

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LAM RESEARCH CORP.,
Petitioner

v.

INPRIA CORP.,
Patent Owner.

Case IPR2024-00033
Patent 9,823,564

**PATENT OWNER'S RESPONSE
TO PETITION FOR *INTER PARTES*
REVIEW OF U.S. PATENT NO. 9,823,564**

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Exhibit No.	Description	Previously Submitted
2001	Declaration of John S. McCloy, PhD	X
2002	CV of John S. McCloy, PhD	X
2003	U.S. Patent No. 5,874,128	X
2004	U.S. Patent No. 5,658,615	X
2005	U.S. Patent No. 6,987,572	X
2006	U.S. Patent No. 7,220,531	X
2007	Seong-Yun Moon, Jong-Man Kim, <i>Chemistry of photolithographic imaging materials based on the chemical amplification concept</i> , Journal of Photochemistry and Photobiology C: Photochemistry Reviews 8 (2007) 157-173	X
2008	Declaration of Jason Stowers, PhD	
2009	Declaration of Sanjay Banerjee, PhD	
2010	CV of Sanjay Banerjee, PhD	
2011	Deposition Transcript of Karey Holland, Ph.D. (July 18, 2023)	

Exhibit No.	Description	Previously Submitted
2012	E-mail with attachments from Cara Key, Digital Repository Librarian, Library Information and Technology, The Valley Library, Oregon State University, to Alan Telecky, Inpria Corporation (Feb. 15, 2024)	

I. Introduction

Patent Owner Inpria Corporation (“Inpria”) hereby responds to the petition for *inter partes* review filed by Petitioner Lam Research Corporation (“Lam”). Lam’s Petition challenges Inpria’s U.S. Patent No. 9,823,564 (“the ’564 patent”) based on five grounds. Each ground fails.

Lam’s first ground asserts anticipation by the publication of the ’564 patent’s priority application.¹ This ground is predicated on Lam’s argument that the claims lack written description support in the priority application (which is substantively the same as the ’564 patent specification). The claim limitations that Lam targets as supposedly lacking foundation are the average thickness ranges of 5 nm to 30 nm for claim 1, and 5 nm to 25 nm for claim 6.

As Inpria explains below—and as supported by the declaration of Dr. Sanjay Banerjee, EX2009²—a POSA would have immediately discerned that the inventors were in possession of the claimed ranges based on the specification’s teachings: (1) describing numerous encompassing and overlapping exemplary ranges, (2) expressly disclosing that “additional ranges of thicknesses within the explicit

¹ U.S. Patent Application No. 12/850,867 (“the ’867 application”) which published as U.S. Patent Publication No. 2011/0293888 (“the ’888 publication”)

² Dr. Banerjee is an expert in the field of the ’564 patent. EX2009, ¶¶1-22; EX2010.

ranges ... are contemplated,” (3) teaching actual examples with overlapping ranges and a 20 nm thickness squarely within both claimed ranges, and (4) explaining several variables that affect thickness and how to control those variables.

Lam's response amounts to a demand for word-for-word disclosure of the claimed ranges, but that is not required. Lam also points to a subsequent prosecution statement regarding obviousness, but that statement is legally irrelevant and it is not nearly as broad as Lam asserts in its unprecedented argument invoking estoppel. The Board should reject Lam's arguments and find the priority application provides written description support—which would render the '888 publication non-prior art.

Lam's two other primary references also fail to qualify as prior art. Stowers 2008 is the Ph.D. thesis of Jason Stowers, the first named inventor on the '564 patent. Although the thesis was completed and submitted to the library in October 2008, Dr. Stowers explains in his declaration that his thesis was under a one-year embargo, meaning that it was not available to the public until October 2009, which is less than a year before the '564 patent's priority date, making it non-prior art. For Trikeriotis, Lam's librarian declarant—Dr. Sylvia Hall-Ellis—introduces evidence that shows the reference was not available until September 2010, making it non-prior art. Although she also relies on other earlier dates, they are either unsupported or insufficient to show public accessibility.

Lam's arguments based on Stowers 2008 and Trikeriotis also fail on the merits. For Lam's Stowers 2008 grounds, Lam attempts to supplement its unpatentability showings using teachings from the '564 patent itself. Lam argues that this is appropriate because, although certain features are not explicitly disclosed in Stowers 2008, they are nevertheless inherently present because the films are the same as the '564 patent's films. But Lam's proofs for inherency are inadequate, only asserting Stowers 2008 and the '564 patent disclose identical films because the identity of precursor chemicals are the same. This ignores the significant differences in concentrations of the solutions used and many differences in the processing of the films, as well as the impact those differences would have on the film's final properties. Because Lam has failed to show the films are inherently the same, its arguments based on Stowers 2008 fail.

Lam also presents alternative theories to inherency for certain claim limitations, but all require unfounded leaps between distinct scientific concepts. For instance, Lam relies on a teaching of patterning a photoresist as meeting the claim limitation requiring the radiation "alters the chemical properties of the coating material." But Lam fails to establish that patterning necessarily results in a chemical change. Lam also points to the fact that a material's capacity to absorb radiation will change when a second material is added to the mix as meaning, according to Lam, the second material is a "radiation sensitive ligand." But the logic simply does not

follow. For claim 7, Lam argues that a material's higher mass density necessarily means a film made of that material will absorb more EUV radiation than a film made from a material that has a lower mass density. But Lam has failed to establish inherency, particularly because EUV radiation absorption relies on factors other than density alone, as Lam's own expert recognized. For claim 12, Lam silently applies a correlation disclosed for one material (HafSOx) to a teaching in Stowers 2008 regarding a different material (ZircSOx) without any explanation why the correlation would be cross-applicable. All of these alternative grounds to inherency should be rejected as well.

Lam's last ground, which is only four-and-a-half pages long, is also deficient. For example, Lam's mapping for the "metal ions with radiation sensitive ligands" limitation is contradicted by other evidence Lam introduced. Specifically, a 2014 article that Lam asserts describes the films of Trikeriotis shows that the ligands Lam identified in its Petition are not the radiation sensitive part of Trikeriotis's films—instead that is a separate "photoactive compound." Additionally, Lam's arguments regarding dependent claims 6, 7, and 12 are separately deficient, as fully explained below.

For these reasons, the Board should reject Lam's Petition in its entirety and uphold the '564 patent's claims. To the extent the Board determines, however, that the claims are unpatentable, Inpria submits a Contingent Motion to Amend

contemporaneously with this Patent Owner's Response which contains amendments that are even more clearly supported by the priority application and further distinguish from the references presented by Lam.

II. Level of Ordinary Skill

For the purposes of this Patent Owner's Response, Inpria applies Lam's definition of a POSA as "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." Pet., 5 (citing EX1002, ¶20); *see also* Inst. Dec. at 5-6 (preliminarily adopting this definition).

III. Claim Construction

The Board need not construe any claim term because no construction is needed to resolve the parties' dispute. *See Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper 11 at 16 (Aug. 14, 2015) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)). Under any reasonable construction of the claim terms, Lam has failed to demonstrate that the prior art discloses or suggests the challenged claims.

IV. The '867 Application Provides Sufficient Written Description Support for the Claimed Average Thickness Ranges

A. Legal Standard for Written Description

The written description requirement is satisfied when the relied-upon disclosure “reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date.” *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc) (citation omitted). “[T]he test requires an objective inquiry into *the four corners of the specification* from the perspective of a person of skill in the art.” *Id.* at 1352 (emphasis added). “[T]he written description requirement does not demand either examples or an actual reduction to practice.” *Id.* at 1352. In other words, Section 112 does not require the specification to describe the claim limitations exactly as they are recited in the claims. *See In re Wertheim*, 541 F.2d 257, 265 (C.C.P.A. 1976) (citing *In re Lukach*, 442 F.2d 967, 969 (C.C.P.A. 1971)); *Ariad*, 598 F.3d at 1352. “If lack of literal support alone were enough to support a rejection under § 112, then the statement of *In re Lukach*, ... 442 F.2d at 969, ... that ‘the invention claimed does not have to be described [in the same words] in order to satisfy the description requirement of § 112,’ is empty verbiage.” *Wertheim*, 541 F.2d at 265 (quotation omitted).

The Federal Circuit has further made clear that “[t]he specification need not expressly recite the claimed range to provide written description support.” *RAI*

Strategic Holdings, Inc. v. Philip Morris Prods. S.A., 92 F.4th 1085, 1090 (Fed. Cir. 2024). Rather, “[i]t is common, and often permissible, for particular claims to pick out a subset of the full range of described features, omitting others.” *ScriptPro, LLC v. Innovation Assocs., Inc.*, 762 F.3d 1355, 1359 (Fed. Cir. 2014).

B. The '867 Application Provides Written Description Support for the Claimed Average Thickness Ranges

The disclosures regarding average thickness of the coating material in the priority '867 application specification are identical to the teachings in the '564 patent specification. *Compare* EX1004, 23:14-26,³ *with* EX1001, 14:43-61. This is not surprising, as the '564 patent was filed as a continuation from the '867 application, and one requirement for filing a continuation is that the follow-on application must add no new matter. Manual of Patent Examining Procedure § 201.07 (“The disclosure presented in the continuation must be the same as that of the original application; i.e., the continuation should not include anything which would constitute new matter if inserted in the original application.”).

³ Citations in this POR to EX1004 and other exhibits at issue in this IPR are referring to the page numbers added to the exhibits, instead of the documents' original pagination.

The shared specification explicitly discloses several ranges of exemplary coating thicknesses:

- No more than about 1 micron (*i.e.*, 1000 nm);
- No more than about 250 nm;
- From about 1 nanometers (nm) to about 50 nm;
- From about 1 nm to about 40 nm;
- From about 1 nm to about 25 nm;

EX1004, 23:14-26.

Each of these ranges either fully encompasses or overlaps nearly entirely with the claimed ranges of 5 nm to 30 nm (claim 1) or 5 nm to 25 nm (claim 6). Moreover, immediately after disclosing this slew of ranges, the specification states 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, 23:22-24 (emphasis added); EX2009, ¶¶27-28. Dr. Holland confirmed her understanding of this paragraph to be “teaching a person of skill in the art that they could make that range,” testifying “[t]hey could do whatever they want ... all these

ranges are available.” EX2011, 56:14-57:16, 175:7-177:25.⁴ To demand more precision than this disclosure provides would convert the written description test into an *in haec verba* test, which the Federal Circuit has repeatedly disavowed. *Ariad*, 598 F.3d at 1352; *see also* Pet., 12 (recognizing *in haec verba* support is not needed).

