

EXHIBIT 048-J

***Inpria Corporation v. Lam Research Corp.*, Case No. 1-22-cv-01359-CJB
Exhibit 048-J - Invalidity Claim Chart for U.S. Patent No. 11,537,048**

U.S. Patent No. 8,536,068 (“Weidman ’068”) issued from an application that published on April 12, 2012 as US Publication Number 2012/0088369 (“Weidman Publication”). The Weidman Publication is prior art to the ’048 Patent under AIA 35 U.S.C. 102(a)(1). Citations below to Weidman ’068 are equally found in the Weidman Publication. Accordingly, any citation to Weidman ’068 below incorporates by reference the equivalent or similar citation found in the Weidman Publication and vice versa. See also US Publication Number 2012/0088193, which published with equivalent disclosures on April 12, 2012.

Weidman ’068 renders Asserted Claims 1-10, 14-20 of the ’048 patent obvious alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified in Defendant’s Invalidity Contentions, including as set forth in this chart.

Cardineau, Brian, “Novel Resist Systems for EUV Lithography: LER, Nanoparticle, Chain-Scission and MORE” (Ph.D. Dissertation, State University of New York) (“Cardineau Dissertation”) published in **2013**. Cardineau Dissertation is therefore prior art to the ’048 Patent under AIA 35 U.S.C. 102(a)(1).

Cardineau, Brian, et al. “Photolithographic properties of tin-oxo clusters using extreme ultraviolet light (13.5 nm).” *Microelectronic engineering* 127 (2014): 44-50 (“Cardineau Paper”) published on **April 24, 2014**. The Cardineau Paper is therefore prior art to the ’048 under AIA 35 U.S.C. 102(a)(1).

Cardineau, Brian, “Molecular Organometallic Resists for EUV (MORE), EUV Symposium TWG, Toyama Japan” (“Cardineau Symposium Presentation”) published on **October 6, 2013**. Cardineau Symposium Presentation is therefore prior art to the ’048 Patent under AIA 35 U.S.C. 102(a)(1). None of the exceptions under 35 U.S.C. §102(b)(1) apply because “Cardineau Symposium Presentation” was published over one year before the purported earliest priority date (October 13, 2015) that the ’048 patent claims.

Molloy, Kieran C. “Precursors for the formation of tin (IV) oxide and related materials.” *Journal of Chemical Research* 2008.10 (2008): 549-554 (“Molloy”) published on **October 21, 2008**. Molloy is therefore prior art to the ’048 Patent under AIA 35 U.S.C. 102(a)(1).

U.S. Patent Publication No. 2011/0183527 (“Cho ’527”) **published on July 28, 2011**. Cho is therefore prior art to the ’048 Patent under AIA 35 U.S.C. 102(a)(1).

Weidman ’068 renders Asserted Claims 1-10, 14-20 of the ’048 Patent obvious alone, in combination with the Cardineau Paper, Cardineau Dissertation, Cardineau Symposium Presentation, Molloy, Cho ’527, and in combination with the general knowledge of a

person of ordinary skill in the art, and/or in combination with the other references identified in Defendant's Invalidity Contentions, including as set forth in this chart.

With respect to the obviousness of the asserted claims under 35 U.S.C. § 103, one or more of the principles enumerated by the United States Supreme Court in *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398 (2007) apply, including: (a) combining various claimed elements known in the prior art according to known methods to yield a predictable result; (b) making a simple substitution of one or more known elements for another to obtain a predictable result; (c) using a known technique to improve a similar device or method in the same way; (d) applying a known technique to a known device or method ready for improvement to yield a predictable result; (e) choosing from a finite number of identified, predictable solutions with a reasonable expectation of success or, in other words, the solution was one which was "obvious to try"; (f) a known work in one field of endeavor prompting variations of it for use either in the same field or a different field based on given design incentives or other market forces in which the variations were predictable to one of ordinary skill in the art; and/or (g) a teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill in the art to modify the prior art reference or to combine the teachings of various prior art references to arrive at the claimed invention. It would have been obvious to a person of ordinary skill in the art to combine Weidman '068 with the general knowledge of a person of ordinary skill in the art, and/or one or more of the references identified in Defendant's Invalidity Contentions in accordance with the principles and rationales set forth above.

Beyond the specific motivations identified in the cited references, motivation to modify and combine particular references comes from: (a) the nature of the problem being solved; (b) the teachings of the prior art; (c) the knowledge of persons of ordinary skill in the art; (d) the fact that the references address the same or similar technical issues as the '048 patent; and (e) considerations of efficiency, effectiveness, convenience, cost-savings, and accessibility to combine the various teachings.

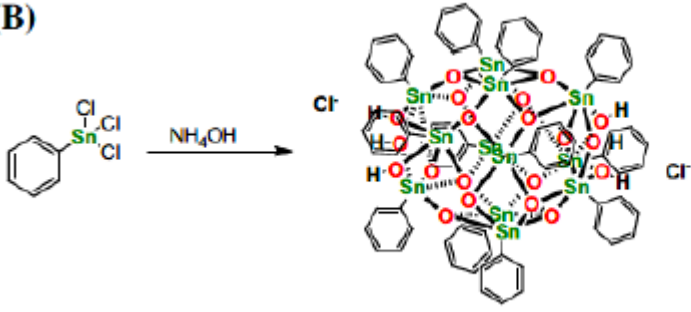
This claim chart is meant to illustrate one example of how the asserted claims are invalid for obviousness. By not discussing portions of a reference in the claim chart below, Defendant does not waive its right to rely on these portions of the reference. Instead, Defendant expressly reserves the right to rely on any and all portions of the cited references. These contentions are not an admission by Defendant that any accused materials are covered by or infringe the asserted claims of the '048 patent, particularly after the claims are construed by the Court. These contentions are not an admission by Defendant as to the proper scope of any asserted claim, the proper construction of any term in any asserted claim, or whether particular elements may be construed at all, or instead, are indefinite. Defendant reserves the right to modify, amend, or supplement these contentions as additional information becomes available during the course of this action and in view of any applicable claim construction order from the Court.

