

EXHIBIT 22



(12) **United States Patent**
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(54) **BIASED PULSE DC REACTIVE SPUTTERING OF OXIDE FILMS**
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4,437,966 A	3/1984	Hope et al.	204/298
4,587,225 A	5/1986	Tsukuma et al.	
4,619,680 A	10/1986	Nourshargh et al.	65/3.12
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.	204/298.04
4,978,437 A	12/1990	Wirz	204/192
5,085,904 A	2/1992	Deak et al.	
5,107,538 A	4/1992	Benton et al.	

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(Continued)

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FOREIGN PATENT DOCUMENTS

DE 37 38 738 C1 1/1989

(Continued)

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OTHER PUBLICATIONS

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(Continued)

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(57) **ABSTRACT**

(58) **Field of Classification Search** 438/769, 438/770, 771, 787, 788; 427/533; 204/192.12, 204/192.15; 257/E21.273, E21.278, E21.462
 See application file for complete search history.

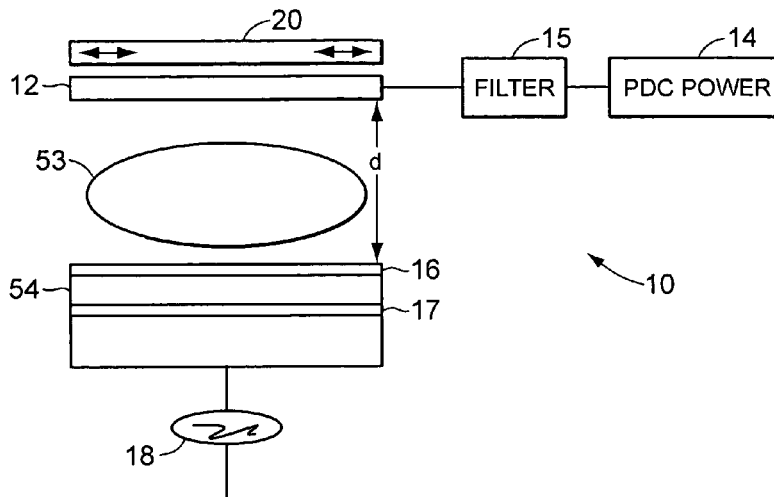
A biased pulse DC reactor for sputtering of oxide films is presented. The biased pulse DC reactor couples pulsed DC at a particular frequency to the target through a filter which filters out the effects of a bias power applied to the substrate, protecting the pulsed DC power supply. Films deposited utilizing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

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,309,302 A	3/1967	Heil	
3,616,403 A	10/1971	Collins et al.	204/192
3,850,604 A	11/1974	Klein	65/32
4,082,569 A	4/1978	Evans, Jr.	
4,111,523 A	9/1978	Kaminow et al.	350/96.14

