UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FUJITSU SEMICONDUCTOR LIMITED, FUJITSU SEMICONDUCTOR AMERICA, INC., ADVANCED MICRO DEVICES, INC., RENESAS ELECTRONICS CORPORATION, RENESAS ELECTRONICS AMERICA, INC., GLOBALFOUNDRIES U.S., INC., GLOBALFOUNDRIES DRESDEN MODULE ONE LLC & CO. KG, GLOBALFOUNDRIES DRESDEN MODULE TWO LLC & CO. KG, TOSHIBA AMERICA ELECTRONIC COMPONENTS, INC., TOSHIBA AMERICA INC., TOSHIBA AMERICA INFORMATION SYSTEMS, INC., TOSHIBA CORPORATION, and THE GILLETTE COMPANY,
Petitioners
v.
ZOND, LLC,
Patent Owner

Case No. IPR2014-00829[1]
Patent 6,805,779 B2

PATENT OWNER'S NOTICE OF APPEAL
35 U.S.C. § 142 & 37 C.F.R. § 90.2

[1] Cases IPR2014-00859, IPR2014-01072, and IPR2014-01020 have been joined with the instant *inter partes* review.

Pursuant to 37 C.F.R. § 90.2(a), Patent Owner, Zond, LLC, hereby provides notice of its appeal to the United States Court of Appeals for the Federal Circuit for review of the Final Written Decision of the United States Patent and Trademark Office ("USPTO") Patent Trial and Appeals Board ("PTAB") in *Inter Partes* Review 2014-00829, concerning U.S. Patent 6,805,779 ("the '779 patent"), entered on November 3, 2015, attached hereto as Appendix A.

ISSUES TO BE ADDRESSED ON APPEAL

A. Whether the PTAB erred in finding claim 46 unpatentable as being obvious under 35 U.S.C. § 103(a) in view of Iwamura, US 5,753,886 ("Iwamura")?

B. Whether the PTAB erred in finding claims 16, 28, 41, 42, and 45 unpatentable as being obvious under 35 U.S.C. § 103(a) in view of Iwamura, Angelbeck, US 3,514,714 ("Angelbeck"), and Pinsley, US 3,761,836 ("Pinsley")?

Simultaneous with submission of this Notice of Appeal to the Director of the United States Patent and Trademark Office, this Notice of Appeal is being filed with the Patent Trial and Appeal Board. In addition, this Notice of Appeal, along with the required docketing fees, is being filed with the United States Court of Appeals for the Federal Circuit.

Respectfully submitted,

Dated: December 28, 2015

/Tarek N. Fahmi/
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APPENDIX A

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Paper 48
Entered: November 3, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

FUJITSU SEMICONDUCTOR LIMITED, FUJITSU SEMICONDUCTOR AMERICA, INC., ADVANCED MICRO DEVICES, INC., RENESAS ELECTRONICS CORPORATION, RENESAS ELECTRONICS AMERICA, INC., GLOBALFOUNDRIES U.S., INC., GLOBALFOUNDRIES DRESDEN MODULE ONE LLC & CO. KG, GLOBALFOUNDRIES DRESDEN MODULE TWO LLC & CO. KG, TOSHIBA AMERICA ELECTRONIC COMPONENTS, INC., TOSHIBA AMERICA INC., TOSHIBA AMERICA INFORMATION SYSTEMS, INC., TOSHIBA CORPORATION, and THE GILLETTE COMPANY,
Petitioners,

v.

ZOND, LLC,
Patent Owner.

Case IPR2014-00829[1]
Patent 6,805,779 B2

Before KEVIN F. TURNER, DEBRA K. STEPHENS, JONI Y. CHANG, SUSAN L.C. MITCHELL, and JENNIFER MEYER CHAGNON, *Administrative Patent Judges*.

CHANG, *Administrative Patent Judge.*

FINAL WRITTEN DECISION
Inter Partes Review
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

[1] Cases IPR2014-00859, IPR2014-01072, and IPR2014-01020 have been joined with the instant *inter partes* review.

I. INTRODUCTION

Taiwan Semiconductor Manufacturing Company, Ltd. and TSMC North America Corporation (collectively, "TSMC") filed a Petition requesting an *inter partes* review. Paper 2 ("Pet."). Patent Owner Zond, LLC ("Zond") filed a Preliminary Response. Paper 8 ("Prelim. Resp."). On November 17, 2014, we instituted the instant trial as to claims 16, 28, 41, 42, 45, and 46 of U.S. Patent No. 6,805,779 B2 (Ex. 1301, "the '779 patent"), pursuant to 35 U.S.C. § 314(a). Paper 9 ("Dec.").

Subsequent to institution, we granted the revised Motions for Joinder filed by other Petitioners (collectively, "GlobalFoundries") listed in the Caption above, joining Cases IPR2014-00859, IPR2014-01072, and IPR2014-01020 with the instant trial (Papers 12–14), and also granted a Joint Motion to Terminate with respect to TSMC (Paper 30). Zond filed a Response (Paper 26, "PO Resp."), and GlobalFoundries filed a Reply (Paper 37, "Reply"). An oral hearing[2] was held on June 15, 2015, and a transcript of the hearing was entered into the record. Paper 47 ("Tr.").

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a). For the reasons set forth below, we determine that GlobalFoundries has shown by a preponderance of the evidence that claim 46 is unpatentable under 35 U.S.C. § 102(b), and that claims 16, 28, 41, 42, and 45 are unpatentable under 35 U.S.C. § 103(a).

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[2] The oral arguments for this review and the following *inter partes* reviews were consolidated: IPR2014-00828, IPR2014-00917, IPR2014-01073, and IPR2014-01076.

A. Related Matters

The parties indicate that the ’779 patent was asserted in several related district court proceedings, including *Zond, LLC v. Advanced Micro Devices, Inc.*, No.1:13-cv-11577-DPW (D. Mass.), and identify other petitions for *inter partes* review that are related to this proceeding. Pet. 1; Paper 5.

B. The ’779 Patent

The ’779 patent relates to a method and a system for generating a plasma with a multi-step ionization process. Ex. 1301, Abs. For instance, Figure 2 of the ’779 patent, reproduced below, illustrates a cross-sectional view of a plasma generating apparatus:

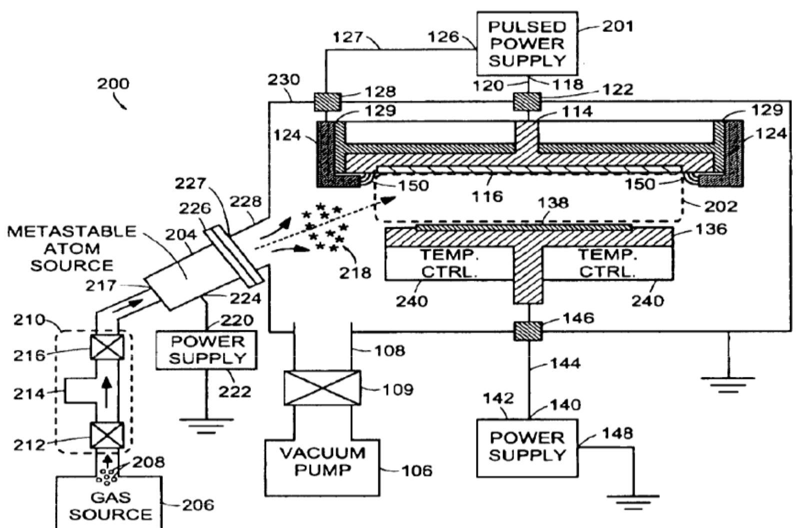

FIG. 2

In the embodiment shown in Figure 2, feed gas source 206 supplies ground state atoms 208 to metastable atom source 204 that generates metastable atoms 218 from ground state atoms 208. *Id*. at 4:26–42. Plasma 202 is generated from metastable atoms 218 in process chamber 230. *Id*. at 5:25–34.

Electrons and ions are formed in metastable atom source 204 along with excited or metastable atoms 218. *Id.* at 8:20–23. In another embodiment, the ions and electrons are separated from excited or metastable atoms 218 and trapped in an electron/ion absorber before excited or metastable atoms 218 are injected into plasma chamber 230. *Id.* at 8:23–26, 18:62–67, Fig. 10. Figure 12B of the '779 patent illustrates the electron/ion absorber and is reproduced below:

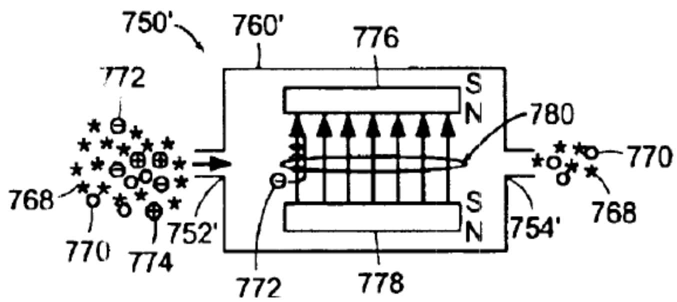

FIG. 12B

As shown in Figure 12B, electron/ion absorber 750′ includes magnets 776 and 778 that generate magnetic field 780, trapping electrons 772 and ions 774 in chamber 760′. *Id.* at 20:9–13. Excited or metastable atoms 768 and ground state atoms 770 then flow through output 754′. *Id.* at 20:19–21.

