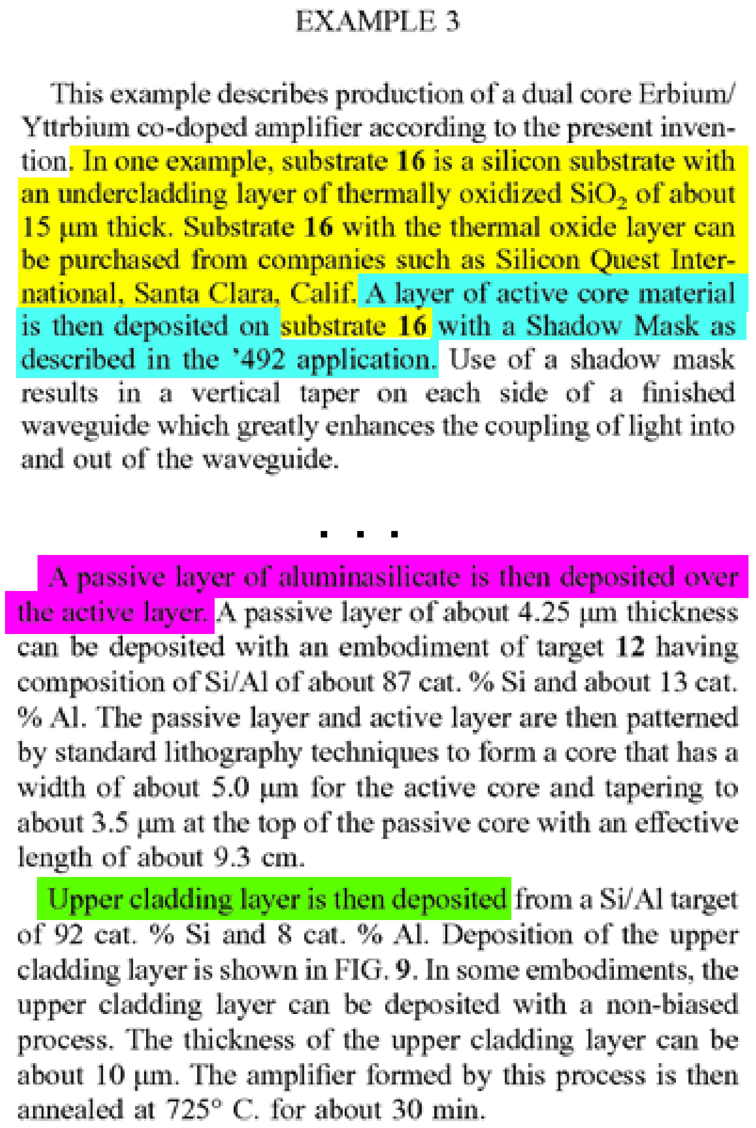
EXAMPLE 2

A waveguide amplifier can be deposited according to the present invention. An embodiment of target **12** having composition 57.4 cat. % Si, 41.0 cat. % Al, 0.8 cat. % Er 0.8 cat. % Yb (the "0.8/0.8 target") can be formed as disclosed in the '341 application. The Er—Yb (0.8/0.8) co-doped Alumino-Silicate film was deposited onto a 6 inch wafer of substrate **16** which includes a 10 μm thick thermal oxide substrate, which can be purchased from companies such as Silicon Quest International, Santa Clara, CA. Target **12** was first cleaned by sputtering with Ar (80 sccm) only in the metallic mode. Target **12** was then conditioned in poison mode by flowing 60 sccm of Argon and 40 sccm of oxygen respectively. The power supplied to target **12** during conditioning was kept at about 6 kW.

An active core film was then deposited on substrate **16**. The thickness of the deposited film is approximately 1.2 μm. The deposition parameters are shown in Table 2.

. . .

A straight waveguide pattern can then formed by standard photolithography techniques. The active core was etched using reactive ion etch followed by striping and cleaning. Next, a 10 μm top cladding layer is deposited using a similar deposition process according to the present invention. An embodiment of target **12** with composition 92 cat. % Si and 8 cat. % Al as shown in FIG. **9** to form the top cladding layer. The index difference between the top cladding layer and the active layer is about 3.7%. The amplifier is then annealed at 725° C. for about 30 min (see FIG. **6**, for example).



EXAMPLE 3

This example describes production of a dual core Erbium/Yttrium co-doped amplifier according to the present invention. In one example, substrate **16** is a silicon substrate with an undercladding layer of thermally oxidized $SiO_2$ of about 15 μm thick. Substrate **16** with the thermal oxide layer can be purchased from companies such as Silicon Quest International, Santa Clara, Calif. A layer of active core material is then deposited on substrate **16** with a Shadow Mask as described in the '492 application. Use of a shadow mask results in a vertical taper on each side of a finished waveguide which greatly enhances the coupling of light into and out of the waveguide.

. . .

A passive layer of aluminasilicate is then deposited over the active layer. A passive layer of about 4.25 μm thickness can be deposited with an embodiment of target **12** having composition of Si/Al of about 87 cat. % Si and about 13 cat. % Al. The passive layer and active layer are then patterned by standard lithography techniques to form a core that has a width of about 5.0 μm for the active core and tapering to about 3.5 μm at the top of the passive core with an effective length of about 9.3 cm.

Upper cladding layer is then deposited from a Si/Al target of 92 cat. % Si and 8 cat. % Al. Deposition of the upper cladding layer is shown in FIG. **9**. In some embodiments, the upper cladding layer can be deposited with a non-biased process. The thickness of the upper cladding layer can be about 10 μm. The amplifier formed by this process is then annealed at 725° C. for about 30 min.

'657 Patent at 18:50–19:21

Substrate 16

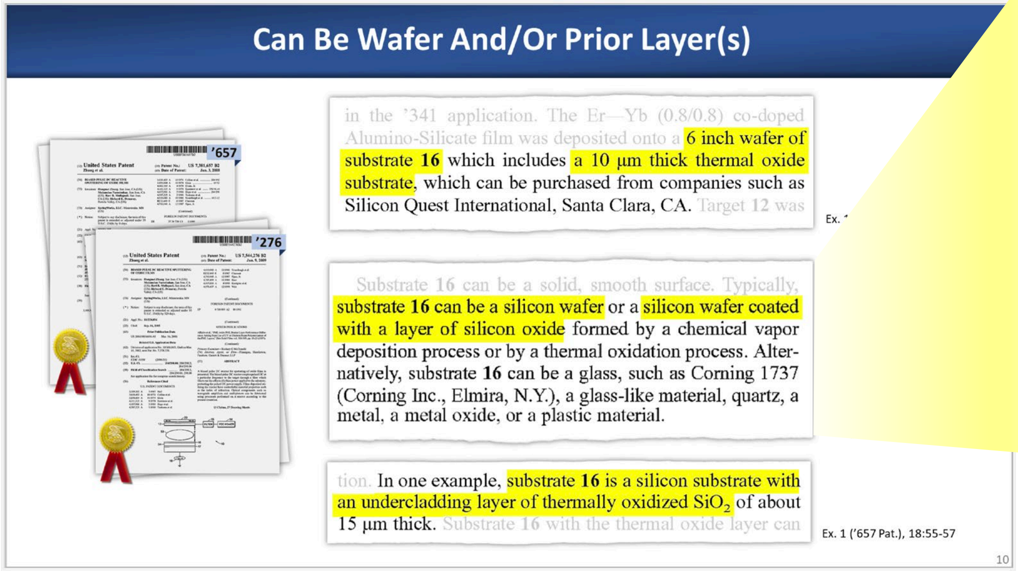
Active layer deposited on substrate 16

Passive layer deposited over active layer

Upper cladding layer deposited over passive layer

# Demaray’s Citations Support the POM of “substrate” is “base material, including but not limited to a wafer coated with an insulator”

## Demaray’s Own Presentation



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Ex. 1 (’657 Pat.), 18:55-57

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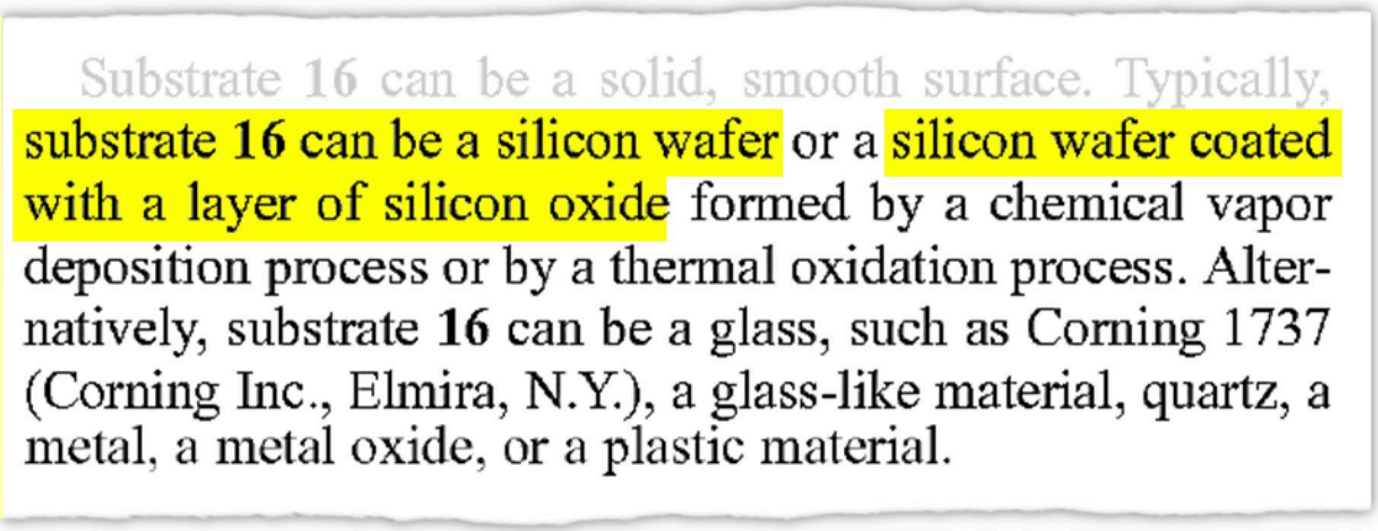
Demaray’s Presentation, Slide 10



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’657 Patent at 7:62-8:1

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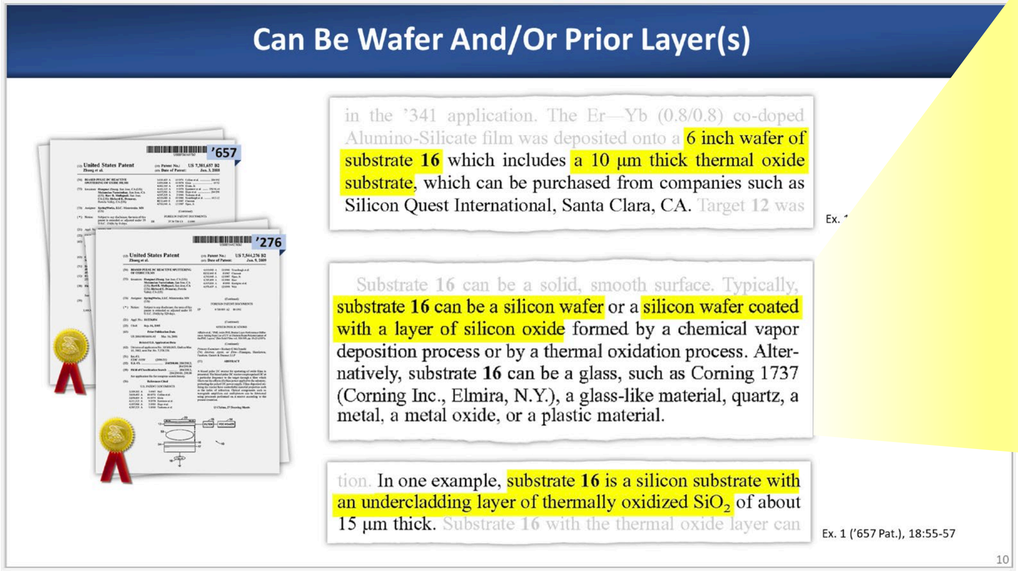
## Demaray's Own Presentation



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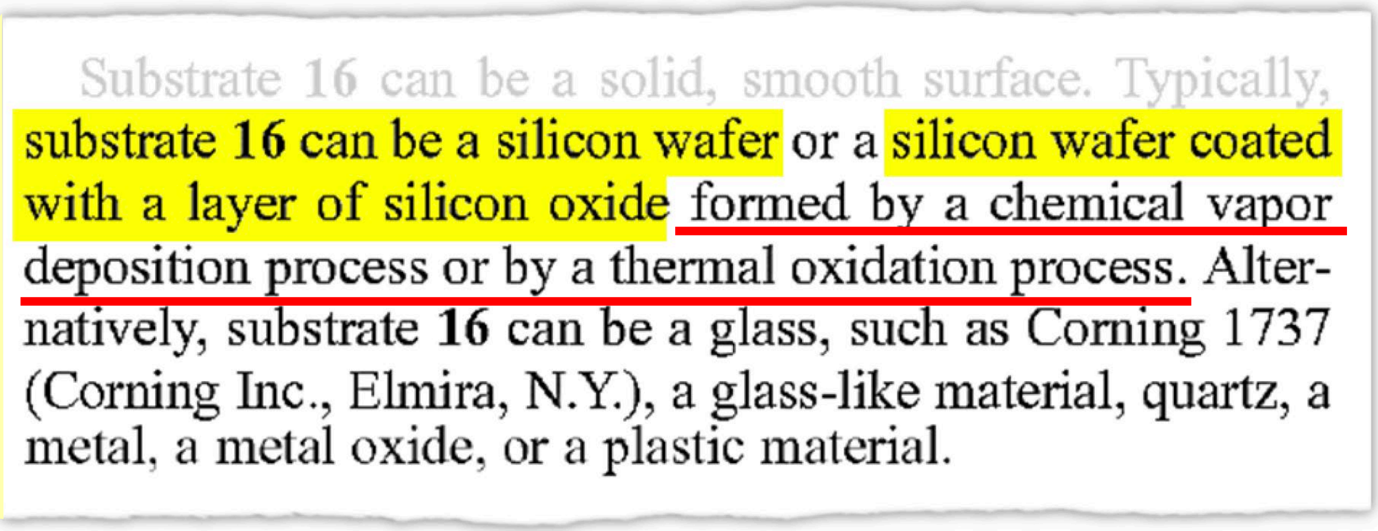
Demaray's Presentation, Slide 10



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'657 Patent at 7:62-8:1

# Demaray’s Citations Support the POM of “substrate” is “base material, including but not limited to a wafer coated with an insulator”

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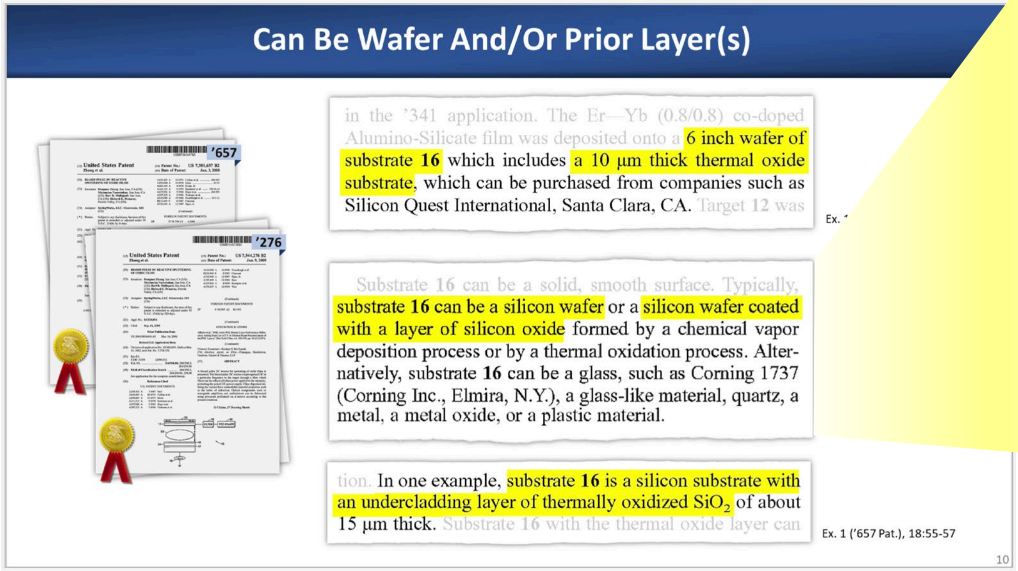

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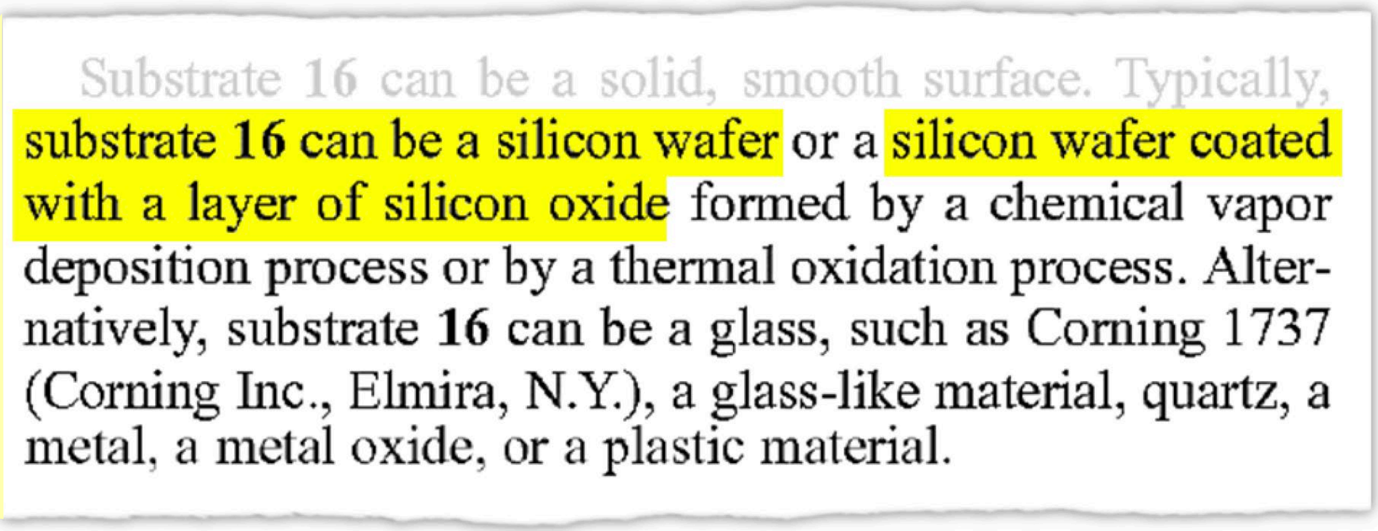
Demaray’s Presentation, Slide 10



