

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,

Petitioner

v.

DEMARAY LLC

Patent Owner

Patent No. 7,381,657

IPR2021-01031

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 7,381,657**

TABLE OF CONTENTS

I.	INTRODUCTION	1
II.	MANDATORY NOTICES	2
III.	PAYMENT OF FEES	3
IV.	GROUND FOR STANDING.....	3
V.	PRECISE RELIEF REQUESTED AND GROUNDS RAISED.....	4
VI.	LEVEL OF ORDINARY SKILL	9
VII.	THE '657 PATENT.....	10
VIII.	CLAIM CONSTRUCTION	11
IX.	DETAILED EXPLANATION OF GROUNDS.....	12
A.	Ground 1: <i>Barber</i> in view of <i>Hirose</i> Renders Obvious Claims 2-4, 6, 8, 10-12, and 21	12
1.	Claim 2	12
2.	Claim 3	34
3.	Claim 4	36
4.	Claim 6	36
5.	Claim 8	37
6.	Claim 10	37
7.	Claim 11	38
8.	Claim 12	38
9.	Claim 21	39
B.	Ground 2: <i>Barber</i> in view of <i>Hirose</i> and <i>Dogheche</i> Renders Obvious Claims 5 and 7	40
1.	Claim 5	40
2.	Claim 7	42
C.	Ground 3: <i>Barber</i> in view of <i>Hirose</i> and <i>Safi</i> Renders Obvious Claim 9	43
1.	Claim 9	43
D.	Ground 4: <i>Barber</i> in view of <i>Hirose</i> and <i>Aokura</i> Renders Obvious Claims 12 and 13.....	45
1.	Claims 12 and 13.....	45

E.	Ground 5: <i>Barber</i> in view of <i>Hirose</i> and <i>Segal</i> Renders Obvious Claims 14-18	48
1.	Claims 14 and 15.....	48
2.	Claim 16.....	51
3.	Claim 17	51
4.	Claim 18.....	52
F.	Ground 6: <i>Barber</i> in view of <i>Hirose</i> , <i>Segal</i> , and <i>Sakawaki</i> Renders Obvious Claim 19.....	53
1.	Claim 19	53
G.	Ground 7: <i>Barber</i> in view of <i>Hirose</i> and <i>Sill</i> Renders Obvious Claim 20	56
1.	Claim 20	56
H.	Ground 8: <i>Barber</i> in view of <i>Hirose</i> and <i>Sellers</i> Renders Obvious Claim 1	59
1.	Claim 1	59
I.	Grounds 9-16: Each of the Above Prior Art Combinations in view of <i>Belkind</i> Renders Obvious the Challenged Claims	66
X.	DISCRETIONARY DENIAL IS NOT APPROPRIATE HERE.....	71
A.	The Board Should Not Deny Institution Under § 325	71
B.	Institution is Appropriate Under § 314(a).....	72
XI.	CONCLUSION.....	76

LIST OF EXHIBITS

Ex. 1001	U.S. Patent No. 7,381,657
Ex. 1002	Declaration of Dr. Vivek Subramanian
Ex. 1003	Curriculum Vitae of Dr. Vivek Subramanian
Ex. 1004	Prosecution History of U.S. Patent No. 7,381,657
Ex. 1005	U.S. Patent No. 6,342,134 to Barber et al.
Ex. 1006	U.S. Patent No. 6,485,602 to Hirose
Ex. 1007	U.S. Patent No. 5,651,865 to Sellers
Ex. 1008	A. Belkind et al., <i>Pulsed-DC reactive sputtering of dielectrics: Pulsing parameter effects</i> (2000)
Ex. 1009	U.S. Patent No. 4,464,223 to Gorin
Ex. 1010	U.S. Patent No. 6,132,564 to Licata
Ex. 1011	U.S. Patent No. 5,942,089 to Sproul
Ex. 1012	U.S. Patent No. 6,352,629 to Wang
Ex. 1013	S. Gibilisco, <i>Handbook of Radio & Wireless Technology</i> (1999)
Ex. 1014	J. Joo, <i>Low-temperature polysilicon deposition by ionized magnetron sputtering</i> (2000)
Ex. 1015	B. Chapman, <i>Glow Discharge Processes</i>
Ex. 1016	U.S. Patent No. 4,579,618 to Celestino
Ex. 1017	International Publication No. WO 02/23588 to Quon
Ex. 1018	International Publication No. WO 01/6300 to Johnson
Ex. 1019	U.S. Patent No. 6,695,954 to Hong
Ex. 1020	U.S. Patent No. 6,153,068 to Ohmi

Ex. 1021	U.S. Patent No. 4,846,920 to Keller
Ex. 1022	U.S. Patent No. 6,911,351 to Kidoguchi
Ex. 1023	U.S. Patent No. 5,302,882 to Miller
Ex. 1024	Pinnacle Plus+ 10KW (325-650 Vdc) Master/Slave AE Bus, DeviceNet, MDXL User, UHF Output User Manual (March 2005)
Ex. 1025	The Advanced Energy MDX Magnetron Drive, Advanced Energy Industries, Inc. (March 1993)
Ex. 1026	Pinnacle 10x6 kW DeviceNet, MDXL User 5702063-C, User Manual, (May 2000)
Ex. 1027	U.S. Patent Publication No. 2002/0027249 A1 to Takemura
Ex. 1028	U.S. Patent Publication No. 2002/0144889 to Tao
Ex. 1029	E. Dogheche, <i>Growth and optical characterization of aluminum nitride thin films deposited on silicon by radio-frequency sputtering</i> , <i>Applied Physics Letters</i> (1999)
Ex. 1030	U.S. Patent No. 6,506,686 to Masuda
Ex. 1031	K. Nam, <i>A study on the high rate deposition of CrN films with x controlled microstructure by magnetron sputtering</i> , <i>Surface & Coatings Technology</i> (2000)
Ex. 1032	D. Mattox, <i>Handbook of Physical Vapor Deposition (PVD) Processing – Film Formation, Adhesion, Surface Preparation and Contamination Control</i> (1998)
Ex. 1033	U.S. Patent No. 5,830,327 to Kolenkow
Ex. 1034	U.S. Patent Publication No. 2001/0041252 to Laird
Ex. 1035	M. Ruske, <i>Properties of SiO₂ and Si₃N₄ layers deposited by MF twin magnetron sputtering using different target materials</i> , <i>Thin Solid Films</i> (1999)

Ex. 1036	W. Sproul, <i>High-rate reactive DC magnetron sputtering of oxide and nitride superlattice coatings</i> (1998)
Ex. 1037	U.S. Patent Publication No. 2003/0029563 to Kaushal
Ex. 1038	U.S. Patent No. 6,627,323 to Nagaraj
Ex. 1039	I. Safi, <i>A novel reactive magnetron sputtering technique for producing insulating oxides of metal alloys and other compound thin films</i> (2000)
Ex. 1040	U.S. Patent No. 6,001,227 to Pavate
Ex. 1041	S. Wolf et al., <i>Silicon Processing for the VLSI Era</i> , Vol. 1 (2000)
Ex. 1042	Declaration of Dr. Ingrid Hsieh-Yee
Ex. 1043	U.S. Patent Publication No. 2001/0031383 to Sakawaki
Ex. 1044	U.S. Patent No. 4,895,631 to Wirz
Ex. 1045	U.S. Patent No. 7,041,391 to Ando
Ex. 1046	U.S. Patent No. 6,657,260 to Yamazaki
Ex. 1047	A. Billard, <i>Low-frequency modulation of pulsed d.c. or r.f. discharges for controlling the reactive magnetron sputtering process</i> , <i>Surface & Coatings Technology</i> (1996)
Ex. 1048	P. Kelly, <i>The deposition of aluminum oxide coatings by reactive unbalanced magnetron sputtering</i> (1996)
Ex. 1049	U.S. Patent No. 7,247,227 to Hanson
Ex. 1050	U.S. Patent No. 7,391,072 to Forbes
Ex. 1051	International Publication No. WO 96/06203 to O'Brien
Ex. 1052	File History of U.S. Patent No. 7,378,356
Ex. 1053	Applied Physics Letters, Vol. 74, No. 9 (March 1, 1999) Webpages https://aip.scitation.org/toc/apl/74/9?size=all& and https://aip.scitation.org/doi/10.1063/1.123501 (visited Sept. 2020)

Ex. 1054	U.S. Patent No. 5,331,218 to Moody
Ex. 1055	<i>Overall Revision of the Rules Regarding Industrial Scientific and Medical (ISM) Equipment</i> , 50 Fed. Reg. 36,061 (September 5, 1985)
Ex. 1056	U.S. Patent No. 6,409,965 to Nagata
Ex. 1057	U.S. Patent No. 6,284,110 to Sill
Ex. 1058	U.S. Patent No. 5,148,133 to Zennamo
Ex. 1059	P. Kelly et al., <i>Reactive pulsed magnetron sputtering process. for alumina films</i> (2000)
Ex. 1060	U.S. Patent Application No. 09/145,323 to Miller et al.
Ex. 1061	U.S. Patent No. 4,960,651 to Pettigrew
Ex. 1062	Pinnacle 20 kW DeviceNet, MDXL User 5702199-A, User Manual, (April 2001)
Ex. 1063	U.S. Patent No. 6,010,583 to Annavarapu
Ex. 1064	RESERVED
Ex. 1065	Pinnacle Plus Pulsed DC Power Supply Data Sheet (April 1999)
Ex. 1066	Advanced Energy Industries, Inc. SEC 10-K (2000)
Ex. 1067	Pinnacle Plus 10kW User 5702269-B, User Manual, (June 2002)
Ex. 1068	Japanese Patent Publication No. JPH10102247A to Aokura and certified English translation of JPH10102247A
Ex. 1069	U.S. Patent Application Publication US 2001/0047838 to Segal
Exs. 1070-1074	RESERVED
Ex. 1075	Complaint filed <i>Demaray LLC v. Intel Corporation</i> , Case No. 6-20-cv-00634 (W.D. Tex.)

Petition for *Inter Partes* Review
Patent No. 7,381,657

Ex. 1076	Complaint filed in <i>Demaray LLC v. Samsung Electronics Co., Ltd.</i> et al., Case No. 6-20-cv-00636 (W.D. Tex.)
Ex. 1077	First Amended Complaint filed in <i>Applied Materials, Inc. v. Demaray LLC</i> , Case No. 5-20-cv-05676 (N.D. Cal.)
Ex. 1078	Preliminary Injunction Motion filed in <i>Applied Materials, Inc. v. Demaray LLC</i> , Case No. 5-20-cv-05676 (N.D. Cal.)
Ex. 1079	Docket Report (October 21, 2020) <i>Applied Materials, Inc. v. Demaray LLC</i> , Case No. 5-20-cv-05676 (N.D. Cal.)
Ex. 1080	Docket Report (October 21, 2020) <i>Demaray LLC v. Intel Corporation</i> , Case No. 6-20-cv-00634 (W.D. Tex.)
Ex. 1081	Docket Report (Oct. 21, 2020) <i>Demaray LLC v. Samsung Electronics Co., Ltd.</i> et al., Case No. 6-20-cv-00636 (W.D. Tex.)
Ex. 1082	Order Governing Proceedings (October 5, 2020) <i>Demaray LLC v. Intel Corporation</i> , Case No. 6-20-cv-00634 (W.D. Tex.)

I. INTRODUCTION

Intel Corporation (“Intel” or “Petitioner”), requests *inter partes* review (“IPR”) of claims 1-21 (“the challenged claims”) of U.S. Patent No. 7,381,657 (“the ’657 patent”) (Ex. 1001), assigned to Demaray LLC (“Patent Owner” or “PO”) according to PTO records.

Intel asserts the same grounds of unpatentability upon which the Board has already instituted review of the challenged claims of the ’657 patent in *Applied Materials, Inc. v. Demaray LLC*, IPR2021-00104 (the “Applied Materials IPR”); *see* Paper 13 (Institution of *Inter Partes* Review, 35 U.S.C. §314) (May 11, 2021), 2. For the same reasons previously considered by the Board, on the exact same trial schedule, Intel seeks to join the Applied Materials IPR. Petitioner does not add or alter any arguments that have been considered by the Board, and Petitioner does not seek to expand the grounds of unpatentability that the Board instituted in the Applied Materials IPR. Accordingly, there exists a reasonable likelihood that Intel will prevail in demonstrating unpatentability of at least one challenged claim based on teachings set forth in the references presented in this Petition.

Because this Petition is filed within one month of the institution of the Applied Materials IPR and this Petition is accompanied by a Motion for Joinder, this Petition is timely and proper under 35 U.S.C. § 315(c).

For reasons below, the challenged claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

Real Party-in-Interest: Petitioner identifies Intel Corporation, Applied Materials, Inc., Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., Samsung Semiconductor, Inc., and Samsung Austin Semiconductor, LLC as the real parties-in-interest.

Related Matters: The '657 patent is at issue in the following cases: *Demaray LLC v. Samsung Electronics Co., Ltd. et al.*, Case No. 6-20-cv-00636 (W.D. Tex.) (“Samsung Litigation”); *Demaray LLC v. Intel Corporation*, Case No. 6-20-cv-00634 (W.D. Tex.) (“Intel Litigation”); *Applied Materials, Inc. v. Demaray LLC*, Case No. 5-20-cv-05676 (N.D. Cal.); (terminated); *Applied Materials, Inc. v. Demaray LLC*, 5-20-cv-09341 (N.D. Cal.); *Applied Materials, Inc. v. Demaray LLC*, IPR2021-00104 (PTAB) (institution granted); *Applied Materials, Inc. v. Demaray LLC*, IPR2021-00106 (PTAB) (institution denied).

The above district court cases also involve U.S. Patent No. 7,544,276, against which Petitioner is also filing an IPR petition.

Counsel and Service Information: Petitioner designates lead and back-up counsel as noted below. Powers of attorney pursuant to 37 C.F.R. § 42.10(b) accompany this Petition.

Lead Counsel: David L. Cavanaugh (Reg. No. 36,476)

Backup Counsel: Richard Goldenberg (Reg. No. 38,895)

Sonal N. Mehta (*pro hac vice* to be requested)

Claire M. Specht (*pro hac vice* to be requested)

Service Information:

- E-mail:

David.Cavanaugh@wilmerhale.com

Richard.Goldenberg@wilmerhale.com

Sonal.Mehta@wilmerhale.com

Claire.Specht@wilmerhale.com

whinteldemarayservicelist@wilmerhale.com

- Post and hand delivery:

Wilmer Cutler Pickering Hale and Dorr LLP
1875 Pennsylvania Avenue NW
Washington, DC 20006
Telephone: 202-663-6000
Facsimile: 202-663-6363

Petitioner consents to service via email at the email addresses above.

III. PAYMENT OF FEES

See the concurrently filed Fee Authorization Form.

IV. GROUNDS FOR STANDING

Petitioner certifies that the '657 patent is available for review and is not barred or estopped from requesting review on the identified grounds.

V. PRECISE RELIEF REQUESTED AND GROUNDS RAISED

Ground 1: Claims 2-4, 6, 8, 10-12, and 21 are unpatentable under 35 U.S.C. § 103 as obvious over *Barber* (Ex. 1005) and *Hirose* (Ex. 1006);

Ground 2: Claims 5 and 7 are unpatentable under § 103 as obvious over *Barber*, *Hirose*, and *Dogheche* (Ex. 1029);

Ground 3: Claim 9 is unpatentable under § 103 as obvious over *Barber*, *Hirose*, and *Safi* (Ex. 1039);

Ground 4: Claims 12 and 13 are unpatentable under § 103 as obvious over *Barber*, *Hirose*, and *Aoknra* (Ex. 1068);

Ground 5: Claims 14-18 are unpatentable under § 103 as obvious over *Barber*, *Hirose*, and *Segal* (Ex. 1069);

Ground 6: Claim 19 is unpatentable under § 103 as obvious over *Barber*, *Hirose*, *Segal*, and *Sakawaki* (Ex. 1043);

Ground 7: Claim 20 is unpatentable under § 103 as obvious over *Barber*, *Hirose*, and *Sill* (Ex. 1057);

Ground 8: Claim 1 is unpatentable under § 103 as obvious over *Barber*, *Hirose*, and *Sellers* (Ex. 1007);

Ground 9: Claims 2-4, 6, 8, 10, 11, 12, and 21 are unpatentable under § 103 as obvious over *Barber*, *Hirose*, and *Belkind* (Ex. 1008);

Ground 10: Claims 5 and 7 are unpatentable under § 103 as obvious over *Barber, Hirose, Belkind, and Dogheche*;

Ground 11: Claim 9 is unpatentable under § 103 as obvious over *Barber, Hirose, Belkind, and Safi*;

Ground 12: Claims 12 and 13 are unpatentable under § 103 as obvious over *Barber, Hirose, Belkind, and Aokura*;

Ground 13: Claims 14-18 are unpatentable under § 103 as obvious over *Barber, Hirose, Belkind, and Segal*;

Ground 14: Claim 19 is unpatentable under § 103 as obvious over *Barber, Hirose, Belkind, Segal, and Sakawaki*;

Ground 15: Claim 20 is unpatentable under § 103 as obvious over *Barber, Hirose, Belkind, and Sill*; and

Ground 16: Claim 1 is unpatentable under § 103 as obvious over *Barber, Hirose, Belkind, and Sellers*.

