

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LAM RESEARCH CORP.,

Petitioner,

v.

INPRIA CORP.,

Patent Owner.

Case No. IPR2024-00033

Patent No. 9,823,564

PETITION FOR *INTER PARTES* REVIEW

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. IDENTIFICATION OF CHALLENGE AND RELIEF REQUESTED	3
III. GROUNDS FOR STANDING (37 C.F.R. § 42.204(A)).....	3
IV. MANDATORY NOTICES	4
A. Real Parties-In-Interest (§ 42.8(b)(1)).....	4
B. Related Matters (§ 42.8(b)(2))	4
C. Identification of Counsel (§ 42.8(b)(3)).....	4
D. Service Information (§ 42.8(b)(4)).....	5
V. POWER OF ATTORNEY (§ 42.10(B))	5
VI. FEE PAYMENT (§ 42.15(A)).....	5
VII. DETAILED EXPLANATION OF GROUNDS OF PATENTABILITY	5
A. Person of Ordinary Skill in the Art (“POSA”).....	5
B. Claim Construction.....	6
C. The ’564 Patent	8
1. Prosecution History.....	8
2. Priority Date.....	10
D. Asserted Prior Art.....	18
1. ’888 Publication (EX1003).....	18
2. Stowers 2008 (EX1008).....	19
3. Stowers 2009 (EX1010).....	22
4. Trikeriotis (EX1024).....	23
E. <u>Ground 1</u> : Claims 1-12 Are Anticipated by the ’888 Publication	24
F. <u>Ground 2</u> : Claims 1-5, 7-10, 12 Are Anticipated by Stowers 2008	33
1. Independent Claim 1	34
a) Preamble: “structure comprising a substrate and a coating material on a surface of the substrate”.....	34

TABLE OF CONTENTS

(continued)

	Page
b) “coating material comprises metal ions with radiation sensitive ligands”	34
c) “coating material has an average thickness from 5 nm to 30 nm”	38
d) “wherein exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material”	39
2. Claim 2	42
3. Claim 3	42
4. Claim 4	42
5. Claim 5	43
6. Claim 7	43
7. Claim 8	45
8. Claim 9	46
9. Claim 10	46
10. Claim 12	47
G. <u>Ground 3</u> : Claims 1-10, 12 Are Obvious Over Stowers 2008	48
1. Independent Claim 1	48
2. Claims 2-5 and 8-10	51
3. Claim 6	51
4. Claim 7	52
5. Claim 12	54
H. <u>Ground 4</u> : Claim 8 Is Obvious Over Stowers 2008 and Stowers 2009	56
I. <u>Ground 5</u> : Claims 1, 3, 6-7, 9, 11-12 Are Anticipated and/or Rendered Obvious by Trikeriotis	58

TABLE OF CONTENTS

(continued)

	Page
1. Independent Claim 1	58
a) Preamble: “structure comprising a substrate and a coating material on a surface of the substrate”	58
b) “coating material comprises metal ions with radiation sensitive ligands”	58
c) “coating material has an average thickness from 5 nm to 30 nm”	59
d) “wherein exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material”	59
2. Claim 3	60
3. Claim 6	60
4. Claim 7	60
5. Claim 9	61
6. Claim 11	61
7. Claim 12	61
J. No Secondary Considerations	62
VIII. DISCRETIONARY DENIAL IS NOT APPROPRIATE	63
A. 35 U.S.C. § 325(d)	63
B. 35 U.S.C. § 314(a)	66
IX. CONCLUSION	67

TABLE OF AUTHORITIES

	Page(s)
Cases	
<i>Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH</i> , IPR2019-01469, Paper 6 (Feb. 13, 2020)	63
<i>Alcon Research, Ltd. v. Apotex Inc.</i> , 687 F.3d 1362 (Fed. Cir. 2012)	38
<i>Apple Inc. v. Fintiv, Inc.</i> , IPR2020-00019, Paper 11 (Mar. 20, 2020)	66
<i>In re Applied Materials, Inc.</i> , 692 F.3d 1289 (Fed. Cir. 2012)	49, 50
<i>Ariad Pharms., Inc. v. Eli Lilly & Co.</i> , 598 F.3d 1336 (Fed. Cir. 2010)	17
<i>Becton, Dickinson & Co. v. B. Braun Melsungen AG</i> , IPR2017-01586, Paper 8 (Dec. 15, 2017)	63
<i>Danisco US Inc. et al v. Novozymes A/S</i> , IPR2021-00188, Paper 10 (May 17, 2021).....	19
<i>Dr. Reddy’s Laboratories S.A. et al. v. Indivior UK Ltd.</i> , IPR2019-00329, Paper 49 (Jun. 3, 2019)	19
<i>E.I. DuPont de Nemours & Co. v. Synvina C.V.</i> , 904 F.3d 996 (Fed. Cir. 2018)	49
<i>Elekta Ltd. v. ZAP Surgical Sys., Inc.</i> , 2023 WL 6152418 (Fed. Cir. Sept. 21, 2023)	57
<i>Gen. Hosp. Corp. v. Sienna Biopharm., Inc.</i> , 888 F.3d 1368 (Fed. Cir. 2018)	15
<i>Genentech, Inc. v. Hospira, Inc.</i> , 946 F.3d 1333 (Fed. Cir. 2020)	39, 50
<i>Group One, Ltd. v. Hallmark Cards, Inc.</i> , 407 F.3d 1297 (Fed. Cir. 2005)	7

<i>Grünethal GmbH v. Antecip Bioventures II LLC</i> , PGR2017-00008, Paper 43 (June 22, 2018)	17
<i>Home Depot USA, Inc. v. Lynk Labs, Inc.</i> , PGR2023-00016, Paper 8 (Aug. 4, 2023)	63
<i>Hospira, Inc. v. Fresenius Kabi USA, LLC</i> , 946 F.3d 1322 (Fed. Cir. 2020)	38, 44, 48
<i>Indivior UK Ltd. v. Dr. Reddy's Labs. S.A.</i> , 18 F.4th 1323 (Fed. Cir. 2021)	15, 16
<i>Lizardtech, Inc. v. Earth Res. Mapping, Inc.</i> , 424 F.3d 1336 (Fed. Cir. 2005)	12
<i>Marinus Pharm, Inc. v. Ovid Therapeutics, Inc.</i> , PGR2023-00020, Paper 9 (Aug. 17, 2023)	65
<i>Mylan Pharms. Inc. v. Merck Sharp & Dohme Corp.</i> , IPR2020-00040, Paper 21 (May 12, 2020)	38, 44, 48
<i>Nespresso USA, Inc. v. K-fee System GmbH</i> , IPR2023-00485, Paper 9 (Sept. 13, 2023)	65
<i>Novo Indus., L.P. v. Micro Molds Corp.</i> , 350 F.3d 1348 (Fed. Cir. 2003)	7
<i>Parus Holdings, Inc. v. Google LLC</i> , 70 F.4th 1365 (Fed. Cir. 2023)	11
<i>In re Peterson</i> , 315 F.3d 1325 (Fed. Cir. 2003)	48
<i>Philip Morris Prod., S.A. v. Rai Strategic Holdings, Inc.</i> , PGR2020-00071, Paper 29 (Jan. 10, 2022)	16
<i>Phillips v. AWH Corp.</i> , 415 F.3d 1303 (Fed. Cir. 2005)	6
<i>Pioneer Pet Prod., LLC v. Oil-Dri Corp. of Am.</i> , IPR2022-01138, Paper 21 (Jul. 21, 2023)	16

<i>PopSockets LLC v. Flygrip, Inc.</i> , IPR2022-00937, Paper 8 (Nov. 1, 2022)	18
<i>Power Oasis Inc. v. T-Mobile USA</i> , 522 F.3d 1299 (Fed. Cir. 2008)	17
<i>Purdue Pharma L.P. v. Faulding Inc.</i> , 230 F.3d 1320 (Fed. Cir. 2000)	12
<i>Quasar Science, LLC v. Colt International Clothing, Inc. d/b/a Colt LED</i> , IPR2023-00613, Paper 8 (Oct. 10, 2023).....	65
<i>Reckitt Benckiser LLC v. Ansell Healthcare Products LLC</i> , IPR2017-00063, Paper 38 (Jan 30, 2018).....	26
<i>Samsung Elecs. Co. v. M&K Holdings Inc.</i> , IPR2018-00696, Paper 55 (Aug. 23, 2021)	7
<i>Syngenta Crop Protection AG v. UPL Ltd.</i> , PGR2023-00017, Paper 8 (Jul. 31, 2023).....	65
<i>Telemac Cellular Corp. v. Topp Telecom, Inc.</i> , 247 F.3d 1316 (Fed. Cir. 2001)	38
<i>Titanium Metals Corp. of Am. v. Banner</i> , 778 F.2d 775 (Fed. Cir. 1985)	27, 29
<i>Toyota Motor Corp. v. Cellport Sys., Inc.</i> , IPR2015-00633, Paper 11 (Aug. 14, 2015).....	6
<i>Valve Corp. v. Ironburg Inventions Ltd.</i> , 8 F.4th 1364 (Fed. Cir. 2021)	19

Statutes

35 U.S.C.	
§ 102.....	3
§ 102(a)	23
§ 102(a)(1)	18, 19, 22, 23
35 U.S.C. § 102(b)(1).....	18
§ 102(b).....	19, 22

35 U.S.C. § 103	3
35 u.s.c. § 112	12, 63
35 U.S.C. § 314(a)	3, 66
35 U.S.C. § 325(d)	3, 63

Regulations

37 C.F.R.	
§ 42.8(b)(1)	4
§ 42.8(b)(2)	4
§ 42.8(b)(3)	4
§ 42.8(b)(4)	5
37 C.F.R. § 42.10(b)	5
37 C.F.R. § 42.15(a).....	5
37 C.F.R. § 42.103	5
37 C.F.R. § 42.204(a).....	4

EXHIBIT LIST

Exhibit	Description
1001	U.S. Patent No. 9,823,564 (“’564 patent”)
1002	Expert Declaration of Karey Holland, Ph.D. (“Holland Declaration”)
1003	U.S. Patent Publication No. 2011/0293888 (“’888 publication”)
1004	U.S. Application No. 12/850,867 Prosecution History (“’867 application PH”)
1005	U.S. Application No. 61/350,103 (“’103 provisional”)
1006	Declaration Sylvia Hall-Ellis, Ph.D. Regarding Authenticity and Public Availability (“Hall-Ellis Declaration”)
1007	’564 Patent Prosecution History (“’564 patent PH”)
1008	Stowers, Jason K. <i>Direct patterning of solution deposited metal oxides</i> . Oregon State University, 2008 (“Stowers 2008”)
1009	U.S. Patent No. 10,782,610 Prosecution History (“’610 patent PH”)
1010	Stowers, Jason, and Douglas A. Keszler. <i>High resolution, high sensitivity inorganic resists</i> . Microelectronic Engineering 86.4-6 (2009): 730-733 (“Stowers 2009”)
1011	Complaint for <i>Inpria Corp. v. Lam Research Corp.</i> , 1-22-cv-01359
1012	Jouve, A., et al. <i>Overcoming pattern collapse of ultra high resolution dense lines obtained with EUV resists</i> . Advances in Resist Technology and Processing XXII. Vol. 5753. SPIE, 2005 (“Jouve”)
1013	Stowers, Jason, Alan Telecky, and Andrew Grenville. <i>Imageable oxides: new solutions for resist</i> . EUVL Symposium. 2010, available at https://euvsymposium.lbl.gov/pdf/2010/pres/RE-08.pdf

Exhibit	Description
1014	Telecky, Alan, et al. <i>Photopatternable inorganic hardmask</i> . Journal of Vacuum Science & Technology B 28.6 (2010): C6S19-C6S22 (“Telecky 2010”)
1015	Summons for <i>Inpria Corp. v. Lam Research Corp.</i> , 1-22-cv-01359
1016	Amador et al. <i>Patterning chemistry of HafSO_x resist</i> . Advances in Patterning Materials and Processes XXXI. Vol. 9051. SPIE, 2014
1017	Reserved
1018	Decker, Shawn R. <i>On the Properties and Characteristics of Solution Processed Hafnium Based Thin-Films from Aqueous Precursors</i> . Oregon State University, 2017
1019	Oleksak et al. <i>Evaluation of Thermal and Radiation Induced Chemistries of Metal Oxo–Hydroxo Clusters for Next-Generation Nanoscale Inorganic Resists</i> . ACS Applied Nano Materials 1.9 (2018): 4548-4556
1020	Reserved
1021	U.S. Patent No. 7,773,365
1022	Stowers et al. <i>Directly patterned inorganic hardmask for EUV lithography</i> . Extreme Ultraviolet (EUV) Lithography II. Vol. 7969. SPIE, 2011 (“Stowers 2011”)
1023	Reserved
1024	Trikeriotis et al. <i>Development of an inorganic photoresist for DUV, EUV, and electron beam imaging</i> . Advances in Resist Materials and Processing Technology XXVII. Vol. 7639. SPIE, 2010 (“Trikeriotis”) (Library Version)
1025	Matsuzawa et al. <i>Theoretical estimation of absorption coefficients of various polymers at 13nm</i> . Journal of Photopolymer Science and Technology 12.4 (1999): 571-576.