C. Illustrative Claim

Although claim 16 depends from independent claim 1, and claim 28 depends from claim 18, GlobalFoundries is not challenging independent claims 1 and 18 in the instant proceeding.[3] Of the challenged claims, 41, 45, and 46 are the only independent claims. Claim 42 depends from claim 41.

[3] Independent claims 1 and 18 are being challenged in Case IPR2014-01073.

Claim 46 is illustrative and reproduced below:

> 46. A method for generating a plasma with a multi-step ionization process, the method comprising:
>
> generating a volume of metastable atoms from a volume of ground state atoms;
>
> *trapping electrons and ions* in the volume of metastable atoms; and
>
> raising an energy of the metastable atoms so that at least a portion of the volume of *metastable atoms is ionized*, thereby generating a plasma with *a multi-step ionization process*.

Id. at 26:5–14 (emphases added).

D. Prior Art Relied Upon

GlobalFoundries relies upon the following prior art references:

Pinsley	US 3,761,836	Sept. 25, 1973	(Ex. 1305)
Angelbeck	US 3,514,714	May 26, 1970	(Ex. 1306)
Iwamura	US 5,753,886	May 19, 1998	(Ex. 1307)

D.V. Mozgrin, et al., *High-Current Low-Pressure Quasi-Stationary Discharge in a Magnetic Field: Experimental Research*, 21 PLASMA PHYSICS REPORTS, NO. 5, 400–09 (1995) (Ex. 1303, "Mozgrin").

A. A. Kudryavtsev and V.N. Skrebov, *Ionization Relaxation in a Plasma Produced by a Pulsed Inert-Gas Discharge*, 28(1) SOV. PHYS. TECH. PHYS. 30–35 (1983) (Ex. 1304, "Kudryavtsev").

E. Grounds of Unpatentability

We instituted the instant trial based on the following grounds of unpatentability (Dec. 31):

Claims	**Basis**	**References**
46	§ 102(b)	Iwamura
16, 28, 41, 42, and 45	§ 103(a)	Iwamura, Angelbeck, and Pinsley[4]

II. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *see also In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1275–79 (Fed. Cir. 2015) ("Congress implicitly approved the broadest reasonable interpretation standard in enacting the AIA,"[5] and "the standard was properly adopted by PTO regulation."). Significantly, claims are not interpreted in a vacuum but are

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[4] Pinsley was omitted inadvertently from the statement of this asserted ground of unpatentability, although included in the corresponding analysis. Pet. 42, 44. Therefore, we treated the statement of the asserted ground as harmless error and presume that GlobalFoundries intended to assert that claims 16, 28, 41, 42, and 45 are unpatentable under § 103(a) based on the combination of Iwamura, Angelbeck, and Pinsley. Dec. 6. Zond addressed the ground as including Pinsley. PO Resp. 23–27.

[5] Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA").

part of, and read in light of, the specification. *United States v. Adams*, 383 U.S. 39, 49 (1966) ("[I]t is fundamental that claims are to be construed in the light of the specifications and both are to be read with a view to ascertaining the invention."). Claim terms are given their ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). An inventor may rebut that presumption by providing a definition of the term in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). In the absence of such a definition, limitations are not to be read from the specification into the claims. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

"excited atoms," "metastable atoms," and "multi-step ionization process"

With the above-stated principles in mind, we construed the following terms in the Decision on Institution: "exited atoms," "metastable atoms," and "multi-step ionization process." Dec. 7–10. Subsequent to institution, neither party challenges any aspect of our claim constructions as to these terms. PO Resp. 14–17; Ex. 2005 ¶¶ 41–42; Ex. 1315 ¶¶ 14–19; *see generally* Reply. Upon review of the entire record before us, including the parties' explanations and supporting evidence concerning these terms, we discern no reason to change those claim constructions for purposes of this Final Written Decision. For convenience, those claim constructions from the Decision on Institution are reproduced below:

Claim Terms	**Claim Constructions**
“excited atoms” (claim 16)	neutral atoms that have one or more electrons in a state that is higher than its lowest possible state (Dec. 7)
“metastable atoms” (claim 46)	excited atoms having energy levels from which dipole radiation is theoretically forbidden (Dec. 7–8)
“multi-step ionization process” (claim 46)	an ionization process having at least two distinct steps (Dec. 9–10)

“plasma”

For this Final Written Decision, we find it necessary to construe the claim term “plasma.” Claim 45 recites “[a] plasma generator that generates a plasma with a multi-step ionization process.” Ex. 1301, 25:1–3.

Dr. Uwe Kortshagen, GlobalFoundries’s expert declarant, testifies that a plasma is a collection of ions, electrons, ground state atoms, excited atoms, and metastable atoms. Ex. 1302 ¶¶ 22–28. Metastable atoms are excited neutral atoms that are in a metastable state, but have not been ionized. Ex. 1301, 7:22–8:10. According to the Specification of the ’779 patent, all excited noble gases (e.g., helium and argon) have metastable states. *Id.* at 7:37–47. As Dr. Kortshagen explains, when generating excited atoms, multiple levels of excited states are formed, and therefore, generating excited atoms means also generating metastable atoms. Ex. 1302 ¶ 25.

Zond’s expert, Dr. Larry D. Hartsough, also testifies that, in the context of the ’779 patent, one with ordinary skill in the art at the time of the invention would have understood that a plasma includes charged particles (ions and electrons), as well as *neutral atoms*—namely, ground state atoms, excited atoms, and metastable atoms—because not every atom is ionized. Ex. 1317, 42:9–43:17. We observe that the ’779 patent uses the term “plasma” in accordance with its ordinary and customary meaning as would be understood by one with ordinary skill in the art. For instance, the Specification of the ’779 patent states that “[a] plasma is a collection of charged particles that move in random directions,” and further explains that a plasma includes excited atoms and metastable atoms. Ex. 1301, 1:7–8, 8:43–48. We are cognizant that, in an ideal situation, a plasma can be *fully ionized*, which contains only charged particles (ions and electrons). Ex. 1317, 42:9–43:17.

Based on the evidence before us, we construe the claim term “plasma” as “a collection of ions, electrons, ground state atoms, excited atoms, and metastable atoms,” consistent with the term’s ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the Specification of the ’779 patent.

Means-Plus-Function Claim Elements

In its Petition, GlobalFoundries identifies four claim elements recited in claims 41 and 42 as means-plus-function elements, invoking 35 U.S.C. § 112, ¶ 6, but Zond did not proffer any claim constructions as to these claim elements prior to institution of this *inter partes* review.[6] Pet. 17–19; Prelim.

[6] Section 4(c) of the AIA re-designated 35 U.S.C. § 112, ¶ 6, as 35 U.S.C. § 112(f). Pub. L. No. 112-29, 125 Stat. 284, 296 (2011). Because the ’779

Resp. 18–19. We agree with GlobalFoundries that these claim elements are written in means-plus-function form and fall under § 112 ¶ 6, because: (1) each claim element uses the term "means for"; (2) the term "means for" in each claim element is modified by functional language; and (3) the term "means for" is not modified by any structure recited in the claim to perform the claimed function. *See Personalized Media Commc'ns, LLC v. Int'l Trade Comm'n*, 161 F.3d 696, 703–04 (Fed. Cir. 1998) (using the term "means for" in a claim creates a rebuttable presumption that the drafter intended to invoke § 112, ¶ 6); *Sage Prods. v. Devon Indus., Inc.*, 126 F.3d 1420, 1427–28 (Fed. Cir. 1997) (the presumption is not rebutted if the term "means for" is modified by functional language and is not modified by any structure recited in the claim to perform the claimed function); *see also Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1349 (Fed. Cir. 2015) (confirming that "use of the word 'means' creates a presumption that § 112, ¶ 6, applies" (citing *Personalized Media*, 161 F.3d at 703)).

The first step in construing a means-plus-function claim element is to identify the recited function in the claim element. *Med. Instrumentation & Diagnostics Corp. v. Elekta AB*, 344 F.3d 1205, 1210 (Fed. Cir. 2003). The second step is to look to the specification and identify the corresponding structure for that recited function. *Id*. A structure disclosed in the specification qualifies as "corresponding" structure only if the specification or prosecution history clearly links or associates that structure to the function

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patent has a filing date before September 16, 2012 (effective date), we refer to the pre-AIA version of § 112 in this Decision.

recited in the claim. *B. Braun Med., Inc. v. Abbott Labs.*, 124 F.3d 1419, 1424 (Fed. Cir. 1997). "While corresponding structure need not include all things necessary to enable the claimed invention to work, it must include all structure that actually performs the recited function." *Default Proof Credit Card Sys., Inc. v. Home Depot U.S.A., Inc.*, 412 F.3d 1291, 1298 (Fed. Cir. 2005).