In addition to the encompassing ranges recited above and statement regarding ranges “within the explicit ranges above,” the specification also describes how the thickness can be varied, explains variables that affect the thickness, and provides specific examples within or overlapping with the claimed ranges. EX2009, ¶¶23-26 For instance, the specification describes various “coating approaches,” including “spin coating,” “spray coating,” “knife edge coating,” and “printing techniques.”

⁴ This portion of Dr. Holland’s testimony also betrays a fundamental misunderstanding of the requirements for written description, with her brushing it off as not “know[ing] the legalese.” EX2011, 177:17-25. When asked whether “the inventor had possession of about 1 nanometers to about 50 nanometers”—a range expressly disclosed in the ’867 application, EX1004, 23:20-21—Dr. Holland was unsure, questioning whether the inventor needed to “actually ma[ke] some photoresist that was 1 nanometer thick.” EX2011, 177:17-25. But “the written description requirement does not demand either examples or an actual reduction to practice.” *Ariad*, 598 F.3d at 1352.

EX1004, 12:20-25, 22:21-30. Additionally, the specification teaches that “multiple coating steps” can be used to “provide greater control over the coating process,” for instance with multiple layers used “to yield an ultimate coating thickness desired.” *Id.*, 22:29-30.

For spin coating specifically, the specification describes a number of ranges of spin speeds that can be used (e.g., “about 500 rpm to about 10,000 rpm”) and spin times (e.g., “about 5 seconds to about 5 minutes”) both of which affect the coating material thickness. *Id.*, 23:1-15 (“The thickness of the coating generally can be a function of the precursor solution concentration, viscosity and the spin speed.”)

The specification also explains that the “concentrations of the species in the precursor solution” can affect the thickness of the coating material and that “lower concentrations overall ... can achieve thinner coatings using reasonable coating parameters.” *Id.*, 21:3-7. As an example, the specification describes that the “metal ion concentration” has an impact on the thickness of the coating, with “more dilute solutions generally consistent with the formation of thinner coating materials.” *Id.*, 11:18-20.

The specification describes embodiments that further support the written description of the claims, with examples “at a thickness [from] 10-50 nm,” *id.*, 35:14-15, and another at “a thickness of 20 nm,” *id.*, 36:29-30. In total, these

disclosures reasonably convey to a POSA that the inventors had possession of both the 5 nm to 30 nm range and the 5 nm to 25 nm range. EX2009, ¶¶23-29.

These facts are analogous to those in *BioDelivery Sciences International, Inc. v. Alvogen PB Research & Development LLC*, where the court determined that the claimed “pH ranges of about 4-6, about 4.5-5.5, and about 4.5-5” were sufficiently supported by following paragraph:

In one embodiment, e.g., when the medicament is buprenorphine, the pH of the mucoadhesive polymeric diffusion environment in the devices of the present invention is between about 4.0 and about 7.5. In another embodiment, the pH of the mucoadhesive polymeric diffusion environment is about 6.0. In one embodiment, the pH of the mucoadhesive polymeric diffusion environment is about 5.5 to about 6.5, or between about 6.0 and 6.5. In yet another embodiment, the pH of the mucoadhesive polymeric diffusion environment is about 7.25. In another embodiment, the pH is between about 7.0 and 7.5, or between about 7.25 and 7.5. In other embodiments, the pH of the device may be about 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, or 7.5, or any incremental value thereof. It is to be understood that all values and ranges between these values and ranges are meant to be encompassed by the present invention.

576 F. Supp. 3d 184, 210-11 (D. Del. 2021), *vacated and remanded on other grounds*, 2022 WL 17828352 (Fed. Cir. Dec. 21, 2022). The court concluded that the above paragraph “allowed an artisan of ordinary skill to ‘immediately discern’ that the inventors possessed the [claimed] pH ranges,” because the “application discloses a pH range for the mucoadhesive layer of about 4.0 to about 7.5, which includes the pH ranges in the relevant asserted claims,” and because the “application explicitly tells the reader ‘all values and ranges between these values and ranges are meant to be encompassed by the present invention.’” *Id.*

Like in *BioDelivery*, the specification here discloses thickness ranges, such as “about 1 nm to about 40 nm,” which include the claimed range of from 5 nm to 30 nm. EX1004, 23:14-22. Also like in *BioDelivery*, the specification tells the reader 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.” *Id.*, 23:22-24. Thus, the specification allows a POSA to immediately discern that the inventors possessed the claimed range.⁵

⁵ There is also no requirement to demonstrate “importance” with respect to a claimed range, as Lam contends. Pet., 15; *In re Eickmeyer*, 602 F.2d 974, 981 (C.C.P.A. 1979) (“We are not persuaded that there is any requirement for appellant to demonstrate the Criticality of a lower limit to meet the description requirement.”).

C. Lam's Contrary Arguments Are Based on Legally Erroneous Rationales

Lam's rebuttal to the evidence shown above is: (1) an observation that some of the claimed endpoints are not listed expressly, and (2) pointing to legally irrelevant prosecution arguments that post-date the priority filing with a vague suggestion that "Inpria should be estopped." Pet., 10-18. Finding for Lam on either of these bases would be legal error.

1. Express Disclosure

Lam argues that the '867 application does not expressly "describe a coating material with a particular thickness of either 5 nm or 30 nm [or] a thickness range of 5 nm to 30 nm" for claim 1. Pet., 15 (emphasis omitted). For claim 6, although Lam concedes "the '867 application does recite a thickness of 25 nm," Lam again points out the fact that the specification does not expressly "recite[] a thickness of 5 nm [or] a thickness range of 5 nm to 25 nm." *Id.* (emphasis omitted). But the law does not require the specification to exactly recite the claim limitations word-for-word. *Ariad*, 598 F.3d at 1352. And Lam's analysis overlooks the express teaching that "thicknesses within the explicit ranges above are contemplated and are within the

present disclosure.” EX1004, 23:22-24.⁶ The mere fact that the endpoints of the claimed ranges are not explicitly recited in the specification, on its own, is insufficient to undermine written description support here, when weighed against the numerous teachings regarding how to accomplish different thicknesses, several overlapping and encompassing ranges, and the express statement that “thicknesses within the explicit ranges” are included. In other words, what more could the patentee have included in the specification to satisfy Lam’s demanded written description test (short of expressly reciting the claimed range, which is not required)?

The precedent Lam presents in its Petition in support of this argument is readily distinguishable. In *General Hospital*, the Federal Circuit held that “[t]he disclosure of a range of concentrations from less than 1×10^{11} particles per ml to some unidentified maximum, does not provide written description support for the claimed concentration of ‘about 6.6×10^{11} particles per ml,’” and that “a disclosed range that *minimally overlaps* with the claimed range does not provide written description support for the claimed range.” *Gen. Hosp. Corp. v. Sienna*

⁶ Lam later addresses this disclosure, but confuses the statement as teaching something that is “not disclosed, but would be obvious.” Pet., 17. The specification’s teaching, however, *is* an express disclosure.

BioPharmaceuticals, Inc., 888 F.3d 1368, 1372-73 (Fed. Cir. 2018) (emphasis added) Here, unlike in *General Hospital*, the '867 application specification specifies several ranges, including narrow ranges, with clearly defined minimum and maximum bounds, that encompass the claimed range, and do not merely “minimally overlap.” *See* EX1004, 23:14-26.

Lam's primary case, *Indivior UK Ltd. v. Dr. Reddy's Labs. S.A.*, 18 F.4th 1323, 1328-30 (Fed. Cir. 2021), is even further afield. In *Indivior*, the claims recited ranges of polymer weight percentages in a mucoadhesive film. *Id.* at 1325-26. The priority application, however did not even “discuss or refer to bounded or closed ranges of polymer weight percentages.” *Id.* at 1326 (quoting *Dr. Reddy's Lab's S.A. v. Indivior UK Ltd.*, IPR2019-00329, Paper 49 at 79 (Jun. 2, 2020)). Instead, the patentee in *Indivior* had pointed to (1) two tables as showing percent polymer content of exemplary film compositions, neither of which expressly listed polymer weight percent, but from which the polymer weight percent could be calculated, and (2) broad, open ended ranges of “at least 25% by weight” and “at least 50%.” *Id.* at 1326-27 (pointing to Tables 1 and 5, from which weight percentages of 48.2 wt % and 58.6 wt % could be calculated); *see also id.* at 1329. In other words, the specification described only two broad, unbounded ranges and the specific examples identified did not even expressly disclose the variable that was the subject of the claimed range. Given that limited disclosure, the Court held that the claimed range

of “about 40 wt % to about 60 wt %” lacked written description support. *Id.* at 1328. Here, unlike in *Indivior*, the '867 application specification specifies several bounded ranges, including narrow ranges, that encompass the claimed range and the examples expressly call out the claimed variable (average thickness) specifying values falling within the claimed ranges. *See* EX1004, 23:14-26, 35:13-15, 36:29-30.

In *Pioneer Pet Prod., LLC v. Oil-Dri Corp. of Am.*, IPR2022-01138, Paper 21, 7-9 (Jul. 21, 2023), the Board determined that “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%.” Unlike in *Pioneer*, the '867 application specification here discloses much more than a couple of specific examples that fall within the claimed range. Again, the '867 application specification specifies several ranges, including narrow ranges, that encompass the claimed range. *See* EX1004, 23:14-26.

In *Grünethal GmbH v. Antecip Bioventures II LLC*, PGR2017-00008, Paper 43, 15-20 (June 22, 2018), the Board determined that the specification did not provide written description support for the claimed range of “about 80 to about 500 mg.” According to the Board, at most, the specification disclosed “a range of ‘about 10 mg to about 100 mg’ administered over the course of 5 to 10 consecutive days, thereby essentially disclosing a list [*sic*] six different ranges that includes the ranges of about 50 mg to about 500 mg and about 80 mg to about 800 mg.” *Id.* (citations

omitted). The Board further noted that the claims “also require that dose to be administered ‘within a six month period,’” “thereby further complicating the process necessary to derive the recited dosing regimen from the ... patent specification.” *Id.* at 19-20. In contrast, here, explicitly disclosed ranges in the ’867 application specification, including the narrow ranges, encompass the claimed range. EX1004, 23:14-26.