Exhibit	Description
1026	Puurunen et al. <i>Hafnium oxide films by atomic layer deposition for high-κ gate dielectric applications: Analysis of the density of nanometer-thin films</i> . Applied Physics Letters 86.7 (2005).
1027	Ober and Giannelis. <i>New oxide nanoparticle extreme-UV photoresists achieve high sensitivity</i> . SPIE Newsroom (2014): 2-4.
1028	<i>Curriculum Vitae</i> of Sylvia D. Hall-Ellis, Ph.D.
1029	<i>Curriculum Vitae</i> of Karey L. Holland, Ph.D.
1030	Anderson, Jeremy T., et al. <i>Solution-processed HfSO_x and ZrSO_x inorganic thin-film dielectrics and nanolaminates</i> . Advanced Functional Materials 17.13 (2007): 2117-2124 (“Anderson”)
1031	Trikeriotis et al. <i>Development of an inorganic photoresist for DUV, EUV, and electron beam imaging</i> . Advances in Resist Materials and Processing Technology XXVII. Vol. 7639. SPIE, 2010 (“Trikeriotis”) (Electronic Version)

I. INTRODUCTION

Lam Research Corporation (“Petitioner”) files this petition for *inter partes* review (“Petition”), seeking cancellation of claims 1-12 of U.S. Patent No. 9,823,564 (“’564 patent”) (EX1001), to Inpria Corporation (“Inpria”). This Petition is supported by the expert declaration of Dr. Karey Holland (EX1002), and exhibits submitted herewith.

The ’564 patent relates to inorganic coating materials for use as UV, EUV or electron beam resist materials, wherein the coating comprises metal ions with radiosensitive ligands. The ’564 patent issued from a continuation application 14/858,612 (“’612 application”), filed September 18, 2015, and purports to claim priority to application 12/850,867 (“’867 application”), filed August 4, 2010. When Inpria filed the continuation ’612 application, it filed an entirely new set of claims, with new independent claim 1 and dependent claim 6 containing limitations that require a thickness of 5 nm to 30 nm and 5 nm to 25 nm, respectively.

As set forth below, the ’867 application does not provide written description support for the thickness limitations in claims 1 and 6 (and neither does the ’612 continuation application specification). Accordingly, the Board should find that claims 1-12 are entitled to a priority date of no earlier than September 18, 2015, when new claims 1 and 6 were filed with the ’612 continuation application. That September 2015 priority date makes the publication of the ’567 application, *i.e.*, the

'888 publication (EX1003), available as prior art. And, as explained herein, the '888 publication anticipates claims 1-12.

Even if claims 1-12 are entitled to an earlier priority date of August 4, 2010 (or June 1, 2010, the date of provisional 61/350,103)—which they are not—they are still unpatentable. As shown below, Stowers 2008 (EX1008) anticipates claims 1-5, 7-10 and 12 and renders claims 1-10 and 12 obvious. Stowers 2008 is the Ph.D. thesis of one of the inventors of the challenged '564 patent, Jason Stowers.¹ Stowers 2008 describes UV, EUV and electron beam patterning of “ZircSO_x and HafSO_x” films. These “ZircSO_x and HafSO_x” films contain the same components, and therefore, have the same properties, as the films exemplified in the '564 patent. Moreover, Stowers 2008 discloses films that are 30 nm thick, thus meeting the 5 nm to 30 nm thickness limitation of claim 1. This is significant because, as discussed below, the thickness limitation of claim 1 was the sole basis for allowance of the claims over a different Stowers reference, Stowers 2009 (EX1010), which also discloses “ZircSO_x and HafSO_x” films, but they have a thickness of 35 nm. As to the 5 nm to 25 nm thickness of claim 6, a POSA could have easily formed a film with a thickness within that range, as Stowers 2008 itself states that ZircSO_x and HafSO_x had already been deposited at thickness as thin as 2 nm.

¹ Stowers' Ph.D. advisor was Douglas Keszler, who is an inventor of the '564 patent.

The Petition also shows that claims 1, 3, 6-7, 9 and 11-12 are anticipated and/or rendered obvious by Trikeriotis. Trikeriotis discloses an inorganic resist made of hafnium oxide nanoparticles with organic ligands that can be used for DUV, EUV, and electron beam lithography. Like Stowers 2008, Trikeriotis discloses 30 nm thick films, thereby meeting the 5 nm to 30 nm thickness that the Examiner found missing from the prior art.

Finally, there are no persuasive reasons for denying institution under § 325(d) or § 314(a), as discussed below. Petitioner respectfully requests that the Board institute review and cancel claims 1-12 of the '564 patent.

II. IDENTIFICATION OF CHALLENGE AND RELIEF REQUESTED

Ground	Basis	References	Claims
1	§ 102	'888 Publication	1-12
2	§ 102	Stowers 2008	1-5, 7-10 and 12
3	§ 103	Stowers 2008	1-10 and 12
4	§ 103	Stowers 2008 and Stowers 2009	8
5	§§ 102 or 103	Trikeriotis	1, 3, 6-7, 9 and 11-12

III. GROUNDS FOR STANDING (37 C.F.R. § 42.204(A))

Petitioner certifies that the '564 patent is available for *inter partes* review, having issued on November 21, 2017, *i.e.*, this Petition is filed more than nine

months after the grant of the patent. Petitioner hereby certifies that it is not barred or estopped from requesting review of the grounds identified.

IV. MANDATORY NOTICES

A. Real Parties-In-Interest (§ 42.8(b)(1))

Petitioner is the sole real-party-in-interest.

B. Related Matters (§ 42.8(b)(2))

Inpria has asserted claims of infringement based on the '564 patent against Petitioner. *Inpria Corp. v. Lam Research Corp.*, 1:22-cv-01359 (D. Del.). This Petition is timely, having been filed within one year of service of the complaint. EX1015.

C. Identification of Counsel (§ 42.8(b)(3))

Petitioner designates Dion M. Bregman (Reg. No. 45,645) as lead counsel, and Michael J. Lyons (Reg. No. 37,386), Ahren C. Hsu-Hoffman (Reg. No. 50,862) Guylaine Haché (Reg. No. 76,083), and Alison P. Patitucci (Reg. No. 75,370) as back-up counsel.

Petitioner consents to electronic service. Please direct all correspondence to lead and back-up counsel at the contact information below.

MLB-Lam-IPR-Team@morganlewis.com

D. Service Information (§ 42.8(b)(4))

This Petition is being served by Priority Mail Express to the correspondence address of record for the '564 patent: CHRISTENSEN, FONDER, DARDI & HERBERT PLLC, 11322 86th Ave. N., Maple Grove, MN 55369, UNITED STATES.

V. POWER OF ATTORNEY (§ 42.10(B))

The Petitioner's Power of Attorney form is filed concurrently in accordance with 37 C.F.R. § 42.10(b).

VI. FEE PAYMENT (§ 42.15(A))

The required fee described in § 42.15(a) is paid under § 42.103, and the Commissioner is hereby authorized to charge all fees pertaining to this matter to Attorney Deposit Account 50-0310 (docket 134507-8002).

VII. DETAILED EXPLANATION OF GROUNDS OF PATENTABILITY

A. Person of Ordinary Skill in the Art ("POSA")

The POSA to whom the '564 patent is directed would have been an individual with at least a graduate degree, such as a masters or Ph.D., in a relevant discipline such as in chemistry, materials science, chemical engineering, physics, or an equivalent field. The POSA would also have 1-3 years of experience in the research, design, development and/or testing of resist materials. EX1002 ¶20.

B. Claim Construction

For the purpose of this IPR, the claims should be given “their ordinary and customary meaning” as understood by a person of ordinary skill at the time of the claimed invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312, 1327 (Fed. Cir. 2005). The Board only construes the claims when necessary to resolve the underlying controversy in the *inter partes* review. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper 11, 16 (Aug. 14, 2015). Except as discussed below, Petitioner believes no express constructions of the claims are necessary.

Claim 8 depends on claim 1 and recites that the claimed structure has “**a metal ion to radiosensitive ligand ratio of at least 2.**” The ’564 patent does not provide written description support for this limitation. Rather, the specification states that “the composition has a molar concentration **ratio of ligands to metal suboxide cations** of at least about 2.” EX1001, 2:31-33; 10:2-4 (“if the mole ratio of peroxide group to the metal cations is at least 2, more stable solutions can be formed.”).² Thus, the ratio of “at least 2” disclosed in the specification is a “ligand to metal” ratio—not the claimed “metal to ligand” ratio.

² Emphasis added unless otherwise noted.

To the extent Inpria argues that the Board should “correct” claim 8 to recite a “radiosensitive ligand to metal ion ratio of at least 2,” Petitioner respectfully submits that it is legally impermissible for the Board to make this change.

Courts (and the Board) may correct “obvious minor typographical and clerical errors in patents” through claim construction. *Novo Indus., L.P. v. Micro Molds Corp.*, 350 F.3d 1348, 1357 (Fed. Cir. 2003); *Samsung Elecs. Co. v. M&K Holdings Inc.*, IPR2018-00696, Paper 55, 13-14 (Aug. 23, 2021). “Major errors are subject only to correction by the PTO.” *Novo*, 350 F.3d at 1357; *id.* at 1356 (“[W]e do not think that Congress intended that the district courts have the authority to correct any and all errors that the PTO would be authorized to correct...”).

To the extent claim 8 recites an error, it is not an obvious error. Again, courts may only correct “obvious minor typographical and clerical errors in patents.” *Novo Indus.*, 350 F.3d at 1357. That is, “[t]he district court can correct an error only if the error is evident from the face of the patent.” *Group One, Ltd. v. Hallmark Cards, Inc.*, 407 F.3d 1297, 1303 (Fed. Cir. 2005). Here, the claim language is linguistically correct as written—there are no grammatical errors, missing words, misspellings, or similar problems that would make the phrase unreadable or suggest there was an obvious error in the claim language. In other words, it is unclear if any error is in the specification or in the claim. EX1002 ¶56.

Moreover, a POSA could reasonably conclude that claim 8 does not recite an error because, as subsequent publications by named inventor Keszler has shown, “[e]ven with excess peroxide in the precursor solution, the **Hf:O₂²⁻ ratio saturates near 2:1 in the solution, and it persists in the film.**” EX1016, 5; EX1019, 5 (“**peroxide content in the films does not exceed ≈0.5 per hafnium ion.**”). In other words, **in the film**, and contrary to the specification’s assertion, by the inventor’s own admission, the **ligand to metal ion ratio could never reach at least 2.** EX1002 ¶¶56-58.³

C. The ’564 Patent

1. The ’564 patent is titled “Patterned Inorganic Layers, Radiation Based Patterning Compositions and Corresponding Methods” and lists Jason K. Stowers, Alan J. Telecky, Douglas A. Keszler and Andrew Grenville as inventors.

1. Prosecution History

The ’564 patent issued from application 14/858,612 (“’612 application”) filed on September 18, 2015, and claims priority to application 12/850,867 (“’867

³ Petitioner notes that Inpria first presented the claim that issued as claim 8 on September 30, 2016 (EX1007, 405), which is after inventor Keszler first reported that the peroxide ligand to metal ratio in the film could never reach 2. *E.g.*, EX1016 (published March 27, 2014).

application”) (EX1004), filed on August 5, 2010, and provisional 61/350,103 (“103 provisional”) (EX1005).

The ’612 application was filed with 20 “new” claims. EX1007, 43, 65. “New” claim 1 of the ’612 application recited:

A structure comprising a substrate and a coating material on a surface of the substrate, wherein the coating material comprises metal ions with radiation sensitive ligands and wherein the coating material has an **average thickness from about 5 nm to about 30 nm**, wherein exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and unexposed regions of the coating material.

Id., 65.

The Examiner issued an office action on June 30, 2016, rejecting the claims as obvious over Stowers 2009 (EX1010). *Id.*, 126. The Examiner stated that Stowers 2009 discloses “aqueous precursor solutions...comprising $\text{ZrOCl}_2 \cdot 8\text{H}_2\text{O}$, $\text{HfOCl}_2 \cdot \text{H}_2\text{O}$, H_2SO_4 , H_2O_2 and purified water...” *Id.* As to the claimed thickness of “about 5 nm to about 30 nm,” the Examiner stated that Stowers 2009 discloses a coating of “2 nm, which encompasses the instant claimed range of about 5 nm.” *Id.* Inpria filed a response on September 30, 2016 in which Inpria argued that the 2 nm disclosure

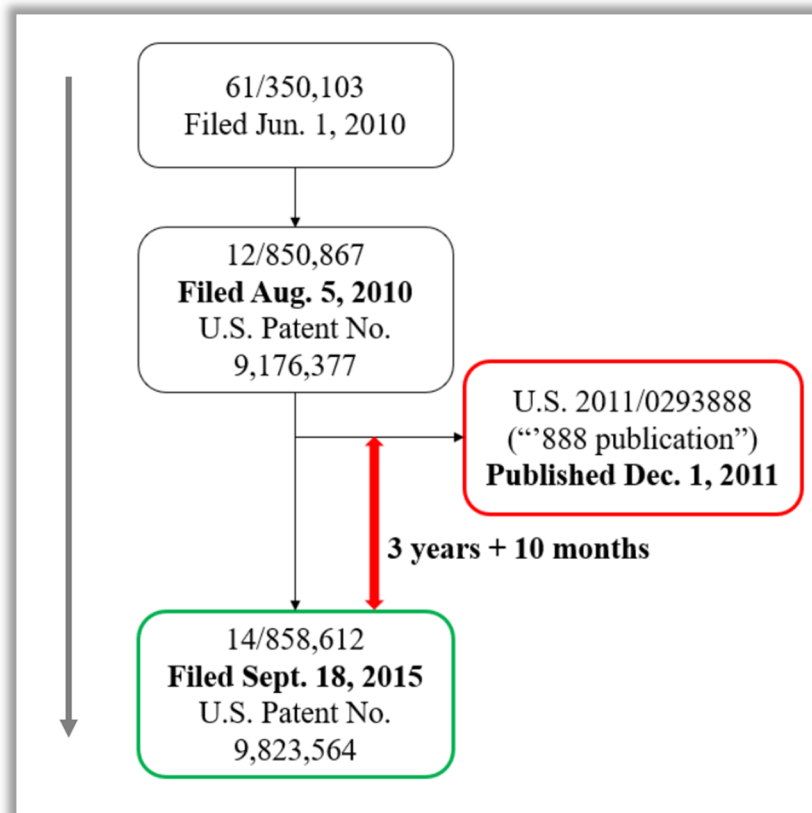
in Stowers 2009 was “line-width-roughness,” not thickness, and that Stowers 2009 disclosed a thickness of 35 nm. *Id.*, 144.

