

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LAM RESEARCH CORP.,

Petitioner,

v.

INPRIA CORP.,

Patent Owner.

Case No. IPR2025-00256

Patent No. 11,537,048

**EXPERT DECLARATION OF SEÁN BARRY, PH.D. IN SUPPORT OF
PETITION FOR *INTER PARTES* REVIEW**

TABLE OF CONTENTS

PETITIONER’S EXHIBIT LIST	6
I. INTRODUCTION.....	8
II. QUALIFICATIONS AND BACKGROUND	8
A. Qualifications	8
B. Bases for Opinions and Materials Considered.....	10
C. Scope of Work.....	10
III. LEGAL PRINCIPLES	10
IV. PERSON OF ORDINARY SKILL IN THE ART (“POSA”).....	14
V. OVERVIEW OF THE ’048 PATENT.....	15
VI. CLAIM CONSTRUCTION.....	15
VII. ANALYSIS OF THE PRIORITY DATE OF THE CHALLENGED CLAIMS.....	20
VIII. THE PRIOR ART	26
IX. PETITION 1: IPR2025-00256 (LATER PRIORITY DATE).....	27
A. My Opinions on the Obviousness of Claims 1-20 in view of Meyer and Weidman.	28
(1) Claim 1	28
(2) Claim 2.....	40
(3) Claim 3.....	40
(4) Claim 4.....	41
(5) Claim 5.....	42
(6) Claim 6.....	42
(7) Claim 7.....	43
(8) Claim 8.....	43
(9) Claim 9.....	44
(10) Claim 10.....	44
(11) Claim 11	45
(12) Claim 12.....	46
(13) Claim 13.....	47

(14)	Claim 14.....	47
(15)	Claim 15.....	48
(16)	Claim 16.....	49
(17)	Claim 17.....	50
(18)	Claim 18.....	52
(19)	Claim 19.....	52
(20)	Claim 20.....	53
B.	My Opinions on the Anticipation and/or Obviousness of Claims 1-5 and 8-20 in view of Berney.....	53
(1)	Claim 1.....	53
(2)	Claim 2.....	71
(3)	Claim 3.....	72
(4)	Claim 4.....	72
(5)	Claim 5.....	73
(6)	Claim 8.....	73
(7)	Claim 9.....	74
(8)	Claim 10.....	74
(9)	Claim 11.....	76
(10)	Claim 12.....	77
(11)	Claim 13.....	79
(12)	Claim 14.....	80
(13)	Claim 15.....	82
(14)	Claim 16.....	85
(15)	Claim 17.....	89
(16)	Claim 18.....	93
(17)	Claim 19.....	94
(18)	Claim 20.....	94
C.	Ground 3: Claims 6 and 7 Are Obvious Over Berney in view of Molloy	95

	(1) Claim 6.....	95
	(2) Claim 7.....	97
X.	PETITION 2: IPR2024-00309 (EARLIER PRIORITY DATE)... ERROR! BOOKMARK NOT DEFINED.	
A.	Ground 1: Claims 1-6 And 8-20 Are Obvious Over Dhas and Cardineau..... Error! Bookmark not defined.	
	(2) Claim 1	Error! Bookmark not defined.
	(3) Claim 2	Error! Bookmark not defined.
	(4) Claim 3	Error! Bookmark not defined.
	(5) Claim 4.....	Error! Bookmark not defined.
	(6) Claim 5	Error! Bookmark not defined.
	(7) Claim 6.....	Error! Bookmark not defined.
	(8) Claim 8.....	Error! Bookmark not defined.
	(9) Claim 9.....	Error! Bookmark not defined.
	(10) Claim 10.....	Error! Bookmark not defined.
	(11) Claim 11	Error! Bookmark not defined.
	(12) Claim 12.....	Error! Bookmark not defined.
	(13) Claim 13	Error! Bookmark not defined.
	(14) Claim 14.....	Error! Bookmark not defined.
	(15) Claim 15.....	Error! Bookmark not defined.
	(16) Claim 16.....	Error! Bookmark not defined.
	(17) Claim 17	Error! Bookmark not defined.
	(18) Claim 18.....	Error! Bookmark not defined.
	(19) Claim 19.....	Error! Bookmark not defined.
	(20) Claim 20.....	Error! Bookmark not defined.
B.	Ground 2: Claim 7 is Obvious Over Dhas, Cardineau, and Molloy Error! Bookmark not defined.	
	(1) Claim 7.....	Error! Bookmark not defined.

- C. Ground 3: Claims 1-5 And 8-20 Are Obvious Over Weidman and Cardineau.....**Error! Bookmark not defined.**
- (1) Claim 1**Error! Bookmark not defined.**
- (2) Claim 2.....**Error! Bookmark not defined.**
- (3) Claim 3**Error! Bookmark not defined.**
- (4) Claim 4.....**Error! Bookmark not defined.**
- (5) Claim 5.....**Error! Bookmark not defined.**
- (6) Claim 8.....**Error! Bookmark not defined.**
- (7) Claim 9.....**Error! Bookmark not defined.**
- (8) Claim 10.....**Error! Bookmark not defined.**
- (9) Claim 11**Error! Bookmark not defined.**
- (10) Claim 12.....**Error! Bookmark not defined.**
- (11) Claim 13**Error! Bookmark not defined.**
- (12) Claim 14.....**Error! Bookmark not defined.**
- (13) Claim 15**Error! Bookmark not defined.**
- (14) Claim 16.....**Error! Bookmark not defined.**
- (15) Claim 17.....**Error! Bookmark not defined.**
- (16) Claim 18.....**Error! Bookmark not defined.**
- (17) Claim 19.....**Error! Bookmark not defined.**
- (18) Claim 20.....**Error! Bookmark not defined.**
- D. Ground 4: Claims 6 and 7 Are Obvious in View of Weidman, Cardineau, and Molloy**Error! Bookmark not defined.**
- (1) Claim 6.....**Error! Bookmark not defined.**
- (2) Claim 7.....**Error! Bookmark not defined.**

XI. CONCLUSION**ERROR! BOOKMARK NOT DEFINED.**

PETITIONER'S EXHIBIT LIST

Exhibit	Description
1001	U.S. Patent No. 11,537,048 (“’048 Patent”)
1002	’048 Patent Prosecution History
1003	Expert Declaration of Seán Barry, Ph.D. (“Barry Declaration”)
1004	<i>Curriculum Vitae</i> of Seán Barry, Ph.D.
1005	U.S. Patent No. 8,536,068 (“Weidman”)
1006	U.S. Patent Application No. 2017/0102612 (“Meyers”)
1007	U.S. Patent No. 9,328,416 (“Dhas”)
1008	B. Cardineau, et al., <i>Photolithographic properties of tin-oxo clusters using extreme ultraviolet light (13.5 nm)</i> , Microelectronic Engineering 127 (2014) 44-50 (“Cardineau”)
1009	K. Molloy, <i>Precursors for the formation of tin(IV) oxide and related materials</i> , J. Chem. Research (Oct. 2008) 549-554 (“Molloy”)
1010	<i>Inpria Corp. v. Lam Research Corp.</i> , No. 1-22-cv-01359, Dkt. No. 199, Joint Claim Construction Brief (D. Del. Oct. 18, 2024)
1011	R. Del Re, <i>Molecular organometallic resists of tin and tellurium</i> , Legacy Theses & Dissertations (2009 - 2024), 1370 (Jan. 1, 2015)
1012	J. Son, et al., <i>Acid-Stable Peroxonioobophosphate Clusters To Make Patterned Films</i> , Chemistry - A European Journal, 21(18) (Apr. 27, 2015)
1013	J. Jiang, <i>Organic Inorganic Photoresist And Laser Induced Heating Process For Next Generation Lithography</i> (July 2015)
1014	R Del Re, et al., <i>Low-line edge roughness extreme ultraviolet photoresists of organotin carboxylates</i> , Journal of Micro/Nanolithography, MEMS, and MOEMS, Vol. 14, Issue 4, 043506 (Nov. 9, 2015),

1015	R. Del Re, et al., <i>Low-LER Tin Carboxylate Photoresists using EUV</i> , Extreme Ultraviolet (EUV) Lithography VI (2015).
1016	Maeng et al., <i>Atomic Layer Deposition of Ta-Based Thin Films: Reactions of Alkylamide Precursor with Various Reactants</i> , J. Vacuum Sci. & Technol. B 24:2276 (2006)
1017	November 2024 email chain between Alison Patitucci and Elsevier
1018	Summons for <i>Inpria Corp. v. Lam Research Corp.</i> , 1-22-cv-01359
1019	Declaration of Alison Patitucci
1020	PCT published Application WO 2020263750 (“Berney”)
1021	<i>Inpria Corp. v. Lam Research Corp.</i> , No. 1-22-cv-01359, Dkt. No. 59, Scheduling Order (D. Del. Jan. 1, 2024)

I. INTRODUCTION

1. My name is Seán Barry, and I have been retained by counsel for Petitioner Lam Research Corporation (“Petitioner”) to provide opinions regarding the validity of claims 1-20 (“Challenged Claims”) of U.S. Patent No. 11,537,048 (EX1001, “the ’048 patent”), which I understand is assigned to Inpria Corporation (“Inpria”). I further understand that Petitioner is petitioning for *inter partes* review of the ’048 patent and is requesting cancellation of claims 1-20. My opinions in this expert declaration support Petitioner’s request for *inter partes* review of the ’048 patent and the cancellation of claims 1-20.

II. QUALIFICATIONS AND BACKGROUND

A. Qualifications

2. I have been involved in the fields of atomic layer deposition (ALD), chemical vapor deposition (CVD), materials chemistry, thermal characterization, and surface chemistry (including deposition, etch, and chemical masking) for over 25 years. My education, research, and experience in this field is detailed in my curriculum vitae, attached as EX1004 to the to the Petition.

3. I am currently chair of the chemistry department at Carleton University, where I have been a professor since 2007. Previously, I was a lecturer at the University of Ottawa and an assistant professor at Carleton University in Chemistry. I have also been a visiting researcher at Harvard University in Chemistry and Chemical Biology, and a visiting professor of Inorganic Chemistry

at the University of Helsinki.

4. At Carleton University, I regularly teach two courses in surface chemistry and nanostructures, and give seven lectures of the surface chemistry of atomic layer deposition/atomic layer epitaxy/area selective deposition and photolithography. I also teach several lectures on precursor and surface chemistry for the non-profit organization ALD Academy.

5. I am the director of the Facility for Nanoscience, Surfaces, and Sensor Interfaces (FANSSI), which was commissioned in 2015 by a Canadian infrastructure grant to study surface chemistry and atomic layer deposition.

6. I am on the advisory board for the American Chemical Society (ACS) journal Chemistry of Materials. I have also served as a chair for numerous meetings of professional societies, including the American Vacuum Society's 2023 Atomic Layer Deposition meeting in Bellevue, Washington, and the Area Selective Deposition 2024 meeting in Montréal, Canada.

7. I am an inventor on over six U.S. patent applications relating to chemical vapor deposition and an author on over 110 peer-reviewed publications.

8. My academic research focuses on developing precursors for thin film deposition and surface masking for growth inhibition, as well as surface mechanistic chemistry and gas-phase reactivity. I have deep expertise in "main group" chemistry as well as in "transition metal" chemistry. I am also the recipient

of five research grants funding studies related to chemical vapor deposition, including deposition of metal-based precursors.

9. I obtained my Ph.D. in Inorganic Chemistry from University of Ottawa and my B.Sc. in Chemistry with Honors from Queen's University. I was also a post-doctoral fellow at Cornell University (Ithaca, New York, USA), Department of Material Science and Engineering (1997-1998) and Harvard University (Cambridge, Massachusetts, USA), Department of Chemistry and Chemical Biology (1998-2000 and 2002-2003).

B. Bases for Opinions and Materials Considered

10. In addition to my education, knowledge of the relevant published art, training, and experience, in forming the opinions I provide in this declaration, I have also considered the exhibits in the exhibit list at the front of this declaration.

C. Scope of Work

11. I have been retained by Petitioner as an expert in this matter to provide my various opinions regarding the '048 patent. I receive compensation for my services. No part of my compensation is dependent upon my opinions given or the outcome of this case. I do not have any current or past affiliation with Petitioner, or the named inventors on the '048 patent, or Inpria.

III. LEGAL PRINCIPLES

12. For my opinions in this declaration, I understand that it requires

applying various legal principles. As I am not an attorney, I have been informed about various legal principles that govern my analysis. I have used my understanding of those principles in forming my opinions. I summarize my understanding of those legal principles as follows:

13. **Burden of Proof.** I understand that Petitioner bears the burden of proving unpatentability in this proceeding by a preponderance of the evidence. I am informed that this preponderance of the evidence standard means that Petitioner must show that unpatentability is more probable than not.

14. **Claim Construction.** I have also been told that when I review and consider the claims in the challenged patent that the claim term(s) should be given their ordinary and customary meaning as understood from the perspective of one of ordinary skill in the art at the time of the invention, taking into account the claim language itself, specification, and prosecution history pertaining to the patent, as well as relevant extrinsic evidence. I have applied this standard in formulating my opinions.

15. **Anticipation.** I have been asked to consider the question of anticipation, namely, whether the claims cover something that is new, or novel. I am told that the concept of anticipation requires that each and every element of a challenged claim is present in or otherwise taught by a single reference. I also understand that an anticipatory reference does not need to explicitly describe each

element because anticipation can occur when a claimed limitation is necessarily present, inherent or otherwise implicit in the relevant reference.

16. **Obviousness.** I have been asked to consider the question of obviousness. Again, I am told that this analysis must be from the perspective of the person of ordinary skill in the art, and whether such person would consider any differences between the prior art and what is claimed to have been obvious. To make this assessment, I have been informed that the concept of patent obviousness involves four factual inquiries: the scope and content of the prior art; the differences between the claimed invention and the prior art; the level of ordinary skill in the art; and so-called secondary considerations of non-obviousness.

17. I have further been instructed that one must consider what the person of ordinary skill in the art knew, and what the art taught; suggested; or motivated the person of ordinary skill in the art to further pursue; and to differentiate between steps that were routinely done (such as in response to known problems, steps, or obstacles), and those which, for example, may have represented a different way of solving existing or known problems. Further I have been informed that one cannot use the challenged patent (here, the '564 patent) as a guide from which to select prior art elements, or otherwise engage in hindsight.

18. I am also informed that when there is some recognized reason to solve a problem, and there are a finite number of identified, predictable, and known

solutions, a person of ordinary skill in the art has good reason to pursue the known options within his or her technical grasp. If such an approach leads to the expected success, it is likely not the product of innovation but of ordinary skill and common sense. In addition, when a patent simply arranges old elements, with each performing its known function, and yields no more than what one would expect from such an arrangement, the combination is obvious. A suitable POSA would have at least a graduate degree, e.g., M.Sc. or Ph.D., in a relevant discipline such as chemistry, materials science, chemical engineering, physics, or an equivalent field, and 2-3 years of experience in the research, design, development, and/or testing of resist materials.

19. I understand that before reaching any final conclusion on obviousness, the obviousness analysis requires consideration of objective indicia of nonobviousness, if offered. These must be considered to ensure that, for example, there were not some unanticipated problems, obstacles, or hurdles that may seem easy to overcome in hindsight, but which were not readily overcome prior to the relevant invention date of the patents/claims at issue here. I understand that these objective indicia are also known as “secondary considerations of non-obviousness,” and may include long-felt but unmet need and unexpected results, among others. I also understand, however, that any offered evidence of secondary considerations of non-obviousness must be comparable with the scope of the

challenged claims. This means that for any offered evidence of secondary considerations of non-obviousness to be given substantial weight, I understand the proponent of that evidence must establish a “nexus” or a sufficient connection or tie between that evidence and the merits of the claimed invention, which I understand specifically incorporates any novel element(s) of the claimed invention. If the secondary considerations evidence offered actually results from something other than the merits of the claim, then I understand that there is no nexus or tie to the claimed invention. I also understand it is the patentee that has the burden of proving that a nexus exists.

20. However, I understand that secondary considerations will not overcome a strong showing of obviousness.

IV. PERSON OF ORDINARY SKILL IN THE ART (“POSA”)

21. As I mentioned above, I have been informed by counsel that my analysis is to be conducted from the perspective of a person of ordinary skill in the art at the time of the invention. I also understand that the person of ordinary skill in the art is assumed to know, understand, and be familiar with all of the relevant prior art, and that such person is a person of ordinary creativity.

22. I have also been informed by counsel that in defining a person of ordinary skill in the art, the following factors may be considered: (1) the educational level of the inventor; (2) the type of problems encountered in the art;

(3) prior art solutions to those problems; (4) rapidity with which innovations are made; and (5) sophistication of the technology and educational level of active workers in the field.

23. After considering the above-mentioned factors, it is my opinion that a POSA would have been an individual with at least a graduate degree, such as a M.Sc. or Ph.D., in a relevant discipline such as in chemistry, materials science, chemical engineering, physics, or an equivalent field. A POSA would also have 1-3 years of experience in the research, design, development and/or testing of resist materials. I am clearly a POSA and have applied this standard throughout my declaration.

V. OVERVIEW OF THE '048 PATENT

24. I have reviewed the '048 Patent and understand that the patent names as inventors Stephen T. Meyers, et al. ("'048 patent," EX1001) to Inpria Corporation ("Inpria").

VI. CLAIM CONSTRUCTION

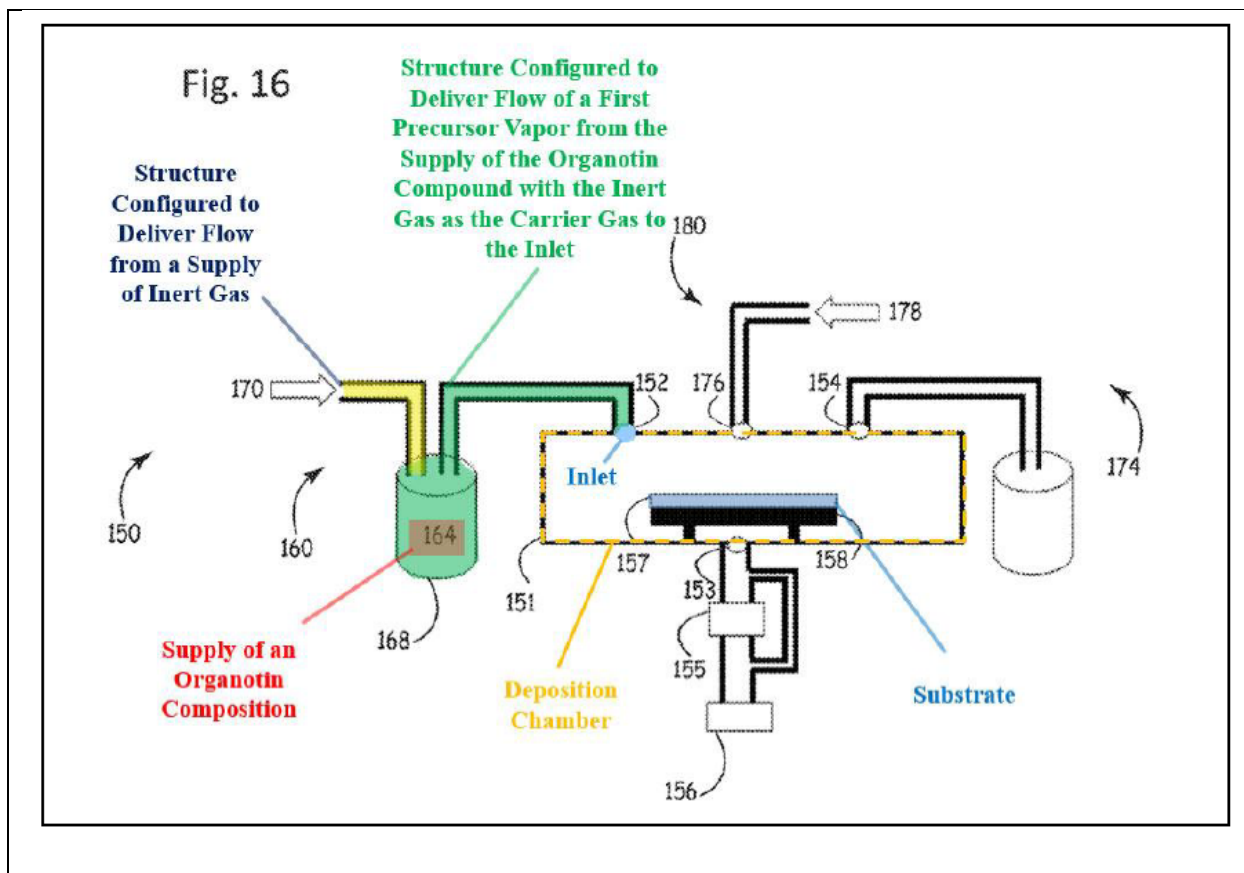
25. I understand that claim construction is the process of determining the meaning of a term or phrase in a patent claim. I understand that the proper construction of a term is how a POSA would have understood the term based on its use in the claims, specification, the file history of the patent. I further understand that the claims are construed before the Board using the same claim construction

standard that applies in the district courts. I have followed these principles in my analysis throughout this declaration. For the purposes of this declaration, I do not believe that any express constructions are needed and have applied the plain and ordinary meaning of all terms to a POSA. I have been informed that certain terms must be construed as MPF terms. The following MPF constructions apply solely to the '048 Patent petitions, without conceding whether they satisfy the requirements of 35 U.S.C. § 112, and I am not offering an opinion on indefiniteness in this declaration. I understand that claims 1, 4, and 12 have been alleged to include “structure” terms that should be construed as MPF. However, even if Inpria argues these terms are not construed as MPF, it is my opinion that the limitations are still taught by the prior art, i.e., the claims are unpatentable regardless of interpretation. I have been informed that the rebuttable presumption that § 112(6) does not apply to terms lacking the word “means” is overcome because the claims fail to recite sufficiently definite structure for the “structure” or “configuration” terms. In my opinion, from the perspective of a POSA, the terms “structure” and “configuration” imply a generic “black box” for performing the specified functions.

26. I have been informed the *structure configured to deliver flow from a supply of inert gas* of Claim 1 could be in something referred to as means-plus-function format, which I have also been informed could mean that this term would

be limited to the corresponding structure in the specification and equivalents of that structure. In my opinion, in the context of the '048 Patent, the claim language of a structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet perform various operations that would be understood by a POSA to be a “**conduit** extending from the vessel 168 to the inlet 152” and equivalents thereof.¹ EX1010, 40. The corresponding structure is, as shown in Figure 16, a conduit 174 to deliver a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof”, e.g., to inlet 154 of deposition chamber 151, and equivalents thereof. See EX1001 at 19:23-25, Fig. 16. If Figure 16 was new matter, then the structure without regard to Figure 16 but based on Inpria’s arguments in the parallel proceedings is a conduit (like a pipe) for delivering a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof” and equivalents thereof. See EX1010 at 30, 39. Either way, it is my opinion that the term means a conduit for performing the claimed functions and equivalents thereof.

¹ Emphasis added throughout unless otherwise noted.



27. I have been informed the *structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet* of Claim 1 could be in something referred to as means-plus-function format, which I have also been informed could mean that this term would be limited to the corresponding structure in the specification and equivalents of that structure.

28. I have been informed the *configuration providing for selection of the pressure and/or the temperature in the deposition chamber* terms of claim 10 could be in something referred to as means-plus-function format, which I have also been

informed could mean that this term would be limited to the corresponding structure in the specification and equivalents of that structure. In my opinion, in the context of the '048 Patent, the claim language of the *configuration providing for selection of the pressure and/or the temperature in the deposition chamber* would be best understood as a first and second vessel and/or a controller for selecting the pressure and/or the temperature in the deposition chamber, and equivalents thereof. See EX1001 at 20:1-10 (“A first vessel contains a liquid alkyl tris(dialkylamido)tin compound of sufficient vapor pressure to produce suitable partial pressures for transport in the inert carrier gas. A second vessel contains liquid water or a water/alcohol mix. By **controlling** vessel temperatures, inert gas flow rate, and total system pressure, vapor-phase $\text{RSn}(\text{NR}'_2)_3$ and H_2O are transported independently to a chamber evacuated to <0.1 Torr, more generally from about 0.01 Torr to about 25 Torr, and in some atmospheric pressure CVD pressures >25 Torr.”).

29. I have been informed the *one or more vapor inputting structures / first vapor inputting structure / second vapor inputting structure* terms of claims 12 to 17 could be in something referred to as means-plus-function format, which I have also been informed could mean that this term would be limited to the corresponding structure in the specification and equivalents of that structure. In my opinion, in the context of the '048 Patent, the claim language of the *one or*

more vapor inputting structures / first vapor inputting structure / second vapor inputting structure would be best understood as per Figure 16, as inlet 154 or inlet 176 connecting a deposition chamber 151 to a source of vapor and equivalents thereof. EX1001, 19:23-27.

VII. ANALYSIS OF THE PRIORITY DATE OF THE CHALLENGED CLAIMS

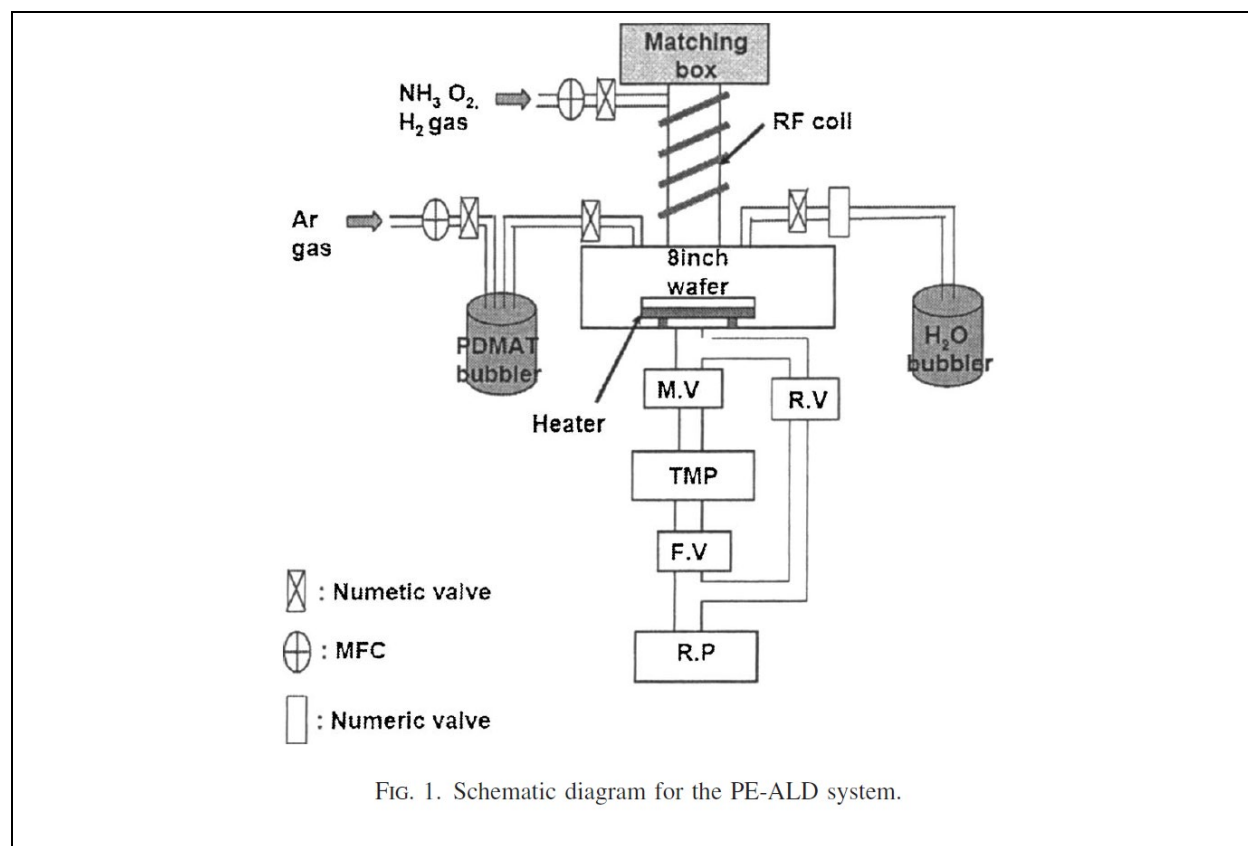
30. It is my understanding that a patent must have a so-called written description of the claimed invention(s), and that the test for sufficiency of a written description is whether the disclosure of the application relied upon reasonably conveys to those skilled in the art at the time that the inventor had possession of the claimed subject matter as of the filing date. It is my understanding that the specification must provide written description support for each and every limitation of the claims; in other words, if some limitations of a claim are supported by the specification but one or more are not, then the claim lacks written description support. The full scope of the claim, read as a whole, must find written description support in the specification. I have been informed that during prosecution, Inpria improperly inserted into the specification a modified version of an apparatus figure from the Maeng reference (as Figure 16 of the '048 patent), and argued that the Maeng reference supplied the structure that they previously argued it lacked. It is my understanding that the patent law requires a patent

applicant to provide an adequate written description of the invention. I understand that during prosecution, the Examiner issued a rejection on the grounds that the original specification failed to provide support for multiple limitations present in issued claim 1: “6. Claim limitation ‘structure configured to deliver flow from a supply of an organotin compound,’”² “7. Claim limitation ‘structure configured to deliver flow from a supply of an inert gas,’” and “8. Claim limitation ‘structure to deliver a second precursor vapor.’” Ex. 1002 at 480-81 (8/12/21 OA at pages 3-4). In response to this rejection, on January 20, 2021, PO explained that it had “amended [the specification] to refer to new Fig. 16” and that “[a]s amended, the specification discloses the structures in items 6-8 . . . on page 4 of the Office Action.” *Id.* at 459. PO further revised new Figure 16 and related text in an April 5, 2021 amendment to disclose a third inlet to the depicted deposition chamber. *Id.* at 252-53, 265. I further understand that, during prosecution, PO asserted that Figure 16 and related text were supported by disclosures in a prior art article, Maeng et al., “Atomic Layer Deposition of Ta-Based Thin Films: Reactions of Alkylamide Precursor with Various Reactants,” J. Vacuum Sci. & Technol. B 24:2276 (2006) (“Maeng Article”), purportedly incorporated by reference into the original specification. *See* Ex. 1002 at 456-57 (PO explaining that the amendments

² Before issuance of the ’048 Patent, I understand that PO amended this limitation to clarify that it was “a first precursor vapor” being delivered. *See* Ex. 1002 at 198.

supported “via the incorporation by reference of Maeng et al. ... in particular to Fig. 1 of Maeng et al.”), 459 (“Applicant has amended the specification and figured based on incorporation by reference to provide the asserted missing disclosure.”). I have reviewed the Maeng Article. The Maeng Article provides the following “schematic diagram” for a plasma enhanced atomic layer deposition (“PE-ALD”) system. The Maeng Article describes the system as follows: Sample size as large as 8 in. can be loaded and the chamber is pumped by turbo molecular pump with a base pressure of 10^{-7} Torr. The $[\text{Ta}(\text{NMe}_2)_5]$ (powder) was contained in a bubbler and its temperature was kept at $65\text{ }^{\circ}\text{C}$ to generate high enough vapor pressure. To prevent possible condensation of the precursor inside the delivery lines, the temperature of all the lines were kept at slightly higher temperature than that of bubbler. Ar was used as carrier and purging gas and the flow was controlled by mass flow controller (MFC) upstream to the main chamber. The flow rates were set as 50 sccm for carrier gas and 75 sccm for purging gas, respectively. Also, the flows of NH_3 , H_2 , and O_2 were all controlled by MFC while the flow of water vapor was controlled by leak valve. The flow rates of O_2 , NH_3 , and H_2 were set as 30, 20, and 20 sccm, respectively. With these flow, the chamber pressure during reactant exposure increased to about 10 mTorr at standard growth condition. The water flow was controlled by leak valve by monitoring the pressure with capacitance manometer to be constant at 0.5 mTorr. The temperature of the water

was maintained constant at room temperature by immersing the bubbler in silicon oil. For PEALD, oxygen or hydrogen plasma was generated by a radio frequency remote type inductively coupled plasma generator, which is composed of a quartz tube connected to the sample chamber with auto matching box. For oxygen and hydrogen, the plasma power was set at 300 and 500 W, respectively. The deposition cycle consists of the following steps: exposure of the substrate to PDMAT for a set time t_s , purging of the chamber, exposure of reactant for a set time t_r , and purging. *Maeng at 2276-77.*



31. Based on my review of the application, I can confirm that the

apparatus figure introduced by Inpria during prosecution is not supported by the original disclosure. For example, Inpria relied on 19:64-20:4 of the '048 Patent. *Id.*, 31. But this passage only mentions the “inert gas source” and the precursor (“bubbler vessels”); it does not describe **structures configured to deliver flow** of an organotin compound or a second precursor vapor, as claim 1 requires, and thus cannot support the modifications made to the Maeng’s figure to include structures performing the recited functions. Although PO pointed to the Maeng Article’s Figure 1 as support for its amendment to the specification to add Figure 16, there are several differences between these two systems and, in view of this, it is my opinion that Figure 16 is different from and not supported by the Maeng Article’s Figure 1. For example, the Maeng Article’s Figure 1 does not disclose any vapor deposition system for the “formation of an organotin oxide hydroxide layer on a substrate,” nor does it disclose “[s]tructure 160 [] configured to supply organotin compound 164 to deposition chamber 151,” as PO claims are illustrated in Figure 16. Ex. 1001 at 19:21-24. Rather, the Maeng Article discloses a bubbler containing PDMAT, a tantalum compound that does not comprise tin or an organic ligand bound to the tantalum with a metal-carbon bond. EX1016 (Maeng Article) at 2277. In addition, the Maeng Article describes that the system has “delivery lines,” which are in the form of a “conduit” or tube. *Id.* at 2276-77. However, during prosecution, PO specifically argued that this structure would not

work to deliver an organotin compound. Ex. 1002 at 275.

32. I understand when new matter is added when additional information is added to a patent application after the original filing date. In my opinion, the remainder of the '048 patent specification does not support Figure 16, the differences between the Maeng Article's Figure 1 or Figure 16, or the modifications one would need to make to the system shown in the Maeng Article's Figure 1 for it to become of a suitable structure for the delivery of an organotin compound. I understand that PO has asserted that this passage of the '048 Patent purportedly supports the limitations of claim 1 that the Examiner found to be unsupported: A vapor deposition method for direct deposition of organotin oxide hydroxides with the general formulae $\text{RSnO}(3/2-x/2)(\text{OH})_x$ ($0 < x < 3$) and can comprise in some embodiments an inert gas source connected to separate heated bubbler vessels. A first vessel contains a liquid alkyl tris(dialkylamido)tin compound of sufficient vapor pressure to produce suitable partial pressures for transport in the inert carrier gas. Ex. 1001 at 19:64-20:4. This passage, however, references only the sources of inert gas ("inert gas source") and the precursor ("bubbler vessels"). It does not describe any structures configured to deliver flow of an organotin compound or a second precursor vapor, as required by claim 1. Therefore, in my opinion, this passage neither supports Figure 16 nor supports modifications to the Maeng Article's apparatus to include structures performing

the recited functions.

33. Based on my interpretation of the original disclosure in the application and the claims in the '048 patent, it is my opinion that the '048 patent is not entitled to the priority date associated with the original disclosure.

VIII. THE PRIOR ART

34. **Weidman.** I understand that U.S. Patent No. 8,536,068 to **Weidman**, et al. (“Weidman”) (Ex1005) is prior art under post-AIA § 102(a)(1), as it published on April 12, 2012, which precedes the earliest possible effective priority date of the '048 Patent.

35. **Meyers.** As discussed above, I believe that the Challenged Claims are not entitled to an effective filing date before January 20, 2021, as discussed supra at Section X, U.S. Patent Application No. 20170102612 to Meyers, et al. (“Myers”) (EX1006), which published on April 13, 2017 is prior art under at least post-AIA § 102(a)(1). The '048 Patent claims priority to Meyers as a continuation application, and Meyers discloses everything except for the new matter added by Inpria during prosecution.

36. **Berney.** As discussed above, I am of the opinion that the Challenged Claims are not entitled to an effective filing date earlier than before January 20, 2021, as discussed supra at Section X, WO 2020263750 to Berney (“Berney”) (EX1020), which published on December 30, 2020, is prior art under post-AIA §

102(a)(2).

37. **Molloy.** Because the Challenged Claims are not entitled to an effective filing date before **January 20, 2021**, *Precursors for the formation of tin(IV) oxide and related materials*, by Kieran C. Molloy (“**Molloy**”) (EX1009), which published online on October 1, 2008, is prior art under at least post-AIA § 102(a)(1).

38. **Cardineau.** I have reviewed the paper titled “Photolithographic properties of tin-oxo clusters using extreme ultraviolet light (13.5 nm)” by Brian Cardineau, et al. (“**Cardineau**”) (Ex 1008)—a named inventor on the ’048 Patent—was available online by no later than April 24, 2014, and the print version was published on September 5, 2014, according to the publisher Elsevier. EX1008.

39. **Dhas.** It is my understanding that because the Challenged Claims are not entitled to an effective filing date earlier **than January 20, 2021**, as discussed *supra* at Section X, U.S. Patent No. 9,328,416 to Dhas, et al. (“**Dhas**”) (EX1007), which was filed on January 17, 2014, published on July 23, 2015, and issued on May 3, 2016, is prior art under at least post-AIA §102(a)(1). Even if the Challenged Claims were entitled to the earliest possible priority date of October 13, 2015, Dhas is prior art under post-AIA §102(a)(1) because it published on July 23, 2015.