Regarding *Philip Morris Prod., S.A. v. RAI Strategic Holdings, Inc.*, PGR2020-00071, Paper 29 (Jan. 10, 2022), the Federal Circuit expressly overruled the finding on which Lam relies—that the “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%*.’” Pet., 16 (emphasis added) (quoting *Phillip Morris*, Paper 29, 40). The Federal Circuit held that “substantial evidence does not support the Board’s finding that claims 10 and 27 reciting a heating member ... having a length of *about 75% to about 85%* ... lack written description support under § 112.” *RAI Strategic Holdings, Inc. v. Philip Morris Prod. S.A.*, 92 F.4th 1085, 1092 (Fed. Cir. 2024) (emphasis added). The Federal Circuit further noted that its decision was “based on the unique facts of this case” which were factually distinguishable from precedent relied upon by the Board. *Id.*

The above cases cited by Lam are also distinguishable because, unlike the specifications at issue in those cases, the ’867 application specification here

explicitly states that a POSA “will recognize that additional ranges of thicknesses within the explicit ranges above are contemplated and are within the present disclosure” and explains how to achieve such ranges. EX1004, 23:14-26. Neither Lam nor Dr. Holland refute this disclosure about what a POSA “will recognize.” Lam’s only response is that the written description requirement is not satisfied if the subject matter is merely obvious over what is expressly disclosed. *See* Pet., 17-18 (citing cases). But the claimed range is not merely obvious from the disclosure. As discussed above, a POSA would have understood from the disclosure that the claimed range is actually disclosed.

2. Estoppel

Lam’s argument turns on its belief that “Inpria should be estopped” from asserting written description support here based on prosecution history statements made in 2016 regarding non-obviousness over prior art. Pet., 17 (citing EX1007, 508). This is also the basis that the Board adopted in its institution decision. Inst. Dec., 11-14 (regarding “Statements Made During Examination”). That argument is misguided for a few reasons.

First, those prosecution statements are legally irrelevant to the written description inquiry. The Federal Circuit has made clear that the written description inquiry is to be guided by a POSA’s understanding at the relevant timeframe—2010 here—based on the “four corners” of the original specification. *Ariad*, 598 F.3d at

1351; *U.S. Steel Corp. v. Phillips Petroleum Co.*, 865 F.2d 1247, 1251 (Fed. Cir. 1989) (“application sufficiency under § 112, first paragraph, must be judged as of the filing date”) (quoting *In re Glass*, 492 F.2d 1228, 1232 (C.C.P.A. 1974)); *Anascape, Ltd. v. Nintendo of Am. Inc.*, 601 F.3d 1333, 1337 (Fed. Cir. 2010) (rejecting reliance on issued claims in the allegedly priority patent because those claims were added by amendment and “not present in the original [priority] specification, and cannot contribute written description support for the [continuation] claims as of the [priority] filing date.”)

Second, on the merits, the statement made in prosecution is far narrower than the “estoppel” Lam attempts to apply. Leaving aside whether Lam has shown any of the other predicates for estoppel have been satisfied, estoppel is inappropriate here based solely on the fact that it is not the “identical issue” as in the prosecution. *In re Freeman*, 30 F.3d 1459, 1465 (Fed. Cir. 1994) (“Issue preclusion is appropriate only if: (1) the issue is identical to one decided in the first action...”). At the time the statement in question was made, the applicant was responding to an obviousness rejection based on Stowers 2009 and another reference referred to as “Meyers.”⁷ EX1007, 507-08; EX1009, 264 (similarly responding to reliance on Stowers 2009, which it calls “Stowers et al.”). For the thickness limitation, the Examiner had relied

⁷ WO 2008/082448

on Stowers 2009, and the applicant distinguished Stowers 2009 in two ways. First, because the Examiner's rejection was predicated on overlapping ranges due to the use of the word "about" in the claims, the applicant deleted the word "about" from the ranges. EX1007, 507-508. Second, the applicant explained that "Stowers [2009] teaches a thickness of 35 nm or greater" meaning that, after amendment, "*the ranges* do not overlap and they are not close enough that one would expect them to have the same properties." *Id.*, 508 (emphasis added). In other words, the applicant was distinguishing the claimed range of 5 nm to 30 nm from a range of "35 nm or greater" in the context of obviousness.

But here, the comparison is not between the claimed range and a completely non-overlapping range of "35 nm or greater," it is a comparison between the claimed range and the entire disclosure of the specification, including numerous encompassing and overlapping ranges, a teaching that "ranges of thicknesses within the explicit ranges ... are contemplated," and actual examples with overlapping ranges or points falling within the claimed range. Put pointedly, the question of whether "5 nm to 30 nm" is sufficiently similar to a range of "35 nm or greater" to render the former obvious is a different question from whether a POSA reading "about 1 nm to about 25 nm" in the specification would have viewed "5 nm to 25 nm" or "5 nm to 30 nm" as a completely separate inventions.

The Board should reject Lam's attempted invocation of estoppel and find that a POSA would have understood the 5 nm to 30 nm range and the 5 nm to 25 nm range claimed to have been within the possession of the inventor.

To the extent the Board has concerns of fairness regarding statements made in prosecution, that is the role for prosecution history estoppel. The Supreme Court in *Festo* explained the doctrine as follows:

In some cases the Patent and Trademark Office (PTO) may have rejected an earlier version of the patent application on the ground that a claim does not meet a statutory requirement for patentability. ... When the patentee responds to the rejection by narrowing his claims, this prosecution history estops him from later arguing that the subject matter covered by the original, broader claim was nothing more than an equivalent. Competitors may rely on the estoppel to ensure that their own devices will not be found to infringe by equivalence.

Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., 535 U.S. 722, 727, (2002).

In other words, when a patent applicant narrows their claims (either through amendment or argument) to overcome the prior art, they are estopped from later arguing infringement by the doctrine of equivalents of subject matter falling within the claim scope they surrendered to secure the claims' allowance. Inpria is not arguing here that a 35 nm thick film meets the amended range of "5 nm to 30 nm"

based on the doctrine of equivalents. Instead the question is whether a POSA would have understood the patent applicant in 2010 to have had possession of ranges of “5 nm to 30 nm” or “5 nm to 25 nm” based on the specification’s numerous overlapping and encompassing ranges, explicit disclosure of 25 nm, examples overlapping with and falling within the range, and several disclosures of variables affecting thickness.

Lam cites no precedent for its expanded application of prosecution history estoppel. *RAI Strategic Holdings, Inc. v. Philip Morris Products S.A.*, 92 F.4th 1085 (Fed. Cir. 2024) certainly does not hold that a non-obviousness argument made during prosecution can be used to estop a patentees counter-arguments to a written description challenge. In fact, as explained above, the outcome of *RAI* is the opposite of what Lam seeks here—the Federal Circuit overturned the Board’s finding of no written description. And the ranges in the specification of *RAI* were fewer than disclosed here and less overlapping with the claimed range—but still the claim was upheld.

	Claim	Specification
<i>RAI</i>	“about 75% to about 85%”	“about 75% to about 125%” “about 80% to about 120%”

		“about 85% to about 115%” “about 90% to about 110%”
'564 Patent	“5 nm to 30 nm” “5 nm to 25 nm”	Less than 1000 nm Less than 250 nm About 1 nm to about 50 nm About 1 nm to about 40 nm About 1 nm to about 25 nm “additional ranges of thicknesses within the explicit ranges above”

The Federal Circuit did not create a general rule in *RAI* that written description should be found lacking if there is any evidence tending to support that the disclosed range “behaves any differently than the claimed range,” *RAI*, 92 F.4th at 1091—in fact it cautioned against such “[b]roadly articulated rules,” noting that their “determination [was] highly factual and dependent on ‘the nature of the invention and the amount of knowledge imparted to those skilled in the art by the disclosure,’” *id.* (first quoting *Indivior*, 18 F.4th at 1329-30, and then quoting *Wertheim*, 541 F.2d at 262) (first alteration in original). The Federal Circuit’s fact-intensive distinguishing of a 1965 CCPA case—*In re Baird*, 348 F.2d 974 (C.C.P.A. 1965)—in *RAI* says nothing about the written description inquiry here.

Furthermore, even if a “behaves any differently” test for written description were appropriate, there is no basis to find claim 6 lacks written description. There is absolutely no indication that the range of “5 nm to 25 nm” “behaves any differently” than “about 1 nm to about 25 nm.” An argument in prosecution that the range of “35 nm or greater” does not render obvious a range of “5 nm to 30 nm” certainly does not provide proof of “behaves any differently” for these much more similar ranges.

For all of these reasons, the Board should find that the '867 application disclosure provides sufficient written description support for the 5 nm to 30 nm average thickness range recited in claim 1 and the 5 nm to 25 nm average thickness range recited in claim 6. If the Board finds written description support in the '867 application is sufficient, the effective priority date of the claims is no later than August 5, 2010.

V. Lam's Primary References Are Not Prior Art

Lam relies on the '888 publication, Stowers 2008, and Trikeriotis as its primary references. None are prior art.

A. '888 Publication Is Not Prior Art

For the reasons given above, the claims are supported by the '867 application, and thus the '888 publication (which is the publication of the '867 application) is not prior art. EX1003, 1.

B. Stowers 2008 Is Not Prior Art

Stowers 2008 is a Ph.D. dissertation by Jason Stowers submitted to Oregon State University in 2008. As Dr. Stowers explains in a declaration submitted with this Patent Owner's Response, EX2008, although he presented and defended the research that was the subject of his doctoral dissertation on August 14, 2008 (the date indicated on the face of Stowers 2008, EX1008, 2-6), the document on which Lam relies was not completed and submitted to the Oregon State University Library until a few months later in October 2008. EX2008, ¶4. This is consistent with the Oregon State University Library record that Lam's declarant (Dr. Sylvia Hall-Ellis) retrieved. *See* EX1006, ¶47 (referring to an "Entered" field showing "20081021"). The Oregon State University Library, however, allows for submissions to be placed under "Embargo" for a period of time before it is released to the public for reasons that include "Intellectual Property (patent, etc.)":

► Private Embargo - Private to Public

• **Embargo** Temporarily restrict access to your work.

Restricted to
Private

until 2 Years

Then set it to
Public

Reason For Embargo
Intellectual Property (patent, etc.)

EX2008, Attachment B (available at <https://guides.library.oregonstate.edu/Scholars-Archive/Embargoes>).