The Examiner maintained the rejection in an office action issued on October 18, 2016. The Examiner stated that Stowers 2009 discloses the thickness limitation because an average thickness of 35 nm is “about 30 nm.” *Id.*, 490. Inpria overcame the rejection by deleting the term “about” and arguing that “the ranges do not overlap and they are not close enough that one would expect them to have the same properties.” *Id.*, 508.

In allowing the claims on August 23, 2017, the Examiner stated that “[n]o other prior art teaches a structure comprising a coating material comprising metal ions with radiation sensitive ligands, wherein the coating material has an average thickness from 5 nm to 30 nm...” *Id.*, 587.

2. Priority Date

The '612 application, which issued as the '564 patent, was filed on September 18, 2015, and claims priority to the '867 application, filed August 5, 2010, and the '103 provisional. The priority chain is illustrated below:



The first utility application in the priority chain, the '867 application, published on December 1, 2011, as the '888 publication. As explained below, the '888 publication qualifies as prior art because claims 1-12 are not entitled to an effective filing date earlier than September 18, 2015, when the '612 application was filed.

In assessing whether the '888 publication qualifies as prior art, the Board must consider the '564 patent claims' priority date. *Parus Holdings, Inc. v. Google LLC*, 70 F.4th 1365, 1373 (Fed. Cir. 2023) ("Because Parus asserted that Kurnagov-262 is not prior art by claiming priority from the application from which it stems, the

Board needed to determine whether the challenged claims satisfied the written description requirement.”); *Motorola Mobility LLC v. Lagan Precision Co., Ltd.*, IPR2022-01156, Paper 13, 9 (Jan. 4, 2023) (“Board routinely makes determinations regarding priority dates of challenged claims and in doing so, often analyzes whether the challenged claims have written description support from earlier applications in a priority chain.”).

Claims are not entitled to the filing date of an earlier-filed application unless the earlier-filed application provides adequate written-description support for those claims under § 112. To comply with the written description requirement, the specification “must describe the invention sufficiently to convey to a person of skill in the art that the patentee had possession of the claimed invention at the time of the application, *i.e.*, that the patentee invented what is claimed.” *Lizardtech, Inc. v. Earth Res. Mapping, Inc.*, 424 F.3d 1336, 1345 (Fed. Cir. 2005). While “the disclosure as originally filed does not have to provide in *haec verba* support for the claimed subject matter at issue...one skilled in the art, reading the original disclosure, must immediately discern the limitation at issue in the claims.” *Purdue Pharma L.P. v. Faulding Inc.*, 230 F.3d 1320, 1323 (Fed. Cir. 2000).

Claim 1 (the sole independent claim) and claim 6 of the '564 patent recite:

1. A structure comprising a substrate and a coating material on a surface of the substrate, wherein the coating

material comprises metal ions with radiation sensitive ligands and wherein the **coating material has an average thickness from 5 nm to 30 nm**, wherein exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material.

6. The structure of claim 1 wherein the **average thickness is from 5 nm to 25 nm**.

The '867 application, filed on June 1, 2010, does not contain written description support for the thickness limitations in claims 1 and 6. There is nothing in the specification that demonstrates that the inventors believed that a coating with “an average thickness from 5 nm to 30 nm” or “from 5 nm to 25 nm” were part of their invention. To the contrary, the only discussion in the '867 application concerning the thickness of the coating is reproduced below in its entirety:

In some embodiments, it can be desirable to use a thin coating to facilitate formation of small and highly resolved features. In some embodiments, the coating materials can have an average **thickness of no more than about 1 micron**, in further embodiments **no more than about 250 nanometers (nm)**, in additional embodiments **from about 1 nanometers (nm) to about 50 nm**, in other

embodiments **from about 1 nm to about 40 nm** and in some embodiments **from about 1 nm to about 25 nm**. A person of ordinary skill in the art will recognize that additional ranges of thicknesses within the explicit ranges above are contemplated and are within the present disclosure.

EX1004, 23, lines 16-26; EX1007, 43 (Inpria relying on this passage as support for the average thickness limitations).

The coating material was produced according to the method of Example 2 with a ZrO^{+2} -based coating composition. The coating material was deposited at a **thickness form (sic) 10-50 nm**.

Id., 35, lines 14-15.

The resist was applied with a **thickness of 20 nm** by spin coating on a silicon wafer, followed by a post-apply bake of 50° C.

Id., 36, lines 29-30.

22. The method of claim 14 wherein the layer of coating material has an average **thickness from about 1 nm to about 40 nm**.

Id., 40, claim 22.

As these passages make clear, the '867 application does not describe a coating material with a particular thickness of either 5 nm or 30 nm, let alone a thickness **range** of 5 nm to 30 nm (claim 1). While the '867 application does recite a thickness of 25 nm, it never recites a thickness of 5 nm, let alone a thickness **range** of 5 nm to 25 nm (claim 6).⁴ There is absolutely no indication in the '867 application that the inventors gave any importance to these specific claimed thickness ranges when they filed the application. EX1002 ¶66. In fact, the first time that Inpria disclosed these ranges was on **September 18, 2015**, in the “new” claims filed with the '612 application. EX1007, 65, 9-18-2015 claims.

It is well established that “[t]he disclosure of a broad range of values **does not** by itself provide a **written description support** for a particular **value within that range**.” *Gen. Hosp. Corp. v. Sienna Biopharm., Inc.*, 888 F.3d 1368, 1372 (Fed. Cir. 2018) (emphasis added). “Instead, where a specification discloses a broad range of values and a value within that range is claimed, the disclosure must allow one skilled in the art to **immediately discern the limitation at issue in the claims**.” *Id.*; *Indivior UK Ltd. v. Dr. Reddy’s Labs. S.A.*, 18 F.4th 1323, 1328–1329 (Fed. Cir. 2021).

⁴ The '103 provisional does not disclose the ranges or the endpoints either. EX1005, 2 (“thickness range of **20 nm to 40 nm**.”)

Indivior is instructive. There, the Federal Circuit determined that a claim directed to a film comprising “about 40 wt % to about 60 wt % of a water-soluble polymeric matrix” lacked written description support in a specification that did not recite either of the two end values (40% and 60%) and did not disclose or claim the range (40–60%). *Indivior*, 18 F.4th at 1325. *Indivior* also considered a narrower claim directed to a film comprising “about 48.2 wt % to about 58.6 wt % of the water-soluble polymeric matrix,” and concluded that it also lacked written description support in the specification, even though the specification provided examples of films having the two end point values of the range (48.2% and 58.6%). *Id.* The court concluded that finding written description support on those facts would “amount[] to cobbling together numbers after the fact.” *Id.* at 1329.

Here, claim 1 of the ’564 patent lacks written description support in the ’867 application because the specification does not disclose either of the two end values (5 nm and 30 nm) or the range (5 nm to 30 nm). *Pioneer Pet Prod., LLC v. Oil-Dri Corp. of Am.*, IPR2022-01138, Paper 21, 8 (Jul. 21, 2023) (“an example having a sodium bentonite content of 65% and an example having a sodium bentonite content of 70% [did not] support the amended range of 60% to 80%”); *Philip Morris Prod., S.A. v. Rai Strategic Holdings, Inc.*, PGR2020-00071, Paper 29, 40 (Jan. 10, 2022) (disclosure of two endpoints of “about 75%” and “about 85%” did not provide written description for claim reciting range of “about 75% to about 85%”).

As to dependent claim 6, while the specification discloses a range of 1 nm to 25 nm, that disclosure does not provide written description support for the claimed range of 5 nm to 25 nm. *Grünethal GmbH v. Antecip Bioventures II LLC*, PGR2017-00008, Paper 43, 17 (June 22, 2018) (“about 50 to about 500 mg” did not provide written description support for claim reciting “about 80 to about 500 mg.”).

Moreover, having successfully argued that 30 nm and 35 nm “are not close enough that one would expect them to have the same properties” (EX1007, 508), Inpria should be estopped from now arguing that 5 nm is “close enough” to 1 nm or 10 nm, or that 30 nm is “close enough” to 25 nm, 40 nm, or 50 nm, such that these endpoint values provide support for the claimed ranges of 5 nm to 30 nm (claim 1) or 5 nm to 25 nm (claim 6). *See also* EX1009, 264 (“A person skilled in the art would not understand a 5 nm different (sic) to fall within the scope of about 30 nm.”); EX1002 ¶67.

Finally, the specification’s general statement that “[a] person of ordinary skill in the art will recognize that additional ranges of thicknesses within the explicit ranges above are contemplated and are within the present disclosure” does not provide written description support for the specifically claimed ranges. It is well settled that “[e]ntitlement to a filing date does not extend to subject matter which is not disclosed, but would be obvious over what is expressly disclosed.” *Power Oasis Inc. v. T-Mobile USA*, 522 F.3d 1299, 1306 (Fed. Cir. 2008); *Ariad Pharms., Inc. v.*

Eli Lilly & Co., 598 F.3d 1336, 1352 (Fed. Cir. 2010) (“[A] description that merely renders the invention obvious does not satisfy the [written description] requirement.”).

Therefore, claims 1-12 are not entitled to a priority date of earlier than **September 18, 2015**, *i.e.*, the actual filing date of the ’564 patent, when the thickness limitations of “5 nm to 30 nm” or “5 nm to 25 nm” were first presented in the new claims.

D. Asserted Prior Art

1. ’888 Publication (EX1003)

The ’888 publication published on December 1, 2011. Because claims 1-12 are not entitled to an effective filing date earlier than September 18, 2015, the ’888 publication is prior art under post-AIA § 102(a)(1). None of the exceptions of § 102(b)(1) apply, because the ’888 publication published more than one year prior to September 18, 2015, the actual filing date of the ’564 patent.

As noted above, the ’564 patent is entitled to a priority date of no earlier than **September 18, 2015**. As such, the published version of the ’867 application (the ’888 publication, published almost four years earlier on **December 1, 2011**), is prior art. *See PopSockets LLC v. Flygrip, Inc.*, IPR2022-00937, Paper 8, 23 (Nov. 1, 2022) (“Because Petitioner shows that claims 2 and 8 are entitled only to the filing date of the application that issued as the ’024 patent, Petitioner sufficiently establishes at

this stage that the Provisional Application and the '476 [parent] Publication are prior art to claims 2 and 8.”); *Danisco US Inc. et al v. Novozymes A/S*, IPR2021-00188, Paper 10, 30 (May 17, 2021) (“challenged claims are entitled to no priority date earlier than their actual filing date. Thus, [the parent publication] is prior art.”); *Dr. Reddy’s Laboratories S.A. et al. v. Indivior UK Ltd.*, IPR2019-00329, Paper 49, 12 (Jun. 3, 2019), *aff’d* 18 F.4th 1323 (Fed. Cir. 2021) (challenged claims were not entitled to claim priority to earlier filed grandparent application and that same earlier-filed application’s U.S. publication was prior art).

2. Stowers 2008 (EX1008)

Stowers 2008 published on October 21, 2008. EX1006 ¶¶44-50, 67. Stowers 2008 is therefore prior art to the '564 patent under pre-AIA § 102(b) (if the '564 patent is entitled to its purported August 5, 2010 or June 1, 2010 priority date) or post-AIA § 102(a)(1) (if the '564 patent is not entitled to its priority date).⁵

⁵ Inpria submitted Stowers 2008 in an IDS and characterized it as **dated “August 14, 2008.”** EX1007, 53. *Valve Corp. v. Ironburg Inventions Ltd.*, 8 F.4th 1364, 1374 (Fed. Cir. 2021) (“The IDS is significant...because of the applicant’s characterization of the Burns article as being dated 2010, which is before the critical date of each patent.”)

Stowers 2008 is a doctoral dissertation titled *Direct Patterning of Solution Deposited Metal Oxides* by Jason K. Stowers, who is a named inventor on the challenged '564 patent. Douglas Keszler, who is also an inventor of the '564 patent, was Stowers' Ph.D. advisor. According to the Stowers dissertation, inventor Keszler “made numerous contributions in suggesting experiments, interpreting of results, and editing through the entirety of this dissertation.” EX1008, 9.

Stowers 2008 discusses “the use of lithography for the direct patterning of metal oxide thin films.” *Id.*, 18. Relevant here is Stowers 2008’s work on HafSOx and ZircSOx films.⁶ As disclosed in Stowers 2008, “[w]ork in direct patterning was initiated after the development of the thin-film chemistry of the material HafSOx [citing Anderson (EX1030)].” EX1008, 18; *see also id.* (“HafSOx is an aqueous

⁶ HafSOx and ZircSOx are terms coined by the Keszler laboratory. *See* EX1030, 2 (“We demonstrate that useful dielectrics can be produced with new hafnium and zirconium oxide sulfates and their derivatives, as exemplified by the parent compositions $\text{HfO}_{2-x}(\text{SO}_4)_x$ and $\text{ZrO}_{2-x}(\text{SO}_4)_x$ ($0.46 \leq x \leq 1$), which we designate HafSOx and ZircSOx, respectively.”)

solution-deposited material based on various compositions of hafnium oxide sulfate that was initially designed as a high-k dielectric.”⁷

Stowers 2008 explains that “HafSO_x, and its zirconium analog ZircSO_x, can be deposited in films ranging in thickness from 2 to 500 nm.” EX1008, 18.