'048 Patent Claims	Disclosure of Prior Art
Claim 1	
[1p] A system comprising: a deposition chamber having an interior isolated from the ambient atmosphere	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses “an apparatus for deposition of a film on a substrate,” which is a system. Weidman '068, 8:41-42. Weidman thus discloses “[a] system comprising.” Cardineau Paper also discloses methods of preparing photoresists by spincoating organotins onto substrates. Cardineau Paper, 48. Weidman '068's “processing chamber or...deposition chamber may be pressurized at a pressure within a range from about 0.01 Torr to about 100 Torr.” Weidman '068, 9:16-18. Weidman '068's “chamber or the substrate may be heated....” <i>Id.</i> 9:21-22. Because the deposition chamber may be heated and/or pressurized, a POSA would understand that the chamber is “isolated from the ambient atmosphere.”
[1a] a substrate within the interior of the deposition chamber configured to receive a deposition on a surface of the substrate,	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068's “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.” Weidman '068, 8:41-46. Weidman '068's “apparatus includes a first precursor inlet in fluid communication with a supply of a first precursor,” <i>id.</i>, 8:47-49, and “[a] supply of a second precursor containing reactive, moieties crosslinkable with the substituents in the first precursor,” <i>id.</i>, 8:52-56.

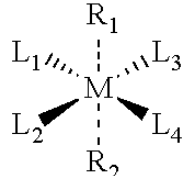
'048 Patent Claims	Disclosure of Prior Art
	According to Weidman '068, “[t]he apparatus include a radiation source or can be connected to a second apparatus for exposing the deposited layer radiation selected from EUV, far UV. X-ray and e-beam radiation such that upon exposure to the radiation, reactive, cross-linkable moieties present in the first precursor and second precursor in the deposited layer remain partially unreacted and soluble to developer solution.” <i>Id.</i>, 8:63-9:3. Figure 1A (below) “shows substrate 100 with a deposited layer 110 on the substrate, formed by one or more ALD cycles.” <i>Id.</i>, 13:36-37. FIG. 1A  Weidman '068, Fig. 1A.
[1b] wherein the substrate is maintained at a temperature of less than 200° C.;	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses a “chamber or...substrate [that] may be heated to a temperature of ...less than about 200° C, or less than about 100°.” Weidman '068, 9:21-26.
[1c] an inlet into the deposition chamber;	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses an “apparatus [which] includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties,” Weidman '068, 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,” <i>id.</i>, 8:52-56. “The apparatus includes a reactant gas inlet in fluid communication with a supply of a reactant gas in fluid communication with a supply of a reactant gas selected from ozone, H₂O, H₂O, NH₃, reactive oxygen, reactive nitrogen, and reactive hydrogen” <i>Id.</i>, 8:49-52
[1d] structure configured to deliver flow from	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation.

'048 Patent Claims	Disclosure of Prior Art
a supply of an inert gas;	Weidman '068's "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." Weidman '068, 7:48-52. Weidman '068 discloses an apparatus for performing vapor deposition that includes one or more inlets into the deposition chamber, <i>id.</i>, 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." <i>Id.</i>, 8:16-20. "Each inlet may be controlled by an appropriate 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." <i>Id.</i>, 7:53-56. And Weidman '068's "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" where "[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..." <i>Id.</i>, 11:66-12:6. Thus, Weidman '068 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. Weidman '068 and Cardineau Paper discloses the claimed "structure [e.g., Weidman '068's gas channels etc.] configured to deliver flow from a supply of an inert gas."
[1e] a supply of an organotin composition comprising a 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	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068's apparatus includes supplies of "A, B, and C reactants," Weidman '068, 8:48-52, and "A" reactants can include a "metal oxide precursor," <i>id.</i>, 9:29-31. 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." <i>Id.</i> 8:48-52. Weidman states that "an ALD process cycle may include alternating pulses of 'A' precursor (for example, metal oxide precursor)..." <i>Id.</i> 9:29-31.

'048 Patent Claims	Disclosure of Prior Art
a metal-carbon bond and	Weidman '068's "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." <i>Id.</i>, 9:44-57. Also, Weidman '068's examples of substituents 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...." <i>Id.</i> 3:29-33. Weidman '068 also discloses that the metals may 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." <i>Id.</i> 4:48-51. Cardineau Paper discloses using tin compounds as EUV photoresists given tin's higher EUV absorbance. Cardineau Paper discloses that tin has higher optical densities than carbon, and resists based on tin-oxo clusters should "provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise." Cardineau Paper, 45. 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." Cardineau Paper, 45. Cardineau Paper's tin-oxo clusters are prepared from the organotin trichlorides "[a]llyltin trichloride," "[b]utyltin trichloride," and "[p]henyltin trichloride." <i>Id.</i>, 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."). These are compounds "represented by the formula $R\text{SnX}_3$ wherein R is an organic ligand with 1-31 carbon atoms bound to Sn with a metal-carbon bond" and X is Chloro (Cl).

'048 Patent Claims	Disclosure of Prior Art
	<i>Id.</i>, 44 (“[E]valuation 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).”). (B)  Cardineau Paper, 48. A POSA would have been motivated to combine the references as related to the same subject matter as the '048 Patent—i.e., preparation of photoresists. A POSA would have been motivated to use Cardineau Paper's precursors in Weidman '068's apparatus to achieve superior lithographic performance, improved sensitivity and lower shot noise of films as Cardineau Paper discloses. Although Cardineau Paper discloses depositing the precursor compounds using spin coating, Weidman '068 discloses that using a vapor deposition apparatus provides more reliable coating compared to spin-coating. Weidman '068, 4:64-5:11 (“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.”); <i>see also id.</i> 5:27-32. Thus, a POSA would have been motivated to use Cardineau Paper's precursors as the “supply of the precursors” in Weidman '068's apparatus for more reliable coating.