Upon review of the parties' contentions and the Specification, we set forth our claim constructions in the Decision on Institution for the means-plus-function elements identified by the parties. Dec. 10–12. Neither party challenges any aspect of our claim constructions as to these claim elements. *See* PO Resp. 15–16; Reply 1–2. Based on this entire record, we also discern no reason to modify our claim constructions at this juncture. For convenience, our claim constructions are reproduced in the table below:

Means-plus-function claim elements with recited functions in italics	**Corresponding structures**
means for *generating a magnetic field proximate to a volume of ground state atoms to substantially trap electrons proximate to the volume of ground state atoms* (claim 41)	**magnets**—e.g., magnets 566*a–d*, 570*a–d*, 712, 714 that generate a magnetic field as shown in Figures 7, 7A, and 10 of the '779 patent. *See* Ex. 1301, 16:1–20 ("The magnets 566*a–d*, 570*a–d* create a magnetic field 574 that substantially traps and accelerates electrons (not shown) in the chamber 554."), 18:34–41, Figs. 7, 7A, 10.

Means-plus-function claim elements with recited functions in italics	**Corresponding structures**
means for *generating a volume of metastable atoms from the volume of ground state atoms* (claim 41)	**a metastable atom source**—e.g., metastable atom sources 402, 450, 500, 550, 600, 650, 700, 735 as shown in Figures 4–11 of the ’779 patent. Ex. 1301, 14:24–26, 14:46–48, 15:46–67, 16:29–31, 17:27–34, 18:7–16, 19:11–12.
means for *raising an energy of the metastable atoms so that at least a portion of the volume of metastable atoms is ionized, thereby generating a plasma with a multistep ionization process* (claim 41)	**a power supply** generating an electric field between a cathode assembly and an anode as shown in Figures 2 and 3 of the ’779 patent. Ex. 1301, 8:39–5, 11:4–14.
means for *trapping electrons and ions in the volume of metastable atoms* (claim 42)	**an electron ion/absorber**—e.g., electron ion/absorbers 536, 618, 664, 728, 750, 750', and 750" shown in Figures 6, 8, 9, 10, and 12A–12C of the ’779 patent. Ex. 1301, 14:66–15:9, 16:56–62, 17:35–42, 18:42–67, 19:56–20:32.

B. Principles of Law

To establish anticipation, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *Net MoneyIN, Inc. v. VeriSign, Inc*., 545 F.3d 1359, 1369 (Fed. Cir. 2008); *Karsten Mfg. Corp. v. Cleveland Golf Co.*, 242 F.3d 1376, 1383 (Fed. Cir. 2001). “A reference anticipates a claim if it discloses the claimed invention such that a skilled artisan could take its teachings in combination with his own knowledge of the particular art and be in possession of the invention." *In re Graves*, 69 F.3d 1147, 1152 (Fed. Cir. 1995) (internal citation and emphasis omitted). Moreover, "it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom." *In re Preda*, 401 F.2d 825, 826 (CCPA 1968).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

We also recognize that prior art references must be "considered together with the knowledge of one of ordinary skill in the pertinent art." *Paulsen*, 30 F.3d at 1480 (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)); *Translogic*, 504 F.3d at 1259–1262. Notwithstanding that Dr. Hartsough provides a definition of "a person of ordinary skill in the art" in the context of the ’779 patent,[7] we are mindful that the level of ordinary skill in the art also is reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); *In re GPAC Inc*., 57 F.3d 1573, 1579 (Fed. Cir. 1995); *In re Oelrich*, 579 F.2d 86, 91 (CCPA 1978).

We analyze the instituted grounds of unpatentability with the above-stated principled in mind.

C. Anticipation by Iwamura

GlobalFoundries asserts that claim 46 is unpatentable under 35 U.S.C. § 102(b) as anticipated by Iwamura. Pet. 42–53, 59–60. In support of this asserted ground of unpatentability, GlobalFoundries provides detailed explanations as to how each claim limitation is described by Iwamura. *Id*. GlobalFoundries also proffers the Declaration of Dr. Kortshagen (Ex. 1302) to support its Petition, and a Supplemental Declaration of Dr. Kortshagen (Ex. 1315) to support its Reply to Zond’s Response.

In its Response, Zond counters that Iwamura does not disclose all of the claim limitations set forth in claim 46. PO Resp. 43–52, 59. As support, Zond directs our attention to a Declaration of Dr. Hartsough (Ex. 2005).

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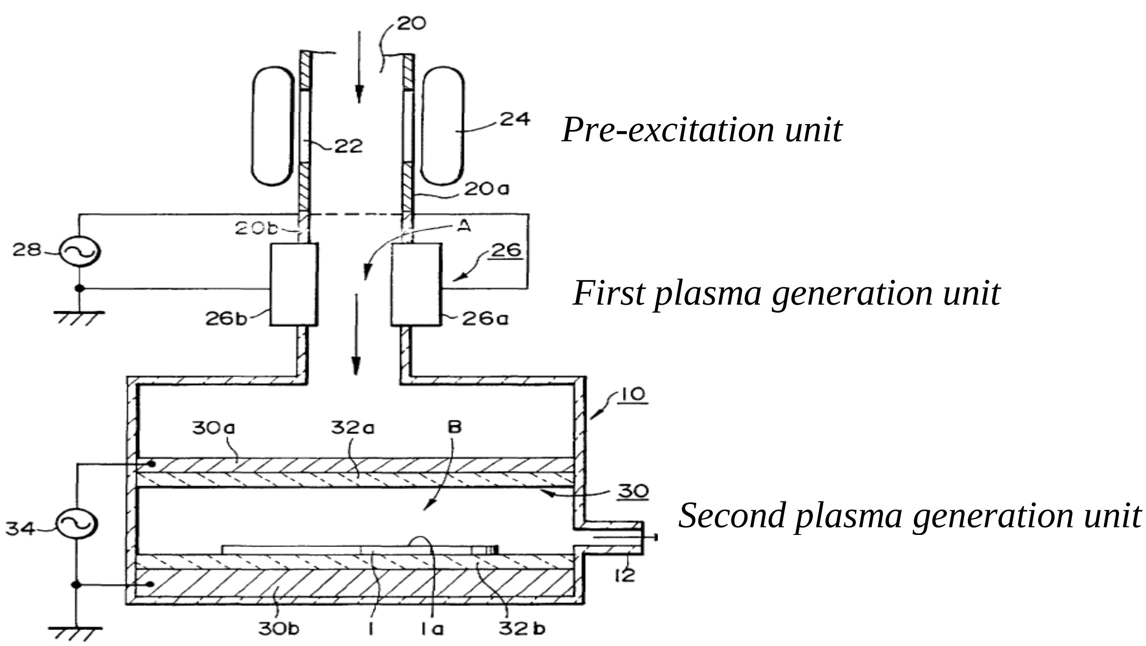
[7] “[A] person of ordinary skill in the art at the time of filing of the ’779 Patent [is] someone who holds at least a bachelor of science degree in physics, material science, or electrical/computer engineering with at least two years of work experience or equivalent in the field of development of plasma-based processing equipment.” Ex. 2005 ¶ 12.

We have reviewed the entire record before us, including the parties' explanations and supporting evidence presented during this trial. We begin our discussion below with a brief summary of Iwamura, and then we address the parties' contentions in turn.

Iwamura

Iwamura discloses a plasma treatment apparatus for generating a stable plasma with a multi-step ionization process to treat a semiconductor wafer. Ex. 1307, Abs., 6:67–7:8. Figure 1 of Iwamura, reproduced below (with our annotations added), illustrates a plasma treatment apparatus.

FIG. 1



As shown in Figure 1 of Iwamura, plasma chamber 10 is coupled to the gas supply pipe (shown as items 20a and 20b). Gas supply 20 supplies a gas capable of plasma discharge (e.g., helium or argon, a noble gas) through a pre-excitation unit that includes ultraviolet lamp 24, and a first plasma generation unit that includes electrodes 26. Ex. 1307, 6:67–7:17, 49. Ultraviolet lamp 24 causes photoionization, raising the excitation level of the gas and generating excited and metastable atoms from ground state atoms. *Id*. at 7:55–60. Thereafter, a plasma is generated from the gas in plasma region A, between electrodes 26 (the first plasma generation unit), and a plasma also is generated in plasma region B, between electrodes 30 (the second plasma generation unit). *Id*. at 7:61–65, 8:4–9, 8:32–46. According to Iwamura, because the excitation level of the gas is raised first, a stable plasma can be generated inside the plasma chamber. *Id*. at 8:32–37. Consequently, the uniformity of the plasma density as well as the yield of the treatment of the semiconductor wafer can be improved. *Id*. at 8:41–46.

<u>Generating a plasma with a multi-step ionization process</u>

Claim 46 recites "generating a plasma with *a multi-step ionization process*" in the preamble, and "raising an energy of the metastable atoms so that at least *a portion of the volume of metastable atoms is ionized*, thereby generating a plasma with a multi-step ionization process" in the body of the claim. Ex. 1301, 26:5–6, 26:12–16 (emphases added).

As we discussed above in the Claim Construction Section of this Decision, metastable atoms are excited neutral atoms that are in a metastable state, but have not been ionized, and all excited noble gases (such as helium and argon) have metastable states. And we construe the claim term "plasma" as "a collection of ions, electrons, ground state atoms, excited atoms, and metastable atoms," consistent with the term's ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the Specification of the ’779 patent. Furthermore, we construe the claim term “multi-step ionization process” broadly, but reasonably, as “an ionization process having at least two distinct steps,” in light of the Specification.