According to Stowers 2008:

The films are characterized by being atomically smooth surfaces. Taken together, these properties serve as an excellent starting point for the development of a directly patterned metal oxide. Furthermore, with the proper patterning characteristics this material could be adapted as a high quality inorganic resist.

Id.

In Chapter 3, Stowers 2008 states that UV and EUV “patterning of HafSO_x and ZircSO_x was significantly improved on by changing chemistries to a peroxide based system.” EX1008, 143. Like the ’564 patent, the HafSO_x and ZircSO_x films of Stowers 2008 were made by combining HfOCl₂ or ZrOCl₂, H₂O₂, and H₂SO₄ in solution and spin coating the solutions onto wafers to form films. EX1008, 52;

⁷ As admitted by the ’103 provisional, the coating materials of the ’564 patent are also “based on the solution-deposited dielectric HafSO_x” disclosed in Anderson. EX1005, 4.

EX1001, Example 2. As a result, the HafSO_x and ZircSO_x coating materials of Stowers 2008 and '564 patent are the same in all material respects. EX1002 ¶¶101-104.⁸ Stowers 2008 discloses HafSO_x and ZircSO_x coating materials with thicknesses of 30 to 35 nm. *Id.*, 68.

3. Stowers 2009 (EX1010)

Stowers 2009 published on December 3, 2008. EX1006 ¶¶51-58, 67. Stowers 2009 is therefore prior art to the '564 patent under pre-AIA § 102(b) (if the '564 patent is entitled to its purported August 5, 2010 or June 1, 2010 priority date) or post-AIA § 102(a)(1) (if the '564 patent is not entitled to its priority date).⁹

⁸ Notably, the ZircSO_x precursor solutions of Stowers 2008 have the same peroxide to Zr ion ratio (ratio of 0.75) as the ZircSO_x precursor solutions in Example 2 of the '564 patent (ratio of 0.66 – 0.88). EX1002 ¶38. And while the peroxide to Hf ion ratio is higher in the '564 patent's HafSO_x's precursor solution (ratio of 6.25 – 8.33) (*id.*), that ratio does not remain in the films, as it saturates to 0.5 peroxide to one metal ion. *See, e.g.*, EX1016, 5; EX1002 ¶56.

⁹ Inpria submitted Stowers 2009 in an IDS and characterized it as **dated “2009.”** EX1007, 53. Moreover, the Examiner rejected the claims over Stowers 2009 (*id.*, 126) and Inpria did not dispute that Stowers 2009 was prior art. *Id.*, 507.

Stowers 2009 is an article titled *High resolution, high sensitivity inorganic resists*, and lists Jason Stowers and Douglas Keszler as authors. Stowers 2009 discloses “[n]ew inorganic electron-beam resists [that] have been developed on the basis of the aqueous chemistries of Zr and Hf.” EX1010, Abstract. Specifically, “[t]he resists are derived from the film chemistry of the hafnium and zirconium oxide sulfates known as HafSO_x and ZircSO_x, respectively,” as disclosed in Anderson (EX1030). *Id.*, 19. As with Stowers 2008, the coatings of Stowers 2009 were made by combining HfOCl₂ or ZrOCl₂, H₂O₂, and H₂SO₄ in solution and spin coating the solution onto wafers to form films. *Id.* Stowers 2009 discloses HafSO_x and ZircSO_x coating materials that are 35 nm thick.

4. Trikeriotis (EX1024)

Trikeriotis published on March 25, 2010. EX1006 ¶¶59-67; *see also* EX1031, Cover. Trikeriotis is therefore prior art to the ’564 patent under pre-AIA § 102(a) (if the ’564 patent is entitled to its purported August 5, 2010 or June 1, 2010 priority date) or post-AIA § 102(a)(1) (if the ’564 patent is not entitled to its priority date).

Trikeriotis is an article titled *Development of an inorganic photoresist for DUV, EUV, and electron beam imaging*, and lists Markos Trikeriotis as author, among others. Trikeriotis discloses an inorganic resist made of hafnium oxide nanoparticles with organic ligands that can be used for DUV, EUV, and electron beam lithography. EX1024, 16. Trikeriotis states that “[t]he different ligands on the

surface of the nanoparticles give them unique properties, allowing these films to act as positive or negative tone photoresists for 193 nm or electron beam lithography.”

Id., Abstract.

E. Ground 1: Claims 1-12 Are Anticipated by the '888 Publication

The '612 application, which issued as the '564 patent, was filed with 20 “new” claims. In the Remarks accompanying the Preliminary Amendment, Inpria stated that “[t]he specification supports the new claims as noted in the following discussion.” EX1007, 43. In particular, Inpria stated:

The specification supports new claims 1 and 13, for example, at page 3, lines 9-23, page 5, lines 26-27, page 8, lines 14-17, page 21, lines 16-18 and page 23, line 16 to page 24, line 18. The specification supports claims 2, 4 and 5, for example, page 3, lines 13-15. The specification supports claims 3, 14 and 18, for example, at page 15, line 19 to page 16, line 16 and original claim 10. The specification supports claims 6 and 20, for example, at page 21, lines 16-28. The specification supports claim 7, for example, at page 9, lines 13-25 and page 13, lines 2-5.
... No new matter is introduced by the claims.

Id. “New” claims 1-7 issued as the '564 patent's claims 1-7.

The claims that issued as the '564 patent's claims 8-12 were added later, as “new” claims 21-25. *Id.*, 405. In the accompanying Remarks, Inpria stated:

Support for new claim 21 can be found, for example, at page 2, line 30. Support for new claim 22 can be found, for example, at page 22, lines 15-18. Support for new claim 23 can be found, for example, at page 25, line 22-23. Support for new claim 24 can be found, for example, at page 20, lines 10-11. Support for new claim 25 can be found, for example, at page 23, lines 26-30. No new matter is added.

Id., 141. Each of these cited passages is found verbatim in the '888 publication, as shown below:

'564 Patent Claims	"Support" in the Specification	'888 Publication
Claim 1	Page 3, lines 9-23	¶¶ 0009-0010
	Page 5, lines 26-27	¶ 0032
	Page 8, lines 14-17	¶ 0039
	Page 21, lines 16-18	¶ 0068
	Page 23, line 16 to page 24, line 18	¶¶ 0073-0075
Claims 2, 4 and 5	Page 3, lines 13-15	¶ 0009
Claim 3	Page 15, line 19 to page 16, line 16	¶ 0056
Claim 6	Page 21, lines 16-28	¶ 0068
Claim 7	Page 9, lines 13-25	¶ 0041
	Page 13, lines 2-5	¶ 0050
Claim 8	Page 2, line 30	¶ 0007
Claim 9	Page 22, lines 15-18	¶ 0070
Claim 10	Page 25, line 22-23	¶ 0079
Claim 11	Page 20, lines 10-11	¶ 0065
Claim 12	Page 23, lines 26-30	¶ 0074

In light of Inpria’s affirmative statements during prosecution that “[t]he specification supports the new claims” and that “[n]o new matter is introduced by the claims,” Inpria cannot dispute that the ’888 publication, which, contains the same disclosure as the ’564 patent specification, and as shown above, is prior art, and anticipates claims 1-12. *Reckitt Benckiser LLC v. Ansell Healthcare Products LLC*, IPR2017-00063, Paper 38, 15-16 (Jan 30, 2018) (“Patent Owner does not dispute, and logically cannot dispute, that the [parent application’s] publication, if prior art, anticipates the challenged claims.”); *Motorola Mobility*, IPR2022-01156, Paper 13, 23 (granting institution based on finding that parent application’s publication qualified as prior art and there was a reasonable likelihood that it anticipated the claims).

For the sake of completeness, the table below demonstrates how the ’888 publication anticipates each of claims 1-12. *See also* EX1002 ¶¶74-93.

’564 Patent Claims	’888 Publication (EX1003)
1. A structure comprising a substrate and a coating material on a surface of the substrate,	“[T]he invention pertains to a patterned structure comprising a substrate and a patterned inorganic material on a surface of the substrate.” ¶0010.
coating material comprises metal ions with radiation sensitive ligands and	“Generally, the patterned coating material comprises metal suboxide cations, ligands comprising a peroxide group and inorganic polyatomic anions.” ¶0009. “ The coating materials can be designed to be sensitive to selected radiation,

	such as ultraviolet light and/or electron beams.” ¶0032. “Specifically, the precursor solution can comprise sufficient radiation sensitive ligands such that the solution has a molar concentration ratio of radiation sensitive ligands to metal suboxide cations of at least about 2 and in some embodiments at least about 5.” ¶0039. “Radiation sensitive ligands of particular interest have a peroxide group, —O—O—.” ¶0059.
coating material has an average thickness from 5 nm to 30 nm,	In Example 4, which “describes a method that has been used to pattern an Hf suboxide based coating material ... [t]he resist was applied with a thickness of 20 nm by spin coating on a silicon wafer, followed by a post-apply bake of 50° C.” ¶¶0102-0107. It is “an elementary principle of patent law that when, as by recitation of ranges or otherwise, a claim covers several compositions, the claim is ‘anticipated’ if one of them is in the prior art.” <i>Titanium Metals Corp. of Am. v. Banner</i>, 778 F.2d 775, 782 (Fed. Cir. 1985). A thickness of 20 nm falls squarely within the claimed range of “from 5 nm to 30 nm.” The ’888 publication also discloses thickness ranges that overlap with the claimed range. ¶¶0068, 0100.
exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material	“The method can comprise irradiating a layer of coating material with extreme ultraviolet light at a dose of no more than about 100 mJ/cm².” ¶0011.

creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material.

“Specifically, the **un-irradiated coating material can be relatively more easily dissolved** by suitable developer compositions while the exposed coating material can remain appropriately resistant to the developer composition. Since the **un-irradiated coating material can be relatively more easily dissolvable with a developer in comparison with the irradiated coating material**, the contact time with the developer can be reduced while still maintaining desired removal of the coating composition.” ¶0043.

“While not wanting to be limited by theory, it is believed that **upon absorption of the radiation, the peroxide functional groups are fragmented, and the composition correspondingly condenses through the formation of bridging metal-oxygen bonds**. Through the condensation reaction, the radiation pattern is transferred to a pattern in the coating material. Specifically, there is a pattern of irradiated, and correspondingly condensed, coating material and of **un-irradiated coating material, which is substantially unchanged from its composition prior to patterned irradiation of the coating material.**” ¶0046.

“With **electron beam** lithography, the electron beam generally induces secondary electrons which **generally modify the irradiated material.**” ¶0075.

2...the metal ions comprise metal suboxide ions.	“Generally, the patterned coating material comprises metal suboxide cations , ligands comprising a peroxide group and inorganic polyatomic anions.” ¶0009.
3...metal of the metal ions comprises...Zr...Hf...	“Metal suboxide cations of particular interest include, for example, ZrO^{+2}, ZrOOH^+, $\text{Zr}(\text{OH})_2^{+2}$, $\text{Zr}(\text{OH})_3^+$, HfO^{+2}, HfOOH^+, $\text{Hf}(\text{OH})_2^{+2}$, $\text{Hf}(\text{OH})_3^+$, combinations thereof and/or combinations with other metal suboxide cations.” ¶0056. “10. The aqueous inorganic patterning composition of claim 1 comprising...Zr...Hf...”
4...radiation sensitive ligands comprise peroxide ligands.	“Generally, the patterned coating material comprises metal suboxide cations, ligands comprising a peroxide group and inorganic polyatomic anions.” ¶0009.
5...coating material further comprises polyatomic anions.	“Generally, the patterned coating material comprises metal suboxide cations, ligands comprising a peroxide group and inorganic polyatomic anions. ” ¶0009.
6...average thickness is from 5 nm to 25 nm.	In Example 4, which “describes a method that has been used to pattern an Hf suboxide based coating material ... [t]he resist was applied with a thickness of 20 nm by spin coating on a silicon wafer, followed by a post-apply bake of 50° C.” ¶¶0102-0107. It is “an elementary principle of patent law that when, as by recitation of ranges or otherwise, a claim covers several compositions, the claim is ‘anticipated’ if one of them is in the prior art.” <i>Titanium Metals Corp. of Am. v. Banner</i>, 778 F.2d 775, 782 (Fed. Cir. 1985). A thickness of