IX. PETITION 1: IPR2025-00256 (LATER PRIORITY DATE)

A. My Opinions on the Obviousness of Claims 1-20 in view of Meyer and Weidman.

(1) Claim 1

40. In my opinion, Claim 1 is rendered obvious by Wang. Claim 1 includes the following features, each of which I address in my analysis below:

1[p] *A system, comprising:*

1[a] *a deposition chamber having an interior isolated from the ambient atmosphere;*

1[b] *a substrate within the interior of the deposition chamber configured to receive a deposition on a surface of the substrate;*

1[c] *wherein the substrate is maintained at a temperature of less than 200° C;*

1[d] *an inlet into the deposition chamber;*

1[e] *a structure configured to deliver flow from a supply of an inert gas;*

a. Preamble: “system comprising”

41. If the preamble is limiting, it is my opinion that Meyers teaches or suggests it. Meyers discloses a “method for forming a radiation patternable coating comprising a metal oxo-hydroxo network with metal cations having organic ligands with metal carbon bonds and metal oxygen bonds, the method comprising inputting into a deposition chamber closed from the ambient atmosphere”

EX1006, ¶ 9.

42. It is my opinion that a POSA would understand that the deposition

chamber is part of a system for performing vapor deposition methods. EX1001 at claim 1. For example, Meyers notes that “[c]ommercial CVD apparatuses can be adapted for this use or specific equipment can be used.” EX1006, ¶ 0079.

43. It is also my opinion that Weidman discloses “**an apparatus** for deposition of a film on a substrate.” EX1005, 8:41-42. Weidman further discusses that “the apparatus comprises a deposition chamber for atomic layer deposition of a film on a substrate” and “a chamber configured to operate in both an ALD mode as well as a conventional CVD mode...” *Id.*, 8:43-45; 9:12-15.

44. In an example that I’ve reviewed in Weidman, “the apparatus comprises a deposition chamber for atomic layer deposition of a film on a substrate. The chamber comprises a process area for supporting a substrate. The apparatus includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties. The apparatus includes a reactant gas inlet in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O₂, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen.” *Id.*, 8:48-52.

b. “deposition chamber having an interior isolated from the ambient atmosphere”

45. Meyers discloses a “deposition chamber closed from the ambient atmosphere.” EX1006, ¶ 0009. Meyers further teaches that the pressure and the

temperature in the chamber can be selected, indicating that the deposition chamber is isolated from the ambient atmosphere. *Id.*, ¶ 0082; EX1001 at claim 1.

46. It is my opinion that Weidman also discloses an apparatus having a deposition chamber and that the deposition chamber may be “pressurized” (e.g., “at a pressure within a range from about 0.1 Torr to about 10 Torr”) and/or heated (e.g., “such as within a range from about 50° C to about 400° C”), i.e., a POSA would understand that the chamber is “isolated from the ambient atmosphere.”

c. “a substrate within the interior of the deposition chamber configured to receive a deposition on a surface of the substrate”

47. It is my opinion that Meyers discloses that “[g]enerally, a **substrate** can be configured with a **surface** to receive the hydrolyzed or oxidized composition.” *Id.*, ¶ 9; *see id.*, ¶ 78 (“In CVD methods, two or more reactant gases are generally mixed in the chamber in the vicinity of the **substrate** surface.”). Meyers notes that “any suitable solution coating process can be used to **deliver the precursor solution to a substrate** in addition to the vapor deposition processes disclosed herein.” EX1006, ¶ 0070; *see also Id.* at ¶ 0069 (“A vapor deposition method for direct deposition of organotin oxide hydroxides...”).

48. It is my opinion that one of ordinary skill in the art would understand the substrate is within the interior of the deposition chamber to receive the deposition. EX1001 at claim 1; *see* EX1001, ¶¶ 32 (describing “in situ hydrolysis

process” (*i.e.*, in the chamber”)), ¶ 78 (“In CVD methods, two or more reactant gases are generally mixed in the chamber in the vicinity of the substrate surface.”).

49. Weidman also discloses this limitation, e.g., “a deposition chamber for atomic layer deposition of a film on a substrate.” EX1005, 8:43-45; EX1001 at claim 1.

d. “wherein the substrate is maintained at a temperature of less than 200° C”

50. In my opinion, Meyers teaches or at least renders obvious maintaining a substrate at a temperature from about 40 °C to about 175 °C, and from about 50 °C to about 160 °C, both ranges are temperatures of less than 200° C, and notes that a POSA would recognize that “additional ranges of pressure and temperature within the explicit ranges above are contemplated and re [*sic*, “are”] within the present disclosure.” EX1006, ¶ 0082. Weidman also discloses that “the chamber or substrate may be heated to a temperature of ... less than about 200° C ... or less than about 100°.” EX1005, 9:21-26.

51. Additionally, a POSA also would be motivated to maintain the substrate at a temperature of less than 200 °C because, as Meyers explains, reaction temperatures below about 200 °C limit dealkylation and/or prevent excessive dehydration and condensation of an oxide hydroxide. EX1006 at ¶ 0082; EX1001 at claim 1.

e. “an inlet into the deposition chamber”

52. It is my opinion that Meyers teaches that a secondary reactant can enter the deposition chamber through an inlet into the chamber. EX1006, ¶ 0079. Meyers describes how “[t]he secondary reactant to drive hydrolysis/oxidation can be introduced through **a separate inlet into the chamber.**” *Id.*, ¶¶ 78-79.

53. It is also my opinion that Weidman also discloses that the apparatus can include one or more **inlets** into the deposition chamber. EX1005, 8:47-61 (including examples such as “a **first precursor inlet,**” “a **reactant gas inlet,**” “a **purge gas inlet,**” and “an **auxiliary gas inlet**”).

f. “a structure configured to deliver flow from a supply of an inert gas”

54. As I discussed above with respect to claim construction, the structure as tied to Figure 16 of the '048 Patent is a conduit to deliver from a supply of inert gas, e.g., connecting “vessel 168” to “supply of inert gas 170,” and equivalents thereof or, if not tied to Figure 16, a conduit (like a pipe) a supply of inert gas, e.g., connecting an interconnected vessel (like a vaporization chamber) to a supply of inert gas, and equivalents thereof.

55. Although Meyers discloses a CVD machine generally, it does not explicitly disclose a conduit (like a pipe) connecting a vessel to a supply of inert gas or equivalents thereof. Instead, Weidman discloses an apparatus for performing

vapor deposition that includes one or more inlets into the deposition chamber, EX1005, 8:47-61, and that “the various gases for the process may be pulsed into **an inlet** through a **gas channel**, from various holes or **outlets**, and into a **central channel**.” *Id.*, 8:16-20. Weidman also describes that “[e]ach inlet may be controlled by an appropriate **flow controller** such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) that allows flow of each of the reactants to the substrate to perform a[n] ALD process.” *Id.*, 7:53-56. Weidman also discloses that the “processing chamber would include separate supplies of the A, B, and C reactants, along with a **supply of** carrier, purge and **inert gases** such as **argon** and nitrogen in fluid communication with gas inlets for each of the reactants and gases” and that “[t]he substrate...can be exposed to a metal-containing “A” precursor gas or vapor formed by passing a **carrier gas** (for example, nitrogen or **argon**) through an ampoule of the precursor...can be delivered at any suitable flow rate...” EX1005, 11:66-12:6. As such, Weidman discloses conduits like gas channels, outlets, central channels and conduits through flow controllers to supply an inert carrier gas to a vessel, e.g., from the source of the precursor. Thus, the Meyers+Weidman combination discloses the claimed “structure [e.g., Weidman’s gas channels] configured to deliver flow from a supply of an inert gas.”

56. A POSA would be motivated to use Weidman’s gas channels to

couple a supply of inert gas through the precursor ampoule to the inlet to the deposition chamber to deliver Meyer's precursors because Meyers teaches that inert gases such Nitrogen and Argon can be used as carrier gases in ALD (sequential) and CVD (continuous) systems. EX1006, ¶ 0079. ("Inert gases such as N₂, Ar or the like may be used in appropriate capacities as carrier gases, purge gases, or pressure modulating gases in both sequential and continuous flow regimes.").

g. "a supply of an organotin composition comprising a compound described by the formula $R\text{SnX}_3$, where R is an organic ligand with 1-31 carbon atoms and is bound to Sn with a metal-carbon bond"

57. It is my opinion that Meyers teaches inputting into a deposition chamber a first precursor vapor including a compound having the formula $R_n\text{SnX}_{4-n}$ where $n=1$ in which R is a hydrocarbyl group with 1-31 carbon atoms (hydrocarbyl is an organic ligand bound to tin with a metal-carbon bond). EX1006, ¶ 0080. Accordingly, a POSA would understand that the deposition apparatus would include a supply of the compounds of $R_n\text{SnX}_{4-n}$ in order to prepare the first precursor vapor. *Id.*, ¶ 0009.

58. It is also my opinion that Meyers teaches specific examples of compounds of $R_n\text{SnX}_{4-n}$ (e.g. $(\text{CH}_3)_2\text{CHSn}(\text{NMe}_2)_3$, where $n = 1$ and R is $(\text{CH}_3)_2\text{CH}$ - (isopropyl group, which has 3 carbon atoms) and where the CH group

is bonded directly to tin forming a metal-carbon bond. *Id.*, 0144. In the combination, this compound could be provided in Weidman's ampoule.

- h. "wherein X is selected from the group consisting of alkylamido or dialkylamido ($\text{—NR}^1\text{R}^2$, where R^1 and R^2 are independently hydrocarbon groups with 1-10 carbon atoms or hydrogen), siloxo ($\text{—OSiR}^1\text{R}^2\text{R}^3$, where $\text{R}^1, \text{R}^2, \text{R}^3$ are independently hydrocarbon groups with 1-10 carbon atoms), silylamido ($\text{—N}(\text{SiR}^1_3)(\text{R}^2)$, where R^1 and R^2 are independently hydrocarbon groups with 1-10 carbon atoms), disilylamido ($\text{—N}(\text{SiR}^1_3)(\text{SiR}^2_3)$ where R^1 and R^2 are independently hydrocarbon groups with 1-10 carbon atoms), alkoxo and aryloxo (—OR , where R is an alkyl or aryl group with 1-10 carbon atoms), azido (—N_3), alkynido ($\text{—C}\equiv\text{CR}$, where R is a hydrocarbon group with 1-9 carbon atoms), amidato ($\text{—NR}^1(\text{COR}^2)$ where R^1 and R^2 are independently hydrocarbon groups with 1-7 carbon atoms or hydrogen), amidinato ($\text{—NR}^1\text{C}(\text{NR}^2)\text{R}^3$ where R^1 and R^2 are independently hydrocarbon groups with 1-8 carbon atoms or hydrogen), imido ($\text{—N}(\text{COR}^1)(\text{COR}^2)$, where R^1 and R^2 are independently hydrocarbon groups with 1-8 carbon atoms or hydrogen), or fluorinated analogues thereof, or combinations thereof" (hereinafter, "X group limitation")"**

59. It is also my opinion that Meyers teaches a method for forming a radiation patternable coating using vapor deposition, including inputting into a deposition chamber a first precursor vapor including a compound having the formula $\text{R}_n\text{SnX}_{4-n}$ where $n=1$ in which R is a hydrocarbyl group with 1-31 carbon atoms and X is a hydrolysable or oxidizable ligand. Meyers teaches the claimed X groups. *Id.*, ¶¶ 0009, 0055-0056, 0080 (describing a list of suitable ligands

identical to the claim language above).

- i. **“a structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet”**

60. As I discussed above with respect claim construction, the structure for this MPF term as tied to Figure 16 of the '048 Patent is “the conduit extending from the vessel 168 to the inlet 152” and equivalents thereof or, if not tied to Figure 16, “a class of structures for delivering flow, e.g., a conduit (such as a pipe)” from an interconnected vessel (such as a vaporization chamber, as recited in claim 4), and equivalents thereof.

61. Although Meyers discloses the source and the chamber, it is silent on the structure for delivering flow. Weidman describes “[p]urge and inert gases such as argon and nitrogen in fluid communication with gas inlets for each of the reactants and gases,” and notes that “[e]ach inlet may be controlled by an appropriate flow controller such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) that allows flow of each of the reactants to the substrate to perform a[n] ALD process.” EX1005, 7:48-57. Weidman also discloses the “processing chamber would include separate supplies of the **A, B, and C reactants**, along with a **supply of carrier, purge and inert gases**...in fluid communication with gas inlets for each of the reactants and gases” and that “[t]he substrate...can be exposed to a metal-containing **“A”**

precursor gas or vapor formed by passing a carrier gas...through an ampoule of the precursor...can be delivered at any suitable flow rate...” EX1005, 11:65-12:2. Id., 11:65-12:2. Weidman also discloses that “the various gases for the process may be pulsed into an inlet through a gas channel, from various holes or outlets, and into a central channel.” Id., 8:16-20. As such, Weidman discloses conduits like gas channels, outlets, central channels and conduits through flow controllers to supply precursor gases to the chamber.

62. Thus, Meyers+Weidman renders obvious “a structure to deliver a first precursor vapor (e.g., above precursors) from the supply of the organotin compound (e.g., the ampoule with Meyer’s precursor) with the inert gas as a carrier gas (e.g., argon) to the inlet.”

j. “to provide for formation of an organotin layer on the substrate surface within the deposition chamber”

63. In my opinion, Meyers describes “vapor deposition methods for deposition of organotin oxide hydroxide thin-film photoresists. Potential deposition methods include, for example, physical vapor deposition (PVD), chemical vapor deposition (CVD), atomic layer deposition (ALD), or modifications thereof. For example, one or more gaseous $RnSnX(4-n)$ compounds can be introduced to a reaction chamber and reacted with a co-precursor such as H_2O ... thereby producing a radiation sensitive organotin oxide hydroxide coating. EX1006, ¶

0033. Meyers notes that the ALD process can include sequentially adsorbing, chemisorbed, or decomposed the precursor on a “substrate surface.”

64. Thus, it is my opinion that Meyers discloses “to provide for formation of an organotin layer on the substrate surface within the deposition chamber.”

k. “a structure to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the first precursor vapor”

65. It is my opinion that the structure as tied to Figure 16 of the '048 Patent is a conduit 174 connecting a source of a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof” to inlet 154 of deposition chamber 151 and equivalents thereof or, if not tied to Figure 16, a conduit (like a pipe) connecting a source of a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof” to an inlet of a deposition chamber and equivalents thereof.

66. It is my opinion that Meyers teaches **an inlet** (i.e., a pipe) for delivering into the chamber a secondary precursor vapor (secondary reactant) that is capable of reacting (hydrolysis/oxidation) with the composition comprising a compound described by the formula $RSnX_3$. Meyers teaches that the second precursor vapor can include water. EX1006, ¶¶ 0077, 0079.

67. It is also my opinion that Weidman discloses that the apparatus

includes supplies of A, B, and C reactants. B reactants can include water (H_2O) or hydrogen peroxide (H_2O_2). EX1005, 5:55-65, 8:48-52, 10:1-10, 16:4-7. Weidman further discloses the B reactant is delivered to the substrate by passing a gas through an ampoule (*i.e.*, a structure configured to deliver a second precursor vapor). *Id.*, 12:38-41. Weidman also discloses that “the various gases for the process may be pulsed into an inlet through a gas channel, from various holes or outlets, and into a central channel.” *Id.*, 8:16-20.

68. Thus, Meyers+Weidman discloses a structure (e.g., gas channels etc.) to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the first precursor vapor.

l. “under conditions in the deposition chamber to form a composition with non-volatile components and a volatile component comprising hydrolysis reaction product with X”

69. Meyers teaches a method for forming a radiation patternable coating using vapor deposition, EX1006, ¶ 143, including inputting a first precursor vapor comprising $\text{R}_n\text{SnX}_{4-n}$ (n can be 1, EX1006, ¶¶ 142-143, where “X is a ligand having a hydrolysable bond with Sn” under conditions in the deposition chamber to form a composition with non-volatile components and a volatile component comprising a reaction product with X, and that the materials hydrolyze during the

coating and baking process to for non-volatile components (e.g. organotin oxide hydroxides) and volatile products (e.g. volatile dialkylamines and alcohols). *Id.*, ¶¶ 144-145.

m. “wherein the substrate is configured with a surface to receive the non-volatile components of the composition”

70. Meyers discloses “wherein a substrate is configured with a surface to receive the non-volatile components of the composition.” *Id.*, ¶¶ 0143-0145 (as part of a recitation of a method for forming a radiation patternable coating).

(2) Claim 2

71. Meyers+Weidman discloses claim 2, which depends on claim 1 and recites “the substrate comprises a **silicon wafer**.” Meyers describes that “[a] coating material can be formed through deposition and subsequent processing of the precursor solution onto a selected substrate,” and that “[s]ome substrates of particular interest include, for example, **silicon wafers**.” *Id.*, ¶ 0069 (emphasis added). Weidman also discloses that the substrate can be a silicon wafer (e.g., “200 mm or 300 mm diameter wafers” comprising “crystalline silicon,” “silicon oxide,” “strained silicon,” etc.). EX1005, 7:30-41.

(3) Claim 3

72. Claim 3, which depends from claim 1, recites that “the inert gas comprises nitrogen or argon.” Meyers discloses that, “[t]o facilitate deposition the

substrate may be heated or may be cooled depending on the precursor properties,” and that “[i]nert gases such as N₂, Ar or the like may be used in appropriate capacities as carrier gases.” EX1006, ¶ 0079. Weidman also discloses that the apparatus includes a supply of inert gases such as argon and nitrogen and an inlet to supply the inert gas to the deposition chamber. EX1005, 8:48-52.

(4) Claim 4

- a. “the structure configured to deliver flow comprises: an aerosol generator configured to generate an aerosol from a liquid comprising the organotin compound, a vaporization chamber configured to receive an injection of organotin compound, a flash evaporator configured to evaporate the organotin compound, or a bubbler configured for bubbling an inert carrier gas through a liquid comprising the organotin compound, and”**

73. This claim is written in the alternative, and Meyers discloses “bubbler vessels...” EX1006, ¶ 0082. Meyers also teaches a method for forming a radiation patternable film using CVD, including methods for delivering flow that result from the claimed structures configured to deliver flow. *Id.*, ¶ 0079 (“precursors with relatively low vapor pressures may be introduced using flow of vapor, aerosol, and/or direct liquid injection into a vaporization chamber”). Weidman also teaches a bubbler (an ampoule of precursor liquid through which a carrier gas is passed). EX1006, 13:16-20.

- b. “wherein the deposition on the surface of the substrate comprises chemical vapor deposition”**

74. Meyers teaches that the deposition (the hydrolyzed or oxidized composition formed in the deposition chamber) on a surface of a substrate was conducted using chemical vapor deposition. *Id.*, ¶¶ 0009, 0144-145. Weidman also discloses devices “configured to operate in both an ALD mode as well as a conventional CVD mode” “to deposit photoresist materials.” EX1005 at 12-15.

(5) Claim 5

75. Meyers+Weidman discloses claim 5, which depends on claim 1 and recites “the second precursor vapor comprises **water vapor**.” Meyers lists H₂O as a small molecule gas-phase reagent to be used in vapor deposition. *Id.*, ¶ 0077 (“[t]o perform the vapor deposition, generally one or more metal-containing precursors are reacted on or more with small molecule gas-phase reagents such as **H₂O** ...”). Weidman also discloses a non-metal reactant “B” can include “vapors of water,” where the non-metal reactant “B” can be reasonably interpreted to be the second precursor recited in claim 5. EX1005, 5:55-62.

(6) Claim 6

76. Meyers+Weidman discloses claim 6, which depends on claim 1 and recites “further comprising a flow comprising a third precursor vapor comprising a composition represented by the formula ML_v, where v is 2≤v≤6 and L is an oxidizable ligand or a ligand having a hydrolysable M-L bond or a combination thereof, and M is a metal selected from groups 2-16 of the periodic table.”

Meyers teaches inputting into a deposition chamber a third precursor vapor with the formula ML_v . Meyers discusses at ¶ 0145:

6. The method of additional inventive concept 1 where a third precursor is separately inputted to the chamber the precursor comprising ML_v , where v is $2 \leq v \leq 6$ and L is an oxidizable ligand or a ligand having a hydrolysable M-L bond or a combination thereof, and M is a metal selected from groups 2-16 of the periodic table.

(7) Claim 7

77. Meyers+Weidman discloses claim 7, which depends on claim 6 and recites that “the third precursor vapor comprises **SnL_4** .” Meyers teaches compounds of formula SnL_4 ($Sn(NMe_2)_4$ or $Sn(OtBu)_4$ wherein $L_4 = (NMe_2)_4$ or $(OtBu)_4$). Meyers teaches a third precursor comprising ML_v can be inputted into the chamber (third precursor vapor). $Sn(NMe_2)_4$ and $Sn(OtBu)_4$ are compounds of ML_v where v is 4 and L is a ligand having a hydrolysable M-L bond and M is a metal of group 14 of the periodic table. EX1006, ¶¶ 0078, 0080. Accordingly, a POSA would understand that the third precursor vapor can comprise $Sn(NMe_2)_4$ or $Sn(OtBu)_4$. *Id.*, ¶¶ 0131, 0134.

(8) Claim 8

78. Meyers+Weidman discloses claim 8, which depends on claim 1 and recites “the interior has a pressure from about 0.01 Torr to about 25 Torr.” Meyers teaches a vapor deposition method including a chamber having an interior pressure from about 0.01 Torr to about 25 Torr. *Id.*, ¶ 0082 (“By controlling vessel

temperatures, inert gas flow rate, and total system pressure, vapor-phase $\text{RSn}(\text{NR}'_2)_3$ and H_2O are transported independently to a chamber evacuated to <0.1 Torr, more generally from about 0.01 Torr to about 25 Torr, and in some atmospheric pressure CVD pressures >25 Torr.”).

79. Meyers also recites “[a] method for forming a radiation patternable coating comprising an oxo-hydroxo network with metal cations having organic ligands with metal carbon bonds and metal oxygen bonds,” where “the deposition chamber has a pressure from about 0.01 Torr to about 25 Torr.” *Id.*, ¶¶ 0143-0145.

(9) Claim 9

80. Meyers+Weidman discloses claim 9, which depends on claim 1 and recites “the interior has a temperature from about 40°C . to about 175°C .”³ Meyers teaches a vapor deposition method, including where the interior of the deposition chamber (e.g. chamber walls) has a temperature from about 40°C . to about 175°C . *Id.*, ¶ 0082 (“The gases, the chamber walls and/or the substrate can be heated in various embodiments, generally to a temperature from about 40°C to about 175°C .”).

(10) Claim 10

81. In my opinion, the structure for this Petition is a first and second

³ Petitioner preserves right to argue indefiniteness of claim 9 as a mixed claim type.

vessel and/or a controller and equivalents thereof.

82. Meyers+Weidman discloses claim 10, which depends on claim 1 and recites the system of claim 1 “comprising a **configuration** providing **for** selection of the pressure and/or the temperature in the deposition chamber.” Meyers teaches that the temperature in the reaction chamber can be selected to control the reaction process. *Id.*, ¶ 0078. Meyers does not explicitly teach a configuration for selecting the pressure and/or temperature in the deposition chamber. Weidman, however, teaches that “the substrate temperature and chemistry can be selected specifically not to promote formation of an insoluble oxide precursor material, but to remain soluble unless exposed to far UV or EUV radiation.” EX1005, 15:56-60. Weidman also discloses a Central Processing Unit (CPU) “that can be used in an industrial setting for controlling various chambers and sub-processors.” [CITE WEIDMAN] It would be obvious to a POSA to use this CPU to select and control substrate temperature and pressure. [CITE EXPERT]

83. Thus, Meyers+Weidman discloses a configuration for selection of the pressure and/or temperature in the deposition chamber.

(11) Claim 11

84. Meyers+Weidman discloses claim 11, which depends from claim 1 and recites the system of claim 1, where “the flow comprises a **vapor**.” Meyers discloses this by teaching chemical vapor deposition methods including bubbler

vessels configured to deliver flow of a liquid alkyl tris(dialkylamido) tin compound (a compound of R_nSnX_{4-n} where n is 1, R is alkyl, and X is dialkylamido) in an inert carrier gas, and flash evaporator that can be used to deliver precursor vapors into the chamber. EX1006, ¶ 0082. Weidman also discloses that the “substrate...can be exposed to a metal-containing ‘A’ precursor gas or vapor...delivered at any suitable flow rate...” [CITE]

(12) Claim 12

85. Meyers+Weidman discloses claim 12, which depends from claim 1 and recites the system of claim 1, where “the structure configured to deliver flow comprises one or more **vapor inputting structures**.”

86. Meyers describes various inputting structures, such as a bubbler, a flow controller, various valves and inlets. *See Id.*, ¶ 0079-0082 (noting, for example, that “[f]lash evaporators can be used to introduce a controlled amount of precursor vapors into the reaction chamber to correspondingly control the reaction process in the chamber”).

87. Weidman describes “[a] processing chamber is configured to expose the substrate to a sequence of gases and/or plasmas” that includes “separate supplies of the A, B, and C reactants, along with a supply of carrier, purge and inert gases such as argon and nitrogen in fluid communication with **gas inlets** for each of the reactants and gases.” EX1005, 8:48-52.

88. Weidman further discusses “an apparatus for deposition of a film on a substrate” that includes a deposition chamber. And the apparatus includes “a first precursor inlet in fluid communication with a supply of precursor,” and “a reactant gas inlet in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O₂, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen.” *Id.*, 8: 47-52.

(13) Claim 13

89. The Meyers and Weidman combination discloses claim 13, which depends from claim 12 and recites the system of claim 12 where “the **vapor inputting structures provide for control of the flow.**” As discussed above for claim 12, Weidman discusses apparatuses having inlets in fluid communication with various supply content, including gases. Weidman further discloses that “[e]ach inlet may be controlled by an appropriate **flow controller** such as a mass flow controller or volume flow controller in communication with a **central processing unit (CPU)** that allows flow of each of the reactants to the substrate to perform a ALD process as described herein.” *Id.* at 8:52-57.

(14) Claim 14

90. Meyers+Weidman discloses claim 14, which depends from claim 1 and recites the system of claim 1, where “a **first vapor inputting structure** is configured to deliver a first vapor flow and a **second vapor inputting structure** is

configured to deliver a second vapor flow **at the same time.**”

91. Meyers teaches inputting a second precursor vapor at the same time as a first precursor vapor. EX1006, ¶0143-0145. Meyers also teaches chemical vapor deposition as a potential deposition method, which includes a continuous deposition process. EX1006, ¶0033; see also, ¶0078 (noting that “[i]n CVD methods, two or more reactant gases are generally mixed in the chamber in the vicinity of the substrate surface”).

92. Weidman describes an “apparatus [that] includes a first precursor **inlet** in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties.” *Id.*, 8: 47-49. Weidman also notes that “the ‘A’, ‘B’, and purge gases can flow **simultaneously**, and the substrate and/or gas flow nozzle can oscillate such that the substrate is sequentially exposed to the A, purge, and B gases as desired.” *Id.*, 6: 17-21.

(15) Claim 15

93. Meyers+Weidman discloses claim 15, which depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are **sequential.**”

94. Meyers teaches inputting a first precursor vapor and a second precursor vapor sequentially. EX1006, ¶0143-0145. Meyers also teaches atomic

layer deposition as a potential deposition method, which includes a sequential deposition process. EX1006, ¶ 0033.

95. Weidman describes an “apparatus [that] includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties.” EX1005, 8: 47-49.

(16) Claim 16

96. Meyers+Weidman discloses claim 16, which depends on claim 1 and recites the system of claim 1 where “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow, the second vapor flow, and a third vapor flow are **sequential**.”

97. Meyers teaches that a first vapor flow and a second vapor flow can be delivered sequentially, and also teaches inputting a third precursor vapor into a deposition chamber (a third vapor flow). Meyers teaches that “one or more vapor-phase precursor compounds ... such as $\text{Sn}(\text{NMe}_2)_4$, or $\text{Sn}(\text{OtBu})_4$ ” “are delivered sequentially ... with the organotin-containing precursors.” EX1006, ¶ 0048.

Although Meyers does not specifically teach that the first vapor flow, second vapor flow, and third vapor flow are delivered sequentially, Meyers teaches that vapor-phase precursors such as $\text{Sn}(\text{NMe}_2)_4$ or $\text{Sn}(\text{OtBu})_4$ can be inputted sequentially with organotin-containing precursors to alter the R:Sn ratio.

98. Meyers also teaches that ALD (which includes a sequential deposition process) is a suitable deposition methods. Accordingly, a POSA would understand that the third vapor flow could also be delivered sequentially along with a first vapor flow and a second vapor flow using ALD methods.

99. Weidman describes an “apparatus [that] includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties.” *Id.*, 8: 47-49. *see also id.* at 9:29-42 (“an ALD process cycle may include **alternating pulses** of ‘A’ precursor (for example, metal oxide precursor), ‘B’ reactant, ‘C’ precursor (for example, metal oxide precursor), and ‘B’ reactant”). Weidman also notes that “the ‘A’, ‘B’, and purge gases can flow simultaneously, and the substrate and/or gas flow nozzle can **oscillate** such that the substrate is sequentially exposed to the A, purge, and B gases as desired.” *Id.*, 6: 17-21.

100. A POSA would also understand that there are a limited number of obvious choices of continuous or alternating delivery methods, which would have been obvious-to-try.

(17) Claim 17

101. The Meyers and Weidman combination discloses claim 17, which recites the system of claim 1 where “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to

deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are at the **same time** and a third vapor flow is **sequential**.” *Id.*, ¶0033.

102. Meyers teaches that a first precursor vapor (first vapor flow) and a second precursor vapor (second vapor flow) can be delivered at the same time, and also teaches inputting a third precursor vapor into a deposition chamber (a third vapor flow). EX1006, ¶ 0078. Meyers also teaches chemical vapor deposition, which includes a continuous deposition process, and atomic layer deposition (ALD), which includes a sequential deposition process, as potential deposition methods. *Id.*, ¶ 0033.

103. Meyers teaches that the first vapor flow and second vapor flow can be “input sequentially” and that the third vapor flow can be “separately inputted to the chamber.” *Id.* at claim 1 and 6. For example, Meyers teaches that vapor-phase precursors such as $\text{Sn}(\text{NMe}_2)_4$ or $\text{Sn}(\text{OtBu})_4$ can be inputted sequentially with organotin-containing precursors to alter the R:Sn ratio. *Id.*, ¶ 0080. Meyers also teaches that both CVD (which includes a continuous deposition process) and ALD (which includes a sequential deposition process) are suitable deposition methods.

104. Weidman also discloses “both an ALD mode as well as a conventional CVD mode may be used to deposit photoresist material” and that ALD process cycles may include alternating pulses of different precursors, so a POSA would know that varying which precursors are introduced at the same time

or sequentially is a simple design choice that would be obvious to try. EX1005, 9:12-15.

105. Accordingly, a POSA would understand that the third vapor flow would be delivered sequentially using ALD methods along with a first vapor flow and a second vapor flow delivered at the same time using CVD methods. *Id.*, ¶¶ 0077-0078.

(18) Claim 18

106. The Meyers and Weidman combination discloses claim 18, which depends from claim 1 and recites the system of claim where “the interior has a temperature from about 45° C. to about 200° C.” Meyers teaches that the deposition chamber has a temperature from about 40° C. to about 175° C, which overlaps with the claimed range. *Id.*, ¶ 0082. Weidman also discloses that “the chamber or substrate may be heated to a temperature of ... less than about 200° C ... or less than about 100°.” EX1005, 9:21-26.

(19) Claim 19

107. The Meyers and Weidman combination discloses claim 19, which depends from claim 1, and recites “the system of claim 1 wherein X is alkylamido or dialkylamido.” Meyers teaches that useful X ligands include alkylamido and dialkylamido, and discloses specific examples of compounds of RSnX_3 where X is dialkylamido ($\text{—NR}^1\text{R}^2$, where R^1 and R^2 are independently hydrocarbon groups

with 1-10 carbon atoms or hydrogen; -NMe₂ is a dialkylamido group where R¹ and R² are each methyl (Me), which is a hydrocarbon group with 1 carbon atom).

EX1006, ¶ 0080.

(20) Claim 20

108. The Meyers and Weidman combination discloses claim 20, which depends from claim 1, and recites the system of claim 1 where “X is alkoxo and aryloxo.” Meyers teaches that useful X ligands include alkoxo and aryloxo, and discloses specific examples of compounds of RSnX₃ where X is alkoxo ((—OR, where R is an alkyl group with 1-10 carbon atoms; -O^tBu is an alkoxo group where R is t-butyl, which is an alkyl group with 4 carbon atoms). *Id.*, ¶ 0080.

B. My Opinions on the Anticipation and/or Obviousness of Claims 1-5 and 8-20 in view of Berney

(1) Claim 1

a. Preamble: “system comprising”

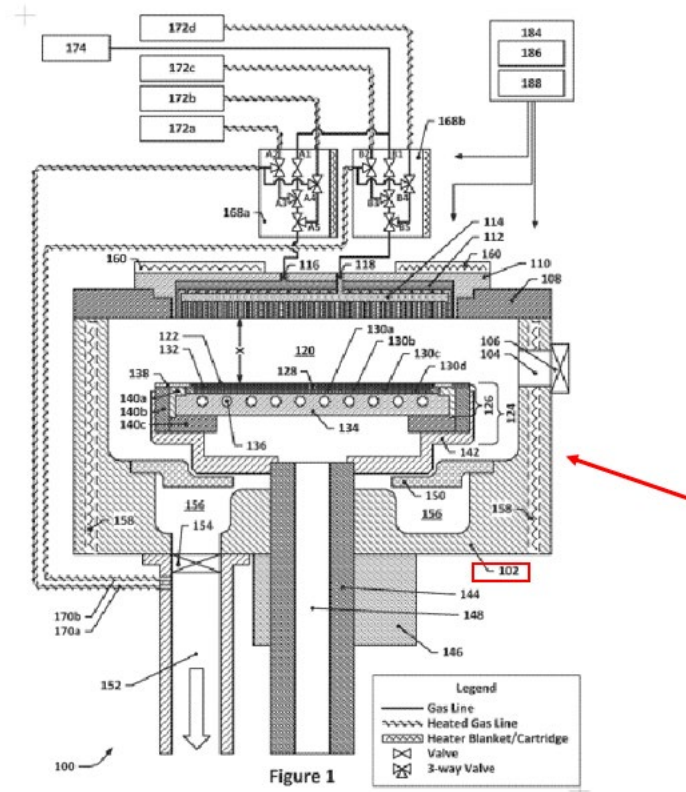
109. Berney discloses “an example dry deposition apparatus for generating EUV-sensitive photoresist layers.” EX1020 ¶ 0009, Fig. 1. Berney thus discloses “[a] system comprising.” *Id.*, ¶¶ 0072, 0074.

b. “deposition chamber having an interior isolated from the ambient atmosphere”

110. Berney discloses “an apparatus 100...that has a **processing chamber 102**,” as shown in Figure 1 below. *Id.*, ¶ 0038. Berney states that the processing

chamber may be “isolated from the environment” using a gate valve to seal the wafer transfer passage. *Id.*, ¶ 0038. A POSA would know that the other side of the gate valve (or, if present, more than one gate valves or other mechanisms) is at ambient atmosphere, and sealing the wafer transfer passage would isolate the processing chamber from the ambient atmosphere. *Id.*, ¶ 0018. In contrast, Berney also describes the environment for conventional spin-on photoresists (not vapor deposition), which are applied in an “**an atmospheric environment, e.g., at typical atmospheric pressures.**” *Id.*, ¶ 0036.

111. Berney also discloses that dry deposition processes “may be performed in a range of different temperature and pressure environments, and are often performed at **sub-atmospheric conditions.**” *Id.*, ¶ 0014. A POSA would understand that a deposition chamber would be isolated from the ambient atmosphere in order to attain different temperature and pressure environments, including sub-atmospheric conditions, for processing. *Id.*, ¶¶ 0018, 0037.

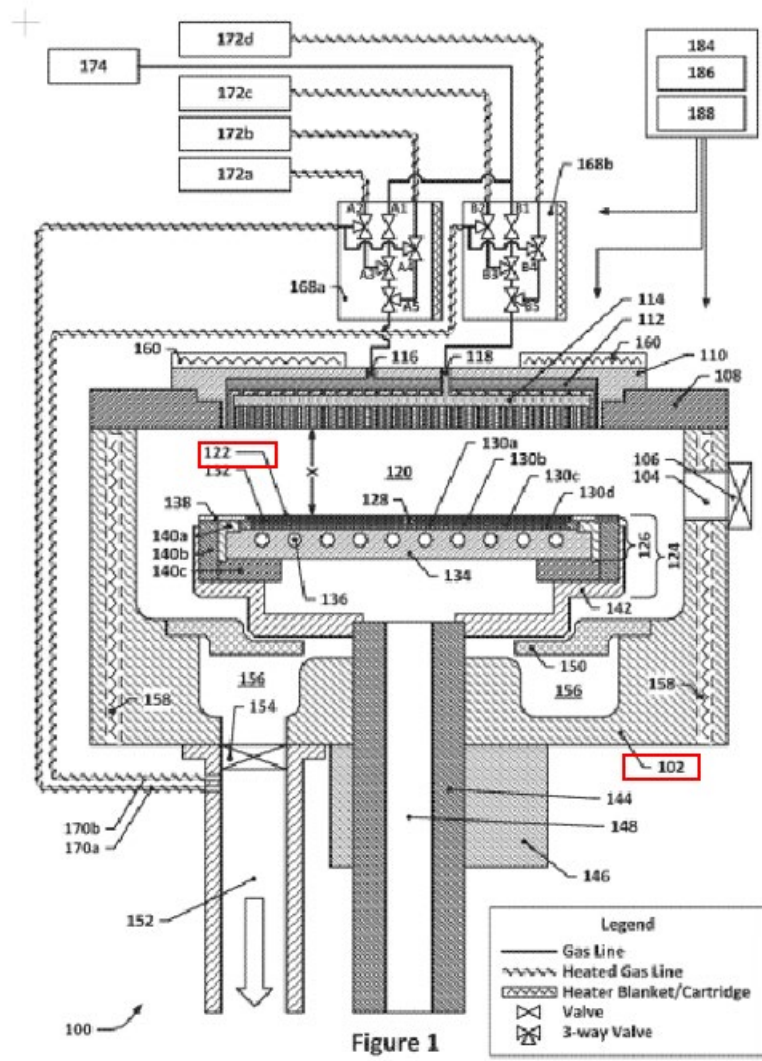


Id., at Figure 1 (annotated).