GlobalFoundries takes the position that Iwamura’s second plasma generation unit is an energy source that ionizes at least a portion of the excited or metastable atoms inside a chamber, generating a plasma with a multi-step ionization process. Pet. 45–53, 59–60. As GlobalFoundries points out, for the first step, Iwamura’s pre-excitation unit and/or first plasma generation unit raise the excitation level of the gas, generating excited or metastable atoms from the ground state atoms. *Id*.; Ex. 1307, 7:55–60, 9:46–48, Figs. 1, 2. And for the second step, Iwamura’s second plasma generation unit ionizes at least a portion of the excited or metastable atoms, generating a plasma inside the chamber. Ex. 1307, 8:32–46, 9:8–12, Figs. 1, 2.

Zond counters that Iwamura’s second plasma generation unit does not ionize excited or metastable atoms because “the atoms are already ionized before they enter the chamber.” PO Resp. 50–52. As support, Dr. Hartsough testifies that “the atoms entering Iwamura’s chamber are *not excited or metastable*, but rather activated (i.e., ionized to a plasma).” *Id*.; Ex. 2005 ¶¶ 165–68 (emphasis added).

Zond’s argument and Dr. Hartsough’s testimony, however, are predicated on the premise that the gas is *fully ionized*, containing no excited or metastable atom, before reaching Iwamura’s second plasma generation unit inside the chamber. That premise squarely contradicts Iwamura’s disclosure. Notably, Iwamura explicitly discloses that "the first plasma generation unit *preactivates* the gas and the second plasma generation unit activates the gas and forms activated gas species." Ex. 1307, 2:61–65 (emphasis added). Iwamura also describes "preactivation" to mean that "the gas is *not yet fully ionized*, but its excitation level is high." *Id*. at 2:34–39 ("[T]he gas reaching the downstream plasma generation position maintains the ionized or near-ionized state, formed by *preactivation, i.e., the gas is not yet fully ionized,* but its excitation level is high, due to the upstream plasma preactivation." (emphasis added)).

Moreover, if the gas were *fully ionized* before reaching Iwamura's second plasma generation unit, as Zond alleges, there would be no reason to have a second plasma generation unit, much less having a second plasma generation unit to generate a plasma inside the chamber. On the contrary, Iwamura explicitly states that "a second plasma generation unit [is] for activating the gas to *generate a plasma* downstream along the flow path of the gas." *Id.* at 2:59–61 (emphasis added). Iwamura further discloses that the gas is activated by the second plasma generation unit—increasing the density and excitation levels of activated gas species and *generating a plasma*—to improve uniformity and treatment rate. *Id*. at 8:4–46, Fig. 1. In fact, Dr. Hartsough in his cross-examination testimony acknowledges, and Dr. Kortshagen confirms, that the gas reaching Iwamura's second plasma generation unit includes excited and metastable atoms. Ex. 1317, 42:9–43:17, 74:2–76:4; Ex. 1315 ¶¶ 25–33, 89.

Zond's contention that a plasma does not include a volume of excited or metastable atoms also is inconsistent with the ordinary and customary meaning of the term "plasma"—namely, "a collection of ions, electrons, ground state atoms, *excited atoms, and metastable atoms*." As discussed above, both Dr. Kortshagen and Dr. Hartsough agree with that definition. Ex. 1302 ¶¶ 22–28; Ex. 1317, 42:9–43:17. Furthermore, the Specification of the '779 patent discloses that a plasma includes charged particles, excited atoms, and metastable atoms. Ex. 1301, 8:43–48. More importantly, as the Specification explains, a volume of excited or metastable atoms is generated when "*a discharge is created* in a discharge region" between a pair of electrodes, similar to Iwamura's first plasma generation unit, energizing and ionizing a portion of ground state atoms. *Id*. at 13:34–14:23 ("Some of the ground state atoms 208 are *directly ionized*, which releases ions 424 and electrons 426 into the stream of metastable atoms 218. . . . The metastable atoms 218, the free ions 424 and electrons 426 then pass through the output 423 of the metastable atom source 402.") (emphasis added). Therefore, even in the embodiment in which Iwamura's first generation unit generates a plasma, one with ordinary skill in the art would have recognized that the plasma reaching Iwamura's second generation unit includes a volume of excited and metastable atoms.

Given the evidence in this record, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that Iwamura describes "raising an energy of the metastable atoms so that at least a portion of the volume of metastable atoms is ionized, thereby generating a plasma with a multi-step ionization process," as recited in claim 46.

Generating excited or metastable atoms

Claim 46 recites "generating a volume of metastable atoms from a volume of ground state atoms." Ex. 1301, 26:8–9. In its Petition, GlobalFoundries asserts that Iwamura's pre-excitation unit and/or the first plasma generation unit describe an excited or metastable atom source for generating excited or metastable atoms from ground state atoms, as required by claim 46. Pet. 45–48, 60.

Zond counters that Iwamura's first plasma generation unit generates a plasma, and not excited or metastable atoms. PO Resp. 43–47. As support, Dr. Hartsough testifies that "Iwamura's first plasma generation unit generates ionized atoms, i.e., a plasma or 'activated gas' per Iwamura's teaching." Ex. 2005 ¶ 154.

Once again, Zond's argument and Dr. Hartsough's testimony are predicated improperly on the premise that the gas is *fully ionized*, containing no excited or metastable atom, before reaching Iwamura's second plasma generation unit. As we discussed above, that premise contradicts Iwamura's disclosure and the ordinary and customary meaning of the term "plasma," which includes excited and metastable atoms. Both Dr. Kortshagen and Dr. Hartsough agree with that definition, which also is consistent with the Specification of the '779 patent. Ex. 1302 ¶¶ 22–28; Ex. 1317, 42:9–43:17; Ex. 1301, 1:7–8, 8:43–48. Notably, Iwamura explicitly discloses that the gas reaching the second plasma generation unit "*is not yet fully ionized*." Ex. 1307, 2:34–38 (emphasis added).

We also are not persuaded by Zond's argument that GlobalFoundries "alleged that Iwamura teaches the generation of *excited* atoms, instead of the *metastable* atoms," as recited in claim 46. PO Resp. 44 (emphases added). According to the Specification of the '779 patent, all excited noble gases have metastable states. Ex. 1301, 7:37–47. GlobalFoundries specifically points out that Iwamura's feed gas includes helium or argon, both of which are noble gases, and states that "the metastable atom density will often constitute a significant fraction of the total excited atom density." Pet. 47–48 (citing Ex. 1302 ¶ 136; Ex. 1307, 7:48–50). Indeed, Iwamura's gas supply introduces helium or argon into the pre-excitation unit and the first plasma generation unit. Ex. 1307, 7:48–50 ("[A]n inert gas such as helium or argon is introduced through gas supply 20 to replace the air in treatment chamber 10."), Fig. 1. Iwamura discloses that the pre-excitation unit raises the excitation level of the ground state atoms to generate excited atoms, using either an ultraviolet lamp or a magnetron. *Id*. at 7:55–60, 9:38–53. Iwamura also discloses that the first plasma unit pre-activates the gas by exciting the gas to a high excitation level. *Id*. at 2:31–41, 2:56–58. According to Dr. Kortshagen, generating excited argon atoms means also generating metastable atoms because, when generating excited argon atoms, multiple levels of excited states are formed, and some of the lowest states of excited argon atoms are metastable. Ex. 1302 ¶ 25 (citing Ex. 1311; Ex. 1312). Citing Figures 5 and 6 of Exhibit 1211, Dr. Kortshagen testifies that it has been shown that the four lowest excited states of excited argon atoms have at least 100 times higher density than the next higher excited states. *Id*. Based on the evidence in this record, we are persuaded that one of ordinary skill in the art would have recognized that exciting argon atoms would generate metastable atoms.

Furthermore, we do not share Zond's view that Dr. Kortshagen's cross-examination testimony—plasma density is not equivalent to the density of excited atoms—supports Zond's argument that Iwamura's gas reaching the second plasma generation unit does not contain excited or metastable atoms. PO Resp. 30–31 (citing Ex. 2004, 232:5–9). One of ordinary skill in the art would have appreciated that, in a unit volume of gas containing charged particles and excited atoms, the plasma density refers to the number of ions or electrons, whereas the density of excited atoms refers to the number of excited atoms. Ex. 1302 ¶¶ 22–28. It is irrelevant that the plasma density is not equivalent to the density of excited atoms, in that Iwamura's gas could have more excited atoms than ions or electrons. Therefore, Dr. Kortshagen's cross-examination testimony does not undermine GlobalFoundries's evidence, showing that Iwamura's pre-excitation unit and the first plasma generation unit, either alone or in combination, generate a volume of excited or metastable atoms (*see, e.g.*, Ex. 1307, 2:61–65, 2:31–65; Ex. 1315 ¶¶ 25–33, 89; Ex. 1317, 42:9–25, 74:2–76:4).

For the foregoing reasons, we are persuaded that GlobalFoundries has demonstrated, by a preponderance of the evidence, that Iwamura describes "generating a volume of metastable atoms from a volume of ground state atoms," as required by claim 46.