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’657 Patent at 7:62-8:1

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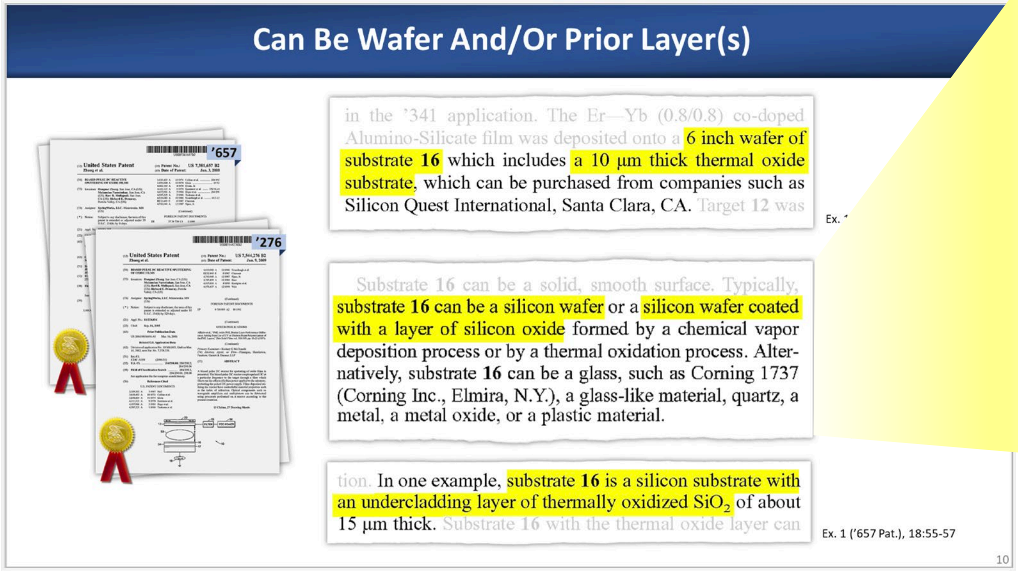

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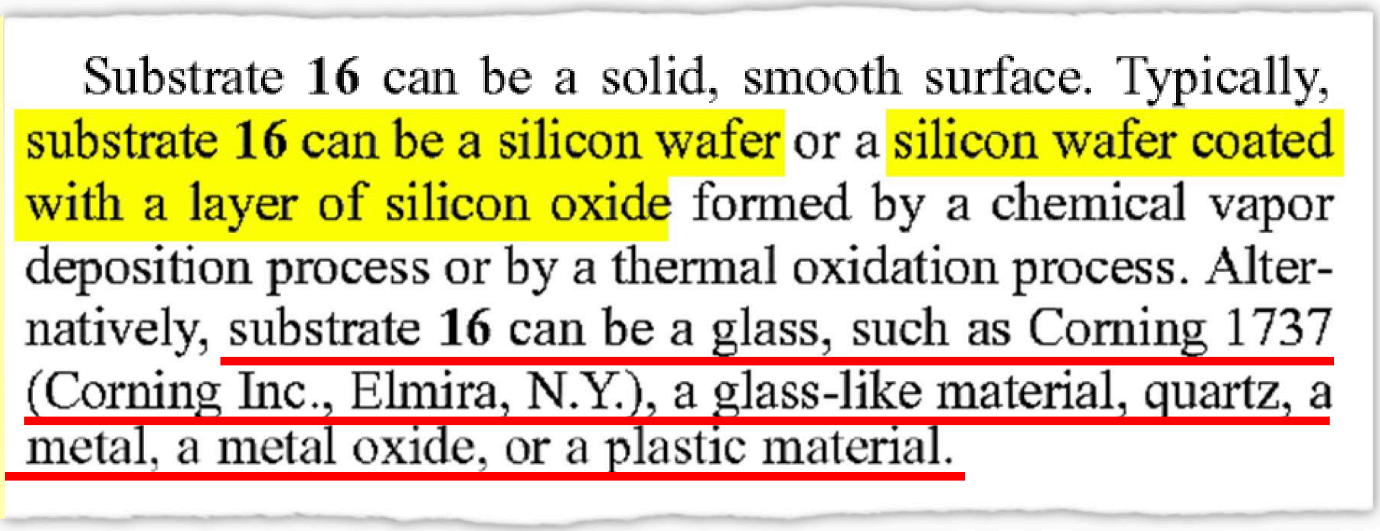
Demaray's Presentation, Slide 10



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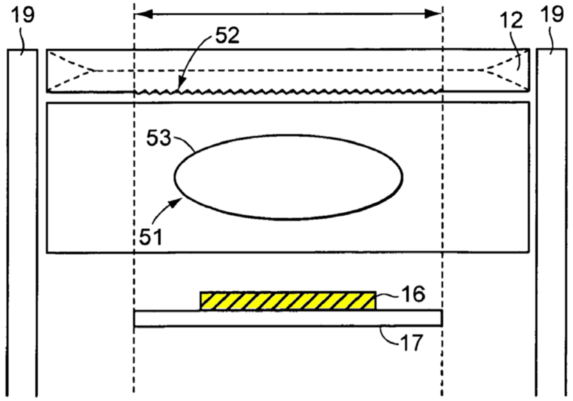
'657 Patent at 7:62-8:1

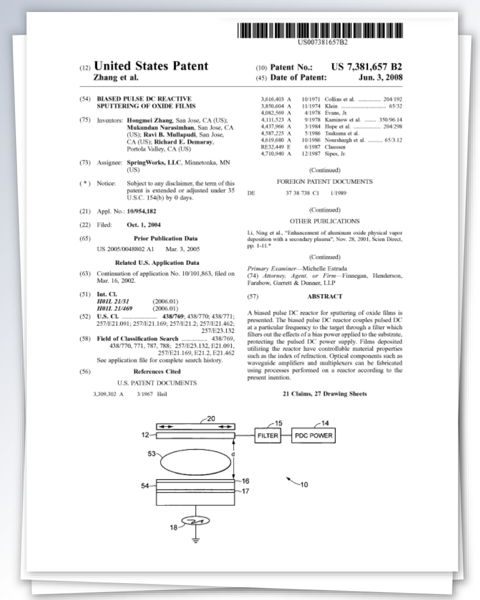
Sputtering Reactor



12. target
16. substrate
17. carrier sheet
19. ground shield
51. region
52. central target region
53. plasma

'657 Patent, Fig. 1B

# The Specification Confirms "substrate" is the "base material, including but not limited to a wafer coated with an insulator"



US007381657B2

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

(10) **Patent No.:** **US 7,381,657 B2**
(45) **Date of Patent:** **Jun. 3, 2008**

(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**

(75) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Mukundan Narasimhan**, San Jose, CA (US); **Ravi B. Mullapudi**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

(73) Assignee: **SpringWorks, LLC**, Minnetonka, MN (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/954,182**

(22) Filed: **Oct. 1, 2004**

(65) **Prior Publication Data**

US 2005/0048802 A1 Mar. 3, 2005

**Related U.S. Application Data**

(63) Continuation of application No. 10/101,863, filed on Mar. 16, 2002.

(51) **Int. Cl.**
***H01L 21/31*** (2006.01)
***H01L 21/469*** (2006.01)

(52) **U.S. Cl.** .................... **438/769**; 438/770; 438/771; 257/E21.091; 257/E21.169; 257/E21.2; 257/E21.462; 257/E23.132

(58) **Field of Classification Search** ............... 438/769, 438/770, 771, 787, 788; 257/E23.132, E21.091, 257/E21.169, E21.2, E21.462
See application file for complete search history.

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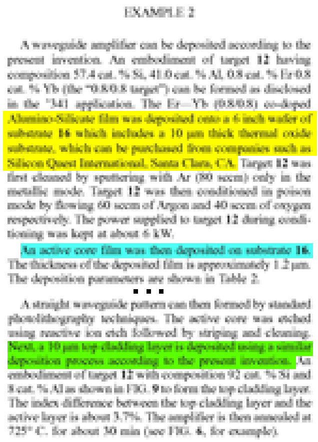
(Continued)

*Primary Examiner*—Michelle Estrada
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

(57) **ABSTRACT**

A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present inention.

**21 Claims, 27 Drawing Sheets**



EXAMPLE 2

A waveguide amplifier can be deposited according to the present invention. An embodiment of target **12** having composition 57.4 cat. % Si, 41.0 cat. % Al, 0.8 cat. % Er 0.8 cat. % Yb (the "0.8/0.8 target") can be formed as disclosed in the '341 application. The Er—Yb (0.8/0.8) co-doped Alumino-Silicate film was deposited onto a 6 inch wafer of substrate **16** which includes a 10 μm thick thermal oxide substrate, which can be purchased from companies such as Silicon Quest International, Santa Clara, CA. Target **12** was first cleaned by sputtering with Ar (80 sccm) only in the metallic mode. Target **12** was then conditioned in poison mode by flowing 60 sccm of Argon and 40 sccm of oxygen respectively. The power supplied to target **12** during conditioning was kept at about 6 kW.

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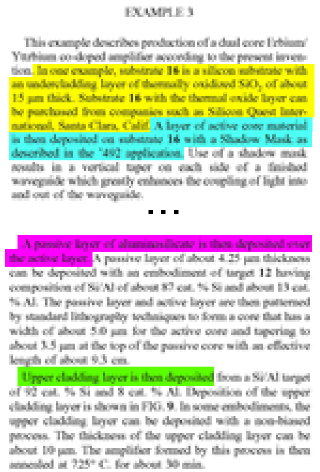
. . .

A straight waveguide pattern can then formed by standard photolithography techniques. The active core was etched using reactive ion etch followed by striping and cleaning. Next, a 10 μm top cladding layer is deposited using a similar deposition process according to the present invention. An embodiment of target **12** with composition 92 cat. % Si and 8 cat. % Al as shown in FIG. **9** to form the top cladding layer. The index difference between the top cladding layer and the active layer is about 3.7%. The amplifier is then annealed at 725° C. for about 30 min (see FIG. **6**, for example).



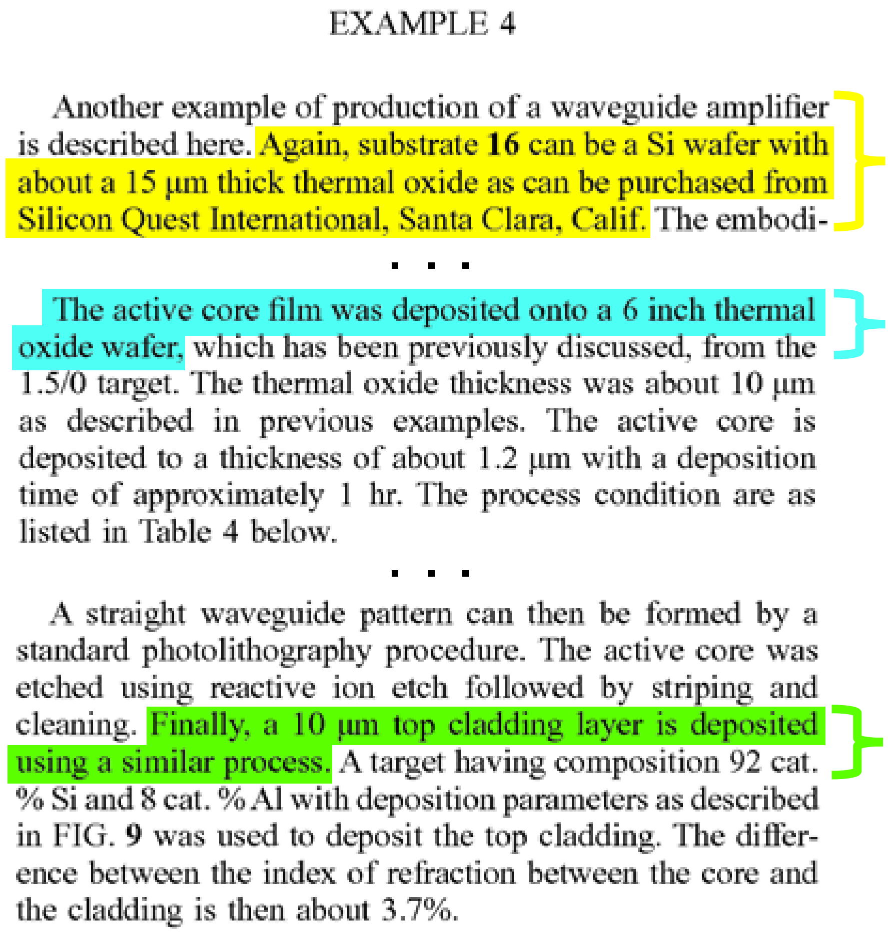
EXAMPLE 3

This example describes production of a dual core Erbium/Ytterbium co-doped amplifier according to the present invention. In one example, substrate **16** is a silicon substrate with an undercladding layer of thermally oxidized $SiO_2$ of about 15 μm thick. Substrate **16** with the thermal oxide layer can be purchased from companies such as Silicon Quest International, Santa Clara, Calif. A layer of active core material is then deposited on substrate **16** with a Shadow Mask as described in the '492 application. Use of a shadow mask results in a vertical taper on each side of a finished waveguide which greatly enhances the coupling of light into and out of the waveguide.

. . .

A passive layer of aluminasilicate is then deposited over the active layer. A passive layer of about 4.25 μm thickness can be deposited with an embodiment of target **12** having composition of Si/Al of about 87 cat. % Si and about 13 cat. % Al. The passive layer and active layer are then patterned by standard lithography techniques to form a core that has a width of about 5.0 μm for the active core and tapering to about 3.5 μm at the top of the passive core with an effective length of about 9.3 cm.

Upper cladding layer is then deposited from a Si/Al target of 92 cat. % Si and 8 cat. % Al. Deposition of the upper cladding layer is shown in FIG. **9**. In some embodiments, the upper cladding layer can be deposited with a non-biased process. The thickness of the upper cladding layer can be about 10 μm. The amplifier formed by this process is then annealed at 725° C. for about 30 min.



EXAMPLE 4

Another example of production of a waveguide amplifier is described here. Again, substrate **16** can be a Si wafer with about a 15 μm thick thermal oxide as can be purchased from Silicon Quest International, Santa Clara, Calif. The embodi-

. . .

The active core film was deposited onto a 6 inch thermal oxide wafer, which has been previously discussed, from the 1.5/0 target. The thermal oxide thickness was about 10 μm as described in previous examples. The active core is deposited to a thickness of about 1.2 μm with a deposition time of approximately 1 hr. The process condition are as listed in Table 4 below.

. . .

A straight waveguide pattern can then be formed by a standard photolithography procedure. The active core was etched using reactive ion etch followed by striping and cleaning. Finally, a 10 μm top cladding layer is deposited using a similar process. A target having composition 92 cat. % Si and 8 cat. % Al with deposition parameters as described in FIG. **9** was used to deposit the top cladding. The difference between the index of refraction between the core and the cladding is then about 3.7%.

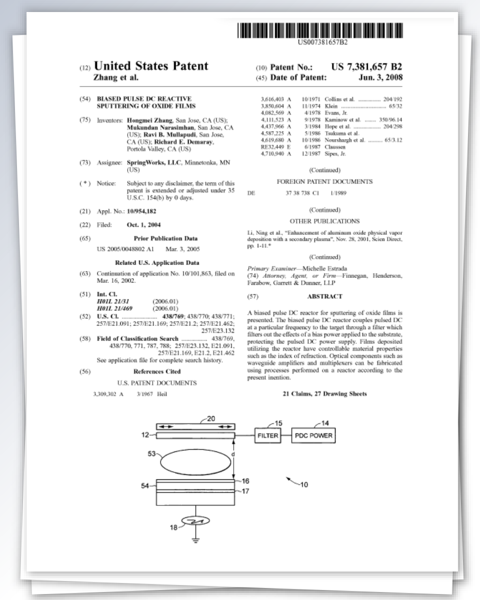
'657 Patent at 19:39–20:17

Substrate 16

Active core film deposited

Cladding film deposited over core film

# The Specification Confirms "substrate" is the "base material, including but not limited to a wafer coated with an insulator"



US007381657B2

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

(10) **Patent No.:** **US 7,381,657 B2**
(45) **Date of Patent:** **Jun. 3, 2008**

(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**

(75) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Mukundan Narasimhan**, San Jose, CA (US); **Ravi B. Mullapudi**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

(73) Assignee: **SpringWorks, LLC**, Minnetonka, MN (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/954,182**

(22) Filed: **Oct. 1, 2004**

(65) **Prior Publication Data**

US 2005/0048802 A1 Mar. 3, 2005

**Related U.S. Application Data**

(63) Continuation of application No. 10/101,863, filed on Mar. 16, 2002.

(51) **Int. Cl.**
*H01L 21/31* (2006.01)
*H01L 21/469* (2006.01)

(52) **U.S. Cl.** ...................... **438/769**; 438/770; 438/771; 257/E21.091; 257/E21.169; 257/E21.2; 257/E21.462; 257/E23.132

(58) **Field of Classification Search** ............... 438/769, 438/770, 771, 787, 788; 257/E23.132, E21.091, 257/E21.169, E21.2, E21.462
See application file for complete search history.

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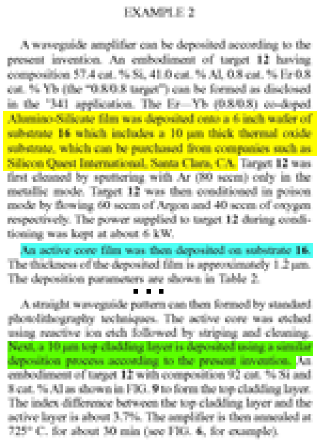
(Continued)

*Primary Examiner*—Michelle Estrada
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

(57) **ABSTRACT**

A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present inention.

**21 Claims, 27 Drawing Sheets**



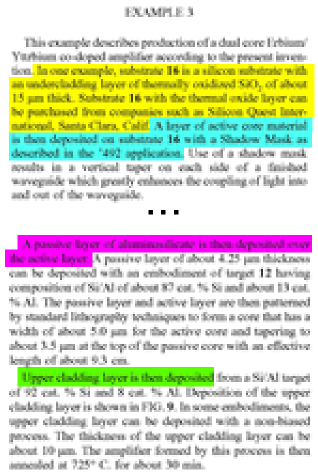
EXAMPLE 2

A waveguide amplifier can be deposited according to the present invention. An embodiment of target **12** having composition 57.4 cat. % Si, 41.0 cat. % Al, 0.8 cat. % Er 0.8 cat. % Yb (the "0.8/0.8 target") can be formed as disclosed in the '341 application. The Er—Yb (0.8/0.8) co-doped Alumino-Silicate film was deposited onto a 6 inch wafer of substrate **16** which includes a 10 μm thick thermal oxide substrate, which can be purchased from companies such as Silicon Quest International, Santa Clara, CA. Target **12** was first cleaned by sputtering with Ar (80 sccm) only in the metallic mode. Target **12** was then conditioned in poison mode by flowing 60 sccm of Argon and 40 sccm of oxygen respectively. The power supplied to target **12** during conditioning was kept at about 6 KW.

An active core film was then deposited on substrate **16**. The thickness of the deposited film is approximately 1.2 μm. The deposition parameters are shown in Table 2.