35 Claims, 27 Drawing Sheets



US 7,378,356 B2

Page 2

U.S. PATENT DOCUMENTS								
5,119,460	A	6/1992	Bruce et al.	5,942,089	A *	8/1999	Sproul et al.	204/192.13
5,173,271	A	12/1992	Chen et al.	5,948,215	A	9/1999	Lantsman	204/192.12
5,174,876	A	12/1992	Buchal et al.	5,952,778	A	9/1999	Haskal et al.	
5,196,041	A	3/1993	Tumminelli et al.	5,961,682	A	10/1999	Lee et al.	65/384
5,200,029	A	4/1993	Bruce et al.	5,966,491	A	10/1999	DiGiovanni	
5,206,925	A	4/1993	Nakazawa et al.	5,977,582	A	11/1999	Fleming et al.	257/310
5,225,288	A	7/1993	Beeson et al.	6,000,603	A	12/1999	Koskenmaki et al.	
5,237,439	A	8/1993	Misono et al.	6,001,224	A	12/1999	Drummond	204/192.12
5,252,194	A	10/1993	Demaray et al.	6,004,660	A	12/1999	Topolski et al.	
5,287,427	A	2/1994	Atkins et al.	6,024,844	A	2/2000	Drummond et al. ...	204/192.12
5,296,089	A	3/1994	Chen et al.	6,045,626	A	4/2000	Yano et al.	
5,303,319	A	4/1994	Ford et al.	6,046,081	A	4/2000	Kuo	
5,306,569	A	4/1994	Hiraki	6,051,114	A	4/2000	Yao et al.	204/192.3
5,309,302	A	5/1994	Vollmann	6,051,296	A	4/2000	McCaulley et al.	
5,338,625	A	8/1994	Bates et al.	6,052,397	A	4/2000	Jeon et al.	
5,355,089	A	10/1994	Treger	6,057,557	A *	5/2000	Ichikawa	257/59
5,381,262	A	1/1995	Arima et al.	6,058,233	A	5/2000	Dragone	
5,427,669	A	6/1995	Drummond	6,071,323	A	6/2000	Kawaguchi	
5,433,835	A	7/1995	Demaray	6,077,642	A	6/2000	Ogata et al.	
5,435,826	A	7/1995	Sakakibara et al.	6,080,643	A	6/2000	Noguchi et al.	
5,457,569	A	10/1995	Liou et al.	6,086,730	A *	7/2000	Liu et al.	204/192.16
5,472,795	A	12/1995	Atita	6,088,492	A	7/2000	Kaneko et al.	
5,475,528	A	12/1995	LaBorde	6,093,944	A	7/2000	VanDover	257/310
5,478,456	A	12/1995	Humpal et al.	6,106,933	A	8/2000	Nagai et al.	
5,483,613	A	1/1996	Bruce et al.	6,117,279	A	9/2000	Smolanoff et al.	
5,499,207	A	3/1996	Miki et al.	6,133,670	A	10/2000	Rodgers et al.	
5,512,147	A	4/1996	Bates et al.	6,146,225	A	11/2000	Sheats et al.	
5,538,796	A	7/1996	Schaffer et al.	6,154,582	A	11/2000	Bazylenko et al.	
5,555,127	A	9/1996	Abdelkader et al.	6,157,765	A	12/2000	Bruce et al.	
5,561,004	A	10/1996	Bates et al.	6,162,709	A	12/2000	Raux et al.	438/513
5,563,979	A	10/1996	Bruce et al.	6,165,566	A	12/2000	Tropsha	
5,565,071	A	10/1996	Demaray et al.	6,168,884	B1	1/2001	Neudecker et al.	
5,569,520	A	10/1996	Bates	6,176,986	B1	1/2001	Watanabe et al.	204/298.13
5,584,974	A *	12/1996	Sellers	6,197,167	B1	3/2001	Tanaka	
5,591,520	A	1/1997	Migliorini et al.	6,198,217	B1	3/2001	Suzuki et al.	