<u>Trapping electrons and ions</u>

Claim 46 recites "trapping electrons and ions in the volume of metastable atoms." Ex. 1301, 26:10–11. GlobalFoundries asserts that

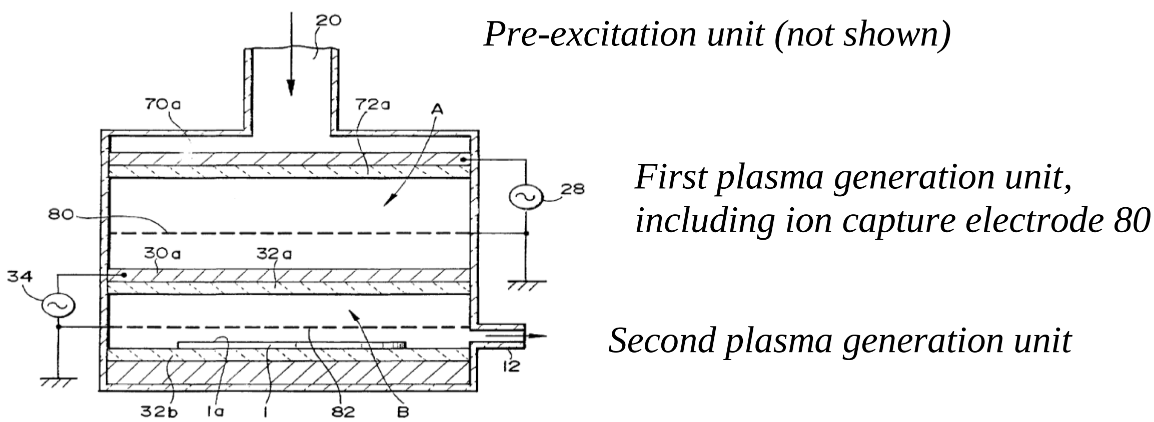
Iwamura describes this limitation because Iwamura's ion capture electrode captures electrons and ions in the volume of excited or metastable atoms. Pet. 32–33, 58–60 (citing Ex. 1307, 11:52–55). Zond disagrees, but Zond does not provide any specific explanation as to why Iwamura's ion capture electrode does not trap electrons and ions. PO Resp. 59.[8] Insofar as Zond relies on its arguments with respect to claims 16, 28, and 42 in connection with an electron/ion absorber, we considered those arguments and found them unavailing for the reasons stated below in our discussion regarding those claims.

Having reviewed the technical disclosure of Iwamura, we determine GlobalFoundries's contention is supported by a preponderance of evidence. For instance, Iwamura discloses a first plasma generation unit that includes an ion capture electrode to capture charged particles, such as electrons and ions. Ex. 1307, 11:52–55.

[8] Zond alleges that claim 46 recites a "means for generating a magnetic field" similar to claim 41 and that the combination of Iwamura, Angelbeck, and Pinsley does not teach such a limitation. PO Resp. 47–50. However, claim 46 does not recite a magnetic field, much less a means for generating a magnetic field. Nor does GlobalFoundries assert a ground of unpatentability based on such a combination of prior art in connection with claim 46. We, therefore, consider Zond's arguments regarding a means for generating a magnetic field in the analysis below with respect to claim 41, but not for the analysis here with respect to claim 46.

Figure 9 of Iwamura is reproduced below with annotations added.

FIG. 9



As shown in Figure 9 of Iwamura, a first plasma generation unit is located downstream from a pre-excitation unit along the flow path of the gas, and the first plasma generation unit includes lower ion capture electrode 80, which is formed from a wire grid or perforated metal sheet. *Id*. at 11:51–55. The pre-excitation unit and first plasma generation unit pre-activate the gas, raising the excitation level of the ground state atoms and generating a volume of excited and metastable atoms. *Id*. at 2:34–39, 2:56–58. Ion capture electrode 80 is connected to ground potential so as to trap electrons and ions in the volume of excited and metastable atoms. *Id*. The second plasma generation unit, which includes a pair of electrodes, activates the gas to generate plasma. *Id*. at 2:59–61, 8:4–9, 8:32–46.

For the reasons stated above, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that Iwamura describes "trapping electrons and ions in the volume of metastable atoms," as recited in claim 46.

Conclusion

For the foregoing reasons, we conclude that GlobalFoundries has demonstrated, by a preponderance of the evidence, that claim 46 is unpatentable as anticipated by Iwamura.

D. Obviousness over Iwamura, Angelbeck, and Pinsley

GlobalFoundries asserts that claims 16, 28, 41, 42, and 45 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Iwamura, Angelbeck, and Pinsley. Pet. 42–59. In support of this asserted ground of unpatentability, GlobalFoundries provides detailed explanations as to how each claim limitation is met by the combination of the references and rationales for combining the references. *Id*. GlobalFoundries also proffers Dr. Kortshagen's Declaration (Ex. 1302) to support its Petition, and Dr. Kortshagen's Supplemental Declaration (Ex. 1315) to support its Reply to Zond's Response.

In its Response, Zond argues that the combination of Iwamura, Angelbeck, and Pinsley does not disclose every claim limitation. PO Resp. 27–58. Some of Zond's arguments essentially reiterate the same arguments presented with regard to claim 46. *Id*. For example, Zond argues that the combination of cited prior art references does not disclose: (1) an excited or metastable atom source for generating excited or metastable atoms from the ground state atoms (*id*. at 28–31, 43–47, 52–53); and (2) an energy source for ionizing the excited or metastable atoms, generating a plasma with a multi-step ionization process (*id*. at 39–41, 50–52, 56–58). We addressed those arguments in our anticipation discussion based on Iwamura above, and found them to be unavailing. Therefore, we focus our discussion below on Zond's additional arguments.

<u>Plasma chamber</u>

Claim 1 recites "a plasma chamber that is *coupled to the excited atom source*, the plasma chamber confining *a volume of excited atoms* generated by the excited atom source; and an energy source that is coupled to the volume of excited atoms confined by the *plasma chamber*." Ex. 1301, 21:19–24 (emphases added). Claims 18 and 45 each recite a similar limitation. *Id*. at 22:36–41, 25:11–15.

GlobalFoundries asserts that Iwamura discloses such a plasma chamber because "Iwamura's pre-excitation unit and the first plasma generation unit, either alone or in combination meet the excited atom source, and are positioned upstream from and coupled to the plasma treatment chamber." Pet. 55–56.

Zond counters that Iwamura's plasma chamber is not coupled to the excited atom source, because the chamber is not coupled *directly* to the pre-excitation unit. PO Resp. 36–40, 55–56. Zond also argues that Iwamura does not disclose a chamber confining a volume of excited or metastable atoms "because in Iwamura's system, the plasma (i.e., pre-activated gas) and not the excited or metastable atoms enter the plasma chamber." *Id*. Dr. Hartsough testifies that Iwamura does not recite expressly the terms "excited" or "metastable," but rather Iwamura discloses that the upstream plasma generation "is generating an activated (pre-activated) plasma gas, as opposed to an excited gas (i.e., excited atom source) as claimed." Ex. 2005 ¶¶ 64–65, 70.

We are not persuaded by Zond's arguments and Dr. Hartsough's testimony as they require Iwamura to recite expressly certain claim terms. An obviousness analysis is not an *ipsissimis verbis* test. *See In re Gleave*, 560 F.3d 1331, 1334 (Fed. Cir. 2009). More significantly, Zond's arguments and Dr. Hartsough's testimony, once again, are predicated improperly on premise that the gas entering Iwamura's plasma chamber is *fully ionized*, containing no excited or metastable atoms. As discussed previously, that premise contradicts Iwamura's disclosure and the ordinary and customary meaning of the term "plasma," which contains excited and metastable atoms. Notably, Iwamura explicitly discloses that the gas reaching the second plasma generation unit inside the chamber "*is not yet fully ionized*." Ex. 1007, 2:34–39 (emphasis added).

Zond's arguments also are not commensurate with the scope of the claims at issue. *See In re Self*, 671 F.2d 1344, 1348 (CCPA 1982) (stating that a limitation not appearing in the claims cannot be relied upon for patentability). Zond attempts to import improperly a limitation—*directly* coupled—from a preferred embodiment disclosed in the Specification into the claims. *See Van Geuns*, 988 F.2d at 1184. Nothing in the claims at issue here requires the plasma chamber to be *directly* coupled to the excited or metastable atom source. In fact, Dr. Hartsough in his cross-examination testimony confirms that, in the context of the '779 patent, the term "coupling" includes an indirect connection. Ex. 1317, 108:13–109:22.

In any event, even if the claims at issue require a direct coupling, Zond's arguments are still unavailing, as they predicate that only Iwamura's pre-excitation unit is the excited or metastable atom source. As discussed above, GlobalFoundries asserts that Iwamura's pre-excitation unit and the first plasma generation unit, either alone or in combination, disclose the excited or metastable atom source. Pet. 55–56. Figure 1 of Iwamura clearly shows that the pre-excitation unit and the first plasma generation unit are disposed on the wall of the gas supply pipe that is coupled to the plasma chamber. Ex. 1307, 6:67–7:17, Fig. 1. Iwamura also states that "[t]reatment chamber 10 is in fluid communication with gas supply 20." *Id*. at 7:8–27, Fig. 1. Zond's expert, Dr. Hartsough, confirms that Iwamura's first plasma generation unit, which includes electrodes 26a and 26b as shown in Figure 1 of Iwamura, "is coupled to the chamber." Ex. 1317, 92:12–13.