'048 Patent Claims	Disclosure of Prior Art
	A POSA would have reasonably expected Cardineau Paper's precursors to successfully form a photoresist layer in Weidman '068's apparatus. Cardineau Paper teaches the organotin precursors react with components of water such as hydroxyl groups (i.e., are hydrolysable) to form tin clusters. Cardineau Paper, 44, 48. Also, Weidman '068 teaches water as a reactant. Weidman '068, 10:1-3 ("examples of 'B' reactants include ozone, H₂O, H₂O₂...."). Cardineau teaches that the organotin precursors react with components of water such as hydroxyl groups (i.e., are hydrolysable) to form tin clusters (<i>see</i> Cardineau Paper, 44: "Several hydrolysis methods were subsequently attempted, and hydrolysis of the organotin trichloride using ammonium hydroxide proved the most successful route"; <i>see also Id.</i>, 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. Weidman '068, 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...."). In the alternative, the combination of Cho '527 and Cardineau Paper provide motivation to provide "a supply of an organotin composition comprising a compound described by the formula RSnX₃, where R is an organic ligand with 1-31 carbon atoms and is bound to Sn with a metal-carbon bond." Cho '527 discloses methods of depositing metal compound layers comprising inputting into a deposition chamber a first precursor vapor comprising a metal and a ligand coordinating to the metal. Cho '527 ¶ 0048: "FIG. 1 is a flow chart illustrating a method of forming a layer in accordance with example embodiments. Referring to FIG. 1, a substrate on which a layer will be formed is loaded in a chamber (S10). The substrate may include a semiconductor substrate such as silicon substrate, a germanium substrate, a silicon-germanium substrate, a silicon-on-insulator (SOI) substrate, a germanium-on-insulator (GOI) substrate, etc. Alternatively, the substrate may include a single crystalline metal oxide substrate. For example, the substrate may include a single crystalline aluminum oxide (Al₂O₃) substrate, a single crystalline strontium titanium oxide (Stria) substrate or a single crystalline magnesium oxide (MgO) substrate." <i>Id.</i> ¶ 0050: "...In example embodiments, the precursor includes a metal and a ligand coordinating to the metal."

'048 Patent Claims	Disclosure of Prior Art
	<i>Id.</i> ¶ 0051: “The precursor may maintain a vapor state in the chamber before the precursor is chemisorbed on a surface of the substrate.” Cho '527 discloses the precursor may have the following formula (I): (1)  Cho '527 ¶ 0059: In the formula (1), M may represent a central metal such as zirconium or hafnium. L₁ to L₄ may be a ligand coordinating to the central metal and independently represent fluoro (F⁻), chloro (Cl⁻), bromo (Br⁻), iodo (I⁻), an alkoxy group having a carbon atom of about 1 to about 10, an aryl group having a carbon atom of about 6 to about 12, an allyl group having a carbon atom of about 3 to about 15, a dienyl group having a carbon atom of about 4 to about 15, a β-diketonate group having a carbon atom of about 5 to about 20, a β-ketoiminato group having a carbon atom of about 5 to about 20, a β-diiminato group having a carbon atom of about 5 to about 20, a hydroxyl group (OH), ammine (NH₃), an amine group having a carbon atom of about 1 to 10, an amido group (NH₂) or an amido group in which an alkyl group having a carbon atom of about 1 to about 10 is substituted for a hydrogen atom. ...For example, L₁ to L₄ may be dimethyl amido, diethyl amido, ethyl methyl amido, ethyl dimethyl amine, diethyl methyl amine or triethyl amine ...” <i>Id.</i> ¶ 0060: “As illustrated in formula (1), zirconium or hafnium may have a coordination number of four. Therefore, zirconium or hafnium may coordinate to four ligands to form a precursor. When the precursor is contacted with the electron donating compound, the electron donating compound may donate an electron to zirconium or hafnium to stabilize the precursor. Hence, when the precursor is contacted with the electron donating compound, the stabilized precursor may have an octahedral structure similar to that of a complex compound including a central metal and six ligands coordinating to the central metal. However, the intermolecular interaction between zirconium or hafnium and

'048 Patent Claims	Disclosure of Prior Art
	the electron donating compound may be substantially weaker than a bonding force between zirconium or hafnium and the ligand.” Cho '527 discloses that the metal in the precursor may be tin. <i>Id.</i> ¶ 0052: “The metal in the precursor may include lithium (Li), beryllium (Be), boron (B), sodium (Na), magnesium (Mg), aluminum (Al), potassium (K), calcium (Ca), scandium (Sc), titanium (Ti), vanadium (V), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), gallium (Ga), germanium (Ge), rubidium (Rb), strontium (Sr), yttrium (Y), zirconium (Zr), niobium (Nb), molybdenum (Mo), technetium (Tc), ruthenium (Ru), rhodium (Rh), palladium (Pd), silver (Ag), cadmium (Cd), indium (In), tin (Sn), antimony (Sb), tellurium (Te), cesium (Cs), barium (Ba), lanthanum (La), lanthanide (Ln), hafnium (Hf), tantalum (Ta), tungsten (W), rhenium (Re), osmium (Os), iridium (Ir), platinum (Pt), gold (Ag), thallium (Tl), mercury (Hg), lead (Pb), bismuth (Bi), polonium (Po), francium (Fr), radium (Ra), actinium (Ac) or actinide (An). For example, the metal may include zirconium or hafnium.” Cho '527 discloses that the ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. Cho '527 discloses that the ligand coordinating to the metal may be an alkyl group having a carbon atom of about 1 to about 10, an aryl group having a carbon atom of about 6 to about 12, or an allyl group having a carbon atom of about 3 to about 15, or chloro(Cl⁻). <i>Id.</i> ¶ 0053: “The ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. In example embodiments, the ligand may include a halogen such as fluoro (F⁻), chloro(Cl⁻), bromo (Br⁻) or iodo (I⁻), a hydroxyl group (OH), ammine (NH₃), an amine group having a carbon atom of about 1 to about 10, amido(NH₂) or an amido group in which an alkyl group having a carbon atom of about 1 to about 10 is substituted for a hydrogen atom, an alkoxy group having a carbon atom of about 1 to about 10, an alkyl group having a carbon atom of about 1 to about 10, an aryl group having a carbon atom of about 6 to about 12, an allyl group having a carbon atom of about 3 to about 15, a dienyl group having a carbon atom of about 4 to about 15, a β-diketonate group having a carbon atom of about 5 to about 20, a β-ketoiminato group having a carbon atom of about 5 to about 20 or a β-diiminato group having a carbon atom of about 5 to about 20. These may be used alone or in a mixture thereof. For example, the ligand may be dimethylamido (N(CH₃)₂), ethyl methyl amido(NCH₃C₂H₅), diethylamido(N(C₂H₅)₂), ethyl dimethyl amine(N(CH₃)₂C₂H₅), diethyl methyl amine(N(C₂H₅)₂CH₃) or triethylamine(N(C₂H₅)₃).”