At least during the 2008-2009 timeframe, Dr. Douglas Keszler's lab (where Dr. Stowers conducted his research) had a policy requiring dissertations to be submitted under embargo for a one year period. EX2008, ¶6. Dr. Stowers complied with this requirement and submitted his dissertation subject to one-year embargo, meaning EX1008 would have been available to the public, at the earliest, in October 2009. EX2008, ¶7. Indeed, contemporaneous evidence from shortly after October 2009 confirms that Dr. Stowers placed his thesis under a one-year embargo. EX2008, Attachment A; *see also* EX2008, ¶8. As such, Stowers 2008 published less than a year before the priority date for the '564 patent (*supra* Section IV), and

because Dr. Stowers is a named inventor, Stowers 2008 is also not prior art “by others” under pre-AIA 35 U.S.C. § 102(a). Therefore, Stowers 2008 does not qualify as prior art.

Lam’s declaration from Dr. Hall-Ellis does not show otherwise. *See* EX1006, ¶¶44-50. First, Dr. Hall-Ellis relies on an alleged “date of creation” on the face of the document. *Id.*, ¶45. But as Dr. Stowers confirms, this is actually the date of defense rather than the date of creation of EX1008. EX2008, ¶4. And in any case, a creation date for a document is insufficient to show public accessibility. *See Hilgraeve, Inc. v. Symantec Corp.*, 271 F. Supp. 2d 964, 975 (E.D. Mich. 2003) (rejecting “dates inprinted on ... documents” that merely “establish ... the date the document was created or printed”). Second, Dr. Hall-Ellis relies on an MARC record that shows the following:

OCLC 263038762 **No holdings in XXX - 2 other holdings**

Books

Type	t	ELvl		Srcce	d	Audn		Ctrl		Lang	eng
BLvl	m	Form		Conf	0	Biog		MRec		Ctry	xx
Cont			bm	GPub		LitF	0	Indx	0		
Desc	a	Ills	a	Fest	0	DtSt	s	Dates	2008		

EX1006, 41 (red annotation added).

But the fact that the library “Entered” the record on October 21, 2008, does not mean it was accessible to the public as of that date. Indeed, as Dr. Stowers

testifies (and the Oregon State University Library website supports), documents entered into their system (such as Stowers 2008) may be inaccessible and under “Embargo” for a period of time. The Oregon State University Library itself has confirmed that it does not currently maintain information regarding thesis embargoes that would have been in effect at the relevant time. EX2012.

Lam also includes a footnote pointing to an IDS in which Inpria included Stowers 2008. Pet., 19 (citing EX1007, 53 (Cite No. 7)). But including a document with an IDS submitted to the PTO is not an admission that the submission is prior art. *See ResQNet.com, Inc. v. Lansa, Inc.*, 594 F.3d 860, 866 (Fed. Cir. 2010). And although Inpria included “August 14, 2008” in the description, it did not describe this as a publication date. As explained above, the August 14, 2008 date on the face of Stowers 2008 merely reflects the presentation date, EX1008, 5 (“Presented August 14, 2008”), not the date it was available to the public, EX2008, ¶¶4, 7.

For these reasons, Stowers 2008 is not prior art.

C. Trikeriotis Is Not Prior Art

For Trikeriotis, the evidence relied upon by Dr. Hall-Ellis shows the document was made publicly accessible *after* the priority date of the '564 patent (August 5, 2010), not before. For instance, Dr. Hall-Ellis relies on the cataloging date at the Library of Congress beginning on September 9, 2010, in which “the cataloging process was completed on September 21, 2010.” EX1006, ¶62. The

MARC record that Dr. Hall-Ellis retrieved indicated the same dates. *Id.*, ¶63. As such, Dr. Hall-Ellis concludes that Trikeriotis “was publicly available on or shortly after September 21, 2010,” *id.*, which makes Trikeriotis non-prior art in view of the priority date of the '564 patent (*supra* Section IV).

Dr. Hall-Ellis also relies on two earlier dates, but neither controverts her conclusion—based on the Library of Congress evidence—that Trikeriotis “was publicly available on or shortly after September 21, 2010.” *Id.* First, Dr. Hall-Ellis relies on a March 25, 2010 date allegedly from the “SPIE website” that she characterizes, without foundation, as a “publication date.” *Id.*, ¶60. Unlike other evidence she relies upon, Dr. Hall-Ellis presents no attachments showing this website. And the hyperlink that she provides for the SPIE website in footnote 21 is defective. *Id.*, ¶60 n.21. As such, because Dr. Hall-Ellis does not disclose the underlying facts or data on which this “March 25, 2010” date is based, this opinion is entitled to little or no weight. 37 C.F.R. § 42.65.

Second, Dr. Hall Ellis relies on dates from the U.S. Copyright Office website. EX1006, ¶65. Dr. Hall-Ellis relies on a date of July 20, 2010, which she calls a “registered” date, and “a publication date of March 3, 2010.” *Id.* But the registration date, standing alone, is insufficient absent evidence that this registration means the document was publicly accessible. *See In re Lister*, 583 F.3d 1307, 1316 (Fed. Cir. 2009) (rejecting reliance on copyright registration date, without more). And Dr.

Hall-Ellis provides no rationale why this registration date would have made the document publicly accessible—instead she relies on analysis “noted above,” *id.*, but there is no such explanation “above” (or anywhere in her declaration). Similarly, for the March 3, 2010 date, Dr. Hall-Ellis gives no explanation what that date means or how that date came to be in the copyright registration she relies upon. *Id.*⁸ As such, her testimony on this point is conclusory and should be rejected. *See Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 15-16 (Aug. 24, 2022) (Precedential) (denying institution where expert testimony consisted of conclusory and unsupported statements “without any supporting evidence or technical reasoning”).

For these reasons, on balance, the evidence Dr. Hall-Ellis relies upon shows Trikeriotis “was publicly available on or shortly after September 21, 2010,” EX1006, ¶63, making it non-prior art.

* * *

⁸ This is particularly noteworthy because this date conflicts with the date from the Library of Congress’s website and also with the date Dr. Hall-Ellis attempts to rely on from the SPIE website. No explanation is provided as to why all of these dates are different.

Because none of Lam's primary references qualify as prior art, the Board should reject Lam's challenges to claims 1-12 of the '564 patent.

VI. The '888 Publication Does Not Anticipate Because It Is Not Prior Art

As described above, the claims are supported by the '867 application, and thus the '888 publication is not prior art. *See supra* at Sections IV.B, V.A. Because the '888 publication is not prior art, it cannot anticipate the claims of the '564 patent.

VII. Lam's Anticipation and Obviousness Arguments Based on Stowers 2008 Are Deficient

A. Lam Has Not Proven Stowers 2008's Films are Identical to the '564 Patent Films.

A principal basis for Lam's argument that Stowers 2008 anticipates or renders the claims obvious is that the films are identical to the '564 patent films. According to Lam, because the films are identical, it is appropriate for Lam to point to the teachings in the '564 patent itself to show inherent properties of the Stowers 2008 films. *See, e.g.,* Pet., 38, 44, 48 (pointing to inherency cases regarding the "work of the inventor" and disclosure of the "patent itself"). Lam's assumption that the films are the same, however, is unsupported and Lam fails to meet the strict requirements of inherency. EX2009, ¶¶30-39. Because Lam predicates its arguments that Stowers 2008 discloses the claim limitations on an assumption that the Stowers 2008 films are identical to the '564 patent films, and because that assumption is unproven, Lam fails to prove unpatentability over Stowers 2008.

1. Legal Standard for Inherent Anticipation

Patent claims are unpatentable for inherent anticipation only “when a single prior art reference discloses each and every limitation of the claim.” *Glaxo Inc. v. Novopharm Ltd.*, 52 F.3d 1043, 1047 (Fed. Cir. 1995); 35 U.S.C. § 102. A claim is inherently anticipated only when the “missing descriptive matter is necessarily present in the [prior art].” *Cont’l Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1268 (Fed. Cir. 1991). But proving inherency is a high burden—it “may not be established by probabilities or possibilities.” *In re Oelrich*, 666 F.2d 578, 581 (C.C.P.A. 1981) (internal quotation omitted). Instead, “[t]he inherent result must inevitably result from the disclosed steps.” *In re Montgomery*, 677 F.3d 1375, 1380 (Fed. Cir. 2012). The “mere possibility [of meeting the claim limitation] is not enough.” *See PersonalWeb Techs., LLC v. Apple, Inc.*, 917 F.3d 1376, 1382 (Fed. Cir. 2019); *see also PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1195 (Fed. Cir. 2014) (“[t]he mere fact that a certain thing may result from a given set of circumstances” in the prior art is insufficient to meet the exacting inherency standard) (internal quotation omitted).

2. Lam’s “Same Films” Inherency Argument Is Deficient

Lam’s Petition repeatedly relies on an assertion that, when compared with the ’564 patent, the films “are the same in all material respects.” Pet., 21-22; *see also id.*, 2, 36-37, 40 (“Therefore, since Stowers 2008 discloses the same films as the

'564 patent, they necessarily satisfy this limitation”), 44 (“same films in all material respects”), 47 (“films of Stowers 2008 are the same as the ... films of the '564 patent”); *see also* EX2011, 178:5-18 (Dr. Holland confirming that for her analysis of claim 7 in EX1002, ¶135, “[t]his opinion is based on the films being the same between Stowers 2008 and the '564 patent.”); *id.*, 169:10-15 (same for claim 12). Neither reference expressly discloses the films are the same, and therefore Lam is relying on inherency. Lam’s theory depends exclusively on the fact the identity of the precursor chemicals is the same. Pet., 2 (“same components”), 21 (listing components), 36 (“same components”), 37 (“exact same components”), 44 (“same components”), 47 (“same components”). But making an assumption that the final films are identical based on the ingredients (without regard to their proportions, concentration, or subsequent processing conditions) is akin to assuming pizza is identical to spaghetti because they are both made from flour and tomato sauce, or that plastic is identical to jet fuel because they are both made from crude oil.

Here, there are significant differences in concentrations and processing conditions, nearly all of which Lam and its expert completely ignore.