The '657 patent claims a March 16, 2002 priority date. *Barber* issued from an application filed February 11, 2000 (Ex. 1005, Cover), *Hirose* issued from an application filed July 18, 2001 (Ex. 1006, Cover). Both qualify as prior art under § 102(e). *Aokura* published on April 21, 1998 (Ex. 1068, Cover) and qualifies as prior art under § 102(b). *Sellers* issued on July 29, 1997 and *Sill* issued September 4, 2001, and both qualify as prior art under § 102(b) (Ex. 1007, Cover; Ex. 1057,

Cover). *Sakawaki* published on October 18, 2001 from an application filed March 19, 2001 (Ex. 1043, Cover) and *Segal* published on December 6, 2001 from an application filed February 13, 2001, and both qualify as a prior art under §§ 102(a) and (e).

Dogheche is an article received on July 24, 1998, accepted for publication on January 5, 1999, and published by the American Institute of Physics in Applied Physics Letters, Vol. 74, No. 9 on March 1, 1999. (Ex. 1029, 1-2; Ex. 1042, ¶¶35-37, Appendix 1029.)¹ *Dogheche* itself demonstrates it was published and publicly available at least as early as March 1999. (e.g., 1999 copyright marking (Ex. 1029, 1-2), “March 1999” date on each page (*id.*, 1-4), citations dated from 1969-1999 (*id.*, 4); Ex. 1042, ¶¶35-37). Other information so confirms. (Ex. 1053, 3 (AIP.org website (visited 2020) showing *Dogheche* in Applied Physics Letters, Vol. 74, No. 9, March 1, 1999), 20-23 (resulting page from hyperlink for *Dogheche* on page 3, including same title, abstract and references cited as in Ex. 1029), Linda Hall Library date stamp (“AUG 04 1999”) (Ex. 1042, ¶¶38, 41, Appendix 1029-A), bibliographic

¹ Petitioner submits Dr. Ingrid Hsieh-Yee’s testimony regarding various references’ printed publication status. (Ex. 1042, ¶¶3-20, Appendix A.) Applied Materials authorized Intel to use Dr. Hsieh-Yee’s declaration from IPR2021-00104 for this Petition.

and MARC records (Ex. 1042, ¶¶39-49, Appendices 1029-B, 1029-C), and citations to *Dogheche* in prior publications (*id.*, ¶50; *id.*, (Appendix 1029-D, 2-4 (May 2000 article), 3 (citation [9] to *Dogheche*), 4-9 (November 2000 article), 9 (citation [9] to *Dogheche*), 10-14 (February 2001 article), 14 (citation [6] to *Dogheche*) and Dr. Hsieh-Yee's testimony (Ex. 1042, ¶¶35-51) demonstrate *Dogheche* was publicly accessible before March 2002.

Safi is an article received on March 20, 2000 and accepted in revised form for publication on August 17, 2000, and published by Elsevier Science B.V in Surface and Coatings Technology Journal (135) in 2000. (Ex. 1039, 1; Ex. 1042, ¶¶67-69, Appendix 1039.) *Safi* itself demonstrates that it was published and publicly available at least as early as 2000 (thus no later than Dec. 31, 2000) (e.g., copyright marking (Ex. 1039, 1), reference to "Surface and Coatings Technology (2000) 48-59 (*id.*, 1-12), citations dated before 2000 (*id.*, 11-12).) Other information so confirms: Linda Hall Library date stamp ("JAN 10 2001") (Ex. 1042, ¶¶70, 73; Appendix 1039-A), bibliographic and MARC records (Ex. 1042, ¶¶71-81, Appendices 1039-B, 1039-C), and citations to *Safi* in prior publications (*id.*, ¶82; *id.*, (Appendix 1039-D (November 2001 article), 6 (citation [3] to *Safi*)) and Dr. Hsieh-Yee's testimony (Ex. 1042, ¶¶67-83) demonstrate that *Safi* was publicly accessible before March 2002.

Belkind is an article dated in 2000 and published by Society of Vacuum Coaters in its 43rd Annual Technical Conference Proceedings (2000). (Ex. 1008, 1; Ex. 1042, ¶¶21-22, Appendix 1008.) *Belkind* itself demonstrates that it was published and publicly available at least as early as 2000 (thus no later than December 31, 2000) (e.g., Ex. 1008, 1 (2000 copyright), 5 (citations dated before 2000); Ex. 1042, ¶¶21-22). Other information so confirms: Linda Hall Library date stamp (“SEP 12 2000”) (Ex. 1042, ¶¶22, 25; Appendix 1008, 10), bibliographic and MARC records (Ex. 1042, ¶¶23-33, Appendix 1008-A, 1008-B) and Dr. Hsieh-Yee’s testimony (Ex. 1042, ¶¶21-34) demonstrate that *Belkind* was publicly accessible before March 2002. (See also Section X.A, Ex. 1052, 1305 (n.2), 1364 (applicant citing *Belkind* in IDS).)

Evidence associated with *Dogheche*, *Safi*, and *Belkind* (including respective copyright markings) provide substantial indicia of publication supporting that these references qualify as prior art. Coupled with Dr. Hsieh-Yee’s testimony (and her supporting evidence², this petition presents evidence sufficient to establish

² As Dr. Hsieh-Yee notes, the Library of Congress and the British Library continue to be closed due to the COVID pandemic (Ex. 1042, ¶¶20, 33, 49, 81), and it was impossible to access additional evidence from these sources to support public

Dogheche, Safi, and Belkind were publicly accessible before the alleged invention of the '657 patent and qualify as prior art. *Hulu, LLC v. Sound View innovation, LLC*, IPR2018-01039, Paper 29 at 12-13, 18 (Dec. 20, 2019) (precedential). Further, none of the asserted references other than *Belkind* were considered during prosecution. (See Ex. 1004; Section X.A.)

VI. LEVEL OF ORDINARY SKILL

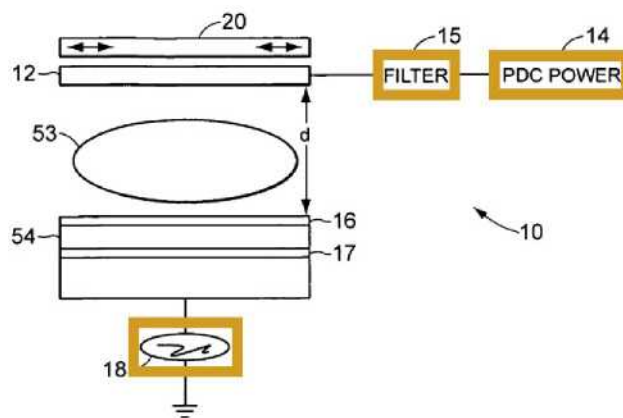
A person of ordinary skill in the art (“POSITA”) would have had, at the time of the '657 patent (March 2002): a Master’s degree in Electrical Engineering or Material Science (or an equivalent subject) plus at least two years of relevant experience (e.g., sputtering deposition of films on substrates (Ex. 1001, 1:10-14, 2:45-47)), or a Bachelor’s degree in Electrical Engineering or Material Science (or an equivalent subject) plus at least four years of relevant experience. More education can substitute for practical experience, and vice versa. (Ex. 1002, ¶¶19-20.)³

accessibility. Petitioner reserves the right to submit such information with supporting expert testimony once those libraries reopen to the public.

³ Petitioner submits Dr. Vivek Subramanian’s declaration (Ex. 1002), an expert in the field of the '657 patent. (Ex. 1002, ¶¶3-38; Ex. 1003.)

VII. THE '657 PATENT

The '657 patent describes a reactor 10, including a target 12 electrically-coupled through a filter 15 to a pulsed-DC power supply 14, and a substrate 16 capacitively-coupled to electrode 17, which is coupled to an RF power supply 18. (Ex. 1001, 5:25-34.) Filter 15 prevents the bias from supply 18 from coupling into DC power supply 14. (*Id.*, 5:56-57.) (Ex. 1002, ¶¶39-41.)



(Ex. 1001 (annotated), Figure 1A.) This arrangement was nothing new. The same manufacturer of the DC supply exemplified in the patent (*id.*, 5:46-48) repeatedly advised the need for an RF filter in similar systems since early 1990s.

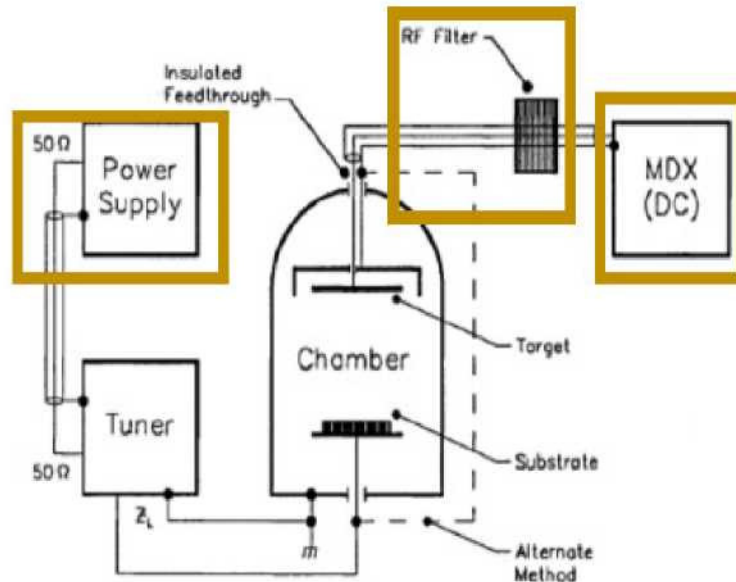


Figure 1- 5. Typical configuration for dc sputtering with RF bias.

(Ex. 1025, 6, 23-24; Ex. 1026, 116, Ex. 1062, 134; Ex. 1024, 151; Section IX; Ex. 1002 (*generally*).)⁴

VIII. CLAIM CONSTRUCTION

During IPR, claims are construed according to the “*Phillips* standard.” *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en banc*); 83 Fed. Reg. 51341 (Oct. 11, 2018). The Board only construes the claims when necessary to resolve the underlying controversy. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper No. 11 at 16 (Aug. 14, 2015); *Nidec Motor Corp. v.*

⁴ Section IX below references exhibits other than the identified prior art for each ground. Such exhibits reflect the state of the art known to a POSITA at the time of the alleged invention consistent with the testimony of Dr. Subramanian.

Zhongshan Broad Ocean Motor Co., 868 F.3d 1013, 1017 (Fed. Cir. 2017). Here, given the correlation between the prior art and the challenged claims, the Board need not construe any terms of the challenged claims to resolve the underlying controversy, as any reasonable interpretation of those terms consistent with their plain meaning reads on the prior art.⁵ (Ex. 1002, ¶54.)

IX. DETAILED EXPLANATION OF GROUNDS

As discussed below, claims 1-21 are unpatentable in view of the prior art. (Ex. 1002, ¶¶13-203.)

A. Ground 1: *Barber* in view of *Hirose* Renders Obvious Claims 2-4, 6, 8, 10-12, and 21

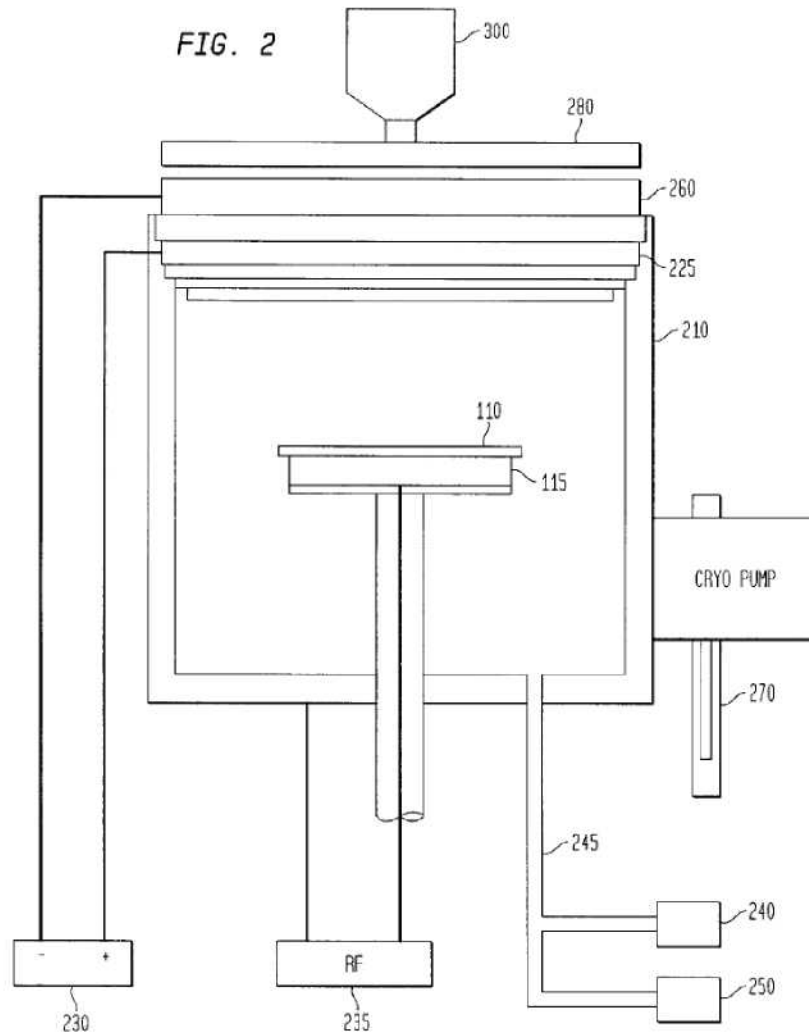
1. Claim 2

a) Claim 2[a] “A method of depositing an insulating film on a substrate, comprising:”

To the extent limiting, *Barber* discloses this preamble. (Ex. 1002, ¶56-60.) *Barber* discloses depositing a piezoelectric film, e.g., aluminum nitride (AlN), a known insulating material. (Ex. 1005, Abstract, 1:15-19, 4:31-34, 5:62-67, 6:42-46, 6:58-62, 7:26-29, 8:44-9:22; Ex. 1002, ¶56; Ex. 1005, 2:50-52 (“insulating films (including piezoelectric films)”); Ex. 1022, 38:63-67 (“*insulating film*...of AlN”

⁵ Petitioner reserves all rights to raise alternative claim construction and other arguments in this and other proceedings as appropriate.

)⁶.) Piezoelectric film 120 (AlN) is deposited on substrate 110 via reactive sputtering using the system of Figure 2. (Ex. 1005, Figs. 1, 2, 5:67-6:3, 7:23-25.) *Barber* also discloses depositing AlN and silicon dioxide on a monitor wafer. (*Id.*, 8:44-48, 9:25-31; Ex. 1002, ¶56.)