- c. “substrate within the interior of the deposition chamber configured to receive a deposition on a surface of the substrate”

112. Berney discloses that a substrate is “passed...into the interior of the processing chamber 102,” as shown in Figure 1 below. *Id.*, ¶0038. The substrate “may include any material construct suitable for photolithographic processing.” *Id.*, ¶ 0019. “The EUV-sensitive metal or metal oxide-containing film may be dry-deposited on the substrate.” *Id.*, ¶ 0017. “EUV-patternable films may be deposited on the substrate using vapor deposition equipment and processes among

those known in the art.” *Id.*, ¶ 0027. A POSA would understand that if films are deposited on the substrates of Berney, these substrates are configured to receive a deposition on their surface. *Id.*, ¶¶ 0017, 0019 X.



Id., at Figure 1 (annotated).

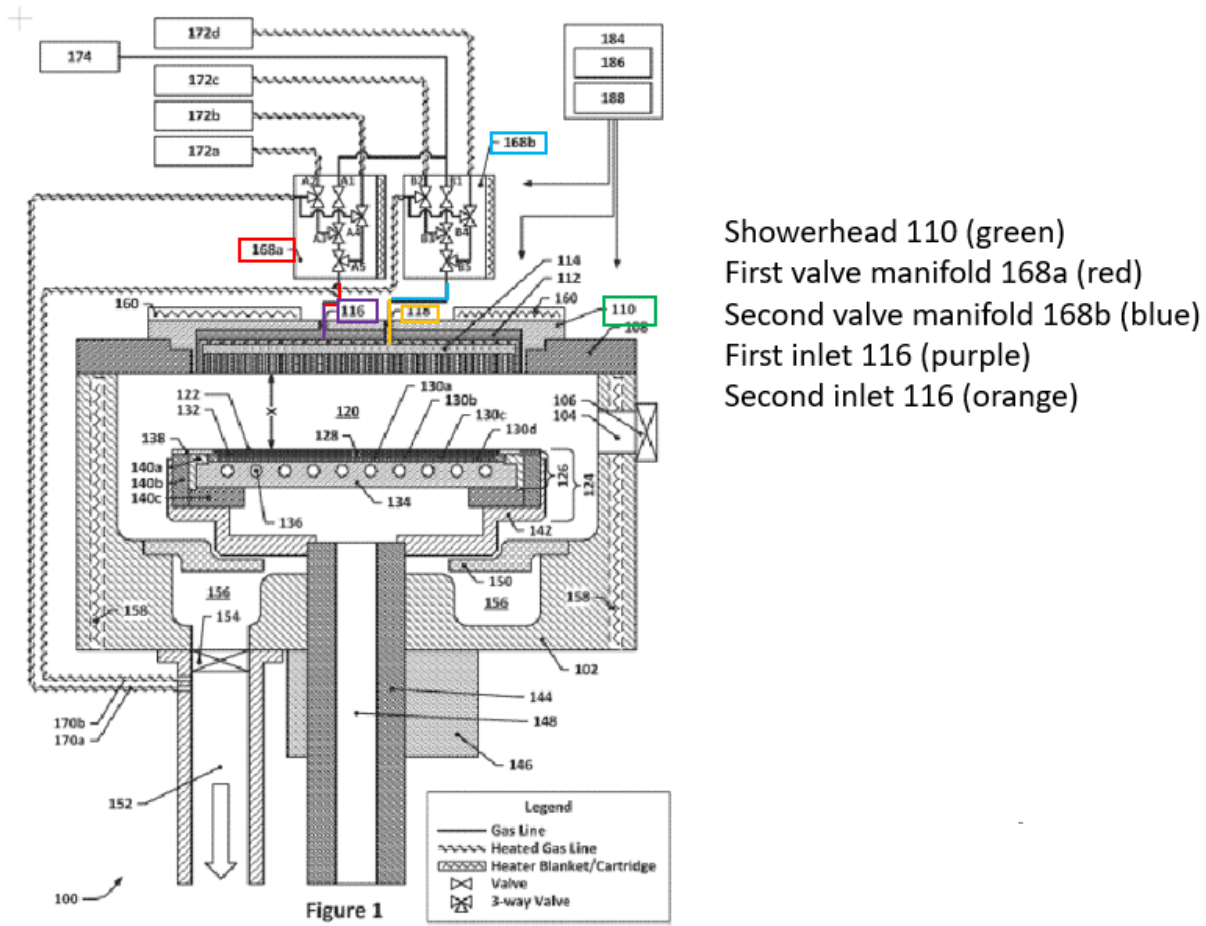
d. “the substrate is maintained at a temperature of less than 200° C”

113. Berney discloses that the substrate temperature can be maintained at a

temperature “from 0°C to 250°C, or **from ambient temperature (23 °C) to 150 °C,**” which is than less than 200° C and thus discloses this limitation. *Id.*, ¶ 0030 (“The temperature of the substrate may preferably be kept at or below the temperature of the reactant streams. For example, the substrate temperature may be from 0°C to 250°C, or from ambient temperature (e.g., 23°C) to 150°C.”).

e. “an inlet into the deposition chamber”

114. Berney discloses “a showerhead 110...includes a first plenum 112 that is provided process gas via a first inlet 116,” and “[e]ach plenum may have a corresponding set of gas distribution ports that fluidically connect the respective plenum with the reaction space 120 through the faceplate of the showerhead 110,” as shown in Figure 1 below.



Id., at Figure 1 (annotated).

f. “structure configured to deliver flow from a supply of an inert gas”

115. I have been informed that this limitation is a MPF term. Berney performs the function: “to deliver flow from a supply of inert gas.” Berney discloses an apparatus for vapor deposition that includes conduits and a manifold that can cause the flow of a purge gas. EX1020 ¶52. The purge gas can be “any suitable inert gas.” EX1020 ¶50.

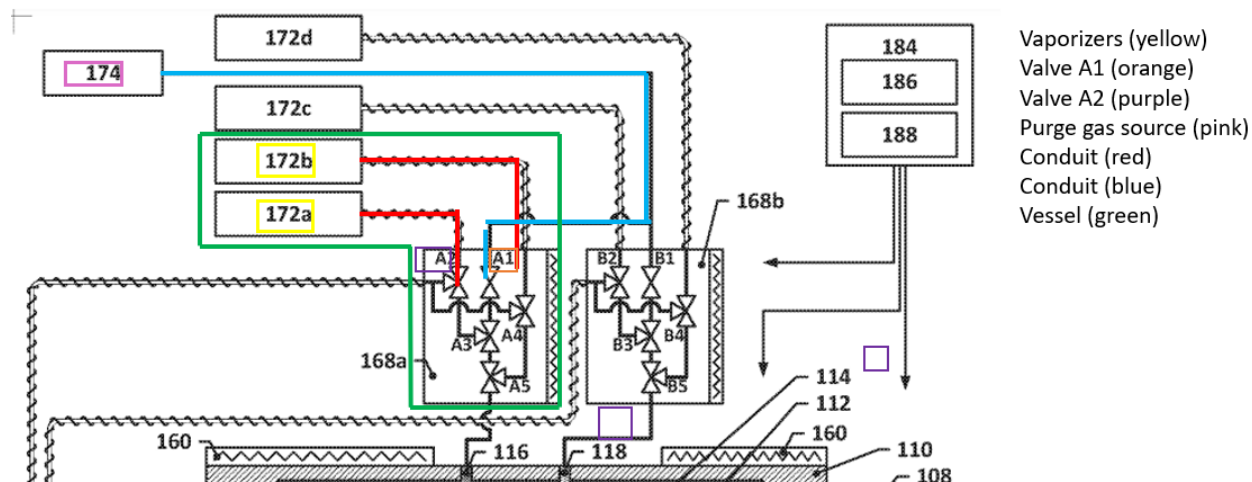
116. It is my understanding that the structure for this Petition as tied to Figure 16 of the '048 Patent is a conduit **configured to deliver flow from a supply of an inert gas, e.g.,** connecting “vessel 168” to “supply of inert gas 170,” and equivalents thereof, or, if not tied to Figure 16, a conduit (like a pipe) **to a supply of inert gas, e.g.,** connecting **to** an interconnected vessel (like a vaporization chamber), and equivalents thereof.

117. Berney discloses valves that cause the flow of a purge gas from the purge gas source: “...it may be desirable to purge one of the vapors...by actuating the valves A1, A3, and A5 so as to cause the purge gas from the purge gas source 174 to be flowed into the first inlet 116.” EX1020 at ¶53. The purge gas source also has a conduit that delivers flow of the purge gas to first valve manifold 168a, as shown in Figure 1 below. Since the claim element of the “structure configured to deliver flow” does not require the “structure” connecting to anything, a POSA would understand that the “structure” is simply a conduit for delivering a supply of inert gas, and that the valves and conduit of Berney disclose therefore are “structures configured to deliver flow.”

118. Moreover, although the claim limitation does not require that the structure includes the precursor vessel as Patent Owner seems to argue, a POSA would appreciate that the precursor source includes the precursor vessel and its mixer valve manifold, and as such the source of inert gas connects through a

conduit to the precursor source (that includes its mixer/valve), as shown in Figure 1 below.

119. Thus, Berney discloses “a structure configured to deliver flow from a supply of an inert gas.”



Id., Figure 1 (annotated and zoomed in).

g. “a supply of an organotin composition comprising a compound described by the formula RSnX_3 , where R is an organic ligand with 1-31 carbon atoms and is bound to Sn with a metal-carbon bond”

120. Berney discloses “a supply of an organotin composition” because it discloses “a first inlet 116 and the second inlet 118” that “may be provided processing gases via a gas supply system, which may be configured to provide one or more organometallic precursors...” *Id.*, ¶ 0048. Moreover, the organometallic precursors may be “dispensed from their respective vaporizers

172...into the reaction space 120.” *Id.*, ¶64.

121. Berney’s organometallic precursors comprise the claimed “compound described by the formula $R\text{Sn}X_3$, where R is an organic ligand with 1-31 carbon atoms and is bound to Sn with a metal-carbon bond.” EX1001, at claim 1. In particular, Berney’s precursors can be of “formula $M_aR_bL_c$ where **M is a metal with a high EUV absorption cross-section; R is alkyl**⁴...; L is a ligand, ion or other moiety which is reactive with the counter-reactant; $a > 1$; $b > 1$; and $c > 1$.” EX1020 ¶ 0022. The metal M of the organometallic precursor can be tin. *Id.*, ¶¶ 0021, 0023 (“M may be, for example, be a material such as tin... In some embodiments, M is tin.”). R may be alkyl groups such as i-propyl (3 carbon atoms), t-butyl (4 carbon atoms), and other alkyl groups with 3-5 carbon atoms. *Id.*, ¶ 0023 (“For example, R may be an i-propyl, n-propyl, t-butyl, i-butyl, n-butyl, sec-butyl, n-pentyl, i-pentyl, t-pentyl, sec-pentyl, or a mixture of two or more thereof.”). A POSA would understand that, in formula $M_aR_bL_c$, the alkyl group R is bound to the metal M with a metal-carbon bond. *Id.*, ¶ 0022.

h. “wherein X is selected from the group consisting of alkylamido or dialkylamido ($—NR^1R^2$, where R^1 and R^2 are independently hydrocarbon groups with 1-10 carbon atoms or hydrogen), siloxo ($—OSiR^1R^2R^3$, where

⁴ The ’048 patent acknowledges that the organic ligand R can be an alkyl group.

EX1001 at 11:46-52.

R¹, R² are independently hydrocarbon groups with 1-10 carbon atoms), silylamido (—N(SiR¹₃)(R²), where R¹ and R² are independently hydrocarbon groups with 1-10 carbon atoms), disilylamido (—N(SiR¹₃)(SiR²₃) where R¹ and R² are independently hydrocarbon groups with 1-10 carbon atoms), alkoxo and aryloxo (—OR, where R is an alkyl or aryl group with 1-10 carbon atoms), azido (—N₃), alkynido (—C≡CR, where R is a hydrocarbon group with 1-9 carbon atoms), amidato (—NR¹(COR²) where R¹ and R² are independently hydrocarbon groups with 1-7 carbon atoms or hydrogen), amidinato (—NR¹C(NR²)R³) where R¹ and R² are independently hydrocarbon groups with 1-8 carbon atoms or hydrogen), imido (—N(COR¹)(COR²), where R¹ and R² are independently hydrocarbon groups with 1-8 carbon atoms or hydrogen), or fluorinated analogues thereof, or combinations thereof”

122. Berney discloses that ligand L can be “a moiety that is an amine (such as a **dialkylamino or monoalkylamino group**)” or “an **alkoxy group**.” *Id.*, ¶ 0023. A POSA would understand that the ligand L of Berney is analogous to the claimed X in **RSnX₃**. EX1001, at claim 1. Berney also discloses specific examples of tin precursors with dialkylamido and alkoxo groups of X: “For example, where M is tin, such precursors include...i-propyl(tris)**dimethylamino** tin⁵...and...”

⁵ The '048 patent also teaches i-propyltris(dimethylamino)tin ((iPrSn(NMe₂)₃) as an organometallic precursor. EX1001 27:10-23.

alkyl(tris)(**t-butoxy**) tin compounds such as t-butyl tris(**t-butoxy**) tin⁶.” EX1020 ¶ 0024. A POSA would understand that Berney’s dimethylamino is the claimed dialkylamido ($\text{—NR}^1\text{R}^2$, where R^1 and R^2 are each methyl (hydrocarbon group with 1 carbon atom)), and Berney’s t-butoxy is the claimed alkoxo (—OR , where R is t-butyl (hydrocarbon group with 4 carbon atoms). EX1020. Berney also discloses the “organometallic precursors may be partially fluorinated.” *Id.*, ¶ 0024, which discloses the claimed “or fluorinated analogues thereof” of the ’048 Patent, EX1001, at claim 1.

i. “structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet”

123. As discussed above, this limitation is a MPF term. Berney performs the function: “to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet.” Berney discloses an apparatus for vapor deposition that includes a valve manifold that causes vapors from a supply of organometallic vapor to flow. EX1020 ¶52. These vapors may flow in tandem with a purge gas. EX1020 ¶53.

124. In my opinion, this limitation is a MPF term. Berney performs the

⁶ The ’048 patent also teaches $(\text{CH}_3)_3\text{CSn}(\text{O}^t\text{Bu})_3$ (t-butyl tris(t-butoxy) tin) as a precursor compound for use of vapor deposition. EX1001 18:42.

function: “to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet.” Berney discloses simultaneously flowing vapor from a vaporizer with a purge gas. EX1020 at ¶53. The purge gas is “nitrogen, argon, or other suitably inert gas.” EX1020 at ¶50.

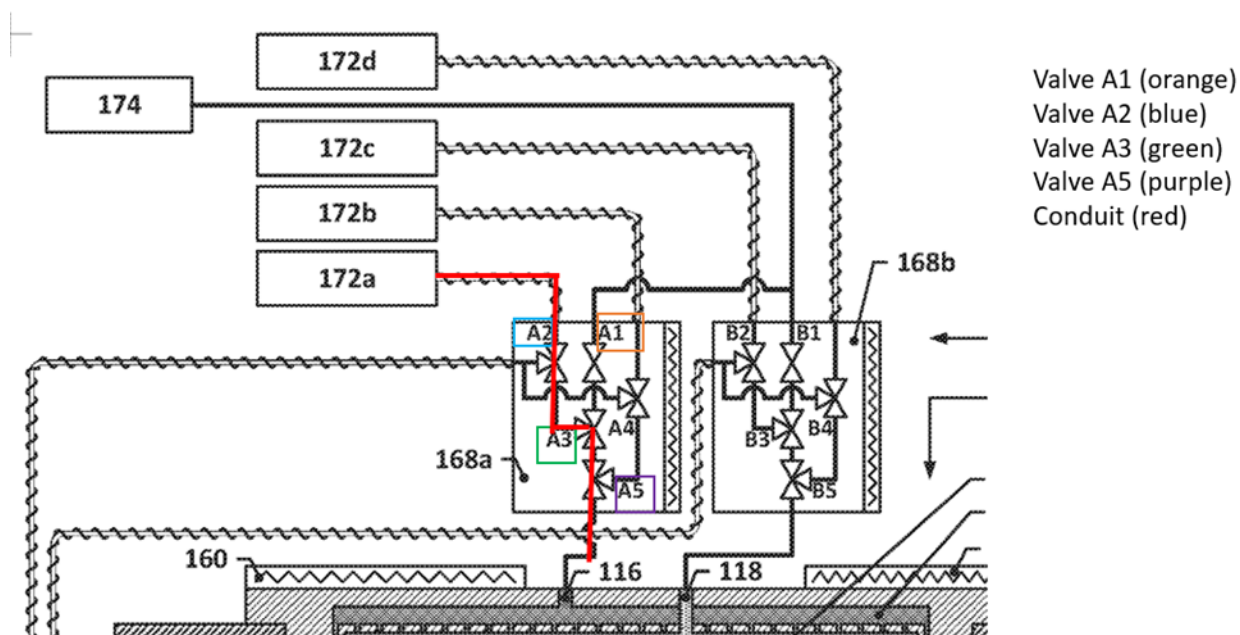
125. It is my understanding that the structure for this Petition as tied to Figure 16 of the '048 Patent is “vessel 168 and the conduit extending from the vessel 168 to the inlet 152” and equivalents thereof or, if not tied to Figure 16, “a class of structures for delivering flow, i.e., an interconnected vessel (such as a vaporization chamber, as recited in claim 4) and conduit (such as a pipe)” and equivalents thereof.

126. Berney discloses an apparatus for performing vapor deposition that includes a conduit (or series of conduits) fluidically connecting a vessel (i.e. “first vaporizer 172a”) to an inlet (i.e., “first inlet 116”) by way of three valves (valve A2, valve A3, and valve A5), as shown in Figure 1 below: “For example, **a first valve manifold 168a may be configured to provide organometallic precursors to the first inlet 116**, while a second valve manifold 168b may be configured to provide counter-reactants to the second inlet 118. In this example, the first valve manifold 168a, for example, includes multiple valves A1-A5. **Valve A2** may, for example, be **a three-way valve that has one port fluidically connected with a**

first vaporizer 172a, another port fluidically connected with a bypass line 170a, **and a third port fluidically connected with a port on another 3-way valve A3**...One of the other ports on **valve A5** may be fluidically connected with the **first inlet 116** while the remaining port on **valve A5** may be fluidically connected with one of the remaining ports on the valve **A3**. The remaining port on the valve **A3** may, in turn, be fluidically connected with the valve **A1** which may be fluidically interposed between the valve **A3** and a purge gas source 174, e.g., **nitrogen, argon, or other suitably inert gas** (with respect to the organometallic precursor and/or the counter-reactant)” EX1020 ¶¶ 0049-0050. A POSA would therefore understand that Berney discloses a conduit.

127. Berney discloses that the flow from the vaporizer can be delivered through the conduit (or series of conduits) and valves to the first inlet: “For example, to **flow vapor from the first vaporizer 172a into the reaction space 120**, the valve **A2** may be actuated to cause the vapor from the first vaporizer 172a to first flow into the first bypass line 170a. This flow may be maintained for a period of time sufficient to allow the flow of the vapor to reach steady state flow conditions. After sufficient time has passed (or after a flow meter, if used, indicates that the flow rate is stable), **valves A2, A3, and A5** may be actuated to cause the **vapor flow from the first vaporizer 172a to be directed to the first inlet.**” *Id.*, ¶ 0053.

128. Thus, Berney discloses “a structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet.”



Id., Figure 1 (annotated and zoomed in).

j. “to provide for formation of an organotin layer on the substrate surface within the deposition chamber”

129. Berney discloses that “[t]he thin films are, in various embodiments, **organometallic** materials, for example **organotin materials** comprising **SnOx**, or other **metal oxides** materials/moieties,” which may be made “**in a vapor phase reaction of an organometallic precursor with a counter-reactant.**” *Id.*, ¶ 0021.

Berney states that “gas streams...of **organometallic precursor and source of counter-reactant may be introduced into a deposition chamber** of a CVD apparatus, where they may **mix and react in the gas phase** to form agglomerated polymeric materials,” and “it is believed that **the product from such vapor-phase reaction becomes heavier in molecular weight** as metal atoms are crosslinked by counter-reactants, **and is then condensed or otherwise deposited onto the substrate.**” *Id.*, ¶ 0029.

k. “structure to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the first precursor vapor”

130. It is my understanding that this limitation is a MPF term. Berney performs the function: “to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the first precursor vapor.” Berney discloses an apparatus for vapor deposition that includes vaporizers for dispensing counter reactants. EX1020 ¶64. Counter-reactants react with an organometallic precursor, and may be water or hydrogen peroxide. EX1020 ¶25

131. In my opinion, the structure for this Petition as tied to Figure 16 of the ’048 Patent is a conduit 174 connecting a source of a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof” to inlet 154 of

deposition chamber 151 and equivalents thereof or, if not tied to Figure 16, a conduit (like a pipe) connecting a source of a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof” to an inlet of a deposition chamber and equivalents thereof.

132. Berney discloses an apparatus for performing vapor deposition that includes a conduit fluidically connecting a vessel to an inlet by way of valves: **“Valve A2 may, for example, be a three-way valve that has one port fluidically connected with a first vaporizer 172a... and a third port fluidically connected with a port on another 3-way valve A3...One of the other ports on valve A5 may be fluidically connected with the first inlet 116 while the remaining port on valve A5 may be fluidically connected with one of the remaining ports on the valve A3.”** EX1020 at ¶50. Berney discloses that a second manifold can be controlled in a similar matter: “It will be appreciated that the second valve manifold 168b may be controlled in a similar manner, e.g., by controlling valves B1-B5, to provide vapors from vaporizers 172c and 172d to the second inlet 118.” EX1020 at ¶54. Accordingly, a POSA would understand that valves B1-B5 can function analogously to valves A1-A5, and that vapors from vaporizers 172c and 172d can flow to the inlet 118 which connects to processing chamber 102. EX1020 ¶49.

133. Berney discloses that “a second valve manifold 168b may be

configured to provide counter-reactants to the second inlet 118.” EX1020 ¶49.

Counter-reactants can include “water, peroxides (e.g., hydrogen peroxide)...”

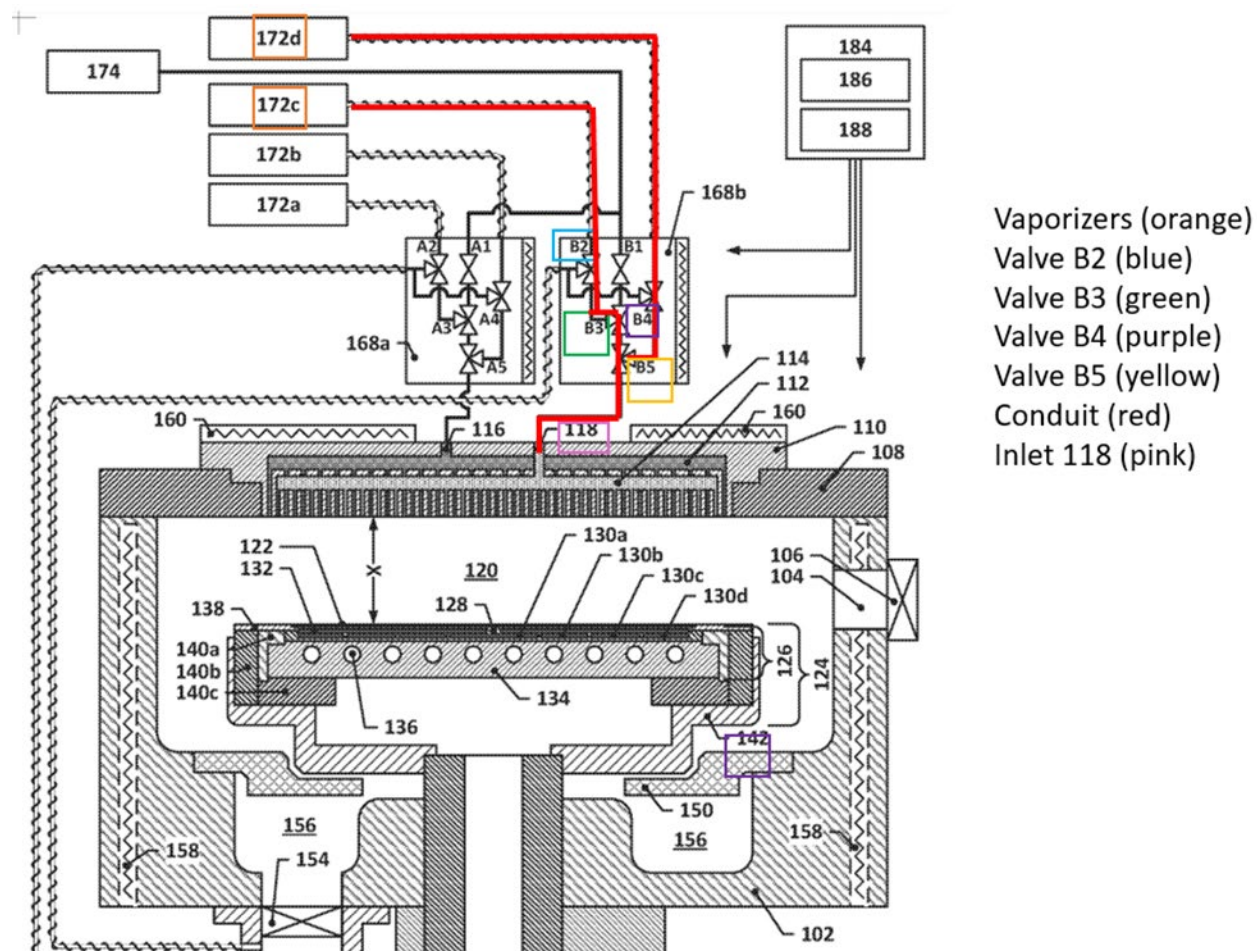
EX1020 ¶25. A POSA would understand that vaporizers 172c and 172d, which are connected to second valve manifold 168b, provide counter reactants such as water or hydrogen peroxide to the second inlet 118. EX1020 ¶49.

134. Berney discloses that “**a second valve manifold 168b** may be **configured to provide counter-reactants to the second inlet 118**,” as shown in Figure 1 below. EX1020 ¶ 0049. “[T]he second inlet 118...may be provided processing gases via a gas supply system, which may be configured to provide...one or more counter-reactants...” *Id.*, ¶ 0048. Counter-reactants can be “dispensed from their **respective vaporizers 172**...” *Id.*, ¶ 0064.

135. Berney defines “fluidically connected” as follows: “For the purposes of this disclosure, the term ‘fluidically connected’ is used with respect to volumes, plenums, holes, etc., that may be connected with one another in order to form a fluidic connection, similar to how the term “electrically connected” is used with respect to components that are connected together to form an electric connection.” EX1020 at ¶51.

136. As such Berney clearly discloses a vessel (i.e. “second vaporizer 172b”) and the conduit extending from the vessel to the inlet (i.e., “second inlet 118”). Thus, Berney discloses “a structure configured to deliver flow of a first

precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet.”



EX1020, Figure 1 (annotated and zoomed in).

- I. “under conditions in the deposition chamber to form a composition with non-volatile components and a volatile component comprising hydrolysis reaction product with X”

137. Berney discloses that “gas streams...of organometallic precursor and source of counter-reactant may be introduced into a deposition chamber of a CVD

apparatus, where they may mix and react in the gas phase to form agglomerated polymeric materials,” and “it is believed that the product from such vapor-phase reaction becomes heavier in molecular weight as metal atoms are crosslinked by counter-reactants, and is then condensed or otherwise deposited onto the substrate.” *Id.*, ¶ 0029. A POSA would understand that the product of the reaction between the organometallic precursor and counter-reactant is a composition with non-volatile components that are deposited onto the substrate (assuming that the components that have condensed onto the substrate are no longer a vapor), and that the vapor-phase reaction also produces a volatile component with X through a hydrolysis reaction.

m. “wherein the substrate is configured with a surface to receive the non-volatile components of the composition.”

138. Berney discloses a film constituent is delivered “to the substrate as a **vapor-phase reactant, where it then condenses or adsorbs onto the exposed surface of the substrate.**” EX1020 ¶0014. “[T]he substrate 122 temperature may be controlled to a level that promotes condensation, or at least deposition, of the reactants on the substrate 122.” *Id.*, ¶ 0056. From this, a POSA would understand that the substrate is configured with a surface to receive the non-volatile components of the composition. EX1001, at claim 1.

(2) Claim 2

139. Claim 2 depends on claim 1 and recites that “the substrate comprises a **silicon wafer.**” Berney discloses that “such substrates may be **silicon wafers.**” EX1020 ¶ 0019; EX1001 at claim 2.

(3) Claim 3

140. Claim 3 depends on claim 1 and recites that “the inert gas comprises **nitrogen or argon.**” Berney discloses that examples of a purge gas source includes “**nitrogen, argon,** or other suitably inert gas.” EX1020 ¶ 0050; EX1001 at claim 3.

(4) Claim 4

- a. “**the structure configured to deliver flow comprises an aerosol generator configured to generate an aerosol from a liquid comprising the organotin compound, a vaporization chamber configured to receive an injection of organotin compound, a flash evaporator configured to evaporate the organotin compound, or a bubbler configured for bubbling an inert carrier gas through a liquid comprising the organotin compound**”

141. Claim 4 depends from claim 1.⁷ Berney discloses that organometallic precursors can be “dispensed from their **respective vaporizers 172...**” EX1020 ¶ 0064. A POSA would understand that the vaporizer to be any of the “aerosol generator, vaporization chamber, a flash evaporator, or bubbler” that converts the organotin into a vapor. EX1001 at claim 4. To the extent Patent Owner contends that this limitation refers to a class of structures for delivering flow (i.e., an

⁷ Petitioner preserves right to argue indefiniteness of claim 4.

interconnected vessel and conduit), Berney discloses this structure as discussed *supra* for this limitation. At a minimum, Berney discloses an equivalent structure because the vaporizer delivers flow.

b. “wherein the deposition on the surface of the substrate comprises chemical vapor deposition”

142. Berney discloses that “[s]uitable processes for forming... **polymerized organometallic material on a substrate include**, for example, **depositing it using chemical vapor deposition (CVD)...**” EX1020 ¶ 0027; EX1001 at claim 4.

(5) Claim 5

143. Claim 5 depends on claim 1 and recites that “the second precursor vapor comprises water vapor.” Berney discloses “the second inlet 118...may be provided processing gases via a gas supply system, which may be configured to provide...**one or more counter-reactants**...” EX1020 ¶ 0048. The counter-reactants can include “**water**” *Id.*, ¶ 0025; EX1001 at claim 5.

(6) Claim 8

144. Claim 8 depends on claim 1 and recites that “the interior has a pressure from about 0.01 Torr to about 25 Torr.” Berney discloses that “[t]he CVD process is **generally conducted at reduced pressures, such as from 10**

milliTorr⁸ to 10 Torr,” including **“0.5 to 2 Torr.”** EX1020 ¶ 0030. As such a POSA would understand that Berney’s CVD process is conducted at the reduced pressures of **“0.5 to 2 Torr”** which falls within the about 0.01 Torr to about 25 Torr claimed range. EX1001 at claim 8.

(7) Claim 9

145. Claim 9 depends on claim 1 and recites that “the interior has a temperature from about 40° C. to about 175° C.”⁹ Berney discloses “maintain[ing] the **temperature of the interior wall surfaces of the processing chamber 102...to between 80 °C and 120 °C, e.g., 100 °C.**” EX1020 ¶ 0062; EX1001 at claim 9.

(8) Claim 10

146. Claim 10 depends on claim 1 and recites “comprising a **configuration** providing for selection of the pressure and/or the temperature in the deposition chamber.”

147. It is my understanding that this limitation is a MPF term. Berney performs the function: “selection of the pressure and/or the temperature in the deposition chamber.” Berney discloses a controller that **may be programmed to**

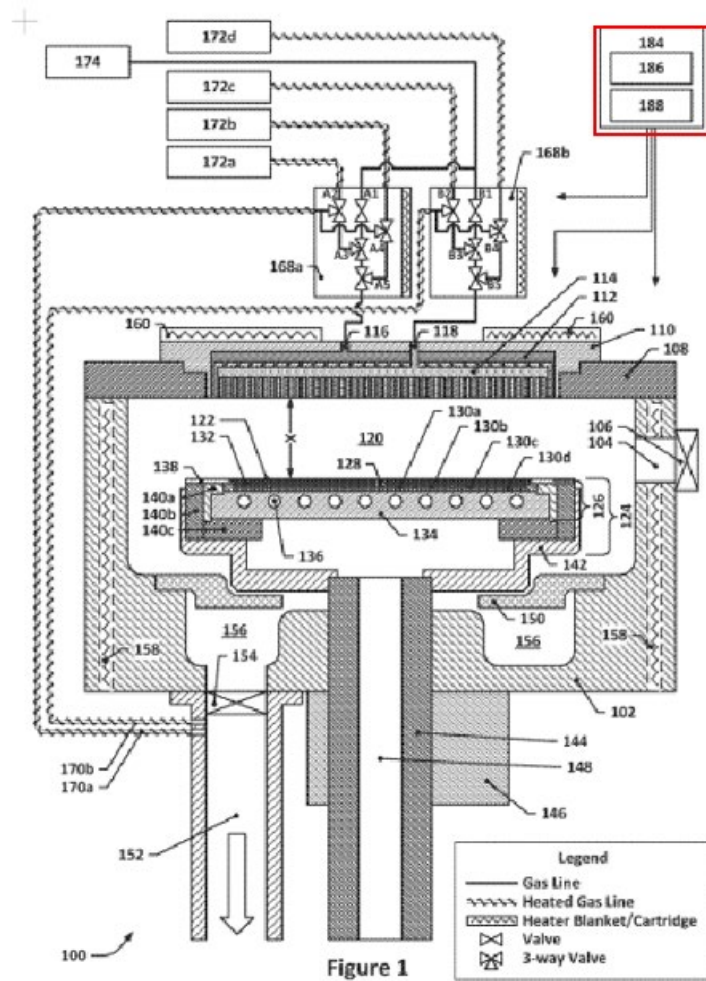
⁸ 10 milliTorr is equivalent to 0.01 Torr.

⁹ Petitioner preserves right to argue indefiniteness of claim 9 as a mixed claim type.

control any of the processes disclosed herein, including the...**temperature settings (e.g., heating and/or cooling), pressure settings...**” *Id.*, ¶ 0077; EX1001 at claim 10.

148. It is my understanding, the structure for this Petition is a first and second vessel and/or a controller and equivalents thereof.

149. Berney discloses a “controller 184 may control the various heater systems of the apparatus 100 to maintain the temperature of the interior wall surfaces of the processing chamber 102...” as shown in Figure 1 below with annotations identifying the controller 184. EX1020 ¶ 0062. *See also Id.*, ¶ 0077 above. Therefore, Berney discloses a controller. Thus, Berney discloses a “configuration providing for selection of the pressure and/or the temperature in the deposition chamber.”



EX1020 at Figure 1 (annotated).

(9) Claim 11

150. Claim 11 depends on claim 1 and recites “the flow comprises a vapor.”¹⁰ While it is unclear which flow, Berney discloses that “it may be desirable to simultaneously flow vapor from one of the vaporizers 172a or 172b in tandem with flowing gas from the purge gas.” *Id.*, ¶ 0053. The purge gas can

¹⁰ Petitioner preserves right to argue indefiniteness of claim 11.

be “**nitrogen, argon, or other suitably inert gas.**” *Id.*, ¶ 0050. Accordingly, Berney discloses that the flow from a supply of the inert gas (i.e., “flowing gas from the purge gas”) includes a vapor (i.e., “vapor from one of the vaporizers”).

(10) Claim 12

151. Claim 12 depends on claim 1 and recites “the structure configured to deliver flow comprises one or more vapor inputting structures.”¹¹

152. It is my understanding that this limitation is a MPF term. Berney performs the function: “vapor inputting.” Berney discloses valves and showerhead for providing flow of gas. EX1020, ¶53, 47.

153. It is my understanding that the structure for this Petition as tied to Figure 16 of the '048 Patent is an inlet 154 or inlet 176 connecting a deposition chamber 151 to a source of vapor and equivalents thereof or, if not tied to Figure 16, an inlet connecting a deposition chamber to a source of vapor and equivalents thereof.