	Stowers 2008	'564 Patent
Metal Concentration	0.5 M EX1008, 68	0.16 M (Zr) 0.15 M (Hf) EX1001, 21:59, 64

Rests	15 minute rests after each addition. EX1008, 68	5 minute rests after each addition. EX1001, 21:23-55
Pre-exposure bake	None disclosed	40-200° C for 0.1-5 minutes 50° C EX1001, 22:20-21, 23:36-37.
Post-exposure bake	300° C for 5 minutes EX1008, 68-69	40-200° C for 1-5 minutes 75° C EX1001, 22:43, 23:38
Spin coating conditions	3000 rpm for 30 seconds, EX1008, 68	100 RPM for 5 seconds and then 3000 RPM for 30-60 seconds EX1001, 22:17-20
Substrate	silicon wafer chips or silicon coupons EX1008, 68	Five inch silicon wafers EX1001, 22:7
Metal to peroxide ratio	1 to 0.75 EX1008, 68	1 to 0.66-0.88 (Zr) 1 to 6.62-8.81 (Hf) EX1002, ¶¶38 (calculations based on EX1001, 21:10-67 (Example 1)); POPR, 29 n.4 (noting the error in the calculations); EX2011, 123:6-124:12 (Dr. Holland admitting the error). ⁹

⁹ For the hafnium to peroxide ratio, Lam and Dr. Holland presented a saturation theory based on non-prior art “subsequent publications by named inventor Keszler.” Pet., 8 (citing EX1016, 5; EX1019, 5); EX1002, ¶¶56-58; *see* EX1016 (including a 2014 date); EX1019 (including a 2018 date). But Dr. Holland explained her understanding of these disclosures as teaching that, although the hafnium ions are saturated by peroxide at a ratio of 2 to 1, the excess peroxide “hangs around” in the

It is clear that these differing conditions led to different properties of the films, as demonstrated by differences in the film thickness. The '564 patent describes the films in the examples as varying between “10-50 nm,” with a specific example at 20 nm, EX1001, 22:37-38, 23:35-36, whereas Stowers 2008 disclosed “films 30 to 35-nm thick,” EX1008, 68. Lam has provided no basis to assume that these differences in concentration and processing, which had an impact on one property (thickness), would necessarily have no effect on other properties of the film—such as the film’s response to radiation exposure. *See* EX2009, ¶¶30-39 (Dr. Banerjee explaining how differences in the coating material concentrations and processing could affect the characteristics of the film).

solution. EX2011, 137:22-139:9. Later, Dr. Holland confirmed that the excess peroxide that does not bond with the hafnium that hangs around in the solution would “persist[] in the film.” EX2011, 163:8-166:17 (interpreting “it persists in the film” in EX1016, 5 to be the peroxide, not the ratio). As such, according to Dr. Holland, even if the hafnium ions are saturated in solution, the ratio of metal to peroxide *in the film* can exceed that ratio because the excess peroxide that “hangs around” persists in the film. As such, per Dr. Holland’s explanations, the *films* are different.

Because Lam has not proven the films in Stowers 2008 are inherently the same as the '564 patent's films, Lam has not proven Stowers 2008 meets the claim limitations reciting certain radiation exposure responses. This includes Lam's reliance on inherency for claim 1's limitations of "radiation sensitive ligands" and that "radiation alters the chemical properties of the coating material." EX1001, 24:7-16; Pet., 34-41.¹⁰ For anticipation over Stowers 2008 for claim 7, Lam relies exclusively on this inherency theory. Pet., 43-44. For obviousness over Stowers 2008 for claim 7, Lam still relies on this inherency theory, but adds an alternative argument based on mass density, discussed below. Pet., 52-54. For claim 12, Lam again relies exclusively on this inherency theory for its anticipation ground for Stowers 2008. Pet., 47-48. And for its obviousness ground over Stowers 2008, Lam repeats this inherency theory, but also adds a "correspond[ing]" dose theory, discussed below. Pet., 54-56.

For clarity, if the Board agrees that Lam failed to prove that the Stowers 2008 films are inherently the same as the films in the '564 patent, it can reject Lam's

¹⁰ Although Lam also includes obviousness arguments for claim 1 based on Stowers 2008 in Ground 2, the portion of that obviousness ground addressing claim 1 adds no new rationales for these radiation limitations. See Pet., 48-51 (only addressing thickness).

anticipation grounds for claims 7 and 12 based on Stowers 2008. For claim 1 and Lam's obviousness arguments for claims 7 and 12, the Board must also address Lam's alternative grounds, described below.

B. Lam's Alternative Rationales to Inherency Also Fail

1. Claim 1 – Radiation Sensitive Ligands

For claim 1's limitation requiring that the "coating material comprises ... radiation sensitive ligands," apart from Lam's inherency theory described above, Lam also presents a flawed "extinction coefficient" theory. Pet., 35-36. Lam's theory—repeated by Dr. Holland, EX1002, ¶100—hinges on a statement in Stowers 2008 that "[i]t is expected that these extinction coefficients will be different with the presence of peroxide in the as-deposited material." EX1008, 69. Dr. Holland explains that an "extinction coefficient is a property that determines how strongly a material absorbs radiation at a particular wavelength." EX1002, ¶100.

Even accepting this description of extinction coefficient, it does not logically follow that if a mixture (e.g., HafSO_x plus peroxide) is "expected" to have a different extinction coefficient than the original material (e.g., HafSO_x), that the added material (peroxide) is a "radiation sensitive ligand." EX2009, ¶¶44-46. Indeed, when asked to explain "why is it necessarily the case that if you expect the extinction coefficient to change with the addition of peroxide, why that means, necessarily, peroxide is radiation sensitive as a ligand," Dr. Holland's response was "I don't

know. I just have what I've got written here.” EX2011, 148:8-17. Different materials have different properties, including how strongly the material absorbs radiation. EX2009, ¶45. For instance, water, which absorbs radiation at a different strength than a metal, does not become a “radiation sensitive ligand” even if it is added to a metal and the extinction coefficient of water + metal is “expected” to be different than the extinction coefficient of metal alone. *Id.*

Lam presents no other arguments that Stowers 2008 discloses or renders obvious the radiation sensitive ligand, which is a limitation present in every claim through dependency. Thus, if the Board agrees that Lam has failed to prove its “same films” inherency theory and its “extinction coefficient” theory, the Board should reject all of Lam's arguments based on Stowers 2008.

2. Claim 1 – Exposure ... Alters the Chemical Properties of the Coating Material Creating ... Differential Dissolution Rates

For the limitation in claim 1 requiring that the radiation exposure causes a chemical property change in the coating material affecting dissolution rates, Lam's alternative theory for this limitation is yet another unproven inherency argument. For this limitation, Lam points to Stowers 2008's statement that “ZircSO_x could be patterned by UV light in either positive or negative tone” and a general description that “[u]nder 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.” EX1008, 68, 70-72. From there, Lam makes the unsupported leap that “[i]n other words, Stowers 2008 discloses that exposure of a ZircSOx 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.” Pet., 40-41 (emphasis added); *see also* EX1002, ¶108 (repeating this same conclusion without citation or support); *but see* EX2009, ¶¶40-43 (Dr. Banerjee explaining that UV or EUV patterning does not necessarily alter chemical properties).

But the context from which Lam plucks the second quotation is telling. After the first quote that “ZircSOx could be patterned,” Stowers 2008 continues by describing difficulties with “positive-tone patterning” and noting that the “dual tone of this resist system will still need to be further investigated, as it may prove enlightening to the exposure and development mechanisms.” EX1008, 70. In other words, Stowers 2008 was suggesting further investigation into “exposure and development mechanisms,” undermining Lam’s conclusion that exposure necessarily and inherently “altered the chemical properties” of the resist, as the claim requires.

Casting further doubt as to the understanding of the mechanism of action of exposure on Stowers 2008’s films, in the sentence immediately following the one quoted by Lam, Stowers 2008 notes that “[u]nderstanding this exposure mechanism

is critical to understanding how to optimize resist performance,” and then noting difficulties with understanding those exposure mechanisms in thin films. EX1008, 71 (noting the films “do not have sufficient volume per unit area to generate a signal large enough to be measured under most analyses”). All of this shows that Lam and Dr. Holland’s assumption that radiation exposure necessarily “altered the chemical properties of the film” is without basis.

Lam’s subsequent reliance on HafSOx disclosures in Stowers 2008 is even more attenuated and based on shakier evidence. Pet., 41. At the outset, Stowers qualified his results regarding HafSOx in this chapter with a statement that his “research did not generate significant results because of processing errors,” leading to only a “single sample set” that was usable. EX1008, 72-73 (describing this sample as exhibiting “very poor resist performance,” “low contrast” with “poor edge definition of the lines,” and “unoptimized results”). Lam then points to that single sample as showing “HafSOx films could be patterned by EUV,” and Lam then leaps to the conclusion that patterning “indicates that exposure to EUV altered the chemical properties of the film.” Pet., 41. But that is the same unexplained leap that it made with the ZircSOx disclosures above—that patterning necessarily means “altered the chemical properties” as the claim requires. Because Lam has not proven patterning necessarily results in “altered ... chemical properties,” its proof of unpatentability over Stowers 2008 is deficient.

As with the radiation sensitive ligands limitation, if the Board agrees that Lam has failed to prove its “same films” inherency theory and has failed to prove patterning necessarily results in “altered ... chemical properties,” the Board should reject all of Lam’s challenges based on Stowers 2008.

3. Claim 7 – High Absorption of EUV Radiation Relative to Conventional Radiation Based Resists

The Board can reject Lam’s argument that Stowers 2008 anticipates claim 7 if it rejects Lam’s unproven theory that the Stowers 2008 films are the same as the ’564 patent films. Pet., 43-44 (relying only on theory that the films “are the same”). For Lam’s obviousness ground, it adds another inherency theory. Stowers 2008 does not expressly disclose that the HafSOx and ZircSOx films it was creating and testing “ha[d] high absorption of EUV radiation relative to conventional radiation-based resists.” So, Lam must rely on the films inherently meeting this claim limitation.

Lam’s theory is that EUV absorbance for Stowers 2008 films is higher than conventional resists because the density of HafSOx and ZircSOx materials is higher than materials in conventional resists, such as PMMA. Pet., 52-54. But Lam has not proven that higher mass density of a material necessarily equates to higher EUV absorbance in a film, and as such, Lam’s inherency argument fails. EX2009, ¶¶48-50.