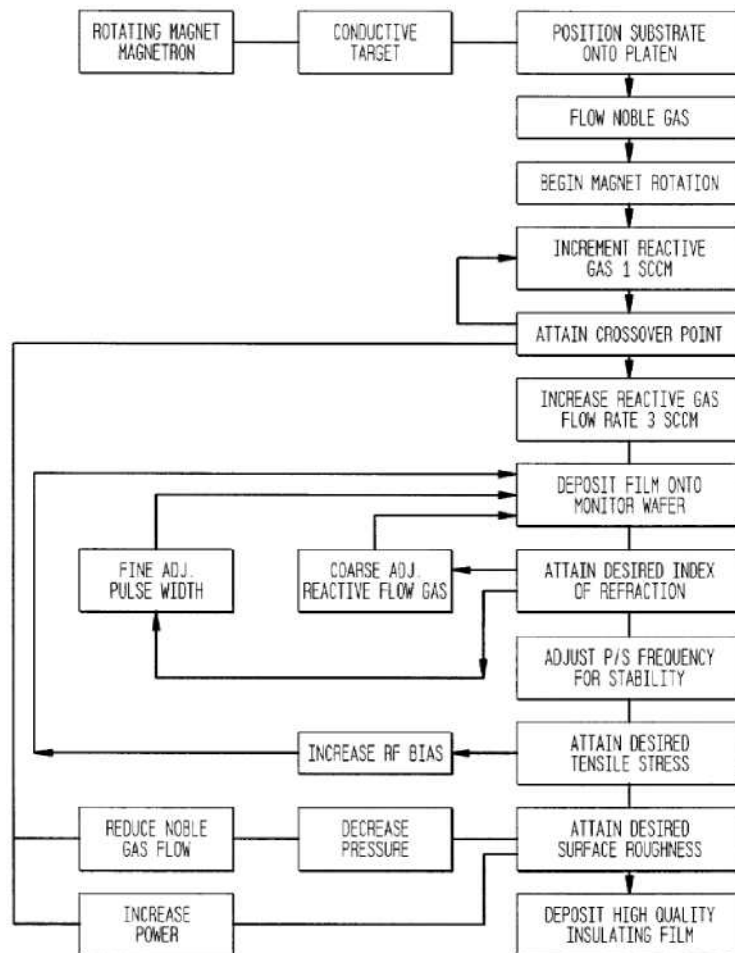


⁶ Emphasis herein is added unless noted otherwise.

(Ex. 1005, FIG. 2.) Pressure within plasma chamber 210 is regulated by valve 270 and source 240, which introduces a noble gas (e.g., Ar), and source 250, which introduces a reactive gas (e.g., O₂, N₂). (*Id.*, 6:4-13, 6:27-29; Ex. 1002, ¶57.)

Pulsed DC power source 230 applies a bias across target 260 and anode ring 225 to ionize the noble gas, forming a plasma. (Ex. 1005, 6:4-11, 7:30-34; 8:49-52.) Noble gas ions bombard target 260 and eject target materials (e.g., aluminum). (*Id.*, 7:30-34, 6:42-46; *id.*, 2:1-5 (conventional techniques).) The freed materials, reacted with the reactive gas (e.g., nitrogen), are deposited on substrate 110, forming a film (e.g., AlN film). (*Id.*, 7:34-36, 8:44-9:22.) Radio Frequency (RF) power supply 235 applies a bias to platen 115 positioning substrate 110 to control deposited film property. (*Id.*, 6:15-17, 6:29-31, Fig. 5, 7:1-2, 8:43-9:22 (AlN), 9:23-10:11 (SiO₂); Ex. 1002, ¶¶58-60.)

FIG. 5



(Ex. 1005, FIG. 5.) *Barber*'s process controls gas flows to attain a "cross-over point" and adjusting parameters to deposit high-quality films. (*Id.*, 7:1-8:12.) (Ex. 1002, ¶¶58-60; *infra* Sections IX.A.1(b)-(f).)

b) Claim 2[b] "providing a process gas between a target and a substrate;"

Barber discloses providing a noble gas and a reactive gas (collectively, or one of noble gas (e.g., argon) or reactive gas (e.g., nitrogen, oxygen), the claimed "process gas") into chamber 210 between target 260 and substrate 110. (Ex. 1005,

6:8-13.) Substrate 110 is “disposed such that it is in communication with the target and gasses.” (*Id.*, 6:14-17; FIG. 2; Ex. 1002, ¶61 (annotated FIG. 2.) Target 260 is bombarded by the ionized noble gas and reacts with the reactive gas. (Ex. 1005, 2:1-9, 6:6-11, 7:30-36; 8:49-52; Ex. 1002, ¶61; Section IX.A.1(a).)

c) Claim 2[c]

(1) 2[c](1): “providing pulsed DC power to the target...such that the voltage on the target alternates between positive and negative voltages;”

Barber discloses applying **positive** DC pulses to target 260 at a pulse frequency (Ex. 1005, 2:21-26, 7:14-17, 8:45-48, 8:66-9:3, 9:17-22) and that the “**reverse-bias** pulse width” of the DC supply may be adjusted for tuning the deposited film property (*id.*, 9:6-11, 9:48-53; Ex. 1002, ¶¶63-72). A POSITA would have understood that *Barber*’s reference to a “reverse-bias” pulse refers to a **positive** bias pulse, which is consistent with the ’657 patent and the state of the art at the time. (Ex. 1002, ¶¶63-64; Ex. 1001, 5:50-51 (“The **reverse** voltage is 10% of the negative target voltage.”); 5:39-43 (positive-bias period known as “**reverse** time”); Ex. 1008, 1-2 (**positive**-bias period is “off-time”), 3 (“off-time” also called “**reverse** time”).) *Barber*’s disclosure that “increasing the [reverse] pulse width...**lowers the deposition rate**” (Ex. 1005, 9:6-11) is consistent with a POSITA’s and the ’657 patent’s understanding that positive-pulse periods are off-times. (Ex. 1002, ¶65; Ex. 1001, 10:57-58 (long “reverse time” decreases “deposition rate”).)

A POSITA would have understood that, in sputtering process, a **negative bias must be applied to the target** at times in a DC-based sputtering system (e.g., as in *Barber*) in order to attract the **positively-charged gas ions** of the plasma. (Ex. 1002, ¶66.) This is because the **positively-charged** gas ions must be accelerated towards a **negatively-biased** target to knock off the target material for deposition. (*Id.*, ¶66; Ex. 1005, 2:1-5, 7:30-34.) This would not occur if the target is only positively-biased, consistent with Coulomb’s Law (like charges repel and opposite charges attract). (Ex. 1002, ¶¶66-67; Ex. 1007, 3:8-16, 3:39-41, 3:53-54 (a “negative” target voltage is the “normal” sputtering voltage); Ex. 1008, 1-2, 4 (“[s]puttering takes place **only** during the on-time”).) (Ex. 1052, 1382-1384 (recognition by applicant during prosecution of parent application that applying negative target bias so that “the target functions as a cathode” and to allow “gas ions [to] accelerate toward the target”).)

Accordingly, *Barber*’s pulsed-DC supply 230 necessarily provides a **negative** bias to target 260 during its reactive-sputtering process in order to attract positively-charged gas ions (e.g., ionized argon, Ar^+) to facilitate target material bombardment for deposition onto substrate 110. (Ex. 1002, ¶68.) Thus, a POSITA would have understood that the voltage provided by supply 230 to target 260 necessarily alternates between positive and negative voltages at a pulse frequency because target 260, being an electrode, receives such voltage (Ex. 1005, 6:4-8, 8:45-48). Such

understanding is consistent with as disclosed in *Miller*, incorporated by reference in *Barber*. (Ex. 1005, 2:14-26, 8:44-9:22 (applying *Miller*'s pulsed DC technique to deposit films).) *Miller* discloses that in “**pulsed DC reactive sputtering**,” **negative** cathode/target bias is “reversed periodically” to **positive** for depositing insulating films. (Ex. 1060, 4:24-5:5, 6:2-11, 6:26-29, 7:6-11, 8:14-10:22, 11:14-12:30, FIGS. 4a-b; Ex. 1002, ¶¶69-72; Section IX.A.1(a).) Therefore, *Barber* discloses and/or inherently discloses limitation 2[c](1).

(2) 2[c](2): [] “through a narrow band rejection filter []” ;

Barber in view of *Hirose* discloses and/or suggests this claim element. (Ex. 1002, ¶¶73-100.) *Barber* explains that reactive sputtering at the “cross-over point” is “effective in optimizing the deposition conditions” (Ex. 1005, 7:36-40), that its pulsed-DC supply characteristics should be monitored/adjusted “to achieve a stable waveform” (*id.*, 7:59-60, 8:66-9:2), and determining the “cross-over point” based on such characteristics (*id.*, 7:14-17, 7:40-47, 7:60-67 (improving film quality by adjusting pulse-DC bias's pulse width and power), 8:54-59.) (Ex. 1002, ¶¶74.)

Also, a POSITA would have understood that the two power supplies in *Barber* (DC supply 230 and RF supply 235) operate at different frequencies, where the pulsed-DC supply operates at a lower frequency e.g., 100 kHz (Ex. 1005, 8:45-48), and RF supply 235 operates at a higher radio frequency. (*Id.*, 6:29-31, 9:12; Ex. 1002, ¶¶75-76.) Known RF frequency ranges at the time ranged from near 1 MHz

to tens of MHz, including the 13.56 MHz typically used in plasma systems. (Ex. 1002, ¶76; Ex. 1009, 3:7-11; Ex. 1010, 9:13-15 (RF-bias to substrate “in the range of from about 0.2 to 80 MHz, for example, at 13.56 MHz”); Ex. 1011, 5:9-17; Ex. 1012, 4:61-64; Ex. 1055, 22.)

While *Barber* does not expressly disclose providing the pulsed DC power (*see* claim element 2[c](1)) “through a narrow band rejection filter,” a POSITA would have known the benefits of filters in plasma systems/processes to block interference/current of one power supply from another, which would have been considered when implementing *Barber*’s dual-supply system/processes. (Ex. 1002, ¶¶75-77.)

Indeed, *Hirose* discloses “a plasma processing apparatus” 10 with a chamber 11 and two power supplies (14, 15) of different frequencies connected to respective filters (20, 21), where such filter’s optimum resonance point can be modified, e.g., to adjust plasma process conditions. (Ex. 1006, 3:45-4:38, Abstract; Ex. 1002, ¶¶77-78.)

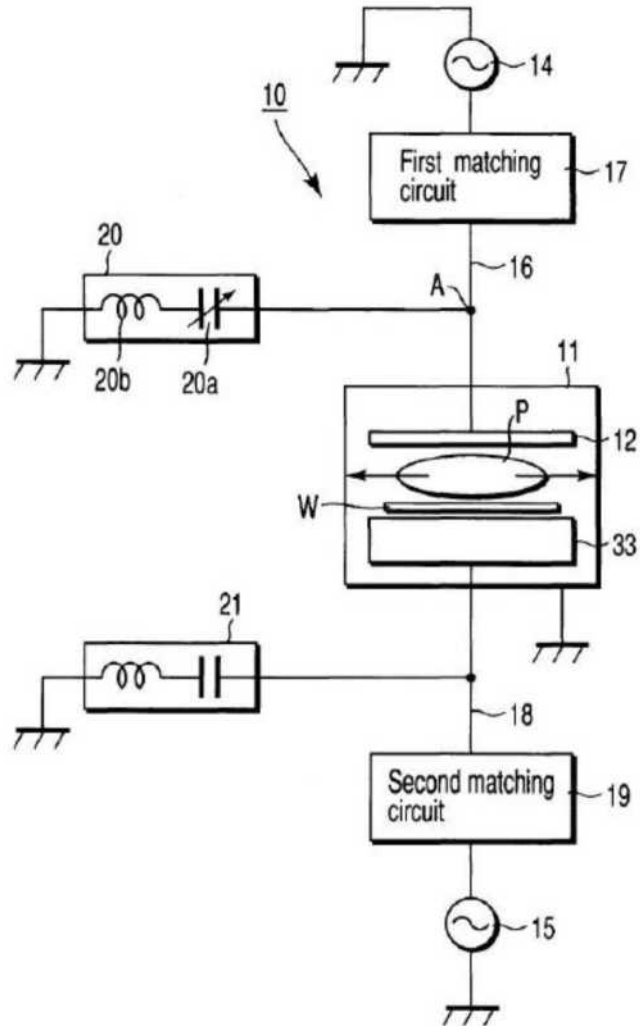


FIG. 1

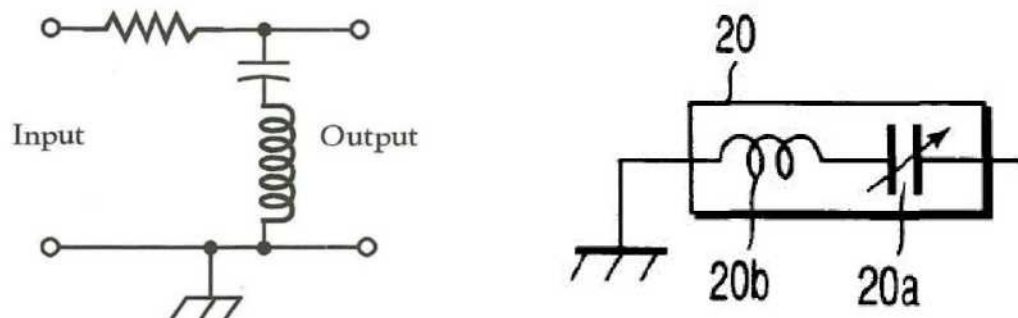
(Ex. 1006, FIG. 1.)

Hirose explains that first filter circuit 20 is placed between power supply 14 and upper electrode 12 to “selectively filter[] a high-frequency current output from the second high-frequency power supply 15 for preventing the current from reaching the first high-frequency power supply 14.” (*Id.*, 4:9-16.) Second

filter circuit 21 is likewise used to isolate supply 15 from high-frequency current from supply 14. (*Id.*, 4:16-21, 5:63-6:4; Ex. 1002, ¶79.)

Each filter (e.g., filter 20) includes “an LC series resonant circuit,” which includes a capacitor and an inductor. (*Id.*, 4:11-13; Fig. 1 (20b, 20a).) The filter’s circuit constant may be **varied** by changing the values of the inductor and capacitor to adjust the resonance point thereof to adjust plasma process conditions. (*Id.*, 2:45-51, 6:2-4, 6:9-12, 7:20-30; FIGS. 7-9.)⁷ (*Id.*, 4:45-67, FIGS. 2-4 (showing voltage waveform distortion without filter); Ex. 1002, ¶80.)

A POSITA would have understood that *Hirose*’s filters are well-known **band-rejection filters**. (Ex. 1002, ¶¶81-82; Ex. 1006, 4:9-16; Ex. 1013, 4-6 (Figure 2-9(F) disclosing a filter similar to *Hirose*).)

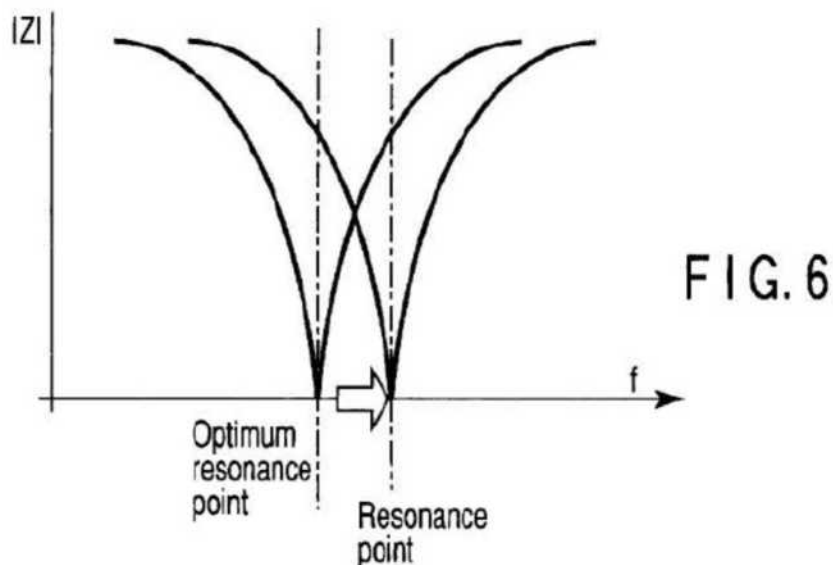


⁷ The filter’s resonance point corresponds to the frequency the filter designed to isolate. (*Id.*, 5:7-10, 8:34-38.)

(Ex. 1013, Figure 2-9(F))

(Ex. 1006, Fig. 1 (excerpt))

(Ex. 1002, ¶¶81-82.) Additionally, *Hirose*'s filter has a very narrow frequency response, as suggested by the V-shaped curve in Figure 6.



(Ex. 1006, FIG. 6.)⁸ Thus, a POSITA would have understood that *Hirose*'s filter is tuned to reject a narrow band of frequency, which operates like a narrow band-rejection filter (aka notch filter) (*id.*, 5:7-10, 8:34-38). (Ex. 1002, ¶¶81-82; *compare* Ex. 1013, 5 at FIG. 2-9(G) (“sharp response...occurs at or near a single resonant frequency”) *with* Ex. 1006, FIG. 6 (similar).)