'048 Patent Claims	Disclosure of Prior Art
	Cho '527 discloses a number of example precursors: Cho '527 ¶ 0055: “In example embodiments, the precursor having the metal and the ligand may include tetrakis(ethylmethanido)zirconium($\text{Zr}(\text{NCH}_3\text{C}_2\text{H}_5)_4$), tetrakis(ethylmethanido)hafnium($\text{Hf}(\text{NCH}_3\text{C}_2\text{H}_5)_4$), tetrakis(diethylamido)zirconium($\text{Zr}(\text{N}(\text{C}_2\text{H}_5)_2)_4$), tetrakis(diethylamido)hafnium($\text{Hf}(\text{N}(\text{C}_2\text{H}_5)_2)_4$), tetrakis(dimethylamido)zirconium($\text{Zr}(\text{N}(\text{CH}_3)_2)_4$), tetrakis(dimethylamido)hafnium($\text{Hf}(\text{N}(\text{CH}_3)_2)_4$), tetrakis(ethylmethanido)zirconium($\text{Zr}(\text{N}(\text{CH}_3)_2\text{C}_2\text{H}_5)_4$), tetrakis(ethylmethanido)hafnium($\text{Hf}(\text{N}(\text{CH}_3)_2\text{C}_2\text{H}_5)_4$), tetrakis(diethylmethanido)zirconium($\text{Zr}(\text{N}(\text{C}_2\text{H}_5)_2\text{CH}_3)_4$), tetrakis(diethylmethanido)hafnium($\text{Hf}(\text{N}(\text{C}_2\text{H}_5)_2\text{CH}_3)_4$), tetrakis(triethylamine)zirconium($\text{Zr}(\text{N}(\text{C}_2\text{H}_5)_3)_4$), tetrakis(triethylamine)hafnium($\text{Hf}(\text{N}(\text{C}_2\text{H}_5)_3)_4$), cyclopentadienyl-tris(dimethylamido)zirconium($(\text{C}_5\text{H}_5)\text{Zr}(\text{N}(\text{CH}_3)_2)_3$), cyclopentadienyl-tris(dimethylamido)hafnium($(\text{C}_5\text{H}_5)\text{Hf}(\text{N}(\text{CH}_3)_2)_3$), cyclopentadienyl-tris(ethylmethanido)zirconium($(\text{C}_5\text{H}_5)\text{Zr}(\text{N}(\text{C}_2\text{H}_5)(\text{CH}_3))_3$) or cyclopentadienyl-tris(ethylmethanido)hafnium($(\text{C}_5\text{H}_5)\text{Hf}(\text{N}(\text{C}_2\text{H}_5)(\text{CH}_3))_3$). These may be used alone or in a mixture thereof.” Cyclopentadienyl-tris(dimethylamido)zirconium($(\text{C}_5\text{H}_5)\text{Zr}(\text{N}(\text{CH}_3)_2)_3$), cyclopentadienyl-tris(dimethylamido)hafnium($(\text{C}_5\text{H}_5)\text{Hf}(\text{N}(\text{CH}_3)_2)_3$), cyclopentadienyl-tris(ethylmethanido)zirconium($(\text{C}_5\text{H}_5)\text{Zr}(\text{N}(\text{C}_2\text{H}_5)(\text{CH}_3))_3$) or cyclopentadienyl-tris(ethylmethanido)hafnium($(\text{C}_5\text{H}_5)\text{Hf}(\text{N}(\text{C}_2\text{H}_5)(\text{CH}_3))_3$) are precursors of the formula $\text{R}_n\text{ZrX}_{4-n}$ or $\text{R}_n\text{HfX}_{4-n}$ wherein R is an organic ligand with 1-31 carbon atoms bound to Zr or Hf with a metal-carbon bond, $n=1-3$ and X is a ligand having a hydrolysable bond with Zr or Hf. For example, the molecular structure for cyclopentadienyl-tris(dimethylamido)hafnium is as follows:

'048 Patent Claims	Disclosure of Prior Art
	As can be seen from the above structure, R is cyclopentadienyl, which is an organic ligand with 5 carbons and bound to Hf, and the ligand is dimethylamido, which forms a hydrolysable bond with Hf. As noted above, Cho '527 discloses that the metal in the precursor may be tin. From the disclosure of Cho '527, a POSA would have immediately envisaged a precursor having the formula R_nSnX_{4-n} wherein R is an organic ligand with 1-31 carbon atoms bound to Sn with a metal-carbon bond, $n=1-3$ and X is a ligand having a hydrolysable bond with Sn. A POSA would have been motivated to select a compound of formula (I) of Cho '527 for use as a precursor in vapor deposition because Cho '527 teaches that the ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. At the time of the alleged invention, a person of ordinary skill in the art would have been motivated to use a tin compound for a photoresist because tin is has one of the highest EUV optical densities relative to carbon of all the elements in the periodic table, and therefore can maximize the use of the precious EUV photons. Cardineau Dissertation discloses "Tin compounds have myriad literature examples, high EUV optical densities and low oxidation potentials, making them ideal candidates for MORE [Molecular Organometallic Resists for EUV]." Cardineau Dissertation at 142. "Elements were then selected based on optical density, cost, toxicity and radioactivity." <i>Id.</i> at 139.

'048 Patent Claims	Disclosure of Prior Art
	Cardineau Symposium Presentation discloses that tin is “one of the darkest elements (high EUV optional density at standard state density relative to carbon) in the periodic table”, therefore “Tin is used as “fuel” in many EUV sources.” Cardineau Symposium Presentation at 4, 6. Optical Density of the Elements The MORE program is exploring the utility of compounds made from the darkest elements in the periodic table. “Metal oxide films can have significantly better etch performance than even the best organic films (HfO₂ ~ 25x better).*” <i>Id.</i> at 3. A person of ordinary skill in the art would be motivated to modify Cho using tin compounds as disclosed in Cardineau Dissertation, Cardineau Symposium Presentation and the Cardineau Paper because tin is more efficient, less toxic, and non-radioactive as a photoresist material for EUV as disclosed in Cardineau Dissertation and Cardineau Symposium Presentation.