154. Berney discloses an inlet that provides gas to a reaction space via a showerhead, as shown as Figure 1 below: “The **showerhead 110**...includes a first plenum 112 that is **provided process gas via a first inlet 116**...The showerhead 110 may...have more than two plenums, although two plenums is generally the

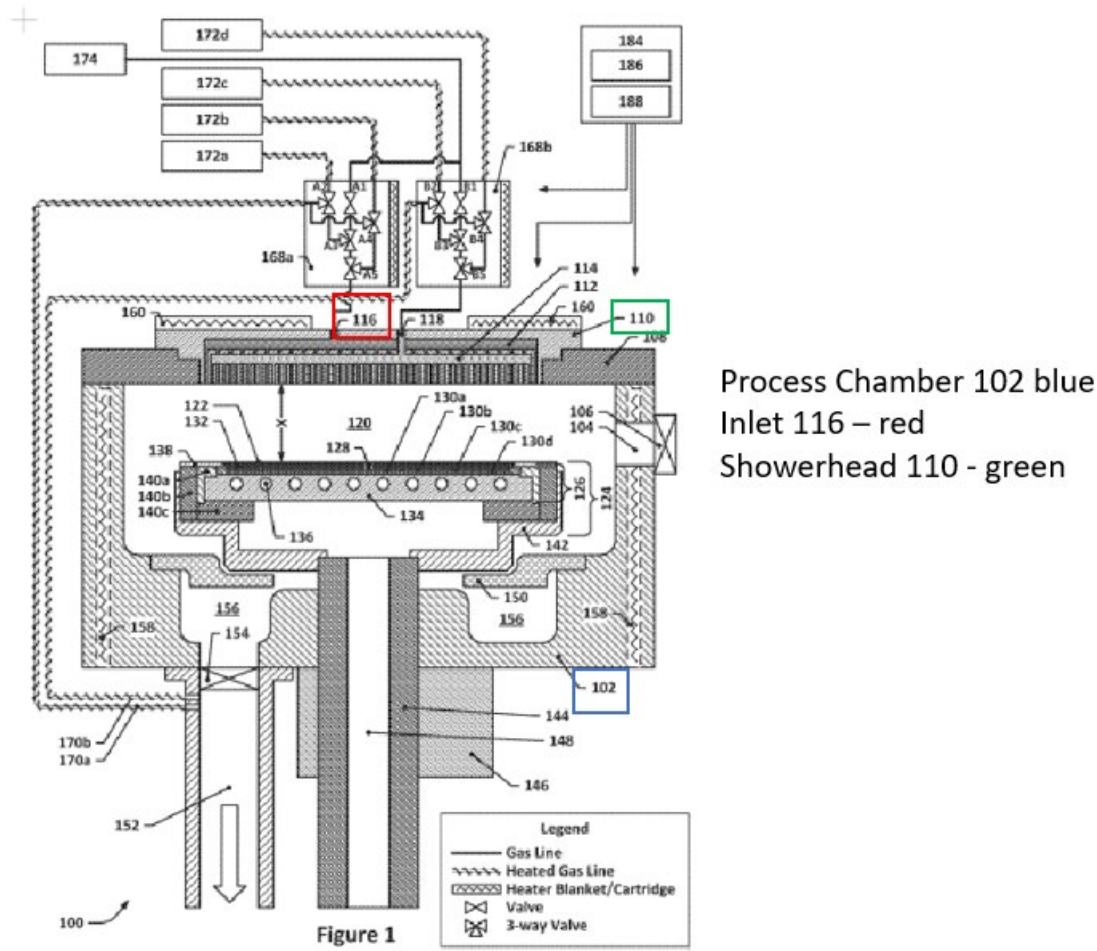
¹¹ Petitioner preserves right to argue indefiniteness of claim 12.

minimum required to maintain separation between the organometallic precursor and the counter-reactant prior to **release of the organometallic precursor and the counter-reactant into the reaction space 120 of the processing chamber 102.**

EX1020 at ¶47.

155. Berney also discloses multiple valves that deliver flow of a purge gas: “the first valve manifold 168a...includes multiple valves A1-A5,” and “the valve A1...may be fluidically interposed between the valve A3 and a purge gas source 174.” *Id.*, ¶0063.

156. Thus, Berney discloses “one or more vapor inputting structures.”



EX1020 at Figure 1 (annotated)

(11) Claim 13

157. Claim 13 depends on claim 12 and recites “the vapor inputting structures provide for control of the flow.”

158. For “the vapor inputting structures,” it is my opinion that the structure is the same as identified for claim 12.

159. Berney discloses that “**gas flow** from the vaporizers 172 supplying the gas to be used in the dry deposition process **may be initiated and allowed to**

reach steady state, e.g., by causing the valves A1-A5 ... to be selectively actuated...” *Id.*, ¶0063. Therefore, Berney teaches that the vapor inputting structures (i.e., “valves A1-A5”) provide for control of the flow (i.e., “gas flow...may be initiated and allowed to reach steady state”).

(12) Claim 14

160. Claim 14 depends from claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow at the same time.”

161. For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

162. Berney discloses a first structure that performs the function of “deliver[ing] a first vapor flow,” and a second structure that performs the function of “deliver[ing] a second vapor flow at the same time.” For example, Berney discloses that **“the controller may be configured to cause an organometallic precursor and a corresponding counter-reactant to be simultaneously dispensed from their respective vaporizers 172 and through respective plenums of the showerhead 110 into the reaction space 120 for a given duration of time”** as described in block 308 of Figure 3 below. EX1020 ¶ 0064; EX1001 at claim 14. Berney also discloses “a controller having one or more processors...to a) cause...a **first valve...to be actuated to cause a vapor-phase of a first organometallic**

precursor to be flowed...into the reaction space...and b) cause...a second valve...to be actuated to cause a vapor-phase of a first counter reactant to be flowed...into the reaction space... *Id.*, 32:1-23. Berney discloses “perform[ing] (a) and (b) simultaneously.” *Id.*, 34:12.

163. From this, a POSA would understand Berney to disclose a first vapor inputting structure (i.e., “a first valve”) is configured to deliver a first vapor flow (i.e., “a vapor-phase of a first organometallic precursor”) and a second vapor inputting structure (i.e., “a second valve”) is configured to deliver a second vapor flow (i.e., “a vapor-phase of a first counter reactant”), wherein the first vapor flow and the second vapor flow are at the same time (i.e., “cause an organometallic precursor and a corresponding counter-reactant to be simultaneously dispensed”; “perform[ing] (a) and (b) simultaneously”). EX1001 at claim 14.

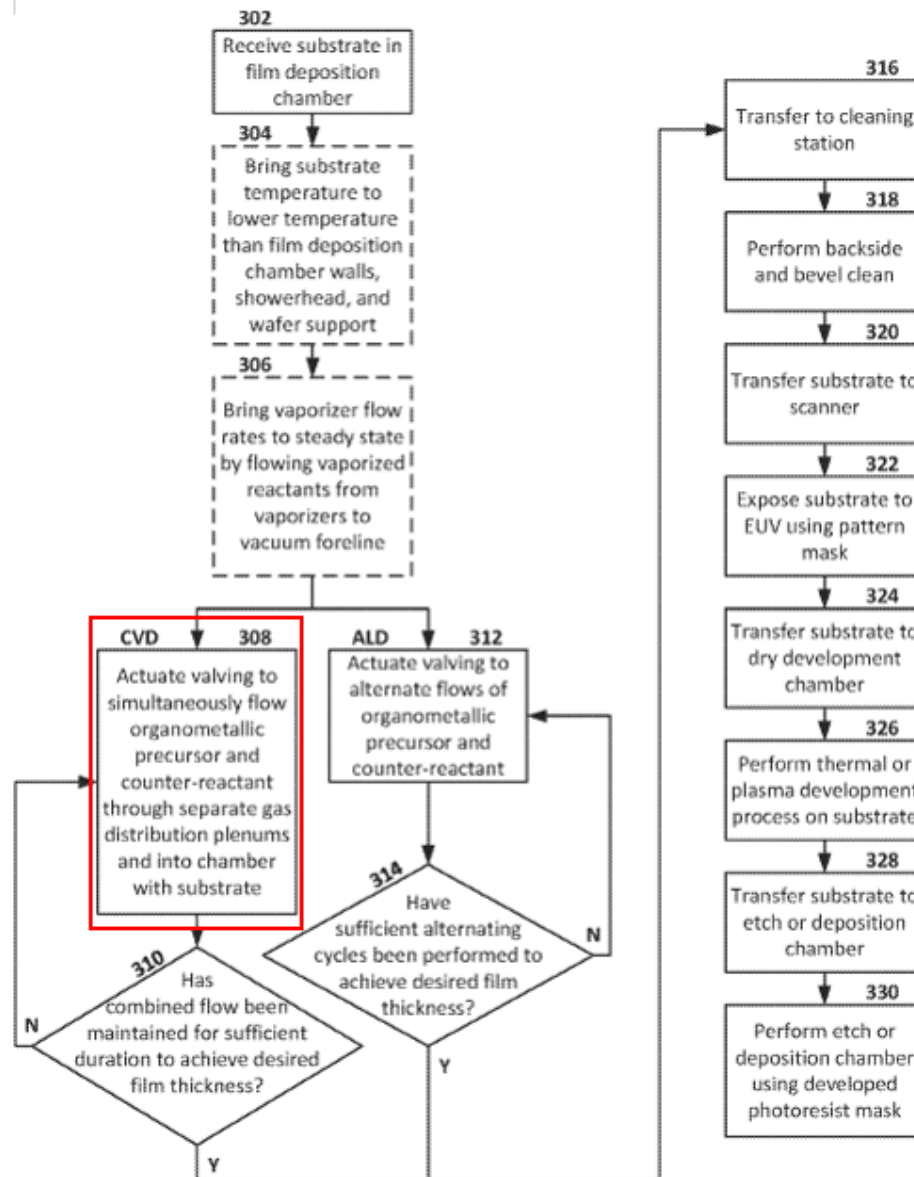


Figure 3

EX1020 at Figure 3 (annotated).

(13) Claim 15

164. Claim 15 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting

structure is configured to deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are **sequential**.”

165. It is my understanding that, for the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

166. In my opinion, Berney discloses that “the valving of the apparatus 100 may be actuated to *alternate* flows of the organometallic precursor and the corresponding counter-reactant, e.g, first flow the organometallic precursor through the showerhead 110 and then stop the flow of the organometallic precursor and start the flow of the counter-reactant through the showerhead 110” as described in block 312 of Figure 3 below. *Id.*, ¶ 0065. Berney also discloses “a controller having one or more processors...to a) cause...a first valve...to be actuated to cause a vapor-phase of a first organometallic precursor to be flowed...into the reaction space...and b) cause...a second valve...to be actuated to cause a vapor-phase of a first counter reactant to be flowed...into the reaction space...” *Id.*, 32:1-23. Berney discloses “perform[ing] (a) and (b) in an alternating fashion...” *Id.*, 32:16. Figure 3 specifically identifies “[a]ctuate valving to alternate flows of organometallic precursor and counter-reactant.” *Id.*, Figure 3.

167. From this, a POSA would understand Berney to disclose a first vapor inputting structure (i.e., “a first valve”) is configured to deliver a first vapor flow

(i.e., “a vapor-phase of a first organometallic precursor”) and a second vapor inputting structure (i.e., “a second valve”) is configured to deliver a second vapor flow (i.e., “a vapor-phase of a first counter reactant”), wherein the first vapor flow and the second vapor flow are sequential (i.e., “stop the flow of the organometallic precursor and start the flow of the counter-reactant through the showerhead 110”; “alternate flows of organometallic precursor and counter-reactant”). EX1001 at claim 15.

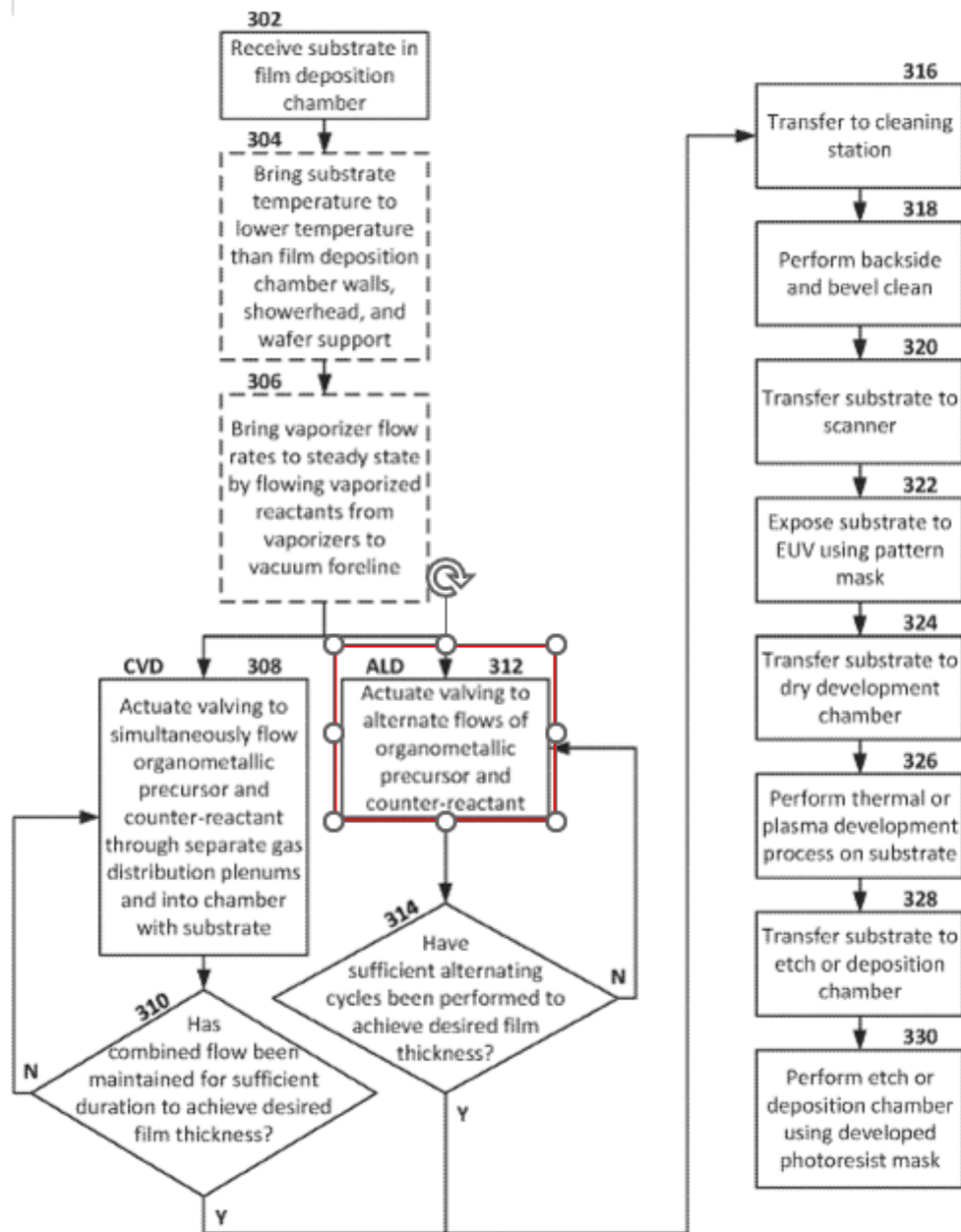


Figure 3

EX1020 at Figure 3 (annotated).

(14) Claim 16

168. Claim 16 depends on claim 1 and recites “a first vapor inputting

structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow, the second vapor flow, and a third vapor flow are **sequential**.”

169. For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

170. Berney discloses that “the valving of the apparatus 100 may be actuated to alternate flows of the organometallic precursor and the corresponding counter-reactant, e.g, first flow the organometallic precursor through the showerhead 110 and then stop the flow of the organometallic precursor and start the flow of the counter-reactant through the showerhead 110” as described in block 312 of Figure 3 below. EX1020 ¶ 0065. A POSA would understand that the valving represents a first vapor inputting structure and a second inputting structure, and the first vapor flow (i.e., “vapor-phase of a first organometallic precursor”) and the second vapor flow (i.e., “vapor-phase of a first counter-reactant”) are sequential and form a sub-layer on the substrate. Ex. Declaration. Berney also discloses “[a] second organometallic precursor (different from the first) may then be flowed across the substrate to create a second sub-layer on top of the first sub-layer.” *Id.*, ¶ 0066. A POSA would understand that first sub-layer would include the layer formed from the sequential flow of the first vapor flow (i.e., “vapor-phase of a first organometallic precursor”) and the second vapor flow (i.e., “vapor-phase

of a first counter-reactant”), and therefore the third vapor flow (i.e., “vapor-phase of a second organometallic precursor”) is also sequential. EX1001 at claim 16.

171. Additionally, Berney discloses an apparatus for providing photoresist films comprising “a controller having one or more processors...to a) cause...**a first valve...to be actuated to cause a vapor-phase of a first organometallic precursor to be flowed...into the reaction space...and b) cause...a second valve...to be actuated to cause a vapor-phase of a first counter reactant to be flowed...into the reaction space...**” EX1020 at 32:1-23. The apparatus also is capable of “controlling the one or more processors to: c) cause...**a third valve...to be actuated to cause a vapor-phase of a second organometallic precursor to be flowed...into the reaction space...**” *Id.*, at 34:19-24. A POSA would understand that the first valve and the second valve represent the first vapor inputting structure and second inputting structure, respectively. EX1001 at claim 16.

172. For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

173. Thus, a POSA would understand that Berney discloses a first vapor inputting structure (i.e. “first valve”) is configured to deliver a first vapor flow (i.e. “vapor-phase of a first organometallic precursor”) and a second vapor inputting structure (i.e., “second valve”) is configured to deliver a second vapor flow (i.e., “vapor-phase of a first counter reactant”), wherein the first vapor flow (i.e.,

“vapor-phase of a first organometallic precursor”), the second vapor flow (i.e., “vapor-phase of a first counter reactant”), and a third vapor flow (i.e., “vapor-phase of a second organometallic precursor”) are sequential (i.e., “stop the flow of the organometallic precursor and start the flow of the counter-reactant through the showerhead 110”; “alternate flows of organometallic precursor and counter-reactant”). EX *Id.*, at claim 16.

174. A POSA would also understand that there are a limited number of obvious choices of continuous or alternating delivery methods, which would have been obvious-to-try.

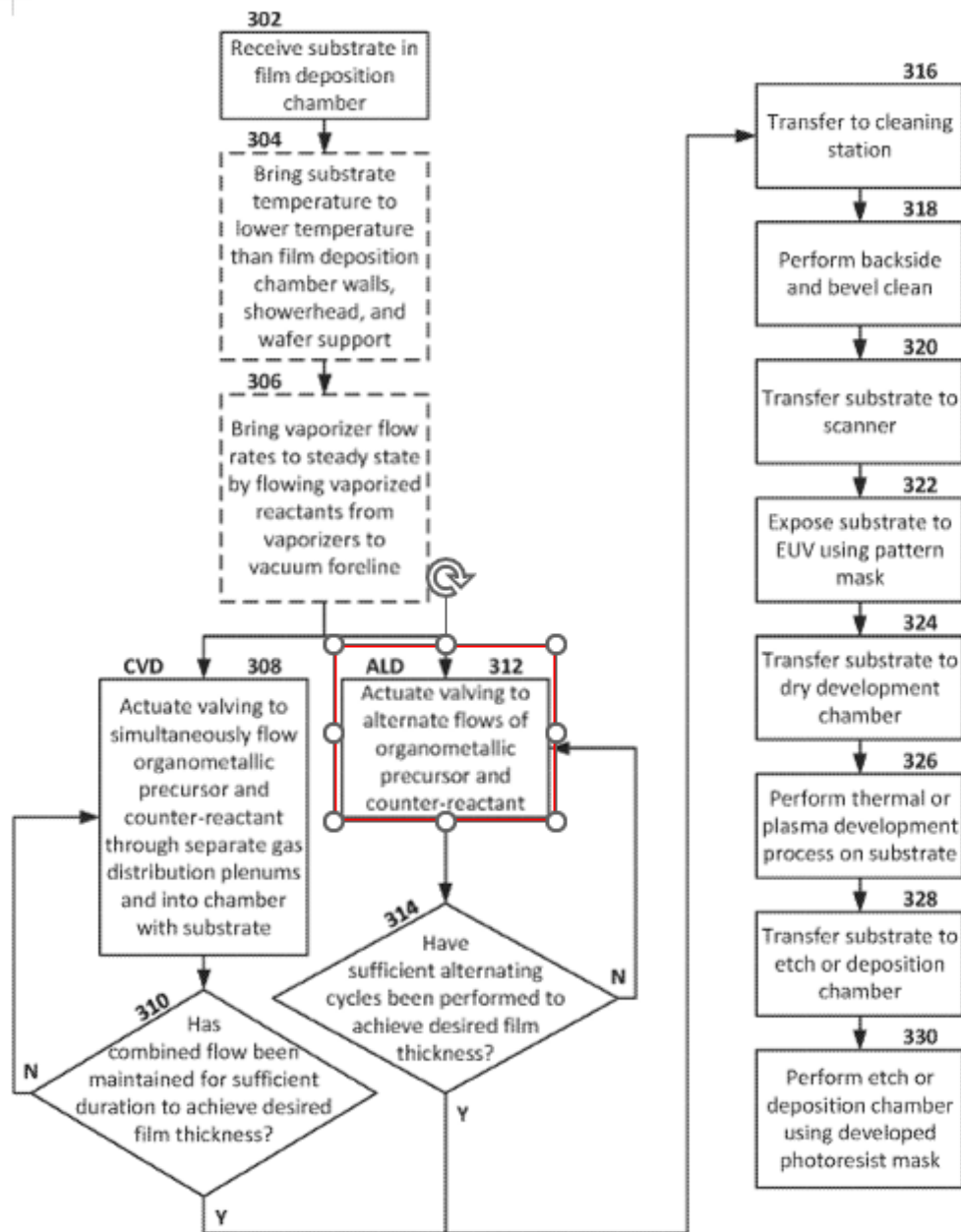


Figure 3

EX1020 at Figure 3 (annotated).

(15) Claim 17

175. Claim 17 depends on claim 1 and recites “a first vapor inputting

structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are **at the same time** and a **third vapor flow is sequential.**”

176. For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

177. Berney discloses that “the controller may be configured to cause an organometallic precursor and a corresponding counter-reactant to be simultaneously dispensed from their respective vaporizers 172 and through respective plenums of the showerhead 110 into the reaction space 120 for a given duration of time” as described in block 308 of Figure 3 below. *Id.*, ¶ 0064. A POSA would understand that the first vapor flow (i.e., flow of the organometallic precursor from its respective vaporizer) and the second vapor flow (i.e., flow of the counter-reactant from its respective vaporizer) are at the same time and form a sub-layer on the substrate. EX1001 at claim 17.

178. Berney also discloses “[a] **second organometallic precursor** (different from the first) **may then be flowed across the substrate to create a second sub-layer** on top of the first sub-layer.” EX1020 ¶ 0066.

179. Additionally, Berney discloses an apparatus for providing photoresist films comprising “a controller having one or more processors...to a) cause...a **first**

valve...to be actuated to cause a vapor-phase of a first organometallic precursor to be flowed...into the reaction space...and b) cause...a second valve...to be actuated to cause a vapor-phase of a first counter reactant to be flowed...into the reaction space... *Id.*, 32:1-23. The apparatus also is capable of “controlling the one or more processors to: c) cause...**a third valve...to be actuated to cause a vapor-phase of a second organometallic precursor to be flowed...into the reaction space...**” *Id.*, 34:19-24. A POSA would understand that the first valve and the second valve represent the first vapor inputting structure and second inputting structure, respectively. EX1001 at claim 17.

180. The apparatus further includes a “first vaporizer,” “second vaporizer,” and “third vaporizer, and located within each vaporizer is a quantity of “the first organometallic precursor,” “the first counter-reactant,” and “the second organometallic precursor,” respectively. EX1020 35:7-9. The apparatus can be used to “**perform (a) and (b) to form a first sublayer on a substrate...and f) perform...(c)...to form a second sub-layer on top of the first sub-layer.**” *Id.*, 35:15-18. Berney discloses “perform[ing] (a) and (b) simultaneously.” *Id.*, 34:12. A POSA would understand that first sub-layer would include the layer formed from the flow of the first vapor flow (i.e., “vapor-phase of a first organometallic precursor”) and the second vapor flow (i.e., “vapor-phase of a first counter reactant”) at the same time, and the second sub-layer would be formed after

formation of the first sub-layer, and therefore the third vapor flow (i.e., “vapor-phase of a second organometallic precursor”) is sequential. EX1001 at claim 17.

181. Thus, a POSA would understand that Berney discloses a first vapor inputting structure (i.e., “first valve”) is configured to deliver a first vapor flow (i.e., “vapor-phase of a first organometallic precursor”) and a second vapor inputting structure (i.e., “second valve”) is configured to deliver a second vapor flow (i.e., “vapor-phase of a first counter reactant”), wherein the first vapor flow (i.e., “vapor-phase of a first organometallic precursor”) and the second vapor flow (i.e., “vapor-phase of a first counter reactant”) are at the same time (i.e., “cause an organometallic precursor and a corresponding counter-reactant to be simultaneously dispensed”; “perform[ing] (a) and (b) simultaneously”), and a third vapor flow (i.e., “vapor-phase of a second organometallic precursor”) is sequential (i.e., “stop the flow of the organometallic precursor and start the flow of the counter-reactant through the showerhead 110”; “alternate flows of organometallic precursor and counter-reactant”).

182. A POSA would also understand that there are a limited number of obvious choices of continuous or alternating deliver methods, which would have been obvious-to-try.

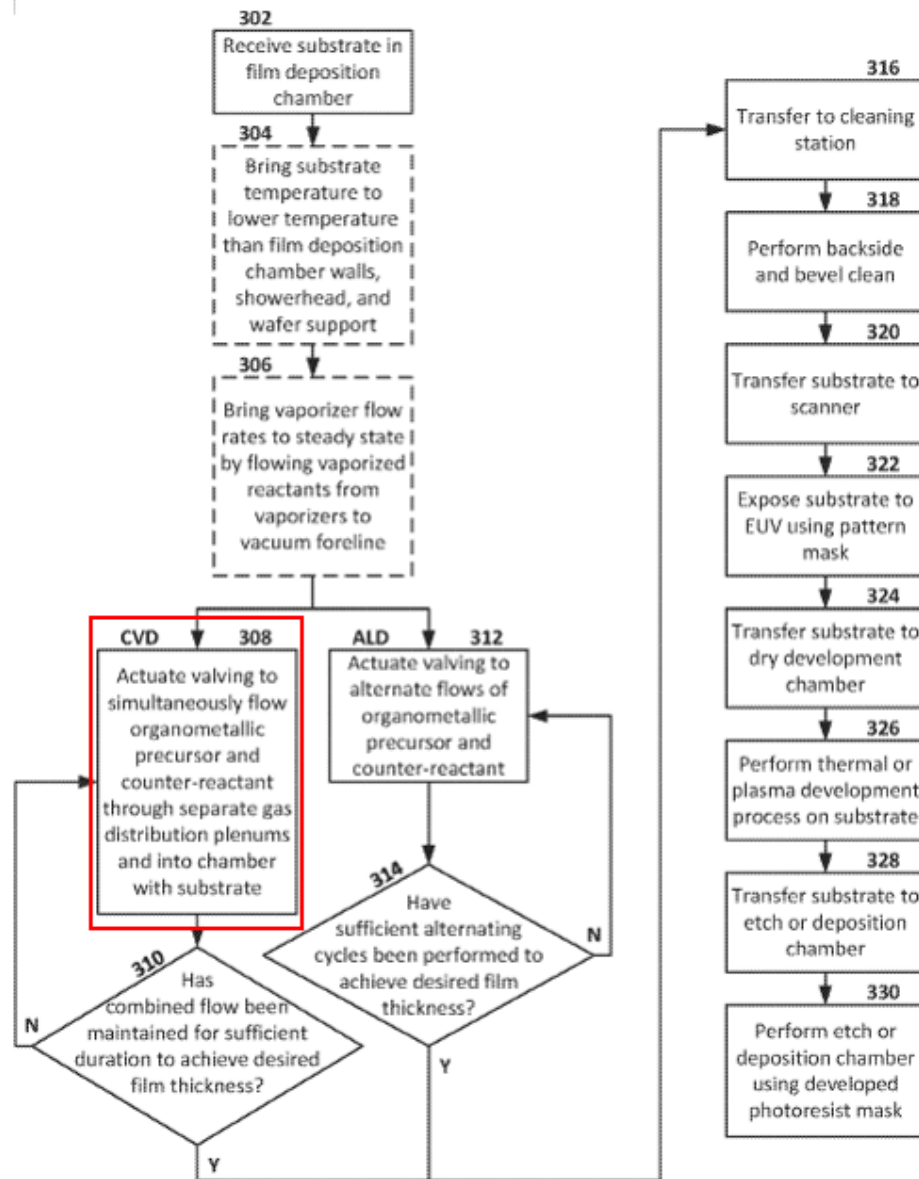


Figure 3

EX1020 at Figure 3 (annotated).

(16) Claim 18

183. Claim 18 depends on claim 1 and recites “the interior has a temperature from about 45° C. to about 200° C.” Berney discloses “maintain[ing]

the **temperature of the interior wall surfaces of the processing chamber**

102...to between 80 °C and 120 °C, e.g., 100 °C.” *Id.*, ¶ 0062.

(17) Claim 19

184. Claim 19 depends on claim 1 and recites “X is alkylamido or dialkylamido.” Berney discloses that L can be “a moiety that is an amine (such as a **dialkylamino or monoalkylamino group**).” *Id.*, ¶ 0023. A POSA would understand that ligand L of Berney is analogous to X, and the monoalkylamino and dialkylamino groups of Berney are alkylamino and dialkylamido groups, respectively. v. Berney also discloses specific examples of tin precursors with dialkylamido groups of X. “For example, where M is tin, such precursors include...i-propyltris(**dimethylamino**¹²...” *Id.*, ¶ 0024. A POSA would understand that dimethylamino is dialkylamido as defined in claim 1 ($\text{—NR}^1\text{R}^2$, where R^1 and R^2 are each methyl (hydrocarbon group with 1 carbon atom). EX1001 at claim 19.

(18) Claim 20

185. Claim 20 depends on claim 1 and recites “X is alkoxo and aryloxo.” Berney discloses that ligand L can be “an **alkoxy** group.” EX1020 ¶ 0023. A

¹² The '048 patent also teaches i-propyltris(dimethylamino)tin ((iPrSn(NMe₂)₃) as an organometallic precursor. EX1020 at 27:10-23.

POSA would understand that ligand L of Berney is analogous to X, and the alkoxy groups of Berney are alkoxy groups. Ex. Declaration. Berney also discloses specific examples of tin precursors with alkoxy groups of X. “For example, where M is tin, such precursors include...alkyl(tris)(**t-butoxy**) tin compounds such as t-butyl tris(**t-butoxy**) tin¹³.” *Id.*, ¶ 0024. A POSA would understand that t-butoxy is alkoxy as defined in claim 1 (—OR, where R is t-butyl (hydrocarbon group with 4 carbon atoms). EX1001 at claim 20.

C. Ground 3: Claims 6 and 7 Are Obvious Over Berney in view of Molloy

(1) Claim 6

186. In my opinion, the Berney and Molloy combination discloses claim 6, which depends on claim 1 and recites “further comprising a flow comprising a third precursor vapor comprising a composition represented by the formula ML_v , where v is $2 \leq v \leq 6$ and L is an oxidizable ligand or a ligand having a hydrolysable M-L bond or a combination thereof, and M is a metal selected from groups 2-16 of the periodic table.”

187. It is my opinion that this combination discloses each limitation of

¹³ The '048 patent also teaches $(CH_3)_3CSn(O^tBu)_3$ (t-butyl tris(t-butoxy) tin) as a precursor compound for use of vapor deposition. EX1001 at 18:42.

claim 1 for the reasons discussed in Ground 2. All reasoning and support for that ground is incorporated herein.

188. Moreover, Berney also discloses that “**more than one organometallic precursor** is included in the vapor stream.” EX1020 ¶ 0017. Also, “[t]he depicted **apparatus 100...is configured to provide multiple organometallic precursors**. *Id.*, ¶ 0017. From this, a POSA would understand Berney to disclose at least a third precursor vapor.

189. Berney also discloses applying a second organometallic precursor on the substrate: “**A second organometallic precursor (different from the first) may then be flowed** across the substrate to create a second sub-layer...” EX1020 ¶ 0066. Although Berney does not disclose a composition represented by the formula ML_v , a POSA would have known that compounds of formula ML_v were being used as precursors in vapor deposition techniques and would have had an expectation that the compositions of formula ML_v could successfully be included in a third precursor vapor. EX1001 at claim 6.

190. Molloy discloses inorganic tin compounds for chemical vapor deposition purposes, CVD purposes, including $SnMe_4$, a “precursor of choice” in dual-source CVD processes that provide films with desirable properties produced with high deposition rates (“polycrystalline with a refractive index of 2.00–2.10, have visible-light transmission of 84% and resistivity of $0.6 \Omega cm$ ” (citations

omitted)) and deposition temperatures as low as 30°C. EX1009, 549-550.

191. A POSA would further understand that SnMe_4 is a composition represented by the formula ML_v , where M is tin (Sn; group 14 of the periodic table), v is 4, and L is methyl (Me), which is a ligand having a hydrolysable M-L bond.

192. A POSA would appreciate that Berney and Molloy are analogous art, and would have been motivated to combine the references because Berney discloses beneficial properties with using a second organometallic precursor, and Molloy teaches organometallic (e.g. organotin) precursors. A POSA would have been motivated to select SnMe_4 (i.e. a compound of formula ML_v) for inclusion in the third vapor precursor in order to obtain a film with the desirable properties described by Molloy. Finally, a POSA would have had a reasonable expectation of success that Molloy's precursors could form a film using the apparatus of Berney since Molloy teaches that SnMe_4 is a precursor for vapor deposition methods.

(2) Claim 7

193. The Berney and Molloy combination discloses claim 7, which depends on claim 6 and recites that “the third precursor vapor comprises SnL_4 .” Berney discloses that “In some embodiments, **more than one organometallic precursor** is included in the vapor stream.” EX1020 ¶ 0017. Also “[t]he depicted **apparatus 100...is configured to provide multiple organometallic precursors.**

Id., ¶ 0017. From this, a POSA would understand Berney to disclose at least a third precursor vapor. EX1001 at claim 7. Berney also discloses applying a second organometallic precursor on the substrate: “**A second organometallic precursor (different from the first) may then be flowed** across the substrate to create a second sub-layer...” EX1020 ¶ 0066. Berney discloses that using a second organometallic precursor can provide beneficial properties during exposure, such as offsetting potential gradient effects. EX1020 ¶0066.

194. Although Berney does not disclose compounds of formula SnL_4 , a POSA would have known that compounds of formula SnL_4 were being used as precursors in vapor deposition techniques and would have had an expectation that the compositions of formula ML_v could successfully be included in a third precursor vapor.

195. Molloy discloses inorganic tin compounds for chemical vapor deposition purposes, CVD purposes, including SnMe_4 , a “precursor of choice” in dual-source CVD processes that provide films with desirable properties produced with high deposition rates (“polycrystalline with a refractive index of 2.00–2.10, have visible-light transmission of 84% and resistivity of $0.6 \Omega\text{cm}$ ” (citations omitted)) and deposition temperatures as low as 30°C . EX1009, 549-550.

196. A POSA would further understand that SnMe_4 is a composition represented by the formula SnL_4 , where M is tin (Sn; group 14 of the periodic

table) and L is methyl (Me), which is a ligand having a hydrolysable M-L bond.

197. A POSA would appreciate that Berney and Molloy are analogous art, and would have been motivated to combine them because Berney discloses benefits of using a second organometallic precursor, and Molloy teaches organometallic (e.g. organotin) precursors. A POSA would have been motivated to select SnMe_4 (i.e. a compound of formula SnL_4) for inclusion in the third vapor precursor in order to obtain a film with the desirable properties described by Molloy. Finally, it is my understanding that a POSA would have had a reasonable expectation of success that Molloy's precursors could form a film using the apparatus of Berney since Molloy teaches that SnMe_4 is a precursor for vapor deposition methods.

X. PETITION 2: IPR2024-00309 (EARLIER PRIORITY DATE)

A. Ground 1: Claims 1-6 And 8-20 Are Obvious Over Dhas and Cardineau

198. In my opinion Dhas's vapor deposition system alone or in combination with Cardineau discloses or suggests each and every limitation of claims 1-20 of the '048 Patent. Thus, Dhas, alone or in combination with Cardineau, anticipates or renders obvious those claims.

(2) Claim 1

a. Preamble: "system comprising"

199. Dhas discloses a system, i.e., an "**apparatus** for preparing a reaction

chamber and depositing materials on substrates.” EX1007 at 1:18-20. Cardineau also discloses methods of preparing photoresists by spincoating organotins onto silicon substrates. EX1008 at 48.

b. “deposition chamber having an interior isolated from the ambient atmosphere”

200. Dhas discloses a reaction chamber process station “having a **process chamber** body 802 for maintaining a low pressure environment” as shown in Figure 8 below. EX1007 at 19:65-20:4. A POSA would understand that to maintain a low pressure environment as compared to ambient atmosphere, the interior of the process chamber is isolated from the ambient atmosphere.

.