5,597,660	A	1/1997	Bates et al.	6,204,111	B1	3/2001	Uemoto et al.	
5,603,816	A	2/1997	Demaray et al.	6,210,544	B1	4/2001	Sasaki	
5,607,560	A *	3/1997	Hirabayashi et al. ..	6,214,660	B1	4/2001	Uemoto et al.	
5,607,789	A	3/1997	Treger et al.	6,232,242	B1	5/2001	Hata et al.	
5,612,152	A	3/1997	Bates	6,236,793	B1	5/2001	Lawrence et al.	
5,613,995	A	3/1997	Bhandarkar et al.	6,242,129	B1	6/2001	Johnson	
5,645,626	A	7/1997	Edlund et al.	6,242,132	B1	6/2001	Neudecker et al.	
5,654,054	A	8/1997	Tropsha et al.	6,248,291	B1	6/2001	Nakagama et al.	419/46
5,654,984	A	8/1997	Hershbarger et al.	6,248,640	B1	6/2001	Nam	
5,686,360	A	11/1997	Harvey, III et al.	6,261,917	B1	7/2001	Quek et al.	
5,689,522	A	11/1997	Beach	6,280,585	B1	8/2001	Obinata et al.	204/298.19
5,693,956	A	12/1997	Shi et al.	6,280,875	B1	8/2001	Kwak et al.	
5,702,829	A	12/1997	Paidassi et al.	6,281,142	B1	8/2001	Basceri et al.	
5,718,813	A	2/1998	Drummond	6,287,986	B1	9/2001	Mihara	438/763
5,719,976	A	2/1998	Henry et al.	6,288,835	B1	9/2001	Nilsson et al.	
5,731,661	A	3/1998	So et al.	6,290,821	B1	9/2001	McLeod	
5,738,731	A	4/1998	Shindo et al.	6,290,822	B1	9/2001	Fleming et al.	204/192.22
5,755,938	A *	5/1998	Fukui et al.	6,300,215	B1	10/2001	Shin	
5,757,126	A	5/1998	Harvey, III et al.	6,302,939	B1	10/2001	Rabin et al.	
5,762,768	A	6/1998	Goy et al.	6,306,265	B1 *	10/2001	Fu et al.	204/192.12
5,771,562	A	6/1998	Harvey, III et al.	6,344,419	B1	2/2002	Forster et al.	438/758
5,792,550	A	8/1998	Phillips et al.	6,350,353	B2	2/2002	Gopalraja et al.	204/192.3
5,811,177	A	9/1998	Shi et al.	6,356,694	B1	3/2002	Weber	
5,830,330	A *	11/1998	Lantsman	6,358,810	B1	3/2002	Dornfest et al.	438/396
5,831,262	A	11/1998	Greywall et al.	6,361,662	B1	3/2002	Chiba et al.	
5,841,931	A	11/1998	Foresi et al.	6,365,300	B1	4/2002	Ota et al.	
5,847,865	A	12/1998	Gopinath et al.	6,365,319	B1	4/2002	Heath et al.	
5,849,163	A *	12/1998	Ichikawa et al.	6,376,027	B1	4/2002	Lee et al.	
5,853,830	A	12/1998	McCaulley et al.	6,391,166	B1	5/2002	Wang	
5,855,744	A	1/1999	Halsey et al.	6,409,965	B1	6/2002	Nagata et al.	419/26
5,870,273	A	2/1999	Sogabe et al.	6,413,382	B1	7/2002	Wang et al.	204/192.12
5,882,946	A	3/1999	Otani	6,413,645	B1	7/2002	Graff et al.	
5,900,057	A	5/1999	Buchal et al.	6,416,598	B1	7/2002	Sircar	
5,909,346	A	6/1999	Malhotra et al.	6,423,776	B1	7/2002	Akkapeddi et al.	
				6,433,380	B2	8/2002	Shin	
				6,444,750	B1	9/2002	Touhsaent	