'048 Patent Claims	Disclosure of Prior Art
	More specifically, the Cardineau Paper discloses a method of forming a radiation patternable film comprising tin-oxo clusters having the formula $[(R\text{Sn})_{12}\text{O}_{14}(\text{OH})_6]\text{X}_2$. The Cardineau Paper discloses forming tin-oxo clusters from the hydrolysis of organotin trichloride precursors. The organotin precursors of Cardineau Paper are compounds of Cho '527 where the metal in the precursor is tin, the ligand coordinating to the metal can be chloro(Cl^-), t-butyl (i.e. an alkyl group having a carbon atom of 4), phenyl (i.e. an aryl group having a carbon atom of 6), or allyl (i.e. an allyl group having a carbon atom of 3). Accordingly, a POSA would have been motivated to deposit the compounds of Cardineau Paper using vapor deposition methods as taught by Cho '527 because Cho '527 teaches that such compounds are suitable for vapor deposition and that the ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor.
[1f] 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 R^1, R^2, R^3 are independently hydrocarbon groups with 1-10 carbon atoms), silylamido ($-\text{SiR}^1\text{R}^2\text{R}^3\text{NR}^4\text{R}^5$, where R^1, R^2, R^3 are independently hydrocarbon groups with 1-10 carbon atoms or hydrogen, and R^4, R^5 are independently hydrocarbon groups with 1-10 carbon atoms or hydrogen), or a combination thereof.	Claim 1 lacks written description and enablement and is indefinite regarding X is “alkoxo and aryloxo” and therefore the claim is invalid. To the extent that Plaintiff argues that this is a typographical error, and should mean X is alkoxo <u>or</u> aryloxo, which is written in the alternative, so disclosure of any one of the options invalidates the claim. Then this is anticipated or rendered obvious by Weidman '068, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified herein, which discloses and/or suggests this claim element. Weidman '068 discloses that the precursor compounds can include metals with an alkoxo (alkoxide) substituent. Weidman '068, 18:16-22 (“the use of...alkoxides...as metal precursors”), 3:29-33 (“a silicon oxide based precursor containing one or more of...alkoxides,...which hydrolyze on exposure to water to form silanol substituents....”) Weidman '068 also discloses that “[s]pecific materials...include but are not limited to...tin....” <i>Id.</i>, 4:48-51. Cardineau Paper describes using tin compounds for EUV photoresists given tin’s higher EUV absorbance. Cardineau Paper explains: “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.” Cardineau Paper, 45.

'048 Patent Claims	Disclosure of Prior Art
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	Cardineau Paper 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...the controlled hydration of butyltin trichloride, butyltin trialkoxide or butyltin trialkyne.” <i>Id.</i>, 47 (citations omitted). At the time of the alleged invention, a person of ordinary skill in the art would have been motivated to use vapor deposition as the deposition method disclosed in Cho ’527. At the time of the alleged invention, a person of ordinary skill in the art would have been motivated to use a tin compound for a photoresist because tin has one of the highest EUV optical densities relative to carbon of all the elements in the periodic table, and therefore can maximize the use of the precious EUV photons. A person of ordinary skill in the art would be motivated to modify Cho ’527 using a tin compound as disclosed in Cardineau Dissertation, Cardineau Symposium Presentation and the Cardineau Paper because tin is more efficient, less toxic, and non-radioactive as a photoresist material for EUV as disclosed in Cardineau Dissertation and Cardineau Symposium Presentation. <i>See claim 1e.</i> A POSA would have been motivated to use an organotin with an alkoxo ligand of Cardineau Paper in Weidman ’068’s apparatus because Weidman ’068 teaches that precursors can include tin and alkoxo ligands, and in to order to achieve the improved EUV absorbance from tin compounds as Cardineau Paper discloses.

'048 Patent Claims	Disclosure of Prior Art
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	
[1g] structure configured to deliver flow of a	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation.

'048 Patent Claims	Disclosure of Prior Art
first precursor vapor from the supply of the organotin compound with the inert gas as a carrier gas to the inlet	Weidman '068's apparatus includes one or more inlets into the deposition chamber, Weidman '068, 8:47-61, and "the various gases...may be pulsed into an inlet through a gas channel, from various holes or outlets, and into a central channel." <i>Id.</i>, 8:16-20. 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). Weidman discloses "[t]he reactants are typically in vapor gas form," and "[t]he reactants may be delivered with a carrier gas." Weidman '068, 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." <i>Id.</i> at 8:2-4. Weidman '068 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...in communication with a central processing unit (CPU) that allows flow of each of the reactants to the substrate..." <i>Id.</i>, 7:48-57. Weidman '068's chamber has "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 "[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..." <i>Id.</i>, 11:65-12:2. Although Cardineau Paper discloses depositing the precursor compounds using spin coating, Weidman '068 discloses that using a vapor deposition apparatus provides more reliable coating compared to spin-coating. Weidman '068, 4:64-5:11 ("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."); <i>see also id.</i> 5:27-32. Thus, a POSA would have been motivated to use Cardineau Paper's precursors as the "supply of the precursors" in Weidman '068's apparatus for more reliable coating. Thus, Weidman '068 discloses conduits like gas channels, outlets, central channels, and conduits through flow controllers to supply precursor gases to the chamber. Cardineau Paper discloses tin precursors. Thus, the combination

'048 Patent Claims	Disclosure of Prior Art
	of Weidman '068 and Cardineau Paper discloses a structure (e.g., gas channels, etc.) 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. <i>Id.</i>
[1h] to provide for formation of an organotin layer on the substrate surface within the deposition chamber	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses “‘A’ precursors includ[ing] volatile metal-containing compounds, for example, compounds of...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.” Weidman '068, 9:44-57. Weidman '068 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.” <i>Id.</i> 12:11-13. Weidman '068’s deposition chamber (“processing chamber”) 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.”)” <i>Id.</i> 7:46-48. Weidman '068 discloses 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.” <i>Id.</i> 4:48-51. Similarly, Cardineau Paper discloses tin precursors for use as EUV photoresists having higher optical densities than carbon, and that form resists “to provide superior lithographic performance based on more efficient utilization of the EUV photons to give better sensitivity and lower shot noise.” Cardineau Paper, 45. A POSA would have been motivated to use Cardineau’s tin precursors in Weidman’s apparatus to produce resists with improved sensitivity and lower shot noise. The combination of Weidman '068 and Cardineau Paper 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”). <i>Id.</i>