⁸ *Hirose*'s description that “FIG. 6 shows a decrease in the sputter rate” (Ex. 1006, 3:24) refers to the end result of lowering the filter's capacitance and/or inductance value. (Ex. 1002, ¶81; *see, e.g.*, Ex. 1006, 5:7-10; 4:62-5:6.)

A POSITA would have thus found it obvious to modify *Barber*'s system to incorporate a narrow band-rejection filter to prevent the RF power from RF supply 235 from affecting DC supply 230 during *Barber*'s process.⁹ (Ex. 1002, ¶83.) A POSITA would have had reason to consider *Hirose*'s teachings/suggestions in context of *Barber*'s processes as *Hirose*'s arrangement where supply 14 biases upper electrode 12 and supply 15 biases a wafer holder or electrode 33 (Ex. 1006, FIG. 1) is similar to *Barber*'s arrangement with a pulsed-DC supply 230 that biases target 260 and RF supply 235 that biases a substrate platen 115 (Ex. 1005, FIG. 2). (Ex. 1002, ¶84.) That *Hirose* describes a reactive-ion etch (RIE) process would not have deterred a POSITA from considering *Hirose* in context of *Barber*. *Hirose* describes RIE (a known plasma processes/systems) as an *example*. (Ex. 1006, 3:67-4:2 (introducing plasma ions to wafer W surface “for performing, *say*, reactive ion etch (RIE).”), 6:46-48.) Further, a POSITA would have understood that filters like that described in *Hirose* would have also been useful in other plasma process systems, like *Barber*'s. (Ex. 1002, ¶85; Ex. 1006, 8:1-8.) RIE systems were known to be very similar to sputtering systems (like *Barber*'s). (Ex. 1002, ¶85; Ex. 1015, 3

⁹ This is true even if *Hirose* is found not to disclose a **narrow** band rejection filter, as the use of a “narrow” type band rejection filter would have been obvious for the same reasons explained herein. (Ex. 1002, ¶¶73-100.)

(“[r]eactive ion etching systems...are essentially converted sputtering systems.”); Ex. 1057, 1:16-34 (RIE and sputtering are “similar”), 1:56-58; Ex. 1010, 9:23-34.)

A narrow band-rejection filter was a known type of filter used to suppress parasitic signals or to reduce interference. (Ex. 1002, ¶¶86-87; Ex. 1013, 5-6.) Such design concepts would have guided a POSITA to configure such a filter in the *Barber-Hirose* system to block the appropriate RF frequency corresponding to selected RF supply 235. (Ex. 1002, ¶¶86-89; Ex. 1006, 5:7-10, 8:34-38; Ex. 1013, 6.)

A POSITA would have understood that choosing to reject a specific frequency (or narrow band of frequencies) depending on the bandwidth of RF supply 235 selected in *Barber’s* system would have been a known way to achieve the benefits discussed above by *Hirose* and known at the time. (Ex. 1002, ¶89; Ex. 1006, FIGS. 1, 6; Ex. 1023, 7:51-61 (“the type of filter is a mere design choice” and “[t]he filter will **necessarily be designed to reflect the frequency of operation**”); Ex. 1013, 4-6; Ex. 1057, 7:23-34; Ex. 1058, 1:63-2:1; Section IX.G (discussions of configuring filter bandwidth based on the RF supply).) Given that the waveform of *Barber’s* pulsed-DC supply 230 would determine film quality, and in light of *Hirose’s* suggestions (and state of the art knowledge), a POSITA would have found it obvious to design and implement a narrow band-rejection filter in *Barber’s* system to minimize the filter’s impact on the pulsed-DC waveform (not significantly degrade

the waveform signal through filtering) while still protecting the DC supply 230 from the specific frequency signals of RF supply 235. (Ex. 1002, ¶89; Ex. 1016, 4:20-27 (notch filter “intended to attenuate the 13.56 MHz” signal).)

A POSITA would have known the benefits of filters in plasma systems for blocking interference/current of one power supply from another when considering *Barber*. (Ex. 1002, ¶¶90-91; Ex. 1014, 3, FIG. 1 (filter coupled to bipolar pulsed-DC source to “cut off interference” from 2 MHz RF source); Ex. 1016, 3:53-63 (isolating a 100 kHz power supply and a 13.56 MHz power supply to prevent damage); Ex. 1017, 16:20-29; Ex. 1018, 24:29-32; Ex. 1019, 6:60-62 (“RF blocking filter” to mitigate RF current flowing to a DC source), 7:40-42; Ex. 1020, 2:61-3:6, 4:26-31; Ex. 1021, 7:66-8:2; Ex. 1010, 6:40-41.)

The '657 patent explains that “[p]ulsed DC power supply 14 *can be any* pulsed DC power supply, for example an AE Pinnacle plus 10K by Advanced Energy.” (Ex. 1001, 5:46-48.) That manufacturer (AE) had been guiding POSITAs since early 1990s that “[y]ou *must place an ac blocking filter* in series with the output of the dc power supply if...us[ing] a dc power supply in combination with an ac power supply...” (Ex. 1025, 23) “... *because 13.56 MHZ can damage the typical dc magnetron power supply*” (*id.*). (Ex. 1002, ¶91.)

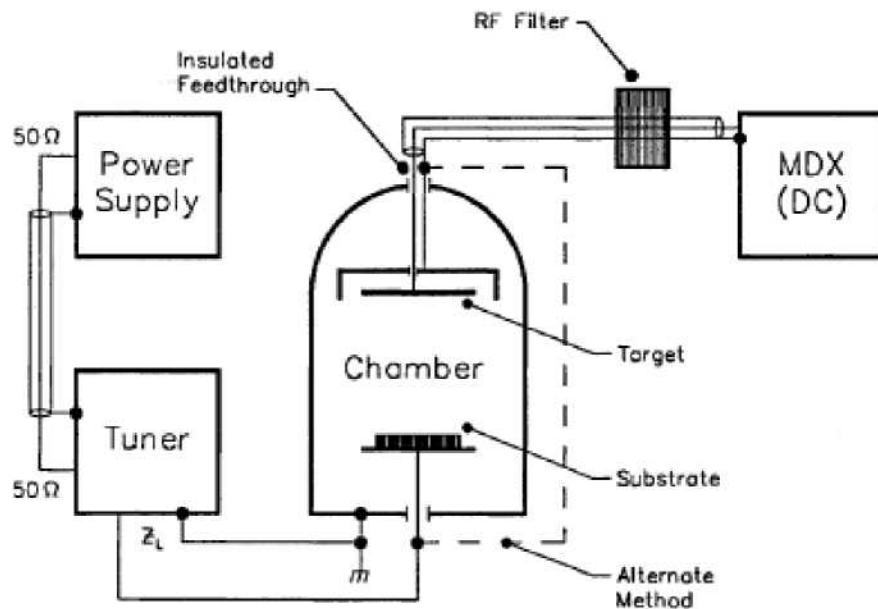


Figure 1- 5. Typical configuration for dc sputtering with RF bias.

(Ex. 1025, 24.)¹⁰ (Ex. 1026, 116 cautioning in 2000: “*If you are using both an RF power supply and a Pinnacle supply in the same system, include an RF filter in the system*” or “[d]amage to the Pinnacle unit could result”); Ex. 1062, 134 (similar caution for Pinnacle unit in 2001); Ex. 1067, 141, and Ex. 1024, 151 (similar cautions for **Pinnacle Plus** (a pulsed-DC supply like that identified in ’657 patent (Ex. 1001, 5:46-48)); Ex. 1065, 2; Ex. 1066, 7 (Pinnacle Plus platform introduced in 1999); Ex. 1002, ¶¶91-96.)

¹⁰ The MDX 10 kW supply in Ex. 1025 was known to be able to provide positive/negative pulsed-DC power when operated with a Sparc-Le unit. (Ex. 1011, 3:66-4:3, 6:7-11 3:66-4:3; Ex. 1002, ¶98.)

A POSITA would have had reasons to consider such design concepts/guidance associated with known pulsed-DC supplies in a plasma system with an RF source when contemplating *Barber*'s system. (Ex. 1002, ¶¶97-98; Ex. 1001, 5:46-48; Ex. 1008, 1; Ex. 1011, 6:7-11; Ex. 1048, 2-3 (Table 1).) Armed with such knowledge, a POSITA would have been motivated to implement a narrow band-rejection filter coupled to DC supply 230 (as explained above) to prevent RF power from RF supply 235 from damaging DC supply 230, and to reduce interference so that a stable waveform is provided to achieve optimal film deposition. (Ex. 1002, ¶¶97-98; Ex. 1005, 7:59-60, 8:66-9:2; Ex. 1006, Figs. 2-3, 3:4-10, 4:57-61.) This would have been true, especially where the RF supply 235 was selected to provide power at a commonly used frequency known to damage such DC supplies (e.g., 13.56 MHz). (Ex. 1002, ¶¶97-98; Ex. 1025, 23.)

Such a modification would have been achieved through using known design/engineering skills available to a POSITA at the time, as it would have involved a combination of known technologies (e.g., like the known system arrangements as described in *Barber* and narrow band-rejection filter designs as in *Hirose* and known in the state of the art) according to known methods (e.g., known circuit design skills to implement a narrow band-rejection filter in a plasma system) to yield a foreseeable system/process like that described above. (Ex. 1002, ¶¶99-100.) *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007).

d) Claim 2[d] “providing an RF bias that corresponds to the narrow band rejection filter to the substrate; and”

Barber in view of *Hirose* discloses and/or suggests this limitation for similar reasons explained for claim elements 2[a], 2[c]. (Ex. 1002, ¶101.) *Barber* discloses RF supply 235 applying “a bias voltage to the substrate platen 115” (Ex. 1005, 6:29-31) and that “bias is applied to the substrate to control [deposited film’s] tensile stress” (*id.*, 9:12). Furthermore, as discussed, a POSITA would have modified *Barber* to include a narrow band-rejection filter that blocks RF supply frequency for the reasons explained. (Section IX.A.1(c); Ex. 1002, ¶101.) Accordingly, for these reasons, and those in Sections IX.A.1(a) and IX.A.1(c), the *Barber-Hirose* combination discloses and/or suggests the limitations of claim 2[d]. (Ex. 1002, ¶101.)

e) Claim 2[e] “providing a magnetic field to the target;”

Barber discloses using rotating magnet assembly 280 to “produce a magnetic field to penetrate the target material 260 and form an arc over its surface facing the substrate 110,” where “[t]he magnetic field generated across target 260 helps to confine free electrons near the surface of the target.” (Ex. 1005, 6:17-27, 8:66-9:2.) Accordingly, *Barber* discloses “providing a magnetic field to the target,” which a POSITA would have recognized, would have been implemented in the combined *Barber-Hirose* system and process for the reasons indicated above. (Ex. 1002, ¶102;

Section IX.A.1(c).) Thus, the *Barber-Hirose* combination discloses and/or suggests this limitation. (Ex. 1002, ¶102.)

- f) **Claim 2[f] “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.”**

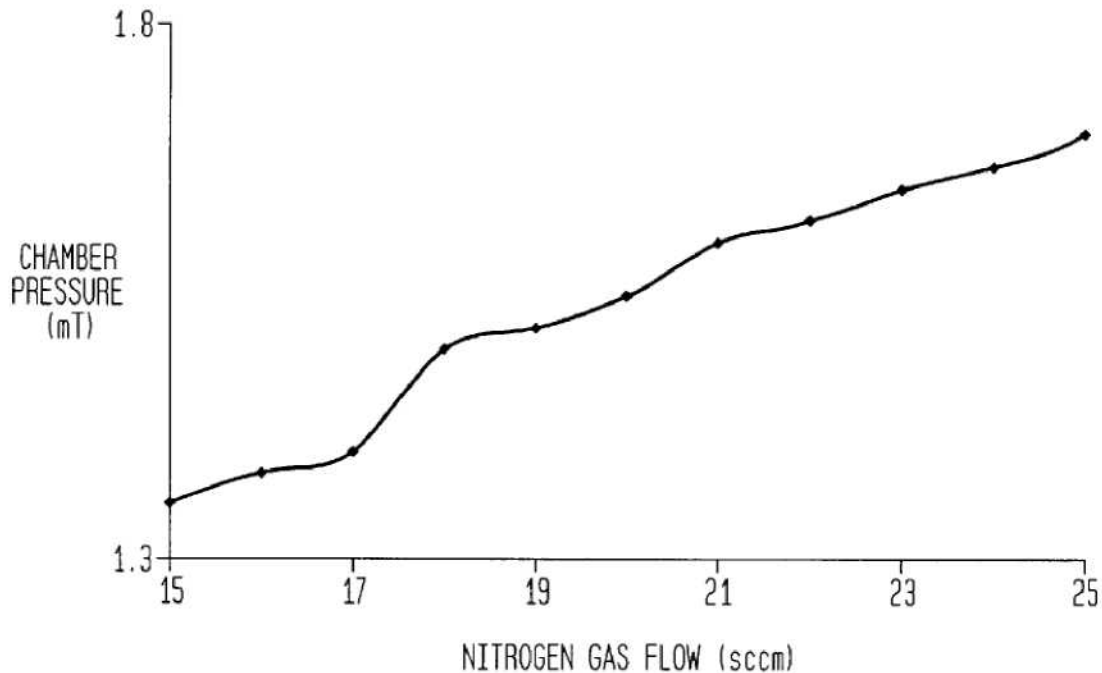
Barber discloses depositing silicon dioxide (“oxide material”) on substrate 110, and depositing AlN (“insulating film”). (Ex. 1005, 3:44-55 (forming piezoelectric layer [AlN] 120 on layers 125 that are deposited on substrate 110), 3:56-57, 4:24-26 and 7:65-8:5 (layers 125 being silicon dioxide), Abstract; Ex. 1002, ¶¶103-104.)

Barber’s AlN deposition process discloses and/or suggests “the insulating film is formed by reactive sputtering in a mode between a metallic mode and a poison mode” in three ways discussed below. (Ex. 1002, ¶¶105-114.)

First, *Barber* discloses depositing AlN by reactive sputtering *in a metallic mode and such process continued into a poison mode* with reference to Figure 3. Given that such process extends continuously from one mode to the other, *Barber* discloses forming an insulating film by reactive sputtering “in a mode between a metallic mode and a poison mode.” *Barber* discloses depositing AlN, first at a low

reactive gas flow rate and then at a high flow rate to obtain a “cross-over curve.”

FIG. 3



(Ex. 1005, FIG. 3.) *Barber* discloses:

At low flow of reactive gas..., all the nitrogen is being reacted with **metallic** aluminum so introduction of small amounts of nitrogen does not increase the chamber pressure. As the gas flow is increased, gas...in the chamber that cannot react with metal...causes an increase in pressure in the chamber. At a very high flow rate..., the target material becomes filly [sic] “**poisoned**” or coated with the reaction product (AlN) such that any further gas admitted into the chamber will not react with target...contribut[ing] to a pressure increase.

(*Id.*, 6:51-62, 8:45-48.) The “curve” reflects “the behavior of a **metallic** target fully consuming reactive gas to the behavior of the fully **poisoned** target” (*id.*, 6:63-67), necessarily including a mode between the metallic/poison mode. Thus, *Barber* discloses “the insulating film is formed by reactive sputtering in a mode between a metallic mode and a poison mode.” (Ex. 1002, ¶106.)

Barber discloses this limitation in a **second way** with reference to Figure 5. *Barber* discloses reactive sputtering AlN by “maintain[ing] at a rate corresponding substantially to, but greater than, the flow rate at the cross-over point” to “optimiz[e] the deposition conditions.” (Ex. 1005, 7:19-25, 7:36-38, FIG. 5; *id.*, 6:32-37, 7:1-8:12.) The “cross-over point” reflects a reactive gas flow rate that “strongly effects a reaction with the target material.” (*Id.*, 6:37-42.) Near that point, “**target will continue to be conductive** while depositing a coating on the substrate, and **poisoning of the target itself is controlled.**” (*Id.*, 7:34-40.) Because this “controlled” poisoning indicates a mode where the **poisoned** target surface is continuously sputtered/removed to expose the **metallic/conductive** surface for reactive sputtering in such mode, a POSITA would have understood that *Barber* discloses reactive sputtering AlN “in a mode between a metallic mode and a poison mode.” (Ex. 1002, ¶¶107-108; Ex. 1008, 3-4 (maintaining “in an intermediate mode”), Ex. 1059, 3-4 (controlled/partial poisoning is “between the metallic and poisoned regimes”).)