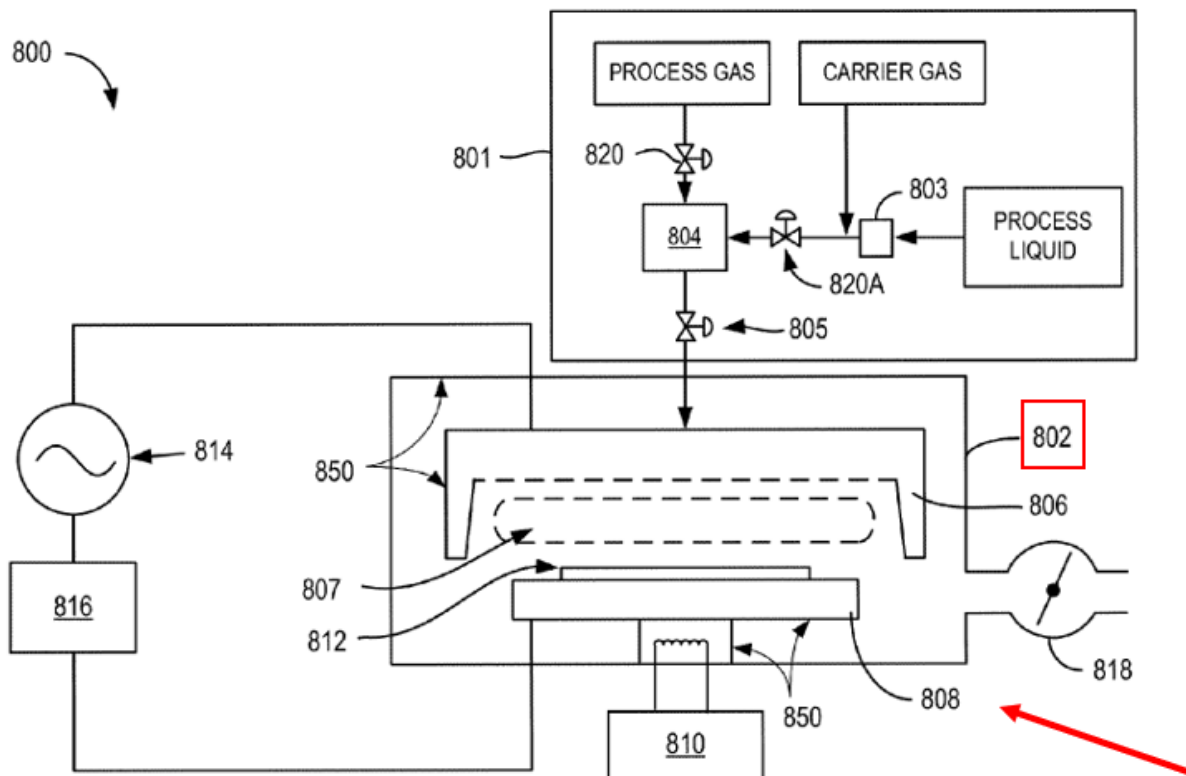


FIG. 8

EX1007 at Figure 8 (annotated).

- c. **“substrate within the interior of the deposition chamber configured to receive a deposition on a surface of the substrate”**

201. Dhas discloses a **“substrate 812 in the process station 800”** as shown in Figure 8 below. *Id.*, at 23:36-37. The substrate “is introduced to the process station 800...to be used for **depositing film on the substrate 812.**” *Id.*, at 23:39-42. “Showerhead 806 distributes process gases toward substrate 812.” *Id.*, at

21:5-6. A POSA would understand that if films are deposited on the substrates of Dhas, these substrates are capable of receiving a deposition on their surface.

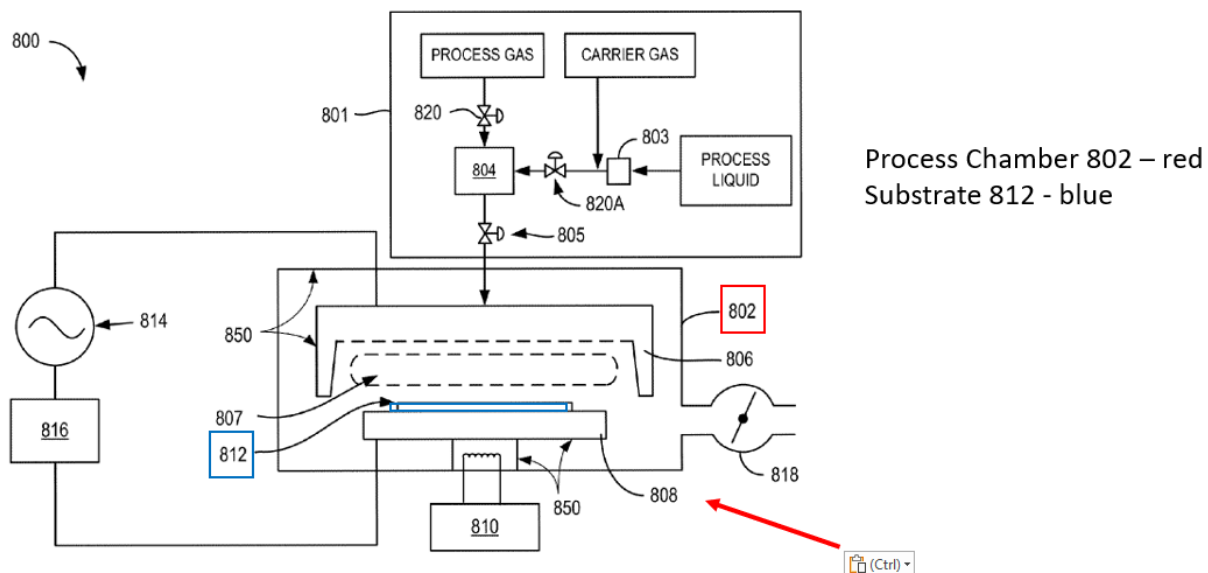


FIG. 8

EX1007 at Figure 8 (annotated).

d. “the substrate is maintained at a temperature of less than 200° C”

202. Dhas discloses that “temperature of the substrate may be maintained between about 180-550°C,” which overlaps with a temperature of less than 200° C.

EX1007 at 17:12-13.

203. Dhas’s disclosed temperature range of 180 °C to 550 °C anticipates the claimed range of “less than 200° C, since “[a] prior art reference that discloses

an overlapping but different range than the claimed range can be anticipatory.”

This is true “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).

204. From my understanding, if Dhas’s temperature range is broader than the claimed range, then there is no identifiable criticality of the claimed dimension demonstrated in the ’048 patent. Thus, in my opinion the patentee has not established that the claimed range is “critical to the operability of the claimed invention.” *UCB, Inc. v. Actavis Labs. UT, Inc.*, 65 F.4th 679 (2023).

205. Further, if Dhas’s claimed ranges do not anticipate, it is my understanding that they at least render the claim obvious based on the overlapping ranges, since the case law is clear that “[o]nce 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.* Here, the ’048 Patent does not include any embodiments using the claimed range, and the specification includes vague statements about the claimed temperature. ADD A COUPLE OF EXEMPLARY CITATIONS.

e. “an inlet into the deposition chamber”

206. Dhas discloses that “[t]he apparatus may include a reaction

chamber having one or more inlets for delivering gas phase reactants, a heated injection module coupled with the inlet for vaporizing and/or atomizing liquid phase reactants, an outlet for removing materials from the reaction chamber, a plasma generation source for exposing the reaction chamber to plasma, and a controller configured to perform any of the methods disclosed herein.” EX1007 at 3:16-24. Dhas also discloses a heated injection module with a conduit leading to a reaction chamber, as shown in Figure 7 below.¹⁴ Dhas states: “In this state, the TEOS is carried by the helium and co-reactant out of the heated injection module 700 through conduit 706. The atomized TEOS may be vaporized in conduit 706, which may also be heated. Alternatively or in addition, the TEOS may flash vaporize as it enters the heated injection module. The conduit 706 may lead to a reaction chamber. The inclusion of helium in this atomization process helps ensure that conduit 706 leading to the reaction chamber and the gas therein are maintained at a stable, uniform temperature.”).

¹⁴ Dhas discloses that Figure 8 incorporates Figure 7: “The vaporization point 803 may be the heated injection module shown in FIG. 7, for example.” EX1007 at 20:21-11.

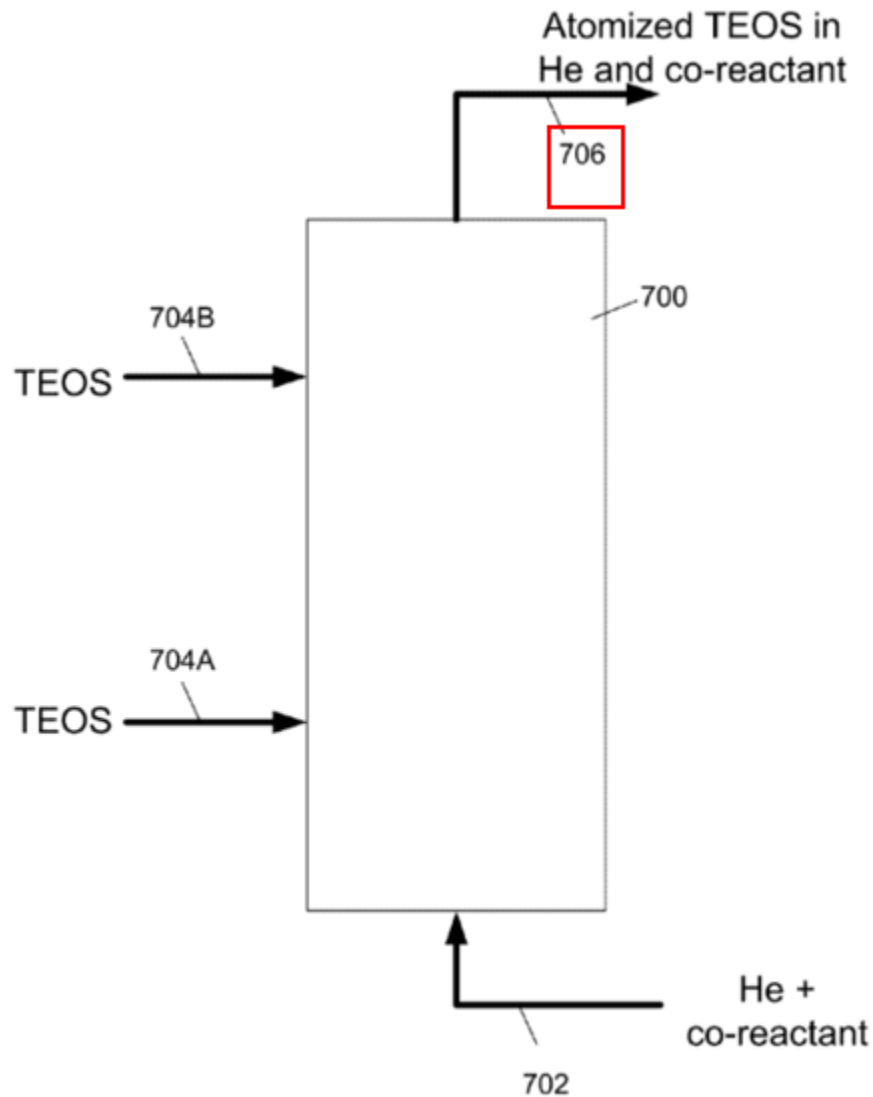


FIG. 7

Id. at Figure 7 (annotated).

f. “structure configured to deliver flow from a supply of an inert gas”

207. In my opinion, Dhas performs the function: “to deliver flow from a supply of inert gas.” Dhas discloses a conduit that delivers helium (an inert gas).

EX1007, 19:27-30

208. In my opinion, a POSA would understand that Figure 16 of the '048 Patent is a conduit configured to deliver flow from a supply of an inert gas, e.g., connecting “vessel 168” to “supply of inert gas 170,” and equivalents thereof, or, if not tied to Figure 16, a conduit (like a pipe) to a supply of inert gas, e.g., connecting to an interconnected vessel (like a vaporization chamber), and equivalents thereof.

209. Dhas discloses a conduit that delivers helium (an inert gas) and a reactant: “FIG. 7 shows a simplified representation of a heated injection module 700 used in the context of deposition using TEOS and a co-reactant such as oxygen. The **helium** and **optional co-reactant** are **delivered** through **conduit 702**” as shown in Figure 7 below. *Id.*, 19:27-30. Dhas additionally discloses that “[f]or example, the instructions may include flowing a liquid reagent and helium into a heated injection module at certain flow rates to atomize/vaporize the liquid reagent, **and flowing the vaporized stream to the reaction chamber.**” *Id.*, 22:63-67.

210. Thus, in my opinion Dhas discloses “a structure configured to deliver flow from a supply of an inert gas.”

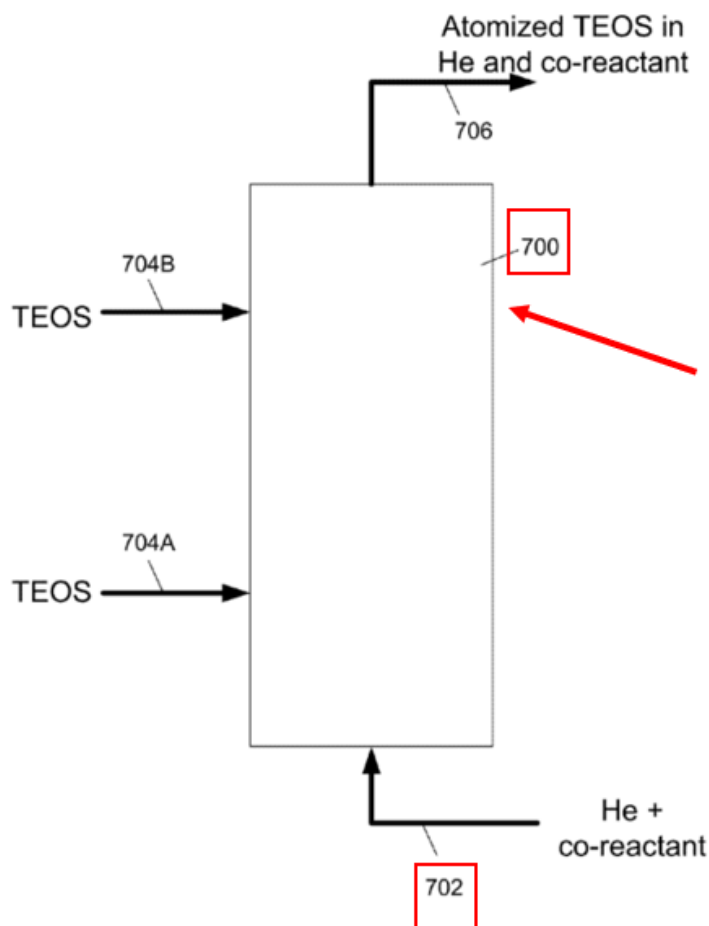


FIG. 7

Id. at Figure 7 (annotated).

g. “a supply of an organotin composition comprising a compound described by the formula RSnX_3 , where R is an organic ligand with 1-31 carbon atoms and is bound to Sn with a metal-carbon bond”

211. From my understanding, although Dhas does not teach a supply of an organotin composition described by the formula RSnX_3 , Dhas teaches depositing organometallics with water: “In certain cases, the deposited film contains **metal**...Example precursors may include... **organometallics**, etc. Appropriate

metal-containing precursors will include the metal that is desired to be incorporated into the film...The embodiments may also be practiced with a variety of co-reactants...The co-reactants are often, but not always, nitrogen- or **oxygen-containing reactants**...Examples of oxygen-containing co-reactants include ... **water**, mixtures thereof, etc.” *Id.*, 17:61-18:30.

212. Dhas discloses exposing a photoresist to UV light. *Id.*, 26:31-47. (“Lithographic patterning of a film typically comprises some or all of the following steps, each step enabled with a number of possible tools: (1) application of photoresist on a workpiece... **(3) exposing the photoresist to visible or UV or x-ray light ...**”).

213. In my opinion, Cardineau discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Cardineau explains that “[b]oth tin and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon” such that “these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise.” EX1008 at 45. Cardineau also discloses the importance of EUV in microelectronics: “Extreme ultraviolet (EUV, 13.5-nm wavelength) lithography is thought to be the next imaging technology for

fabricating microelectronic devices....” *Id.* at 44.

214. Based on my understanding, Cardineau’s tin-oxo clusters are prepared from the organotin trichlorides allyltin trichloride, butyltin trichloride and phenyltin trichloride. *Id.* at 49 (“Organotin trichloride was quickly added to the flask while stirring, and the solution was refluxed for 30 min. ... **Allyltin trichloride** (3.992 g, 15 mmol) was used as the organotin trichloride... **Butyltin trichloride** (4.233, 15 mmol) was used as the organotin trichloride...**Phenyltin trichloride** (4.533 g, 15 mmol) was used as the organotin trichloride.”). Allyltin trichloride, butyltin trichloride, and phenyltin trichloride are compounds “represented by the formula RSnX_3 wherein R is an organic ligand with 1-31 carbon atoms bound to Sn with a metal-carbon bond” and X is Chloro (Cl). *See Id.* at 44 (“Here we describe the synthesis and lithographic evaluation of thin films of tin-oxo clusters ($[(\text{RSn})_{12}\text{O}_{14}(\text{OH})_6]\text{X}_2$, Fig. 1A) using extreme ultraviolet light (EUV, 13.5 nm).”).

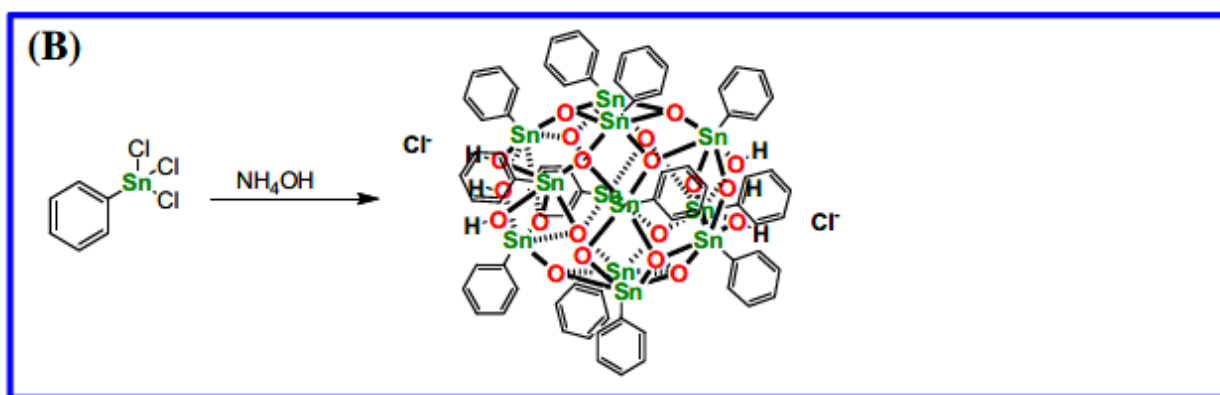


Fig. 6B, *Id.* at 48.

215. In my opinion, as EUV lithography gained prominence over UV lithography, a POSA would have been motivated to modify Dhas to work with Cardineau's chemistry. The references are also analogous, both relating to the same subject matter as the '048 Patent—i.e., the preparation of photoresists. A POSA also would have been motivated to use Cardineau's precursors for more reliable coating, and also to use tin precursors to achieve the superior lithographic performance and improved sensitivity and lower shot noise of films as disclosed by Cardineau. EX1008, 45.

216. Finally, a POSA would have reasonably expected Cardineau's precursors to successfully form a photoresist layer in Dhas's apparatus, which teaches depositing organometallics with water, since Cardineau teaches an organometallic (organotin) that reacts with components of water such as hydroxyl groups (i.e. are hydrolysable) to form tin clusters. EX1008, 44 ("Several hydrolysis methods were subsequently attempted, and hydrolysis of the organotin trichloride using ammonium hydroxide proved the most successful route"), 48 ("Hydrolysis of phenyltin trichloride using ammonium hydroxide produces a soluble polymeric material which shows evidence that it is the tin cluster").

h. "wherein X is selected from the group consisting of alkylamido or dialkylamido ($\text{—NR}^1\text{R}^2$, where R^1 and R^2 are independently hydrocarbon groups with 1-10

carbon atoms or hydrogen), siloxo ($\text{—OSiR}^1\text{R}^2\text{R}^3$, where $\text{R}^1, \text{R}^2, \text{R}^3$ are independently hydrocarbon groups with 1-10 carbon atoms), silylamido ($\text{—N(SiR}^1_3\text{)(R}^2\text{)}$, where R^1 and R^2 are independently hydrocarbon groups with 1-10 carbon atoms), disilylamido ($\text{—N(SiR}^1_3\text{)(SiR}^2_3\text{)}$ where R^1 and R^2 are independently hydrocarbon groups with 1-10 carbon atoms), alkoxo and aryloxo (—OR , where R is an alkyl or aryl group with 1-10 carbon atoms), azido (—N_3), alkynido ($\text{—C}\equiv\text{CR}$, where R is a hydrocarbon group with 1-9 carbon atoms), amidato ($\text{—NR}^1(\text{COR}^2)$ where R^1 and R^2 are independently hydrocarbon groups with 1-7 carbon atoms or hydrogen), amidinato ($\text{—NR}^1\text{C(NR}^2\text{)R}^3$) where R^1 and R^2 are independently hydrocarbon groups with 1-8 carbon atoms or hydrogen), imido ($\text{—N(COR}^1\text{)(COR}^2\text{)}$, where R^1 and R^2 are independently hydrocarbon groups with 1-8 carbon atoms or hydrogen), or fluorinated analogues thereof, or combinations thereof” (hereinafter “X group limitation”)

217. I note that Dhas discloses depositing films containing metal, and metal alkoxides and metal alkylamides as precursors for the metal-containing films: “In certain cases, the deposited film contains **metal**. Examples of metal-containing films that may be formed include ...**metal alkoxides**...” EX1007 at 17:61-18:1. Dhas also discloses specific examples of metal-containing precursors that include alkoxo and dialkylamido ligands: Further examples of metal-containing precursors that may be employed include ...**tetraethoxytitanium**...” *Id.*, 18:5-10.

218. Dhas does not specifically disclose **tin** precursor compounds having alkoxo (alkoxide) substituents. However, I note that Cardineau discloses tin

compounds for use as EUV photoresists because of tin's higher EUV absorbance. Specifically, Cardineau explains that "[b]oth tin and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon" such that "these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise." EX1008 at 45.

219. I also note that Cardineau discloses organotins having ligands X that are alkoxo groups (alkoxo is —OR, where R is an alkyl group with 1-10 carbon atoms): "[t]in clusters have been synthesized by either the dehydration of butylstannoic acid, or the controlled hydration of butyltin trichloride, **butyltin trialkoxide** or butyltin trialkyne." *Id.*, 47 (citations omitted). A POSA would have been motivated to use an organotin with an alkoxo ligand of Cardineau in Dhas's apparatus because Dhas discloses metal alkoxides as a precursor for metal-containing films, and also to use tin precursors to achieve the superior lithographic performance and improved sensitivity and lower shot noise of films as disclosed by Cardineau.

- i. **"structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet"**

220. In my opinion Dhas performs the function: to deliver flow of a first

precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet.” Dhas discloses that liquid reagent vapors can be delivered with a carrier gas, such as argon (i.e. an inert gas). Dhas does not specifically disclose organotins, but in analogous art Cardineau discloses organotin precursors for resists. EX1007 at 49.

221. From my understanding, Figure 16 of the '048 Patent is “vessel 168 and the conduit extending from the vessel 168 to the inlet 152” and equivalents thereof or, if not tied to Figure 16, “a class of structures for delivering flow, i.e., an interconnected vessel (such as a vaporization chamber, as recited in claim 4) and conduit (such as a pipe)” and equivalents thereof. Dhas discloses this structure.

222. From my understanding, Dhas discloses a heated injection module that delivers helium (an inert gas) and a reactant: “FIG. 7 shows a simplified representation of **a heated injection module 700** used in the context of deposition using TEOS and a co-reactant such as oxygen. EX1007 at 19:27-29. Dhas additionally discloses that “[f]or example, the instructions may include **flowing a liquid reagent and helium into a heated injection module at certain flow rates to atomize/vaporize the liquid reagent, and flowing the vaporized stream to**

the reaction chamber.” *Id.*, 22:63-67. Dhas also discloses¹⁵ *Id.*, 19:43-52 (“In this state, the TEOS is carried by the helium and co-reactant out of the heated injection module 700 through conduit 706. The atomized TEOS may be vaporized in conduit 706, which may also be heated. Alternatively or in addition, the TEOS may flash vaporize as it enters the heated injection module. The conduit 706 may lead to a reaction chamber. The inclusion of helium in this atomization process helps ensure that conduit 706 leading to the reaction chamber and the gas therein are maintained at a stable, uniform temperature.”).

223. I also note that Dhas discloses inlets in the reaction chamber: “The apparatus may include a reaction chamber having one or more inlets for delivering gas phase reactants, a heated injection module coupled with the inlet for vaporizing and/or atomizing liquid phase reactants, an outlet for removing materials from the reaction chamber, a plasma generation source for exposing the reaction chamber to plasma, and a controller configured to perform any of the methods disclosed herein.” *Id.*, 3:16-24.

224. Dhas also discloses a showerhead for distributing process gases toward the substrate. *Id.*, 21:5-8. (“Showerhead 806 distributes process gases

¹⁵ Dhas discloses that Figure 8 incorporates Figure 7: “The vaporization point 803 may be the heated injection module shown in FIG. 7, for example.” EX1007 at 20:21-11.

toward substrate 812. In the embodiment shown in FIG. 8, substrate 812 is located beneath showerhead 806, and is shown resting on a pedestal 808). Dhas also teaches a conduit and valve in Figure 8.

225. Thus, based on my understanding Dhas discloses a structure to deliver a first precursor vapor (e.g., Dhas' precursor reactant vapor) Precursor “A” reactant)) from the supply of the organotin compound (e.g., Cardineau's organotin compound from Dhas' the ampoule injection module 700) with the inert gas as a carrier gas (e.g., Dhas' argon or helium) to the inlet.

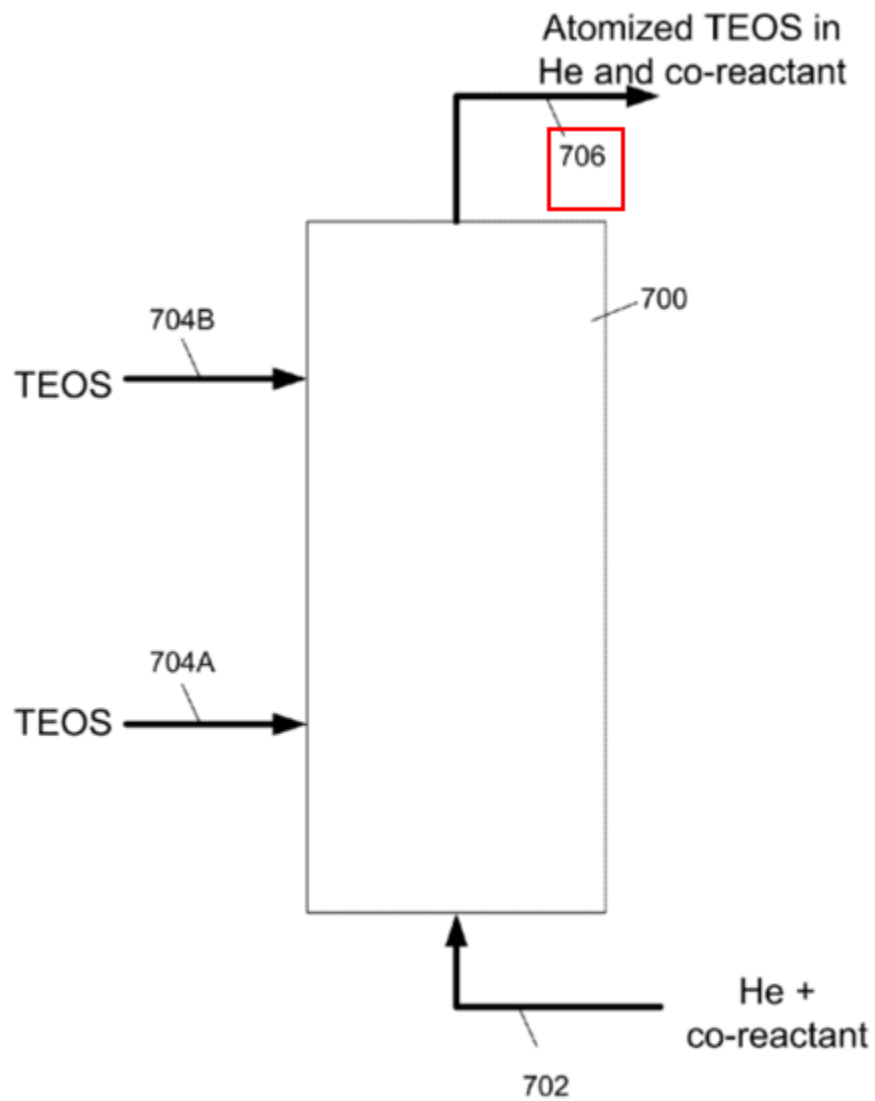


FIG. 7

Id. at Figure 7 (annotated).

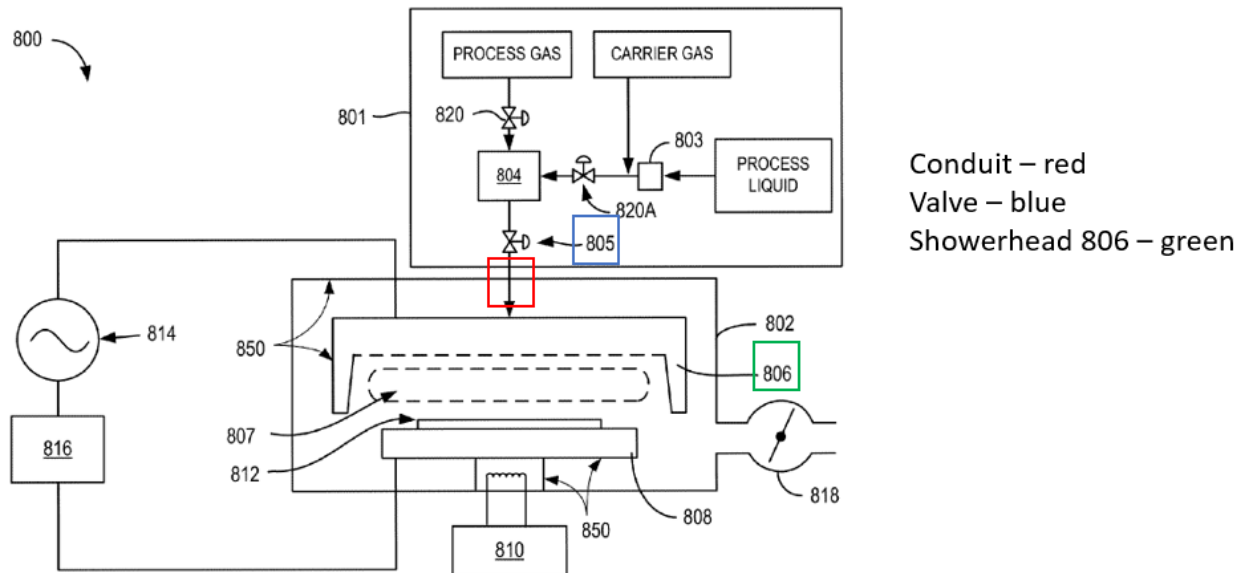


FIG. 8

Id. at Figure 8 (annotated).

j. “to provide for formation of an organotin layer on the substrate surface within the deposition chamber”

226. I note that Dhas discloses deposited metal-containing films, although Dhas does not specifically disclose deposited organotin-containing films: “In certain cases, the deposited film contains **metal**. Examples of metal-containing films that may be formed include oxides and nitrides of aluminum, titanium, hafnium, tantalum, tungsten, manganese, magnesium, strontium, etc., as well as elemental metal films. *Id.*, 17:61-65.

227. However, in my opinion Cardineau discloses tin compounds for use as

EUV photoresists because of tin's higher EUV absorbance. Specifically, Cardineau explains that "[b]oth **tin** and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon" such that "these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise." EX1008 at 45.

228. From my understanding, a POSA would have been motivated to use Cardineau's tin precursors to form an organotin layer on the substrate surface in Dhas's chamber to achieve improved EUV absorbance.

k. "structure to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the first precursor vapor"

229. In my opinion, Dhas performs the function: "to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet."

230. In my opinion, the Figure 16 of the '048 Patent is "vessel 168 and the conduit extending from the vessel 168 to the inlet 152" and equivalents thereof or, if not tied to Figure 16, "a class of structures for delivering flow, i.e., an interconnected vessel (such as a vaporization chamber, as recited in claim 4) and

conduit (such as a pipe)” and equivalents thereof.

231. I note that Dhas discloses one or more inlets in the reaction chamber: “[t]he apparatus may include a reaction chamber having one or more inlets for delivering gas phase reactants, a heated injection module coupled with the inlet for vaporizing and/or atomizing liquid phase reactants, an outlet for removing materials from the reaction chamber, a plasma generation source for exposing the reaction chamber to plasma, and a controller configured to perform any of the methods disclosed herein.” EX1007 at 3:16-24.

232. Based on my review, Dhas discloses a vaporization point, which may be a heated injection module. *Id.*, 20:18-22. (“The embodiment of FIG. 8 includes a vaporization point 803 for vaporizing liquid reactant to be supplied to mixing vessel 804. The vaporization point 803 may be the heated injection module shown in FIG. 7, for example.”) Dhas additionally discloses that “[f]or example, the instructions may include **flowing a liquid reagent and helium into a heated injection module at certain flow rates to atomize/vaporize the liquid reagent, and flowing the vaporized stream to the reaction chamber.**” *Id.*, 22:63-67.

Dhas discloses that oxygen-containing co-reactants include water: “Examples of oxygen-containing co-reactants include **water**, mixtures thereof, etc.” *Id.* at 17:61-18:30, and at 19:27-30. Dhas discloses “[o]ne or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in

Figure 8 below. Dhas also discloses conduits from the process gas to mixing vessel 804, and from vaporization point 803 to mixing vessel 804, and a conduit and a valve 805 to the chamber, as shown in Figure 8 below. Thus, in my opinion Dhas discloses “a structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet.”

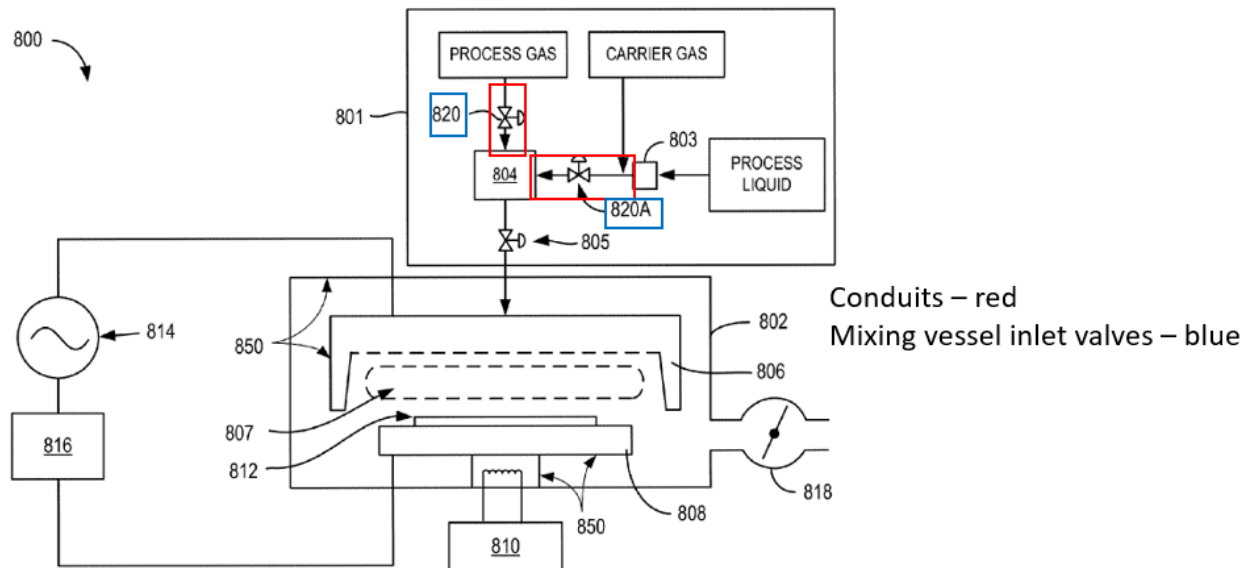


FIG. 8

Id. at Figure 8 (annotated).

- I. “under conditions in the deposition chamber to form a composition with non-volatile components and a volatile component comprising hydrolysis reaction product with X”

233. In my opinion, Dhas discloses the formation of a composition with non-volatile components (chemisorbed molecules of first film precursor P1) and a volatile component (gas phase and physisorbed P1). *Id.*, 6:39-46. (“In one example ALD process, a substrate surface, including a population of surface-active sites, is exposed to a gas phase distribution of a first film precursor (P1). **Some molecules of P1 may form a condensed phase atop the substrate surface,** including chemisorbed species and physisorbed molecules of P1. **The reactor is then evacuated to remove gas phase and physisorbed P1 so that only chemisorbed species remain.**”)

234. I note that Dhas teaches depositing organometallics with water: “In certain cases, the deposited film contains **metal**...Example precursors may include metal alkylamines, metal alkoxides, metal alkylamides, metal halides, metal β -diketonates, metal carbonyls, **organometallics**, etc. Appropriate **metal-containing precursors** will include the metal that is desired to be incorporated into the film...The embodiments may also be practiced with a variety of co-reactants...The co-reactants are often, but not always, nitrogen- or **oxygen-containing reactants**...Examples of oxygen-containing co-reactants include oxygen, ozone, nitrous oxide, carbon monoxide, nitric oxide, nitrogen dioxide, sulfur oxide, sulfur dioxide, oxygen-containing hydrocarbons ($C_xH_yO_z$), **water**, mixtures thereof, etc.” *Id.*, 17:61-18:30. Dhas also discloses “[i]n some PEALD reactions, the reactants

are delivered separately, and a purge or sweep may be used after delivery of one or more of the reactants to remove residual reactants from the chamber.” *Id.*, 10:2-5.

235. Although Dhas does not specifically disclose that the composition with non-volatile components includes an organotin, from my understanding, Cardineau teaches that the organotin precursors may react with components of water (i.e. are hydrolysable) to form tin clusters. *See* EX1008 at 44: “Several hydrolysis methods were subsequently attempted, and hydrolysis of the organotin trichloride using ammonium hydroxide proved the most successful route”. *See also Id.* at 48: “Hydrolysis of phenyltin trichloride using ammonium hydroxide produces a soluble polymeric material which shows evidence that it is the tin cluster.” Accordingly, a POSA would have understood that the hydrolysis of the organotin trichlorides of Cardineau would result in displacement of a X ligand (chloride), and would have had a reasonable expectation that Cardineau’s precursors would successfully react with water as disclosed in Dhas to provide a non-volatile component that includes an organotin (i.e., “tin clusters”) and a volatile component comprising hydrolysis reaction product with X (chloride) since Cardineau teaches that the organotin precursors react with components of water to form tin clusters.

m. “wherein the substrate is configured with a surface to receive the non-volatile components of the composition.”