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[11] 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	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068's apparatus for performing vapor deposition includes one or more inlets into the deposition chamber, Weidman '068, 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." <i>Id.</i>, 8:16-20. Weidman '068's apparatus includes supplies of A, B, and C reactants, where B reactant includes water or hydrogen peroxide. Weidman '068, 5:55-65, 8:48-52, 10:1-10, 16:4-7. Weidman '068's B reactant is delivered to the substrate by passing a gas through an ampoule (<i>i.e.</i>, a structure configured to deliver a second precursor vapor). <i>Id.</i>, 12:38-41. Weidman discloses that the apparatus includes supplies of A, B, and C reactants. <i>Id.</i> 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). <i>Id.</i> 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...."), <i>Id.</i> 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."). 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>i.e.</i>, a structure configured to deliver a second precursor vapor). <i>Id.</i>, 12:38-41. Cardineau Paper teaches that the organotin precursors react with components of water such as hydroxyl groups (<i>i.e.</i> are hydrolysable) to form tin clusters. Cardineau Paper, 44, 48. Accordingly, a POSA would have reasonably expected

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	Cardineau Paper's precursors to successfully react with a second precursor vapor comprising water as disclosed in Weidman '068 since Cardineau Paper teaches that the organotin precursors react with components of water to form tin clusters. Thus, Weidman '068 alone and/or in combination with Cardineau Paper 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.
[1j] under conditions in the deposition chamber to form a composition with non-volatile components and a volatile component comprising hydrolysis reaction product with X	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses that "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." Weidman '068, 16:4-7. Per Weidman '068, "[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." <i>Id.</i>, 9:44-57. And "[n]on-limiting examples of 'B' reactants include ozone, H₂O, H₂O₂,..." <i>Id.</i>, 10:1-5. As Weidman '068 explains, "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." <i>Id.</i>, 10:5-10. $\text{Substrate-OSiH}_2\text{X}_2 + \text{H}_2\text{O} \rightarrow \text{Substrate-O—SiH}_2\text{—OH} + \text{HX}_2$ <i>Id.</i>, 10:12-13. A POSA would understand Weidman '068 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

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	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). Cardineau Paper teaches that the organotin precursors react with components of water (such as hydroxyl groups) (i.e. are hydrolysable) to form tin clusters. <i>See</i> Cardineau Paper, 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.” Accordingly, a POSA would have understood that the hydrolysis of Cardineau Paper’s organotin trichlorides would displace a X ligand (chloride), and would have reasonably expected Cardineau Paper’s precursors to successfully react with water per Weidman ’068 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).
[1k] wherein the substrate is configured with a surface to receive the non-volatile components of the composition.	Weidman ’068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman ’068’s “B” reactant reacts with the “A” precursor with loss of the volatile HX2 byproduct. Weidman ’068 discloses that “[n]on-limiting examples of ‘A’ precursors include volatile metal-containing compounds, for example,...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.” Weidman ’068, 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.” <i>Id.</i>, 10:1-5. “[I]f 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.” <i>Id.</i>, 10:5-10.

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	$\text{Substrate-OSiH}_2\text{X}_2 + \text{H}_2\text{O} \rightarrow \text{Substrate-O-SiH}_2\text{-OH} + \text{HX}_2$ <i>Id.</i>, 10:12-13. A POSA would understand that the substrate receives the non-volatile components (i.e., not the volatile HX₂ byproduct). Although Weidman '068 does not disclose that the non-volatile components includes an organotin, Cardineau Paper's organotin precursors react with components of water such as hydroxyl groups (i.e. are hydrolysable) to form tin clusters to produce non-volatile components. <i>See</i> Cardineau Paper, 48. Accordingly, a POSA would have had a reasonable expectation that Cardineau Paper's precursors would successfully react with water as disclosed in Weidman '068 to provide a non-volatile component that includes an organotin (i.e., "tin clusters").
Claim 2	
The system of claim 1 wherein the substrate comprises a silicon wafer.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 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 silicon wafers...." Weidman '068, 7:32-37.
Claim 3	
The system of claim 1 wherein the inert gas comprises nitrogen or argon.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068's apparatus includes a supply of inert gases (e.g., argon and nitrogen) and an inlet to supply them to the deposition chamber. Weidman '068, 8:48-52.
Claim 4	
The system of claim 1 wherein the structure configured to	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses the delivery of precursors using a carrier gas through a heated ampoule. Weidman '068, 11:65-12:2, 12:37-40.

'048 Patent Claims	Disclosure of Prior Art
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, <u>or</u> a bubbler configured for bubbling an inert carrier gas	A POSA would have known that passing a carrier gas through a heated ampoule—which is in effect a bubbler or vaporization chamber—is a common method for generating a reactant gas from a liquid.

'048 Patent Claims	Disclosure of Prior Art
through a liquid comprising the organotin compound, and	
wherein the deposition on the surface of the substrate comprises chemical vapor deposition.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses a chamber that operates in both CVD and ALD modes to deposit resists. Weidman '068, 9:12-14. a POSA would understand that ALD is a type of CVD.
Claim 5	
The system of claim 1 wherein the second precursor vapor comprises water vapor.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses water vapor as a "B" reactant. Weidman '068, 5:55-62.
Claim 6	
The system of claim 1 further comprising a flow comprising a third precursor vapor comprising a composition represented by the formula ML_v , where v is	Weidman '068, Cardineau Paper, and/or Molloy, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. In Weidman '068, "[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..." Weidman '068, 13:5-9. Further, "at least two different types of metalcontaining (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" <i>Id.</i>, 6:45-50, 6:52-55. Therefore, Weidman '068 teaches a third precursor vapor (i.e., "second metal-containing precursor gas or vapor").

'048 Patent Claims	Disclosure of Prior Art
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.	A POSA would have known ML_v compounds were common in vapor deposition and would have had a reasonable expectation of success incorporating them as a third precursor vapor. Molloy Paper discloses organotin compounds for CVD purposes, including SnMe₄, that provide films with desirable properties produced with high deposition rates and deposition temperatures as low as 30°C. Molloy Paper, 549-550. A POSA would further understand that SnMe₄ 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. A POSA would appreciate that the references are analogous art and would have been motivated to combine them because Molloy teaches organometallic (e.g. organotin) precursors. A POSA would have been motivated to select SnMe₄ (i.e., compound of formula ML_v) for inclusion in the third vapor precursor 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 successfully form a film using Weidman '068's apparatus since Molloy teaches that SnMe₄ is a precursor for vapor deposition methods.
Claim 7	
	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. In Weidman '068, “[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...” Weidman '068, 13:5-9. 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” <i>Id.</i>, 6:45-50; <i>see id.</i>, 6:52-55. Therefore, Weidman '068 teaches a third precursor vapor (i.e., “second metal-containing precursor gas or vapor”). A POSA would have known that such compounds were being used as precursors in vapor deposition techniques and provide films with enhanced properties. A POSA would have expected that such compositions could successfully be included in a third precursor vapor.