. . .

A straight waveguide pattern can then formed by standard photolithography techniques. The active core was etched using reactive ion etch followed by striping and cleaning. Next, a 10 μm top cladding layer is deposited using a similar deposition process according to the present invention. An embodiment of target **12** with composition 92 cat. % Si and 8 cat. % Al as shown in FIG. **9** to form the top cladding layer. The index difference between the top cladding layer and the active layer is about 3.7%. The amplifier is then annealed at 725° C. for about 30 min (see FIG. **6**, for example).



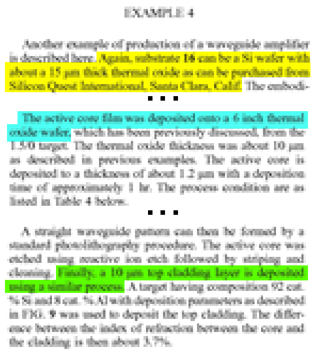
EXAMPLE 3

This example describes production of a dual core Erbium/Ytterbium co-doped amplifier according to the present invention. In one example, substrate **16** is a silicon substrate with an undercladding layer of thermally oxidized $SiO_2$ of about 15 μm thick. Substrate **16** with the thermal oxide layer can be purchased from companies such as Silicon Quest International, Santa Clara, Calif. A layer of active core material is then deposited on substrate **16** with a Shadow Mask as described in the '492 application. Use of a shadow mask results in a vertical taper on each side of a finished waveguide which greatly enhances the coupling of light into and out of the waveguide.

. . .

A passive layer of aluminasilicate is then deposited over the active layer. A passive layer of about 4.25 μm thickness can be deposited with an embodiment of target **12** having composition of Si/Al of about 87 cat. % Si and about 13 cat. % Al. The passive layer and active layer are then patterned by standard lithography techniques to form a core that has a width of about 5.0 μm for the active core and tapering to about 3.5 μm at the top of the passive core with an effective length of about 9.3 cm.

Upper cladding layer is then deposited from a Si/Al target of 92 cat. % Si and 8 cat. % Al. Deposition of the upper cladding layer is shown in FIG. **9**. In some embodiments, the upper cladding layer can be deposited with a non-biased process. The thickness of the upper cladding layer can be about 10 μm. The amplifier formed by this process is then annealed at 725° C. for about 30 min.



EXAMPLE 4

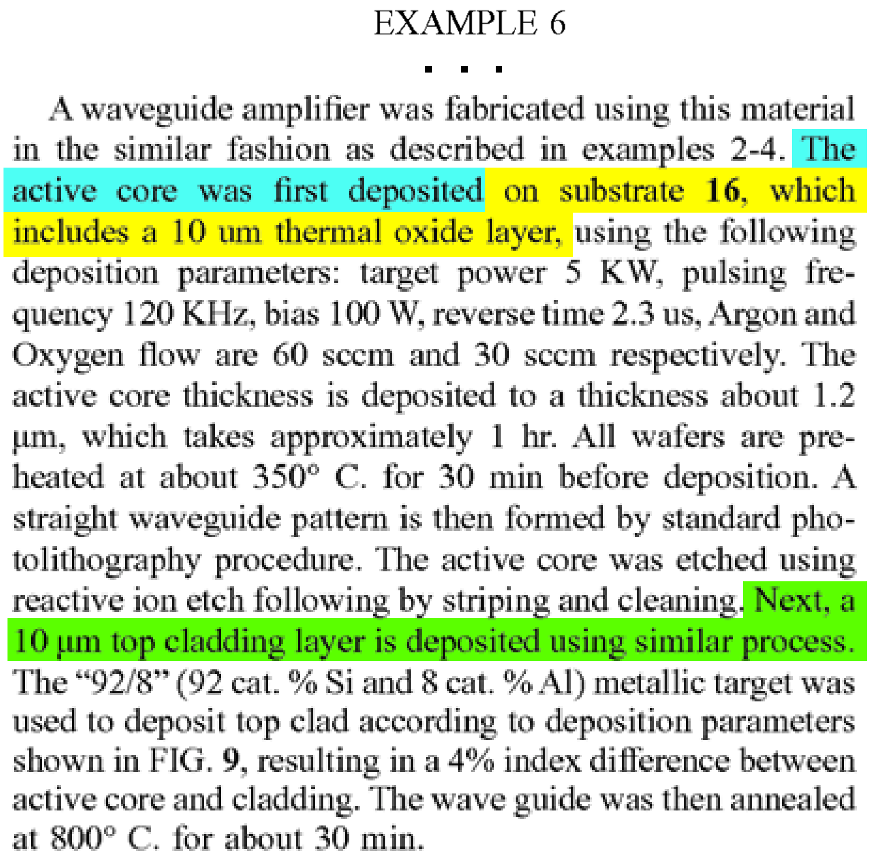
Another example of production of a waveguide amplifier is described here. Again, substrate **16** can be a Si wafer with about a 15 μm thick thermal oxide as can be purchased from Silicon Quest International, Santa Clara, Calif. The embodi-

. . .

The active core film was deposited onto a 6 inch thermal oxide wafer, which has been previously discussed, from the 1.5/0 target. The thermal oxide thickness was about 10 μm as described in previous examples. The active core is deposited to a thickness of about 1.2 μm with a deposition time of approximately 1 hr. The process condition are as listed in Table 4 below.

. . .

A straight waveguide pattern can then be formed by a standard photolithography procedure. The active core was etched using reactive ion etch followed by striping and cleaning. Finally, a 10 μm top cladding layer is deposited using a similar process. A target having composition 92 cat. % Si and 8 cat. % Al with deposition parameters as described in FIG. **9** was used to deposit the top cladding. The difference between the index of refraction between the core and the cladding is then about 3.7%.



EXAMPLE 6

. . .

A waveguide amplifier was fabricated using this material in the similar fashion as described in examples 2-4. The active core was first deposited on substrate **16**, which includes a 10 um thermal oxide layer, using the following deposition parameters: target power 5 KW, pulsing frequency 120 KHz, bias 100 W, reverse time 2.3 us, Argon and Oxygen flow are 60 sccm and 30 sccm respectively. The active core thickness is deposited to a thickness about 1.2 μm, which takes approximately 1 hr. All wafers are preheated at about 350° C. for 30 min before deposition. A straight waveguide pattern is then formed by standard photolithography procedure. The active core was etched using reactive ion etch following by striping and cleaning. Next, a 10 μm top cladding layer is deposited using similar process. The "92/8" (92 cat. % Si and 8 cat. % Al) metallic target was used to deposit top clad according to deposition parameters shown in FIG. **9**, resulting in a 4% index difference between active core and cladding. The wave guide was then annealed at 800° C. for about 30 min.

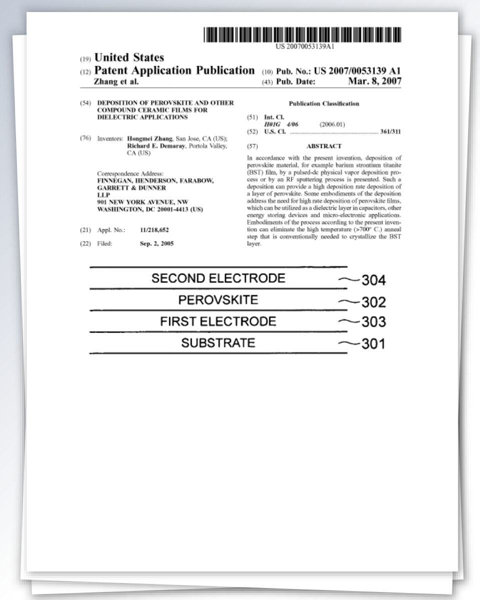
'657 Patent at 20:62–21:55

Substrate 16

Active core deposited

Cladding layer deposited over active core

# Intrinsic Evidence Confirms "substrate" is the "base material, including but not limited to a wafer coated with an insulator"



US 20070053139A1

(19) **United States**
(12) **Patent Application Publication**
**Zhang et al.**

(10) **Pub. No.: US 2007/0053139 A1**
(43) **Pub. Date: Mar. 8, 2007**

(54) **DEPOSITION OF PEROVSKITE AND OTHER COMPOUND CERAMIC FILMS FOR DIELECTRIC APPLICATIONS**

(76) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

Correspondence Address:
**FINNEGAN, HENDERSON, FARABOW,**
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(21) Appl. No.: **11/218,652**

(22) Filed: **Sep. 2, 2005**

**Publication Classification**

(51) **Int. Cl.**
*H01G 4/06* (2006.01)
(52) **U.S. Cl.** .......... **361/311**

(57) **ABSTRACT**

In accordance with the present invention, deposition of perovskite material, for example barium strontium titanite (BST) film, by a pulsed-dc physical vapor deposition process or by an RF sputtering process is presented. Such a deposition can provide a high deposition rate deposition of a layer of perovskite. Some embodiments of the deposition address the need for high rate deposition of perovskite films, which can be utilized as a dielectric layer in capacitors, other energy storing devices and micro-electronic applications. Embodiments of the process according to the present invention can eliminate the high temperature (>700° C.) anneal step that is conventionally needed to crystallize the BST layer.

## Named Inventors' Other Patent Publication

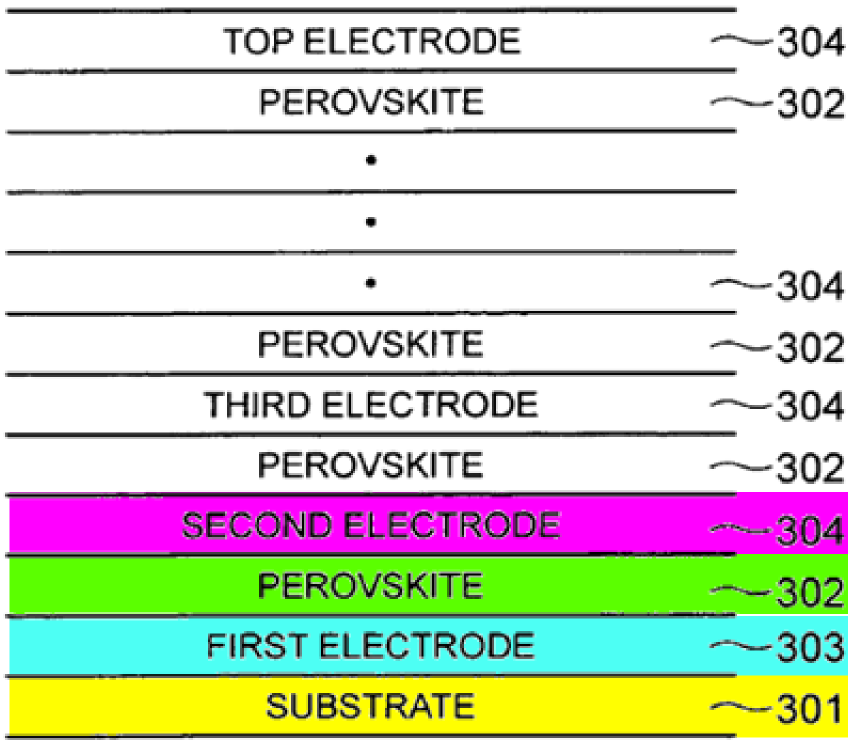
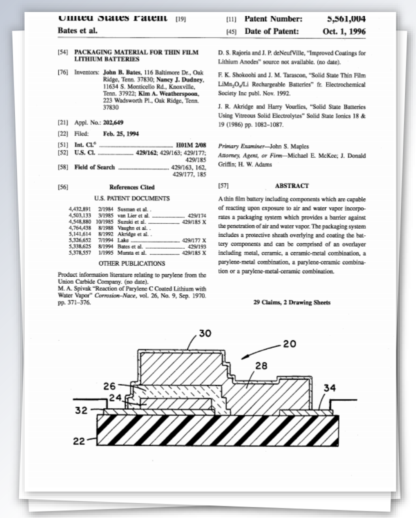


FIG. 6

[0062] FIG. 6A illustrates a parallel coupled stacking. As shown in FIG. 6A, a substrate **301**, which for example can be a high temperature plastic substrate, such as polyimide, is loaded into load lock **503**. Electrode layer **303**, for example, can be deposited in chamber **504**. A dielectric perovskite layer **302** is then deposited on electrode layer **303**. Perovskite layer **302** can be about 0.1 to 1 μm and can be deposited in chamber **505** according to embodiments of the present invention. The wafer can then be moved to chamber **506** where the next electrode layer **304** of thickness of about 0.1 μm or more is deposited. A second capacitor stack can then be deposited over the first capacitor stack formed by first electrode layer **303**, perovskite layer **302**, and second electrode layer **304**. This capacitor stack includes second perovskite layer **305** and third electrode layer **306**. In some

U.S. Patent Publ'n No. 2007/0053139, [0062], Fig. 6
(cited on face of Asserted Patents)

# Intrinsic Evidence Confirms "substrate" is the "base material, including but not limited to a wafer coated with an insulator"



United States Patent [19] [11] Patent Number: 5,561,004
Bates et al. [45] Date of Patent: Oct. 1, 1996

[54] PACKAGING MATERIAL FOR THIN FILM LITHIUM BATTERIES

[76] Inventors: **John B. Bates**, 116 Baltimore Dr., Oak Ridge, Tenn. 37830; **Nancy J. Dudney**, 11634 S. Monticello Rd., Knoxville, Tenn. 37922; **Kim A. Weatherspoon**, 223 Wadsworth Pl., Oak Ridge, Tenn. 37830

[21] Appl. No.: **202,649**

[22] Filed: **Feb. 25, 1994**

[51] **Int. Cl.**$^6$ .......... **H01M 2/08**
[52] **U.S. Cl.** .......... **429/162**; 429/163; 429/177; 429/185
[58] **Field of Search** .......... 429/163, 162, 429/177, 185

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J. R. Akridge and Harry Vourlies, "Solid State Batteries Using Vitreous Solid Electrolytes" Solid State Ionics 18 & 19 (1986) pp. 1082–1087.

*Primary Examiner*—John S. Maples
*Attorney, Agent, or Firm*—Michael E. McKee; J. Donald Griffin; H. W. Adams

[57] **ABSTRACT**

A thin film battery including components which are capable of reacting upon exposure to air and water vapor incorporates a packaging system which provides a barrier against the penetration of air and water vapor. The packaging system includes a protective sheath overlying and coating the battery components and can be comprised of an overlayer including metal, ceramic, a ceramic-metal combination, a parylene-metal combination, a parylene-ceramic combination or a parylene-metal-ceramic combination.

**29 Claims, 2 Drawing Sheets**

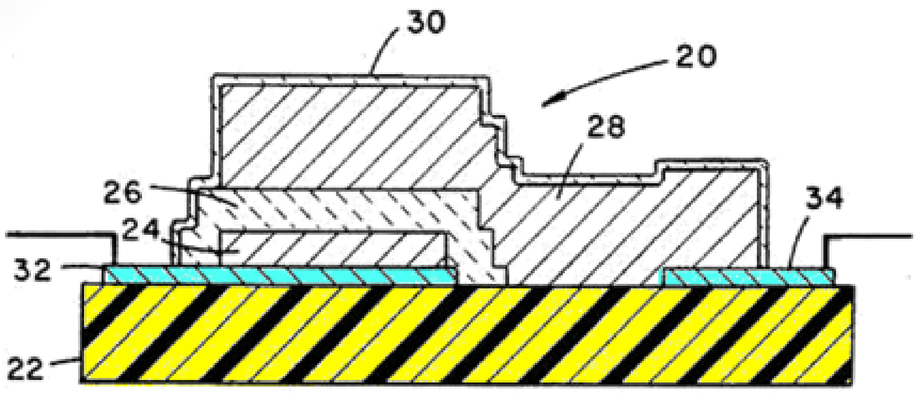
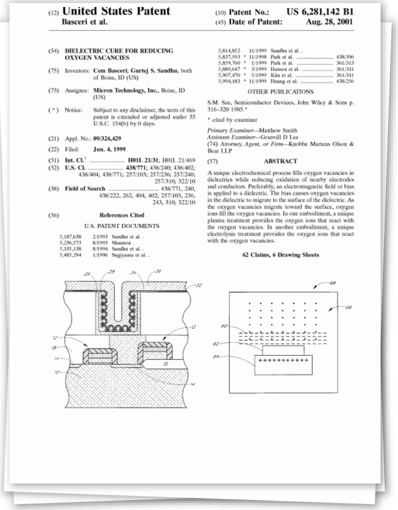


Fig. 1

The substrate 22 underlying the battery 20 may be comprised of glass, alumina, sapphire or various semiconductor or polymer materials. To enable electrical power to be withdrawn from the battery 20, two current collector films 32 and 34 are deposited upon the substrate 22, and then the cathode film 24 is deposited upon the collector 32. The current collector films 32 and 34 of the depicted battery 20 are separated from one another as shown in FIG. 1, and the first collector film 32 is slightly larger in area (when viewed in plan) than that of the second collector 34.

U.S. Pat. 5,561,004 at 2:5-14, Fig. 1
(cited on face of Asserted Patents)



(12) United States Patent (10) Patent No.: US 6,281,142 B1
Basceri et al. (45) Date of Patent: Aug. 28, 2001

(54) DIELECTRIC CURE FOR REDUCING OXYGEN VACANCIES

(75) Inventors: **Cem Basceri**; **Gurtej S. Sandhu**, both of Boise, ID (US)

(73) Assignee: **Micron Technology, Inc.**, Boise, ID (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/326,429**

(22) Filed: **Jun. 4, 1999**

(51) **Int. Cl.**$^7$ .......... **H01L 21/31**; H01L 21/469
(52) **U.S. Cl.** .......... **438/771**; 438/240; 438/402; 438/404; 438/771; 257/103; 257/236; 257/240; 257/310; 322/10
(58) **Field of Search** .......... 438/771, 240, 438/222, 262, 404, 402; 257/103, 236, 243, 310; 322/10

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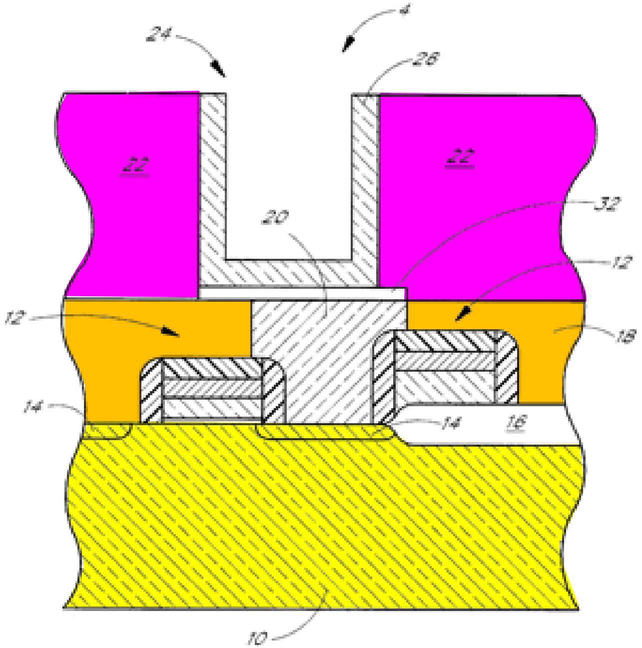
* cited by examiner

*Primary Examiner*—Matthew Smith
*Assistant Examiner*—Granvill D Lee
(74) *Attorney, Agent, or Firm*—Knobbe Martens Olson & Bear LLP

(57) **ABSTRACT**

A unique electrochemical process fills oxygen vacancies in dielectrics while reducing oxidation of nearby electrodes and conductors. Preferably, an electromagnetic field or bias is applied to a dielectric. The bias causes oxygen vacancies in the dielectric to migrate to the surface of the dielectric. As the oxygen vacancies migrate toward the surface, oxygen ions fill the oxygen vacancies. In one embodiment, a unique plasma treatment provides the oxygen ions that react with the oxygen vacancies. In another embodiment, a unique electrolysis treatment provides the oxygen ions that react with the oxygen vacancies.

