UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GLOBALFOUNDRIES U.S., INC., GLOBALFOUNDRIES DRESDEN MODULE ONE LLC & CO. KG, GLOBALFOUNDRIES DRESDEN MODULE TWO LLC & CO. KG, and THE GILLETTE COMPANY,
Petitioners
v.
ZOND, LLC,
Patent Owner

Case No. IPR2014-01076[1]
Patent 6,805,779 B2

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

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[1] Case IPR2014-01019 has 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 2014-01076, 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 43 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 5, 6, 8, 19, 22, and 23 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 40
Entered: November 3, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GLOBALFOUNDRIES U.S., INC., GLOBALFOUNDRIES DRESDEN MODULE ONE LLC & CO. KG, and GLOBALFOUNDRIES DRESDEN MODULE TWO LLC & CO. KG, and
THE GILLETTE COMPANY,
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v.

ZOND, LLC,
Patent Owner.

Case IPR2014-01076[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] Case IPR2014-01019 has been joined with the instant *inter partes* review.

I. INTRODUCTION

GLOBALFOUNDRIES U.S., Inc., GLOBALFOUNDRIES Dresden Module One LLC & Co. KG, GLOBALFOUNDRIES Dresden Module Two LLC & Co. KG (collectively, "the GlobalFoundries entities") filed a revised Petition requesting *inter partes* review of claims 5, 6, 8, 19, 22, 23, and 43 of U.S. Patent No. 6,805,779 B2 ("the '779 patent"). Paper 4 ("Pet."). Zond, LLC ("Zond") filed a Preliminary Response. Paper 9 ("Prelim. Resp."). Upon consideration of the Petition and Preliminary Response, we instituted the instant trial on November 17, 2014, pursuant to 35 U.S.C. § 314 (a). Paper 11 ("Dec."). Subsequent to institution, we granted the revised Motion for Joinder filed by The Gillette Company ("Gillette"), joining Case IPR2014-01019 with the instant trial.[2] Paper 14. Zond filed a Response (Paper 25, "PO Resp."), and GlobalFoundries filed a Reply (Paper 29, "Reply"). An oral hearing[3] was held on June 15, 2015, and a transcript of the hearing was entered into the record. Paper 39 ("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 43 is unpatentable under 35 U.S.C. § 102(b), and that claims 5, 6, 8, 19, 22, and 23 are unpatentable under 35 U.S.C. § 103(a).

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[2] In this Decision, we refer to the GlobalFoundries entities (the original Petitioner) and Gillette as "GlobalFoundries," for efficiency.

[3] The oral arguments for this review and the following *inter partes* reviews were consolidated: IPR2014-00828, IPR2014-00829, IPR2014-00917, and IPR2014-01073.

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. Paper 7; Ex. 1113.

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. 1101, Abs. For instance, Figure 2 of the ’779 patent, reproduced below, illustrates a cross-sectional view of a plasma generating apparatus:

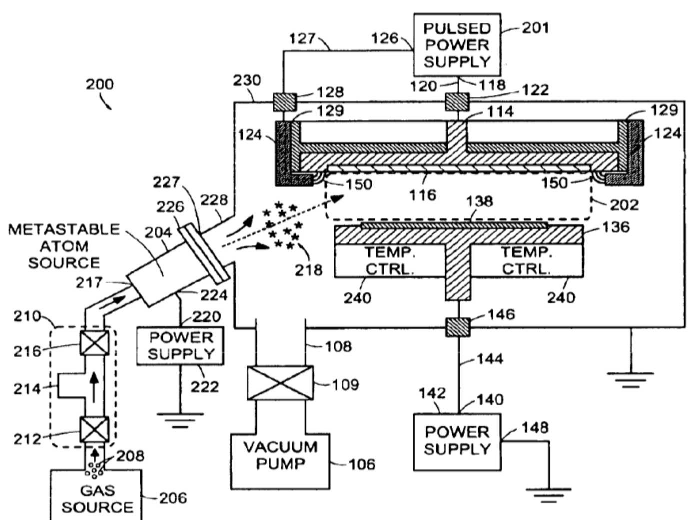


FIG. 2

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:

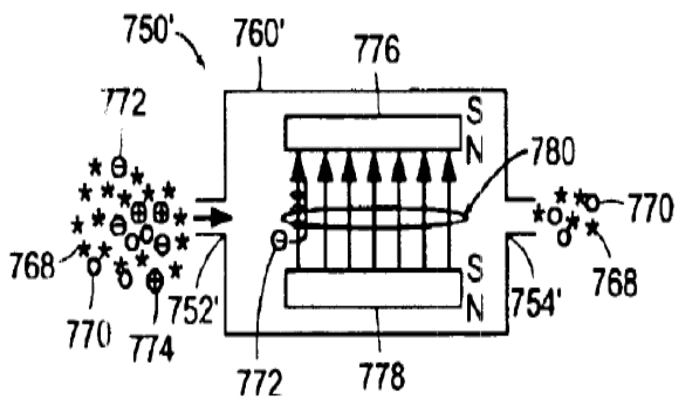


FIG. 12B

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

Of the challenged claims in the instant proceeding, claim 43 is the only independent claim. Claims 5, 6, 8 depend directly from claim 1.

Claims 19, 22, and 23 depend directly from claim 18. Independent claims 1 and 18, however, are not being challenged in this proceeding.[4]

Claim 43 is illustrative:

> 43. A plasma generator that generates a plasma with a multi-step ionization process, the plasma generator comprising:
>
> a feed gas source comprising ground state atoms;
>
> an *excited atom source* that is coupled to the feed gas source, the excited atom source generating excited atoms from the ground state atoms;
>
> 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,
>
> wherein a pressure differential exists between a pressure in the excited atom source and a pressure in the plasma chamber, the pressure differential increasing at least one of a rate at which the excited atoms are generated from the ground state atoms and a density of the excited atoms; and
>
> an energy source that is coupled to the volume of excited atoms confined by the plasma chamber, the energy source raising an energy of excited atoms in the volume of excited atoms so that at least a portion of the excited atoms in the volume of excited atoms is ionized, thereby *generating a plasma with a multi-step ionization process*.

Ex. 1101, 24:25–47 (emphases added).

D. Prior Art Relied Upon

GlobalFoundries relies upon the following prior art references:

Pinsley	US 3,761,836	Sept. 25, 1973	(Ex. 1105)
Angelbeck	US 3,514,714	May 26, 1970	(Ex. 1106)

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

Iwamura	US 5,753,886	May 19, 1998	(Ex. 1107)

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. 1103, "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. 1104, "Kudryavtsev").

E. Grounds of Unpatentability

We instituted the instant trial based on the following grounds of unpatentability (Dec. 30):

Claims	**Basis**	**References**
43	§ 102(b)	Iwamura
5, 6, 8, 19, 22, and 23	§ 103(a)	Iwamura, Angelbeck, and Pinsley[5]

[5] Pinsley was omitted inadvertently from the statement of this asserted ground of unpatentability, although included in the corresponding analysis. Pet. 52. Therefore, we treated the statement of this asserted ground as mere harmless error and presume that GlobalFoundries intended to assert that claims 5, 6, 8, 19, 22, and 23 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. 23–26, 31–36.

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,"[6] and "the standard was properly adopted by PTO regulation."). Significantly, claims are not interpreted in a vacuum but are 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).

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

"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: "excited 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. 15–17; Ex. 2005 ¶¶ 41–42; Ex. 1115 ¶¶ 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 1)	neutral atoms that have one or more electrons in a state that is higher than its lowest possible state (Dec. 7)
"metastable atoms" (claim 18)	excited atoms having energy levels from which dipole radiation is theoretically forbidden (Dec. 7–8)
"multi-step ionization process" (claim 1)	an ionization process having at least two distinct steps (Dec. 8–9)

"plasma"

For this Final Written Decision, we find it necessary to construe the claim term "plasma." Claim 43 recites "[a] plasma generator that generates a plasma with a multi-step ionization process." Ex. 1101, 24:25–26.