236. In my opinion, Dhas discloses a substrate surface receiving non-volatile components (molecules of first film precursor P1). EX1007 at 6:39-46. (“◆... a substrate surface, including a population of surface active sites, is exposed to a gas phase distribution of a first film precursor (P1). **Some molecules of P1 may form a condensed phase atop the substrate surface**, including chemisorbed species and physisorbed molecules of P1. **The reactor is then evacuated to remove gas phase and physisorbed P1 so that only chemisorbed species remain**”).

237. Although Dhas does not specifically disclose that the composition with non-volatile components includes an organotin (although it does discuss organometallics), I note that Cardineau teaches that the organotin precursors react with components of water such as hydroxyl groups (i.e. are hydrolysable) to form tin clusters. *See* EX1008 at 44: “Several hydrolysis methods were subsequently attempted, and hydrolysis of the organotin trichloride using ammonium hydroxide proved the most successful route”. *See also Id.*, at 48: “Hydrolysis of phenyltin trichloride using ammonium hydroxide produces a soluble polymeric material which shows evidence that it is the tin cluster.” Accordingly, from my understanding a POSA would have understood that the hydrolysis of the organotin trichlorides of Cardineau would result in displacement of a X ligand (chloride), and

would had reasonable expectation that Cardineau’s precursors would successfully react with water as disclosed in Dhas to provide a non-volatile component that includes an organotin (i.e., “tin clusters”) and a volatile component comprising hydrolysis reaction product with X (chloride) since Cardineau teaches that the organotin precursors react with components of water to form tin clusters.

(3) Claim 2

238. Claim 2 depends on claim 1 and recites that “the substrate comprises a **silicon wafer**.” In my opinion, Dhas discloses that the terms “wafer,” “wafer substrate,” and “partially fabricated integrated circuit” are interchangeable. EX1007 at 5:40-42. Further, Dhas discloses that “‘partially fabricated integrated circuit’ can refer to a **silicon wafer** during any of many stages of integrated circuit fabrication thereon.” *Id.*, 5:42-45.

(4) Claim 3

239. Claim 3 depends on claim 1 and recites that “the inert gas comprises nitrogen or argon.” I note that Dhas discloses that inert gases include argon (Ar): “In many cases, the chamber clean chemicals include fluorine-containing species, for example NF₃ that may be optionally mixed with **inert gas such as He or Ar**. *Id.*, 18:64-67.

(5) Claim 4

- a. “the structure configured to deliver flow comprises an aerosol generator configured to generate an aerosol from a liquid comprising the organotin compound, a vaporization chamber configured to receive an injection of organotin compound, a flash evaporator configured to evaporate the organotin compound, or a bubbler configured for bubbling an inert carrier gas through a liquid comprising the organotin compound”

240. Claim 4 depends from claim 1.¹⁶ Based on my review, Dhas discloses an aerosol generator or vaporization chamber (heated injection module): “Thus, by **atomizing** the liquid reagent in the presence of helium in the **heated injection module** and using helium as a carrier gas for delivering the liquid reagent to the reaction chamber, the transient cold spots in the reagent delivery system can be minimized or avoided.” *Id.*, 11:45-49. Dhas also discloses a bubbler: “One alternative method for vaporizing the liquid reagent is to use a **bubbler**. With this technique, carrier gas (e.g., helium or helium mixed with a co-reactant) is bubbled through a container holding the liquid reagent. The liquid reagent and/or the carrier gas may be heated to aid vaporization. **As the bubbles travel through the liquid reagent, some amount of the liquid reagent vaporizes and is carried out with the carrier gas.**” *Id.*, 19:53-57.

- b. “wherein the deposition on the surface of the substrate comprises chemical vapor deposition.”

¹⁶ Petitioner preserves right to argue indefiniteness of claim 4.

241. I note that Dhas discloses that “[f]or example, in some embodiments, a process station may be switchable between an ALD mode, a CFD mode, and a **CVD process mode.**” *Id.*, 24:4-6.

(6) Claim 5

242. Claim 5 depends on claim 1 and recites that “the second precursor vapor comprises water vapor.” In my opinion, Dhas discloses that a co-reactant such as oxygen passes through the heated injection module: “FIG. 7 shows a simplified representation of a heated injection module 700 used in the context of deposition using TEOS and a co-reactant such as oxygen. **The helium and optional co-reactant are delivered through conduit 702**” as shown in Figure 7 below. *Id.*, 19:27-30. I note that Dhas additionally discloses that the oxygen co-reactant can be water: “Examples of oxygen-containing co-reactants include oxygen, ozone, nitrous oxide, carbon monoxide, nitric oxide, nitrogen dioxide, sulfur oxide, sulfur dioxide, oxygen-containing hydrocarbons ($C_xH_yO_z$), **water**, mixtures thereof, etc.” *Id.*, 17:61-18:30.

(7) Claim 6

243. Claim 6 depends on claim 1 and recites “further comprising a flow comprising a third precursor vapor comprising a composition represented by the formula ML_v , where v is $2 \leq v \leq 6$ and L is an oxidizable ligand or a ligand having a hydrolysable M-L bond or a combination thereof, and M is a metal selected from

groups 2-16 of the periodic table.”

244. Based on my review, Dhas discloses that more than one film can be deposited onto the substrate. “In a number of cases, more than one recipe may be used to deposit material on substrates within a single reaction chamber.” *Id.*, 2:42-44. I note that Dhas discloses a second source gas that includes a second reagent for depositing a film on a substrate: “(...) flowing a first source gas including a first reagent and helium into a reaction chamber and exposing the reaction chamber to a first plasma to deposit a first film on surfaces of the reaction chamber while no substrate is present in the reaction chamber, where the first reagent is liquid at room temperature; providing a substrate to the reaction chamber; and **flowing a second source gas into the reaction chamber and exposing the reaction chamber to a second plasma to thereby deposit a second film on the substrate, where the second source gas includes a second reagent that is liquid at room temperature**, and where the second source gas is substantially free of helium.” *Id.*, 2:1-14. I also note that Dhas further discloses that the deposited film “contains metal.” *Id.*, 17:61. Metal-containing precursors include tetrakis-dimethylamido titanium: “Further examples of metal-containing precursors that may be employed include trimethylaluminum, tetraethoxytitanium, **tetrakis-dimethylamido titanium**, hafnium tetrakis(ethylmethylethylamide), bis(cyclopentadienyl)manganese, bis(n-propylcyclopentadienyl)magnesium, etc.” *Id.*, 18:5-10; which is a compound

of formula ML_v , where v is 4, dimethylamido is a ligand having a hydrolysable M-L bond, and M is titanium, which is a metal selected from group 4 of the periodic table. A POSA would understand that dimethylamido is a dialkylamido¹⁷_[OBJ]. Accordingly, Dhas teaches a flow comprising a third precursor vapor (i.e., “second source gas”) comprising a composition represented by the formula ML_v (i.e., “tetrakis-dimethylamido titanium”).

(8) Claim 8

245. Claim 8 depends on claim 1 and recites that “the interior has a pressure from about 0.01 Torr to about 25 Torr.” Based on my review, Dhas discloses that “[d]uring this conditioning layer deposition process, **the reaction chamber pressure will typically be between about 1-10 Torr, for example between about 2-4 Torr.**” *Id.*, 13:59-61.

(9) Claim 9

246. Claim 9 depends on claim 1 and recites that “the interior has a temperature from about 40° C to about 175° C.”¹⁸ The lower limit of the temperature range disclosed by Dhas (180° C) overlaps with the upper limit of the temperature range disclosed by claim 9 (“**about** 175 °C”), as 180° C is about 175°

¹⁷ The '048 patent acknowledges that dialkylamido ligands are suitable for CVD applications. EX1001 at 8:60-9:5.

¹⁸ Petitioner preserves right to argue indefiniteness of claim 9 as a mixed claim type.

C *Id.*, 13:61-63 (““The temperature of the substrate may be maintained between about 180-550° C.””).

247. Thus, in my opinion, although the disclosed temperature in Dhas of 180° C is slightly above 175 ° C , a small difference of 5 ° C falls within the “about” qualifier in the claim. In any event, from my understanding, “a prima facie case of obviousness exists where the claimed ranges or amounts do not overlap with the prior art but are merely close. *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 783, 227 USPQ 773, 779 (Fed. Cir. 1985). This is particularly the case where “[t]he proportions are so close that prima facie one skilled in the art would have expected them to have the same properties.” *Titanium Metals Corp. of America v. Banner*, 778 F.2d 775, 783, 227 USPQ 773, 779 (Fed. Cir. 1985). I believe a POSA would expect processing at 175 or 180 ° C would have the same properties, and there is nothing in the ’048 Patent to suggest otherwise, and, instead, the qualifier “about” suggests the opposite.

248. Moreover, in my opinion the difference amounts to a routine optimization based on differences in the respective materials used. *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

249. In any event, I note that Weidman discloses that “**the chamber or the substrate may be heated to a temperature of less than about 500° C., for example, about 400° C. or less, such as within a range from about 50° C. to about**

400° C., and in other embodiments less than about 300° C., less than about 200° C., or **less than about 100°.**” EX1005 at 9:20-26. Accordingly, in my opinion POSA familiar with Weidman would have known to use these lower temperatures. EX1001 at claim 9.

(10) Claim 10

250. Claim 10 depends on claim 1 and recites “comprising a configuration providing for selection of the pressure and/or the temperature in the deposition chamber.”

251. In my opinion, Dhas performs the function: “selection of the pressure and/or the temperature in the deposition chamber.”

252. In my opinion the structure for a first and second vessel and/or a controller and equivalents thereof.

253. In particular, I note that Dhas performs the function: “selection of the pressure and/or the temperature in the deposition chamber.” Dhas teaches adjusting process conditions (such as pressure or temperature) of the system. EX1007 at, 25:61-65).

254. The structure for this Petition is a first and second vessel and/or a controller and equivalents thereof.

255. I note that Dhas discloses a system controller that can adjust parameters including temperature: “In some embodiments, parameters adjusted by

system controller 950 may relate to process conditions. Non-limiting examples include process gas composition and flow rates, **temperature**, **pressure**, plasma conditions (such as RF bias power levels and exposure times), etc.” EX1007 at 25:61-65. I also note that Dhas discloses a reaction chamber process station for maintaining a low-pressure environment: “FIG. 8 schematically shows an embodiment of a reaction chamber process station 800. For simplicity, process station 800 is depicted as a standalone process station having a process chamber body 802 for maintaining a low-pressure environment.” *Id.*, 19:65-20:2. Thus, in my opinion, Dhas discloses a “configuration providing for selection of the pressure and/or the temperature in the deposition chamber.”

(11) Claim 11

256. Claim 11 depends on claim 1 and recites “the flow comprises a vapor.”¹⁹ Dhas performs the function: “vapor inputting.” In my opinion, Dhas discloses inlet valves that can control the flow of process gases. EX1007, 20:14-16.

257. While it is unclear which flow, I note that Dhas discloses that “[f]or example, the instructions may include flowing a liquid reagent and helium into a heated injection module at certain flow rates to atomize/vaporize the liquid reagent, and flowing the vaporized stream to the reaction chamber.” *Id.*, 22:63-67.

¹⁹ Petitioner preserves right to argue indefiniteness of claim 11.

Accordingly, from my understanding Dhas discloses that the flow from a supply of the inert gas (i.e., “flowing a liquid reagent and helium”) includes a vapor (i.e., “the vaporized stream”).

(12) Claim 12

258. Claim 12 depends on claim 1 and recites “the structure configured to deliver flow comprises one or more vapor inputting structures.”²⁰

259. Dhas performs the function: “vapor inputting.” Dhas discloses inlet valves that can control the flow of process gases. EX1007, 20:14-16.

260. I note that Dhas discloses that a “reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in Figure 8 below. Id., 20:14-16. Figure 8 below shows that gases can flow from the mixing vessel 804 through valve 805 into process chamber body 802 to showerhead 806 via a conduit. Thus, in my opinion, Dhas discloses “one or more vapor inputting structures.”

²⁰ Petitioner preserves right to argue indefiniteness of claim 12.

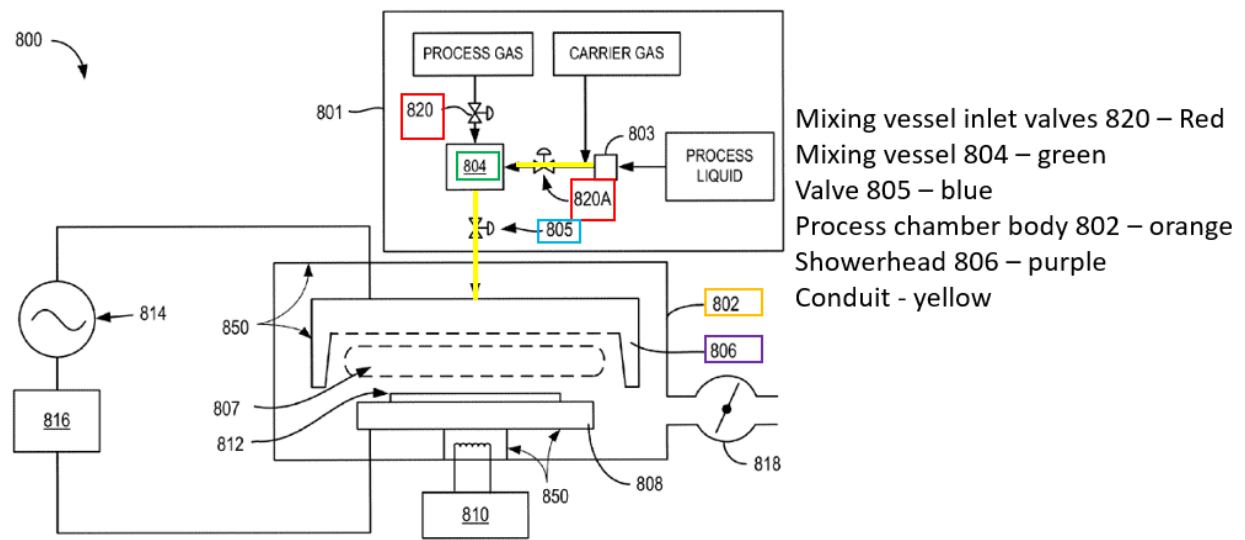


FIG. 8

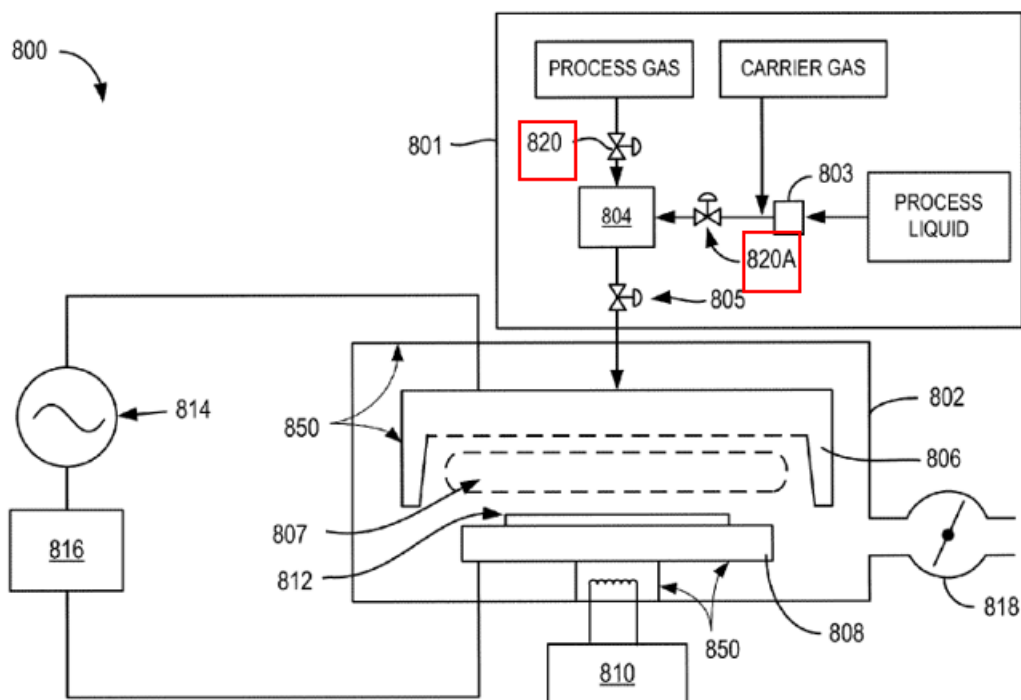


FIG. 8

Id. at Figure 8 (annotated).

(13) Claim 13

261. Claim 13 depends on claim 12 and recites “the vapor inputting structures provide for control of the flow.” For “the vapor inputting structures,” the structure is the same as identified for claim 12.

262. I note that Dhas discloses “[o]ne or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in Figure 8 below. *Id.*, 20:14-16. Therefore, in my opinion, Dhas teaches that the vapor inputting structures (i.e., “one or more mixing vessel inlet valves 820”)

provide for control of the flow (i.e., “may control introduction of process gases”).

263. Dhas also discloses that “reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in Figure 8 below. *Id.*, 20:14-16. Figure 8 below shows that gases can flow from the mixing vessel 804 through valve 805 into process chamber body 802 to showerhead 806 via a conduit. Thus, in my opinion, Dhas discloses “one or more vapor inputting structures.”

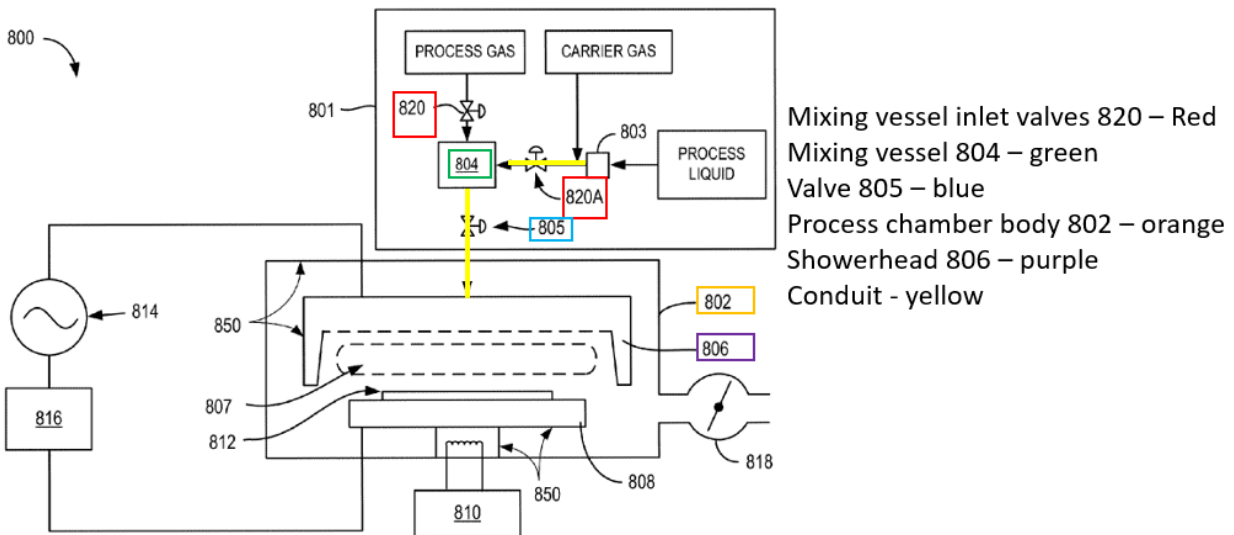


FIG. 8

Id. at Figure 8 (annotated).

(14) Claim 14

264. Claim 14 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow at the same time.”

265. For the “first vapor inputting structure” and “second vapor inputting structure,” in my opinion, the structure is the same as identified for claim 12.

266. Based on my review, I note that Dhas discloses a process station with one or more inlet valves (a first vapor inputting structure and a second vapor inputting structure) to control delivery of process gases as shown in Figure 8 below. *Id.*, 20:10-16. (“**Process station 800 fluidly communicates with reactant delivery system 801 for delivering process gases to a distribution showerhead 806. Reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804**”). Dhas also discloses the process station may be operated in CVD process mode: “It will be appreciated that in some embodiments, each process station may have different or multiple purposes. For example, in some embodiments, a process station may be switchable between an ALD mode, a CFD mode, and a **CVD process mode.**” *Id.*, 24:2-6.

267. In my opinion, Dhas discloses that flow of first reactant (first vapor flow) and flow of co-reactant (second vapor flow) are delivered at the same time:

“Where a CVD reaction is desired, the first reactant (e.g., TEOS) and optional co-reactant (e.g., oxygen) are flowed into the reaction chamber at least partially at the same time, and the reaction chamber is exposed to plasma while the reactants are flowing to the chamber.” *Id.*, 14:55-65. *See also* Figure 5.

268. Dhas also discloses that “reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in Figure 8 below. *Id.*, 20:14-16. Figure 8 below shows that gases can flow from the mixing vessel 804 through valve 805 into process chamber body 802 to showerhead 806 via a conduit.

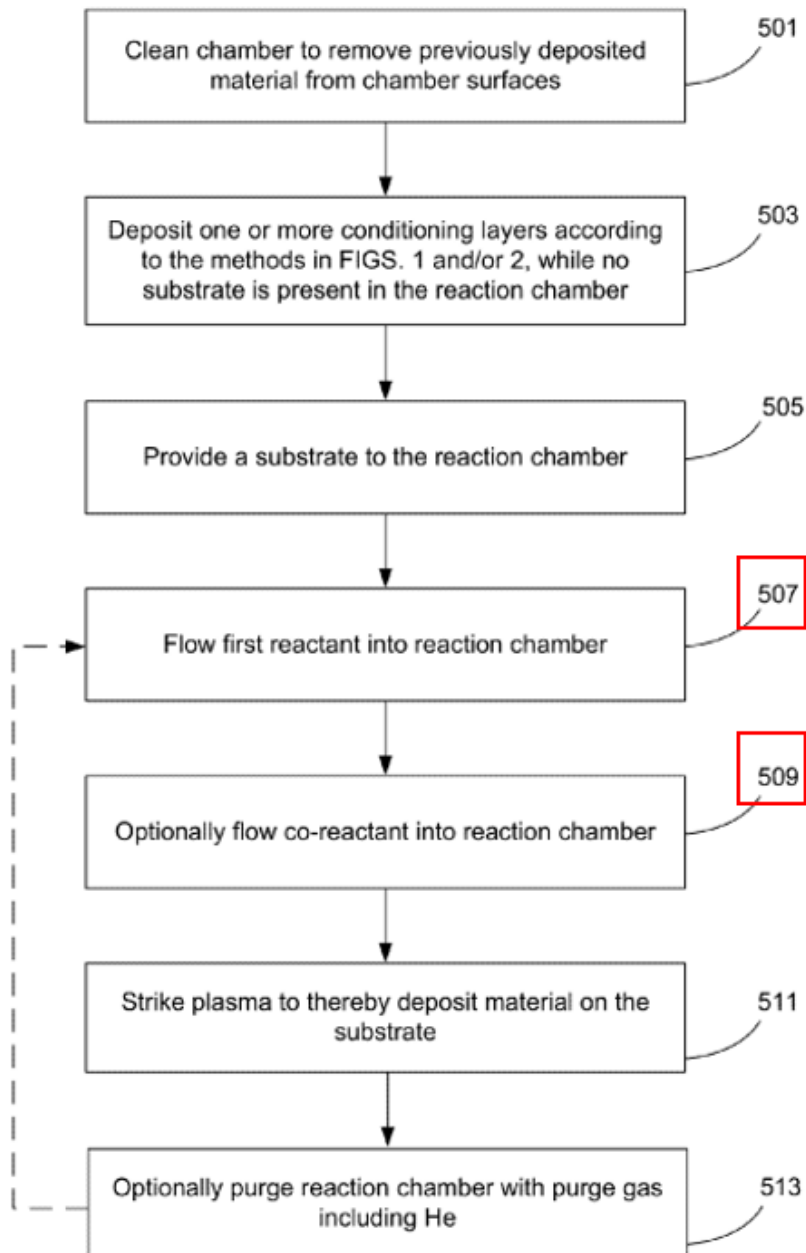


FIG. 5

Id. at Figure 5 (annotated).

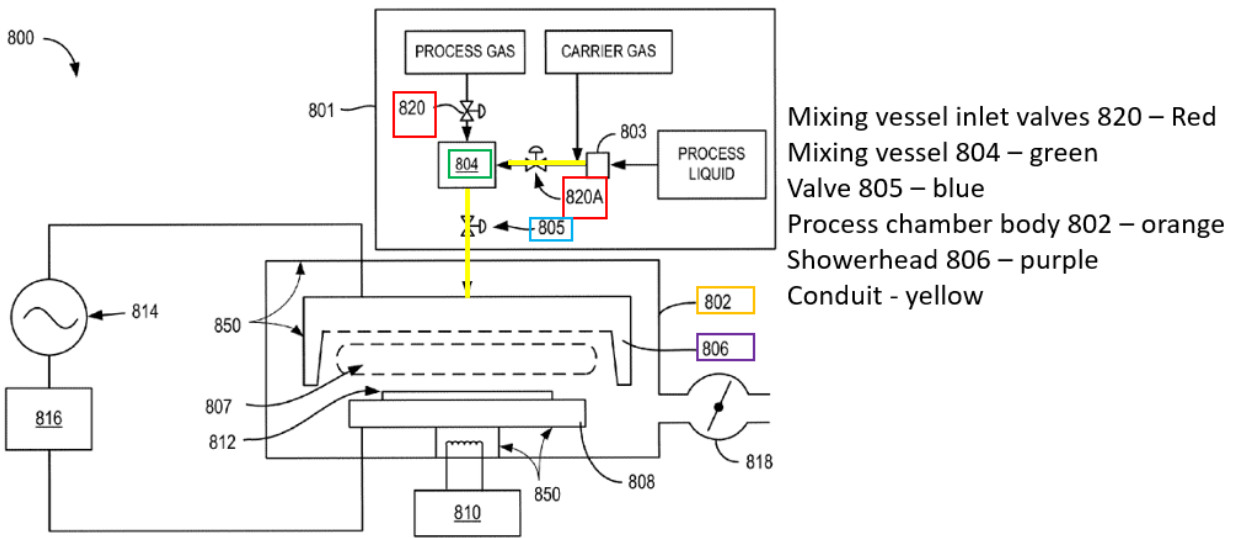


FIG. 8

Id. at Figure 8 (annotated).

(15) Claim 15

269. Claim 15 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are sequential.” For the “first vapor inputting structure” and “second vapor inputting structure”, I note that the structure is the same as identified for claim 12.

270. In my opinion, Dhas discloses a process station with one or more inlet valves (a first vapor inputting structure and a second vapor inputting structure) to control delivery of process gases as shown in Figure 8 below. *Id.*, 20:10-16.

(“**Process station 800 fluidly communicates with reactant delivery system 801 for delivering process gases to a distribution showerhead 806.** Reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. **One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804**”). I also note that Dhas discloses the process station may be operated in ALD process mode: “It will be appreciated that in some embodiments, each process station may have different or multiple purposes. For example, in some embodiments, a process station may be switchable between **an ALD mode**, a CFD mode, and a CVD process mode.” *Id.*, 24:4-6.

271. From my understanding Dhas discloses that the first reactant (first vapor flow) and co-reactant (second vapor flow) are sequential: “Another possibility is to deposit material on substrates through an ALD reaction. **Where this is the case, operations 507 and 511 occur in a cyclic manner** such that the first reactant is delivered to the reaction chamber in 507 before the plasma is struck at 511. In various cases, the reaction chamber may be purged after operation 507 and before operation 511 to remove unadsorbed first reactant from the reaction chamber. As mentioned above, **in operation 509 the co-reactant may be provided in a cyclic manner**, or may be provided continuously.” *Id.*, 14:65-15:7.

See also Figure 5.

272. Dhas also discloses that “reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in Figure 8 below. Id., 20:14-16. Figure 8 below shows that gases can flow from the mixing vessel 804 through valve 805 into process chamber body 802 to showerhead 806 via a conduit.

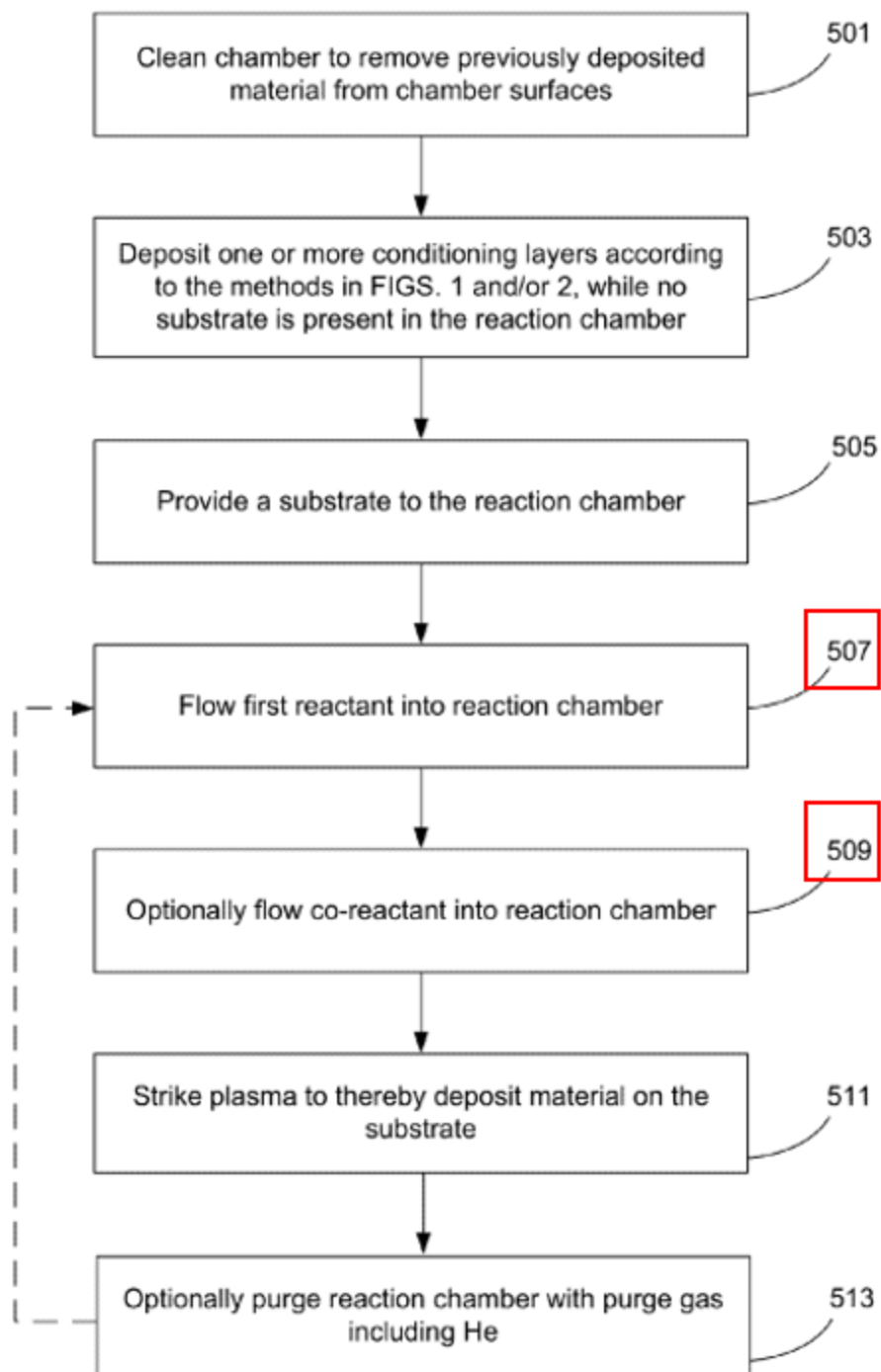


FIG. 5

Id. at Figure 5 (annotated)

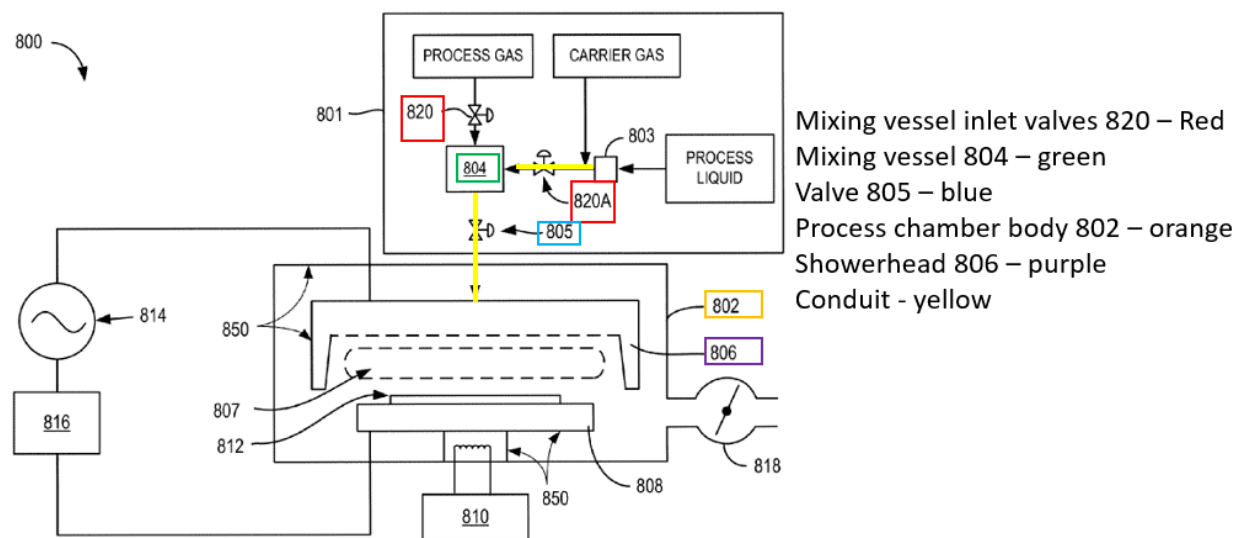


FIG. 8

Id. at Figure 8 (annotated).

(16) Claim 16

273. Claim 16 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow, the second vapor flow, and a third vapor flow are sequential.” For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

274. In my opinion, Dhas discloses a process station with one or more inlet valves (a first vapor inputting structure and a second vapor inputting structure) to

control delivery of process gases as shown in Figure 8 below. *Id.*, 20:10-16.

(“Process station 800 fluidly communicates with reactant delivery system 801 for delivering process gases to a distribution showerhead 806. Reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804”).

275. I note that Dhas also discloses a “reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in Figure 8 below. *Id.*, 20:14-16. Figure 8 below shows that gases can flow from the mixing vessel 804 through valve 805 into process chamber body 802 to showerhead 806 via a conduit.

276. Dhas discloses a third source gas (a third vapor flow): “As such, the method may further include before providing a substrate to the reaction chamber, **flowing a third source gas** including a third reagent and helium into the reaction chamber and exposing the reaction chamber to a third plasma to thereby deposit a third film on surfaces of the reaction chamber while no substrate is present in the reaction chamber, where the third reagent is liquid at room temperature, where the first plasma is exposed to the reaction chamber for a duration between about 30-90

seconds, where the third plasma is exposed to the reaction chamber for a duration between about 60-350 seconds, and where a deposition rate is higher during deposition of the first film than during deposition of the third film.” *Id.*, 2:1-14.

277. I note that Dhas discloses that the flow of first reactant (first vapor flow) and flow of co-reactant (second vapor flow) are sequential: “Another possibility is to deposit material on substrates through an ALD reaction. Where this is the case, **operations 507 and 511 occur in a cyclic manner** such that the first reactant is delivered to the reaction chamber in 507 before the plasma is struck at 511. In various cases, the reaction chamber may be purged after operation 507 and before operation 511 to remove unadsorbed first reactant from the reaction chamber. As mentioned above, **in operation 509 the co-reactant may be provided in a cyclic manner**, or may be provided continuously.” *Id.*, 14:65-15:7; *id.* at Fig. 5 . Dhas also discloses the process station may be operated in ALD process mode: “It will be appreciated that in some embodiments, each process station may have different or multiple purposes. For example, in some embodiments, a process station may be switchable between **an ALD mode**, a CFD mode, and a CVD process mode.” *Id.*, 24:2-6. Accordingly, I believe that a POSA would understand that first vapor flow (flow of first reactant), the second vapor flow (flow of co-reactant), and the third vapor flow (i.e., “the third source gas”), are sequential.

278. In my opinion, A POSA would also understand that there are a limited number of obvious choices of continuous or alternating delivery methods, which would have been obvious-to-try.