We do not agree with Zond's argument that Dr. Kortshagen's refusal to mark the location of the "coupling" on a figure, during cross-examination, undermines GlobalFoundries's contention. PO Resp. 38 (citing Ex. 2004, 174:24–175:7). In fact, during the same cross-examination, Dr. Kortshagen already explained with sufficient specificity as to how Figure 1 of Iwamura shows the pre-excitation unit and first plasma generation unit are coupled to the plasma chamber:

> So if we look at Figure 1 again, for example, and there is a plasma chamber, which is number 10, and then if we consider *the preexcitation unit and the first plasma generation unit A as the metastable atom source*, that metastable atom source includes the gas supply line 20, so this is the metastable atom source which is *coupled to the plasma chamber*, and because the metastable atoms from Iwamura's metastable atom source

> will be entering the plasma chamber, *the plasma chamber does confine the metastable atoms that are generated by the metastable atom source*.

Ex. 2004, 170:17–171:7 (emphases added). We credit Dr. Kortshagen's cross-examination testimony as his explanation is consistent with Iwamura's disclosure and his original direct testimony. *See* Ex. 1307, 7:8–27, Fig. 1; Ex. 1302 ¶ 156.

Based on the evidence before us, we determine that GlobalFoundries has established, by a preponderance of the evidence, that the combination of Iwamura, Angelbeck, and Pinsley discloses a "plasma chamber," as recited in claims 1, 18, and 45.

<u>An electron/ion absorber</u>

Claim 45 recites "an electron/ion absorber that receives the excited atoms generated by the excited atom source and then traps elections and ions." Ex. 1301, 25:8–11. Each of claims 16, 28, and 42 recites a similar limitation. *Id*. at 22:18–21, 23:17–19, 24:22–24.

GlobalFoundries takes the position that Iwamura's first plasma generation unit that includes an ion capture electrode connected to ground potential for capturing ions and electrons, discloses an "electron/ion absorber," as recited in claims 16, 28, 42, and 45. Pet. 32–34, 54–56, 58–59; Ex. 1307, 11:52–55, Fig. 9.

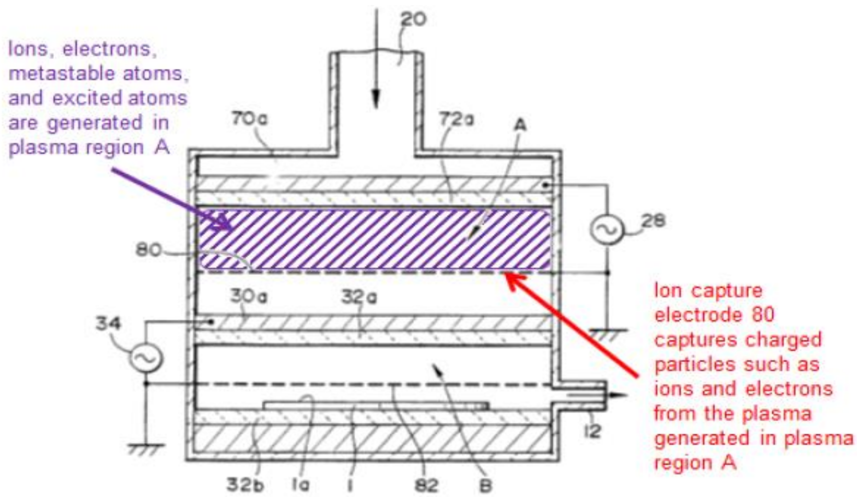
Zond counters that Iwamura does not describe an "electron/ion absorber," as required by the claims, because "Iwamura teaches ion capture only from the plasma and not from the excited or metastable atoms." PO Resp. 42–43, 53–55 (citing Ex. 1307, 11:64–12:4). To support Zond's contentions, Dr. Hartsough testifies that Iwamura "does not teach action on or by the volume of excited or metastable atoms." Ex. 2005 ¶¶ 153, 179.

Zond's arguments and Dr. Hartsough's testimony, however, are predicated improperly on the premise that the gas reaching Iwamura's second plasma generation unit is *fully ionized*, containing no excited or metastable atoms. As discussed previously, that premise contradicts Iwamura's disclosure and the ordinary and customary meaning of the term "plasma," which includes charged particles (ions and electrons) as well as *neutral atoms* (excited and metastable atoms). Both Dr. Kortshagen and Dr. Hartsough agree with that definition, which also is consistent with the Specification of the '779 patent. Ex. 1302 ¶¶ 22–28; Ex. 1317, 42:9–43:17; Ex. 1301, 1:7–8, 8:43–48. Notably, Iwamura explicitly discloses that the gas reaching the second plasma generation unit inside the chamber "*is not yet fully ionized*." Ex. 1307, 2:34–39 (emphasis added).

Additionally, Zond's reliance on the cited portion of Iwamura is misplaced. *See* PO Resp. 42–43, 53–55 (citing Ex. 1307, 11:64–12:4). In fact, that portion of Iwamura states "the provision of the two-stage plasma regions A and B *increases the density of neutral activated gas species and their excitation levels* in downstream plasma region B." Ex. 1307, 11:64–12:4 (emphasis added). One with ordinary skill in the art would have understood that "*neutral* activated gas species" includes *neutral* excited and metastable atoms. Ex. 1302 ¶¶ 22–28. Therefore, Zond's argument that the gas reaching Iwamura's second generation unit does not include excited and metastable atoms also directly contradicts the portion of Iwamura cited by Zond.

Moreover, as Dr. Kortshagen explains, one of ordinary skill in the art would have recognized that Iwamura's ion capture electrode traps electrons and ions in the same manner as disclosed in the '779 patent, using a pair of electrodes. Ex. 1315 ¶¶ 112–116; Ex. 1301, 19:56–20:6, Fig. 12A–12C.

Figure 9 of Iwamura is reproduced below with purple and red annotations added by Dr. Kortshagen (Ex. 1315 ¶ 110):



As annotated, Figure 9 of Iwamura shows the first pair of electrodes includes upper electrode 70a and ion capture electrode 80, which is located below the plasma region A to trap ions and electrons generated in that region. Ex. 1307, 11:46–55. Iwamura also discloses that "ion capture electrode 80 is formed from a wire grid or perforated metal sheet, and is connected to ground potential so as to *capture charged particles such as ions and electrons*." *Id*. (emphasis added). Similarly, the electron/ion absorber disclosed in the '779 patent includes a pair of electrodes: the first electrode is coupled to a power supply, and the second electrode is coupled to ground. Ex. 1301, 19:56–20:6, Fig. 12A. We credit Dr. Kortshagen's testimony (Ex. 1315 ¶¶ 112–116) as it is consistent with the disclosures of Iwamura and the ’779 patent.

Given the evidence before us, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that the combination of Iwamura, Angelbeck, and Pinsley discloses “an electron/ion absorber,” as recited in claims 16, 28, 42, and 45.

Magnetic field

Claim 1 recites “the excited atom source comprising a magnet that generates a magnetic field for substantially trapping electrons proximate to the ground state atoms.” Ex. 1301, 21:14–17. Claims 18 and 41 each recite a similar limitation. *Id*. at 22:31–34, 24:11–14.

GlobalFoundries asserts that the combination of Iwamura, Angelbeck, and Pinsley renders obvious the aforementioned limitation. Pet. 43–50, 54, 57. GlobalFoundries acknowledges that Iwamura does not disclose a magnet for generating a magnetic field. *Id*. Nevertheless, GlobalFoundries maintains that it was well-known in the art at the time of the invention to use a magnet for generating a magnetic field for substantially trapping electrons in a plasma generation apparatus, as evidenced by Angelbeck and Pinsley. *Id*. (citing Ex. 1306, 1:36–41, 2:18–20, 2:50–51, 2:66–67, Fig. 1; Ex. 1305, 2:43–60).

For example, GlobalFoundries points out that Angelbeck discloses a plasma apparatus having a magnet to generate a transverse magnetic field for creating a high density of excited atoms. Pet. 43–50; Ex. 1306, 1:36–41, 2:18–20, 2:29–33. The transverse magnetic field is applied by a magnet with pole pieces for trapping electrons. Ex. 1306, 2:45–54, 2:57–59. According to Angelbeck, such a transverse magnetic field creates a high density of excited atoms and increases the efficiency of excitation. *Id*. at 1:36–41 ("It has been found that a transverse magnetic field applied to a DC discharge gas laser increases the electron temperature and hence the efficiency of excitation . . . ."), 2:18–20 ("A high gas pressure P is advantageous . . . for creating a high density of excited atoms in the laser."), 2:29–33 ("This invention . . . produces the same temperature at a higher pressure by applying a transverse magnetic field.").

Dr. Kortshagen testifies that, in light of the prior art teachings, one of ordinary skill in the art would have been motivated to use a magnet with Iwamura's pre-excitation unit and first plasma generation unit—which are located proximate to the ground state atoms source (gas supply 20)—for trapping electrons, to increase the efficiency of excitation. Ex. 1302 ¶ 139 (citing Ex. 1306, 1:36–41, 2:66–67).