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. 1102 ¶¶ 22–28. Metastable atoms are excited neutral atoms that are in a metastable state, but have not been ionized. Ex. 1101, 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. 1102 ¶ 24.

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. 1117, 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 also includes excited and metastable atoms. Ex. 1101, 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. 1117, 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.

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); *Paulsen*, 30 F.3d at 1480 (stating that "a prior art reference must be 'considered together with the knowledge of one of ordinary skill in the pertinent art.'") (quoting *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)).

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.

[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.

C. Anticipation by Iwamura

GlobalFoundries asserts that claim 43 is unpatentable under 35 U.S.C. § 102(b) as anticipated by Iwamura. Pet. 41–52. 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 a Declaration of Dr. Kortshagen (Ex. 1102) to support its Petition, and a Supplemental Declaration of Dr. Kortshagen (Ex. 1115) to support its Reply.

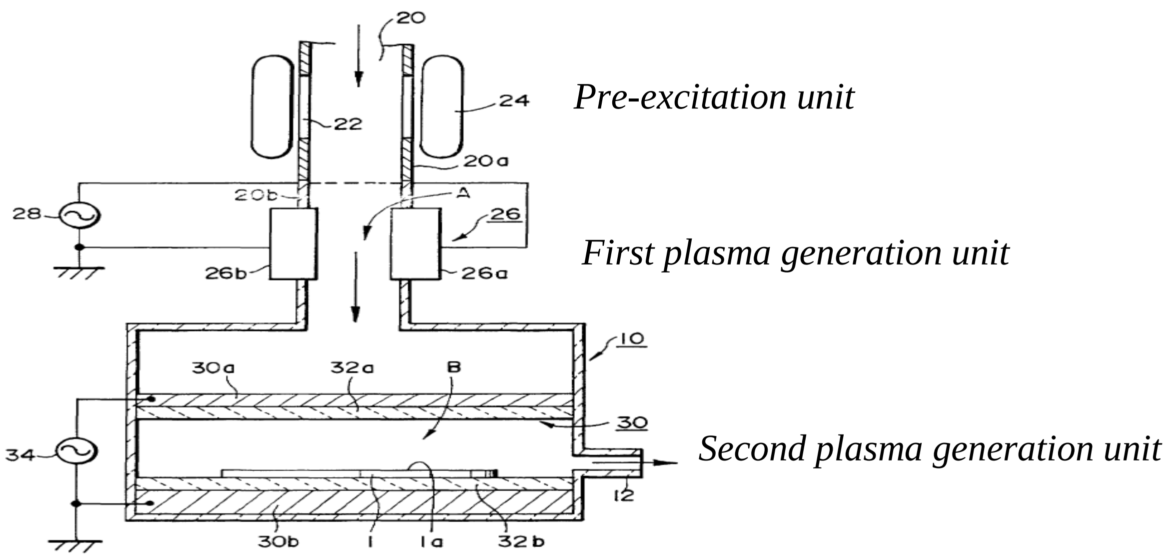
In its Response, Zond counters that Iwamura does not disclose every claim limitation of claim 43. PO Resp. 46–55. As support, Zond directs our attention to a Declaration of Dr. Larry D. Hartsough (Ex. 2005).

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. 1107, Abstract, 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. 1107, 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.

Generating a plasma with a multi-step ionization process

Claim 43 recites:

> an *energy source* that is coupled to the volume of excited atoms confined by the plasma chamber, the energy source raising an energy of excited atoms in *the volume of excited atoms* so that at least a portion of the excited atoms in the volume of excited atoms is *ionized*, thereby generating *a plasma* with *a multi-step ionization process*.