Barber discloses and/or suggests the limitation in **a third way**. *Barber* discloses depositing “near the cross-over point,” e.g., at a flow rate corresponding substantially to, but 3 sccm greater than, the cross-over point. (Ex. 1005, 7:19-23, 7:34-40, FIG. 5.) To the extent that *Barber* does not expressly disclose controlling the reactive sputtering process at or closely above/below the “cross-over point,” a POSITA would have found it obvious to implement such feature. (Ex. 1002, ¶¶109-110.) *Barber* discloses adjusting the flow rate to “improve the deposition rate” (*id.*, 7:40-50, 7:51-8:9) and the “deposition rate is inversely proportional to the amount of reactive gas” (*id.*, 7:44-45). A POSITA would have thus been motivated to reduce the flow rate (i.e., towards the cross-over point) to improve deposition rate, consistent with *Barber*’s goal of achieving high-deposition rate. (Ex. 1002, ¶110; Ex. 1005, 6:32-37, 7:40-42, 7:51-8:9.) Moreover, *Barber* explains that depositing at 3 sccm below the “cross-over point” produces metallic films. (Ex. 1005, 7:23-29.) A POSITA would have been motivated to adjust the gas flow to be within 3 sccm below/above the “cross-over point,” including at such point, to adjust the AlN deposition rate. A POSITA would have had a reasonable expectation of success implementing such feature as *Barber* discloses capability of controlling flow rate to achieve high-deposition rate and attaining the cross-over point. (Ex. 1002, ¶110; Ex. 1005, FIG. 5, 7:1-8:9, 8:59-63.) Accordingly, *Barber* discloses and/or suggests “the insulating film is formed by reactive sputtering in a mode between a metallic

mode and a poison mode.”¹¹ A POSITA would have recognized that such features would have been implemented in the *Barber-Hirose* system/process for the reasons indicated above, and the combination discloses/suggests this limitation. (Ex. 1002, ¶¶109-114; *supra* Section IX.A.1(c).)

Barber’s disclosure of “metallic mode” and “poison mode” are consistent with those of the ’657 patent. (Ex. 1002, ¶114.) *Barber*’s metallic mode is characterized by a low reactive-gas flow, resulting a substantially metallic target and deposited film (Ex. 1005, 6:51-55, 6:63-67, 7:25-26), consistent with such mode described in the ’657 patent. (Ex. 1001, 11:27-37, 11:51-57, 17:6-15.) *Barber*’s poison mode is characterized by a higher reactive-gas flow, resulting a formation of compound (e.g., AlN or Al₂O₃) on the target (e.g., Al), where— depending on the reactive-gas flow—the compound may be removed/sputtered as quickly as formed (not necessarily exposing the metallic target surface) or the compound may form faster than being removed/etched (and having a reduced sputtering/deposition rate) (Ex. 1005, 6:55-67, 7:17-50), consistent with the poison mode described in the ’657 patent (Ex. 1001, 10:44-50, 11:66-12:9, 13:7-8, 17:7-15). (Ex. 1002, ¶114.)

¹¹ To the extent that claim 2[f] is read to require the “insulating film” is formed by the “oxide material,” *Barber* discloses and/or suggests such interpretation as discussed in claim 3. (Ex. 1002, ¶¶111-114; *infra* Section IX.A.2.)

2. Claim 3

- a) “The method of claim 2 wherein the target is a metallic target and the process gas includes oxygen.”**

Barber discloses and/or suggests these limitations. (Ex. 1002, ¶¶115-118.)

Barber’s system provides various process gases, including reactive gases, e.g., nitrogen and oxygen, and noble gas, e.g., argon. (Ex. 1005, 6:8-13.) *Barber* further discloses examples using an aluminum target with nitrogen or a silicon target with oxygen to deposit insulating films. (*Id.*, 6:42-50, 8:44-10:11.) While not expressly disclosed, it would have been obvious to use an aluminum target and an oxygen-containing process gas to form an insulating film based on *Barber* and a POSITA’s knowledge. (Ex. 1002, ¶115.)

A POSITA would have been motivated to implement *Barber*’s deposition process with various metallic targets (e.g., aluminum) and an oxygen-based process gas because it would have improved the versatility of *Barber*’s system. (Ex. 1002, ¶116.) *Barber* does not restrict its applications, providing for variations in target materials and gases to be implemented. (*Id.*; Ex. 1005, 1:18-20, 6:8-13, 6:42-50.)

It was known that using aluminum (disclosed in *Barber*) with an oxygen-based process gas (also disclosed), would have produced aluminum oxide films in *Barber*’s system/process. (Ex. 1002, ¶116; Ex. 1007, 8:50-51 (“a practical example of a reactive sputtering system” is to use “Al to produce Al₂O₃”); Ex. 1060, 4:1-17.)

A POSITA would have understood that aluminum oxide was useful for forming

insulators used in semiconductor devices and for forming a barrier layer in display circuits. (Ex. 1002, ¶116; Ex. 1049, Abstract; Ex. 1050, Abstract.) A POSITA would have thus found it beneficial to use a metallic target (e.g., aluminum) with an oxygen-based process gas in *Barber*'s system/process as it would have expanded applications of *Barber*'s process/system, providing capability to produce aluminum oxide, known for its uses in semiconductor devices. (Ex. 1002, ¶116; Ex. 1005, 1:17-19 (“[t]he invention is particularly useful in fabricating...semiconductor devices.”).) A POSITA would have found it beneficial to deposit insulating films by “reactive sputtering in a mode between a metallic mode and a poison mode” as it would have optimized deposition conditions as discussed in claim 2[f] above, given that *Barber* also aims to provide high-quality insulating films and such processes were known. (Ex. 1002, ¶117; Section IX.A.1(f); Ex. 1005, 7:65-67, Ex. 1008, 3-4, Ex. 1059, 3-4 (depositing **aluminum oxide** in “between the metallic and poisoned regimes”); Ex. 1060, 4:1-17.)¹²

A POSITA would have had a reasonable expectation of success in such implementation, given it would have involved known technologies (e.g., reactive

¹² To the extent that claim 2[f] is read to require the “insulating film” is formed by the “oxide material,” *Barber* discloses and/or suggests such interpretation. (Ex. 1002, ¶117.)

sputtering technology/materials as in *Barber*) according to known methods (e.g., known use of an oxygen process gas to form an oxide layer) to yield the predictable result of depositing aluminum oxide. (Ex. 1002, ¶118.) *See KSR*, 550 U.S. at 416.

3. Claim 4

- a) **“The method of claim 2 wherein the target is a metallic target and the process gas includes one or more of a set consisting of N₂, NH₃, CO, NO, CO₂, halide containing gasses.”**

As explained, *Barber* discloses using an aluminum target with a nitrogen-containing (N₂) process gas to deposit AlN. (Ex. 1005, 6:51-67; Section IX.A.1(a).) Accordingly, *Barber* discloses this limitation, which would have been implemented in the *Barber-Hirose* modified system/process for the reasons explained for claim 2. (Ex. 1002, ¶119; Section IX.A.1.)

4. Claim 6

- a) **“The method of claim 2 wherein the magnetic field is provided by a moving magnetron.”**

Barber discloses using a rotating magnetron to provide a magnetic field to the target. (Ex. 1005, 5:67-6:3.) Rotating magnet assembly 280 “produce[s] a magnetic field to penetrate the target,” where rotating motor 300 rotates magnet assembly 280. (*Id.*, 6:17-27.) Accordingly, *Barber* discloses this limitation, which would have been implemented in the *Barber-Hirose* modified system/process for the reasons explained for claim 2. (Ex. 1002, ¶120.; Section IX.A.1.)

5. Claim 8

- a) “The method of claim 2 wherein the process gas includes a mixture of Oxygen and Argon.”**

Barber discloses and/or suggests this limitation. (Ex. 1002, ¶121.) Section IX.A.2 explains how a POSITA would have been motivated to use an aluminum target with an oxygen-containing process gas to form aluminum oxide films. (Ex. 1002, ¶121.) A POSITA would have also found it obvious to introduce in such process a noble gas, e.g., argon, into the chamber with oxygen, as the ionized noble gas would have facilitated sputtering by “imping[ing] upon the target material and eject[ing] atoms therefrom.” (Ex. 1005, 7:30-36; Ex. 1002, ¶121.) A POSITA would have been motivated to use argon as *Barber* already discloses using it with an aluminum target (Ex. 1005, 8:49-51) and it was known as a relatively inexpensive and commonly-used noble gas. (Ex. 1002, ¶121; Ex. 1032, 7.) Given that oxygen and argon would have been introduced in the process chamber, a POSITA would have understood that the “process gas” would have included a mixture of them. Accordingly, *Barber* discloses and/or suggests this limitation, which would have been implemented in the *Barber-Hirose* system/process for the reasons explained for claim 2. (Ex. 1002, ¶121.; Sections IX.A.1-2.)

6. Claim 10

- a) “The method of claim 2 wherein the process gas further includes nitrogen.”**

For the reasons explained in for claim 4, the *Barber-Hirose* combination discloses and/or suggests this limitation. (Sections IX.A.3; Ex. 1002, ¶122.)

7. Claim 11

- a) **“The method of claim 2 wherein providing pulsed DC power to a target includes providing pulsed DC power to a target which has an area larger than that of the substrate.”**

A POSITA would have understood in context of *Barber* that the target has an area larger than the substrate. (Ex. 1005, FIG. 2 (showing target larger than substrate); Ex. 1002, ¶123.) A POSITA would have understood that using a target with an area larger than the substrate would have improved film uniformity. (Ex. 1002, ¶123; Ex. 1041, 11 (target’s diameter made larger than wafer’s “to improve thickness uniformity.”) Thus, while not expressly disclosed, a POSITA would have been motivated (and found obvious) to provide a target area in *Barber*’s system/process larger than that of substrate 110, (suggested in Figure 2), to improve film uniformity. (Ex. 1002, ¶123.) Accordingly, *Barber* discloses and/or suggests this limitation, which would have been implemented in the *Barber-Hirose* modified system/process for the reasons explained for claim 2. (Ex. 1002, ¶123.; Section IX.A.1.)

8. Claim 12

- a) **“The method of claim 2, further including uniformly sweeping the target with a magnetic field.”**

Barber discloses that “the magnet rotation...is stabilized...to **achieve uniform target erosion.**” (Ex. 1005, 7:11-13.) As a POSITA would have understood from *Barber*, the target region exposed to the magnetic field is preferentially sputtered/eroded due to increased ion concentration caused by the magnetic field. (Ex. 1002, ¶124; Ex. 1005, 2:27-30, 6:23-27.) Given that the magnetron’s magnetic field is able to achieve uniform target erosion, a POSITA would have understood that *Barber* discloses “uniformly sweeping the target with a magnetic field,” which would have been implemented in the *Barber-Hirose* modified system/process for the reasons explained for claim 2. (Ex. 1002, ¶124; Section IX.A.1.)

9. Claim 21

a) “The method according to claim 2, wherein the RF frequency is about 2 MHz.”¹³

Barber in view of *Hirose* discloses and/or suggests this limitation. (Ex. 1002, ¶125.) As discussed, a POSITA would have been motivated to configure/tune the *Barber-Hirose* filter as a narrow band-rejection filter to block RF supply’s specific frequency. (Section IX.A.1(c)(2).) For similar reasons, a POSITA would have been motivated to configure *Barber*’s RF supply 235 to operate in accordance with the application of *Barber*’s process. Configuring RF source 235 to provide signals at 2 MHz would have been an obvious design choice among known frequency options

¹³ Petitioner assumes here that “RF frequency” relates to the “RF bias” in claim 2.

available at the time, as demonstrated by *Hirose*. (Ex. 1006, 4:42-45 (supply 15 operating at 2 MHz); Ex. 1010, 9:13-16 (RF supply operating from “0.2 to 80 MHz”); Ex. 1002, ¶125.)¹⁴ Filter implementations were also known to block 2 MHz RF power. (Ex. 1002, ¶125; Ex. 1014, 3, FIG. 1 (filter to “cut off interference” from 2 MHz RF source); Ex. 1017, 16:20-29 (filter 324 blocking 2 MHz power).) With such knowledge and skill, a POSITA would have found it obvious to implement RF supply 235 having a common frequency and configure/tune the filter implemented in the *Barber-Hirose* system/process to block a 2 MHz signal with a reasonable expectation of success for reasons similar to those above for claim 2[c](2). (Ex. 1002, ¶125; Section IX.A.1(c)(2).)

B. Ground 2: *Barber* in view of *Hirose* and *Dogheche* Renders Obvious Claims 5 and 7

1. Claim 5

a) “The method of claim 2 wherein the target is a ceramic target.”

While not expressly disclosed, a POSITA would have found it obvious to implement a ceramic target in the *Barber-Hirose* system/process in view of *Dogheche*. (Ex. 1002, ¶¶126-129; Section IX.A.1.)

¹⁴ The '657 patent does not mention any criticality of the conventional 2 MHz RF frequency. (Ex. 1001, 5:57-60.)

Dogheche discloses depositing AlN using reactive sputtering techniques. (Ex. 1029, 2.) *Dogheche* discloses using an AlN target in a nitrogen-containing process gas to deposit AlN films. (*Id.* 2 (Table I), 4 (“aluminum nitride target.”).) Since AlN is a ceramic material, *Dogheche* discloses using a ceramic target. (Ex. 1002, ¶¶126-127; Ex. 1047, 2 (“AlN” being a ceramic material).) *Dogheche* informed POSITAs of the “increasing interest” of such film for optical/electronics applications (Ex. 1029, 2.)

A POSITA would have recognized the benefits of using an AlN target in *Barber’s* modified system because it would have expanded the system’s capability to deposit high-quality AlN films, through additional target materials, of known optical/electronics applications. (Ex. 1002, ¶¶126-127; Ex. 1029, 2-3.) A POSITA would have recognized AlN targets could be used to deposit other useful films, e.g., an aluminum oxynitride layer (AlN_xO_y). (Ex. 1046, 19:28-39.) A POSITA would have been motivated to include a ceramic target (e.g., AlN) in the *Barber-Hirose* system to take advantage of such uses, particularly when process gases (i.e., argon and nitrogen) used in *Dogheche* to form AlN films were already available in *Barber* and that *Barber’s* “invention is particularly useful in fabricating acoustic resonators and semiconductor devices.” (Ex. 1005, 1:17-19, 6:8-13.) Such an implementation would have been consistent with *Barber’s* goal to achieve high-quality AlN films. (*Id.*, 5:10-12; 5:24-49; Ex. 1002, ¶¶127-128.)

A POSITA would have been further motivated and had a reasonable expectation of success in implementing the modification given the use of ceramic targets were known (Ex. 1001, 2:25-28; Ex. 1029, 2; Ex. 1046, 19:28-34; Ex. 1060, 13-14 (claims 1 and 6)), and that it would have involved a combination of known technologies (e.g., as in *Barber* and *Dogheche*) according to known methods (e.g., known processes to deposit AlN using AlN/ceramic target) to yield a system that deposits films proven useful for various applications. (Ex. 1002, ¶129.) *See KSR*, 550 U.S. at 416. Accordingly, the *Barber-Hirose-Dogheche* discloses and/or suggests this limitation. (Ex. 1002, ¶129.; Section IX.A.1.)

2. Claim 7

a) “The method of claim 2 further including holding the temperature of the substrate substantially constant.”

While *Barber* does not expressly disclose this limitation, a POSITA would have found it obvious to implement such feature in the *Barber-Hirose* process in view of *Dogheche* and a POSITA’s knowledge. (Ex. 1002, ¶¶130-133.)

Dogheche produces high-quality AlN films by maintaining the “substrate temperature...at a low temperature of 400 °C” during deposition. (Ex. 1029, 2.) Accordingly, a POSITA would have been motivated to maintain the substrate temperature in the above disclosed *Barber-Hirose-Dogheche* system/process (claim 5) substantially constant at an optimal temperature to obtain high-quality film. (Ex. 1002, ¶131; Section IX.B.1.)

Dogheche discloses that, at a constant 400 °C and a certain nitrogen content, the “best texture [of the AlN film] is obtained.” (Ex. 1029, 2.) Therefore, a POSITA would have been motivated to obtain similar results through substrate temperature control (e.g., substantially constant at 400 °C), especially that *Barber* looked to deposit high-quality AlN films. (Ex. 1005, 5:10-12; 5:24-49; Ex. 1060, 10:9-13; Ex. 1002, ¶132.)