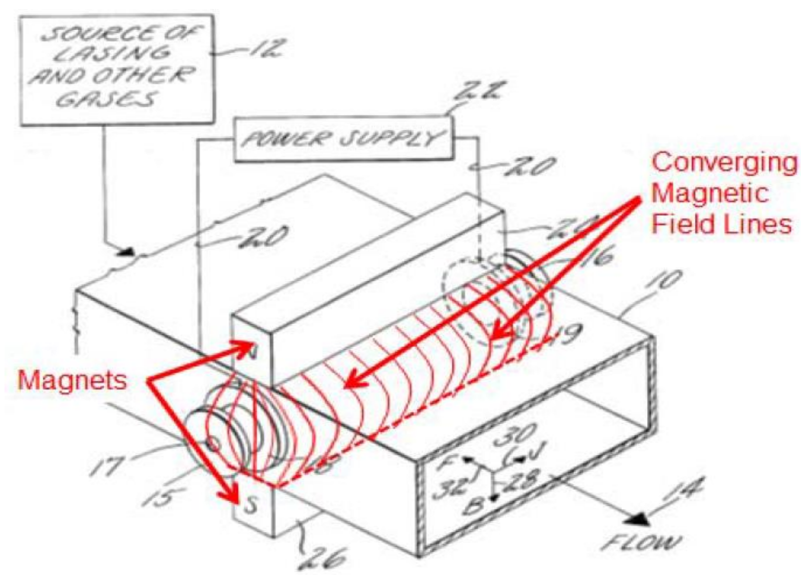
Zond counters that the combination of Iwamura, Angelbeck, and Pinsley does not teach generating a magnetic field that substantially traps electrons proximate to the ground state atoms. PO Resp. 31–36, 47–50. In particular, Zond alleges that Angelbeck's enclosed tube does not receive ground state atoms from a feed gas source, as required by the claims at issue. *Id*. Zond further alleges that Angelbeck's system produces a plasma, not excited or metastable atoms. *Id*. Zond also maintains that Pinsley's magnetic fields do not trap electrons, as they can still easily flow to the anode. *Id*.

Nonobviousness, however, cannot be established by attacking references individually where, as here, the ground of unpatentability is based upon the teachings of a combination of references. *In re Keller*, 642 F.2d 413, 425 (CCPA 1981). GlobalFoundries relies upon Angelbeck for the disclosure of trapping electrons using a magnetic field, and not for the feed gas source, which is taught by Iwamura. Pet. 43–50, 54, 57. There is no dispute that Iwamura's gas supply, supplying a feed gas that contains ground state atoms, discloses "a feed gas source," as recited in the claims at issue. Ex. 1307, 2:5–7, 7:48–50 ("an inert gas such as helium or argon is introduced through gas supply 20").

Zond's arguments also are predicated improperly on the premise that the gas in the chamber of Angelbeck is *fully ionized*, containing no excited or metastable atoms. That premise contradicts the express disclosure of Angelbeck, which describes a system for "creating *a high density of excited atoms*," Ex. 1306, 2:18–20 (emphasis added), and the ordinary and customary meaning of the term "plasma," which includes excited and metastable atoms. As discussed above, both Dr. Kortshagen and Dr. Hartsough agree with that definition, which also is consistent with the Specification of the '779 patent. Ex. 1302 ¶¶ 22–28; Ex. 1317, 42:9–43:17; Ex. 1301, 1:7–8, 8:43–48. Interestingly, Zond's other arguments acknowledge that Angelbeck's system generates excited atoms. PO Resp. 25 ("*The excited atoms* in Angelbeck's laser or Pinsley's laser, however, must return to their ground state." (emphasis added)).

Zond's arguments also narrowly focus on a few sentences in the references, failing to consider the references as a whole, in the context of the knowledge that a person of ordinary skill in the art would have had with respect to using magnets to trap electrons in a plasma apparatus. *See Randall Mfg. v. Rea*, 733 F.3d 1355, 1362–63 (Fed. Cir. 2013). The level of ordinary skill in the art is reflected by the prior art of record. *GPAC*, 57 F.3d at 1579. When Pinsley and Angelbeck are considered properly in their entirety, a person having ordinary skill in the art would have appreciated that the magnets of Pinsley and Angelbeck substantially trap electrons in the same manner as disclosed in the ’779 patent.

As GlobalFoundries points out, applying a magnetic field in a plasma apparatus to trap electrons is disclosed in both Pinsley and Angelbeck. Pet. 43–50 (citing, *e.g.*, Ex. 1305, 2:43–60; Ex. 1306, 1:36–41, 2:18–20, 2:50–51, 2:66–67, Fig. 1). For instance, Pinsley discloses a plasma apparatus that utilizes a magnet to generate a magnetic field for trapping electrons. Ex. 1305, 1:51–54, 2:43–47. Pinsley’s sole Figure is reproduced below with annotations added by Dr. Kortshagen (Ex. 1315 ¶ 40).



As shown in the annotated figure above, conduit 10 includes anode 18, cathode 19, and magnets 24, 26, for generating a magnetic field. Ex. 1305, 2:27–42. According to Pinsley, "the interaction between the current and the magnetic field will result in an upstream force as indicated by the force vector 32," and "[t]his force is exerted upon the electrons, and *tends to maintain the electrons in an area between the anode and cathode*," trapping the electrons. *Id*. at 2:43–47 (emphasis added).

Dr. Kortshagen testifies that one of ordinary skill in the art would have understood that Pinsley's magnets 24 and 26 will produce magnetic field lines that converge near the magnets. Ex. 1315 ¶ 41. Dr. Kortshagen further testifies that Pinsley's magnetic field lines converge near the magnets similar to the magnetic field lines depicted in Figure 7A of the '779 patent, and like the '779 patent, Pinsley's configuration can trap electrons substantially. *Id*. ¶¶ 39–46. In fact, Zond's expert, Dr. Hartsough in his cross-examination testimony acknowledges that converging magnetic field lines will substantially trap electrons. Ex. 1317, 123:4–13.

Based on the evidence in this record, we credit Dr. Kortshagen's testimony (Ex. 1315 ¶¶ 39–46, 58–59) that magnets, such as those disclosed in Pinsley and Angelbeck, generate a magnetic field that substantially trap electrons in a plasma apparatus. Notably, the Admitted Prior Art (Figure 1 of the '779 patent) discloses a plasma sputtering apparatus, having magnets that generates magnetic field to trap electrons. Ex. 1301, 3:9–18 ("The magnetic field 132 is shaped to trap and concentrate secondary electrons proximate to the target surface."). Dr. Hartsough acknowledges that, since the mid-1970s, using magnets for trapping electrons in magnetron sputtering systems was well-known in the art. Ex. 1317, 20:13–21:1. Both Dr. Kortshagen's testimony (Ex. 1315 ¶¶ 39–46, 58–59) and Dr. Hartsough's cross-examination testimony (Ex. 1317, 123:4–13) are consistent with the prior art of record, including the Admitted Prior Art, which recognizes a magnet field is strongest at the poles of the magnet and weakest in the region at the center between the poles (Ex. 1301, 3:12–13).

We also are not persuaded by Zond's argument that Pinsley's magnetic field does not trap electrons, as they can still easily flow to the anode. PO Resp. 49–50. Dr. Hartsough acknowledges that whether the trapped electrons flow to the anode is immaterial to the teaching of trapping electrons using a magnetic field, because most of the trapped electrons, including those illustrated by Figure 7A of the '779 patent, will flow to the anode. Ex. 1317, 139:20–24. Furthermore, Pinsley discloses that the "interaction between the current and the magnetic field will result in an upstream force [and this] force is exerted upon the electrons, and tends to maintain the electrons in an area between the anode and cathode." Ex. 1305, 2:43–47.

As discussed above, the prior art of record clearly shows that it was well-known in the art at the time of the invention to use *magnets* in a plasma apparatus for *trapping electrons*. Based on the prior art of record, we agree with Dr. Kortshagen that "the use of magnets and their corresponding magnetic fields to trap electrons . . . was already known in the prior art," at the time of the invention. *See* Ex. 1315 ¶ 37.

In view of the foregoing, we determine that GlobalFoundries has established, by a preponderance of the evidence, that the combination of

Iwamura, Angelbeck, and Pinsley discloses an excited or metastable atom source comprising a magnet that generates a magnetic field for substantially trapping electrons proximate to the ground state atoms, as recited in claims 1, 18, and 41.

Rationale to combine

Zond asserts that one of ordinary skill in the art "would have been dissuaded from using a gas laser of Pinsley or Angelbeck to achieve the claimed plasma generation apparatus of the '779 patent because the high energy atoms are not maintained in that state in a gas laser and instead, are used to create light." PO Resp. 23–24. To that end, Zond advances several arguments. *Id*. at 23–27, 31–36, 47–50.

First, Zond alleges that the "excited atoms in Angelbeck's laser or Pinsley's laser . . . must return to their ground state to release energy so that the laser will operate according to its intended purpose: to emit light." *Id*. at 24–25. We do not find that argument persuasive.

As an initial matter, whether the excited atoms return to a ground state is immaterial to the teachings of Angelbeck and Pinsley of how to increase the efficiency of exciting atoms using magnets. Ex. 1306, 1:36–41; Ex. 1305, 2:43–48. One of ordinary skill in the art would have understood that, as a matter of plasma physics, excited atoms generated by plasma generators may return to their ground state as they flow through the chamber. *See* Ex. 1315 ¶ 65.