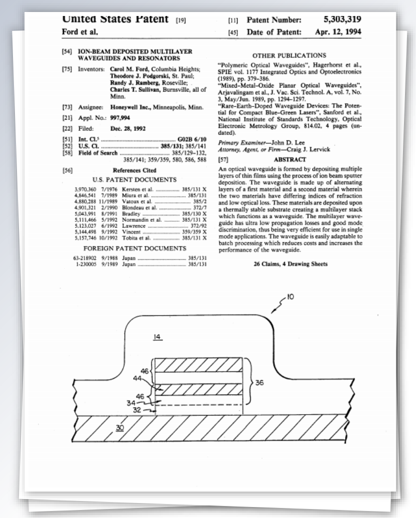
**62 Claims, 6 Drawing Sheets**



As discussed with respect to FIG. 1, the memory cell 4 comprises the semiconductor substrate 10, the plurality of transistor gate electrodes 12, the adjacent transistor active areas 14, the field oxide elements 16, the first insulating layer 18 and the "poly plug" 20. A structural layer 22 is then formed over the first insulating layer 18. A via 24 is formed in the structural layer 22 to expose the underlying poly plug 20.

U.S. Pat. 6,281,142 at 8:1-8, Fig. 1
(cited on face of Asserted Patents)

# Intrinsic Evidence Confirms “substrate” is the “base material, including but not limited to a wafer coated with an insulator”



United States Patent [19]
Ford et al.

[11] Patent Number: 5,303,319
[45] Date of Patent: Apr. 12, 1994

[54] ION-BEAM DEPOSITED MULTILAYER WAVEGUIDES AND RESONATORS

[75] Inventors: **Carol M. Ford**, Columbia Heights; **Theodore J. Podgorski**, St. Paul; **Randy J. Ramberg**, Roseville; **Charles T. Sullivan**, Burnsville, all of Minn.

[73] Assignee: **Honeywell Inc.**, Minneapolis, Minn.

[21] Appl. No.: **997,994**

[22] Filed: **Dec. 28, 1992**

[51] **Int. Cl.**$^5$ .......... **G02B 6/10**
[52] **U.S. Cl.** .......... **385/131**; 385/141
[58] **Field of Search** .......... 385/129-132, 385/141; 359/359, 580, 586, 588

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“Mixed-Metal-Oxide Planar Optical Waveguides”, Arjavalingam et al., J. Vac. Sci. Technol. A, vol. 7, No. 3, May/Jun. 1989, pp. 1294-1297.
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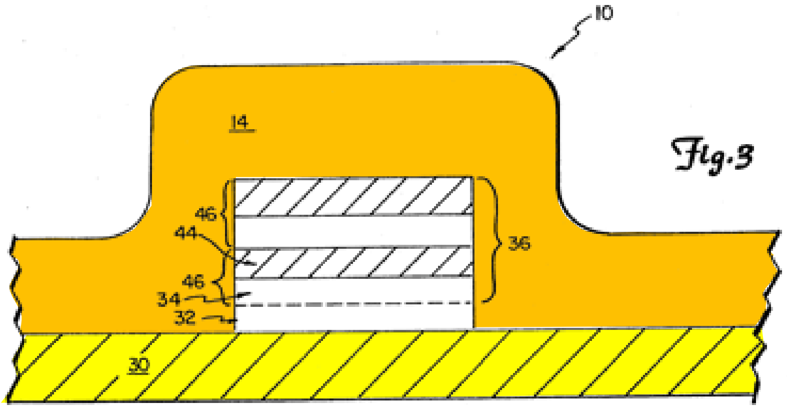
*Primary Examiner*—John D. Lee
*Attorney, Agent, or Firm*—Craig J. Lervick

[57] **ABSTRACT**

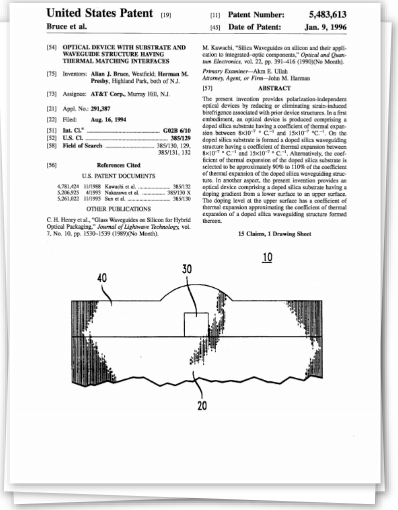
An optical waveguide is formed by depositing multiple layers of thin films using the process of ion beam sputter deposition. The waveguide is made up of alternating layers of a first material and a second material wherein the two materials have differing indices of refraction and low optical loss. These materials are deposited upon a thermally stable substrate creating a multilayer stack which functions as a waveguide. The multilayer waveguide has ultra low propagation losses and good mode discrimination, thus being very efficient for use in single mode applications. The waveguide is easily adaptable to batch processing which reduces costs and increases the performance of the waveguide.

**26 Claims, 4 Drawing Sheets**



Waveguide **10** comprises a stack of material **12** which is attached to a substrate **30**. A protective coating or upper isolation layer **14** is placed on top of both multilayer stack **12** and substrate **30**. Upper isolation layer **14** can shield the waveguide from environmental attacks such as moisture, chemical attack, etc. Furthermore,

U.S. Pat. 5,303,319 at 2:66-3:3, Fig. 3
(cited on face of Asserted Patents)



United States Patent [19]
Bruce et al.

[11] Patent Number: 5,483,613
[45] Date of Patent: Jan. 9, 1996

[54] OPTICAL DEVICE WITH SUBSTRATE AND WAVEGUIDE STRUCTURE HAVING THERMAL MATCHING INTERFACES

[75] Inventors: **Allan J. Bruce**, Westfield; **Herman M. Presby**, Highland Park, both of N.J.

[73] Assignee: **AT&T Corp.**, Murray Hill, N.J.

[21] Appl. No.: **291,387**

[22] Filed: **Aug. 16, 1994**

[51] **Int. Cl.**$^6$ .......... **G02B 6/10**
[52] **U.S. Cl.** .......... **385/129**
[58] **Field of Search** .......... 385/130, 129, 385/131, 132

[56] **References Cited**

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5,206,925 4/1993 Nakazawa et al. .......... 385/130 X
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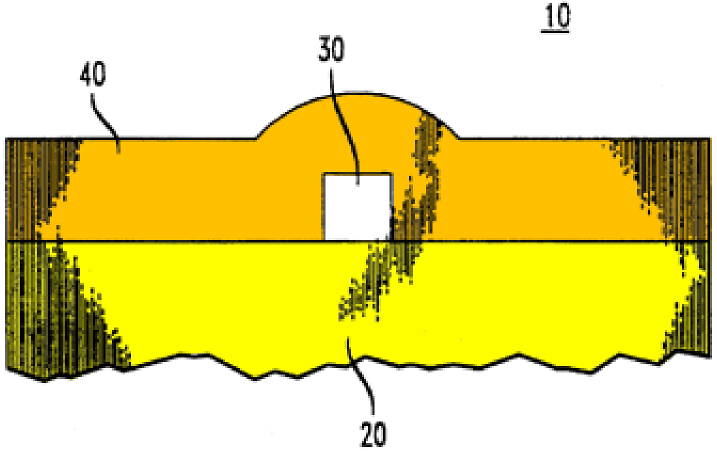
M. Kawachi, “Silica Waveguides on silicon and their application to integrated-optic components,” *Optical and Quantum Electronics*, vol. 22, pp. 391-416 (1990)(No Month).

*Primary Examiner*—Akm E. Ullah
*Attorney, Agent, or Firm*—John M. Harman

[57] **ABSTRACT**

The present invention provides polarization-independent optical devices by reducing or eliminating strain-induced birefrigence associated with prior device structures. In a first embodiment, an optical device is produced comprising a doped silica substrate having a coefficient of thermal expansion between $8\times10^{-7}$ ° C.$^{-1}$ and $15\times10^{-7}$ °C.$^{-1}$. On the doped silica substrate is formed a doped silica waveguiding structure having a coefficient of thermal expansion between $8\times10^{-7}$ ° C.$^{-1}$ and $15\times10^{-7}$ ° C.$^{-1}$. Alternatively, the coefficient of thermal expansion of the doped silica substrate is selected to be approximately 90% to 110% of the coefficient of thermal expansion of the doped silica waveguiding structure. In another aspect, the present invention provides an optical device comprising a doped silica substrate having a doping gradient from a lower surface to an upper surface. The doping level at the upper surface has a coefficient of thermal expansion approximating the coefficient of thermal expansion of a doped silica waveguiding structure formed thereon.

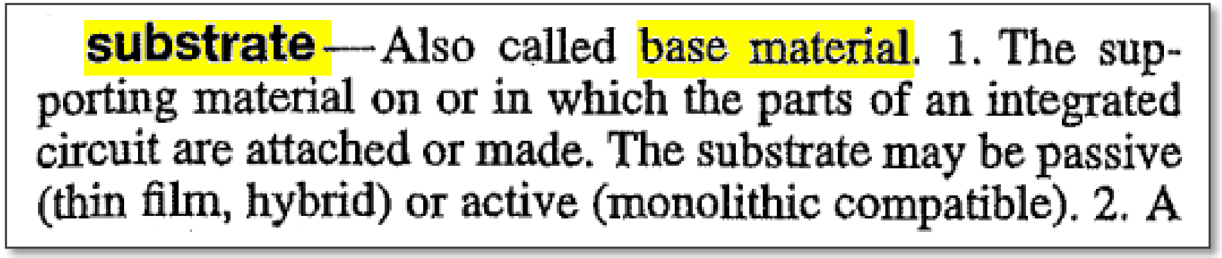
**15 Claims, 1 Drawing Sheet**



Referring to the drawings, FIG. **1** is a schematic view of an optical device **10** having a substrate **20**, a waveguiding element **30**, and a cladding layer **40**. In conventional applications, substrate **20** is typically a silicon wafer with a thermally oxidized $SiO_2$ surface layer. The $SiO_2$ layer in such devices functions as a first cladding layer for the waveguiding element. In a first embodiment of the present invention, layer **20** is a doped silica substrate, the doped silica substrate having a coefficient of thermal expansion which approximates the coefficient of thermal expansion of the waveguiding element material layer.

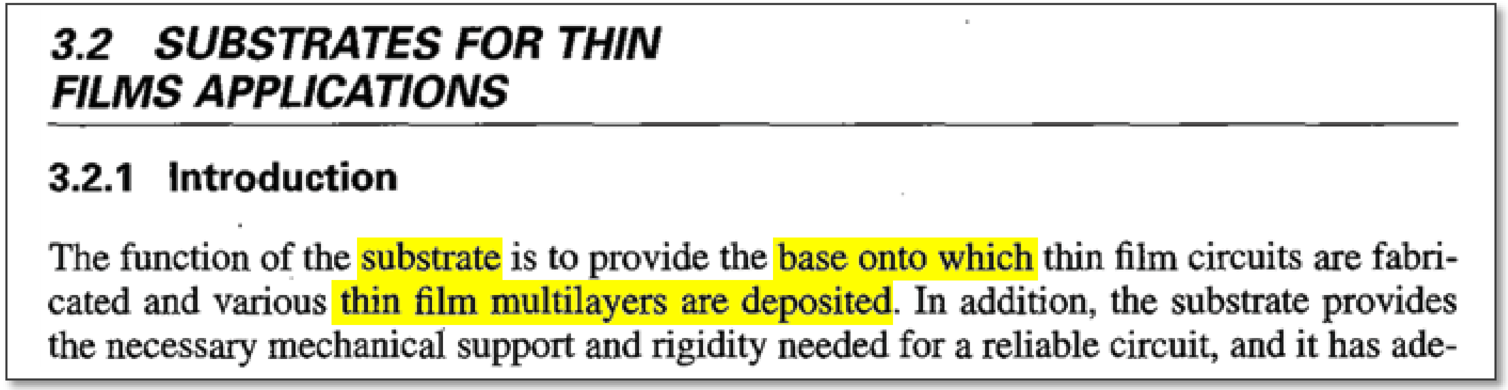
U.S. Pat. 5,483,613 at 2:47-57, Fig. 1
(cited on face of Asserted Patents)

# Plain meaning of “substrate” is “base material, including but not limited to a wafer coated with an insulator”



**substrate**—Also called base material. 1. The supporting material on or in which the parts of an integrated circuit are attached or made. The substrate may be passive (thin film, hybrid) or active (monolithic compatible). 2. A

Dkt. 61-1 (Modern Dictionary of Electronics (1999)), 2797



***3.2 SUBSTRATES FOR THIN FILMS APPLICATIONS***

**3.2.1 Introduction**

The function of the substrate is to provide the base onto which thin film circuits are fabricated and various thin film multilayers are deposited. In addition, the substrate provides the necessary mechanical support and rigidity needed for a reliable circuit, and it has ade-

Dkt. 61 (Thin Film Technology Handbook (1997)), 2815.

# “metallic mode” / poison mode”

’657 Patent, Claim 1

# “metallic mode” / “poison mode” Disputes

| Demaray’s Proposal | Defendants’ Proposal |
|---|---|
| metallic mode: “mode of operation in which the surface of the target is substantially metallic”<br>poison mode: “mode of operation in which the rate of the thin film formation on the surface of the target equals or exceeds the rate of sputter removal of the surface of the target” | Plain and ordinary meaning |

# “metallic mode” / “poison mode” Disputes

## Court’s Preliminary Construction

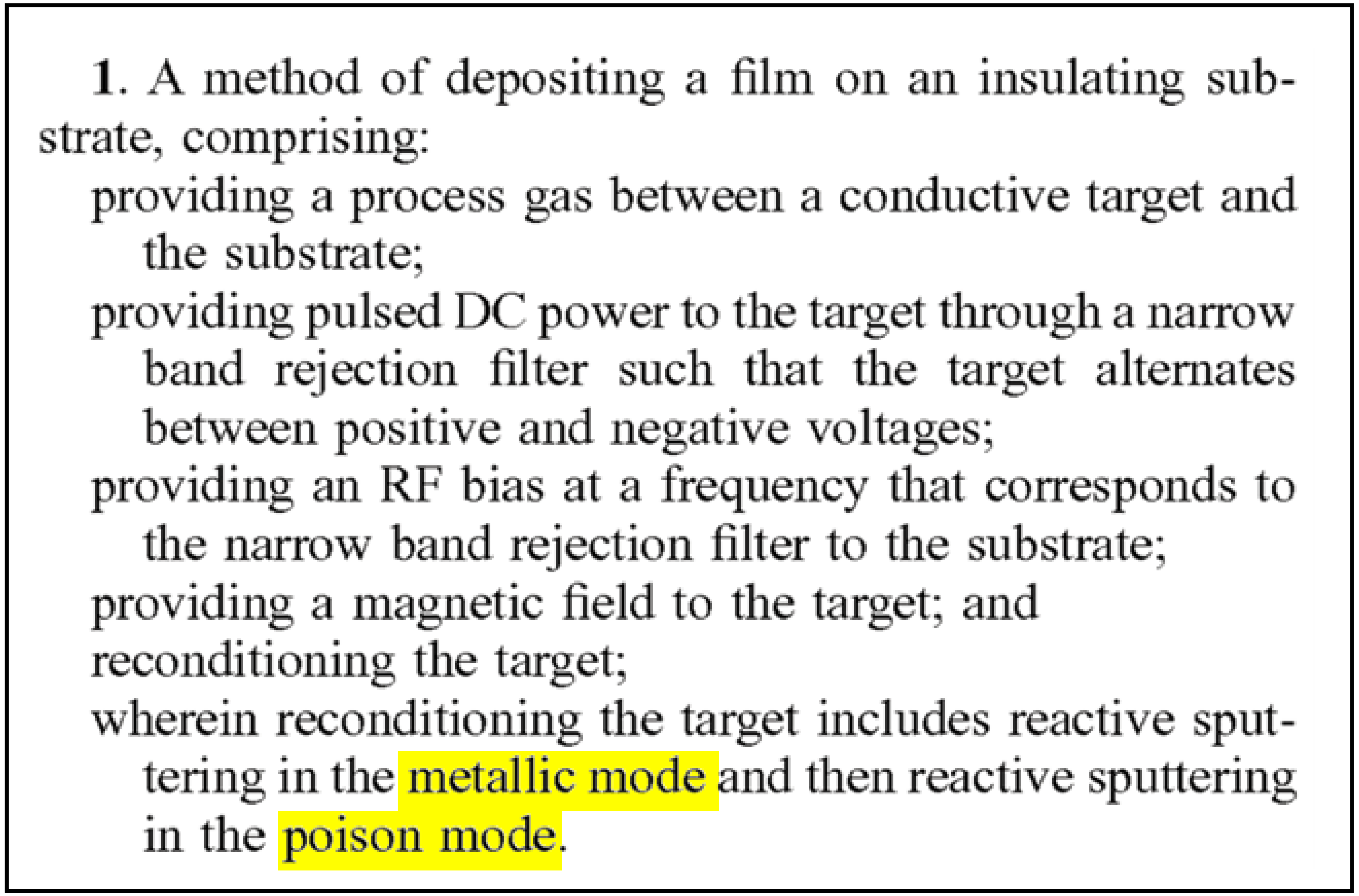
metallic mode: Plain-and-ordinary meaning wherein the plain-and-ordinary meaning is “mode of operation in which the surface of the target is substantially metallic, and is characterized by a small addition of reactive gas to the inert gas flow, a higher impedance magnetron discharge, an incomplete oxidation of film, and a higher voltage (as compared to poison mode)”

Demaray’s Proposal

poison mode: Plain-and-ordinary meaning wherein the plain-and-ordinary meaning is “mode of operation in which the rate of the thin film formation on the surface of the target equals or exceeds the rate of sputter removal of the surface of the target, and is characterized by a lower voltage (as compared to poison mode)”

Demaray’s Proposal

# Asserted Claim 1 of the '657 Patent



1. A method of depositing a film on an insulating substrate, comprising:

providing a process gas between a conductive target and the substrate;

providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;

providing an RF bias at a frequency that corresponds to the narrow band rejection filter to the substrate;