Ex. 1101, 24:41–47 (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 "a plasma" as "a collection of ions, electrons, ground state atoms, excited atoms, and metastable atoms," consistent with its 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. 41–47, 50–52. 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 ground state atoms. *Id.*; Ex. 1107, 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, generates a plasma inside the chamber. Ex. 1107, 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 already are ionized* before they enter the chamber. PO Resp. 53–55. As support, Dr. Hartsough testifies that "the atoms entering Iwamura's chamber are *not excited*, but rather activated (i.e., ionized to a plasma)." Ex. 2005 ¶¶ 121, 123 (emphasis added).

Zond's arguments and Dr. Hartsough's testimony, however, are predicated on the premise that the gas is *fully ionized* containing no excited or metastable atoms, 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. 1107, 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. 1117, 42:9–43:17, 74:2–76:4; Ex. 1115 ¶¶ 25–33, 89.

Zond's contention that a plasma does not include a volume of excited 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. 1102 ¶¶ 22–28; Ex. 1117, 42:9–43:17. Furthermore, the Specification of the '779 patent discloses that a plasma includes charged particles as well as neutral excited and metastable atoms. Ex. 1101, 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 14:4–14:23 ("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 discloses an energy source that raises "an energy of excited atoms in the volume of excited atoms so that at least a portion of the excited atoms in the volume of excited is ionized, thereby generating a plasma with a multi-step ionization process," as recited in claim 43.

<u>Excited atom source</u>

Claim 43 recites "an *excited atom source* that is coupled to the feed gas source, the excited atom source generating *excited atoms* from the ground state atoms." Ex. 1101, 24:29–31 (emphases added). In its Petition, GlobalFoundries asserts that Iwamura's pre-excitation unit and/or first plasma generation unit describe an excited atom source for generating excited atoms from ground state atoms. Pet. 41–45, 47–48; Ex. 1007, 6:67–8:32–46, Fig. 1. Zond counters that Iwamura's first plasma generation unit generates a plasma, and not excited atoms. PO Resp. 27–31, 46–47. As support, Dr. Hartsough testifies that "Iwamura's first plasma generation unit generates a plasma or 'activated gas' per Iwamura's teaching." Ex. 2005 ¶ 50.

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. 1102 ¶¶ 22–28; Ex. 1117, 42:9–43:17, 74:2–76:4; Ex. 1101, 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. 1107, 2:34–38 (emphasis added).

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. 1002 ¶¶ 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. 1107, 2:61–65, 2:31–65; Ex. 1115 ¶¶ 25–33, 89; Ex. 1117, 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 discloses an excited atom source that generates excited atoms from ground state atoms, as required by claim 43.

<u>Plasma chamber</u>

Claim 43 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, . . . an energy source that is coupled to the volume of excited atoms confined by the *plasma chamber*." Ex. 1101, 24:32–34, 41–42 (emphases added). GlobalFoundries asserts that Iwamura discloses a plasma chamber, as recited in claim 43, because "Iwamura's pre-excitation unit and the first plasma generation unit, either alone or in combination meet the excited atom source, are positioned upstream from, and coupled, to the plasma treatment chamber." Pet. 48, 50–51.

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. 36–41, 47–49, 53–54. Zond also argues that Iwamura does not disclose a plasma chamber confining a volume of excited atoms. *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, 109, 121.

We are not persuaded by Zond's arguments and Dr. Hartsough's testimony as they require Iwamura to recite expressly certain claim terms. An anticipation 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 the 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. 1107, 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 claim. *See Van Geuns*, 988 F.2d at 1184. Nothing in claim 43 requires the plasma chamber to be *directly* coupled to the excited 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. 1117, 108:13–109:22.