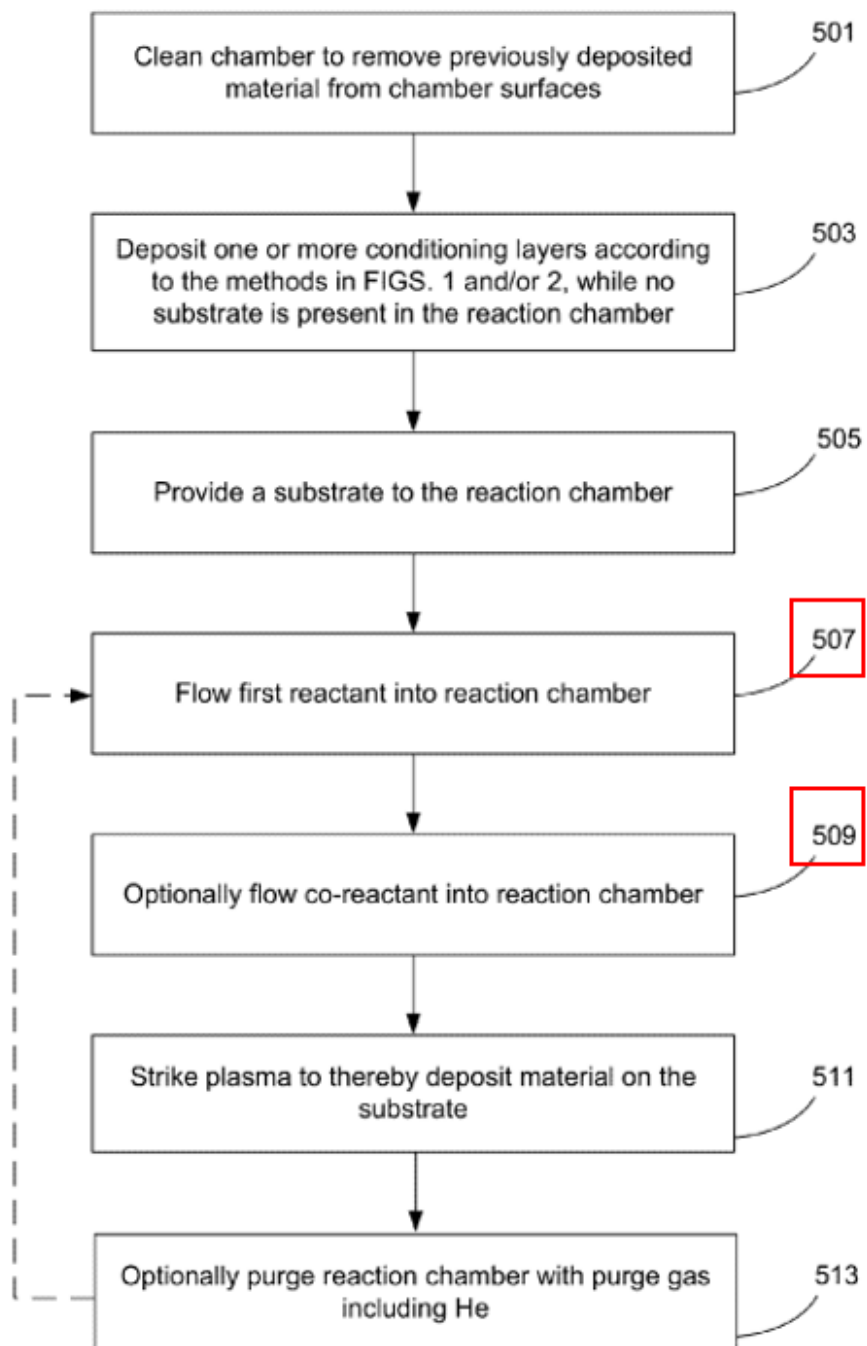


FIG. 5

Id. at Figure 5 (annotated)

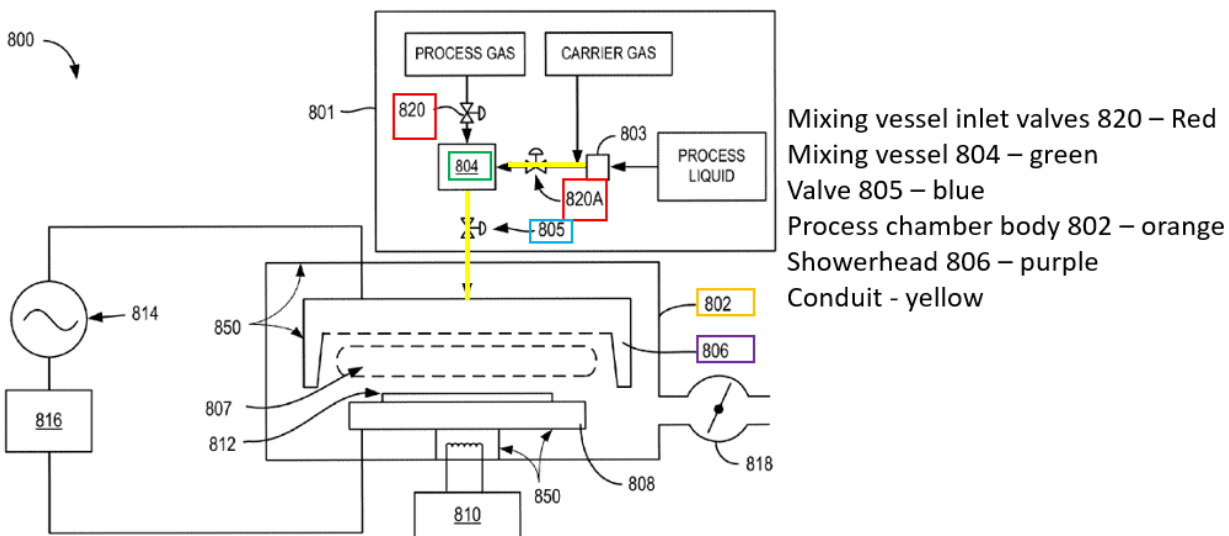


FIG. 8

Id. at Figure 8 (annotated).

(17) Claim 17

279. Claim 17 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are at the same time and a third vapor flow is sequential.” For the “first vapor inputting structure” and “second vapor inputting structure,” I note that the structure is the same as identified for claim 12.

280. Based on my review, Dhas also discloses that “reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process

gases for delivery to showerhead 806. One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804,” as shown in Figure 8 below. *Id.*, 20:14-16. Figure 8 below shows that gases can flow from the mixing vessel 804 through valve 805 into process chamber body 802 to showerhead 806 via a conduit.

281. Dhas discloses a process station with one or more inlet valves (a first vapor inputting structure and a second vapor inputting structure) to control delivery of process gases as shown in Figure 8 below. *Id.*, 20:10-16. (“**Process station 800 fluidly communicates with reactant delivery system 801 for delivering process gases to a distribution showerhead 806.** Reactant delivery system 801 includes a mixing vessel 804 for blending and/or conditioning process gases for delivery to showerhead 806. **One or more mixing vessel inlet valves 820 may control introduction of process gases to mixing vessel 804**”).

282. I note that Dhas discloses a third source gas (a third vapor flow): “As such, the method may further include before providing a substrate to the reaction chamber, **flowing a third source gas** including a third reagent and helium into the reaction chamber and exposing the reaction chamber to a third plasma to thereby deposit a third film on surfaces of the reaction chamber while no substrate is present in the reaction chamber, where the third reagent is liquid at room temperature, where the first plasma is exposed to the reaction chamber for a

duration between about 30-90 seconds, where the third plasma is exposed to the reaction chamber for a duration between about 60-350 seconds, and where a deposition rate is higher during deposition of the first film than during deposition of the third film.” *Id.*, 2:1-14.

283. Dhas discloses that flow of first reactant (first vapor flow) and flow of co-reactant (second vapor flow) are delivered at the same time: “Where a CVD reaction is desired, the first reactant (e.g., TEOS) and optional co-reactant (e.g., oxygen) are flowed into the reaction chamber at least partially at the same time, and the reaction chamber is exposed to plasma while the reactants are flowing to the chamber.” *Id.*, 14:55-65. *See also* Figure 5. Dhas also discloses the process station may be switched between a CVD process mode and ALD process mode: “It will be appreciated that in some embodiments, each process station may have different or multiple purposes. For example, in some embodiments, **a process station may be switchable between an ALD mode, a CFD mode, and a CVD process mode.**” *Id.*, 24:2-6. Accordingly, in my opinion, a POSA would understand that first vapor flow (flow of first reactant) and the second vapor flow (flow of co-reactant) are at the same time, and the third vapor flow (i.e., “the third source gas”) is sequential.

284. I also believe that a POSA would understand that there are a limited number of obvious choices of continuous or alternating deliver methods, which

would have been obvious-to-try.

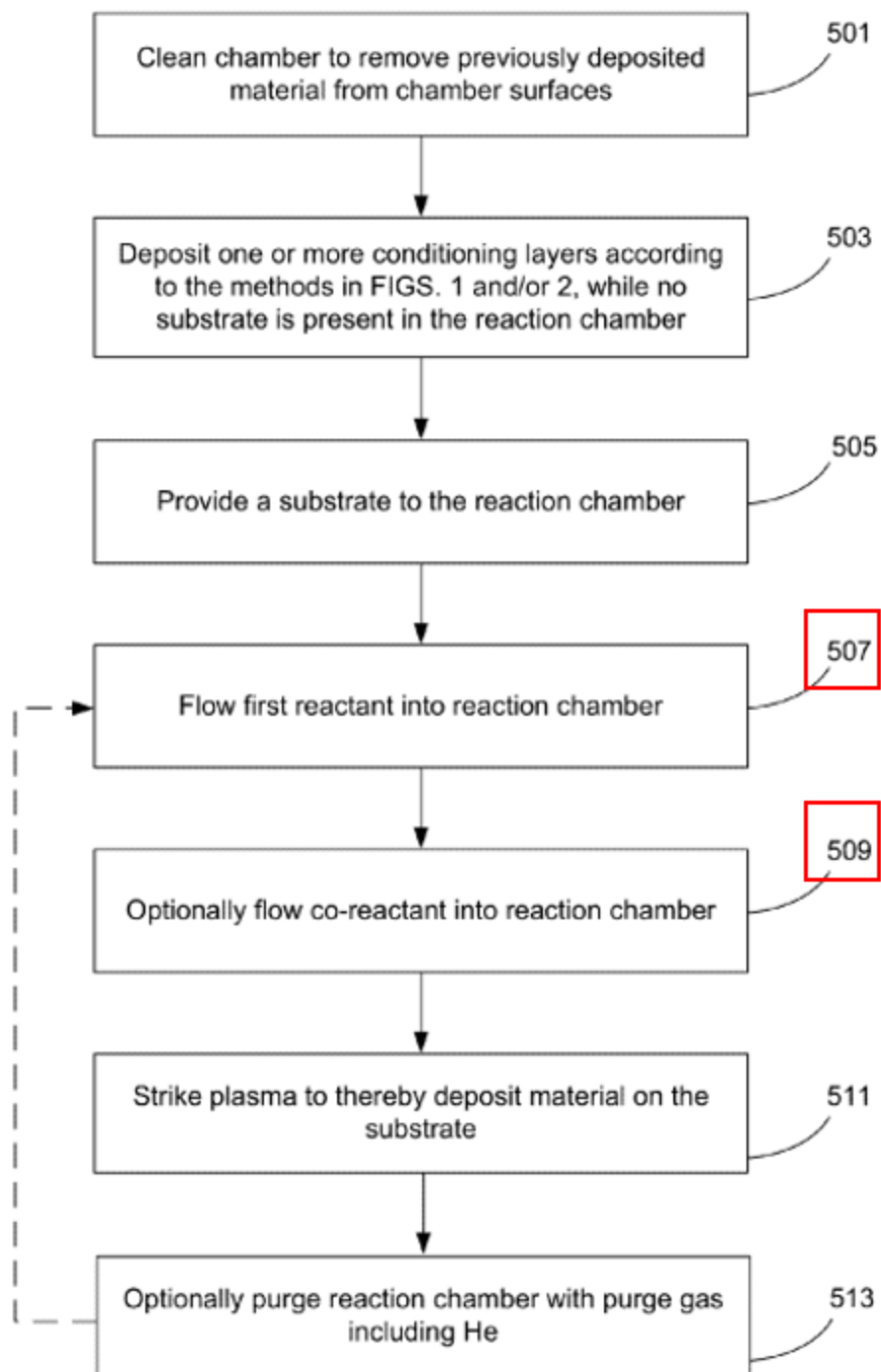


FIG. 5

Id. at Figure 5 (annotated)

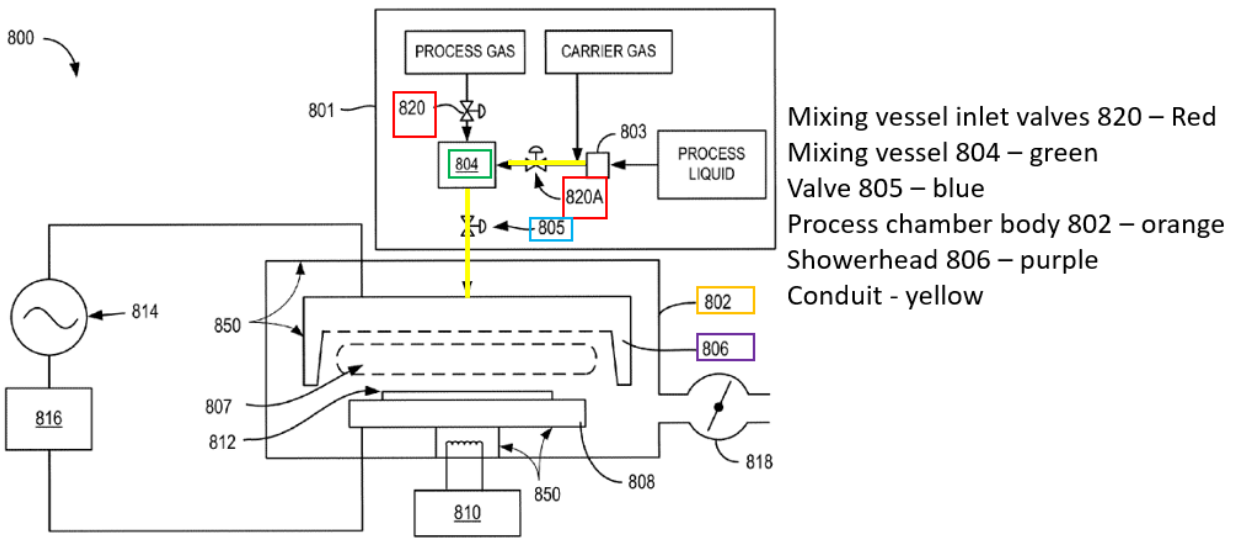


FIG. 8

Id. at Figure 8 (annotated).

(18) Claim 18

285. Claim 18 depends on claim 1 and recites “the interior has a temperature from about 45° C. to about 200° C.” In my opinion, Dhas discloses that “temperature of the substrate may be maintained between about 180-550°C,” which overlaps with a temperature of about 45° C. to about 200° C. *Id.*, 17:12-13. From my understanding, 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.*

(19) Claim 19

286. Claim 19 depends on claim 1 and recites “X is alkylamido or dialkylamido.” Although Dhas discloses metal precursors that include alkylamido substituents, I note that Dhas does not specifically disclose organotin precursors that include alkylamido substituents. EX1007 at 17:65-18:1. (“Example precursors may include metal alkylamines, metal alkoxides, **metal alkylamides**, metal halides, metal β -diketonates, metal carbonyls, organometallics, etc.).

287. However, Cardineau discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Specifically, based on my review, Cardineau explains that “[b]oth tin and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon” such that “these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise.” EX1008 at 45.

288. In my opinion, a POSA would have been motivated to use an organotin of Cardineau with an alkylamido ligand as taught by Dhas in the

apparatus of Dhas because Das teaches that precursors can include alkylamido ligands, and also to use tin precursors in to order to achieve the superior lithographic performance and improved sensitivity and lower shot noise of films as disclosed by Cardineau.

(20) Claim 20

289. Claim 20 depends on claim 1 and recites “X is alkoxo and aryloxo.” Although Dhas discloses metal precursors that include alkoxide (alkoxo) substituents, Dhas does not specifically disclose organotin precursors that include alkoxo substituents. EX1007 at 17:65-18:1. (“Example precursors may include metal alkylamines, **metal alkoxides**, metal alkylamides, metal halides, metal β -diketonates, metal carbonyls, organometallics, etc.).

290. However, based on my review, Cardineau discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Specifically, Cardineau explains that “[b]oth tin and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon” such that “these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise.” EX1008 at 45.

291. In my opinion, a POSA would have been motivated to use an

organotin with Cardineau's alkoxo ligand in Dhas's apparatus because Dhas teaches that precursors can include tin and alkoxo ligands, and also to use tin precursors to achieve the superior lithographic performance and improved sensitivity and lower shot noise of films as Cardineau discloses.

B. Ground 2: Claim 7 is Obvious Over Dhas, Cardineau, and Molloy

(1) Claim 7

292. In my opinion, the Dhas, Cardineau, and Molloy combination discloses claim 7, which depends on claim 6 and recites that "the third precursor vapor comprises SnL_4 ."

293. I believe that the Dhas, Cardineau, and Molloy combination discloses each limitation of claims 1 and 6 for the reasons discussed above in connection with Ground 4. All reasoning and support for that ground is incorporated herein.

294. I note that the Dhas, Cardineau, and Molloy combination further discloses "the third precursor vapor comprises SnL_4 ." "In a number of cases, more than one recipe may be used to deposit material on substrates within a single reaction chamber." EX1007 at 2:42:44. Dhas discloses a second source gas that includes a second reagent for depositing a film on a substrate: "In another aspect of the disclosed embodiments, a method for depositing film on a substrate is provided, including: flowing a first source gas including a first reagent and helium

into a reaction chamber and exposing the reaction chamber to a first plasma to deposit a first film on surfaces of the reaction chamber while no substrate is present in the reaction chamber, where the first reagent is liquid at room temperature; providing a substrate to the reaction chamber; and **flowing a second source gas into the reaction chamber and exposing the reaction chamber to a second plasma to thereby deposit a second film on the substrate, where the second source gas includes a second reagent that is liquid at room temperature**, and where the second source gas is substantially free of helium.” *Id.*, 2:1-14.

295. Although neither Dhas nor Cardineau disclose a compound of formula SnL_4 , in my opinion, a POSA would have known that compounds of formula SnL_4 were being used as precursors in vapor deposition techniques and would have had an expectation that the compositions of formula SnL_4 would successfully be included in a third precursor vapor.

296. From my understanding, Molloy discloses inorganic tin compounds for chemical vapor deposition (“CVD”) purposes, including SnCl_4 a “precursor of choice” in dual-source CVD processes that provide films with desirable properties produced with high deposition rates (“polycrystalline with a refractive index of 2.00–2.10, have visible-light transmission of 84% and resistivity of $0.6 \, \Omega\text{cm}$ ” (citations omitted)) and deposition temperatures as low as 30°C . EX1009, 549-550.

297. In my opinion, a POSA would further understand that SnCl_4 is a composition represented by the formula SnL_4 , where M is tin (Sn; group 14 of the periodic table), and L is methyl (Me), which is a ligand having a hydrolysable M-L bond.

298. In my opinion, a POSA would appreciate that Dhas, Cardineau, and Molloy are analogous art, and would have been motivated to combine the references because Molloy teaches organometallic (e.g. organotin) precursors. I believe that a POSA would have been motivated to select SnMe_4 (i.e. a compound of formula SnL_4) for inclusion in the third vapor precursor in order to obtain a film with the desirable properties described by Molloy. Finally, in my opinion, a POSA would have had a reasonable expectation of success that Molloy's precursors could form a film using the apparatus of Dhas since Molloy teaches that SnMe_4 is a precursor for vapor deposition methods.²¹

C. Ground 3: Claims 1-5 And 8-20 Are Obvious Over Weidman and Cardineau.

(1) Claim 1

²¹ As claim 6 does not require any timing or temporal requirements, the third precursor vapor could be introduced at the same time as the first precursor vapor and/or second precursor vapor or in a subsequent step. If introduced in a subsequent step, an intervening purge step would be administered and so the third precursor vapor would not affect any reaction between components of the first precursor vapor and second precursor vapor.

a. Preamble: “system comprising”

299. Based on my review, Weidman discloses “an apparatus for deposition of a film on a substrate.” EX1005, 8:41-42. In my opinion, Weidman thus discloses “[a] system comprising.” EX1001 at claim 1. Cardineau also discloses methods of preparing photoresists by spincoating organotins onto silicon substrates. EX1008, 48

b. “deposition chamber having an interior isolated from the ambient atmosphere”

300. From my understanding, Weidman discloses that “the processing chamber or **the deposition chamber** may be pressurized at a pressure within a range from about 0.01 Torr to about 100 Torr.” EX1005, 9:16-18. I note that Weidman also teaches “**the chamber** or the substrate may be heated to a temperature of less than about 500° C.” *Id.* 9:21-22. Because the deposition chamber may be heated and/or pressurized, in my opinion, a POSA would understand that the chamber is “isolated from the ambient atmosphere.” EX1001 at claim 1.

c. “substrate within the interior of the deposition chamber configured to receive a deposition on a surface of the substrate”

301. Based on my review, Weidman teaches that “the apparatus comprises a deposition chamber for atomic layer deposition on a film on a **substrate**,” and

“[t]he chamber comprises a process area for supporting a **substrate**.” EX1005, 8:41-46. I also note that Weidman teaches that “[t]he apparatus includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties,” *id.* 8:47-49, and “[a] supply of a second precursor containing reactive, moieties cross-linkable with the substituents in the first precursor may be in fluid communication with the first precursor gas inlet or a separate second precursor gas inlet,” *id.* 8:52-56. According to Weidman, “[t]he apparatus include a radiation source or can be connected to a second apparatus for exposing the **deposited layer** radiation selected from EUV, far UV. X-ray and e-beam radiation such that upon exposure to the radiation, reactive, cross-linkable moieties present in the first precursor and second precursor in the **deposited layer** remain partially unreacted and soluble to developer solution.” *Id.* 8:63-9:3. I note that Figure 1A (reproduced below) “shows substrate 100 with a deposited layer 110 on the substrate, formed by one or more ALD cycles.” *Id.* 13:36-37.

FIG. 1A



d. “the substrate is maintained at a temperature of less than 200° C”

302. I note that Weidman discloses that “the chamber or the **substrate** may be **heated** to a temperature of ...**less than about 200° C**, or less than about 100°.” *Id.*, 9:21-26.

e. “an inlet into the deposition chamber”

303. In my opinion, Weidman teaches that “[t]he apparatus includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties,” *id.*, 8:47-49, and “[a] supply of a second precursor containing reactive, moieties cross-linkable with the substituents in the first precursor may be in fluid communication with the **first precursor gas inlet or a separate second precursor gas inlet.**,” *id.*, 8:52-56. “The apparatus includes a **reactant gas inlet** in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen.” *Id.*, 8:49-52.

f. “structure configured to deliver flow from a supply of an inert gas”

304. In my opinion, the Weidman and Cardineau combination performs the function: “to deliver flow from a supply of inert gas.” Weidman discloses “[t]he processing chamber would include separate supplies of the A, B, and C reactants, along with a supply of carrier, purge **and inert gases** such as argon and nitrogen in fluid communication with gas inlets for each of the reactants and gases.” *Id.*, 8:48-

52.

305. In my opinion, Figure 16 of the '048 Patent is a conduit configured to deliver flow from a supply of an inert gas, e.g., a conduit between connecting “vessel 168” and a “supply of inert gas 170,” and equivalents thereof, or, if not tied to Figure 16, a conduit (like a pipe) to supply inert gas, e.g., connecting a supply of inert gas to an interconnected vessel (like a vaporization chamber), and equivalents thereof.

306. In my opinion, Weidman discloses an apparatus for performing vapor deposition that includes one or more inlets into the deposition chamber, EX1005, 8:47-61, and that “the various gases for the process may be pulsed into an inlet through a gas channel, from various holes or outlets, and into a central channel.” Id., 8:16-20. Weidman also describes that “[e]ach inlet may be controlled by an appropriate flow controller such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) that allows flow of each of the reactants to the substrate to perform a[n] ALD process.” Id., 7:53-56. Weidman also discloses that the “processing chamber would include separate supplies of the A, B, and C reactants, along with a supply of carrier, purge and inert gases such as argon and nitrogen in fluid communication with gas inlets for each of the reactants and gases” and that “[t]he substrate...can be exposed to a metal-containing “A” precursor gas or vapor formed by passing a carrier gas (for

example, nitrogen or argon) through an ampoule of the precursor...can be delivered at any suitable flow rate...” EX1005, 11:66-12:6.

307. Thus, in my opinion, Weidman discloses conduits like gas channels, outlets, central channels and conduits through flow controllers to supply an inert carrier gas to a vessel, e.g., from the source of the precursor. Thus, the Weidman and Cardineau combination discloses the claimed “structure [e.g., Weidman’s gas channels etc.] configured to deliver flow from a supply of an inert gas.”

g. “a supply of an organotin composition comprising a compound described by the formula $R\text{SnX}_3$, where R is an organic ligand with 1-31 carbon atoms and is bound to Sn with a metal-carbon bond”

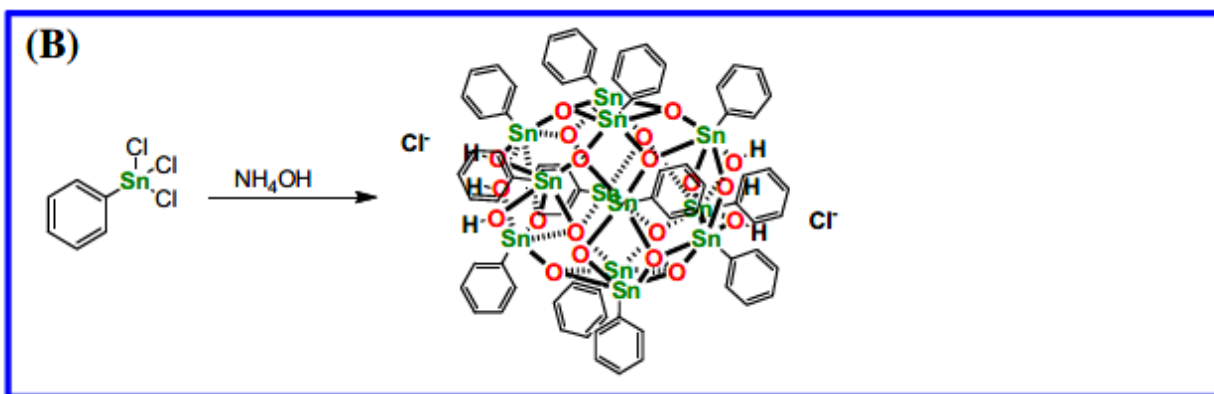
308. In my opinion, the Weidman and Cardineau combination discloses this limitation. Weidman discloses that the apparatus includes supplies of A, B, and C reactants, and A reactants can include a metal oxide precursor. For example, Weidman discloses “[t]he processing chamber would include separate supplies of the A, B, and C reactants, along with the supply of carrier, purge and inert gases such as argon and nitrogen in fluid communication with gas inlets for each of the reactants and gases.” *Id.* 8:48-52. Weidman states that “an ALD process cycle may include alternating pulses of ‘A’ precursor (for example, metal oxide precursor)...” *Id.* 9:29-31. Weidman further discloses that the “A” precursor includes a metal that is bonded to at least one substituent (i.e., chemical group):

“Non-limiting examples of ‘A’ precursors include **volatile metal-containing compounds**, for example, compounds of silicon **or other main group or transition metals** bonded to at least one substituent which will be readily displaced upon reaction with surface bond species such as a hydroxyl group such that the substituent originally on the precursor is lost as a volatile compound and the metal atom together with its remaining substituents become bonded to the surface.” *Id.* 9:44-57. And Weidman discloses examples of substituents that include vinyl or alkyl groups (i.e., “organic ligands”): “a silicon oxide based precursor containing one or more of a vinyl substituent, an allyl substituent, a halomethyl substituent, alkoxides, carboxylates, and halides which hydrolyze on exposure to water to form silanol substituents....” *Id.* 3:29-33. Weidman further discloses that the metals can include tin: “Specific materials according to one or more embodiments include but are not limited to silicon, germanium, **tin**, hafnium, zirconium, titanium, group V and VI metals and oxides thereof.” *Id.* 4:48-51.

309. Although Weidman discloses the use of tin precursors, it does not disclose that the “A” precursor is an organotin composition comprising a compound described by the formula RSnX_3 . Cardineau discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Specifically, I note that Cardineau explains that “[b]oth tin and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon” such

that “these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise.” EX1008 at 45.

310. In my opinion, Cardineau’s tin-oxo clusters are prepared from the organotin trichlorides allyltin trichloride, butyltin trichloride and phenyltin trichloride. *Id.* at 49 (“Organotin trichloride was quickly added to the flask while stirring, and the solution was refluxed for 30 min. ... **Allyltin trichloride** (3.992 g, 15 mmol) was used as the organotin trichloride... **Butyltin trichloride** (4.233, 15 mmol) was used as the organotin trichloride... **Phenyltin trichloride** (4.533 g, 15 mmol) was used as the organotin trichloride.”). Allyltin trichloride, butyltin trichloride, and phenyltin trichloride are compounds “represented by the formula RSnX_3 wherein R is an organic ligand with 1-31 carbon atoms bound to Sn with a metal-carbon bond” and X is Chloro (Cl). *See Id.* at 44 (“Here we describe the synthesis and lithographic evaluation of thin films of tin-oxo clusters $[(\text{RSn})_{12}\text{O}_{14}(\text{OH})_6]\text{X}_2$, Fig. 1A) using extreme ultraviolet light (EUV, 13.5 nm).”).



Id. at 48.

311. A POSA would have been motivated to combine Weidman and Cardineau because the references relate to the same subject matter as the '048 Patent—i.e., the preparation of photoresists. A POSA would have been motivated to use the precursors of Cardineau in the apparatus of Weidman '068 to achieve the improved EUV absorbance as disclosed by Cardineau. *Id.* at 45.

312. Although Cardineau discloses depositing the precursor compounds using spin coating, in my opinion, Weidman discloses that using a vapor deposition apparatus provides more reliable coating compared to spin-coating (EX1005 at 4:64-67 and 5:1-11; *id.* 5:27-32):

The coating of uniform films of any material, particularly inorganic resist films over an organic underlayer with 1 Angstrom uniformity without defects **is difficult to achieve by conventional spin-coating, which are often referred to as “wet” techniques**, or any other commonly established method for coating EUV photoresists. **According to embodiments of the invention, “dry” deposition techniques such as Atomic Layer Deposition (ALD) provide the unique ability to assemble a film with not only atomic layer control**

of thickness but also the placement of reactive functionality that can survive the (mild) deposition conditions and create developer solubility (e.g., reactivity with aqueous developers) together with high sensitivity to EUV (and other radiation such as far UV, DUV and electron beam) involving cross-linking with the loss of solubility, thus allowing patterns to be developed.

(“While materials with such functionality can be prepared in forms suitable for spin-coating, formulations for doing so can prove either too unstable (for example, to traces of air, moisture, handling at room temperature, etc.) or require too high an EUV dose to be practical.”). Thus, in my opinion, POSA would have been motivated to use the Cardineau precursors as the “supply of the precursors” in Weidman’s apparatus for more reliable coating. EX1001 at claim 1.

313. Moreover, in my opinion, a POSA would have had reasonable expectation that Cardineau’s precursors could successfully form a photoresist layer in the apparatus of Weidman. Cardineau teaches that the organotin precursors react with components of water such as hydroxyl groups (i.e., are hydrolysable) to form tin clusters (*see* EX1008 at 44: “Several hydrolysis methods were subsequently attempted, and hydrolysis of the organotin trichloride using ammonium hydroxide proved the most successful route”; *see also Id.* at 48: “Hydrolysis of phenyltin trichloride using ammonium hydroxide produces a soluble polymeric material which shows evidence that it is the tin cluster”), and Weidman teaches that water is a reactant. EX1005 at 10:1-3 (“Non-limiting examples of ‘B’ reactants include

ozone, **H₂O**, **H₂O₂**, NH₃, and reactive oxygen, nitrogen, or hydrogen containing species generated in a plasma....”).

h. X Group Limitation

314. In my opinion, Weidman discloses that the precursor compounds can include metals with an alkoxo (alkoxide) substituent; however, Weidman does not specifically disclose organotins with alkoxo substituents: “The specific composition and properties of the etch mask can be varied with precursor selection and can include a wide variety of materials in addition to silicon dioxide based compositions, for example the use of titanium, zirconium, or hafnium halides, **alkoxides**, or alkylamido complexes as metal precursors and water vapor as the reactant.” *Id.* 18:16-22. Weidman also discloses “a silicon oxide based precursor containing one or more of a vinyl substituent, an allyl substituent, a halomethyl substituent, **alkoxides**, carboxylates, and halides which hydrolyze on exposure to water to form silanol substituents....” *Id.* 3:29-33. Weidman also discloses that the metals can include tin: “Specific materials according to one or more embodiments include but are not limited to silicon, germanium, **tin**, hafnium, zirconium, titanium, group V and VI metals and oxides thereof.” *Id.* 4:48-51.

315. However, I note that Cardineau discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Cardineau explains that “[b]oth tin and oxygen readily absorb EUV photons with optical densities that are

10.5 and 1.7 times greater than carbon” such that “these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise.” EX1008 at 45.

316. Cardineau also discloses organotins having ligands X that are alkoxo groups (alkoxo is —OR, where R is an alkyl group with 1-10 carbon atoms): “[t]in clusters have been synthesized by either the dehydration of butylstannoic acid, or the controlled hydration of butyltin trichloride, **butyltin trialkoxide** or butyltin trialkyne.” *Id.* at 47 (citations omitted). In my opinion, a POSA would have been motivated to use an organotin with an alkoxo ligand of Cardineau in the apparatus of Weidman because Weidman teaches that precursors can include tin and alkoxo ligands, and also in to order to achieve the improved EUV absorbance from tin compounds as disclosed by Cardineau.

- i. **“structure configured to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet”**

317. In my opinion, Figure 16 of the '048 Patent is **“vessel 168 and the conduit extending from the vessel 168 to the inlet 152”** and equivalents thereof or, if not tied to Figure 16, “a class of structures for delivering flow, i.e., an interconnected **vessel** (such as a vaporization chamber, as recited in claim 4) and a

conduit (such as a pipe)” connected to a vessel, and equivalents thereof.

318. In my opinion, the Weidman and Cardineau combination performs the function: “to deliver flow of a first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet.” Weidman discloses that the precursor (i.e. organotin compound) vapors can be delivered with a carrier gas, such as argon (i.e., an inert gas). Add citation. Weidman discloses “[t]he reactants are typically in vapor gas form,” and “[t]he reactants may be delivered with a carrier gas.” EX1005 at 8:1-2. Weidman states that “[a] carrier gas, a purge gas, a deposition gas, or other process gas may contain nitrogen, hydrogen, **argon**, neon helium, or combinations thereof.” *Id.* at 8:2-4.

319. In my opinion, Weidman discloses an apparatus for performing vapor deposition that includes one or more inlets into the deposition chamber, EX1005, 8:47-61, and “the various gases for the process may be pulsed into an inlet through a **gas channel**, from various holes or outlets, and into a central channel.” *Id.*, 8:16-20.

320. In my opinion, Weidman describes “[p]urge and inert gases such as argon and nitrogen in fluid communication with gas inlets for each of the reactants and gases,” and notes that “[e]ach inlet may be controlled by an appropriate flow controller such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) that allows flow of each of

the reactants to the substrate to perform a[n] ALD process.” EX1005, 7:48-57.

Weidman also discloses the “processing chamber would include separate supplies of the **A, B, and C reactants**, along with a **supply of** carrier, purge and **inert gases**...in fluid communication with gas inlets for each of the reactants and gases” and that “[t]he substrate...can be exposed to a metal-containing **“A” precursor** gas or vapor formed by passing a carrier gas...through an ampoule of the precursor...can be delivered at any suitable flow rate...” *Id.*, 11:65-12:2. Thus Weidman discloses conduits like gas channels, outlets, central channels and conduits through flow controllers to supply precursor gases to the chamber.

321. Thus, in my opinion, the Weidman and Cardineau combination renders obvious a structure to deliver a first precursor vapor [e.g., Precursor “A”] from the supply of the organotin compound (e.g., the ampoule) with the inert gas as a carrier gas (e.g., argon) to the inlet (e.g., “gas inlets for each of the reactants and gases”).

j. “to provide for formation of an organotin layer on the substrate surface within the deposition chamber”

322. I note that Weidman discloses precursors including “‘A’ precursors includ[ing] **volatile metal-containing compounds**, for example, compounds of silicon or other main group or transition metals bonded to at least one **substituent** which will be readily displaced upon reaction with surface bond species such as a hydroxyl group **such that the substituent originally on the**

precursor is lost as a volatile compound and the metal atom together with its remaining substituents become bonded to the surface.” EX1005 at 9:44-57.

Weidman also discloses that “[t]he **flow of the “A” precursor gas** is stopped once the **metal-containing precursor has adsorbed onto all reactive surface moieties on the substrate surface.”** *Id.* 12:11-13. Weidman discloses a deposition chamber (processing chamber) that includes a substrate (“A processing chamber is configured to expose the substrate to a sequence of gases and/or plasmas during the vapor deposition process.”). *Id.* 7:46-48. Weidman further discloses that the metals can include tin: “Specific materials according to one or more embodiments include but are not limited to silicon, germanium, **tin**, hafnium, zirconium, titanium, group V and VI metals and oxides thereof.” *Id.* 4:48-51. Weidman therefore teaches the formation of an organotin layer on the substrate surface (i.e., metal-containing precursor has adsorbed onto all reactive surface moieties on the substrate surface”) within the deposition chamber (i.e., “processing chamber”).

k. “structure to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the first precursor vapor”

323. In my opinion, the Weidman and Cardineau combination performs the function: “to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the

first precursor vapor.”

324. I note that Weidman discloses that the apparatus includes supplies of A, B, and C reactants. *Id.* 8:48-52 (“The processing chamber would include separate supplies of the A, B, and C reactants, along with a supply of carrier, purge and inert gases such as argon and nitrogen in fluid communication with gas inlets for each of the reactants and gases.”). B reactants can include **water (H₂O)** or **hydrogen peroxide (H₂O₂)**. *Id.* 10:1-3 (“Non-limiting examples of ‘B’ reactants include ozone, **H₂O**, **H₂O₂**, NH₃, and reactive oxygen, nitrogen, or hydrogen containing species generated in a plasma....”), *Id.* 16:4-7 (“Other examples of an ‘A’ precursor can be for example a volatile Hf or W alkoxide precursor coupled with a ‘B’ reactant such as ozone, **H₂O**, **H₂O₂**, a mixture of **H₂O/H₂O₂**, or some other EUV sensitive bridging ligand.”).