A POSITA would have the capability and reasonable expectation of success in implementing such temperature control feature in a plasma process environment like *Barber*, given such feature were known. (Ex. 1002, ¶133; Ex. 1030, 1:33-40 and 1:60-67 (accurate temperature control), 5:63-6:4 (“high precision” surface temperature control).) Such implementation would have involved applying known technologies (e.g., known sputtering technology (like *Barber*) and temperature control concepts and mechanism (e.g., *Dogheche*; Ex. 1030)) according to known methods (e.g., substrate temperature control processes) to yield the predictable result of depositing high-quality AlN film (consistent with *Barber*’s goals). (Ex. 1002, ¶133.) *See KSR*, 550 U.S. at 416.

C. Ground 3: *Barber* in view of *Hirose* and *Safi* Renders Obvious Claim 9

1. Claim 9

a) **“The method of claim 2 wherein the Oxygen flow is adjusted to adjust the index of refraction of the film.”¹⁵**

Barber in view of *Hirose* and *Safi* discloses and/or suggests this limitation. (Ex. 1002, ¶¶134-137.) As discussed for claims 2[f] and 3, *Barber* discloses and/or suggests using an aluminum target with an oxygen-containing process gas for forming aluminum oxide film. (Sections IX.A.1(f) and IX.A.2.) While *Barber* does not expressly disclose adjusting oxygen flow to adjust the film’s refractive index, a POSITA would have found it obvious to implement such feature in the *Barber-Hirose* process in view of *Safi*. (Ex. 1002, ¶134.)

Safi discloses utilizing an aluminum target with an oxygen-containing process gas to sputter-deposit aluminum oxide. (Ex. 1039, 9.) *Safi* describes setting parameters (including oxygen flow) to obtain aluminum oxide films having a “refractive index” of 1.67, “comparable with the best reported results.” (*Id.*) Based on *Barber* and *Safi*’s disclosures/suggestions, a POSITA would have found it beneficial to adjust the film’s refractive index in the *Barber-Hirose* system by adjusting oxygen flow. A POSITA would have understood that desired/customized films could be obtained by adjusting film properties, including refractive index, based on reactive gas flow. (Ex. 1002, ¶¶135-136; Ex. 1011, 5:22-30, Figs. 4-5 (customizing aluminum-oxide film by correlating process data with refractive

¹⁵ Claim 2 does not recite “Oxygen flow.”

index); 5:30-33.) A POSITA would have understood that different optical properties (e.g., refractive indices) “are of great interest in optical applications”; consistent with *Safi*. (Ex. 1002, ¶136; Ex. 1039, 10.)

Thus, a POSITA would have been motivated to adjust the refractive index of the deposited film by adjusting the oxygen flow in the *Barber-Hirose* system/process to achieve desired refractive indices for different optical applications. (Ex. 1002, ¶137.) A POSITA would have had the capability to implement such modification with an expectation of success since it would have involved applying known technologies (e.g., known reactive sputtering technology and controlled oxygen gas flow (e.g., *Barber* and *Safi*) according to known methods (e.g., controlling oxygen flow to obtain a film of a certain refractive index) to yield the predictable result of a process that deposits a film with desired characteristics. (Ex. 1002, ¶137.) *KSR*, 550 U.S. at 416.

D. Ground 4: *Barber* in view of *Hirose* and *Aokura* Renders Obvious Claims 12 and 13

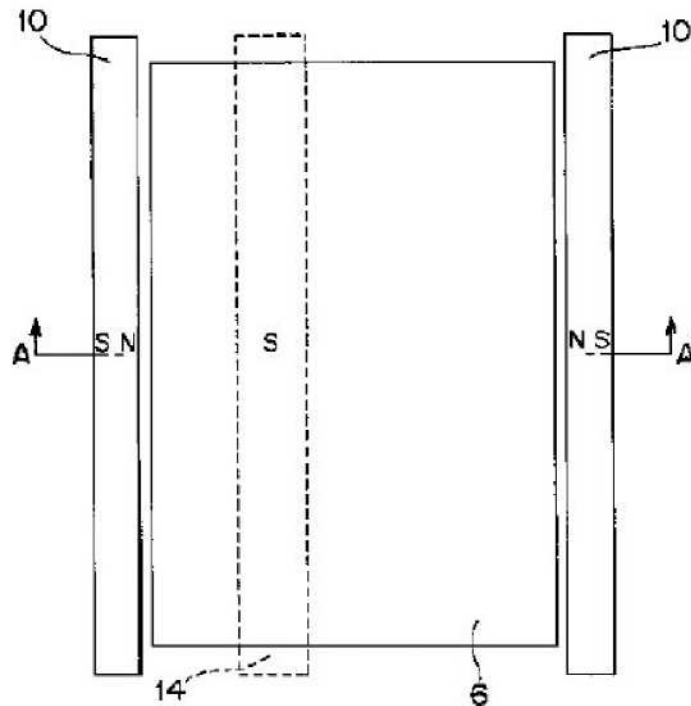
1. Claims 12 and 13

- a) [12] “The method of claim 2, further including uniformly sweeping the target with a magnetic field.”
- b) [13] “The method of claim 12 wherein uniformly sweeping the target with a magnetic field includes sweeping a magnet in one direction across the target where the magnet extends beyond the target in the opposite direction.”

Barber in view of *Hirose* and *Aokura* discloses and/or suggests these limitations. (Ex. 1002, ¶¶138-145.) As explained, *Barber* discloses a rotating magnet assembly that uniformly sweeps the target with a magnetic field. (Section IXA.8.) To the extent “uniformly sweeping” in claim 12 is read to require linear sweeping, and since *Barber* does not expressly disclose such features or uniformly sweeping the target in the manner recited in claim 13, a POSITA would have found it obvious to implement such features in the *Barber-Hirose* system/process in view of *Aokura*. (Ex. 1002, ¶138.)

Aokura discloses a magnetron sputtering apparatus/process. (Ex. 1068, ¶[0001].) Magnet 14 sweeps target 6 with a magnetic field (*id.*, ¶¶[0002], [0014]), where magnet 14 sweeps in a direction across target 6 and extends beyond target 6 in the opposite/perpendicular direction (*id.*, ¶¶[0012]-[0013], FIGS. 1-5, FIG. 2).

【図 2】



(Ex. 1002, ¶139 (annotated Fig. 2).) Such scanning mechanism provides uniform target erosion/sputtering. (*Id.*, ¶¶[0003], [0013]-[0016], FIG. 7.)

Based on a POSITA's knowledge, *Barber*, and *Aokura*, such person would have found it obvious to modify the *Barber-Hirose* system by sweeping the magnet in one direction across target 260 where the magnet extends beyond target 260 in the opposite direction to ensure uniform magnetic field sweeping of the target. (Ex. 1002, ¶140.)

A POSITA would have understood that targets may have different shapes (e.g., to accommodate substrate shape for improving film uniformity, design choices based on different applications). (Ex. 1002, ¶141; Ex. 1032, 14-15), and rectangular

or circular target shapes were common. (Ex. 1068, ¶[0012]; Ex. 1002, ¶141; Ex. 1011, 6:1-3; Ex. 1031, 2; Ex. 1033, 1:32-35; Ex. 1041, 11.) Benefits offered by *Aokura*'s sweeping techniques would have motivated a POSITA to modify *Barber-Hirose* process/system's magnet sweeping techniques/components to improve sputtering/deposition rate and target erosion uniformity, particularly when using a rectangular target as in *Aokura*. (Ex. 1002, ¶142; Ex. 1068, ¶¶[0002]-[0003], [0012]-[0015]; Ex. 1031, 2 (similar mechanism "for high erosion efficiency").) To maximize target usage life, a POSITA would have been motivated to configure the magnet action in *Barber* to ensure that the entire target volume, including target edges, are sputtered/eroded for deposition, as guided by *Aokura*. (Ex. 1002, ¶143; Ex. 1033, 1:48-54; Ex. 1068, ¶[0015].)

A POSITA would have had the skill implementing, and expectation of success in achieving, such modification, since it would have involved applying known technologies (e.g., known sputtering/magnetron designs (*Barber* and *Aokura*)) according to known methods (e.g., known magnet sweeping techniques) to yield the predictable result of prolonging target life while achieving full sputtering action for quality deposition, consistent with the goals of *Barber*. (Ex. 1002, ¶¶144-145.) *KSR*, 550 U.S. at 416.

E. Ground 5: *Barber* in view of *Hirose* and *Segal* Renders Obvious Claims 14-18

1. Claims 14 and 15

- a) [14] “The method of claim 2 wherein the target is an alloyed target.”
- b) [15] “The method of claim 14 wherein the alloyed target includes one or more rare-earth ions.”

While *Barber* does not expressly disclose using an alloyed target including a rare-earth ion, a POSITA would have found it obvious to implement such features in the *Barber-Hirose* system/process in view of *Segal* and a POSITA’s knowledge. (Ex. 1002, ¶¶146-152.)

A POSITA would have understood that various target materials (e.g., element or alloy) were used in systems like that described by *Barber*. (Ex. 1002, ¶147; Ex. 1032, 18-20.) A POSITA would have contemplated various target materials (including alloys) in the *Barber-Hirose* system to enhance its versatility in depositing different films. (Ex. 1002, ¶147.) *Segal* discloses aluminum-alloy targets (formed using the ECAE method), which is useful for manufacturing displays. (Ex. 1069, Abstract, ¶¶[0002]-[0005], [0037], [0041].) *Segal* discloses such target, having a decreased/fine grain size, contains aluminum and non-aluminum materials, including silicon (Si) and/or rare earth elements, e.g., yttrium (Y) and scandium

(Sc).¹⁶ (*Id.*, ¶¶[0041] (“aluminum alloys”), [0010], [0042]-[0048], claims 1,4-5, 14-15; Ex. 1002, ¶148.)

Based on *Barber* and *Segal*, a POSITA would have found it beneficial to use aluminum-alloy targets in the *Barber-Hirose* system. A POSITA would have understood that such targets of fine grain size (as in *Segal*) are structurally stable and homogeneous (Ex. 1069, ¶¶[0010], [0015], [0041], [0051]-[0052], [0058]) and would have improved “film uniformity, sputtering yield, and deposition rate, while reducing arcing” (*id.*, ¶[0007]), consistent with *Barber*’s goal (Ex. 1005, 2:66-3:13). (Ex. 1002, ¶149.) *Segal* discloses providing target stability by adding “at least the minimal amount” of non-aluminum materials (Ex. 1069, ¶[0044]), e.g., Si and/or rare earth elements (*id.*, ¶¶[0045], [0071], [0077]-[0079]). Accordingly, a POSITA would have found it obvious to use alloy targets in the *Barber-Hirose* process/system to improve sputtering processes and films. (Ex. 1002, ¶150.)

A POSITA would have appreciated that alloy targets were known being useful in various applications, e.g., for depositing low-emissivity glass coatings (Ex. 1034, Abstract, ¶[0025] (Si-Al alloy); Ex. 1035, 1-2 (Si-Al alloy)) and for depositing thermal-barrier coating (Ex. 1036, 6 (yttrium-containing alloy), Ex. 1037, ¶[0053],

¹⁶ A POSITA would have understood that yttrium and scandium are rare-earth ions. (Ex. 1002, ¶148.)

Ex. 1038, 1:30-35). Thus, POSITA would have been motivated to use such alloy targets to improve versatility in the applications of *Barber*'s modified system. (Ex. 1002, ¶151.)

A POSITA would have a reasonable expectation of success in implementing alloy targets (including containing rare-earth ion(s)) since they were known to be used in reactive sputtering processes. (Ex. 1002, ¶152; Ex. 1034, ¶[0025], Ex. 1035, 1-2; Ex. 1036, 6.) Moreover, a POSITA would have had the skill to implement, and expectation of success in achieving, such modification, because it would have involved applying known technologies (e.g., known sputtering technology (*Barber*) and materials (e.g., alloy targets, including rare-earth ion containing alloy target (*Segal*)) according to known methods (e.g., known sputtering techniques to deposit coatings and use of different alloy targets) to yield the predictable result of a process that deposits various types of films from an alloy or rare-earth ion containing alloy target as discussed above. (Ex. 1002, ¶152.) *See KSR*, 550 U.S. at 416.

2. Claim 16

a) “The method of claim 14 wherein the alloyed target includes Si and Al.”

Barber in view of *Hirose* and *Segal* discloses and/or suggests these limitations for similar reasons for claim 14; showing use of Al-Si alloyed target in the asserted combination. (Ex. 1002, ¶153; Section IX.E.1.)

3. Claim 17

- a) **“The method of claim 14 wherein the alloyed target includes one or more elements taken from a set consisting of Si, Al,”**

Barber in view of *Hirose* and *Segal* discloses this limitation for similar reasons for claim 14; showing use of Al-Si alloyed target in asserted combination. (Section IX.E.1; Ex. 1002, ¶154.)

4. Claim 18

- a) **“The method of claim 14 wherein the alloyed target is a tiled target.”**

Barber in view of *Hirose* and *Segal* discloses and/or this limitation. (Ex. 1002, ¶¶155-158.) *Barber* does not disclose alloyed tiled targets, but a POSITA would have found it obvious to implement such features in the above-discussed *Barber-Hirose-Segal* system/process in view of *Segal* and a POSITA’s knowledge. (Ex. 1002, ¶155.)

In addition to the reasons for using an alloyed target (*see* Section IX.E.1), a POSITA would have been further motivated to use **tiled** alloyed targets like that described by *Segal*. (Ex. 1069, Fig. 16, ¶[0075] (target of “a tiled assembly”).) A POSITA would have appreciated the benefits of tiled targets as *Segal* teaches that it “present[s] several advantages for the production of very large targets” (i.e., use of “current equipment,” “known methods,” and “easily adaptable to any future evolution of the size of...targets”) and would have offered a broader range of applications of *Barber*’s modified system. (*Id.*, ¶[0076]; Ex. 1002, ¶156; Ex. 1035,

5.) Consistent with reasons for claim 14, a POSITA would have been motivated to use tiled alloy targets for achieving a larger target size (to improve film uniformity (Section IX.A.7)) and expand the applications of *Barber*'s modified system/process. (Ex. 1002, ¶157; Ex. 1069, ¶[0006]; Ex. 1049, Abstract.)

A POSITA would have understood/appreciated that such modification would have involved a combination of known technologies (known sputtering technology (*Barber*) and use of tiled alloy targets (*Segal*)) according to known methods (known use of reactive sputtering technique and use of alloyed tiled targets) to yield the predictable result of a process that deposits a film for various applications as suggested by *Segal*. (Ex. 1002, ¶158.) *See KSR*, 550 U.S. at 416. A POSITA would have been capable of implementing the above modification to *Barber*'s combined system/process and would have done so with expectation that the use of tiled alloy targets would produce quality films for various applications in line with *Barber*'s goal. (Ex. 1002, ¶158.)

F. Ground 6: *Barber* in view of *Hirose*, *Segal*, and *Sakawaki* Renders Obvious Claim 19

1. Claim 19

“The method of claim 18 wherein each tile of the tiled target is formed by prealloy atomization and hot isostatic pressing of a powder.”

Barber in view of *Hirose*, *Segal*, and *Sakawaki* discloses and/or suggests claim 19. (Ex. 1002, ¶¶159-165.) While *Segal* discloses forming tiled alloyed

targets using extrusion (Ex. 1069, Abstract), a POSITA would have understood various available techniques for forming such targets. Thus, a POSITA would have found it obvious to form each tile of the tiled target implemented in the *Barber-Hirose-Segal* process/system by prealloy atomization and hot isostatic pressing of a powder, especially in view of *Sakawaki*. (Ex. 1002, ¶159.)

Sakawaki relates to providing alloyed targets used in sputtering processes. (Ex. 1043, ¶¶[0015], [0069]-[0070].) *Sakawaki* discloses manufacturing alloy targets by first producing alloy powder using a “gas-atomization method” (*id.*, ¶[0072]) and then by performing a “hot isostatic processing (HIP)” on the alloy powder to form alloy targets (*id.*). Thus, a POSITA would have understood that *Sakawaki* discloses forming a target by “prealloy atomization and hot isostatic pressing of a powder.” (Ex. 1002, ¶160.)