	20 nm falls within the claimed range of “from 5 nm to 25 nm.” The ’888 publication also discloses thickness ranges that overlap with the claimed range. ¶¶0068, 0100.
7...coating material has high absorption of EUV radiation relative to conventional radiation-based resists.	“Relative to organic resists, the inorganic coating material provides distinct advantages with respect to absorption of selected radiation as well as high contrast between exposed and non-exposed regions such that high resolution can be achieved with moderate radiation doses.” ¶0050. Organic resists are “conventional” resists. ¶0049 (referring to organic resists as “conventional”); ¶0033 (same). “With appropriate selection of the composition, the patterning composition can be sensitive to, for example, ultraviolet light, x-rays or electron beams, as well as a particular wavelength or range of wavelengths within each radiation type.” ¶0037. “The ultraviolet range can be subdivided in several ways under accepted Standards, such as extreme ultraviolet (EUV) ...” ¶0073. “HfO⁺² provides good absorption of electron beam material and extreme UV radiation.” ¶0057.
8...having a metal ion to radiosensitive ligand ratio of at least 2.	The specification of the ’564 patent does not disclose a “metal ion to radiosensitive ligand ratio of at least 2.” Rather, the specification states that “the composition has a molar concentration ratio of ligands

	to metal suboxide cations of at least about 2.” EX1001, 2:31-33. In other words, the specification describes a “ligand to metal” ratio of at least 2, not a “metal to ligand” ratio. To the extent claim 8 contains an obvious error that is correctable and should recite a “ligand to metal” as opposed to a “metal to ligand” ratio, then the ’888 publication discloses this limitation. EX1003 ¶ 0007 (“the composition has a molar concentration ratio of ligands to metal suboxide cations of at least about 2”). Indeed, during prosecution, Inpria identified the specification at “page 2, line 30” reciting a “molar concentration ratio of ligands to metal suboxide cations of at least about 2” as providing support for this claim. EX1007, 141.
9...coating material has been heated to temperatures from 45° C to 150° C.	“In embodiments in which heat is applied to remove solvent, the coating material can be heated to temperatures from about 45° C to about 150° C.” ¶0070.
10...following exposure an exposed coating region is insoluble in an aqueous solvent.	“In general, the developer can be aqueous acids or bases.” ¶0079. “In additional aspects, the invention pertains to a method for forming a patterned structure comprising ... contacting the irradiated layer with a developing composition to dissolve un-irradiated material to form the patterned inorganic material.” ¶0011. “In particular, the irradiated coating material can result in a stable inorganic material with a high level of resistance to the developer, e.g., a suitable liquid to

	dissolve un-irradiated coating material.” ¶0033. In other words, the developer does not dissolve the irradiated coating material, and only dissolves the un-irradiated coating material.
11...following exposure an exposed coating region is soluble in an organic solvent.	The '888 publication does not disclose this limitation. However, when Inpria presented this claim during prosecution (EX1007, 405), Inpria noted in the Remarks that support for this new claim could be found “at page 20, lines 10-11” of the original specification. <i>Id.</i>, 141. The cited passage recites: “Traditional organic resists are soluble in nonpolar solvents and are deposited onto hydrophobic surfaces.” <i>Id.</i>, 26. If the cited sentence provides written description support for this claim, as stated by Inpria, then the '888 publication, which also contains this sentence (EX1003 ¶0065), anticipates.
12...coating material can be effectively patterned with UV radiation or EUV radiation at a dose of no more than 100 mJ/cm ² .	“The EUV images were obtained using projection lithography with a numerical aperture of 0.25 operating at 13 nm. The resist was applied with a thickness of 20 nm by spin coating on a silicon wafer, followed by a post-apply bake of 50° C. After exposure at approximately 80 mJ/cm², a post-exposure bake of 75° C. was used prior to development in 25% TMAH. The developed patterns are shown in FIGS. 18A-D. The patterns shown in FIG. 18 have pitches of A) 32-nm, B) 30-nm, C) 28-nm and D) 26-nm.” ¶0107. “35. A method for forming a patterned structure comprising ... irradiating a layer

	of coating material with extreme ultraviolet light at a dose of no more than about 100 mJ/cm².” Claim 35. “The method can comprise irradiating a layer of coating material with extreme ultraviolet light at a dose of no more than about 100 mJ/cm² or an electron beam at a dose equivalent to no more than about 300 $\mu\text{C}/\text{cm}^2$ at 30 kV, and contacting the irradiated layer with a developing composition to dissolve un-irradiated material to form the patterned inorganic material.” ¶0011. “The amount of electromagnetic radiation can be characterized by a fluence... Suitable radiation fluences can be from about 1 mJ/cm² to about 150 mJ/cm², in further embodiments from about 2 mJ/cm² to about 100 mJ/cm² and in further embodiments from about 3 mJ/cm² to about 50 mJ/cm².” ¶0074.
--	--

F. Ground 2: Claims 1-5, 7-10, 12 Are Anticipated by Stowers 2008

As shown in detail below, the HafSO_x and ZircSO_x coating materials of Stowers 2008 disclose each and every limitation of claims 1-5, 7-10 and 12 of the '564 patent, and as a result, Stowers 2008 anticipates those claims.¹⁰

¹⁰ For this anticipation ground, Petitioner is relying solely on Stowers 2008 Chapter 3, which focuses on the UV and EUV patterning of HafSO_x and ZircSO_x films.

1. Independent Claim 1

a) **Preamble: “structure comprising a substrate and a coating material on a surface of the substrate”**

Stowers 2008 discloses “[a] new system for directly patterning functional metal oxides by UV and EUV.” EX1008, 65. Precursor “**solutions were spin coated** at 3000 rpm for 30 seconds **resulting in films...**” *Id.*, 68. “**Substrates** were either silicon wafer chips (n+ heavily doped) or silicon coupons with 200 nm of thermal oxide.” *Id.* A POSA would understand that the precursor solutions are spin coated onto wafers, *i.e.*, a substrate. EX1002 ¶96. Stowers 2008 therefore discloses a “structure comprising a substrate and a coating material on a surface of the substrate.”

b) **“coating material comprises metal ions with radiation sensitive ligands”**

Stowers 2008 discloses precursor solutions that were prepared by:

combining the ZrOCl_2 (aq) or HfOCl_2 (aq) with H_2O_2 (aq) to give a metal to peroxide ratio of 1 to 0.75. The solution was allowed to rest for 15 min. to enable ligand exchange to approach equilibrium. Following this, **H_2SO_4 (aq)** was added to give a metal to sulfate ratio of 1 to 0.5-0.7. Again the solution was allowed to rest for 15 min to enable ligand exchange to reach equilibrium.

Id., 68. These “[w]orking solutions were spin coated at 3000 rpm for 30 seconds resulting in films 30 to 35-nm thick.” *Id.*

A POSA would understand that the “working solutions” of Stowers 2008 contain “metal ions,” since, in solution, ZrOCl_2 and HfOCl_2 exist as ZrO^{2+} and HfO^{2+} , *i.e.*, metal cations. EX1002 ¶99; EX1021 ¶0009 (“hafnium suboxide (HfO^{2+}), may be provided by providing an aqueous solution of hafnium oxy chloride ($\text{HfOCl}_2(\text{aq})$).”). Since those precursor solutions in Stowers are spin-coated to make films, it follows that the resulting films also contain metal ions. EX1002 ¶99.

A POSA would also understand that the peroxide groups in Stowers 2008’s precursor solution is a radiation sensitive ligand. EX1002 ¶100. Stowers 2008 states that “both ZircSO_x and HafSO_x are UV sensitive” and that “[t]he extinction coefficients of these materials have previously been determined.” EX1008, 69. Stowers 2008 then notes that “[i]t is expected that these **extinction coefficients will be different with the presence of peroxide in the as-deposited material...**” *Id.*¹¹

¹¹ An extinction coefficient “is a property that determines how strongly a material absorbs radiation at a particular wavelength.” EX1002 ¶100.

Therefore, Stowers 2008 discloses a “coating material compris[ing] metal ions with radiation sensitive ligands.”¹²

Moreover, as shown below, Stowers 2008’s precursor solutions **contain the same components**—HfOCl₂ or ZrOCl₂, H₂O₂, and H₂SO₄—as the precursor solutions used to make the coating materials in the Examples of the ’564 patent.

Specifically, Example 1 of the ’564 patent discloses that “[s]eparate aqueous solutions were prepared for the components of the precursor solution” and “the respective solutions can be referred to as Part A for the metal suboxide cations, Part B for the peroxide-based ligand solution and Part C for the solution comprising polyatomic anions.” *Id.*, 21:18-23. Solution “Part A1” contains “**ZrOCl₂.8H₂O**,” solution “Part A2” contains “**HfOCl₂.8H₂O**,” solution “Part B” contains “**H₂O₂(aq)**” and solution “Part C” contains “**H₂SO₄(aq)**.” *Id.*, 21:22-55.

The ’564 patent also explains that:

The components in the bottles were then combined by pouring Part A1 or Part A2 component solution into Part B component solution, waiting 5 minutes, then pouring

¹² During prosecution, Inpria never disputed that the precursor solutions disclosed in Stowers 2009 (which contain the same components as those of Stowers 2008) form a “coating material compris[ing] metal ions with radiation sensitive ligands.” EX1007, 143-144, 507-8.

Part C into the combined Part A1 or Part A2 and Part B
and waiting another 5 minutes.

Id., 21:51-56.

Finally, “a 30 mL formulation of **Zr based precursor solution** with a final zirconium concentration of 0.16 M was obtained by **combining 4.8 mL of solution Part A1 [ZrOCl₂], 1.8 mL of solution Part B (H₂O₂), 2.16 mL of solution Part C (H₂SO₄(aq)), and 21.24 mL of ultrapure water.**” *Id.*, 21:57-62. Likewise, “a 30 mL formulation of an **Hf based precursor solution** with a final hafnium concentration of 0.15 M was obtained by **combining 4.5 mL of solution Part A2 [HfOCl₂], 16.875 mL of solution Part B (H₂O₂), 1.8 mL of solution Part C (H₂SO₄(aq)), and 6.825 mL of ultrapure water.**” *Id.*, 21:63-67. These Zr and Hf based precursor solutions were **then spin coated to make the coating material** in Example 3 (*id.*, 22:1-55) and Example 4. *Id.*, 22:4-28, 22:56-23:41.

There can be no dispute that the precursor solutions in Stowers 2008 and the '564 patent combine the exact same components—*i.e.*, Part A (HfOCl₂ or ZrOCl₂), Part B (H₂O₂), and Part C (H₂SO₄)—and once combined, the resulting coating materials will also necessarily contain the same components, including “metal ions with radiation sensitive ligands” as claimed. EX1002 ¶¶103-104. Accordingly, a POSA would understand that this limitation is necessarily present in Stowers 2008, since the '564 patent has the exact same components as Stowers 2008 and states that

the “**coating material comprises metal suboxide cations, ligands comprising a peroxide group...**” EX1001, 2:40-43; 22:35-37 (“The **coating material** was produced according to the method of Example 2 with a **ZrO⁺²-based coating composition.**”); 22:61-63 (“The **coating material** was produced and deposited according to the method of Example 2 with an **HfO⁺²-based coating composition.**”). *See Hospira, Inc. v. Fresenius Kabi USA, LLC*, 946 F.3d 1322, 1329-30 (Fed. Cir. 2020) (later “work of the inventor or the patentee” can help “elucidate what the prior art consisted of”); *Alcon Research, Ltd. v. Apotex Inc.*, 687 F.3d 1362, 1369 (Fed. Cir. 2012) (analyzing inherency based on the disclosure of the “patent itself”); *Telemac Cellular Corp. v. Topp Telecom, Inc.*, 247 F.3d 1316, 1327-28 (Fed. Cir. 2001) (finding that features were inherent “as evidenced by [the patentee]’s own documents”); *Mylan Pharms. Inc. v. Merck Sharp & Dohme Corp.*, IPR2020-00040, Paper 21, 53 (May 12, 2020) (“The inventors’ documents, including the patent itself, may provide evidence of an inherent disclosure.”).

c) “coating material has an average thickness from 5 nm to 30 nm”

Stowers 2008 states that “[w]orking [precursor] solutions were spin coated at 3000 rpm for 30 seconds resulting in **films 30 to 35-nm thick.**” EX1008, 68. Stowers 2008 also expressly refers to “**films on the order of 30-nm thick.**” *Id.*, 71; EX1009, 265 (Inpria admitting that “Stowers described **coatings with thicknesses from 30**

to 35 nm in Chapter 3.”). Therefore, Stowers 2008 discloses this limitation because it discloses **30 nm thick HafSO_x and ZircSO_x films**, which is within the claimed range of “from 5 nm to 30 nm.” EX1002 ¶105.

Moreover, it is well-settled that “[a] prior art reference that discloses an overlapping but different range than the claimed range can be anticipatory, even where the prior art range only partially or slightly overlaps with the claimed range.” *Genentech, Inc. v. Hospira, Inc.*, 946 F.3d 1333, 1338 (Fed. Cir. 2020). “Once the patent challenger has established, through overlapping ranges, its *prima facie* case of anticipation, ‘the court must evaluate whether the patentee has established that the claimed range is critical to the operability of the claimed invention.’” *Id.* Petitioner is not aware of any evidence in the specification or prosecution history that the claimed range of “from 5 nm to 30 nm” is critical. In fact, the specification of the ’564 patent does not even disclose that range, so the inventors clearly did not recognize it as being critical. EX1002 ¶¶106-107.

- d) **“wherein exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material”**

First, this limitation is an inherent property of the claimed coating material, as Inpria itself stated during prosecution of a later patent. EX1009, 263 (“Whether or

not claim 10 is amended to remove the reference to e-beam in claim 10 [which recited “wherein interaction of the coating material with EUV and/or e beam radiation alters the chemical properties of the coating material creating a structure with differential dissolution rates”] **is still a description of a property of the coating material.**”). Therefore, since Stowers 2008 discloses the same films as the ’564 patent, they necessarily satisfy this limitation.