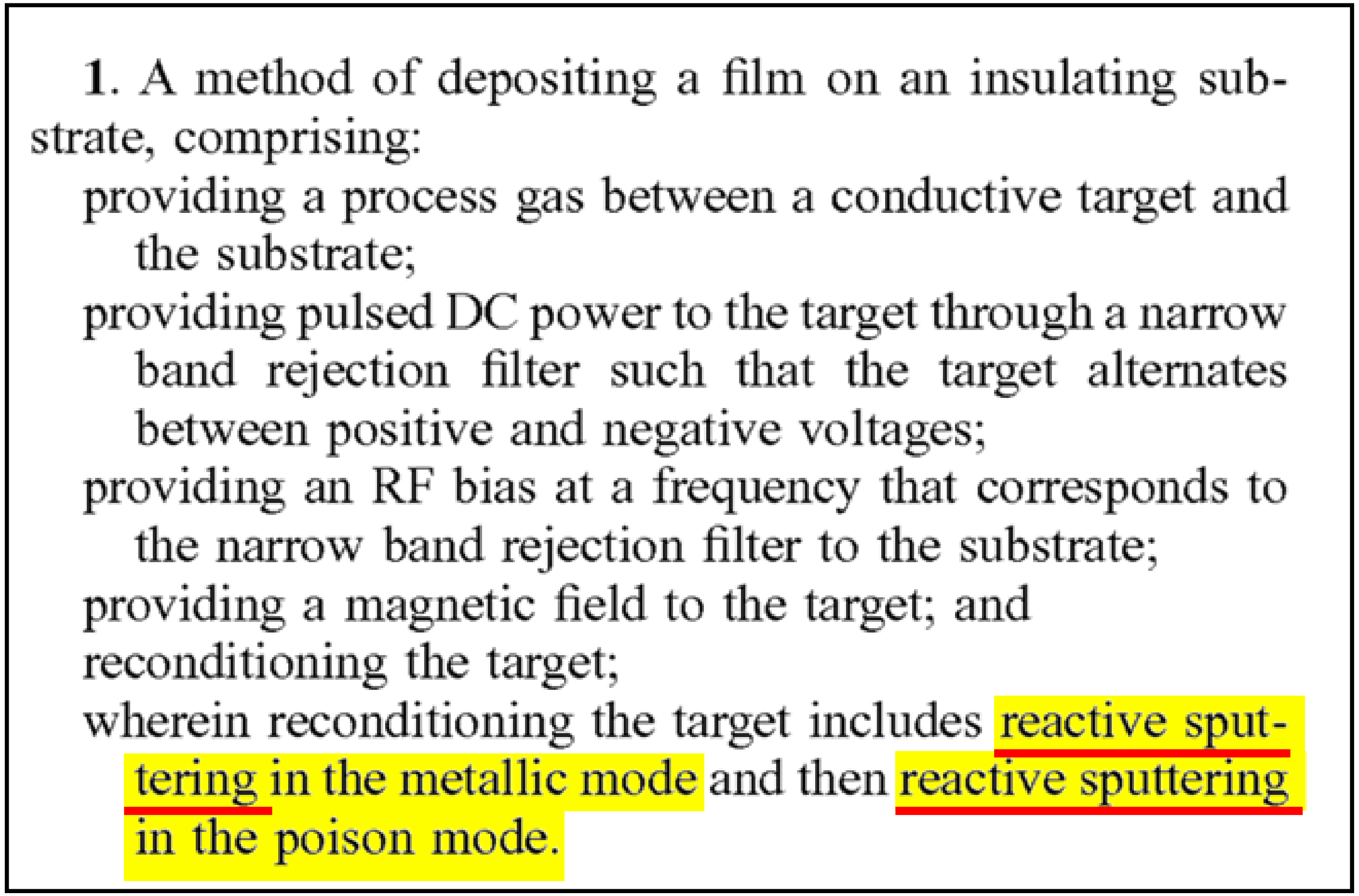
providing a magnetic field to the target; and

reconditioning the target;

wherein reconditioning the target includes reactive sputtering in the metallic mode and then reactive sputtering in the poison mode.

'657 Patent, Claim 1

# Asserted Claim 1 of the '657 Patent



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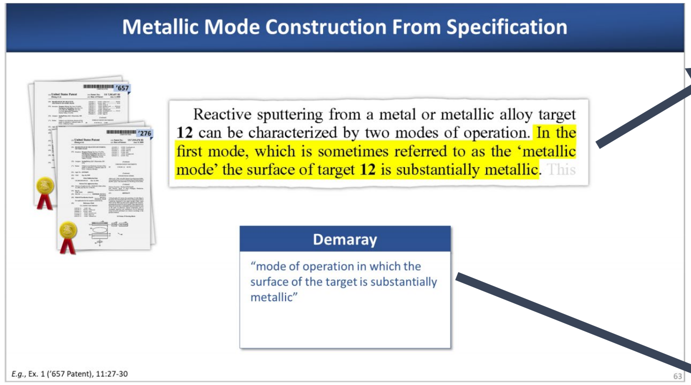
’657 Patent, Claim 1

# Demaray's "Metallic Mode" Proposal



**Metallic Mode Construction From Specification**

Reactive sputtering from a metal or metallic alloy target **12** can be characterized by two modes of operation. In the first mode, which is sometimes referred to as the 'metallic mode' the surface of target **12** is substantially metallic. This

**Demaray**

"mode of operation in which the surface of the target is substantially metallic"

*E.g.*, Ex. 1 ('657 Patent), 11:27-30

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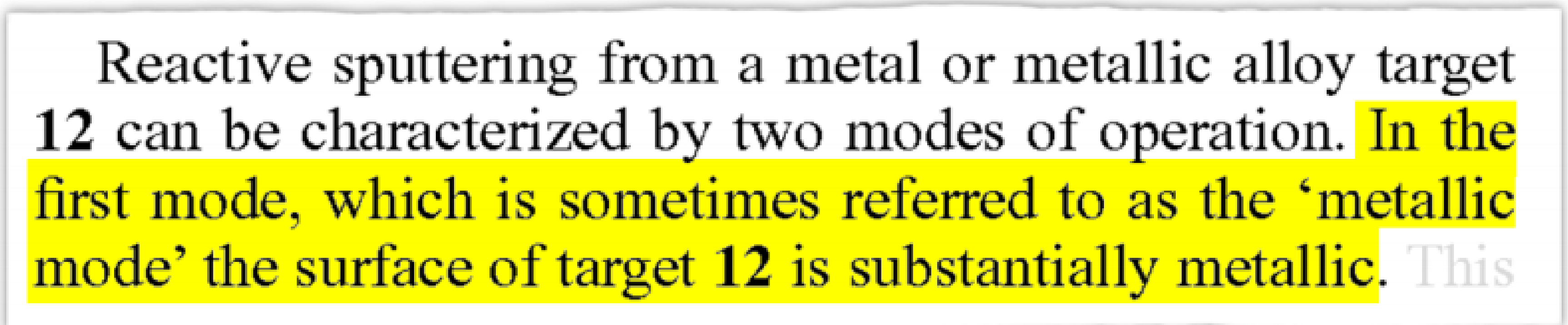
Demaray's *Markman* Slide 63



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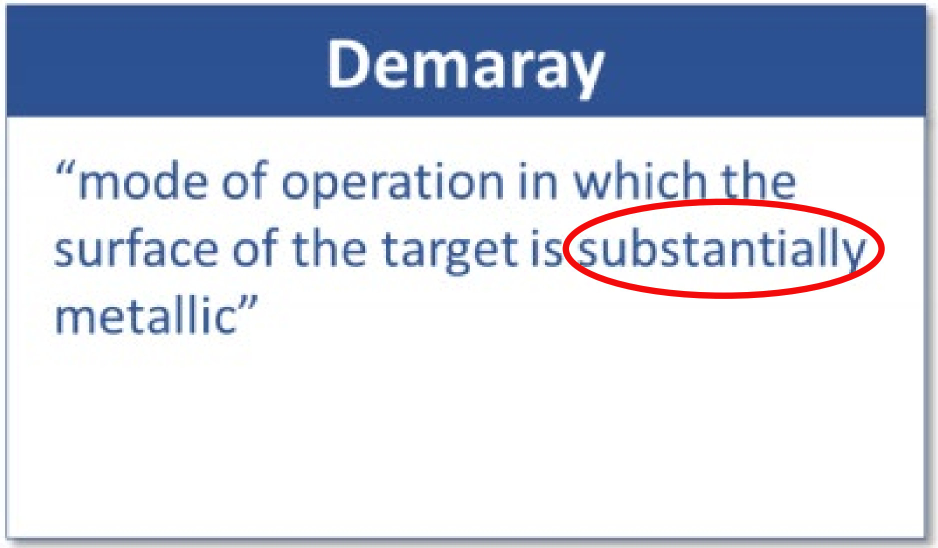


**Demaray**

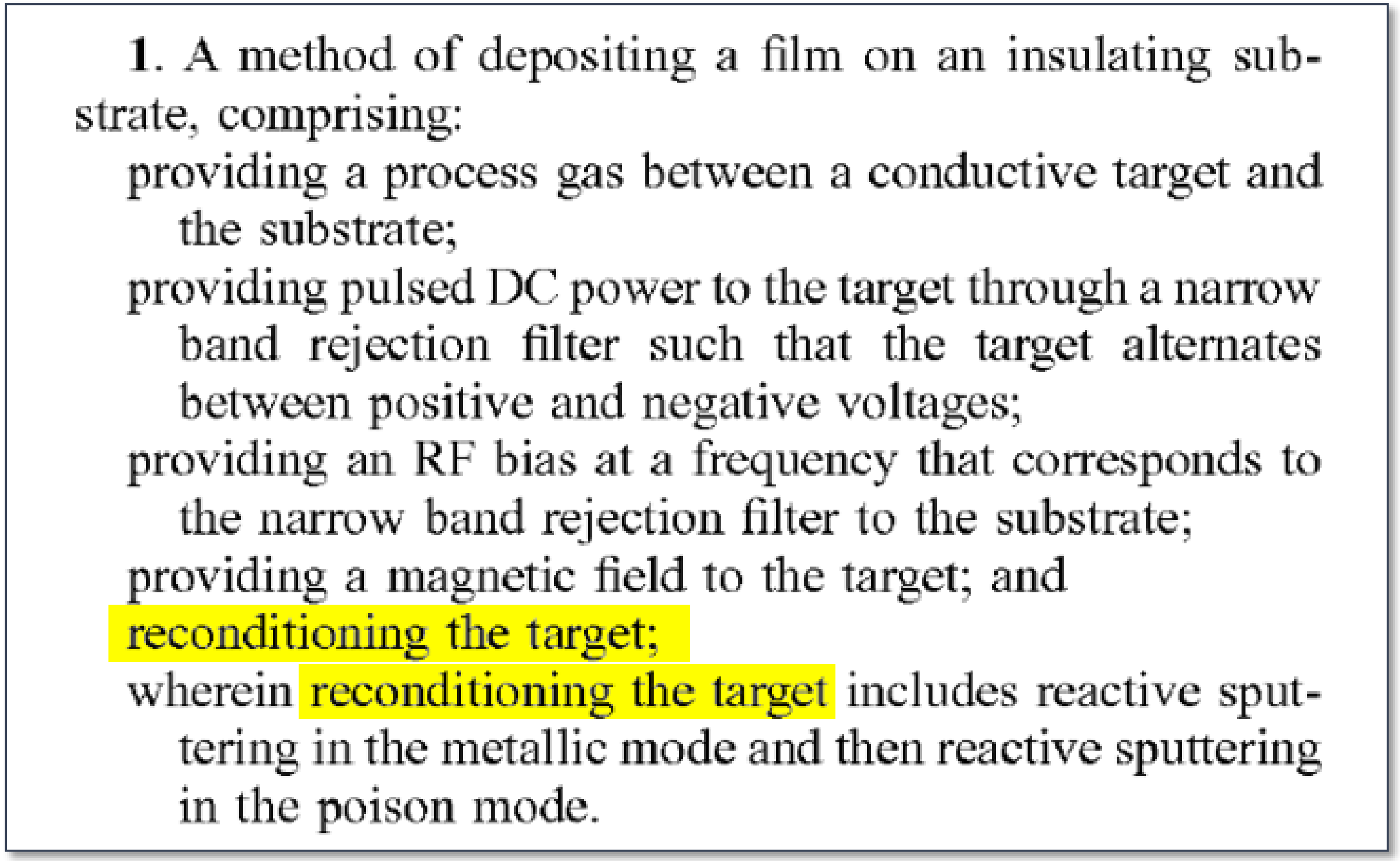
"mode of operation in which the surface of the target is substantially metallic"

?

# “reconditioning the target”

’657 Patent, Claim 1

# Claim 1 of the ’657 Patent



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providing a magnetic field to the target; and

reconditioning the target;

wherein reconditioning the target includes reactive sputtering in the metallic mode and then reactive sputtering in the poison mode.

’657 Patent at Claim 1

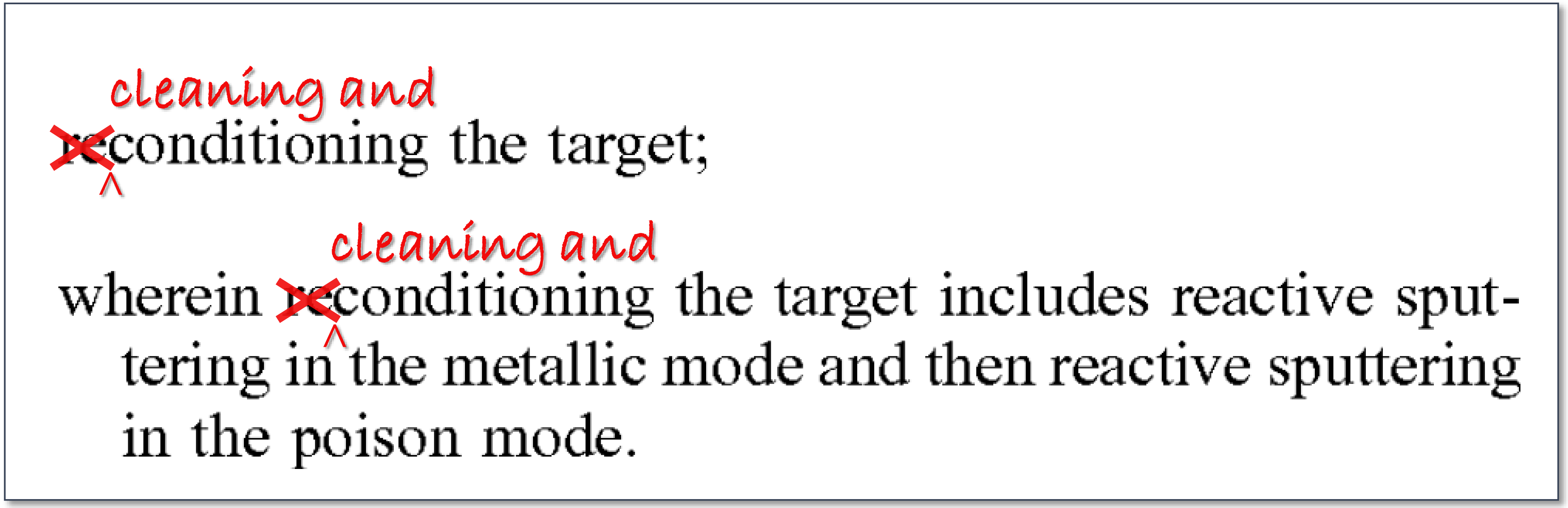
# "reconditioning the target": The Parties' Dispute

| Demaray's Proposal | Defendants' Proposal |
|---|---|
| Plain and ordinary meaning, or<br>"cleaning and conditioning the target" | "conditioning the target between depositions" |

**The Parties' Dispute:**

1. Whether reconditioning includes "cleaning"?
2. Whether reconditioning occurs "between depositions"?

# Demaray's Proposal is Incorrect: Demaray Attempts to Rewrite the Claim and Renders Claim Language Void



cleaning and

~~re~~conditioning the target;

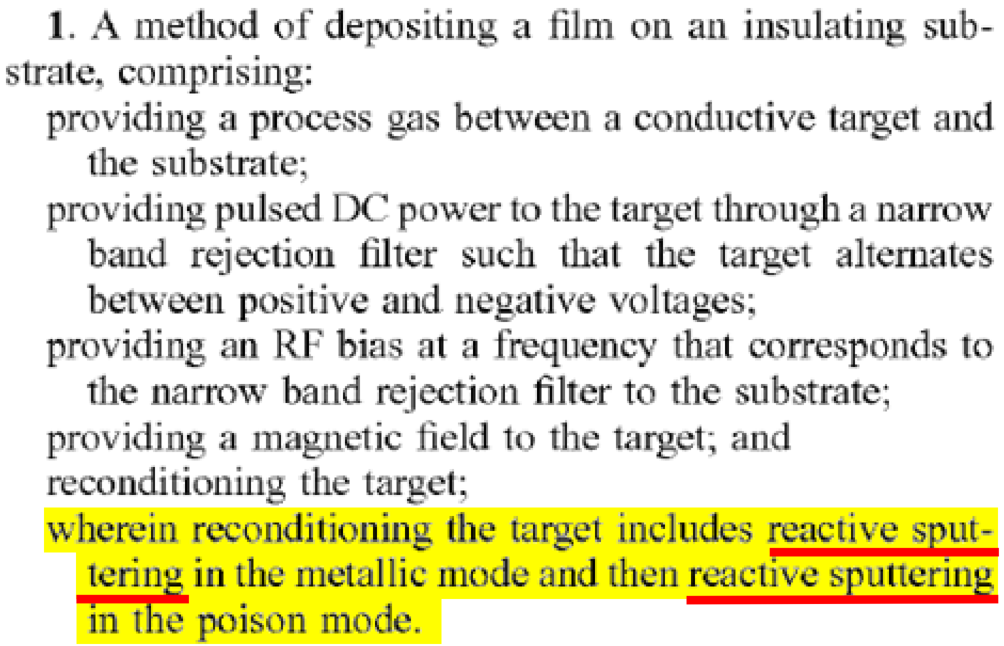
cleaning and

wherein ~~re~~conditioning the target includes reactive sputtering in the metallic mode and then reactive sputtering in the poison mode.