Based on the teachings/suggestions of *Barber, Segal* (Sections IX.E.) and *Sakawaki*, a POSITA would have been motivated to modify the *Barber-Hirose-Segal* combination such that each tile of the tiled target is formed using processes similar to that described by *Sakawaki*.¹⁷ (Ex. 1002, ¶161.)

¹⁷ While *Segal* promotes its specific extrusion processes for forming tiled-alloyed targets, its processes are based on highly-pure aluminum with certain amounts of dopant materials (e.g., Ex. 1069, ¶[0054].) In modifying the combined *Barber*

A POSITA would have recognized the benefits of such modification because such target manufacturing processes were known to produce high-performance and high-density alloy targets of uniform quality that improves sputtering. (Ex. 1002, ¶162; Ex. 1063, 1:42-45, 1:56-63, 1:66-2:46.) Indeed, the quality of deposited films “depends on the quality of the sputtering target, which in turn depends on the quality of its fabrication” and the “target composition and structure” is “important in achieving a high performance, high density” film. (Ex. 1002, ¶162; Ex. 1063, 1:23-

system/process (*see* claims 14, 18), a POSITA would have appreciated available options for forming such alloyed targets, and thus would have contemplated various alloy composition (not necessarily limited to the specific composition exemplified by *Segal*.) (Ex. 1002, ¶161.) Thus, a POSITA would not have been deterred by such features in *Segal* in considering/implementing other processes for forming tiled alloyed targets in the combined *Barber*’s system/process (like described by *Sakawaki*) given the motivation gleaned from *Segal* and the options available in terms of alloy composition for purposes of forming a desired film on the substrate in *Barber*’s system. (*Id.*; Ex. 1034, ¶¶[0024]-[0027]; Ex. 1035, 2; Ex. 1036, 6.) Furthermore, *Segal* acknowledges benefits of continuing use of “hot processing” (like in *Sakawaki*) as it was known to “healing pores and voids, and for eliminating other casting defects.” (Ex. 1069, ¶[0015].)

30, 1:31-45, 1:56-64.) Additionally, a POSITA would have understood that a variety of alloy materials can be formed into an alloy target. (Ex. 1002, ¶163; Ex. 1034, ¶¶[0024]-[0027]; Ex. 1035, 2; Ex. 1036, 6; Ex. 1056, 6:6-11, 6:12-7:21.) Accordingly, a POSITA would have been motivated to combine a target fabrication process (e.g., *Sakawaki*) to form high-performance and high-density alloy targets to improve film quality, consistent with the common goal as in *Barber*. (Ex. 1005, Abstract; Ex. 1069, ¶[0007]; Ex. 1002, ¶163.).

A POSITA would have a reasonable expectation of success in implementing such modification since tiled alloy targets formed based on HIP processes were known (Ex. 1002, ¶164; Ex. 1035, 5; Ex. 1032, 15-16; Ex. 1061, 14:55-64; Ex. 1063, 4:49-58) to produce high-density targets (Ex. 1032, 16; Ex. 1043, ¶[0072]). Because the above-described combination would have involved a combination of known technologies (use of tiled alloyed targets (*Segal* and *Sakawaki*) according to known methods (methods of forming an alloy target (*Sakawaki*)) to yield the predictable result of a process as discussed above to produce high-density targets and high-quality films. (Ex. 1002, ¶¶164-165.) *See KSR*, 550 U.S. at 416.

G. Ground 7: *Barber* in view of *Hirose* and *Sill* Renders Obvious Claim 20

1. Claim 20

- a) “The method according to claim 2, wherein the narrow band-rejection filter has a bandwidth of about 100 kHz.”

Barber in view of *Hirose* and *Sill* discloses and/or suggests this limitation.

(Ex. 1002, ¶¶166-171.) In addition to claim 2 above, a POSITA would have been motivated to adjust the bandwidth of the narrow band-rejection filter (similar to as in *Hirose* (Ex. 1006, 4:9-16, FIGS. 1 and 6) and Section IX.A.1(c)) based on the frequency spread of RF power source 235 that the filter in the combined system is designed to block, as was known at the time. (Ex. 1002, ¶166; Ex. 1054, 1:13-19 (filter's quality factor (Q) affects its bandwidth), 4:14-16 (Q depends on filter components); Ex. 1058, 1:64-2:1 (notch filter bandwidth modified based on Q.)) Thus, a POSITA would have been motivated to configure the narrow band-rejection filter in the *Barber-Hirose* system to address the frequency spread of RF supply 235 in light of *Sill*. (Ex. 1002, ¶166.)

Sill discloses configuring a band-rejection or notch filter to block an RF supply's signal in a sputtering system at its operating frequency. (Ex. 1057, 4:24-28, Abstract.) Consistent with a POSITA's knowledge, *Sill* discloses implementing such filter to **block a specific frequency at a certain bandwidth** by tuning filter circuitry. (*Id.*, 4:66-5:12, FIG. 4 (disclosing a formula used to determine specific frequency to block; Ex. 1002, ¶¶167-168.) The filter bandwidth can be modified, e.g., from tens of Hz to several MHz, including the claimed "bandwidth of about 100 kHz," by tuning the filter circuitry. (Ex. 1057, 5:17-21, 5:48-60, 5:61-6:12, FIG. 6.) Based on such knowledge, and in light of the rationale for implementing a narrow

band-rejection filter in the *Barber-Hirose* system (claim 2[c](2)), a POSITA would have been motivated to design the filter to have a bandwidth frequency spread of RF power source 235, because it was known to implement a desired similar to the filter bandwidth with proper “design choice.” (Ex. 1057, 5:65-6:12; 7:23-44; Ex. 1002, ¶¶167-168.)

A POSITA would have recognized that using RF supply 235 with a particular frequency spread (e.g., 100 kHz) would consequently drive the filter’s design/implementation in the *Barber-Hirose* system/process for similar reasons explained above for claim 2. (Section IX.A.1(c).) Thus, a POSITA would have been motivated to design the filter bandwidth in the *Barber-Hirose* system/process to be compatible with RF supply 235’s frequency spread characteristics to ensure that the relevant portion of the RF signal around its operating frequency is blocked from the pulsed-DC supply, for the reasons discussed for claim 2. (Section IX.A.1(c)(2).) Further guided by *Sill*, a POSITA would have had the capability and reason to design and/or implement the filter in the combined system to have a 100 kHz bandwidth to match the frequency spread of RF supply 235, which would have

been mere choices of known designs options available to a POSITA at the time.¹⁸

(Ex. 1002, ¶169; Ex. 1001, 5:58-65 (the '657 patent uses known RF supply).)

A POSITA would have appreciated that the above-described combination would have involved a combination of known technologies (narrow band-rejection filter designs (as in the *Barber-Hirose* combination and *Sill*) according to known methods (techniques for configuring notch filters *in Sill*) to yield the predictable result of a narrow band-rejection filter tuned to have a bandwidth of about 100 kHz to ensure appropriate RF signals are isolated from pulsed-DC supply 230 (as discussed for claim 2[c])). (Ex. 1002, ¶¶170-171; IX.A.1(c)(2).) *KSR*, 550 U.S. at 416.

H. Ground 8: *Barber* in view of *Hirose* and *Sellers* Renders Obvious Claim 1

1. Claim 1

a) Claim 1[a] “A method of depositing a film on an insulating substrate, comprising:”

To the extent limiting, *Barber* discloses this preamble. As discussed, *Barber* discloses depositing an insulating film (AlN) on a substrate. (Ex. 1005, Abstract, 1:15-19, 4:31-34, 5:62-67, 6:42-46, 8:43-9:22; Section IX.A.1(a).) The substrate may be fabricated with aluminum oxide or quartz (Ex. 1005, 3:63-65), known

¹⁸ The '657 patent discusses no criticality regarding the 100 kHz bandwidth, described for only “some embodiments.” (Ex. 1001, 5:61-63.)

insulating materials. (Ex. 1027, ¶[0065]; Ex. 1001, 4:51-54.) Thus, *Barber* discloses this preamble. (Ex. 1002, ¶172; *infra* Sections IX.H.1(b)-(f).)

b) Claim 1[b] “providing a process gas between a conductive target and the substrate;”

As explained, *Barber* discloses providing a process gas (e.g., noble gas and a reactive gas (collectively, or one of the noble gas (e.g., argon) or reactive gas (e.g., nitrogen), the claimed “process gas”)) between target 260 and substrate 110. (Section IX.A.1(b); Ex. 1005, 2:1-9, 6:6-17, 7:30-36; 8:45-52, FIG. 2.) Target 260 can be aluminum, and thus is a “conductive target.” (Ex. 1005, 6:42-46, 7:36-40.) Thus, *Barber* discloses this limitation. (Ex. 1002, ¶173.)

c) Claim 1[c] “providing pulsed DC power to the target through a narrow band rejection filter such that the target alternates between positive and negative voltages;”

Barber in view of *Hirose* discloses and/or suggests this limitation for the same reasons for claim 2[c]. (Section IX.A.1(c); Ex. 1002, ¶174.)

d) Claim 1[d] “providing an RF bias at a frequency that corresponds to the narrow band rejection filter to the substrate;”

Barber in view of *Hirose* discloses and/or suggests this limitation for the same reasons as claim 2[d]. (Section IX.A.1(d).) Sections IX.A.1(c)-(d) explain why a POSITA would have been motivated to modify *Barber*’s system/process to include a narrow-band rejection filter that blocks signals at the *frequency* of RF supply 235.

(Sections IX.A.1(c)-(d).) Accordingly, the *Barber-Hirose* combination discloses and/or suggests claim 1[d]. (Ex. 1002, ¶175.)

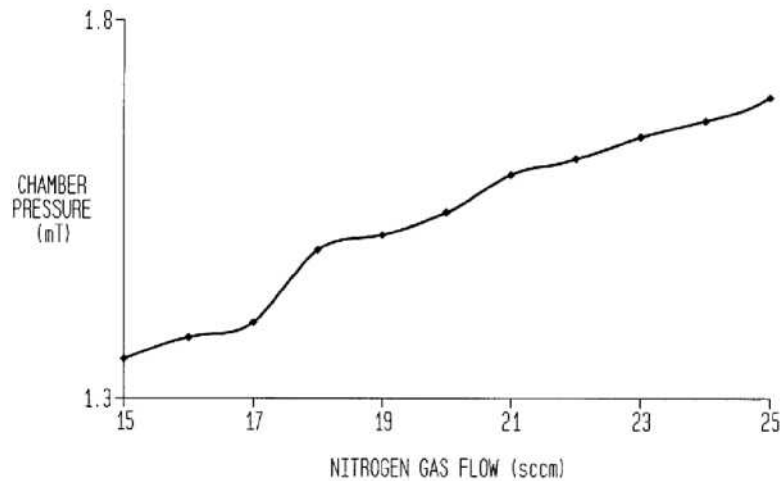
e) Claim 1[e] “providing a magnetic field to the target; and”

Barber discloses this limitation for the same reasons for claim 2[e]. (Section IX.A.1(e).) For similar reasons, such features would have been implemented in the combined *Barber-Hirose* system/process as discussed above for claim 1[c]. (Section IX.H.1(c); Ex. 1002, ¶176.)

f) Claim 1[f] “reconditioning the target; wherein reconditioning the target includes reactive sputtering in the metallic mode and then reactive sputtering in the poison mode.”

Barber in view of *Hirose* and *Sellers* discloses and/or suggests this limitation. (Ex. 1002, ¶¶177-186.) As explained, *Barber* discloses two reactive sputtering process regimes (i.e., the “metallic mode” and the “poison mode”) for depositing AlN using an aluminum target. (Section IX.A.1(f); *see, e.g.*, Ex. 1005, 6:51-67.)

FIG. 3



(Ex. 1005, FIG. 3.)

While *Barber* discloses increasing the gas flow from a low flow rate (“metallic mode”) to a high flow rate (“poison mode”) while performing reactive sputtering in each mode (*id.*, 6:55-58) (reactive sputtering in the metallic mode and *then* reactive sputtering in the poison mode) (Section IX.A.1(f)), *Barber* does not expressly disclose doing so during “reconditioning [of] the target.” A POSITA would have found it obvious to modify the *Barber-Hirose* system/process to perform such “reconditioning” in the same manner, in light of *Sellers* and a POSITA’s contemporaneous knowledge. (Ex. 1002, ¶178.)

Sellers discloses a pulsed DC reactive sputtering process to deposit aluminum compounds, e.g., AlN or aluminum oxide, using an aluminum target. (Ex. 1007, 3:4-31, 3:39-44, 4:37-58, 4:61-63.) *Sellers* explains that, after exposing the target to the atmosphere, a target “condition[ing]” process utilizing pulsed DC sputtering

technique can be used to “sputter[] off oxides and impurities with little or no damage to the target and without arcing.” (*Id.*, 9:1-12.) A POSITA would have understood *Sellers*’ conditioning process is associated with the known “burn-in” process commonly used to decontaminate a target following exposure to the atmosphere or contaminants. (Ex. 1002, ¶179; Ex. 1028, ¶¶[0010]-[0011].)¹⁹

Based on such guidance/knowledge, a POSITA would have been motivated to modify the *Barber-Hirose* process to include a target reconditioning process to ensure quality of sputter-deposited films. (Ex. 1002, ¶180.) A POSITA would have appreciated, as disclosed in *Sellers*, the sputtered material (e.g., aluminum nitride) “not only coats the...substrate, but also coats other surfaces including walls of the chamber” during reactive sputtering. (Ex. 1002, ¶180; Ex. 1007, 3:32-35.) Thus, a POSITA would have recognized that after multiple depositions (as would have been contemplated by *Barber*), the chamber would have eventually been vented to the atmosphere for cleaning of coatings on chamber walls or maintenance between multiple depositions. (Ex. 1002, ¶180; Ex. 1028, ¶¶[0010]-[0011].) A POSITA would have also understood that such cleaning/maintenance process would have

¹⁹ The ’657 patent uses the term “burn-in” interchangeably with the “reconditioning” process. (Ex. 1001, 20:53-55 (“The recondition process (or burn in) consists of.”); Ex. 1002, ¶179.)

exposed any target (e.g., aluminum) in *Barber*'s chamber to the atmosphere and containments. (Ex. 1028, ¶[0010].) Thus, implementing a decontamination process to recondition the target 260 between multiple depositions would have been an obvious modification to *Barber*'s processes to ensure target 260 was clean of impurities for subsequent depositions. (Ex. 1002, ¶180).

A POSITA would have appreciated the benefits of sputtering off impurities with little/no damage to the target and without arcing. (Ex. 1002, ¶181; Ex. 1032, 15, 17; Ex. 1040, 12:4-8 (“remov[ing] any remaining contaminants from the target surface” during burn-in); Ex. 1041, 13-14; Ex. 1051, 16:26-29 (“pre-sputtering procedure...to burn off any surface contaminants” and conditioning the target by introducing oxygen).) A POSITA would have understood reconditioning of target 260 after/between depositions would ensure deposited films containing desired composition without contaminants/impurities—consistent with *Barber*'s goal for high-quality films. (Ex. 1002, ¶182; Ex. 1005, 6:32-34.)

A POSITA would have been motivated to perform reconditioning by using *Barber*'s metallic-poison mode process, including reactive sputtering in the metallic mode and then in the poison mode (*see* above for claim 2[f]) for obtaining the cross-over curve used for “optimizing the deposition conditions.” (Ex. 1002, ¶183; Ex. 1005, 7:1-5, 7:36-39, 8:45-46.) *Barber* describes a “first step” of “determining the cross-over curve on a monitor wafer” (Ex. 1005, 8:45-46), which would have

included reactive sputtering of the target in the metallic mode and then poison mode to identify the optimal conditions for subsequent depositions on substrate 110 for production of semiconductor devices. (Ex. 1002, ¶183.)