Second, Stowers 2008 discloses patterning of ZircSO_x films by exposure to **UV radiation**. EX1008, 68 (“Patterning by **UV light** was achieved...”). Stowers 2008 “found that ZircSO_x could be patterned by **UV light** in either **positive or negative tone.**” *Id.*, 70. Stowers 2008 further explains that:

Under different processing conditions the photoactive element of the resist is either **increasing or decreasing the solubility of the exposed region relative to the unexposed region**. To pattern in negative tone, the **exposure has to make the film more resistant to dissolution** than the unexposed region. Conversely, to pattern in the positive tone the **exposure has to make the film less resistant to dissolution** than the unexposed region.

Id., 70-72. In other words, Stowers 2008 discloses that exposure of a ZircSO_x film to UV radiation altered the chemical properties of the film such that the exposed

regions have a different dissolution rate than the un-exposed regions of the film. EX1002 ¶108.

Stowers 2008 also evaluated whether HafSOx films could be patterned by EUV, but these “experiments were hampered by an error in processing.” EX1008, 73. “Even with these errors, a contrast of 0.3 and a sensitivity of 194 mJ/cm² [d_{0.8}] were demonstrated.” *Id.*; Fig. 3-6 (“Characteristic **contrast curve** for EUV exposed HafSOx”)¹³; Fig. 3-7 (showing “SEM image of 30 nm lines and spaces **patterned** by EUV interference lithography.”). That **HafSOx films could be patterned by EUV** indicates that exposure to EUV altered the chemical properties of the film such that the exposed regions have a different dissolution rate than the un-exposed regions of the film. EX1002 ¶¶109-110.¹⁴

¹³ A contrast curve describes the remaining resist thickness after development of a uniformly illuminated resist film versus the logarithm of the applied exposure dose. The contrast curve of Figure 3-6 shows that as the dose increases, the HafSOx coating becomes more insoluble to the developer. EX1002 ¶110.

¹⁴ During prosecution, Inpria never disputed that “exposure of the coating material” disclosed in Stowers 2009 (which contain the same components as those of Stowers 2008) “to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential

2. Claim 2

Claim 2 depends on claim 1 and recites that “the metal ions comprise **metal suboxide ions**.” Stowers 2008’s films include ZrO^{2+} or HfO^{2+} cations, which are metal suboxide ions. EX1001, 10:45-59 (“**Metal suboxide cations** of particular interest include, for example, ZrO^{2+} ..., [or] HfO^{2+} ...”); EX1021 ¶0009 (“**hafnium suboxide (HfO^{2+})**, may be provided by providing an aqueous solution of hafnium oxy chloride ($\text{HfOCl}_2(\text{aq})$).”); EX1002 ¶111.

3. Claim 3

Claim 3 depends on claim 1 and recites that “the metal of the metal ions comprises...**Zr**...[or] **Hf**...” Stowers 2008’s films include ZrO^{2+} or HfO^{2+} cations. §VII.F.1; EX1002 ¶112.

4. Claim 4

Claim 4 depends on claim 1 and recites that “the radiation sensitive ligands comprise **peroxide ligands**.” Stowers 2008’s films contain **peroxide** as the radiation sensitive ligand. §VII.F.1; EX1002 ¶113.

dissolution rates between exposed and un-exposed regions of the coating material.” EX1007, 143-144, 507-8.

5. Claim 5

Claim 5 depends on claim 1 and recites that “the coating material further comprises **polyatomic anions.**” Stowers 2008 discloses adding H_2SO_4 to the working precursor solutions. EX1008, 52 (“ H_2SO_4 (aq) was added to give a metal to sulfate ratio of 1 to 0.5-0.7” and “the solution was allowed to rest.”). **H_2SO_4 exists in solution as SO_4^{2-} .** EX1021 ¶0009 (“**polyatomic anion in solution**, such as sulfate (SO_4^{2-}), may be provided by providing an aqueous solution of sulfuric acid ($\text{H}_2\text{SO}_4(\text{aq})$)”); EX1002 ¶114.

6. Claim 7

Claim 7 depends on claim 1 and recites that “the coating material has **high absorption of EUV** radiation relative to conventional radiation-based resists.”¹⁵

¹⁵ The '564 patent does not define “conventional radiation-based resists” or what it considers to be a “high absorption of EUV radiation relative to conventional radiation-based resists.” Therefore, Petitioner reserves the right to assert that this claim is indefinite. Solely for the purpose of this IPR, Petitioner assumes that “conventional radiation based resists” include organic resists and “high absorption relative to conventional radiation-based resists” means that the claimed material is expected to absorb more EUV radiation than an organic resist.

As explained by Dr. Holland, the HafSOx films of Stowers 2008 are the same as the HafSOx films of the '564 patent, i.e., they have the same components (HfOCl₂, H₂O₂, and H₂SO₄) and same metal to Hf to peroxide ratio. EX1002 ¶¶115-117.¹⁶ Thus, they are the same films in all material respects. Accordingly, the HafSOx films of Stowers 2008 must necessarily have “high absorption of EUV radiation relative to conventional radiation-based resists,” as asserted by the '564 patent. EX1001, 8:67-9:2 (“**Relative to organic resists, the inorganic coating material** provides distinct advantages with respect to **absorption of selected radiation...**”); 11:26-27 (“**HfO²⁺** provides **good absorption** of...**extreme UV radiation.**”). *See, e.g., Hospira*, 946 F.3d at 1329-30 (“[T]he work of the inventor or the patentee can be used as the evidence of inherency...The later evidence is not itself prior art; it only helps to elucidate what the prior art consisted of.”); *Mylan*, IPR2020-00040, Paper 21, 53 (“The inventors’ documents, including the patent itself, may provide evidence of an inherent disclosure.”).

¹⁶ Although the peroxide to Hf ratio in the HafSOx precursor solution exemplified in the '564 patent is higher than the peroxide to Hf ratio in the HafSOx precursor solution of Stowers 2008, they both will saturate at a ratio of 0.5 peroxide to one Hf in the films. EX1002 ¶116.

7. Claim 8

Claim 8 depends on claim 1 and states that the claimed structure has “**metal ion to radiation sensitive ligand ratio of at least 2.**” A metal to ligand ratio of at least 2 means that there are at least 2 metal ions per ligand, or **at least 1 metal ion per 0.5 ligand.** Thus, the claim requires **0.5 or less ligand per metal ion.** EX1002 ¶118.

Stowers 2008 discloses precursor solutions having a Zr or Hf to peroxide ratio of 1:0.75, which is equal to 0.75 peroxide per one Zr or Hf. This peroxide content is greater than the no more than 0.5 ligand per metal recited in the claims. But, as publications from named inventor Keszler show, “[e]ven with excess peroxide in the precursor solution, **the Hf:O₂²⁻ ratio saturates near 2:1 in the solution, and it persists in the film.**” EX1016, 5; EX1018, 155 (“While a significant amount of free peroxide is typically present in the solutions, **only bound peroxide is present in the final (pre-radiation exposure) films.**”), 157 (“the number of peroxide ligands that are able to bind to each hafnium cluster is relatively small, with **less than one peroxide group per hafnium ion.**”); EX1019, 5. Stated differently, even with more than 0.5 peroxide per metal in the precursor solution, the ratio saturates near 0.5 peroxide per metal, and that ratio persists in the films. EX1002 ¶119.

Accordingly, although the precursor solutions of Stowers 2008 describe more than 0.5 peroxide per Hf or Zr, per the inventor’s own admission, it is inherent that

the resulting films contain a metal to peroxide ratio of approximately 1:0.5, or “at least 2” metal ions per peroxide ligand, as claimed. EX1002 ¶120.¹⁷

8. Claim 9

Claim 9 depends on claim 1 and recites that “the coating material has been heated to temperatures from 45° C to 150° C.” Stowers 2008 discloses that “[p]ositive tone patterning could be achieved by subjecting the resist to a **prebake of 100° C** for two min.” EX1008, 70; EX1002 ¶121.

9. Claim 10

Claim 10 depends on claim 1 and recites that “following exposure an exposed coating region is insoluble in an aqueous solvent.”

A POSA would understand claim 10 to recite a **negative tone resist**. EX1002 ¶122. As the ’564 patent explains:

For a positive-tone resist, the exposed regions are transformed to make such regions selectively removable, while **for negative-tone resist, the unexposed regions are more readily removable.**

EX1001, 1:53-60; EX1023 ¶0037 (“**In the negative patterning**, exposure to radiation converts the irradiated coating material into a material that is **more**

¹⁷ If the claim contains a correctable obvious error, which it does not (§VII.B), this claim is anticipated (Ground 1).

resistant to removal with a developer composition relative to the non-irradiated coating material.”)

Stowers 2008 discloses developing the films “by immersion in .05-1 M **HCl**” (EX1008, 68), which is undisputedly an **aqueous solution** (*id.*, 88 (referring to “6-12 M HCl (**aq**)”)), and states that with HCl, “**ZircSOx could be patterned by UV light** in either positive or **negative tone**” (*id.*, 70). EX1002 ¶122.

10. Claim 12

Claim 12 depends on claim 1 and recites that “the coating material can be **effectively patterned** with UV radiation or EUV radiation at a **dose of no more than 100 mJ/cm²**.”

As explained by Dr. Holland, the ZircSOx and HafSOx films of Stowers 2008 are the same as the ZircSOx and HafSOx films of the ’564 patent, *i.e.*, they have the same components (HfOCl₂ or ZrOCl₂, H₂O₂, and H₂SO₄) and same metal to peroxide ratio. EX1002 ¶123. Thus, they are the same films in all material respects. Accordingly, the ZircSOx and HafSOx films of Stowers 2008 must necessarily be capable of being “effectively patterned with UV radiation or EUV radiation at a dose of no more than 100 mJ/cm²,” as asserted by the ’564 patent. EX1001, 23:33-41 (HafSOx patterned with **EUV dose of 80 mJ/cm²**); 22:50-54 (ZircSOx patterned

with **193 nm UV at a dose of 20 mJ/cm²**); EX1002 ¶124. *See, e.g., Hospira*, 946 F.3d at 1329-30; *Mylan*, IPR2020-00040, Paper 21, 53.¹⁸

G. Ground 3: Claims 1-10, 12 Are Obvious Over Stowers 2008

1. Independent Claim 1

To the extent Inpria argues that claim 1 is not anticipated by Stowers 2008 because Stowers 2008 does not disclose a thickness range of “from 5 nm to 30 nm,” claim 1 still would have been obvious.

There is no dispute that Stowers 2008 teaches HafSOx and ZircSOx films having thicknesses ranging from 30 nm to 35 nm. EX1009, 265 (“Stowers described coatings with thicknesses from 30 to 35 nm in Chapter 3.”) This clearly overlaps with the claimed range of “from 5 nm to 30 nm.” In cases involving overlapping ranges, courts have consistently held that **even a slight overlap** in range establishes a presumption of obviousness. *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003).

A patentee may attempt to rebut this presumption by demonstrating that practicing the process throughout the claimed range produces unexpected results,

¹⁸ Moreover, the ZircSOx precursor solutions of Stowers 2008 contain the same peroxide to Zr ion ratio as the ZircSOx precursor solutions used to make the films in Example 3 of the '564 patent. EX1008, 68 (peroxide to Zr ion ratio of **0.75**); EX1002 ¶38 (peroxide to Zr ion ratio of **0.66 to 0.88**).

and is therefore “critical.” *E.I. DuPont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006, 1008 (Fed. Cir. 2018). Petitioner is not aware of evidence in the specification or prosecution history that the claimed range of “from 5 nm to 30 nm” was deemed critical. Not only does the ’564 patent fail to disclose a range of 5 nm to 30 nm (§VII.C), it also admits that the coatings can have a wide range of thicknesses, including “no more than about 1 micron...no more than about 250 nanometers (nm),...from about 1 nanometers (nm) to about 50 nm,...from about 1 nm to about 40 nm and...from about 1 nm to about 25 nm.” EX1001, 14:50-55. Moreover, in Example 3, “the coating material was deposited at a **thickness from 10-50 nm**” (*id.*, 22:7-8), yet “highly resolved patterns were produced...by 193-nm lithography at a dose level of 20 mJ/cm² (which is far less than the maximum dose recited in claim 12). *Id.*, 22:49-51. The failure to even mention the claimed range and the recitation large ranges described in the specification are clear evidence of a lack of criticality for the claimed “5 nm to 30 nm” thickness. EX1002 ¶128.

Moreover, there is also no dispute that film thickness is a result-effective variable that a POSA would have found obvious to optimize. *In re Applied Materials, Inc.*, 692 F.3d 1289, 1297 (Fed. Cir. 2012) (“A recognition in the prior art that a property is affected by the variable is sufficient to find the variable result-effective.”) Here, A POSA would have known that pattern collapse, which refers to the deformation of photoresist lines that occurs during the development process, was

a serious risk that needed to be mitigated. *E.g.*, EX1012, Abstract (“However for sub 100 nm line width patterns, the pattern collapse, generated during the drying step of the developing process, becomes a serious limiting phenomenon.”); EX1002 ¶¶129-130. A POSA would have recognized that film thickness was one parameter that could be optimized to help avoid pattern collapse. *Id.*, 8 (“we have shown that the mode of pattern collapse depends on the pattern height”). Indeed, Inpria itself has recognized that film thickness can help avoid pattern collapse problems. EX1014, 3 (“To take advantage of the high etch resistance and to mitigate pattern collapse, the films are targeted for a thickness of approximately 30 nm.”); EX1013, 11 (“Pattern Collapse Mitigated” with “Resists (10-20 nm)”); EX1001 at 18:62-19:6.