'657 Patent at Claim 1

# Demaray's Proposal Is Incorrect: Demaray's Attempt to Broaden "Reconditioning" to Include "Cleaning" Is at Odds with the Intrinsic Evidence

## Claim 1 Covers Reactive Sputtering



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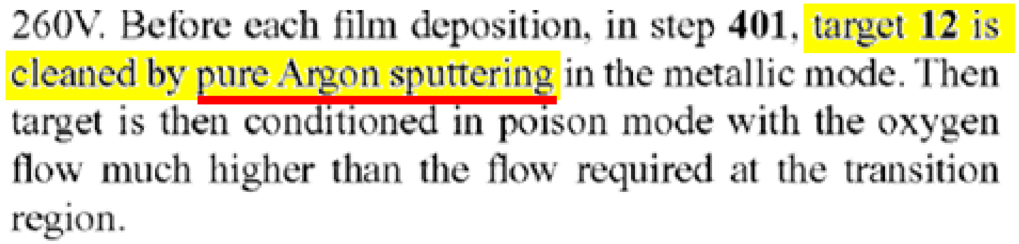
'657 Patent at Claim 1

## Demaray's Evidence Relates to Non-Reactive Sputtering

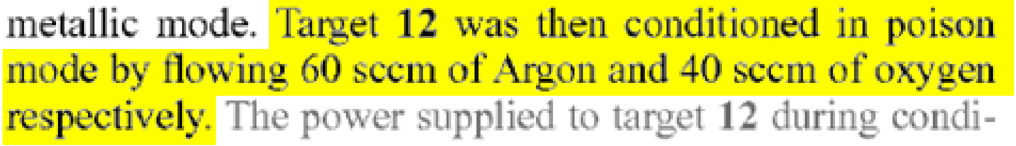


260V. Before each film deposition, in step **401**, target **12** is cleaned by pure Argon sputtering in the metallic mode. Then target is then conditioned in poison mode with the oxygen flow much higher than the flow required at the transition region.

'657 Patent at 17:10-15

# Demaray's Proposal Is Incorrect: Demaray's Attempt to Limit "Conditioning" to Poison Mode Is Inconsistent with the Intrinsic Evidence

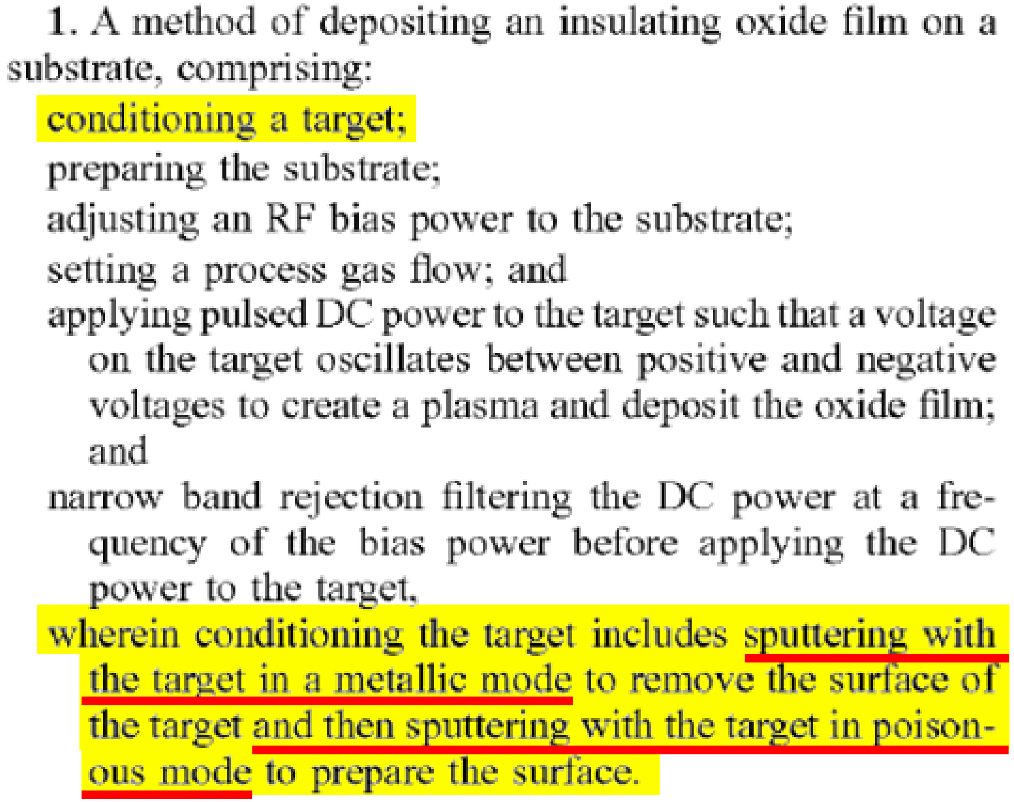
## Demaray's Evidence



metallic mode. Target 12 was then conditioned in poison mode by flowing 60 sccm of Argon and 40 sccm of oxygen respectively. The power supplied to target 12 during condi-

'657 Patent at 18:13-15

## "Conditioning" Includes Both Metallic & Poison Modes



1. A method of depositing an insulating oxide film on a substrate, comprising:

conditioning a target;

preparing the substrate;

adjusting an RF bias power to the substrate;

setting a process gas flow; and

applying pulsed DC power to the target such that a voltage on the target oscillates between positive and negative voltages to create a plasma and deposit the oxide film; and

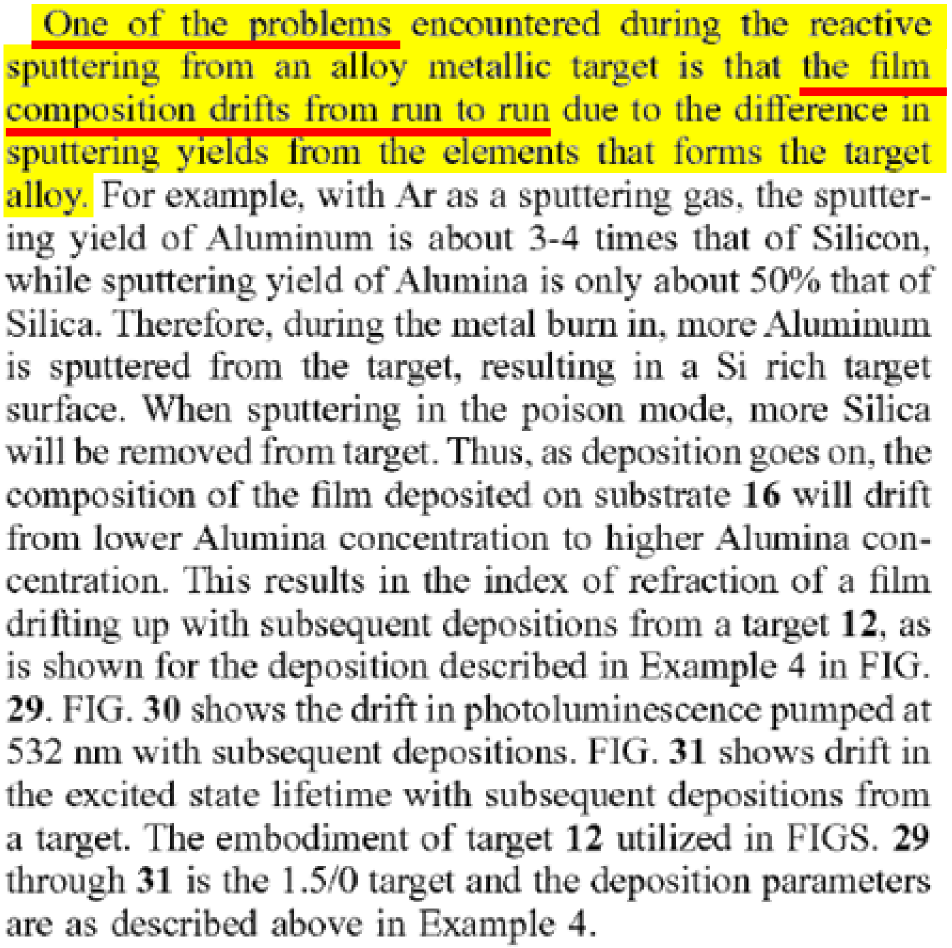
narrow band rejection filtering the DC power at a frequency of the bias power before applying the DC power to the target,

wherein conditioning the target includes sputtering with the target in a metallic mode to remove the surface of the target and then sputtering with the target in poisonous mode to prepare the surface.

Dkt. 61-11 ('356 Patent) at Claim 1;
*see also* '657 Patent at 20:52-55

# Defendants' Proposal Is Correct: Specification Makes Clear Reconditioning Refers to Conditioning Between Depositions

## The Problem



One of the problems encountered during the reactive sputtering from an alloy metallic target is that the film composition drifts from run to run due to the difference in sputtering yields from the elements that forms the target alloy. For example, with Ar as a sputtering gas, the sputtering yield of Aluminum is about 3-4 times that of Silicon, while sputtering yield of Alumina is only about 50% that of Silica. Therefore, during the metal burn in, more Aluminum is sputtered from the target, resulting in a Si rich target surface. When sputtering in the poison mode, more Silica will be removed from target. Thus, as deposition goes on, the composition of the film deposited on substrate **16** will drift from lower Alumina concentration to higher Alumina concentration. This results in the index of refraction of a film drifting up with subsequent depositions from a target **12**, as is shown for the deposition described in Example 4 in FIG. **29**. FIG. **30** shows the drift in photoluminescence pumped at 532 nm with subsequent depositions. FIG. **31** shows drift in the excited state lifetime with subsequent depositions from a target. The embodiment of target **12** utilized in FIGS. **29** through **31** is the 1.5/0 target and the deposition parameters are as described above in Example 4.

'657 Patent at 20:30-51

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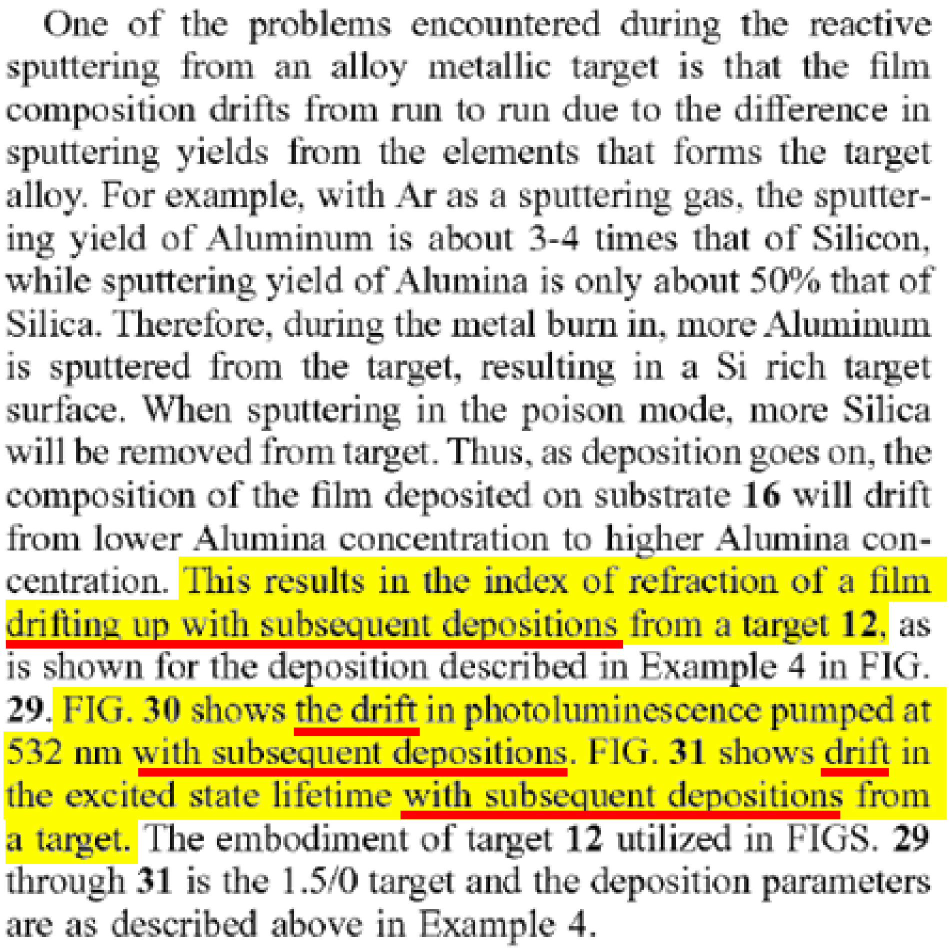

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'657 Patent at 20:30-51

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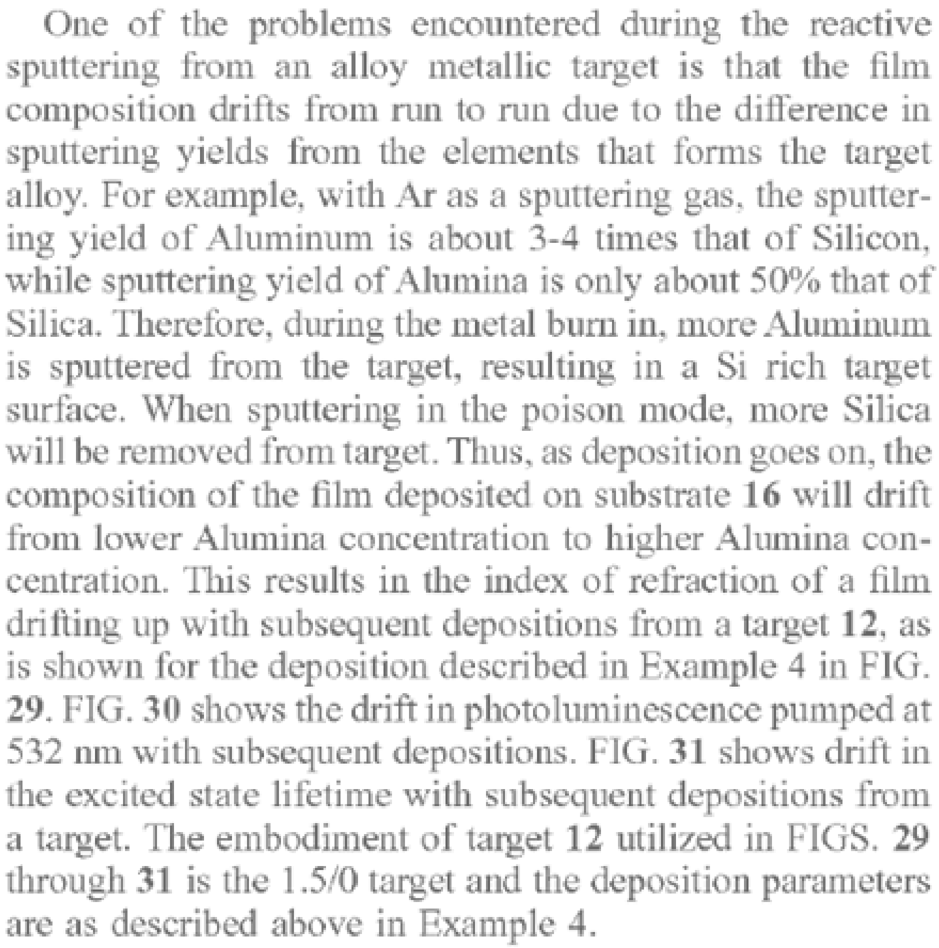

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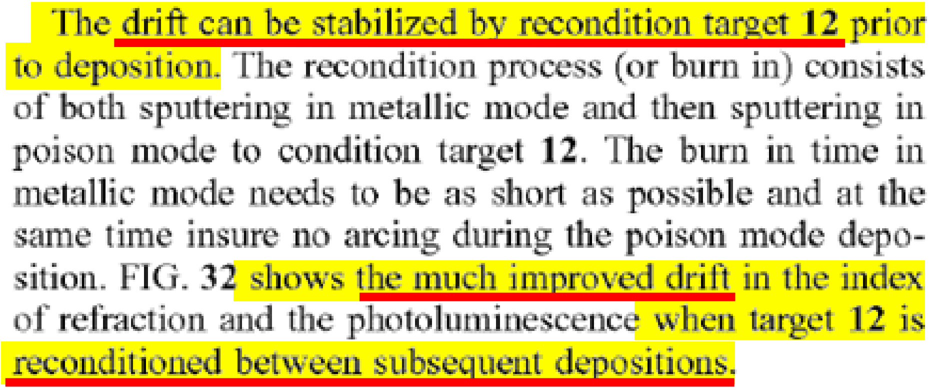
'657 Patent at 20:30-51

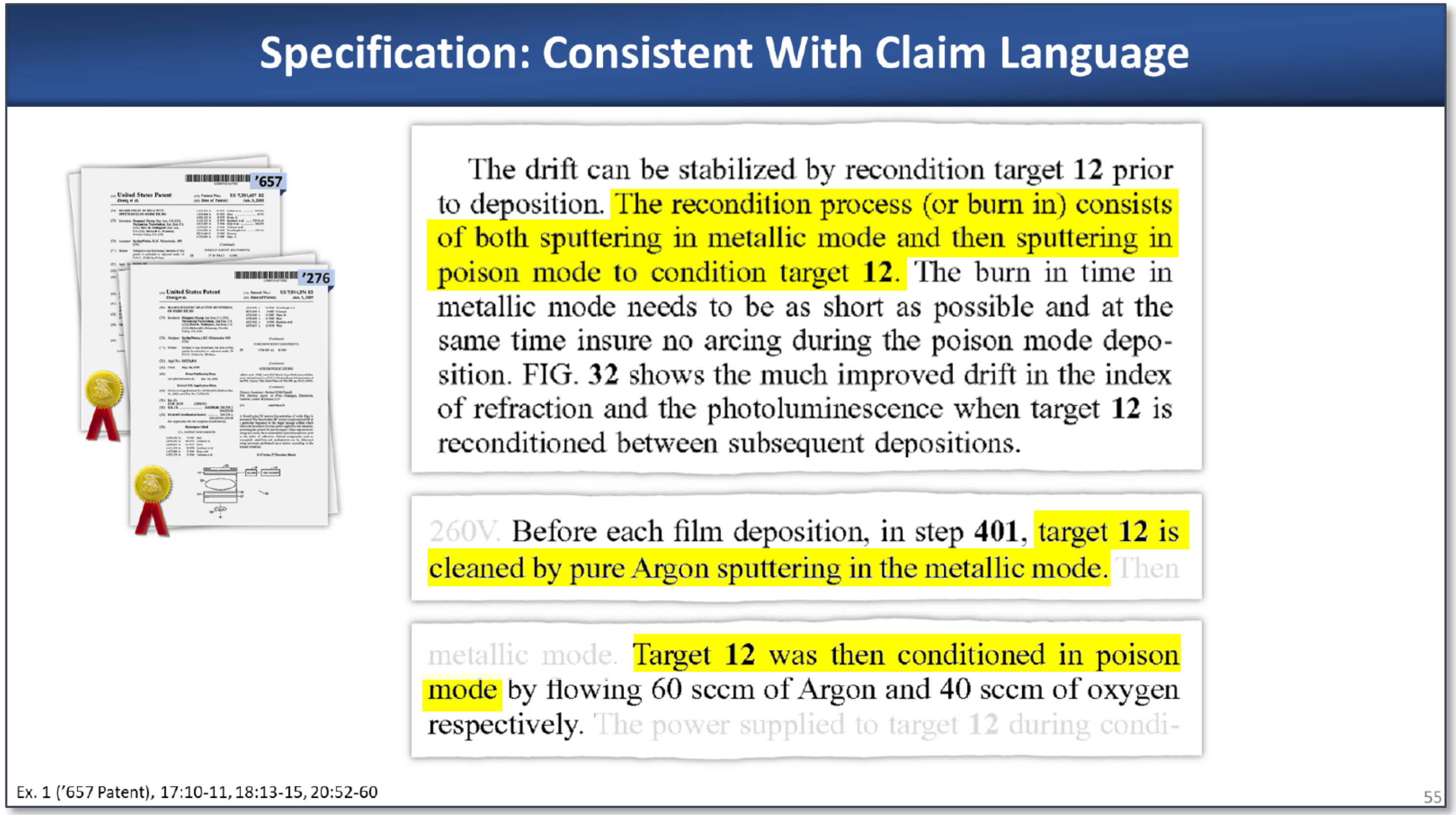
## The Solution



The drift can be stabilized by recondition target **12** prior to deposition. The recondition process (or burn in) consists of both sputtering in metallic mode and then sputtering in poison mode to condition target **12**. The burn in time in metallic mode needs to be as short as possible and at the same time insure no arcing during the poison mode deposition. FIG. **32** shows the much improved drift in the index of refraction and the photoluminescence when target **12** is reconditioned between subsequent depositions.