'048 Patent Claims	Disclosure of Prior Art
	Molloy discloses organotin compounds for CVD 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. Molloy, 549-550. A POSA would understand that SnMe₄ is a composition represented by the formula SnL₄, 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. A POSA would appreciate that Weidman '068, Cardineau Paper, 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 SnMe₄ (i.e. a compound of formula SnL₄) for inclusion in the third vapor precursor to obtain a film with the desirable properties described by Molloy. A POSA would reasonably expect that Molloy’s precursors could form a film using Weidman '068’s apparatus since Molloy teaches that SnMe₄ is a precursor for vapor deposition methods.
Claim 8	
The system of claim 1 wherein the interior has a pressure from about 0.01 Torr to about 25 Torr.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068’s chamber “may be pressurized at a pressure within a range from about 0.01 Torr to about 100 Torr....” Weidman '068, 9:16-:20.
Claim 9	
The system of claim 1 wherein the interior has a temperature from about 40° C. to about 175° C.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses “the chamber or the substrate may be heated to a temperature . . . from about 50°C to about 400°C . . . or less than about 100°C. Weidman '068, 9:20-26.
Claim 10	

'048 Patent Claims	Disclosure of Prior Art
The system of claim 1 comprising a configuration providing for selection of the pressure and/or the temperature in the deposition chamber.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068's "substrate temperature and chemistry can be selected specifically...." Weidman '068, 15:56-61. And Weidman '068's CPU "allows flow of each of the reactants to the substrate" in the deposition chamber. <i>Id.</i>, 7:52-57. A POSA would understand that the flow controller can select pressure by controlling reactant flow, and that the CPU could control the flow controllers and temperature.
Claim 14	
The system of claim 1 wherein 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.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068's apparatus "includes a first precursor inlet in fluid communication with a supply of a first precursor containing substituents with cross-linkable moieties." Weidman '068, 8:47-49. And Weidman '068's "'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." <i>Id.</i>, 6:17-21. Weidman '068 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." <i>Id.</i>, 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." <i>Id.</i>, 8:52-57. Weidman '068 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," <i>id.</i> 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

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	auxiliary gas inlet for supplying one or more auxiliary gases such as inert gases to the deposition chamber.” <i>Id.</i> at 8:52-61. 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.” Weidman ’068, 6:17-21. Thus, Weidman ’068 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”).
Claim 15	
The system of claim 1 wherein 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.	Weidman ’068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman ’068’s “method for forming a radiation sensitive photoresist on a substrate” includes "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...” Weidman ’068, claim 1. And Weidman ’068’s “‘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.” <i>Id.</i>, 6:17-21. Weidman ’068 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.” <i>Id.</i>, 7:46-52. Weidman ’068 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,” <i>id.</i> 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

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	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.” <i>Id.</i> at 8:52-61. 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.” Weidman ’068 at 6:17-21. Thus, Weidman ’068 and Cardineau Paper 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”).
Claim 16	
The system of claim 1 wherein 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	Weidman ’068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman ’068 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.” Weidman ’068 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....” <i>Id.</i> at 7:52-57. Weidman ’068’s “‘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 gases. <i>Id.</i>, 6:17-21. According to Weidman ’068, “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...,” 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.” <i>Id.</i>, 6:52-61; <i>see Id.</i>, 9:29-42.

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vapor flow are sequential.	Weidman '068 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,” <i>Id.</i> 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.” <i>Id.</i> at 8:52-61. Weidman '068 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.” <i>Id.</i> at 6:52-61. Weidman '068 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. <i>Id.</i> at 9:29-42. Thus, Weidman '068 and Cardineu Paper disclose 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”).

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	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.
Claim 17	
The system of claim 1 wherein 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.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068's "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." Weidman '068, 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...." <i>Id.</i>, 7:52-57; <i>id.</i>, 8:47-61. Weidman '068 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," <i>id.</i> 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." <i>Id.</i> at 8:52-61. Weidman '068 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." <i>Id.</i> at 6:17-21. Weidman '068 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

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	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.” <i>Id.</i> at 6:52-61. Weidman '068 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. <i>Id.</i> at 9:29-42. Thus, Weidman '068 and Cardineu Paper discloses a first VIS (i.e., gas inlet) is configured to deliver a first vapor flow (i.e., “A” precursor) and a second VIS (i.e., gas inlet) is configured to deliver a second vapor flow (i.e., “B” reactant) simultaneously, and a third vapor flow (i.e., “C” precursor or “D” reactant) is sequential. A POSA would understand that there are a limited number of obvious choices of continuous or alternating delivery methods, which would have been obvious to try.
Claim 18	
The system of claim 1 wherein the interior has a temperature from about 45° C. to about 200° C.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses “the chamber or the substrate may be heated to a temperature of...less than about 200° C.” Weidman '068, 9:20-26.
Claim 19	
The system of claim 1 wherein	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation.

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X is alkylamido or dialkylamido.	Weidman '068 discloses that “[s]pecific materials according to one or more embodiments include but are not limited to...tin[.]” Weidman '068, 4:48-51. Weidman discloses precursors that include alkylamido 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.” <i>Id.</i> at 18:16-22. Cardineau Paper discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Specifically, Cardineau Paper 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.” Cardineau Paper at 45. A POSA would have been motivated to use an organotin with an alkoxo ligand of Cardineau Paper in Weidman '068’s apparatus because the references are analogous art, and Weidman '068 teaches that precursors can include tin and alkoxo ligands, and to use tin precursors to achieve Cardineau Paper’s benefits. In the alternative, Cho '527 discloses methods of depositing metal compound layers comprising inputting into a deposition chamber a first precursor vapor comprising a metal and a ligand coordinating to the metal. Cho '527 ¶ 0048: “FIG. 1 is a flow chart illustrating a method of forming a layer in accordance with example embodiments. Referring to FIG. 1, a substrate on which a layer will be formed is loaded in a chamber (S10). The substrate may include a semiconductor substrate such as silicon substrate, a germanium substrate, a silicon-germanium substrate, a silicon-on-insulator (SOI) substrate, a germanium-on-insulator (GOI) substrate, etc. Alternatively, the substrate may include a single crystalline metal oxide substrate. For example, the substrate may include a single crystalline aluminum oxide (Al₂O₃) substrate, a single crystalline strontium titanium oxide (SrTiO₃) substrate or a single crystalline magnesium oxide (MgO) substrate.” <i>Id.</i> ¶ 0050: “...In example embodiments, the precursor includes a metal and a ligand coordinating to the metal.”