Thus, film thickness is clearly a “result-effective variable,” rendering optimization of the overlapping range “within the grasp of one of ordinary skill in the art.” *Applied Materials*, 692 F.3d at 1295. Given the ease with which film thickness can be varied, *e.g.*, by adjusting spin rates and times (EX1008, 6; EX1001, 14:30-32 (’564 patent admitting as much)), finding an optimum thickness range would have required nothing more than routine experimentation. EX1002 ¶131. *Genentech*, 946 F.3d at 1341. Stowers 2008 already teaches that depositing films “at 3000 rpm for 30 seconds result[s] in films 30 to 35-nm thick.” EX1008, 70; EX1014, 2 (“Solutions were then spin coated onto silicon substrates at 3000 rpm for 30 s...The resulting film thickness from this procedure was typically 30 nm as

measured by ellipsometry.”). Thus, a POSA could have easily deposited the claimed coatings at a thickness of 5 nm to 30 nm (*e.g.*, by spin coating for approximately 30 seconds) based on the teachings of Stowers 2008 with routine optimization. EX1002 ¶131.

2. Claims 2-5 and 8-10

The limitations of these claims are disclosed in Stowers 2008, as discussed above and incorporated here. §VII.F.2-5, 7-9.

3. Claim 6

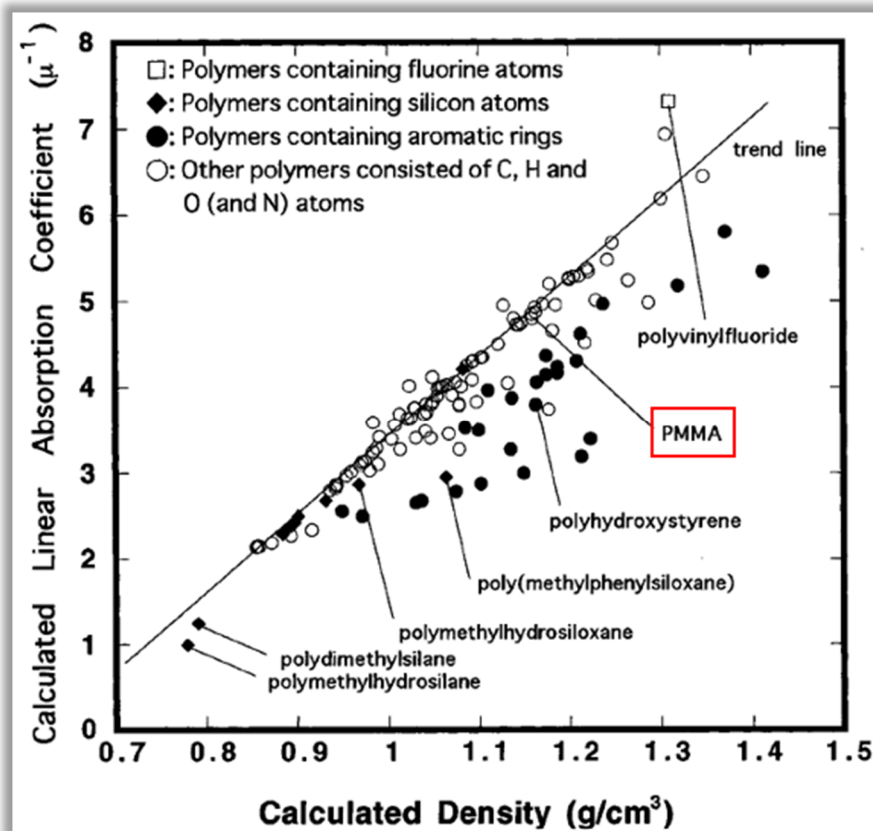
Claim 6 depends on claim 1 and requires that “the average thickness is from **5 nm to 25 nm.**” Stowers 2008 discloses that “HafSO_x, and...ZircSO_x, can be deposited in films ranging in **thickness from 2 to 500 nm.**” EX1008, 2; 66 (“HafSO_x [and] ZircSO_x...materials has (sic) been deposited in **thickness ranges of 3 to 500 nm.**”).

Thus, Stowers 2008 discloses HafSO_x and ZircSO_x films having thicknesses in a range that encompasses the claimed range of “from 5 nm to 25 nm,” thereby establishing a presumption of obviousness. Petitioner is not aware of any evidence of criticality, as discussed above and incorporated here. §VII.F.1. Moreover, it would have been well within the skillset of a POSA to experiment with the spin rates and times to obtain the claimed thickness. EX1002 ¶¶132-133.

4. Claim 7

Claim 7 depends on claim 1 and recites that “the coating material has high absorption of EUV radiation relative to conventional radiation-based resists.” While vague, this limitation is an inherent property of HafSO_x. §VII.F.6; EX1002 ¶135. Even if it is not an inherent property, the limitation would have been obvious.

Stowers 2008 discloses that “ZircSO_x and particularly HafSO_x have a **higher density** than other resists like...PMMA (1.19 g/cm³)” and recites their “**assumed**” densities of “**4 g/cm² for ZircSO_x and 5 g/cm³ for HafSO_x.**” EX1008, 90; 83 (“PMMA [is] a traditional polymer electron beam resist.”). A POSA would have known that as **density increases, EUV absorbance increases**. Indeed, the trend is generally linear as shown below:



EX1025, Figure 3 (Y axis shows calculated absorption coefficient at 13 nm, *i.e.*, EUV). Based on this linear trend, a POSA would have known that ZircSOx and HafSOx films have a higher absorption of EUV relative to PMMA (polymethyl methacrylate, which is a conventional organic resist) because ZircSOx and HafSOx films have a higher assumed mass density than PMMA. EX1008, 90; EX1002 ¶¶136-137.

Indeed, this is similar to what named inventor Stowers described in a 2011 publication. EX1022, 3 (noting a calculated mass density of 4.7 g/cm³ for HafSOx and stating that “[t]his mass density and the compositional information are used to

calculate EUV absorption...which yields an absorption coefficient of $16 \mu\text{m}^{-1}$. For comparison, conventional polyhydroxystyrene (PHS) CARs have an EUV absorption coefficient of approximately $4 \mu\text{m}^{-1}$, so the **MSOx materials are ~4X more absorptive.**”); EX1002 ¶138.

Thus, to the extent Inpria argues that the limitation of claim 7 is somehow not inherent to the claimed material, a POSA would have known that HafSOx and ZircSOx are more absorptive of EUV radiation than conventional resists materials, like PMMA, because the POSA would have known the “assumed” densities of HafSOx and ZircSOx from Stowers 2008, and would have known that as the density increases, so does absorption of EUV. EX1002 ¶139.

5. Claim 12

Claim 12 depends on claim 1 and recites that “the coating material can be effectively patterned with UV radiation or EUV radiation at a dose of no more than 100 mJ/cm^2 .” This limitation is an inherent property of ZircSOx and HafSOx, as discussed above and incorporated here. §VII.F.10; EX1002 ¶143. Even if it is not an inherent property, the limitation would have been obvious.

Stowers 2008 reports that patterning of the ZircSOx “materials with electron beam lithography **produced excellent results.**” EX1008, 127. “ZircSOx films were exposed to determine the highest resolution obtainable with our 30 keV electron

beam lithography system” and “observed that 16 nm wide isolated features can be patterned at a **dose of 112 $\mu\text{C}/\text{cm}^2$** .” *Id.*, 89.

As Stowers himself confirmed in 2011, an “e-beam [or electron beam] **dose of 249 $\mu\text{C}/\text{cm}^2$** (30 keV)...has been **well characterized to correspond to an EUV dose of 25 mJ/cm^2** .” EX1022, 7. Thus, if an e-beam dose of 249 $\mu\text{C}/\text{cm}^2$ “corresponds” to an EUV dose of 25 mJ/cm^2 , a POSA would in turn understand that an e-beam dose of 112 $\mu\text{C}/\text{cm}^2$ “corresponds” to an EUV dose that is less than 25 mJ/cm^2 , *i.e.*, “no more than 100 mJ/cm^2 .” EX1002 ¶145.

Given that Stowers 2008 discloses effective patterning of ZircSOx with an e-beam dose corresponding to an **EUV equivalent dose of less than 25 mJ/cm^2** , a POSA would reasonably expect that those same ZircSOx films “can be effectively patterned with UV radiation or EUV radiation at a dose of no more than 100 mJ/cm^2 .” EX1002 ¶146. The ’103 provisional admits as much:

We present here a directly photopatternable inorganic hardmask for 193 nm lithography. This resist is based on the solution-deposited dielectric HafSOx [Anderson (EX1030)], which has previously been reported to be **high-performance, high-sensitivity electron beam resist** [citing Stowers 2009]...In light of these promising electron-beam results, we have extended our investigation of HafSOx resists as hardmasks directly patterned by 193-nm lithography.... Initial 193-nm exposures using

interference lithography have yielded 60-nm lines and spaces (Figure 2). The platform's demonstrated resolution with e-beam exposure strongly suggests its extendibility to 32 nm.

EX1005, 5; EX1008, 31 (“resists that function well for electron beam lithography are often **good candidates for EUV lithography.**”).

H. Ground 4: Claim 8 Is Obvious Over Stowers 2008 and Stowers 2009

Claim 8 depends on claim 1 and states that the claimed structure has “**metal ion to radiosensitive ligand ratio of at least 2.**” As explained above (§VII.F.7), Stowers 2008 discloses this limitation because it discloses ZircSO_x and HafSO_x films having a metal to peroxide ratio of 1:0.75, which saturates to a ratio of approximately of 1 metal to 0.5 peroxide (i.e., a ratio of 2) in the films, as demonstrated by named inventor Keszler's own publications. *E.g.*, EX1016, 5; EX1002 ¶147.

To the extent Inpria argues that the publication of named inventor Keszler should not be believed, this limitation is disclosed in Stowers 2009. Specifically, Stowers 2009 discloses that “[s]olutions for spin coating were prepared by combining the ZrOCl₂ (aq) or HfOCl₂ (aq) with the remaining reagents [H₂O₂ and H₂SO₄] to produce **metal-to-peroxide ratios of 1:0.5.**” EX1010, 19. This is a “metal ion to radiosensitive ligand ratio of at least 2.” EX1002 ¶148.

A POSA would have been motivated to combine Stowers 2008 and Stowers 2009 because the references are by the named inventors (Jason Stowers and Douglas Keszler) and relate to the same subject matter as the '564 patent, *i.e.*, metal oxide sulfate films for EUV, UV and e-beam lithography. A POSA would have been motivated to incorporate the metal to peroxide ratio of Stowers 2009 into the films of Stowers 2008 with a reasonable expectation of success because Stowers 2009 reports that “[w]ith a 30-keV electron-beam, resist sensitivities as low as 8 $\mu\text{C}/\text{cm}^2$ have been realized.” EX1010, Abstract, Figure 1; EX1002 ¶¶148-149. In essence, using the ratio disclosed in Stowers 2009 in the precursor solutions of Stowers 2008 would have been nothing more than substituting one known ratio for another.¹⁹

¹⁹ Moreover, during prosecution of the **later-filed** '610 patent, the Examiner rejected the claims based on the combination of Stowers 2008 and Stowers 2009 and Inpria never argued that a POSA would not be motivated to combine them. *Elekta Ltd. v. ZAP Surgical Sys., Inc.*, 2023 WL 6152418, at *4 (Fed. Cir. Sept. 21, 2023) (PTAB’s finding of a motivation to combine was supported by substantial evidence, including the prosecution history).

I. Ground 5: Claims 1, 3, 6-7, 9, 11-12 Are Anticipated and/or Rendered Obvious by Trikeriotis

As shown below, Trikeriotis anticipates and/or renders obvious claims 1, 3, 6-7, 9 and 11-12.

1. Independent Claim 1

a) Preamble: “structure comprising a substrate and a coating material on a surface of the substrate”

Trikeriotis discloses “[u]niform **thin films** can be spin-coated on Si **wafers** using either aqueous or PGMEA dispersions of the nanoparticles.” EX1024, 18. Trikeriotis therefore discloses a “structure comprising a substrate and a coating material on a surface of the substrate.” EX1002 ¶151.

b) “coating material comprises metal ions with radiation sensitive ligands”

Trikeriotis discloses “an inorganic resist made of **hafnium oxide nanoparticles** that can be used both for optical (DUV or EUV) and electron beam lithography.” EX1024, 16. Trikeriotis states that “[h]afnium oxide nanoparticles are used as a core to build the inorganic nanocomposite into an imageable photoresist” and that “a variety of **organic ligands** can be used to control the surface chemistry of the final product.” EX1024, 15. “**The absorption coefficient of the films depends on the ligand...**” *Id.*, 18 (*i.e.*, the ligands are radiation sensitive).

Therefore, Trikeriotis discloses a “coating material compris[ing] metal ions with radiation sensitive ligands.” EX1002 ¶152.

c) **“coating material has an average thickness from 5 nm to 30 nm”**

Trikeriotis discloses that “[b]y varying the nanoparticle loading in the dispersion and the spin speed, the **film thickness** can be controlled...In general, **film thicknesses** ranging from **30 nm to 200 nm** can be easily achieved.” EX1024, 18. In Figure 8, Trikeriotis “shows the SEM image of the 60 nm lines and spaces that were printed on the film. **The film that was used was only 30 nm thick.**” *Id.*, 21. Trikeriotis therefore discloses that the “coating material has an average thickness from 5 nm to 30 nm.” EX1002 ¶153.

d) **“wherein exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material”**

Trikeriotis discloses electron beam and UV lithography of the coating material. Figure 5 of Trikeriotis shows “[c]ontrast curves of the nanoparticle films under 254 nm light exposure: **positive tone** (left) and **negative tone** (right).” EX1024, Figure 5. As to electron beam lithography, Trikeriotis discloses that “both **positive tone** and **negative tone** images could be obtained.” EX1024, 22. Trikeriotis, therefore, discloses that “exposure of the coating material to UV, EUV

and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material.” EX1002 ¶¶154-155.