'657 Patent at 20:52-60

# Demaray's Proposal Is Incorrect: Demaray Cherry Picks Passages to Support Its Proposal



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Ex. 1 ('657 Patent), 17:10-11, 18:13-15, 20:52-60

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Demaray's *Markman* Slide 55

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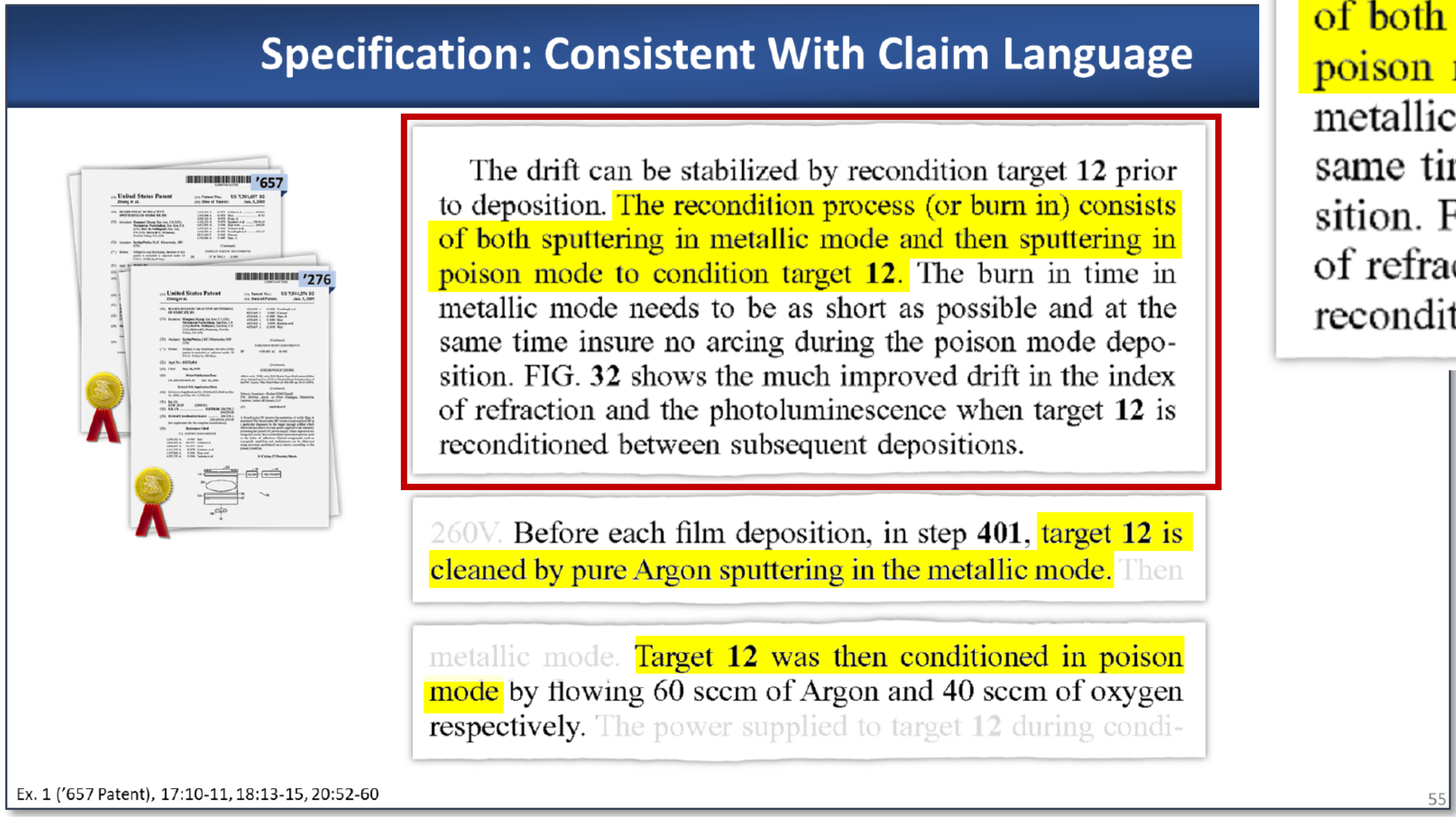
'657 Patent at **20:52-60**



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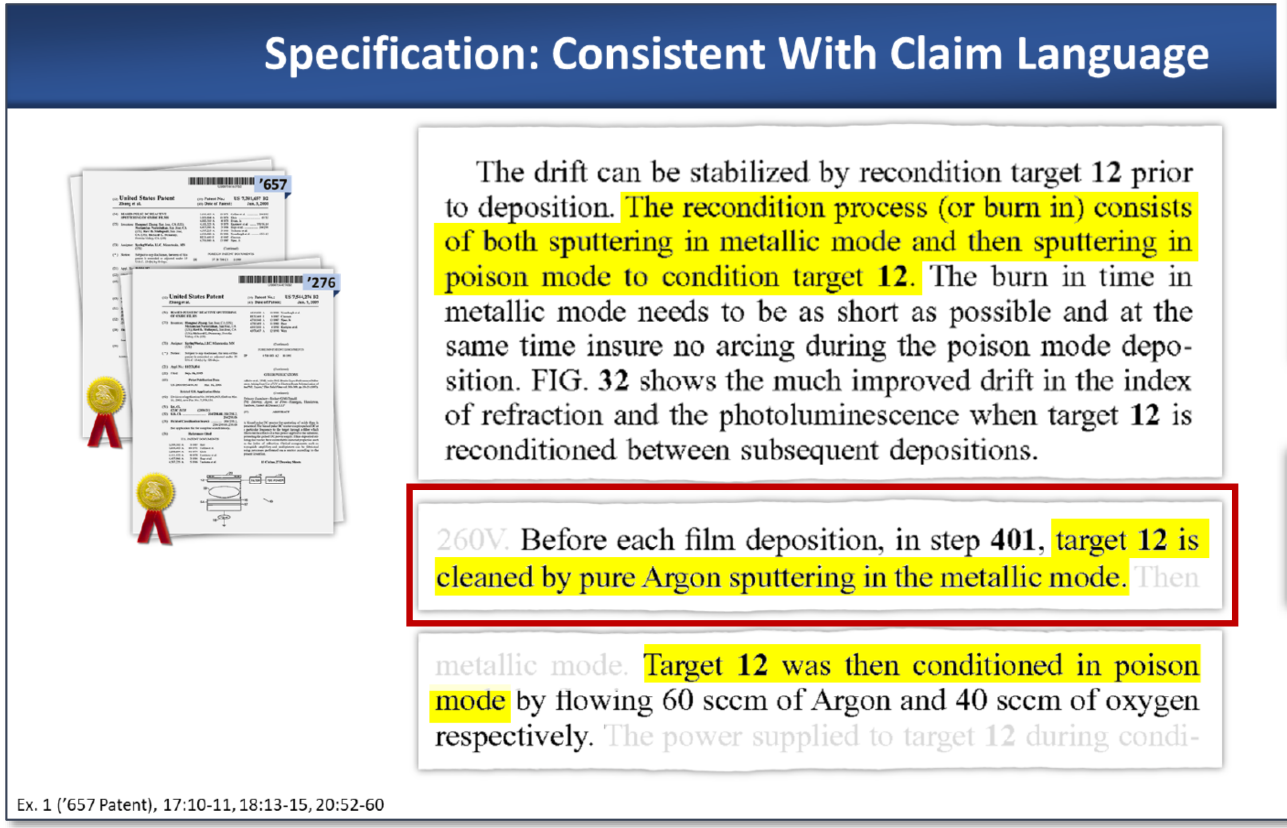

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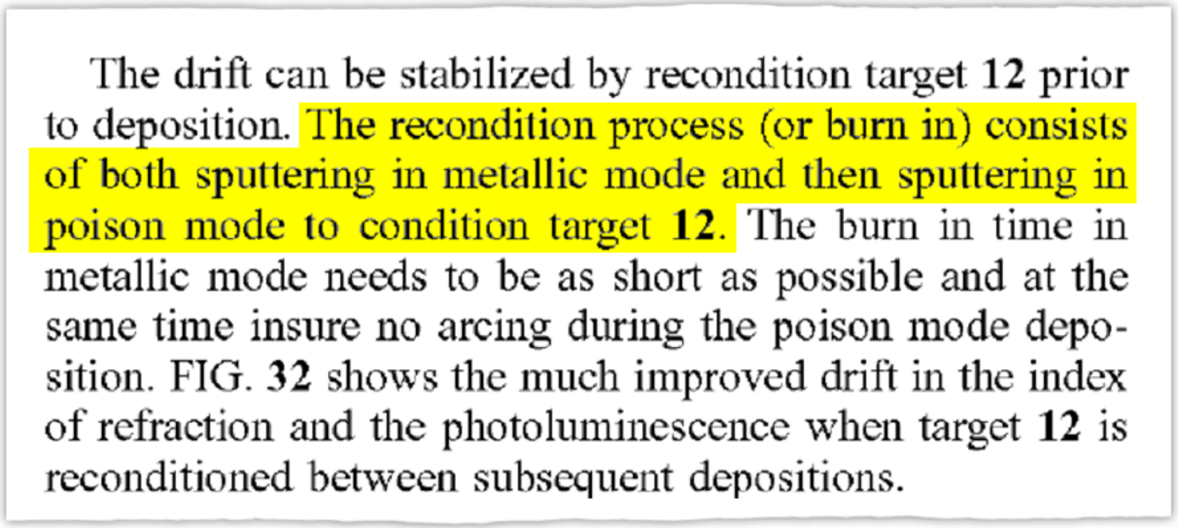
Demaray's *Markman* Slide 55



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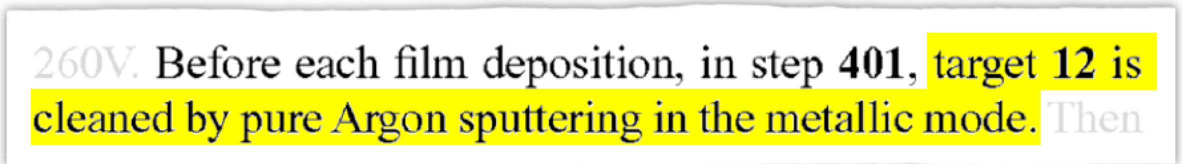
'657 Patent at **20:52-60**



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'657 Patent at **17:10-11**

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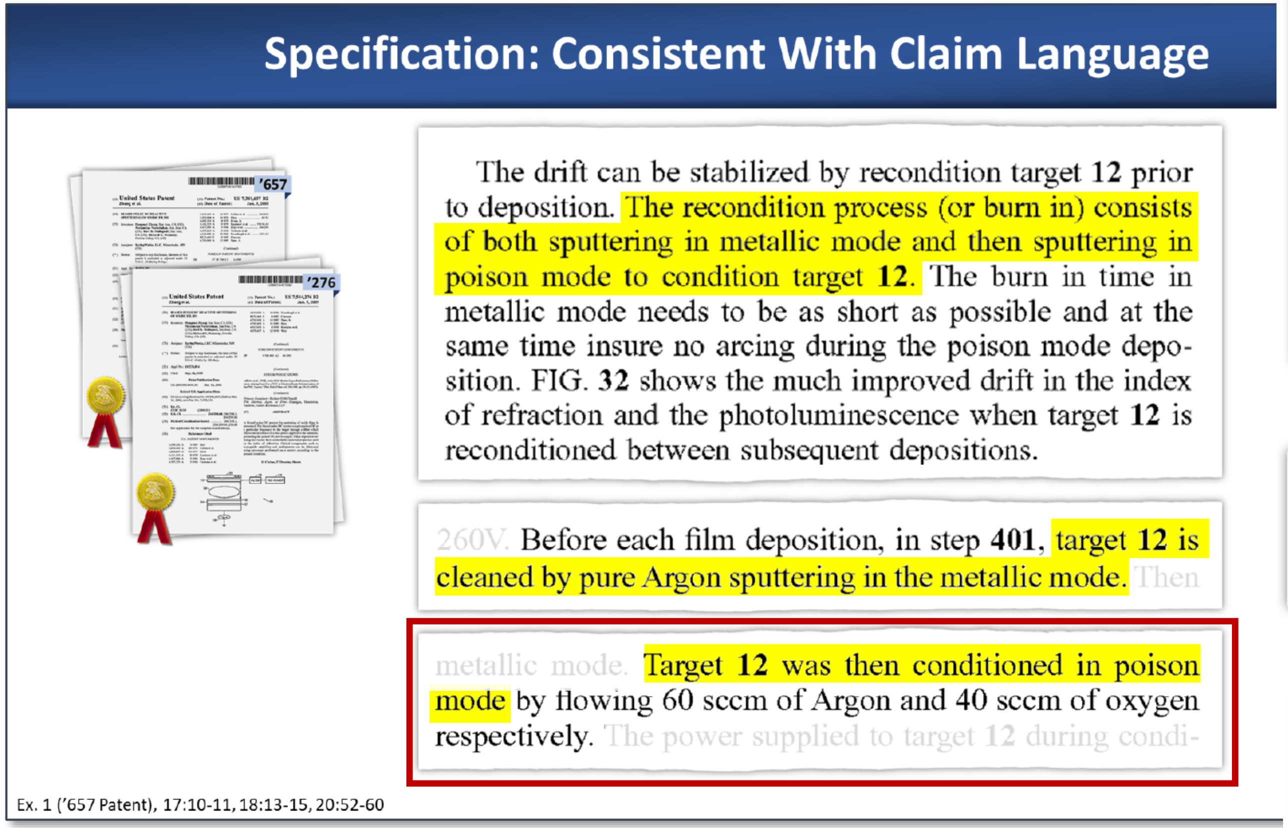

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Ex. 1 ('657 Patent), 17:10-11, 18:13-15, 20:52-60

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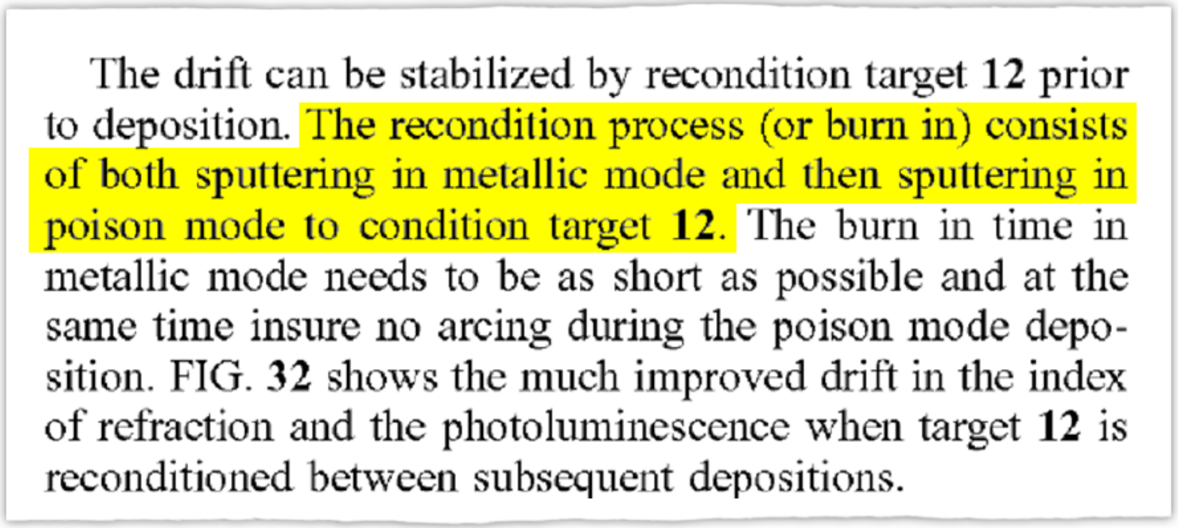
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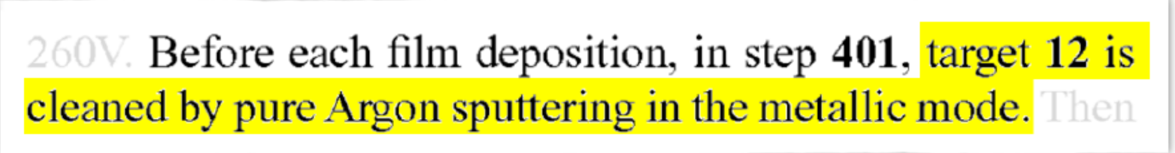
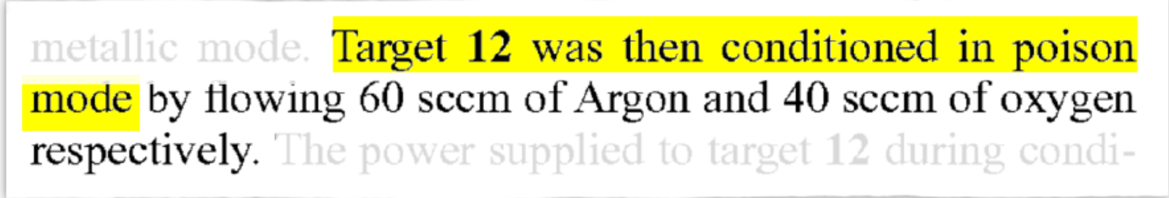
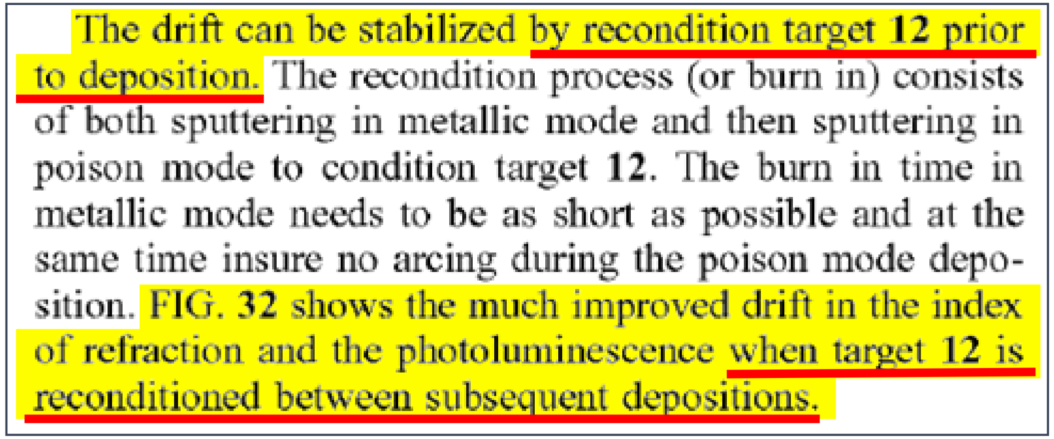