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	<i>Id.</i> ¶ 0051: “The precursor may maintain a vapor state in the chamber before the precursor is chemisorbed on a surface of the substrate.” Cho '527 discloses that the ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. Cho '527 discloses that the ligand coordinating to the metal may be alkylamido and dialkylamido groups, which are interchangeable with chloro. A POSA would have been motivated to replace the chloro ligands of the organotin precursors of Cardineau Paper with the claimed ligands X because Cho '527 discloses that alkylamido and dialkylamido groups were common vapor deposition metal precursor ligands and interchangeable with Cl, and Cho '527 teaches that the ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. <i>Id.</i> ¶ 0053: “The ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. In example embodiments, the ligand may include a halogen such as fluoro (F⁻), chloro(Cl⁻), bromo (Br⁻) or iodo (I⁻), a hydroxyl group (OH), ammine (NH₃), an amine group having a carbon atom of about 1 to about 10, amido(NH₂) or an amido group in which an alkyl group having a carbon atom of about 1 to about 10 is substituted for a hydrogen atom, an alkoxy group having a carbon atom of about 1 to about 10, an alkyl group having a carbon atom of about 1 to about 10, an aryl group having a carbon atom of about 6 to about 12, an allyl group having a carbon atom of about 3 to about 15, a dienyl group having a carbon atom of about 4 to about 15, a β-diketonate group having a carbon atom of about 5 to about 20, a β-ketoiminato group having a carbon atom of about 5 to about 20 or a β-diiminato group having a carbon atom of about 5 to about 20. These may be used alone or in a mixture thereof. For example, the ligand may be dimethylamido (N(CH₃)₂), ethyl methyl amido(NCH₃C₂H₅), diethylamido(N(C₂H₅)₂), ethyl dimethyl amine(N(CH₃)₂C₂H₅), diethyl methyl amine(N(C₂H₅)₂CH₃) or triethylamine(N(C₂H₅)₃).”
Claim 20	
The system of claim 1 wherein X is alkoxo and aryloxo.	Weidman '068, alone, in combination with the general knowledge of a person of ordinary skill in the art, and/or in combination with the other references identified, discloses and/or suggests this claim limitation. Weidman '068 discloses precursors that include 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

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	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 ’068 at 18:16-22. Weidman ’068 also discloses that “[s]pecific materials...include...tin[.]” <i>Id.</i>, 4:48-51. Cardineau Paper discloses tin compounds for use as EUV photoresists because of tin’s higher EUV absorbance. Specifically, Cardineau Paper 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.” Cardineau Paper, 45. A POSA would be motivated to use Cardineau Paper’s organotin with an alkoxo ligand in Weidman ’068’s apparatus, as the references are analogous, Weidman ’068 discloses tin and alkoxo ligands, and Cardineau Paper highlights the benefits of tin precursors and organotin. Cho ’527 discloses methods of depositing metal compound layers comprising inputting into a deposition chamber a first precursor vapor comprising a metal and a ligand coordinating to the metal. Cho ’527 ¶ 0048: “FIG. 1 is a flow chart illustrating a method of forming a layer in accordance with example embodiments. Referring to FIG. 1, a substrate on which a layer will be formed is loaded in a chamber (S10). The substrate may include a semiconductor substrate such as silicon substrate, a germanium substrate, a silicon-germanium substrate, a silicon-on-insulator (SOI) substrate, a germanium-on-insulator (GOI) substrate, etc. Alternatively, the substrate may include a single crystalline metal oxide substrate. For example, the substrate may include a single crystalline aluminum oxide (Al₂O₃) substrate, a single crystalline strontium titanium oxide (SrTiO₃) substrate or a single crystalline magnesium oxide (MgO) substrate.” <i>Id.</i> ¶ 0050: “...In example embodiments, the precursor includes a metal and a ligand coordinating to the metal.” <i>Id.</i> ¶ 0051: “The precursor may maintain a vapor state in the chamber before the precursor is chemisorbed on a surface of the substrate.”

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	Cho '527 discloses that the ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. Cho '527 discloses that the ligand coordinating to the metal may be alkylamido and dialkylamido groups, which are interchangeable with chloro. A POSA would have been motivated to replace the chloro ligands of the organotin precursors of Cardineau Paper with the claimed ligands X because Cho '527 discloses that alkylamido and dialkylamido groups were common vapor deposition metal precursor ligands and interchangeable with Cl, and Cho '527 teaches that the ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. Id. ¶ 0053: “The ligand coordinating to the metal may be varied according to the metal to adjust a boiling point of the precursor. In example embodiments, the ligand may include a halogen such as fluoro (F⁻), chloro(Cl⁻), bromo (Br⁻) or iodo (I⁻), a hydroxyl group (OH), ammine (NH₃), an amine group having a carbon atom of about 1 to about 10, amido(NH₂) or an amido group in which an alkyl group having a carbon atom of about 1 to about 10 is substituted for a hydrogen atom, an alkoxy group having a carbon atom of about 1 to about 10, an alkyl group having a carbon atom of about 1 to about 10, an aryl group having a carbon atom of about 6 to about 12, an allyl group having a carbon atom of about 3 to about 15, a dienyl group having a carbon atom of about 4 to about 15, a β-diketonate group having a carbon atom of about 5 to about 20, a β-ketoiminato group having a carbon atom of about 5 to about 20 or a β-diiminato group having a carbon atom of about 5 to about 20. These may be used alone or in a mixture thereof. For example, the ligand may be dimethylamido (N(CH₃)₂), ethyl methyl amido(NCH₃C₂H₅), diethylamido(N(C₂H₅)₂), ethyl dimethyl amine(N(CH₃)₂C₂H₅), diethyl methyl amine(N(C₂H₅)₂CH₃) or triethylamine(N(C₂H₅)₃).”