In any event, even if the claim requires a direct coupling, Zond’s arguments are still unavailing, as they predicate that only Iwamura’s pre-excitation unit is the excited atom source. As discussed above, GlobalFoundries relies upon Iwamura’s pre-excitation unit and the first plasma generation unit, either alone or in combination, to disclose the excited atom source. Pet. 48. Figure 1 of Iwamura clearly shows that the pre-excitation unit and the first plasma generation unit are disposed on the wall of gas supply pipe that is coupled to the plasma chamber. Ex. 1107, 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. 1117, 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. 48–49 (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. 1107, 7:8–27, Fig. 1; Ex. 1102 ¶ 126.

Based on the evidence before us, we determine that GlobalFoundries has established, by a preponderance of the evidence, that Iwamura discloses a plasma chamber that is coupled to the excited atom source, confining a volume of excited atoms generated by the excited atom source, as recited in claim 43.

<u>Pressure differential</u>

Claim 43 recites

> a pressure differential exists between a pressure in the excited atom source and a pressure in the plasma chamber, the pressure differential increasing at least one of a rate at which the excited atoms are generated from the ground state atoms and a density of the excited atoms.

Ex. 1101, 24:35–40.

GlobalFoundries asserts that one with ordinary skill in the art would have recognized that the differences in cross-sectional area would lead to a pressure differential between Iwamura's preexcitation unit/first plasma generation unit (having higher pressure) as compared to the treatment chamber. Pet. 48–50. GlobalFoundries notes that, according to Iwamura, "the gap between the pair of electrodes in the upstream plasma discharge unit can be made small, the plasma density in the upstream plasma region increased, and the gas adequately activated." *Id*. (citing Ex. 1107, 4:9–12). To support GlobalFoundries's contention, Dr. Kortshagen testifies that the pressure differential increases the density of ground state atoms, thereby increasing the rate at which the excited atoms are generated from the ground state atoms. Ex. 1102 ¶¶ 127–130.

Zond counters that Iwamura does not describe a pressure differential that increases the excitation rate or the density of the excited atoms, as recited in claim 43, because Iwamura generates a plasma instead of excited atoms in the gap between the electrodes of the first plasma generation unit. PO Resp. 49–53. As support, Dr. Hartsough testifies that an increase of *plasma density*, which refers to the ion density, is "not the same as the excitation rate of excited atoms, or the density of excited atoms." Ex. 2005 ¶¶ 117–19.

Zond's argument and Dr. Hartsough's testimony, however, are predicated improperly on the premise that Iwamura's first plasma generation unit generates a *fully ionized* plasma that does not include excited atoms and metastable atoms. As we discussed previously, that premise contradicts Iwamura's disclosure and the ordinary and customary meaning of the term "plasma." Significantly, the Specification of the '779 patent explains that a plasma includes charged particles, excited atoms, and metastable atoms. Ex. 1101, 8:43–48. According to the Specification, a volume of excited or metastable atoms is generated when the excited or metastable atom source *creates a discharge* between a pair of electrodes, like Iwamura's first generation unit, energizing and ionizing a portion of ground state atoms. *Id*. at 13:34–14:23. Consequently, 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 includes a volume of excited and metastable atoms.

As GlobalFoundries points out, Zond does not dispute that Iwamura discloses a pressure differential between the chamber and the gas supply where the preexcitation unit and first plasma generation unit are located. Reply 18–19. Indeed, as shown in Figure 1 of Iwamura, the cross-sectional area of gas supply is sufficiently small compared with the cross-section area of the chamber. According to Dr. Kortshagen, the pressure in the gas supply would be higher than the pressure in the chamber. Ex. 1102 ¶ 127. Based on the evidence before us, we credit Dr. Kortshagen's testimony (*id.* ¶¶ 127–130) that the pressure differential increases the density of atoms, thereby increasing the rate at which the excited atoms are generated from the ground state atoms and a density of the excited atoms, as it is consistent with the prior art disclosure.

Based on the evidence before us, we determine that GlobalFoundries has shown, by a preponderance of the evidence, that Iwamura discloses a "pressure differential" as recited in claim 43.

Conclusion

For the foregoing reasons, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that claim 43 is unpatentable as anticipated by Iwamura.