US 7,378,356 B2

Page 3

6,506,289 B2	1/2003	Demaray et al.	EP	0 652 308 A2	10/1994
6,511,615 B1	1/2003	Dawes et al. 264/1.21	EP	0 639 655 A1	2/1995
6,533,907 B2	3/2003	Demaray et al.	EP	0 820 088	1/1998
6,537,428 B1	3/2003	Xiong et al. 204/192.13	EP	0 867 985 A1	9/1998
6,563,998 B1	5/2003	Farah et al. 385/131	EP	1068899 A1	1/2001
6,576,546 B2	6/2003	Gilbert et al.	EP	1 092 689 A1	4/2001
6,602,338 B2	8/2003	Chen et al. 252/301.4	EP	1 189 080 A2	3/2002
6,605,228 B1	8/2003	Kawaguchi et al. 216/24	JP	2-054764 A2	2/1990
6,615,614 B1	9/2003	Makikawa et al. 65/386	JP	5-230642 A	9/1993
6,632,563 B1	10/2003	Krasnov et al.	JP	6-010127	1/1994
6,673,716 B1	1/2004	D'Couto et al.	JP	6-100333	12/1994
6,683,244 B2	1/2004	Fujimori et al.	JP	7-224379 A	8/1995
6,683,749 B2	1/2004	Daby et al.	JP	7-233469	9/1995
6,750,156 B2	6/2004	Le et al.	KR	2003-0088236	11/2003
6,760,520 B1	7/2004	Medin et al.	WO	WO 2004/106581 A2	12/1994
6,768,855 B1	7/2004	Bakke et al.	WO	WO 96/23085	8/1996
6,818,356 B1	11/2004	Bates	WO	WO 97/35044	9/1997
6,827,826 B2	12/2004	Demaray et al.	WO	WO 99/61674 A1	12/1999
6,846,765 B2	1/2005	Imamura et al.	WO	WO 00/21898 A1	4/2000
6,884,327 B2	4/2005	Pan et al.	WO	WO 00/22742	4/2000
7,262,131 B2	8/2007	Narasimhan et al.	WO	WO 00/36665	6/2000
2001/0027159 A1	10/2001	Kaneyoshi	WO	WO 01/82297 A1	11/2001
2001/0031122 A1	10/2001	Lackritz et al.	WO	WO 02/12932	2/2002
2001/0034106 A1	10/2001	Moise et al.	WO	WO 2004/021532 A1	3/2004
2001/0041460 A1	11/2001	Wiggins	WO	WO 2004/077519 A2	9/2004
2002/0001746 A1	1/2002	Jenson	WO	WO 2004/106582 A2	12/2004
2002/0014406 A1	2/2002	Takashima	WO	WO 2006/063308 A2	6/2006
2002/0033330 A1	3/2002	Demaray et al.	WO	WO 2007/027535 A2	3/2007
2002/0076133 A1	6/2002	Li et al.			
2002/0106297 A1	8/2002	Ueno et al. 419/12			
2002/0115252 A1	8/2002	Haukka et al.			
2002/0134671 A1	9/2002	Demaray et al.			
2002/0140103 A1	10/2002	Kloster et al.			
2002/0170821 A1	11/2002	Sandlin et al.			
2002/0191916 A1	12/2002	Frish et al.			
2003/0019326 A1	1/2003	Han et al. 45/245			
2003/0022487 A1*	1/2003	Yoon et al. 438/642			
2003/0035906 A1	2/2003	Memarian et al.			
2003/0042131 A1*	3/2003	Johnson 204/192.23			
2003/0044118 A1	3/2003	Zhou et al.			
2003/0063883 A1	4/2003	Demaray et al. 385/129			
2003/0077914 A1*	4/2003	Le et al. 438/763			
2003/0079838 A1*	5/2003	Brcka 156/345.48			
2003/0097858 A1	5/2003	Strohhofer et al.			
2003/0127319 A1	7/2003	Demaray et al.			
2003/0134054 A1	7/2003	Demaray et al.			
2003/0141186 A1*	7/2003	Wang et al. 204/298.07			
2003/0143853 A1	7/2003	Celii et al.			
2003/0173207 A1	9/2003	Zhang et al.			
2003/0173208 A1	9/2003	Pan et al.			
2003/0174391 A1	9/2003	Pan et al.			
2003/0175142 A1	9/2003	Milonopoulou et al. 419/49			
2003/0178637 A1	9/2003	Chen et al.			
2003/0185266 A1	10/2003	Henrichs			
2004/0043557 A1	3/2004	Haukka et al.			
2004/0077161 A1	4/2004	Chen et al.			
2004/0105644 A1	6/2004	Dawes			
2004/0259305 A1	12/2004	Demaray et al.			
2005/0000794 A1	1/2005	Demaray et al.			
2005/0006768 A1	1/2005	Narasimhan et al.			
2005/0048802 A1	3/2005	Zhang et al.			
2005/0175287 A1	8/2005	Pan et al.			
2005/0183946 A1	8/2005	Pan et al.			
2006/0054496 A1	3/2006	Zhang et al.			
2006/0057283 A1	3/2006	Zhang et al.			
2006/0057304 A1	3/2006	Zhang et al.			
2006/0071592 A1	4/2006	Narasimhan et al.			
2006/0134522 A1	6/2006	Zhang et al.			
2007/0053139 A1	3/2007	Zhang et al.			