Consistent with contemporaneous knowledge (and discussed by *Sellers*), a POSITA would have found it beneficial to recondition target 260 by using a reactive gas as it would prepare its surface to a condition similar to where sputtering would have occurred. (*id.*, ¶¶184-185; Ex. 1044, 5:58-6:3; Ex. 1045, 3:56-58, 4:29-35, FIG. 2.) Performing reactive sputtering in the metallic mode followed by the poison mode (as described by *Barber*) would have likewise prepared target 260's surface to a condition similar to where actual deposition would occur, which would have improved controllability/stability of deposition processes—consistent with *Barber*'s goals for quality films. (Ex. 1002, ¶¶184-185; Ex. 1005, 7:1-5, 7:36-42; Ex. 1044, 2:41-53.) A POSITA would have known to take advantage of pulsed DC sputtering's "bipolar nature of the target voltage" to sputter clean a target "between runs" (Ex. 1059, 4, 7) and such cleaning improves with increasing "magnitude of the reverse voltage" (*id.*, 8). A POSITA would have understood that such "reconditioning" process would not have been limited to the AlN reactive-sputtering process, and a POSITA would have been motivated (and found obvious) to apply such process to, e.g., Al₂O₃ reactive-sputtering process discussed in Sections IX.A.1(f) and IX.A.2 for reasons discussed above. (Ex. 1002, ¶185; Sections

IX.A.1(f) and IX.A.2; Ex. 1059, 3-4, FIG. 3 (Al_2O_3 reactive-sputtering process including “metallic” mode and “poisoned” mode).)

Accordingly, a POSITA would have had the reason, capability, and reasonable expectation of success, to recondition target 260 as claimed. (Ex. 1002, ¶186.)

I. Grounds 9-16: Each of the Above Prior Art Combinations in view of *Belkind* Renders Obvious the Challenged Claims

Grounds 1-8 demonstrate how prior art combinations stemming from the *Barber-Hirose* combination discloses and/or suggests claims 1-21. (Sections IX.A-IX.H; Ex. 1002, ¶¶55-186.) These Grounds demonstrate how *Barber* discloses the claimed aspects involving providing pulsed DC power to the target such that the target alternates between positive and negative voltages recited in claim elements 2[c] and 1[c]. (Sections IX.A.1(c) and IX.H.1(c).) To the extent *Barber* is read not to disclose such features, it would have been obvious to implement such features in light of *Belkind*. (Ex. 1002, ¶¶187-194.)

Belkind discloses using pulsed DC to perform reactive sputtering for depositing insulator. (Ex. 1008, 1 at Abstract.) *Belkind* discloses biasing a target with pulsed voltages such that the target voltage alternates between positive and negative voltages. (*Id.*, 1-2, FIG. 1.)

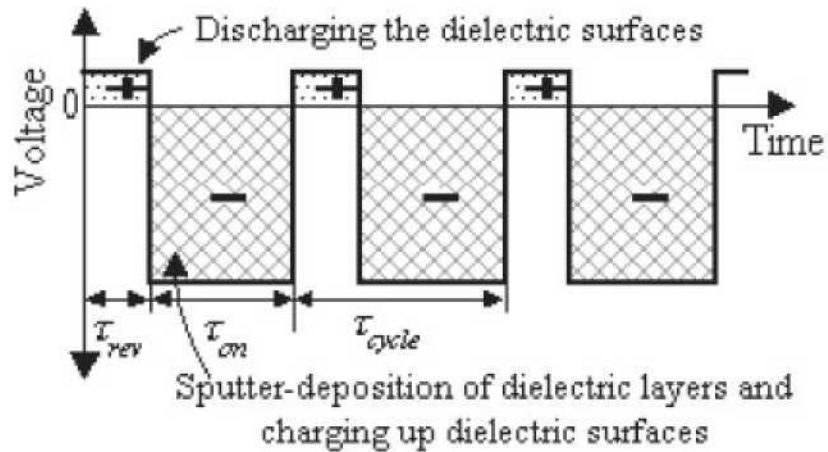
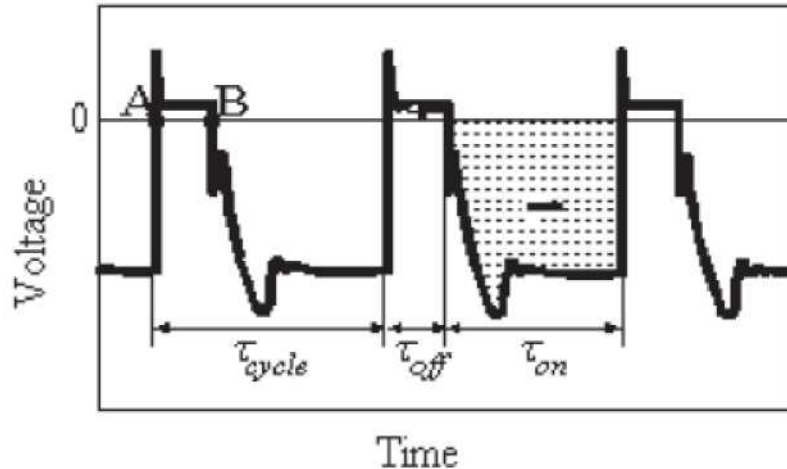


Figure 1. Pulsed voltage used to power a cathode

(*Id.*, FIG. 1.)²⁰ *Belkind* discloses similar features associated with Figure 3. (*Id.*, 2-3, FIG. 3.)

²⁰ *Belkind* uses “cathode” and “target” interchangeably, consistent with the knowledge that a sputtering target serves as power supply’s cathode. (Ex. 1002, ¶188; Ex. 1008, 1-2 (“**cathode** microarcing” and “microarcs...on the **target** surface”); Ex. 1011, 3:61.)



(*Id.*, FIG. 3.)²¹ Furthermore, *Belkind* discloses that “[t]he pulsing parameters must satisfy certain conditions to avoid arcing.” (*Id.*, 1.) Based on *Belkind*, a POSITA would have been motivated to modify the *Barber-Hirose* system/process to provide pulsed-DC power to the target, where the target voltage alternates between positive and negative voltages, with reduced arcing. (Ex. 1002, ¶187-188.)

A POSITA would have understood that arcing is undesired, occurring at the target surface when depositing insulating films (e.g., AlN or Al₂O₃ films in the *Barber-Hirose* combination). (Sections IX.A.1, IX.A.2; Ex. 1007, 6:2-5; Ex. 1008, 1.) *Belkind* explains that arcing is caused by accumulated positive charges on a

²¹ During prosecution of the parent of the ’657 patent, Applicant relied on *Belkind* to support that pulsed DC requires both positive and negative voltages. (Ex. 1052, 1305 (FN 2).)

negatively-biased target, and, by applying positive pulses, accumulated charges are dissipated to avoid arcing **under certain conditions**. (Ex. 1008, 1; Ex. 1002, ¶189.)

A POSITA would have recognized benefits of modifying the *Barber-Hirose* based system/process (noted above) given *Belkind*'s guidance how to avoid target arcing by applying bipolar pulsed-DC with two operating limitations: **pulsing frequency** above a critical frequency (Ex. 1008, 2), and long-enough positive **pulse width** to discharge the insulating film formed during each off-time (or positive pulse) (*id.*, 2, 5). (Ex. 1002, ¶189.)

A POSITA would have found *Belkind* helpful because, while *Barber* discloses adjusting pulsed DC's **pulse frequency** and **pulse width** (Ex. 1005, 7:14-17), it does not discuss how to ensure these adjustments do not cause arcing. Thus, a POSITA would have been motivated to apply the concepts/teachings provided/suggested by *Belkind* to configure DC supply 230 in the *Barber-Hirose* system to provide pulsed-DC power to target 260 such that the target voltage alternates between positive and negative voltages with those operating limitations discussed above to minimize arcing. (Ex. 1002, ¶190.)

A POSITA would have had a reasonable expectation of success in implementing such features as intended given a POSITA's contemporaneous knowledge and *Barber*, *Hirose*, and *Belkind*'s teachings/disclosures. (Ex. 1002, ¶191.) Pulsed-DC supplies were in known use at the time to deposit insulating films

with reduced arcing. (*Id.*; Ex. 1008, 1 (Advanced Energy’s (AE) pulsed-DC supplies); Ex. 1011, 6:7-11 (use of AE pulsed-DC supply and “suppression of arcing”); Ex. 1059, 2-3 (use of AE pulsed-DC supply “significantly reduces the occurrence of arc events”).)

A POSITA would have had the skill to implement, and expectation of success in achieving, the above modification, since it would have involved applications of known technologies (e.g., known pulsed-DC supplies and bipolar supplies (as disclosed by *Barber* and *Belkind* and known in the art) according to known methods (e.g., known techniques for configuring DC supplies and arch suppression) to yield the predictable result of a process that provided bipolar pulsed-DC power to a target with reduced arcing. (Ex. 1002, ¶192.) *KSR*, 550 U.S. at 416.

Accordingly, for the reasons above, to the extent *Barber* is read not to disclose the pulsed-DC power limitations associated with claims 2[c] and 1[c], it would have been obvious to modify the *Barber-Hirose* system/process (including as modified with the additional features based on the prior art associated with the other elements of claims 1 and 2 in Grounds 1 and 8, and the other claims in Grounds 1-9) to implement such DC supply to provide such features in light of *Belkind* and a POSITA’s contemporaneous knowledge. (Ex. 1002, ¶193.) The above positions are applicable to the combinations in Grounds 1-8 for the same reasons. Thus, the positions above (along with those in each respective ground above) demonstrate how

the asserted prior art combinations in further view of *Belkind* disclose and/or suggest claims 1-21. (See Sections IX.A-IX.H, incorporated here and for each of **Grounds 9-16 listed in Section IV.**)

Namely, a POSITA would have had the same motivations, capabilities, and expectations discussed above in Grounds 1-8 and knowledge of those discussed above regarding *Belkind* to modify each asserted combination to provide a pulsed-DC power source like that recited in claims 1 and 2 (explained above.) Therefore, for the same reasons discussed above and in the respective sections for Grounds 1-8, the *Barber-Hirose-Belkind* combination in view of the respective prior art identified in **Grounds 9-16 listed in Section IV**, discloses and/or suggests claims 1-21 (Sections IV, IX.A-IX.H; Ex. 1002, ¶¶194-202.)

X. DISCRETIONARY DENIAL IS NOT APPROPRIATE HERE

A. The Board Should Not Deny Institution Under § 325

While *Belkind* was identified in an IDS during prosecution (Ex. 1004, 898), it was not relied upon in any material way to reject the claims (*see generally id.*). Nor was *Belkind* ever distinguished by Applicant. (*Id.*) Instead, *Belkind* was first identified by Applicant during prosecution of the parent of the '657 patent (Apn. No. 10/101,863) to support its position that pulsed DC requires both positive and negative voltages. (Ex. 1052, 1305, n.2.) Applicant's position is consistent with a POSITA's knowledge as discussed herein. (Sections IX.A.1(c)(1), IX.I.) Thus,

while Petitioner presents *Belkind* here to demonstrate well-known aspects of pulsed-DC supplies, such positions are not at odds with Applicant's use of *Belkind* as a state of the art disclosure because Applicant implicitly agreed as to *Belkind*'s teachings in this regard. (*Supra* Section IX.I; Ex. 1052, 1305.) If anything, Examiner erred in not recognizing such features of *Belkind* to support the unpatentability of pending claims in the '863 application and the application for the '657 patent. (Ex. 1004, 898.) Moreover, the Office did not have the benefit of considering *Belkind* as presented here (in the asserted combinations supported by expert testimony). Thus, discretionary denial under § 325(d) should not be exercised here. *Amber.IO, Inc. D/B/A Two Tap* at 18-20; *Apple, Inc.* at 52-55; *Paragon 28, Inc. v. Wright Medical Technology, Inc.*, IPR2019-00896, Paper 16 at 30 (Oct. 14, 2019); *Apple, Inc. v. Omni Medsci, Inc.*, IPR2020-00029, Paper 7 at 52-55 (April 22, 2020).

B. Institution is Appropriate Under § 314(a)

The Board should decline to exercise its discretion under *NHK Spring Co., Ltd. v. Intri-Plex Techs, Inc.*, IPR2018-00752, Paper 8 (P.T.A.B. Sept. 12, 2018) to deny institution considering any of the Demaray Litigations. (*Supra* Section II (Related Litigations).) The six-factors in *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) ("*Fintiv* factors") favors institution.

PO asserted the '657 patent against Intel and Samsung ("*Texas* Litigations") focusing on products from Applied Materials. (Ex. 1075, ¶¶49-67; Ex. 1076, ¶¶52-

69.) In response, Applied Materials filed declaratory judgment of noninfringement against the patent (Ex. 1077, ¶1) and subsequently moved to enjoin the Texas Litigations from proceeding (Ex. 1078, 1079, 3). These litigations remain in their infancy. Indeed, the CMC in the Applied Litigation was not scheduled to occur until December 10, 2020 (Ex. 1079, 3), and the court held scheduling conferences in the Texas Litigations leaving the parties to prepare proposed schedules. (Ex. 1080, 5-6, Ex. 1081, 5-6.) With this backdrop, Petitioner preliminarily addresses the *Fintiv* factors below, but reserves the right to further address these as the records develop.

That no current evidence of a stay pending IPR exists does not weigh against institution under the **first *Fintiv* factor**. Courts routinely issue stays after institution. *Precision Planting, LLC v. Deere & Co.*, IPR2019-01044, Paper 17 at 14 (Dec. 2, 2019).

Institution is warranted under the **second *Fintiv* factor**. While the parties in the Texas Litigations negotiated proposed schedules based on a court suggested December 27, 2021 trial date, currently there are no trial dates. Even if adopted, there is no evidence to suggest such a trial date will be maintained. A district court will often “extend or accelerate deadlines and modify case schedules for myriad reasons.” *Precision Planting* at 14; see also *Intri-Plex Techs. v. NHK Int’l Corp.*, 3:17-cv-01097-EMC (N.D. Cal.) (D.I. 173, 175); *Sands Revolution II, LLC, v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24 at 8-10

(Jun. 16, 2020). That possibility exists here as the Texas court will consider case amendments post-Markman should an actual trial date materially differ from the court’s default schedule. (Ex. 1082, 10, n.6.) A Markman hearing in late March 2021 (according to the default schedule (*id.*, 8)) would result in the proposed December 27, 2021 trial date being at least three months faster than the default trial date (set “52 weeks after Markman (or as soon as practicable)”).²² (*Id.*, 10.) Any trial date entered does not guarantee entry of final judgment or consider lengthy post-trial briefing. Moreover, with the uncertainty faced by the COVID-19 pandemic, it would be speculative to assume the proposed December 27, 2021 trial date would be maintained.

Likewise, the **third Fintiv factor** favors institution given the infancy of the Texas Litigations and the lack of significant resource investment by the court and the parties in both cases. (Exs. 1080, 1081.)

As to the **fourth Fintiv factor**, there is no evidence that the same invalidity grounds sought here will be at-issue in the Texas Litigations. If anything, evidence suggests there is not complete overlap to the challenged claims at-issue here. (*Supra* Section IV; Ex. 1075, ¶¶49-71 (addressing claim 1 only); Ex. 1076, ¶¶52-76 (same);

²² The Markman in the Texas Litigations scheduled for April 2021 was taken off calendar in March.

Ex. 1080, 5-6; Ex. 1081, 5-6 (discovery issues regarding PO's confidentially served (and thus unavailable) infringement contentions).)

Finally, the **fifth factor** and other circumstances (**factor six**) favor institution. Applied Materials sought review within months of PO's complaints and coordinated with Petitioner and Samsung to present focused grounds. (*infra* Section X.C.) Petitioner's coordinated diligence coupled with the strength of the asserted grounds (*supra* Section IX) favors institution, especially in light of Petitioner's right to seek review within the one-year statutory window. *Silicon Labs., Inc. v. Cresta Tech. Corp.*, IPR2015-00615, Paper 9 at 24-25 (Aug. 14, 2015).

XI. CONCLUSION

For the reasons above, Petitioner requests institution of IPR of the challenged claims.

Respectfully submitted,

Dated: June 4, 2021

By: / David L. Cavanaugh/
David L. Cavanaugh (Reg. No. 36,476)
Counsel for Petitioner

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 7,381,657 contains, as measured by the word-processing system used to prepare this paper, 13,999 words. This word count does not include the items excluded by 37 C.F.R. § 42.24 as not counting towards the word limit.

Respectfully submitted,

Dated: June 4, 2021

By: / David L. Cavanaugh/
David L. Cavanaugh (Reg. No. 36,476)
Counsel for Petitioner
Intel Corporation.

CERTIFICATE OF SERVICE

I hereby certify that on June 4, 2021, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 7,381,657 and supporting exhibits to be served via express mail on the Patent Owner at the following correspondence address of record as listed on PAIR:

HAYNES AND BOONE, LLP

IP Section
2323 Victory Avenue
Suite 700
Dallas TX 75219

By: / David L. Cavanaugh/
David L. Cavanaugh (Reg. No.
36,476)