Lam's theory is based on a "linear trend" proposed between "calculated linear absorption coefficient" and "calculated density" in a journal article directed to polymer resists (i.e., not inorganic resists like HfSO_x and ZrSO_x). EX1025, 4. But a "trend" is insufficient to meet the strict requirements of inherency. EX2009, ¶¶49-50. Inherency cannot be met by probabilities or possibilities, it must be the necessary and inevitable result. *PAR Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1195 (Fed. Cir. 2014) ("Inherency, however, may not be established by probabilities or possibilities.") (quoting *In re Oelrich*, 666 F.2d at 581).

A simple example, based on Lam's own evidence, shows why it is not necessarily the case that a higher mass density of a material equates to higher calculated linear absorption coefficient (even to the extent that that term can be equated to the claimed "absorption of EUV radiation" by the film). Lam relies on Figure 3 of EX1025, pointing to the data point for PMMA. Pet., 53. Per Lam's inherency theory, data points having a higher mass density will necessarily have a higher calculated linear absorption coefficient. But that is not true. As shown below, several data points in this figure have higher density and *lower* calculated linear absorption coefficient than PMMA:

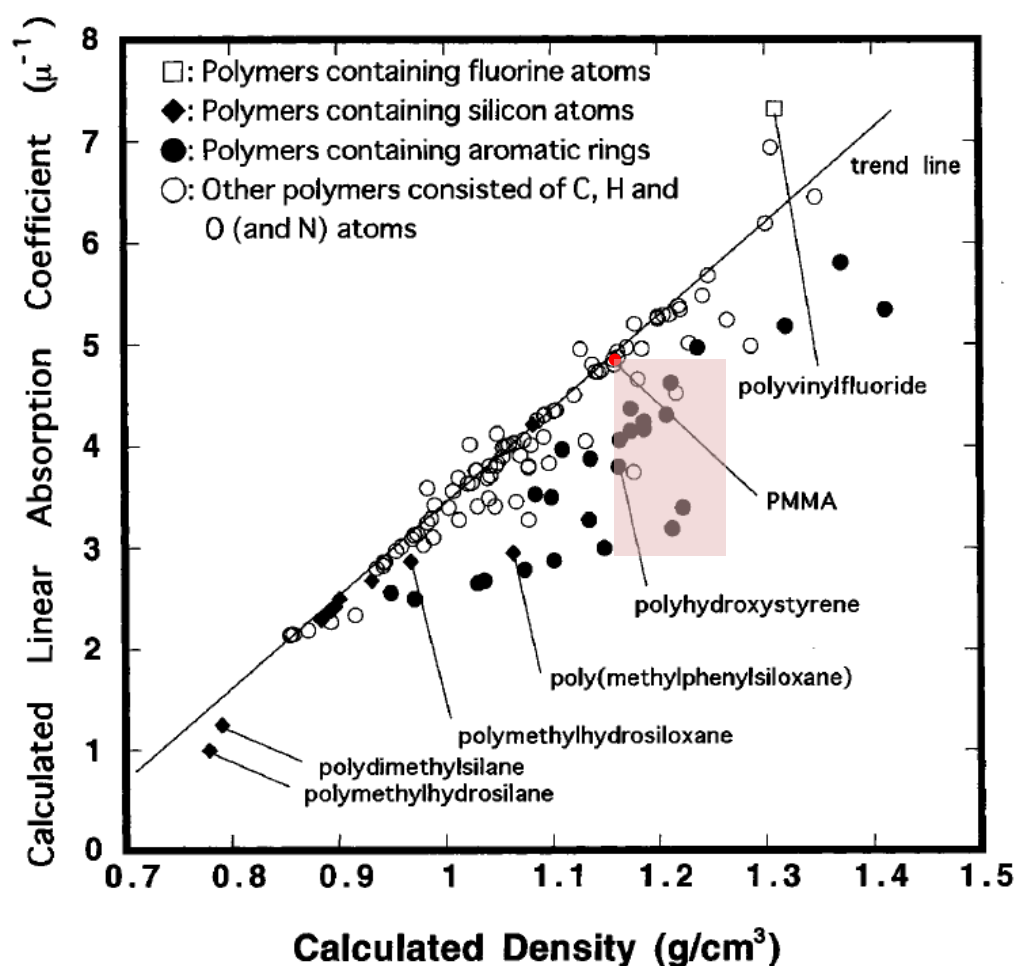


Figure 3. Calculated linear absorption coefficient versus calculated density.

EX1025, 4 (red annotation added to show PMMA datapoint, and pink annotation added to show data points with higher density and lower calculated linear absorption coefficient); EX2009, ¶50. Furthermore, Dr. Holland admitted that density alone is not dispositive because “there are certain elements that might be in these things that would cause them to have different responses.” EX2011, 181:18-182:22; *see also id.*, 183:10-20 (“unless there’s a particular atom involved in the polymer that is changing significantly the absorption”), 225:7-24 (noting absorption is also

“depending on other atoms” because “[t]here are specific atoms that are very absorptive”). For this reason alone, the Board can reject Lam’s argument that higher density of HafSO_x and ZircSO_x in Stowers 2008 inherently means “high absorption of EUV radiation relative to conventional radiation-based resists,” as claimed.

Lastly, Lam relies on an article from 2011 that includes Jason Stowers as a co-author. Pet., 53-54 (citing EX1022). The Board should reject Lam’s attempt to use the inventor’s own work, published after the priority date, against it in this obviousness challenge. Because EX1022 post-dates the priority date, it is irrelevant to what a POSA would have known or been motivated to do. In any event, Lam makes no attempt to link “the current generation of Inpria’s EUV resists,” EX1022, 3—i.e., the subject of that 2011 article—to the films described in Stowers 2008.

For all of these reasons, the Board should reject Lam’s argument that claim 7 is obvious over Stowers 2008.

4. Claim 12 – Effectively Patterned ... at a Dose of No More Than 100 mJ/cm²

For Lam’s obviousness ground for claim 12 based on Stowers 2008, it adds a theory attempting to correlate electron beam dose with EUV dose. Pet., 54-56. Lam’s theory, however, conflates ZircSO_x with HafSO_x and treats them as equal without any rationale for doing so.

For this ground for claim 12, even though Lam's petition had previously relied on Stowers 2008 Chapter 3, which relates to UV and EUV testing,¹¹ Lam curiously turns to Stowers 2008's Chapter 4 regarding electron beam testing, even though claim 12 regards UV/EUV. Pet., 54-56. Within Chapter 4, Lam relies on patterning of "ZircSOx films" with electron beam. Pet., 54-55 (citing EX1008, 89). Specifically, Lam points to a teaching that "16 nm wide isolated features can be patterned at a dose of 112 $\mu\text{C}/\text{cm}^2$." EX1008, 89; *see also* EX2011, 192:12-14 (Dr. Holland confirming that "Stowers is discussing ZircSOx, ... not HafSOx" in this example). This does not expressly disclose the recited "effectively patterned ... at a dose of no more than 100 mJ/cm^2 ." Lam, nevertheless, argues this teaching inherently meets the claim limitations based on a correlation between EUV and electron beam dosing described in a non-prior art 2011 article. Pet., 55 (citing EX1022, 7).

Lam overlooks, however, that this 2011 article is discussing a correlation for HafSOx, not ZircSOx. EX2009, ¶¶52-54. For instance, in the paragraph describing the dosing correlation on which Lam relies, EX1022 is describing "Improved

¹¹ *See, e.g.*, Pet., 33 n.10 (noting that for anticipation, Lam "is relying solely on Stowers 2008 Chapter 3, which focuses on the UV and EUV patterning of HafSOx and ZircSOx films").

Materials” and “New resist compositions and synthesis approaches [that] have resulted in an improved formulation.” EX1022, 7. As explained earlier in the article, “[f]or the current generation of Inpria’s EUV resists, *we have selected hafnium* as the metal because of its high EUV absorption cross section relative to many other metals.” *Id.*, 3 (emphasis added). Although the article also refers to the more general terms “metal oxide precursors” and “MSOx”—which stands for “metal oxide sulfate”—the article repeatedly refers to “hafnium,” never mentioning zirconium or ZircSOx. EX1022, 3, 9 (“Since the resist is wholly inorganic, with hafnium as a major constituent ...”), 10 (referring to “the relatively high concentration of hafnium”), 11 (“MSOx materials are chemically similar to inert hafnia”); *see also* EX2011, 190:11-15 (“Q: And to be clear, [EX1022] only recites hafnium; right? It doesn’t have zirconium? A. Correct.”), 199:25-203:12 (after walking through these same portions of EX1022, Dr. Holland conceding “[t]his article is referring to hafnium as the photoresist metal.”); EX2009, ¶54.¹²

¹² This focus on HafSOx for electron beam studies is further confirmed by the portion of the ’103 provisional on which Lam relies. Pet., 55-56 (quoting EX1005, 5 (referring only to HafSOx)).

Because Lam has provided no basis or explanation why a correlation between electron beam dose and EUV dose for HafSOx would automatically apply to ZircSOx,¹³ and because Lam relies on no teachings in Stowers 2008 of HafSOx patterning at particular electron beam doses, the Board should reject Lam's obviousness arguments for claim 12.

VIII. Lam's Anticipation and Obviousness Arguments Based on Trikeriotis Are Deficient

A. Lam's Mapping of the Claim Limitations to Trikeriotis is Facially Deficient

In Ground 5, Lam alleges that "Trikeriotis anticipates *and/or renders obvious* claims 1, 3, 6-7, 9, and 11-12," Pet., 58 (emphasis added), telegraphing the weakness of its anticipation position. Lam, however, completely fails to provide any analysis as to why the claims are obvious in view of Trikeriotis. Novelty under 35 U.S.C. § 102 and nonobviousness under 35 U.S.C. § 103 are separate conditions of patentability. *Cohesive Techs., Inc. v. Waters Corp.*, 543 F.3d 1351, 1363 (Fed. Cir.

¹³ Dr. Holland attempted to provide some explanation when confronted with the disparity between relying on ZircSOx electron beam doses and a HafSOx correlation, EX2011, 203:18-205:21, but none of that analysis appears in her declaration (let alone Lam's petition) and she provides no factual basis for those newly formed opinions. As such, they should be rejected. 37 C.F.R. § 42.65(a).