OTHER PUBLICATIONS

- Belkind et al., "Using pulsed direct current power for reactive sputtering of Al₂O₃," *J. Vac. Sci. Technol.* A 17(4), pp. 1934-1940 (Jul. 1999).
- Byer et al., "Nonlinear Optics and Solid-state Lasers," *IEEE Journal on Selected Topics in Quantum Electronics*, vol. 6, No. 6, pp. 921-929 (Nov. 2000).
- Fujii et al., "1.54 nm photoluminescence of Er³⁺ doped into SiO₂ films containing Si nanocrystals: Evidence for energy transfer from Si nanocrystals for Er₃₊," *Appl. Phys. Lett.*, 71 (9), pp. 1198-1200 (Sep. 1997).
- Kelly et al., "Reactive pulsed magnetron sputtering process for alumina films," *J. Vac. Sci. Technol.* A 18(6), pp. 2890-2896 (Nov. 2000).
- Kelly et al., "Control of the structure and properties of aluminum oxide coatings deposited by pulsed magnetron sputtering," *J. Vac. Sci. Technol.* A 17(3), pp. 945-953 (May 1999).
- Pan et al., "Planar Er³⁺-doped aluminosilicate waveguide amplifier with more than 10 dB gain across C-band," *Optical Society of America*, 3 pages (2000).
- Roberts et al., "The Photoluminescence of Erbium-doped Silicon Monoxide," Department of Electronics and Computer Science, 7 pages (Jun. 1996).
- Schiller et al., "PVD Coating of Plastic Webs and Sheets with High Rates on Large Areas," European Materials Research Society 1999 Spring Meeting, Strasbourg, France (Jun. 1-4, 1999).
- Shaw et al., "Use of Vapor Deposited Acrlate Coatings to Improve the Barrier Properties of Metallized Film," Society of Vacuum Coaters 505/856-7168, 37th Annual Technical Conference Proceedings, pp. 240-244 (1994).
- Shin et al., "Dielectric and Electrical Properties of Sputter Grown (Ba,Sr)TiO₃ Thin Films," *J. Appl. Phys.*, vol. 86, No. 1, pp. 506-513, (Jul. 1, 1999).
- Shmulovich et al., "Recent progress in Erbium-doped waveguide amplifiers," *Bell Laboratories*, 3 pages (1999).
- Ting et al., "Study of planarized sputter-deposited SiO₂," *J. Vac. Sci. Technol.*, 15(3) pp. 1105-1112 (May/Jun. 1978).
- Van Dover, R.B., "Amorphous Lanthanide-Doped TiO_x Dielectric Films," *Appl. Phys. Lett.*, vol. 74, No. 20, pp. 3041-3043 (May 17, 1999).
- Westlinder et al., "Simulation and Dielectric Characterization of