D. Claims 5, 6, 8, 19, 22, and 23—Obviousness over the Combination of Iwamura, Angelbeck, and Pinsley

GlobalFoundries asserts that claims 5, 6, 8, 19, 22, and 23 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Iwamura, Angelbeck, and Pinsley. Pet. 52–60. In support of that asserted ground of unpatentability, GlobalFoundries provides detailed explanations as to how each claim limitation is met by the references and articulates rationales for combining the references. *Id.* GlobalFoundries also proffers a Declaration of Dr. Kortshagen (Ex. 1102) to support its Petition, and a Supplemental Declaration of Dr. Kortshagen (Ex. 1115) to support its Reply.

In its Response, Zond counters that the combination of the cited prior art does not disclose every claim limitation. PO Resp. 27–46. In particular, Zond alleges that the prior art combination does not teach: (1) an excited atom source, as recited in claims 1, 5, 18, and 19 (*id*. at 27–31, 43–44); (2) a plasma chamber that is coupled to the excited atom source, confining a volume of excited or metastable atoms, as recited in claims 1 and 18 (*id*. at 36–41); (3) an energy source that is coupled to the volume of excited or metastable atoms, ionizing at least a portion of the excited atoms, as recited in claims 1 and 18 (*id*. at 39–43); and (4) a pressure differential, as recited in claims 8 and 23 (*id*. at 55–57). Essentially, Zond reiterates the same arguments presented in connection with claim 43. We addressed those arguments in our analysis above regarding the anticipation ground of unpatentability based on Iwamura as to claim 43, and determined those arguments to be unavailing.

In addition, Zond contends that the combination of Iwamura, Angelbeck, and Pinsley does not teach a magnet that substantially traps electrons proximate to the ground state atoms, increasing the excitation rate and density of excited atoms. PO Resp. 31–36, 44–46. Zond further argues that GlobalFoundries has not provided a sufficient reason to combine the technical disclosures of prior art references. *Id*. at 18–27.

We have reviewed the parties' contentions and supporting evidence and, in our discussion below, we address these additional contentions from Zond in turn.

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. 1101, 21:14–17. Claim 18 recites a similar limitation. *Id*. at 22:31–34. Claims 6 and 22 recite "the magnetic field that substantially traps electrons proximate to the ground atoms increases at least one of a rate at which the excited [or metastable] atoms are generated from the ground state atoms and a density of excited [or metastable] atoms." *Id*. at 21:45–49, 22:61–64.

GlobalFoundries asserts that the combination of Iwamura, Angelbeck, and Pinsley renders obvious the aforementioned limitations. Pet. 52–55, 58–59. 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. 1106, 1:36–41, 2:18–20, 2:50–51, 2:66–67, Fig. 1; Ex. 1105, 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. 52–55, 58–59; Ex. 1106, 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. 1106, 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 in order to increase the efficiency of excitation. Ex. 1102 ¶ 142 (citing Ex. 1106, 1:36–41, 2:66–67). Dr. Kortshagen further testifies that it was well-known that the increased electron density would lead to increased collisions of the electrons with the gas to generate additional excited or metastable atoms, thereby increasing the excitation rate of the ground state atoms. *Id*. ¶ 159.