2008). The tests for anticipation and obviousness are different. *Id.* at 1364. The elements of proof for anticipation and obviousness are different. *Duro-Last, Inc. v. Custom Seal, Inc.*, 321 F.3d 1098, 1107–08 (Fed. Cir. 2003). Thus, “it does not follow that every technically anticipated invention would also have been obvious.” *Cohesive Techs.*, 543 F.3d at 1364; *see also Ericsson Inc. v. Intellectual Ventures*, IPR2014-01471, Paper 10 at 14 (Mar. 18, 2015) (“Although Petitioner may assert that all the elements ... are found in the prior art, we note that not every anticipated claim [would have been] obvious.”). Lam does not identify any differences between the claimed subject matter and Trikeriotis or provide any analysis as to why those differences would have been obvious. As such, Lam’s obviousness arguments for Trikeriotis should be rejected.

Even for anticipation, Lam’s explanations are deficient for at least two reasons:

First, Lam’s analysis for Ground 5 is conclusory in virtually all aspects and fails to meet the particularity requirement for an IPR petition. *See* 35 U.S.C. § 312(a)(3); *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (“In an IPR, the petitioner has the burden *from the onset* to show *with particularity* why the patent it challenges is unpatentable.” (emphases added) (citing 35 U.S.C. § 312(a)(3))); *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016) (requiring “the *initial petition* identify ‘*with particularity*’ the

‘evidence that supports the grounds for the challenge to each claim’” (emphases added)).

For example, claim 1 recites the term “coating material” in the preamble and in claim element 1(b). In its analysis for the preamble, Lam contends that “uniform thin films” are spin-coated. Pet., 58. While not expressly stated, it appears Lam is mapping the “uniform thin films” to the “coating material” recited in the preamble. But for claim element 1(b), Lam references “hafnium oxide nanoparticles” and “organic ligands” without any explanation as to how each relates to the “uniform thin films” that Lam appears to contend is the “coating material” in the preamble. *Id.* Even worse, for claim element 1(b), Lam does not explain what the “coating material” is and completely omits any explanation as to how the supposed “coating material” has “metal ions.” *Id.* Dr. Holland’s declaration suffers from the same deficiencies. See EX1002, ¶¶151-152.

Second, claim element 1(d) recites 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.” The totality of Lam’s analysis is three sentences with a fourth sentence repeating the claim language. Pet., 59-60. In the three sentences, Lam merely reproduces a statement from Trikeriotis that light exposure creates positive and negative images. *Id.* There

is no explanation whatsoever as to how the images establish that the light exposure alters chemical properties of the alleged coating material and that those alterations cause differential dissolution rates. And as Dr. Banerjee testifies, exposure to UV or EUV radiation, even for patterning, does not necessarily result the “radiation alters the chemical properties of the coating material creating an exposed material with differential dissolution rates,” as claimed. EX2009, ¶¶40-43. In fact, Dr. Holland admitted she was unable to find where in Trikeriotis “they said what was the mechanism of exposure.” EX2011, 117:18-118:11. In fact, she clarified that Trikeriotis “shows patterning, but does not explain what causes the resist to be photosensitive or what the chemistry is. It does not explain the chemistry of what happens with exposure.” *Id.*, 118:12-18.

B. Claim 1 – Metal Ions with Radiation Sensitive Ligands

Lam fails to show that Trikeriotis discloses “metal ions with radiation sensitive ligands” as required by claim 1. Lam’s arguments for this limitation are conclusory, and they are contradicted by other evidence introduced by Lam. Because this limitation is present in all challenged claims, through dependency, the Board can reject all of Lam’s arguments based on Trikeriotis on this basis alone.

For this limitation, Lam merely quotes statements in Trikeriotis regarding “hafnium oxide nanoparticles” and “organic ligands,” but it does not explain how this satisfies the claim limitation requiring “metal ions with radiation sensitive

ligands.” Pet., 58. For radiation sensitivity, Lam presents a similar theory as it did with Stowers 2008. Lam quotes Trikeriotis as disclosing “The absorption coefficient of the films depends on the ligand...” then including a parenthetical conclusion that “i.e., the ligands are radiation sensitive.” Pet., 58 (quoting EX1024, 18). This is the same unsupported leap that Lam makes regarding “extinction coefficient” above for Stowers 2008. *See supra* at Section VII.B.1. Again, even assuming that an added component in a film would affect the “absorption coefficient” of the film, it is not necessarily true, based on that fact alone, that the added material is a “radiation sensitive ligand.” EX2009, ¶¶44-47.

Not only is Lam’s argument facially deficient in connecting the prior art with the claim limitations, it is actually contradicted by other evidence Lam introduced with its Petition. In its discussion of claim 12, Lam points to a 2014 article (EX1027, “Ober”), which Lam argues “refer[s] to the films of Trikeriotis.” Pet., 62 (also noting the two authors of Ober, which overlap with the authorship of Trikeriotis). But that article—to the extent it is an accurate reflection of Trikeriotis, as Lam contends—actually disproves Lam’s arguments that Trikeriotis discloses “metal ions with radiation sensitive ligands.” EX2009, ¶¶55-59.

The only ligands that Lam points to for this limitation are “a variety of **organic ligands** [that] can be used to control the surface chemistry of the final product.” Pet., 58 (quoting EX1024, 18) (emphasis original); *see also* EX1024, 16-17 (referring to

“hafnium oxide nanoparticles stabilized with various carboxylic acids” and “surface ligands are replaced by other carboxylic acids via a direct ligand exchange reaction”). This corresponds with Dr. Holland’s understanding of the “ligands” as being “on the metal.” EX2011, 126:18-127:7. But, according to Ober, these organic ligands are not the “photoactive compounds” in Trikeriotis’s films.

As shown in Figure 1 below, Ober displays the “organic ligand shell” as being a coating attached to the zirconium or hafnium oxide core. EX2009, ¶58. Beneath the blown-up illustration of the nanoparticle in Figure 1 is the film, which shows a “photoactive compound” in blue that is separate and distinct from the organic ligands. *Id.*; EX1027, 2 (distinguishing between the “ligands” and the “photoactive compounds,” stating “[t]he ligands are added as reagents during the growth process and combined with photoactive compounds, such as photoacid or photoradical generators.”)

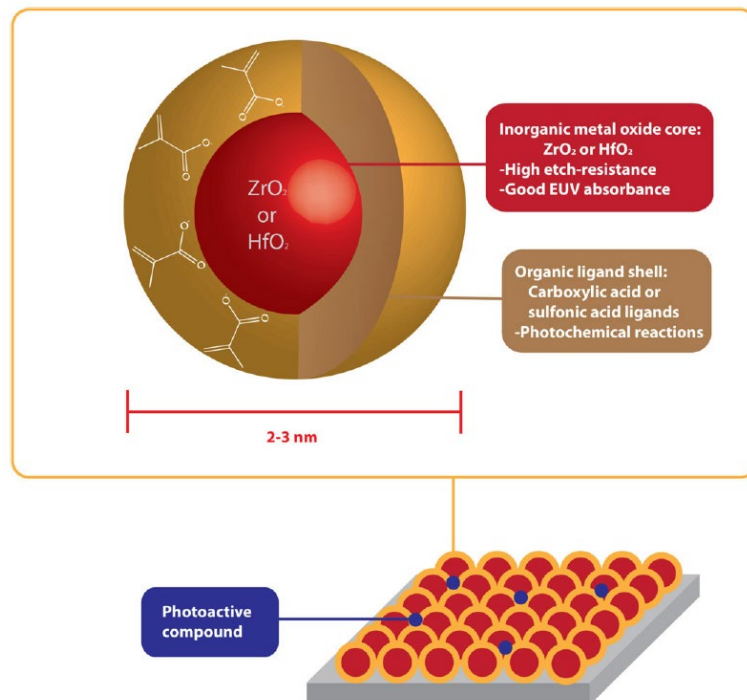


Figure 1. Schematic of the extreme-UV (EUV) nanoparticle photoresist with its core metal oxide and the organic ligand surrounding the core. ZrO_2 : Zirconium dioxide. HfO_2 : Hafnium oxide.

Ex. 1027, 1 (Fig. 1); EX2009, ¶57.

Ober further discloses that it is the “photoactive compound” that is the radiation sensitive part of the film, not the “organic ligands” that Lam pointed to in its Petition. *Id.* This is demonstrated in Figure 2 of Ober:

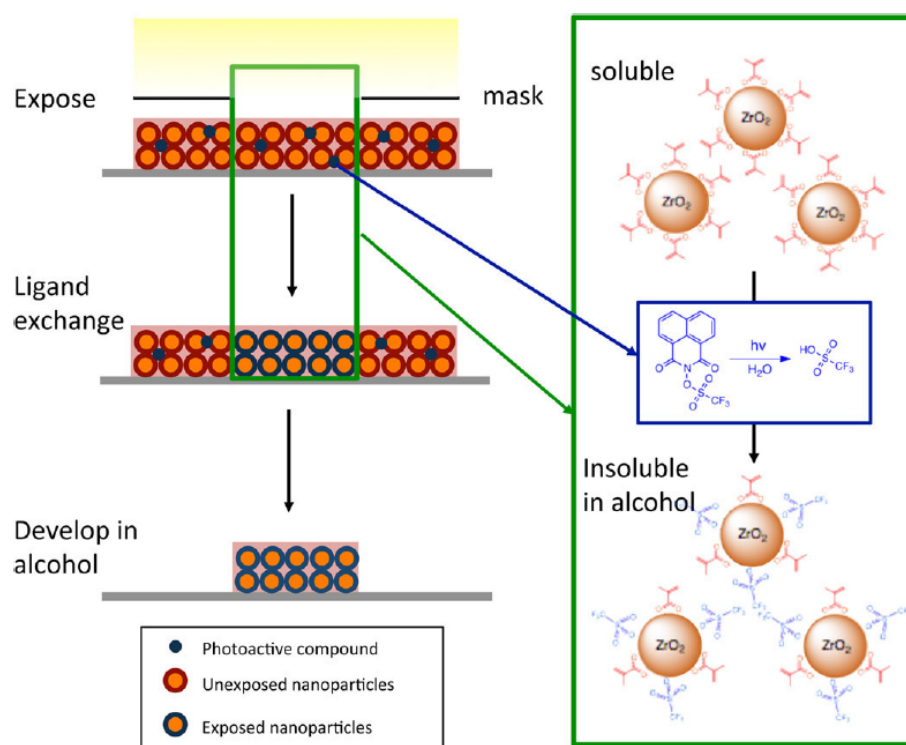


Figure 2. Schematic of the ligand-displacement patterning mechanism for negative-tone pattern formation. $h\nu$: Energy. H_2O : Water.