Insofar as Zond argues that the proposed combination of Iwamura, Angelbeck, and Pinsley would change the principle of operation of

Angelbeck or Pinsley, we are not persuaded. We are cognizant that if the proposed combination of the prior art would change the principle of operation of *the prior art invention being modified*, then the teachings of the references are not sufficient to render the claims prima facie obvious. *See In re Ratti*, 270 F.2d 810, 813 (CCPA 1959). Zond's argument, however, fails to recognize that "the prior art invention being modified" in the combination at issue here is Iwamura's plasma treatment apparatus for generating a stable plasma with a multi-step ionization process to treat a semiconductor wafer, and not Angelbeck's or Pinsley's apparatus. GlobalFoundries relies upon Angelbeck and Pinsley only for the disclosure of using a magnetic field for trapping electrons. Pet. 31–36, 47–50. Zond does not explain adequately as to why using a magnet to generate a magnetic field with Iwamura's pre-excitation unit and first plasma generation unit would change the principle of operation of Iwamura's plasma apparatus. In fact, Iwamura's plasma apparatus, as modified in view of Angelbeck and Pinsley, would have operated on the same principles as before—namely, generating a plasma with a multi-step ionization process—which is the same as that in the '779 patent (Ex. 1301, 21:9–11, 23:24–25). *See In re Umbarger*, 407 F.2d 425, 430–31 (CCPA 1969) (finding *Ratti* inapplicable where the modified apparatus will operate "on the same principles as before").

Second, Zond argues that "both Pinsley and Angelbeck relate to emission of light from lasers," whereas "the invention of the '779 patent confines the excited atoms after they are transformed from the ground state atoms so that they can later be ionized." PO Resp. 23–26. Insofar as Zond argues that Pinsley and Angelbeck are non-analogous art, we do not find such an argument persuasive.

A prior-art reference is considered to be analogous if it is either: (1) from the same field of endeavor, regardless of the problem addressed; or (2) reasonably pertinent to the particular problem with which the inventor is concerned, regardless of the field of endeavor. *See In re Clay*, 966 F.2d 656, 658–59 (Fed. Cir. 1992). "A reference is reasonably pertinent if, even though it may be in a different field from that of the inventor's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to an inventor's attention in considering his problem." *Id.* at 659. In that regard, "[w]hen a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one." *KSR*, 550 U.S. at 417.

Here, the field of plasma generation is not limited to the particular type of plasma chamber disclosed in the '779 patent, as Zond suggests. On the contrary, the prior art of record shows that one of ordinary skill in the art at the time of the invention would have recognized that plasma treatment systems and gas lasers are from the same field of endeavor, and that effects observed in one may be applicable to the other, as explained by Kudryavtsev. Pet. 48; Ex. 1304, 30, 34; Ex. 1302 ¶ 138. In fact, in Pinsley and Angelbeck, the gas is excited in a region between a pair of anode and cathode electrodes to generate a plasma, similar to the '779 patent. Ex. 1305, 2:31–36; Ex. 1306, 2:45–56; Ex. 1301, 6:21–23 ("Numerous other cathode and anode configurations known in the art can be used with the plasma generator of the present invention."), Figs. 1–2. In short, both

Pinsley and Angelbeck are analogous art because they are within the same field of endeavor as the ’779 patent—namely, plasma generation.

Additionally, Pinsley and Angelbeck are reasonably pertinent to the problem addressed by the ’779 patent, at least with respect to generating a magnetic field and using the magnetic field to excite gas atoms efficiently. As we discussed previously, both Pinsley and Angelbeck disclose the application of a magnetic field to improve the efficiency of exciting atoms. Ex. 1305, 2:43–48, Ex. 1306, 1:36–41. Therefore, one with ordinary skill in the art would have looked to the teachings of Pinsley and Angelbeck for how to increase the efficiency of exciting atoms for generating a plasma.

Third, Zond contends that Angelbeck combined with Iwamura and Pinsley teaches away from the claimed subject matter of the ’799 patent because Angelbeck’s anode and cathode force the electrons to the tube wall, where they are removed from the plasma. PO Resp. 31–36, 47–50. As support, Dr. Hartsough testifies that “Angelbeck teaches deflecting the electrons toward the tube walls which, in a flowing feed gas, would have no trapping effect whatsoever on the electrons.” Ex. 2005 ¶ 222.

Zond’s argument and expert testimony, however, improperly rest on the notion that *all of the electrons*, in Angelbeck, are lost to the wall. On the contrary, Angelbeck specifically indicates that “[t]he current-excited discharge passed through the gas within tube 10 creates *a plasma in which the atoms are ionized and the electrons are freed*.” Ex. 1306, 2:54–56 (emphasis added). More importantly, as discussed above, Angelbeck teaches that a magnetic field creates a high density of excited atoms and increases the efficiency of excitation. *Id*. at 1:36–41, 2:18–20, 2:29–33.

Given the evidence before us, we do not discern that Angelbeck criticizes, discredits, or otherwise discourages investigation into using magnetic field to substantially trap electrons. *See In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (noting that a reference does not teach away if it merely expresses a general preference for an alternative invention but does not "criticize, discredit, or otherwise discourage" investigation into the invention claimed); *In re Susi*, 440 F.2d 442, 446 n.3 (CCPA 1971) ("Disclosed examples and preferred embodiments do not constitute a teaching away from a broader disclosure of non-preferred embodiments."). Therefore, a person of ordinary skill would not have been dissuaded from combining Iwamura with Angelbeck and Pinsley.

Finally, Zond argues that GlobalFoundries fails "to provide experimental data or other objective evidence indicating that the structure and process of Iwamura would produce the particular plasma process of the '779 patent" if it were modified by Angelbeck and Pinsley. PO Resp. 24–27 (citing *Epistar v. Trs. of Boston Univ.*, Case IPR2013-00298 (PTAB Nov. 15, 2013) (Paper 18)).

Zond's arguments, however, narrowly focus on the physical differences between the prior art systems, and improperly attempt to bodily incorporate one system into the other. PO Resp. 24–27. Zond's reliance on its interpretation of *Epistar*, a non-precedential Board decision, is misplaced. "It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements." *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012); *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (en banc) (noting that the criterion for obviousness is not whether the references can be combined physically, but whether the claimed invention is rendered obvious by the teachings of the prior art as a whole). In that regard, one with ordinary skill in the art is not compelled to follow blindly the teaching of one prior art reference over the other without the exercise of independent judgment. *Lear Siegler, Inc. v. Aeroquip Corp.*, 733 F.2d 881, 889 (Fed. Cir. 1984); *see also KSR*, 550 U.S. at 420–21 (stating that a person with ordinary skill in the art is "a person of ordinary creativity, not an automaton," and "in many cases . . . will be able to fit the teachings of multiple patents together like pieces of a puzzle").

Here, GlobalFoundries relies upon Angelbeck and Pinsley to show that generating a magnetic field to trap electrons in a plasma apparatus was well-known in the art at the time of the invention. Pet. 31–36, 47–50. Indeed, both Angelbeck and Pinsley teach the use of a magnet to generate a magnetic field for increasing the efficiency of exciting atoms in a plasma apparatus. Ex. 1305, 2:43–48; Ex. 1306, 1:36–41. Zond's expert, Dr. Hartsough, also acknowledges that, since the mid-1970s, using magnets for trapping electrons in magnetron sputtering systems was well-known in the art. Ex. 1317, 20:13–21:1. Moreover, the Admitted Prior Art (Figure 1 of the '779 patent) discloses a plasma sputtering apparatus, having magnets that generates magnetic field to trap electrons. Ex. 1301, 3:9–18 ("The magnetic field 132 is shaped to trap and concentrate secondary electrons proximate to the target surface.").

Given the evidence before us, we agree with Dr. Kortshagen that one with ordinary skill in the art would have been motivated, in view of

Angelbeck and Pinsley, to use a magnet with Iwamura's pre-excitation unit and first plasma generation unit—which are located proximate to the ground state atoms source (gas supply 20)—for generating a magnetic field to trap electrons, in order to increase the efficiency of excitation of ground state atoms. Ex. 1302 ¶¶ 128–30, 137–39. We credit Dr. Kortshagen's testimony, as it is consistent with the disclosures of Angelbeck and Pinsley, and other prior art of record.

Upon consideration of the parties' contentions and the evidence in this entire record, we determine that GlobalFoundries has demonstrated that combining the technical disclosures of Iwamura, Angelbeck, and Pinsley is merely a predictable use of prior art elements according to their established functions—an obvious improvement. *See KSR*, 550 U.S. at 417 ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill."). Therefore, GlobalFoundries has provided an articulated reason with rational underpinnings for modifying Iwamura in view of Angelbeck and Pinsley.

Conclusion

For the foregoing reasons, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that claims 16, 28, 41, 42, and 45 are unpatentable over the combination of Iwamura, Angelbeck, and Pinsley.

III. CONCLUSION

For the foregoing reasons, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that claims 16, 28, 41, 42, 45, and 46 are unpatentable based on the following grounds:

Claims	**Basis**	**References**
46	§ 102(b)	Iwamura
16, 28, 41, 42, and 45	§ 103(a)	Iwamura, Angelbeck, and Pinsley

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 16, 28, 41, 42, 45, and 46 of the ’779 patent are held *unpatentable*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing:

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Respectfully submitted,

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