325. In my opinion, Figure 16 of the '048 Patent is a conduit 174 connecting a source of a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof” to inlet 154 of deposition chamber 151 and equivalents thereof or, if not tied to Figure 16, a conduit (like a pipe) connecting a source of a “second precursor vapor comprising water, hydrogen peroxide or a combination thereof” to an inlet of a deposition chamber and equivalents thereof. Weidman discloses that the B reactant is delivered to the substrate by passing a carrier gas through an ampoule (i.e., a structure configured to deliver a second

precursor vapor). *Id.*, 12:38-41.

326. I note that Weidman discloses an apparatus for performing vapor deposition that includes one or more inlets into the deposition chamber, EX1005, 8:47-61, and that “the various gases for the process may be pulsed into an inlet through a gas channel, from various holes or outlets, and into a central channel.” *Id.*, 8:16-20. Weidman discloses that the apparatus includes supplies of A, B, and C reactants. B reactants can include water (H₂O) or hydrogen peroxide (H₂O₂). EX1005, 5:55-65, 8:48-52, 10:1-10, 16:4-7. Weidman further discloses that the B reactant is delivered to the substrate by passing a gas through an ampoule (i.e., a structure configured to deliver a second precursor vapor). *Id.*, 12:38-41.

327. In my opinion, although Weidman does not specifically disclose the reaction of water, hydrogen peroxide or a combination thereof with the organotin composition in the first precursor vapor, Cardineau teaches that the organotin precursors react with components of water such as hydroxyl groups (i.e. are hydrolysable) to form tin clusters. *See* EX1008 at 44: “Several hydrolysis methods were subsequently attempted, and hydrolysis of the organotin trichloride using ammonium hydroxide proved the most successful route”. *See also Id.* at 48: “Hydrolysis of phenyltin trichloride using ammonium hydroxide produces a soluble polymeric material which shows evidence that it is the tin cluster.” Accordingly, a POSA would have had reasonable expectation that Cardineau’s

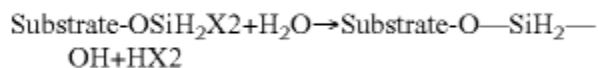
precursors would successfully react with a second precursor vapor comprising water as disclosed in Weidman since Cardineau teaches that the organotin precursors react with components of water to form tin clusters.

328. Thus, in my opinion, Weidman and Cardineau discloses a structure (e.g., gas channels etc.) to deliver a second precursor vapor comprising water, hydrogen peroxide or a combination thereof capable of reacting with the composition in the first precursor vapor.

- I. **“under conditions in the deposition chamber to form a composition with non-volatile components and a volatile component comprising hydrolysis reaction product with X”**

329. I note that Weidman discloses that “[o]ther examples of an ‘A’ precursor can be for example a volatile Hf or W alkoxide precursor coupled with a ‘B’ reactant such as ozone, H₂O, H₂O₂, a mixture of H₂O/H₂O₂, or some other EUV sensitive bridging ligand.” EX1005 at 16:4-7. Weidman also discloses that “[n]on-limiting examples of ‘A’ precursors include volatile metal-containing compounds, for example, compounds of silicon or other main group or transition metals bonded to at least one substituent which will be readily displaced upon reaction with surface bond species such as a hydroxyl group **such that the substituent originally on the precursor is lost as a volatile compound and the metal atom together with its remaining substituents become bonded to the**

surface.” *Id.* at 9:44-57. And “[n]on-limiting examples of ‘B’ reactants include ozone, H₂O, H₂O₂, NH₃, and reactive oxygen, nitrogen, or hydrogen containing species generated in a plasma, and in specific embodiments, a remote plasma.” *Id.* at 10:1-5. As Weidman explains, “if B is simply water vapor, reaction with the remaining substituent X₂ still attached to the silicon atom (already bonded to the surface as a result of its exposure to reactant ‘A’ in the previous step can result in the formation of an Si—OH moiety with loss of a volatile byproduct HX₂.” *Id.* at 10:5-10.



Id. at 10:12-13.

330. From this, in my opinion, a POSITA would understand Weidman to disclose, under conditions in the deposition chamber to form a composition with non-volatile components (i.e., “the metal atom together with its remaining substituents become bonded to the surface”) and a volatile component (i.e., “the substituent originally on the precursor is lost as a volatile compound”) comprising hydrolysis reaction product with X (i.e., “if B is simply water vapor, reaction with the remaining substituent X₂....can result in the formation of an Si—OH moiety with loss of a volatile byproduct HX₂). EX1001 at claim 1.

331. Although Weidman does not specifically disclose that the composition

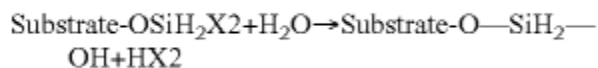
with non-volatile components includes an organotin, Cardineau teaches that the organotin precursors react with components of water (such as hydroxyl groups) (i.e. are hydrolysable) to form tin clusters. *See* EX1008 at 44: “Several hydrolysis methods were subsequently attempted, and hydrolysis of the organotin trichloride using ammonium hydroxide proved the most successful route”. *See also Id.* at 48: “Hydrolysis of phenyltin trichloride using ammonium hydroxide produces a soluble polymeric material which shows evidence that it is the tin cluster.”

332. Accordingly, I believe a POSA would have understood that the hydrolysis of the organotin trichlorides of Cardineau would result in displacement of a X ligand (chloride), and would have had a reasonable expectation that Cardineau’s precursors would successfully react with water as disclosed in Weidman to provide a non-volatile component that includes an organotin (i.e., “tin clusters”) and a volatile component comprising hydrolysis reaction product with X (chloride) since Cardineau teaches that the organotin precursors react with components of water to form tin clusters.

m. “wherein the substrate is configured with a surface to receive the non-volatile components of the composition.”

333. I note that Weidman discloses that the “B” reactant reacts with the “A” precursor with loss of the volatile HX₂ byproduct. Weidman discloses that “[n]on-limiting examples of ‘A’ precursors include volatile metal-containing

compounds, for example, compounds of silicon or other main group or transition metals **bonded to at least one substituent which will be readily displaced upon reaction with surface bond species such as a hydroxyl group** such that the substituent originally on the precursor is lost as a volatile compound and the metal atom together with its remaining substituents become bonded to the surface.” *Id.* at 9:44-57. And “[n]on-limiting examples of ‘B’ reactants include ozone, H₂O, H₂O₂, NH₃, and reactive oxygen, nitrogen, or hydrogen containing species generated in a plasma, and in specific embodiments, a remote plasma.” *Id.* at 10:1-5. Weidman states that “if B is simply water vapor, reaction with the remaining substituent X₂ still attached to the silicon atom (already bonded to the surface as a result of its exposure to reactant ‘A’ in the previous step can result in the formation of an Si—OH moiety with loss of a volatile byproduct HX₂.” *Id.* at 10:5-10.



Id. at 10:12-13,

334. In my opinion, a POSA would understand that the substrate receives the non-volatile components (i.e., not the volatile HX₂ byproduct). EX1001 at claim 1.

335. Although Weidman does not specifically disclose that the non-volatile

components includes an organotin, Cardineau teaches that the organotin precursors react with components of water such as hydroxyl groups (i.e. are hydrolysable) to form tin clusters to produce non-volatile components. *See* EX1008 at 48: “Hydrolysis of phenyltin trichloride using ammonium hydroxide produces a soluble polymeric material which shows evidence that it is the tin cluster.” Accordingly, in my opinion, a POSA would have had a reasonable expectation that Cardineau’s precursors would successfully react with water as disclosed in Weidman to provide a non-volatile component that includes an organotin (i.e., “tin clusters”) since Cardineau teaches that the organotin precursors react with components of water to produce non-volatile components (i.e., “soluble polymeric material”). EX1001 at claim 1.

(2) Claim 2

336. Claim 2 depends on claim 1 and recites that “the substrate comprises a **silicon wafer**.” In my opinion, Weidman discloses that “[s]ubstrates on which embodiments of the invention may be useful include, but are not limited to semiconductor wafers, such as crystalline silicon (e.g., Si<100> or Si<111>), silicon oxide, strained silicon, silicon germanium, doped or undoped polysilicon, doped or undoped silicon wafers....” EX1005 at 7:32-37; EX1001 at claim 2.

(3) Claim 3

337. Claim 3 depends on claim 1 and recites that “the inert gas comprises

nitrogen or argon.” In my opinion, Weidman discloses that the apparatus includes a supply of inert gases such as argon and nitrogen and an inlet to supply the inert gas to the deposition chamber: “The processing chamber would include separate supplies of the A, B, and C reactants, along with a supply of carrier, purge and **inert gases such as argon and nitrogen** in fluid communications with gas inlets for each of the reactants and gases.” EX1005 at 8:48-52.

(4) **Claim 4**

- a. **“the structure configured to deliver flow comprises an aerosol generator configured to generate an aerosol from a liquid comprising the organotin compound, a vaporization chamber configured to receive an injection of organotin compound, a flash evaporator configured to evaporate the organotin compound, or a bubbler configured for bubbling an inert carrier gas through a liquid comprising the organotin compound”**

338. Claim 4 depends from claim 1. I note that although Weidman does not specifically use the terms aerosol generator, vaporization chamber, flash evaporator, or bubbler, it discusses the delivery of precursors using a carrier gas through a heated ampoule. EX1005 at 11:65-12:2 (“The substrate having active sites can be exposed to a metal-containing ‘A’ precursor gas or vapor formed by **passing a carrier gas** (for example, nitrogen or argon) **through an ampoule of the precursor**, which may be in liquid form. The ampoule may be heated.”), 12:37-40 (“After the first purge, the substrate active sites can be exposed a ‘B’

reactant gas or vapor formed by passing a carrier gas (for example, nitrogen or argon) through an ampoule the ‘B’ reactant. The ampoule may be heated.”). In my opinion, a POSA would know that passing a carrier gas through an ampoule is a bubbler is a common method for generating a reactant gas from a liquid. EX1001 at claim 4.

b. “wherein the deposition on the surface of the substrate comprises chemical vapor deposition.”

339. Weidman discloses “a chamber configured to operate in both an ALD mode as well as a conventional **CVD** mode may be used to deposit photoresist materials....” EX1005 at 9:12-14. In my opinion, a POSA would understand that ALD is a type of CVD. EX1001 at claim 4.

(5) Claim 5

340. Claim 5 depends on claim 1 and recites that “the second precursor vapor comprises water vapor.” Weidman explicitly mentions “vapors of water” as an example of the “B” reactant: “**Then a non-metal reactant ‘B’, for example vapors of water** or hydrogen peroxide/water, or water along with a volatile acid (such as HCl) or base (such as NH₃) or a gas or plasma containing an active hydrogen, oxygen or nitrogen species, **is delivered to the surface**, wherein the previously reacted terminating substituents or ligands of the first half reaction are reacted with the new ligands from the ‘B’ reactant, creating an exchange by-

product.” EX1005 at 5:55-62; EX1001 at claim 5.

(6) Claim 8

341. Claim 8 depends on claim 1 and recites that “the interior has a **pressure from about 0.01 Torr to about 25 Torr.**” In my opinion, Weidman discloses: “The ALD process provides that the processing chamber or the deposition chamber may be pressurized at a pressure within a range **from about 0.01 Torr to about 100 Torr**, for example **from about 0.1 Torr to about 10 Torr**, and more specifically, **from about 0.5 Torr to about 5 Torr.**” EX1005 at 9:16-9:20; EX1001 at claim 8.

(7) Claim 9

342. Claim 9 depends on claim 1 and recites that “the interior has a temperature from about 40° C. to about 175° C.”²² In my opinion, Weidman discloses “**the chamber or the substrate may be heated to a temperature of less than about 500° C., for example, about 400° C. or less, such as within a range from about 50° C. to about 400° C., and in other embodiments less than about 300° C., less than about 200° C., or less than about 100°.**” EX1005 at 9:20-26; EX1001 at claim 9.

(8) Claim 10

²² Petitioner preserves right to argue indefiniteness of claim 9 as a mixed claim type.

343. Claim 10 depends on claim 1 and recites “comprising a **configuration** providing for selection of the pressure and/or the temperature in the deposition chamber.”

344. In my opinion, the Weidman and Cardineau combination performs the function: “selection of the pressure and/or the temperature in the deposition chamber.” Weidman discloses “**the substrate temperature and chemistry can be selected specifically** not to promote formation of an insoluble oxide precursor material, but to remain soluble unless exposed to far UV or EUV radiation, thereby providing an effective patterning method.” EX1005 at 15:56-61; EX1001 at claim 10.

345. I note that Weidman discloses a flow controller that can control the flow of reactants to the deposition chamber: “[e]ach inlet may be controlled by **an appropriate flow controller** such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) **that allows flow of each of the reactants to the substrate** to perform a ALD process as described herein.” EX1005 at 7:52-57. A POSA would understand that the flow controller can provide for selection of the pressure by controlling the flow of the reactants. EX1001 at claim 10.

346. Thus, in my opinion, the Weidman and Cardineau combination discloses “one or more vapor inputting structures.”

(9) **Claim 11**

347. Claim 11 depends on claim 1 and recites “the flow comprises a vapor.”²³ In my opinion, while it is unclear which “flow” is to “comprise[] a vapor” for claim 11, Weidman discloses that “[t]he substrate having active sites can be exposed to a **metal-containing “A” precursor gas or vapor formed by passing a carrier gas (for example, nitrogen or argon) through an ampoule of the precursor**, which may be in liquid form.” EX1005, 11:65-12:1. Weidman therefore discloses that the flow (i.e. “carrier gas”) comprises a vapor (i.e., “metal-containing “A” precursor gas or vapor”). EX1001 at 11.

(10) **Claim 12**

348. Claim 12 depends on claim 1 and recites “the structure configured to deliver flow comprises **one or more vapor inputting structures**.”²⁴

349. In my opinion, the Weidman and Cardineau combination performs the function: “vapor inputting.” It also discloses the structure of Figure 16 of the ’048 Patent is an inlet 154 or inlet 176 connecting a deposition chamber 151 to a source of vapor and equivalents thereof or, if not tied to Figure 16, an inlet connecting a deposition chamber to a source of vapor and equivalents thereof.

350. I note that Weidman discloses “[a] processing chamber is configured

²³ Petitioner preserves right to argue indefiniteness of claim 11.

²⁴ Petitioner preserves right to argue indefiniteness of claim 12.

to expose the substrate to a sequence of gases and/or plasmas” that includes “separate supplies of the A, B, and C reactants, along with a supply of carrier, purge and inert gases such as argon and nitrogen in fluid communication **with gas inlets for each of the reactants and gases.**” EX1005, 8:48-52. Weidman further discusses “an apparatus for deposition of a film on a substrate” that includes a deposition chamber. And the apparatus includes “a first precursor inlet in fluid communication with a supply of precursor,” and “a reactant gas inlet in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O₂, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen.”

351. Thus, in my opinion, the Weidman and Cardineau combination discloses “one or more vapor inputting structures.”

(11) Claim 13

352. Claim 13 depends on claim 12 and recites “the vapor inputting structures provide for control of the flow.” For “the vapor inputting structures,” the structure is the same as identified for claim 12.

353. As discussed above, Weidman discloses “the vapor inputting structures” of claim 12. I note that Weidman further discloses that “[e]ach inlet **may be controlled by an appropriate flow controller** such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) **that allows flow of each of the reactants to the substrate** to perform

a ALD process as described herein.” EX1005 at 7:52-57.

(12) Claim 14

354. Claim 14 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow at the same time.” For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

355. In my opinion, Weidman describes an “apparatus [that] includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties.” *Id.*, 8:47-49. Weidman also notes that “the ‘A’, ‘B’, and purge gases can flow simultaneously, and the substrate and/or gas flow nozzle can oscillate such that the substrate is sequentially exposed to the A, purge, and B gases as desired.” *Id.*, 6:17-21.

356. In my opinion, Weidman discloses “[t]he processing chamber would include separate supplies of the A, B, and C reactants, along with a supply of carrier, purge and inert gases such as argon and nitrogen in fluid communication with **gas inlets** for each of the reactants and gases.” EX1005 at 8:48-52. “**Each inlet** may be controlled by an appropriate flow controller such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) that allows flow of each of the reactants to the substrate to perform a

ALD process as described herein.” *Id.* at 8:52-57.

357. In my opinion, Weidman further teaches that “[t]he apparatus includes **a first precursor inlet** in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties,” and “[t]he apparatus includes **a reactant gas inlet** in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O₂, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen,” *id.* at 8:47-52. “A supply of a second precursor containing reactive, moieties cross-linkable with the substituents in the first precursor may be in fluid communication with the **first precursor gas inlet** or a separate **second precursor gas inlet**,” and “[t]he apparatus can further include an auxiliary gas inlet for supplying one or more auxiliary gases such as inert gases to the deposition chamber.” *Id.* at 8:52-61; EX1005, ¶X.

358. Weidman also notes that “the ‘A’, ‘B’, and purge gases can flow **simultaneously**, and the substrate and/or gas flow nozzle can oscillate such that the substrate is sequentially exposed to the A, purge, and B gases as desired.” EX1005, 6:17-21.

359. Thus, in my opinion, the Weidman and Cardineau combination discloses a first vapor inputting structure (e.g., gas inlet) is configured to deliver a first vapor flow and a second vapor inputting structure (e.g., gas inlet) is configured to deliver a second vapor flow at the same time (e.g., “the ‘A’, ‘B’, and

purge gases can flow simultaneously”).

(13) Claim 15

360. Claim 15 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are sequential.” For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

361. In my opinion, Weidman discloses “[a] method for forming a radiation sensitive photoresist on a substrate comprising: exposing a substrate sequentially to alternating pulses of a first precursor containing substituents with cross-linkable moieties and a reactant selected from...H₂O, H₂O₂...to form a deposited layer ...” EX1005, claim 1. Weidman also discloses that “the ‘A’, ‘B’, and purge gases can flow simultaneously, and the substrate and/or gas flow nozzle can oscillate such that the substrate is **sequentially exposed** to the A, purge, and B gases as desired.” EX1005, 6:17-21.

362. I note that Weidman teaches that “[a] processing chamber is configured to expose the substrate to **a sequence of gases and/or plasmas during the vapor deposition process**,” and “[t]he processing chamber would include **separate supplies** of the A, B, and C reactants, along with a supply of carrier,

purge and inert gases such as argon and nitrogen **in fluid communication with gas inlets for each of the reactants and gases.**” EX1005 at 7:46-52.

363. I note that Weidman also teaches that “[t]he apparatus includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties,” and “[t]he apparatus includes a reactant gas inlet in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O₂, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen,” *id.* at 8:47-52. “A supply of a second precursor containing reactive, moieties cross-linkable with the substituents in the first precursor may be in fluid communication with the first precursor gas inlet or a separate second precursor gas inlet,” and “[t]he apparatus can further include an auxiliary gas inlet for supplying one or more auxiliary gases such as inert gases to the deposition chamber.” *Id.* at 8:52-61; EX1005, ¶X.

364. Weidman discloses that “the ‘A’, ‘B’, and purge gases can flow simultaneously, and the substrate and/or gas flow nozzle can oscillate such that the substrate is **sequentially exposed** to the A, purge, and B gases as desired.” EX1005 at 6:17-21.

365. Thus, in my opinion, Weidman+Cardineau discloses a first vapor inputting structure (i.e., gas inlet) is configured to deliver a first vapor flow (i.e., “A” reactant) and a second vapor inputting structure (i.e., gas inlet) is configured

to deliver a second vapor flow (i.e., “B” reactant), wherein the first vapor flow (i.e., “A” reactant) and the second vapor flow (i.e., “B” reactant) are sequential (i.e., “alternating pulses” or “sequentially exposed”).

(14) Claim 16

366. Claim 16 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow, the second vapor flow, and a third vapor flow are sequential.” For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

367. In my opinion, Weidman teaches that “[a] processing chamber is configured to expose the substrate to **a sequence of gases and/or plasmas during the vapor deposition process,**” and “[t]he processing chamber would include **separate supplies** of the A, B, and C reactants, along with a supply of carrier, purge and inert gases such as argon and nitrogen **in fluid communication with gas inlets for each of the reactants and gases.**” EX1005at 7:46-52. “Each inlet may be controlled by an appropriate flow controller such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) that allows flow of each of the reactants to the substrate to perform a ALD process....” *Id.* at 7:52-57.

368. I note that Weidman also teaches that “[t]he apparatus includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties,” and “[t]he apparatus includes a reactant gas inlet in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O₂, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen,” *id.* at 8:47-52. “A supply of a second precursor containing reactive, moieties cross-linkable with the substituents in the first precursor may be in fluid communication with the first precursor gas inlet or a separate second precursor gas inlet,” and “[t]he apparatus can further include an auxiliary gas inlet for supplying one or more auxiliary gases such as inert gases to the deposition chamber.” *Id.* at 8:52-61; EX1005, ¶X.

369. In my opinion, Weidman discloses that “the ‘A’, ‘B’, and purge gases can flow simultaneously, and the substrate and/or gas flow nozzle can oscillate such that the substrate is **sequentially exposed** to the A, purge, and B gases as desired.” EX1005 at 6:17-21. Weidman teaches that “a different type of second reactant (a ‘D’ reactant) may be utilized in a reaction sequence, in which ‘B’ and ‘D’ reactants are different to provide a reaction sequence in which the following pulsed ALD cycle is utilized A, B, C, D, A, B, C, D . . . (with purges between each pulse),” and “instead of pulsing the reactants, the gases can flow simultaneously from a gas delivery head or nozzle and the substrate and/or gas delivery head can

be moved such that the substrate is **sequentially exposed** to the gases.” *Id.* at 6:52-61.

370. Weidman further explains:

[A]n ALD process cycle may include alternating pulses of “A” precursor (for example, metal oxide precursor) and “B” reactant with a purge between each pulse of precursor and reactant. Alternatively, an ALD process cycle may include alternating pulses of “A” precursor (for example, metal oxide precursor), “B” reactant, “C” precursor (for example, metal oxide precursor), and “B” reactant, where the “A” and “C” precursors are the same or different, with a purge between each pulse of precursor and reactant. An ALD process cycle may include alternating pulses of “A” precursor, “B” reactant, “C” precursor, and “D” reactant, where the “A” and “C” metal oxide precursors are the same or different and the “B” and “D” reactants are the same or different, with a purge between each pulse of precursor or reactant.

Id. at 9:29-42.

371. Thus, in my opinion, the Weidman+Cardineu combination discloses a first vapor inputting structure (i.e., gas inlet) is configured to deliver a first vapor flow (i.e., “A” precursor) and a second vapor inputting structure (i.e., gas inlet) is configured to deliver a second vapor flow (i.e., “B” reactant), wherein the first vapor flow (i.e., “A” precursor), the second vapor flow (i.e., “B” reactant), and a third vapor flow (i.e., “C” precursor or “D” reactant) are sequential (i.e., “a sequence of gases and/or plasmas” and “sequentially exposed”).

372. In my opinion, a POSA would also understand that there are a limited number of obvious choices of continuous or alternating delivery methods, which

would have been obvious-to-try.

(15) Claim 17

373. Claim 17 depends on claim 1 and recites “a first vapor inputting structure is configured to deliver a first vapor flow and a second vapor inputting structure is configured to deliver a second vapor flow, wherein the first vapor flow and the second vapor flow are at the same time and a third vapor flow is sequential.” For the “first vapor inputting structure” and “second vapor inputting structure,” the structure is the same as identified for claim 12.

374. In my opinion, Weidman teaches that “[a] processing chamber is configured to expose the substrate to **a sequence of gases and/or plasmas during the vapor deposition process,**” and “[t]he processing chamber would include **separate supplies** of the A, B, and C reactants, along with a supply of carrier, purge and inert gases such as argon and nitrogen **in fluid communication with gas inlets for each of the reactants and gases.**” EX1005 at 7:46-52. “Each inlet may be controlled by an appropriate flow controller such as a mass flow controller or volume flow controller in communication with a central processing unit (CPU) that allows flow of each of the reactants to the substrate to perform a ALD process....” *Id.* at 7:52-57.

375. In my opinion, Weidman also teaches that “[t]he apparatus includes a first precursor inlet in fluid communication with a supply of a first precursor

containing substituents with cross-linkable moieties,” and “[t]he apparatus includes a reactant gas inlet in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O₂, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen,” *id.* at 8:47-52. “A supply of a second precursor containing reactive, moieties cross-linkable with the substituents in the first precursor may be in fluid communication with the first precursor gas inlet or a separate second precursor gas inlet,” and “[t]he apparatus can further include an auxiliary gas inlet for supplying one or more auxiliary gases such as inert gases to the deposition chamber.” *Id.* at 8:52-61; EX1005, ¶X.

376. I note that Weidman discloses that “**the ‘A’, ‘B’, and purge gases can flow simultaneously**, and the substrate and/or gas flow nozzle can oscillate such that the substrate is **sequentially exposed** to the A, purge, and B gases as desired.” EX1005 at 6:17-21. Weidman teaches that “a different type of second reactant (a ‘D’ reactant) may be utilized in a reaction sequence, in which ‘B’ and ‘D’ reactants are different to provide a reaction sequence in which the following pulsed ALD cycle is utilized A, B, C, D, A, B, C, D . . . (with purges between each pulse),” and “instead of pulsing the reactants, **the gases can flow simultaneously** from a gas delivery head or nozzle and the substrate and/or gas delivery head can be moved such that the substrate is **sequentially exposed** to the gases.” *Id.* at 6:52-61.

377. I note that Weidman further explains:

[A]n ALD process cycle may include alternating pulses of “A” precursor (for example, metal oxide precursor) and “B” reactant with a purge between each pulse of precursor and reactant. Alternatively, an ALD process cycle may include alternating pulses of “A” precursor (for example, metal oxide precursor), “B” reactant, “C” precursor (for example, metal oxide precursor), and “B” reactant, where the “A” and “C” precursors are the same or different, with a purge between each pulse of precursor and reactant. An ALD process cycle may include alternating pulses of “A” precursor, “B” reactant, “C” precursor, and “D” reactant, where the “A” and “C” metal oxide precursors are the same or different and the “B” and “D” reactants are the same or different, with a purge between each pulse of precursor or reactant.

Id. at 9:29-42.

378. Thus, in my opinion, the Weidman+Cardineu combination a first vapor inputting structure (i.e., gas inlet) is configured to deliver a first vapor flow (i.e., “A” precursor) and a second vapor inputting structure (i.e., gas inlet) is configured to deliver a second vapor flow (i.e., “B” reactant), wherein the first vapor flow (i.e., “A” precursor) and the second vapor flow are at the same time (i.e., “flow simultaneously”) and a third vapor flow (i.e., “C” precursor or “D” reactant) is sequential (i.e., “a sequence of gases and/or plasmas” and “sequentially exposed”).

379. Thus, in my opinion, POSA would also understand that there are a limited number of obvious choices of continuous or alternating delivery methods, which would have been obvious-to-try.

(16) Claim 18

380. Claim 18 depends on claim 1 and recites “the interior has a temperature from about 45° C. to about 200° C.” Based on my review, Weidman discloses “**the chamber or the substrate may be heated to a temperature of** less than about 500° C., for example, about 400° C. or less, such as within a range from about 50° C. to about 400° C., and in other embodiments less than about 300° C., **less than about 200° C., or less than about 100°.**” EX1005 at 9:20-26.

(17) Claim 19

381. Claim 19 depends on claim 1 and recites “X is alkylamido or dialkylamido.” In my opinion, although Weidman discloses precursors that include alkylamido substituents, Weidman does not specifically disclose organotin precursors that include alkylamido substituents. EX1005 at 18:16-22. (“The specific composition and properties of the etch mask can be varied with precursor selection and can include a wide variety of materials in addition to silicon dioxide based compositions, for example the use of titanium, zirconium, or hafnium halides, alkoxides, or **alkylamido** complexes as metal precursors and water vapor as the reactant.”). I note that Weidman also discloses that the metals can include tin: “Specific materials according to one or more embodiments include but are not limited to silicon, germanium, **tin**, hafnium, zirconium, titanium, group V and VI metals and oxides thereof.” *Id.* 4:48-51.

382. However, I note that Cardineau discloses tin compounds for use as EUV photoresists because of tin's higher EUV absorbance. Specifically, Cardineau explains that "[b]oth tin and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon" such that "these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise." EX1008 at 45.

383. As such, in my opinion, POSA would have been motivated to use an organotin with an alkoxo ligand of Cardineau in the apparatus of Weidman because Weidman and Cardineau are analogous art, and Weidman teaches that precursors can include tin and alkoxo ligands, and also in to order to use tin precursors in to order to achieve the superior lithographic performance and improved sensitivity and lower shot noise of films as disclosed by Cardineau.

(18) Claim 20

384. Claim 20 depends on claim 1 and recites "X is alkoxo and aryloxo." Although Weidman discloses precursors that include alkoxo substituents, in my opinion, Weidman does not specifically disclose organotin precursors that include alkoxo substituents. EX1005 at 18:16-22. ("The specific composition and properties of the etch mask can be varied with precursor selection and can include

a wide variety of materials in addition to silicon dioxide based compositions, for example the use of titanium, zirconium, or hafnium halides, **alkoxides**, or alkylamido complexes as metal precursors and water vapor as the reactant.”).

Weidman also discloses that the metals can include tin: “Specific materials according to one or more embodiments include but are not limited to silicon, germanium, **tin**, hafnium, zirconium, titanium, group V and VI metals and oxides thereof.” *Id.* 4:48-51.

385. However, in my opinion, Cardineau discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Specifically, Cardineau explains that “[b]oth tin and oxygen readily absorb EUV photons with optical densities that are 10.5 and 1.7 times greater than carbon” such that “these higher optical densities should allow resists based on these tin-oxo clusters to better utilize the EUV photons that are used in EUV lithography to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise.” EX1008 at 45.

386. As such, I believe that a POSA would have been motivated to use an organotin with an alkoxo ligand of Cardineau in the apparatus of Weidman because Weidman and Cardineau are analogous art, and Weidman teaches that precursors can include tin and alkoxo ligands, and also in to order to use tin precursors in to order to achieve the superior lithographic performance and

improved sensitivity and lower shot noise of films as disclosed by Cardineau.

D. Ground 4: Claims 6 and 7 Are Obvious in View of Weidman, Cardineau, and Molloy

(1) Claim 6

387. In my opinion, the Weidman, Cardineau, and Molloy combination discloses claim 6, which depends on claim 1 and recites “further comprising a flow comprising a **third precursor vapor** comprising a composition represented by the formula **ML_v**, where v is $2 \leq v \leq 6$ and L is an oxidizable ligand or a ligand having a hydrolysable M-L bond or a combination thereof, and M is a metal selected from groups 2-16 of the periodic table.”

388. In my opinion, the Weidman, Cardineau, and Molloy combination discloses each limitation of claim 1 for the reasons discussed above in connection with Ground 5. All reasoning and support for that ground is incorporated herein.

389. From my understanding, the Weidman, Cardineau, and in view of Molloy combination also discloses the remaining limitation. Weidman teaches that, “[a]fter the second purge, a second metal-containing precursor gas or vapor is delivered to the substrate surface,” and “[t]he metal-containing precursor can be an ‘A’ precursor...., or the metal-containing precursor can be a ‘C’ precursor....” “[T]he ‘C’ precursor can be the same or different from the ‘A’ precursor.” I note that Weidman further states that “ALD sequences...such as pulses of ‘A’

precursor, 'B' reactant, 'C' precursor, and 'D' reactant (including purges between each pulse) can be utilized.” Further, “at least two different types of metal-containing (e.g., silicon) precursors can be utilized” with “the 'C' metal-containing precursor is different from the 'A' metal-containing precursor thereby providing ALD cycle A, B, C, B, A, B, C, B, A, B, C, B” *Id.* 6:45-50, 6:52-55.

“Likewise a different type of second reactant (a 'D' reactant) may be utilized in a reaction sequence, in which 'B' and 'D' reactants are different to provide a reaction sequence in which the following pulsed ALD cycle is utilized A, B, C, D, A, B, C, D . . . (with purges between each pulse).” Therefore, Weidman teaches a third precursor vapor (i.e., “a second metal-containing precursor gas or vapor”).

390. I note that although Weidman discloses the use of a third precursor vapor, neither Weidman nor Cardineau disclose a composition represented by the formula ML_v. However, in my opinion, a POSA would have known that compounds of formula ML_v were well known and being used as precursors in vapor deposition techniques and would have had an expectation that the compositions of formula ML_v could successfully be included in a third precursor vapor.

391. I note that Molloy discloses inorganic tin compounds for chemical vapor deposition purposes, including SnMe₄ a “precursor of choice” in dual-source CVD processes that provide films with desirable properties produced with high

deposition rates (“polycrystalline with a refractive index of 2.00–2.10, have visible-light transmission of 84% and resistivity of 0.6 Ωcm ” (citations omitted)) and deposition temperatures as low as 30°C. EX1009, 549-550.

392. In my opinion, a POSA would further understand that SnMe_4 is a composition represented by the formula ML_v , where M is tin (Sn; group 14 of the periodic table), v is 4, and L is methyl (Me), which is a ligand having a hydrolysable M-L bond.

393. In my opinion, a POSA would appreciate that Weidman, Cardineau, and Molloy are analogous art, and would have been motivated to combine the references because Molloy teaches organometallic (e.g. organotin) precursors. I believe that a POSA would have been motivated to select SnMe_4 (i.e. a compound of formula ML_v) for inclusion in the third vapor precursor in order to obtain a film with the desirable properties described by Molloy. Finally, in my opinion, a POSA would have had a reasonable expectation of success that Molloy’s precursors could successfully form a film using the apparatus of Weidman since Molloy teaches that SnMe_4 is a precursor for vapor deposition methods.²⁵

²⁵ As claim 6 does not require any timing or temporal requirements, the third precursor vapor could be introduced at the same time as the first precursor vapor and/or second precursor vapor or in a subsequent step. If introduced in a subsequent step, an intervening purge step would be administered and so the third precursor vapor would not affect any reaction between components of the first precursor vapor and second precursor vapor.

(2) Claim 7

394. In my opinion, the Weidman, Cardineau, and Molloy combination discloses claim 7, which depends on claim 6 and recites that “the third precursor vapor comprises SnL_4 .”

395. In my opinion, the Weidman, Cardineau, and Molloy combination discloses each limitation of claims 1 and 6 for the reasons discussed above in connection with Ground 5. All reasoning and support for that ground is incorporated herein.

396. In my opinion, the Weidman, Cardineau, and Molloy combination also discloses the remaining limitation. Weidman teaches that, “[a]fter the second purge, a second metal-containing precursor gas or vapor is delivered to the substrate surface,” and “[t]he metal-containing precursor can be an ‘A’ precursor...., or the metal-containing precursor can be a ‘C’ precursor....” “[T]he ‘C’ precursor can be the same or different from the ‘A’ precursor.” Weidman further states that “ALD sequences...such as pulses of ‘A’ precursor, ‘B’ reactant, ‘C’ precursor, and ‘D’ reactant (including purges between each pulse) can be utilized.” Further, “at least two different types of metal-containing (e.g., silicon) precursors can be utilized” with “the ‘C’ metal-containing precursor is different from the ‘A’ metal-containing precursor thereby providing ALD cycle A, B, C, B, A, B, C, B, A, B, C, B” “Likewise a different type of second reactant (a ‘D’

reactant) may be utilized in a reaction sequence, in which ‘B’ and ‘D’ reactants are different to provide a reaction sequence in which the following pulsed ALD cycle is utilized A, B, C, D, A, B, C, D . . . (with purges between each pulse).”

Therefore, Weidman teaches a third precursor vapor (i.e., “a second metal-containing precursor gas or vapor”).

397. I note that although Weidman discloses the use of a third precursor vapor, neither Weidman nor Cardineau discloses a compound of formula SnL_4 . However, in my opinion, a POSA would have known that compounds of formula SnL_4 were being used as precursors in vapor deposition techniques and provide films with enhanced properties. In my opinion, a POSA would have had an expectation that the compositions of formula SnMe_4 could successfully be included in a third precursor vapor.

398. I note that Molloy discloses organotin compounds for chemical vapor deposition purposes, including SnMe_4 a “precursor of choice” in dual-source CVD processes that provide films with desirable properties produced with high deposition rates (“polycrystalline with a refractive index of 2.00–2.10, have visible-light transmission of 84% and resistivity of $0.6 \Omega\text{cm}$ ” (citations omitted)) and deposition temperatures as low as 30°C . EX1009, 549-550.

399. Thus I believe that a POSA would further understand that SnMe_4 is a composition represented by the formula SnL_4 , where M is tin (Sn; group 14 of the

periodic table), and L is methyl (Me), which is a ligand having a hydrolysable M-L bond.

400. It is my opinion that one of skill in the art would appreciate that Weidman, Cardineau, and Molloy are analogous art, and would have been motivated to combine the references because Molloy teaches organometallic (e.g. organotin) precursors. A POSA would have been motivated to select SnMe_4 (i.e. a compound of formula SnL_4) for inclusion in the third vapor precursor in order to obtain a film with the desirable properties described by Molloy. Finally, I believe that a POSA would have had a reasonable expectation of success that Molloy's precursors could successfully form a film using the apparatus of Weidman since Molloy teaches that SnMe_4 is a precursor for vapor deposition methods.

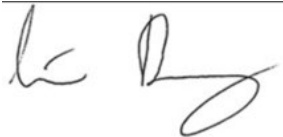
XI. CONCLUSION

401. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true. I further declare that all statements made herein were made with the knowledge that willful false statements and the like are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code.

402. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be

subject to cross examination in the case and that cross examination will take place within the United States. If cross examination is required of me, I will appear for cross examination within the United States during the time allotted for cross examination.

DATE: December 13, 2024

By: 
Seán Barry, Ph.D.