FOREIGN PATENT DOCUMENTS

US 7,378,356 B2

Page 4

- Yoshikawa, K. et al., "Spray formed aluminum alloys for sputtering targets," *Power Metallurgy*, vol. 43, No. 3, pp. 198-199 (2000).
- Zhang, Hongmei et al. "High Dielectric Strength, High k TiO₂ Films by Pulsed DC, Reactive Sputter Deposition," (2002).
Office Action dated Mar. 25, 2005, received in Application No. 10/954,182.
- Dorey, R.A., "Low temperature micromoulding of functional ceramic devices," Grant summary for GR/S84156/01 for the UK Engineering and Physical Sciences Research Council, 2 pages (2004).
- Howson, R.P., "The reactive sputtering of oxides and nitrides," *Pure & Appl. Chem.* 66(6):1311-1318 (1994).
Office Action issued Sep. 21, 2005 in U.S. Appl. No. 11/100,856.
Office Action issued on Aug. 8, 2005 in U.S. Appl. No. 10/101,341.
Office Action issued on Oct. 3, 2005 in U.S. Appl. No. 10/650,461.
Office Action issued on Oct. 19, 2005 in U.S. Appl. No. 10/851,542.
- Kim, H-K. and Yoon, Y., "Characteristics of rapid-thermal-annealed LiCoO₂ cathode film for an all-solid state thin film microbattery," *J. Vac. Sci. Technol. A* 22(4):1182-1187 (2004).
Response to Office Action filed on Oct. 17, 2005 in U.S. Appl. No. 10/291,179.
- Final Office Action issued on Dec. 14, 2005 in U.S. Appl. No. 10/291,179.
- PCT Invitation to Pay Additional Fees for PCT/US01/22750, dated Mar. 13, 2002.
- PCT International Search Report for PCT/US01/22750, dated Jul. 19, 2002.
- PCT Written Opinion for PCT/US01/22750, dated Jul. 23, 2002.
- PCT International Preliminary Examination Report for PCT/US01/22750, dated Oct. 8, 2002.
- Office Action issued on Nov. 28, 2005 in U.S. Appl. No. 09/903,081.
Response to Office Action filed on Dec. 21, 2005 in U.S. Appl. No. 10/954,182.
- Response to Office Action filed on Jul. 25, 2005 in U.S. Appl. No. 10/954,182.
- Office Action issued on Oct. 25, 2005, in U.S. Appl. No. 10/954,182.
Response to Office Action filed on Nov. 8, 2005, in U.S. Appl. No. 10/101,341.
- Office Action issued on Feb. 13, 2006, in U.S. Appl. No. 10/101,341.
Response to Office Action filed on Jan. 3, 2006 in U.S. Appl. No. 10/650,461.
- PCT International Preliminary Examination Report mailed Apr. 15, 2004 in PCT/US03/24809.
- Office Action issued on Dec. 2, 2005 in U.S. Appl. No. 10/789,953.
Specification and Preliminary Amendment as filed for U.S. Appl. No. 11/297,057.
- Office Action issued on Mar. 24, 2005 in U.S. Appl. No. 10/851,542.
Response to Office Action dated Jul. 25, 2005 in U.S. Appl. No. 10/851,542.
- Response to Office Action filed Jan. 19, 2006 in U.S. Appl. No. 10/851,542.
- PCT International Search Report and Written Opinion for Application No. PCT/US2004/014524 dated Mar. 2, 2005.
- PCT International Preliminary Report on Patentability for Application No. PCT/US2004/014524, dated Dec. 8, 2005.
- PCT International Search Report for Application No. PCT/US2004/014523 dated Jan. 17, 2005.
- PCT Written Opinion for Application No. PCT/US2004/014523 dated Jan. 17, 2005.
- PCT International Preliminary Report on Patentability for Application No. PCT/US2004/014523, dated Dec. 8, 2005.
Specification as filed for U.S. Appl. No. 11/297,057.
Response to Office Action filed Feb. 20, 2002, for US Patent No. 6,506,289.
- Response to Office Action filed Jul. 17, 2002, for US Patent No. 6,506,289.
- Response to Office Action filed Feb. 28, 2006 in U.S. Appl. No. 09/903,081.
- Response to Office Action filed Mar. 2, 2006 in U.S. Appl. No. 10/789,953.