260V. Before each film deposition, in step 401, target 12 is cleaned by pure Argon sputtering in the metallic mode. Then

'657 Patent at 17:10-11


metallic mode. Target 12 was then conditioned in poison mode by flowing 60 sccm of Argon and 40 sccm of oxygen respectively. The power supplied to target 12 during condi-

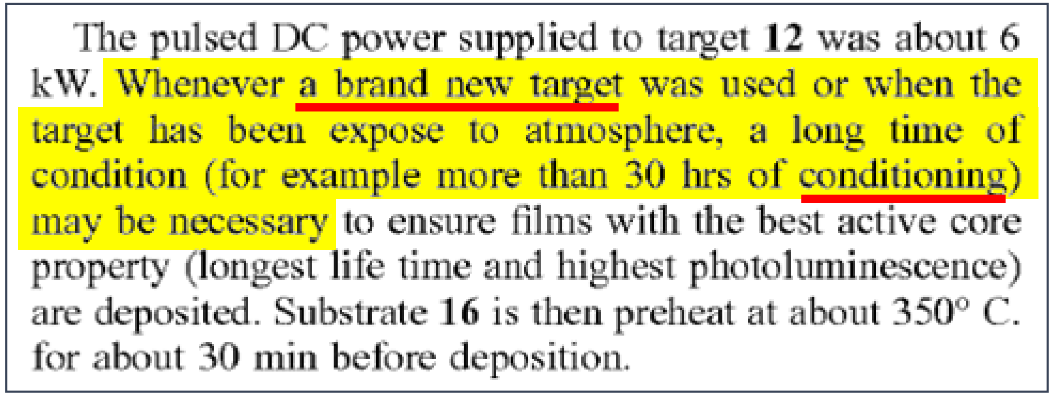
'657 Patent at 18:13-15

# Dr. Glew's Evidence on Timing of "Reconditioning"



The drift can be stabilized by recondition target 12 prior to deposition. The recondition process (or burn in) consists of both sputtering in metallic mode and then sputtering in poison mode to condition target 12. The burn in time in metallic mode needs to be as short as possible and at the same time insure no arcing during the poison mode deposition. FIG. 32 shows the much improved drift in the index of refraction and the photoluminescence when target 12 is reconditioned between subsequent depositions.

'657 Patent at 20:52-60



The pulsed DC power supplied to target 12 was about 6 kW. Whenever a brand new target was used or when the target has been expose to atmosphere, a long time of condition (for example more than 30 hrs of conditioning) may be necessary to ensure films with the best active core property (longest life time and highest photoluminescence) are deposited. Substrate 16 is then preheat at about 350° C. for about 30 min before deposition.

'657 Patent at 19:53-60

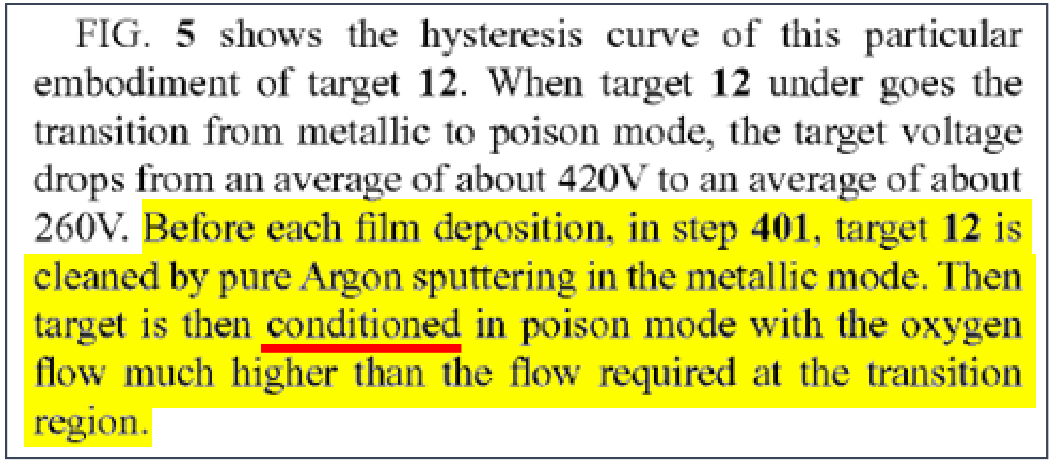


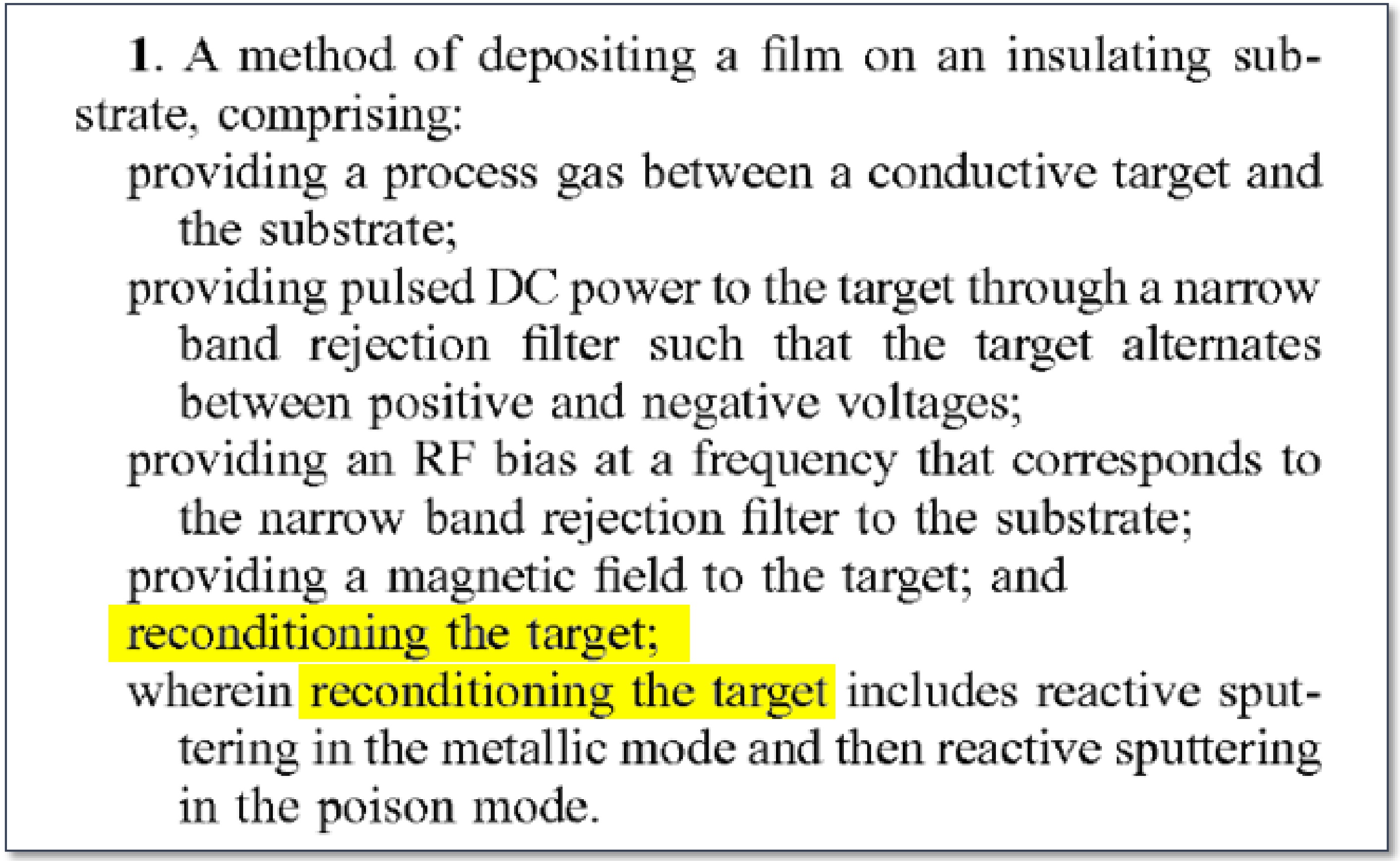
FIG. 5 shows the hysteresis curve of this particular embodiment of target 12. When target 12 under goes the transition from metallic to poison mode, the target voltage drops from an average of about 420V to an average of about 260V. Before each film deposition, in step 401, target 12 is cleaned by pure Argon sputtering in the metallic mode. Then target is then conditioned in poison mode with the oxygen flow much higher than the flow required at the transition region.

'657 Patent at 17:6-15

# “reconditioning the target”

’657 Patent, Claim 1

# Claim 1 of the ’657 Patent



1. A method of depositing a film on an insulating substrate, comprising:

providing a process gas between a conductive target and the substrate;

providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;

providing an RF bias at a frequency that corresponds to the narrow band rejection filter to the substrate;

providing a magnetic field to the target; and

reconditioning the target;

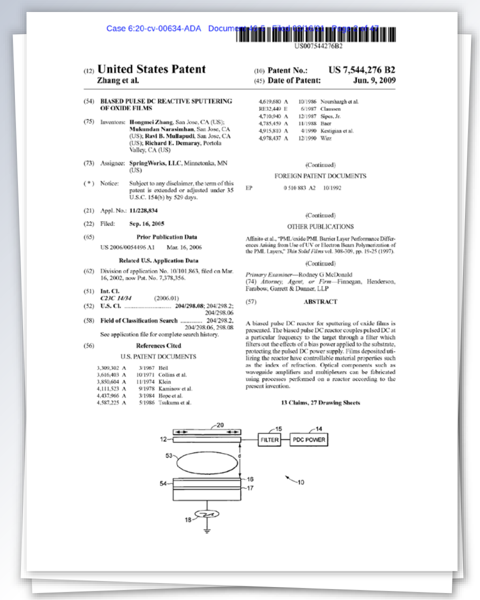
wherein reconditioning the target includes reactive sputtering in the metallic mode and then reactive sputtering in the poison mode.

’657 Patent at Claim 1

# “the temperature of the substrate substantially constant”

’276 Patent, Claim 10

# Claim 10 of the ’276 Patent



US007544276B2

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

(10) **Patent No.: US 7,544,276 B2**
(45) **Date of Patent: Jun. 9, 2009**

(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**

(75) Inventors: **Hongmei Zhang**, San Jose, CA (US); **Mukundan Narasimhan**, San Jose, CA (US); **Ravi B. Mullapudi**, San Jose, CA (US); **Richard E. Demaray**, Portola Valley, CA (US)

(73) Assignee: **SpringWorks, LLC**, Minnetonka, MN (US)

( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 529 days.

(21) Appl. No.: **11/228,834**

(22) Filed: **Sep. 16, 2005**

(65) **Prior Publication Data**

US 2006/0054496 A1 Mar. 16, 2006

**Related U.S. Application Data**

(62) Division of application No. 10/101,863, filed on Mar. 16, 2002, now Pat. No. 7,378,356.

(51) **Int. Cl.**
*C23C 14/34* (2006.01)

(52) **U.S. Cl.** .............................. **204/298.08**; 204/298.2; 204/298.06

(58) **Field of Classification Search** .............. 204/298.2, 204/298.06, 298.08
See application file for complete search history.

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| RE32,449 | E | 6/1987 | Claussen |
| 4,710,940 | A | 12/1987 | Sipes, Jr. |
| 4,785,459 | A | 11/1988 | Baer |
| 4,915,810 | A | 4/1990 | Kestigian et al. |
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(Continued)

*Primary Examiner*—Rodney G McDonald
(74) *Attorney, Agent, or Firm*—Finnegan, Henderson, Farabow, Garrett & Dunner, LLP

(57) **ABSTRACT**

A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing the reactor have controllable material properties such as the index of refraction. Optical components such as waveguide amplifiers and multiplexers can be fabricated using processes performed on a reactor according to the present invention.

**13 Claims, 27 Drawing Sheets**

**10**. The reactor of claim **6**, further including a temperature controller for holding the temperature of the substrate substantially constant.

’276 Patent, Claim 10

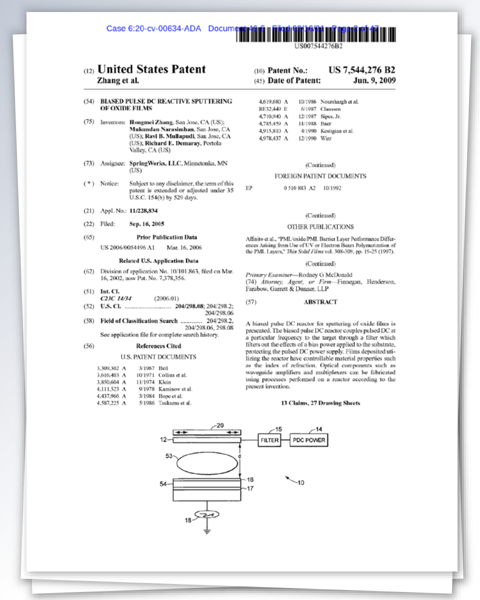
What does “substantially constant” mean in the context of this patent?

# The “Substantially Constant” Dispute

**Court’s Preliminary Construction:** Plain and ordinary meaning

| Claim Term | Demaray’s Proposal | Defendants’ Proposal |
|---|---|---|
| “the temperature of the substrate substantially constant” | Plain and ordinary meaning<br>or “substantially constant” means “within about 10 °C” | “within about 10 °C of the set temperature” |

# Defendants' Proposal Is Consistent With the Intrinsic Evidence



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(58) **Field of Classification Search** ............ 204/298.2, 204/298.06, 298.08
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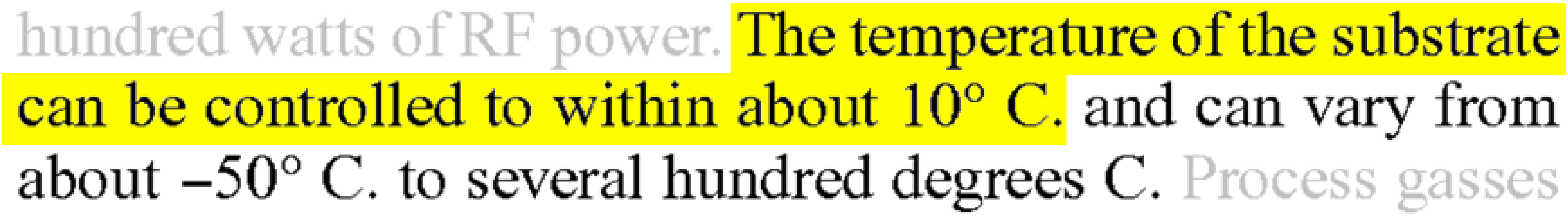
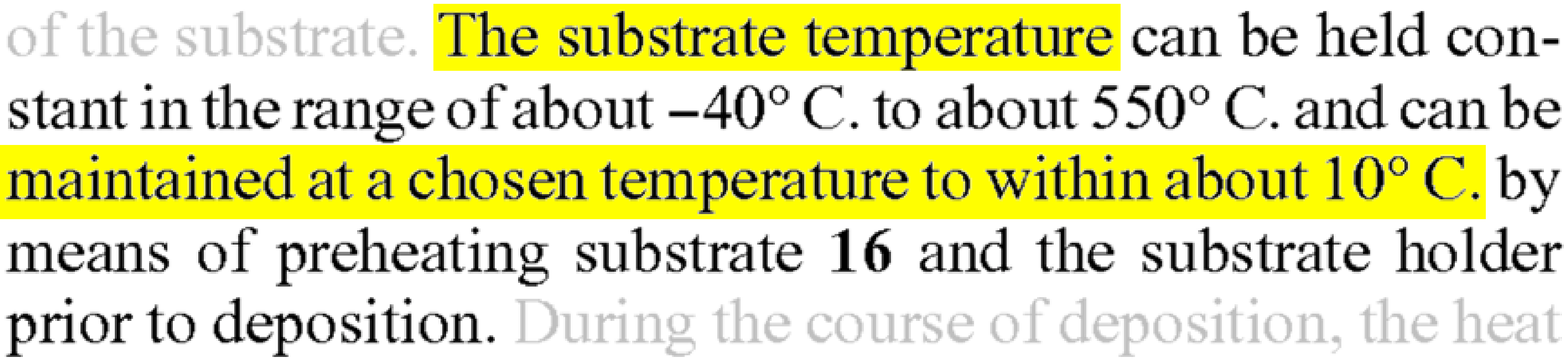


hundred watts of RF power. The temperature of the substrate can be controlled to within about 10° C. and can vary from about –50° C. to several hundred degrees C. Process gasses

'276 Patent, 3:1-3



of the substrate. The substrate temperature can be held constant in the range of about –40° C. to about 550° C. and can be maintained at a chosen temperature to within about 10° C. by means of preheating substrate 16 and the substrate holder prior to deposition. During the course of deposition, the heat

'276 Patent, 9:19-23

# Defendants' Proposal Is Correct: Demaray's Expert Confirms the 10 °C Difference is Measured from a Temperature Sensor's Reading

## Demaray's Expert

Q. So essentially the staying within 10 degrees is within 10 degrees of whatever you've measured the temperature at?

A. Right. The reality is one only measures the temperature where the temperature sensor is. There might be two temperature sensors, there might be three, but, you know, they're not everywhere.

Q. Okay. So – and based on whatever that temperature sensor is measuring, **a person of ordinary skill in the art would understand the temperature of the substrate substantially constant to be within about 10 degrees of whatever that measurement is**. Do I understand that right?

A. **Yes**. And that is how one sets processes. Any – any parameter for a process typically has a range where you say 1,000 watts plus or minus 20 watts, or 300 degrees plus or minus 5 degrees, or something. **So there's always a process setting, so that's – one of skill in the art would understand that 10 degrees is the process setting for the temperature control. That – that defines "substantially constant."**

Dkt. 58-7 (Dr. Glew Depo. Tr.), 278:6-279:5

# Demaray's Proposal is Incomplete

| Claim Term | Demaray's Proposal |
|---|---|
| "the temperature of the substrate substantially constant" | Plain and ordinary meaning<br>or "substantially constant" means "within about 10 °C" **[*of what*?]** |

# The Jury Would Benefit From Defendants' Proposed Construction

| Claim Term | Defendants' Proposal |
|---|---|
| "the temperature of the substrate substantially constant" | "within about 10 °C of a set temperature" |