EX1027, 2 (Fig. 2).

Here, Ober shows the nanoparticles in orange, the organic ligands in red, and the photoactive compounds in blue interspersed amongst the nanoparticles. EX2009, ¶59. Figure 2 makes clear that it is the “photoactive compounds” that are reacting to the radiation (“ $h\nu$: Energy”), where Ober discloses that the resulting

photoacid or photoradicals act on the nanoparticles by “ligand-displacement.”¹⁴ *Id.*; EX1027, 2. Critically, this figure shows nothing happening to the organic ligands themselves based on exposure. Instead, after exposure of the photoactive compound to radiation, the photoacid or photoradicals resulting from the exposure displace some of the organic ligands. EX2009, ¶59. For these reasons, the evidence Lam produced actually shows that the “organic ligands” Lam points to for this limitation are *not* “radiation sensitive.” *Id.*

The Board can reject all of Lam's arguments based on Trikeriotis on this basis alone.

¹⁴ This confusion between the “photoactive compounds” and the organic ligands persisted during Dr. Holland's deposition. Dr. Holland was asked to confirm what in Trikeriotis she considered to be the “radiation sensitive ligand.” EX2011, 214:19-219:24. She pointed to DPAP, which Trikeriotis describes as a “photoinitiator” (EX1024, 20), even though, according to Dr. Holland, Trikeriotis “doesn't say it's a ligand.” *Id.*, 215:21-216:1, 216:17-23, 218:4-9; *see also* EX1027, 2 (describing “2,2-dimethoxy-2-phenylacetophenone” (DPAP) as “a photoradical generator”). When pressed to confirm this was her opinion as to what the “radiation sensitive ligand” was in Trikeriotis, she opined “[t]hat's the best I can do on here because he doesn't state it differently.” *Id.*, 218:18-23.

C. Claim 6 –Average Thickness of 5 nm to 25 nm

Trikeriotis does not disclose a film with a thickness in the range of average thicknesses in claim 6. The only disclosure that Lam identifies in Trikeriotis for this claim limitation is that the “film that was used” for one of the tests “was only 30 nm thick.” Pet., 60 (quoting EX1024, 21).

The only rationale Lam presents in trying to bridge the gap is “[i]t would have been within the routine skillset of a POSA to experiment with the spin rate and time to obtain the desired thickness.” *Id.* (citing EX1002, ¶157). This says nothing about a POSA’s motivation to make such a modification. And although Trikeriotis’s teachings on thickness are limited, it seems to indicate a POSA would have wanted to go *thicker*, rather than thinner.

For instance, Trikeriotis discloses that “[i]n general, film thicknesses ranging from 30 nm to 200 nm can be easily achieved.” EX1024, 18. In other words, Trikeriotis only points to film thicknesses *above* the thickness of the example Lam points to—even when speaking in “general” terms. Even the paragraph that discusses the “30 nm thick” example indicates Trikeriotis was aiming for thicker films, noting: “Currently, optimization of the photoresist formulation is underway to pattern 60 nm features *on thicker films*.” *Id.*, 21 (emphasis added).

For these reasons, the Board should reject Lam’s challenge to claim 6 based on Trikeriotis because Lam fails to explain a persuasive obviousness rationale and

Trikeriotis appears to only teach modification in the opposite direction as Lam suggests.

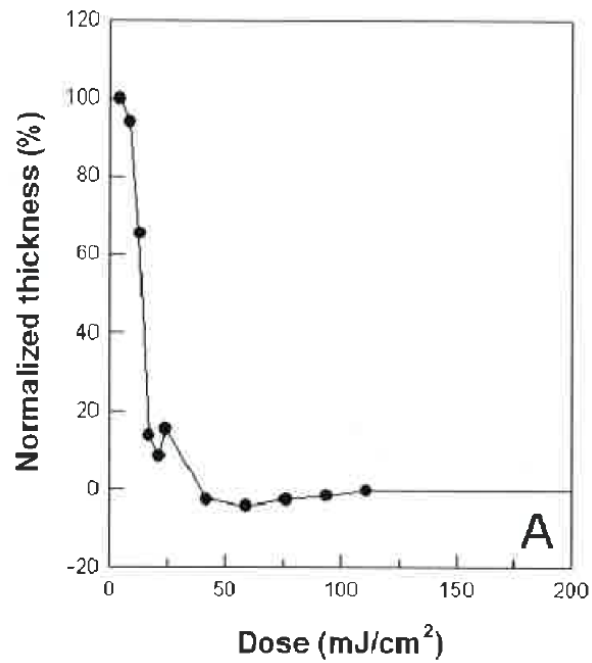
D. Claim 7 – High Absorption of EUV Radiation

For claim 7, Lam relies on the same inherency theory discussed above for *Stowers 2008*, that a higher mass density of a material necessarily means a film would have higher absorption of EUV radiation. Pet., 60-61. This inherency theory is faulty and should be rejected for the reasons described above. *See supra* at Section VII.B.3; EX2009, ¶¶48-51.

E. Claim 12 – Effectively Patterned with No More than 100 mJ/cm²

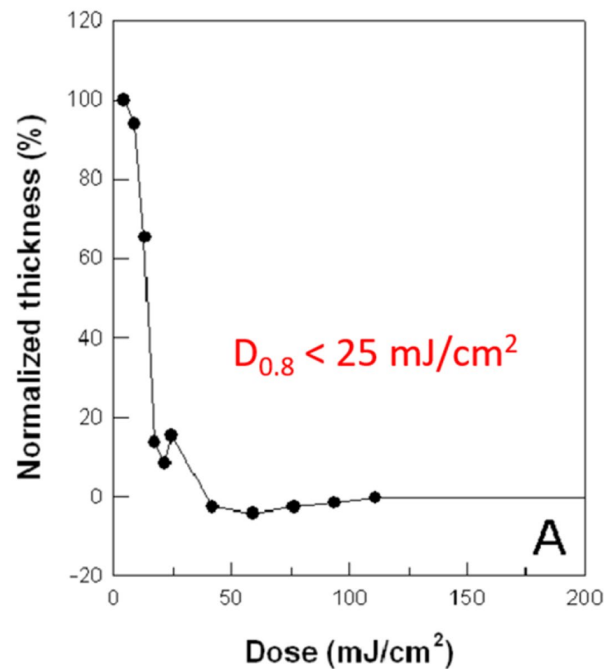
For claim 12, Lam argues the films in Trikeriotis meet the claim limitation based on a theory that relies on a “D_{0.8}”—a variable that is not disclosed in Trikeriotis and which Dr. Holland could not even explain what it meant. Pet., 61-62. Because this was the lynchpin of Lam’s argument that Trikeriotis meets this claim limitation, and because there is no evidentiary basis for Lam’s theory, the Board should reject Lam’s challenge to claim 12.

Lam argues that Figure 5A of Trikeriotis shows that its films “could be patterned in positive tone with a 254 nm UV radiation dose of less than 100 mJ/cm² as it shows a sensitivity D_{0.8} of less than 25 mJ/cm².” Pet., 61-62. Lam provides no explanation of what “sensitivity” is, why that is the same as D_{0.8}, or how Figure 5 of Trikeriotis (below) shows D_{0.8} of less than 25 mJ/cm²:



EX1024, 19 (Fig. 5).

Critically, Dr. Holland does not provide any such explanation either, instead only adding an annotated version of Figure 5 with $D_{0.8} < 25 \text{ mJ/cm}^2$ pasted onto the figure:



EX1002, ¶161.

When asked at deposition “what is D 0.8,” she could not explain. EX2011, 225:25-228:24. Because Dr. Holland failed to provide the underlying facts or data regarding $D_{0.8}$, how the value of $< 25 \text{ mJ/cm}^2$ was calculated here, or why this signifies effective patterning,¹⁵ the Board should give this portion of Dr. Holland’s testimony no weight. 37 C.F.R. § 42.65(a).

¹⁵ Dr. Holland testified that “effective patterning,” to her meant “produces a pattern that is effective to their needs.” EX2011, 130:18-25. She nowhere connected $D_{0.8}$ to “produc[ing] a pattern that is effective to [a user’s] needs.”

Making matters worse, Lam elicited redirect testimony on this very point, EX2011, 236:1-241:2, but Dr. Holland's redirect testimony only adds more confusion. There, Dr. Holland testified that $D_{0.8}$ is actually a typo and instead it should be $D_{0.9}$. *Id.*, 239:9-15, 240:23-241:1. The reason Dr. Holland expressed for this belief was based on a previous portion of Trikeriotis referring to the resolution of positive tone imaging at 0.9 micrometers. *Id.*, 237:6-15, 239:19-241:1. But this makes Lam's unpatentability theory even more murky, as now it is unclear whether Dr. Holland was meaning to write $D_{0.8}$ or $D_{0.9}$, what that term even means, whether it relates to resolution (which is expressed in μm , not mJ/cm^2) or sensitivity, or what "resolution" or "sensitivity" mean.

As such, Lam's argument as to how Trikeriotis meets the limitations of this claim is entirely without evidentiary basis or explanation. The Board should reject Lam's challenge to claim 12 based on Trikeriotis.¹⁶

¹⁶ Lam also relies on a non-prior art 2014 article, EX1027, as disclosing 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 ($<5\text{mJ}/\text{cm}^2$).” Pet., 62 (quoting EX1027, 1-2). But, as with $D_{0.8}$, Lam does not explain what "sensitivity" means or why that is an effective patterning dose.

IX. Conclusion

For at least the above reasons, Inpria respectfully requests that the Board find that Lam has not carried its burden with respect to unpatentability and that the challenged claims should be confirmed.

Respectfully submitted,

Dated: July 31, 2024

By: /Daniel Zeilberger/
Daniel Zeilberger (Reg. No. 65,349)
Counsel for Patent Owner

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Patent Owner's Response contains, as measured by the word-processing system used to prepare this paper, 12,340 words. This word count does not include the items excluded by 37 C.F.R. § 42.24.

Respectfully submitted,

Dated: July 31, 2024

By: /Daniel Zeilberger/
Daniel Zeilberger (Reg. No. 65,349)
Counsel for Patent Owner

CERTIFICATE OF SERVICE

I hereby certify that on July 31, 2024, I caused a true and correct copy of the foregoing Patent Owner's Response and accompanying exhibits to be served via email on Petitioner at the following addresses:

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