- ASM Handbook*, Formerly Ninth Edition, Metals Handbook, vol. 15, Casting, Davis et al. (Eds.), ASM International, pp. 372-373, 376-383, and 410-411 (1988).
- Masuda, H. & Kawai, S., "Wide-band and gain-flattened hybrid fiber amplifier consisting of an EDFA and a multiwavelength pumped raman amplifier," *IEEE Photonics Technology Lett.* 11(6):647-649 (1999).
- Snoeks, E. et al., "Cooperative upconversion in erbium-implanted soda-lime silicate glass optical waveguides," *J. Opt. Soc. Am. B* 12(8):1468-1474 (1995).
- Response to Office Action filed Jul. 27, 2006, in U.S. Appl. No. 10/291,179.
- Notice of Allowance mailed Mar. 25, 2004 for US Patent No. 6,827,826.
- Notice of Allowance issued on Oct. 8, 2002, in U.S. Patent No. 6,533,907.
- Notice of Allowance issued on Oct. 21, 2004, in U.S. Appl. No. 10/101,492.
- Response to Office Action filed on Aug. 9, 2006 in U.S. Appl. No. 10/954,182.
- Office Action issued on Aug. 2, 2006, in U.S. Appl. No. 10/101,341.
Response to Office Action filed on Jul. 24, 2006, in U.S. Appl. No. 10/650,461.
- Response to Office Action filed Jul. 26, 2006 in U.S. Appl. No. 10/851,542.
- Barbier, D., "Performances and potential applications of erbium doped planar waveguide amplifiers and lasers," *Proc. OAA*, Victoria, BC, Canada, pp. 58-63, (Jul. 21-23, 1997).
- Kelly, P.J. et al., "A novel technique for the deposition of aluminum-doped zinc oxide films," *Thin Solid Films* 426(1-2):111-116 (2003).
- Tomaszewski, H. et al., "Yttria-stabilized zirconia thin films grown by reactive r.f. magnetron sputtering," *Thin Solid Films* 287:104-109 (1996).
- Response to Final Office Action filed Apr. 14, 2006, in U.S. Appl. No. 10/291,179.
- Office Action mailed Apr. 27, 2006, in U.S. Appl. No. 10/291,179.
- Final Office mailed May 8, 2006 in U.S. Appl. No. 09/903,081.
- Response to Office Action file Feb. 17, 2006 in U.S. Appl. No. 11/100,856.
- Office Action issued on Mar. 9, 2006, in U.S. Appl. No. 10/954,182.
Response to Office Action filed on May 15, 2006, in U.S. Appl. No. 10/101,341.
- Final Office Action issued on May 19, 2006 in U.S. Appl. No. 10/789,953.
- Office Action from Singapore Patent Office in Appl. No. 200505388-9, dated Mar. 20, 2006.
- Office Action mailed Apr. 19, 2006 in U.S. Appl. No. 10/851,542.
- Belkind, A. et al., "Pulsed-DC Reactive Sputtering of Dielectrics: Pulsing Parameter Effects," 43rd Annual Technical Conference Proceedings-Denver: 86-90 (Apr. 15-20, 2000).
- Scholl, R., "Power Supplies for Pulsed Plasma Technologies: State-Of-The-Art And Outlook," *Advances Energy Industries, Inc.*, pp. 1-8 (1999).
- Scholli, R., "Power Systems for Reactive Sputtering of Insulating Films," *Advances Energy Industries, Inc.*, pp. 1-8 (Aug. 2001).
- Final Office Action dated Oct. 12, 2006, in U.S. Appl. No. 10/291,179.
- Response to Final Office Action dated Nov. 3, 2006, in U.S. Appl. No. 10/291,179.
- Office Action dated Dec. 1, 2006, in U.S. Appl. No. 10/291,179.
Amendment dated Oct. 19, 2006, in U.S. Appl. No. 09/903,081.
Office Action dated Dec. 18, 2006, in U.S. Appl. No. 09/903,081.
Response to Office Action dated Sep. 11, 2006 in U.S. Appl. No. 11/100,856.
- Office Action dated Dec. 1, 2006, in U.S. Appl. No. 11/100,856.
Office Action dated Oct. 31, 2006, in U.S. Appl. No. 10/954,182.
Response to Office Action dated Dec. 6, 2006, in U.S. Appl. No. 10/954,182.
- Supplemental Preliminary Amendment dated Feb. 6, 2007, in U.S. Appl. No. 11/228,834.

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