2. Claim 3

Claim 3 depends on claim 1 and recites that “the metal of the metal ions comprises...**Hf**...” Trikeriotis’ films are based on **hafnium** oxide. EX1002 ¶156.

3. Claim 6

Claim 6 depends on claim 1 and requires that “the average thickness is from **5 nm to 25 nm**.” As noted above, in Figure 8, “**the film that was used was only 30 nm thick**.” EX1024, 21. It would have been within the routine skillset of a POSA to experiment with the spin rate and time to obtain the desired thickness. EX1002 ¶157.

4. Claim 7

Claim 7 depends on claim 1 and recites that “the coating material has high absorption of EUV radiation relative to conventional radiation-based resists.” Trikeriotis’s films are based on hafnium oxide. A POSA would know hafnium oxide has a mass density of $\sim 9.68 \text{ g/cm}^3$. *See, e.g.*, EX1026, 4. As explained above in Ground 3, POSA would have also known that PMMA, a conventional organic resist, has a mass density of $\sim 1.19 \text{ g/cm}^3$. EX1008, 90. Since a POSA would have known that as the mass density increases, the EUV absorption increases (EX1025, Figure

3), a POSA would have known that hafnium oxide has a higher absorption of EUV than organic resists. EX1002 ¶158.

5. Claim 9

Claim 9 depends on claim 1 and recites that “the coating material has been heated to temperatures from 45° C to 150° C.” Trikeriotis discloses that “[f]ilms with the desired thickness are prepared and then **baked at 130°C** for 60 sec on a hot plate.” EX1024, 20; EX1002 ¶159.

6. Claim 11

Claim 11 depends on claim 1 and recites that “following exposure an exposed coating region is soluble in an organic solvent.” This claim recites positive tone image developed in organic solvent. EX1002 ¶160. Trikeriotis discloses that “[f]or the **positive tone imaging**, the film is baked after exposure (PEB) at 130°C for 3 min and then aqueous **tetrametylammonium hydroxide** (TMAH) is used for the development.” EX1024, 20. TMAH is an organic compound, *i.e.*, it contains carbon. EX1002 ¶160. Aqueous tetrametylammonium hydroxide is therefore an “organic” solvent. *Id.*

7. Claim 12

Claim 12 depends on claim 12 and recites that “the coating material can be **effectively patterned** with UV radiation or EUV radiation at a **dose of no more than 100 mJ/cm²**.” Figure 5A of Trikeriotis shows that the discloses films could be

patterned in positive tone with a 254 nm UV radiation dose of less than 100 mJ/cm^2 as it shows a sensitivity **$D_{0.8}$ of less than 25 mJ/cm^2** . EX1002 ¶161. Moreover, as confirmed by Ober and Giannelis, “[w] have found that a hafnium oxide (HfO_2) core with a diameter of 2nm, surrounded by organic ligands (binding molecules), **can be patterned at EUV wavelengths with extremely high sensitivity ($<5 \text{ mJ/cm}^2$)**.” EX1027, 1-2 (referring to the films of Trikeriotis).

J. No Secondary Considerations

Inpria did not identify any evidence of secondary considerations during prosecution of the '564 patent. However, during prosecution of the '872 patent, Inpria argued that “the high ligand to metal suboxide cation ratio [of at least 2] leads to unexpected improvement in the properties of Stowers.” EX1004, 656; EX1009, 269 (“Appellant has demonstrated that exceptional and unexpected radiation-induced selective desorption of the coating material can be achieved by increasing the peroxide ligand concentrations by at least a factor of four.”). Inpria did not, however, point to any data, in the specification or elsewhere, supporting that assertion. Regardless, named inventor Keszler’s work has demonstrated that even with a ratio of peroxide to metal ion of at least 2, the ratio saturates at 0.5, and that ratio persists in the film. *E.g.*, EX1016, 5. Moreover, “[i]ncreasing the amount of peroxide in the solutions above a molar ratio of 0.5 **does not cause further changes in the radiation chemistry of the films**.” EX1018, 160; EX1002 ¶¶163-164.

VIII. DISCRETIONARY DENIAL IS NOT APPROPRIATE

A. 35 U.S.C. § 325(d)

The Board should reject any argument that it should exercise its discretion to deny institution under 35 U.S.C. § 325(d). The record confirms that the Examiner either (1) was not presented with the same or substantially the same art or arguments as Petitioner's, or (2) materially erred in allowing claims 1-12 of the '564 patent. *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6, 8 (Feb. 13, 2020) (citing *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 (Dec. 15, 2017)).

Regarding Ground 1, the Examiner never questioned the priority claim made by Inpria during the prosecution of the '564 patent, nor did the Examiner issue any rejection concerning whether the claims contained sufficient written description support in the application that led to the '564 patent.²⁰ Accordingly, the Examiner committed a material error by not considering whether the '888 publication anticipated the claims. *Home Depot USA, Inc. v. Lynk Labs, Inc.*, PGR2023-00016, Paper 8, 37 (Aug. 4, 2023) ("We also find the Examiner's error here is further compounded by not having identified that the claims of the '705 patent are not

²⁰ The § 112 rejection was based on indefiniteness. *E.g.*, EX1007, 489.

entitled to claim priority to any of the filing dates of any of its ancestor applications, and thus, not having searched for and considered a substantial pool of prior art.”)

For Grounds 2-4, the Petition relies on Stowers 2008 (EX1008), a reference that Inpria submitted in an IDS but was not relied upon by the Examiner to reject the claims. Instead, the Examiner rejected the claims based on Stowers 2009 (EX1010). Stowers 2009 discloses HafSO_x/ZircSO_x films having a **thickness of 35 nm**. EX1007, 490. Stowers 2008 discloses the same HafSO_x/ZircSO_x films as Stowers 2009, but the films are “**30 to 35-nm thick**” (EX1008, 68)—thus disclosing the claimed range of “5 nm to 30 nm.” Had the Examiner appreciated Stowers 2008’s disclosure of **30-nm thick films**, she would not have allowed the claims.

Specifically, as explained above, the Examiner rejected the claims based on Stowers 2009 because it “discloses the coating material has an average thickness 35 nm (about 30nm).” EX1007, 490; *see also id.*, 498 (Examiner stating that “Stowers [2009] teach[es] the thickness of the film is 35 nm, which meets the limitation of ‘about 30 nm.’”). In response, Inpria amended claim 1 “to remove the term ‘about’” and argued that “the ranges do not overlap and they are not close enough that one would expect them to have the same properties.” *Id.*, 508. In allowing the claims, the Examiner stated that “[n]o other prior art teaches a structure comprising a coating

material...wherein the coating material has an average thickness from 5 nm to 30 nm...”).²¹

The Examiners’ failure to appreciate that Stowers 2008 discloses HafSO_x/ZircSO_x resist films that are “30 to 35-nm thick” constitutes material error. *Quasar Science, LLC v. Colt International Clothing, Inc. d/b/a Colt LED*, IPR2023-00613, Paper 8, 8 (Oct. 10, 2023) (“On this record, Petitioner demonstrates that the Examiner overlooked Ducharme’s teachings of the limitations that were the basis for allowing the challenged claims.”); *Nespresso USA, Inc. v. K-fee System GmbH*, IPR2023-00485, Paper 9, 38 (Sept. 13, 2023) (“Examiner erred in allowing the claims of the ’430 patent because the limitations outlined in the reasons for allowance are shown to be disclosed in Yaokim, Jarisch, Rossi, and Castellani.”).

The fact that Stowers 2008 was cited in an IDS does not change the result, especially where it is clear the Examiner did not appreciate the relevance of Stowers 2008. *Marinus Pharm, Inc. v. Ovid Therapeutics, Inc.*, PGR2023-00020, Paper 9, 15 (Aug. 17, 2023) (“We, thus, find that the Examiner erred by either overlooking, or failing to appreciate, the materiality of the disclosure of Zhang,” which was cited in an IDS and Third-Party Submission); *Syngenta Crop Protection AG v. UPL Ltd.*,

²¹ Inpria never disputed that Stowers 2009 discloses each and every element of claim 1 except for the “5 nm to 30 nm” thickness limitation. EX1007, 143-144, 507-508.

PGR2023-00017, Paper 8, 8 (Jul. 31, 2023) (finding error where “although Tobler was cited in an IDS, the examiner did not reject the claims over that reference, or even discuss it in any manner.”).

Finally, in Ground 5, the Petition relies on Trikeriotis (EX1024), a reference that was neither cited by Inpria nor relied upon by the Examiner to reject the claims. The arguments in Ground 5 do not overlap with previously considered arguments since the films of Trikeriotis include different radiosensitive ligands than Stowers 2008 and 2009. Moreover, Trikeriotis discloses films that are 30 nm thick, which, as noted above, was a claim feature the Examiner concluded was missing from the prior art.

B. 35 U.S.C. § 314(a)

The Board should also reject any argument that it should exercise its discretion to deny institution under 35 U.S.C. § 314(a). As explained below, the six factors set out in *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential) do not justify denying institution.

The parallel district court litigation is still in the very early stages, with Petitioner yet to file an Answer, and currently, there is no evidence that the court will or will not grant a stay if trial is instituted (factor 1). The court has not issued a scheduling order, fact discovery has not started, and no trial date has yet been set (factor 2). There are not any substantive issues related to the ’564 patent that have

been resolved by the court in the parallel district court litigation (factor 3). Given the early stage of the parallel proceeding, there is a minimal risk of the Board redoing the work of another tribunal (factor 5). Finally, it is unknown as to the amount of overlap there will be between the issues raised in this Petition and the parallel district court litigation, as no infringement contentions have yet been served and the complaint has only alleged infringement of claim 1 of the '564 Patent (factor 4). EX1011 ¶¶29-32.

IX. CONCLUSION

Claims 1-12 of the '564 patent are unpatentable, and Petitioner respectfully requests that the Board institute trial.

Dated: October 16, 2023

Respectfully Submitted,

/ Dion M. Bregman /
Dion M. Bregman, Reg. No. 45,645

Counsel for Petitioner

LISTING OF THE CHALLENGED CLAIMS

Claim No.	Claim Language
1	A structure comprising a substrate and a coating material on a surface of the substrate, wherein the coating material comprises metal ions with radiation sensitive ligands and wherein the coating material has an average thickness from 5 nm to 30 nm, wherein exposure of the coating material to UV, EUV and/or electron-beam radiation alters the chemical properties of the coating material creating an exposed coating material with differential dissolution rates between exposed and un-exposed regions of the coating material.
2	The structure of claim 1 wherein the metal ions comprise metal suboxide ions.
3	The structure of claim 1 wherein the metal of the metal ions comprises Cu, Al, Sc, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Y, Zr, Nb, Mo, In, Sn, Sb, Hf, Ta, W, Ir, Pt, La, Ce, Pr, Nb, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu or a combination thereof.
4	The structure of claim 1 wherein the radiation sensitive ligands comprise peroxide ligands.
5	The structure of claim 1 wherein the coating material further comprises polyatomic anions.
6	The structure of claim 1 wherein the average thickness is from 5 nm to 25 nm.
7	The structure of claim 1 wherein the coating material has high absorption of EUV radiation relative to conventional radiation-based resists.

8	The structure of claim 1 having a metal ion to radiosensitive ligand ratio of at least 2.
9	The structure of claim 1 wherein the coating material has been heated to temperatures from 45° C. to 150° C.
10	The structure of claim 1 wherein following exposure an exposed coating region is insoluble in an aqueous solvent.
11	The structure of claim 1 wherein following exposure an exposed coating region is soluble in an organic solvent.
12	The structure of claim 1 wherein the coating material can be effectively patterned with UV radiation or EUV radiation at a dose of no more than 100 mJ/cm ² .

CERTIFICATE OF COMPLIANCE

The undersigned certifies that the attached Petition for *Inter Partes* Review of U.S. Patent 9,823,564 contains 13,986 words (as calculated by the word processing system used to prepare this Petition), excluding the parts of the Petition exempted by 37 C.F.R. § 42.24(a)(1).

Dated: October 16, 2023

Respectfully Submitted,

/ Dion M. Bregman /

Dion M. Bregman, Reg. No. 45,645

Counsel for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105, I certify that I caused to be served a true and correct copy of the foregoing: Petition for *Inter Partes* Review of U.S. Patent 9,823,564 and the exhibits cited therein by Priority Mail Express on this day, October 16, 2023, on the correspondence address of record for the subject patent as follows: CHRISTENSEN, FONDER, DARDI & HERBERT PLLC, 11322 86th Ave. N., Maple Grove, MN 55369, UNITED STATES.

A courtesy copy of this Petition for *Inter Partes* Review of U.S. Patent 9,823,564 and the exhibits cited therein was also served via email on October 16, 2023 on Patent Owner's counsel of record in the district court litigation against Lam Research Corp.:

Warren K. Mabey , Jr.
Fish & Richardson, P.C.
222 Delaware Avenue, 17th Floor
Wilmington, DE 19899-1114
Telephone: (302) 652-5070
Email: mabey@fr.com

Michael R. Headley
Fish & Richardson, P.C.
500 Arguello Street Suite 400
Redwood City, CA 94063
Telephone: (650) 839-5139
Email: Headley@fr.com

Dated: October 16, 2023

Respectfully Submitted,

/ Dion M. Bregman /
Dion M. Bregman, Reg. No. 45,645

Counsel for Petitioner