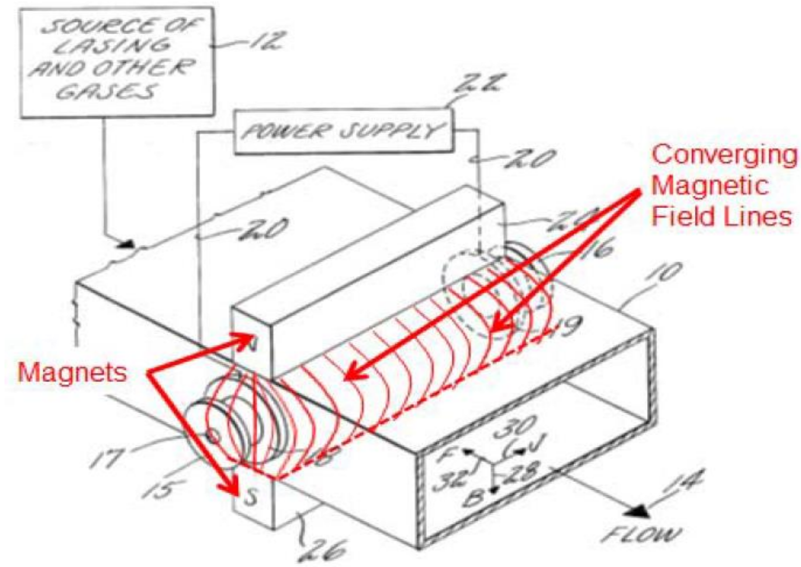
Zond counters that the combination of Iwamura, Angelbeck, and Pinsley does not teach a magnet that substantially traps electrons proximate to the ground state atoms, increasing the excitation rate and density of excited atoms. PO Resp. 31–36, 44–46. In particular, Zond alleges that Angelbeck's enclosed 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. 52–55, 58–59. 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 claims at issue. Ex. 1107, 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. 1106, 2:18–20 (emphasis added), and the ordinary and customary meaning of the term "plasma," which includes excited and metastable atom. 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. 1102 ¶¶ 22–28; Ex. 1117, 42:9–43:17; Ex. 1101, 1:7–8, 8:43–48. Interestingly, Zond's other arguments acknowledge that Angelbeck's system generates excited atoms. PO Resp. 24–25 ("*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 prior art 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 (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. 26–27, 48–49 (citing, *e.g.*, Ex. 1105, 2:43–60; Ex. 1106, 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. 1105, 1:51–54, 2:43–47. Pinsley's sole Figure is reproduced below with annotations added by Dr. Kortshagen (Ex. 1115 ¶ 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. 1105, 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. 1115 ¶ 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 substantially trap electrons. Ex. 1115 ¶¶ 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. 1117, 123:4–13.

Based on the evidence in this record, we credit Dr. Kortshagen's testimony (Ex. 1115 ¶¶ 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. 1101, 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. 1117, 20:13–21:1. Both Dr. Kortshagen's testimony (Ex. 1115 ¶¶ 39–46, 50–51) and Dr. Hartsough's cross-examination testimony (Ex. 1117, 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. 1101, 3:12–13).

We also are not persuaded by Zond's argument that Pinsley's magnetic fields do not trap electrons, as they can still easily flow to the anode. PO Resp. 31–36, 44–46. 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. 1117, 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. 1105, 2:43–48.

With respect to claims 6 and 22, Zond additionally argues that an increase of the plasma density in Iwamura "is clearly not the same as the excitation rate of excited atoms, the density of excited atoms, generation rate of metastable atoms, or the density of metastable atoms." PO Resp. 46; Ex. 2005 ¶ 100 (citing Ex. 1107, 4:10–11). Zond's attack on Iwamura individually, however, does not undermine GlobalFoundries's obviousness ground of unpatentability that is based upon the combination of Iwamura, Angelbeck, and Pinsley. *See Keller*, 642 F.2d at 425. As discussed above, Angelbeck discloses using a magnet to generate a magnetic field for creating a high density of excited atoms. Ex. 1106, 1:36–41, 2:18–20, 2:29–33. The magnetic field traps electrons proximate to ground state atoms, thereby increasing the density of the electrons. *Id*. at 2:50–51. As Dr. Kortshagen explains, one of ordinary skill in the art would have recognized that the increased electron density would lead to increased collisions of the electrons with feed gas to generate additional excited or metastable atoms, increasing the excitation rate of the ground state atoms to an excited or metastable state. Ex. 1102 ¶¶ 158–159. Dr. Kortshagen also points out that such a relationship is well-known in the art, as evidenced by Kudryavtsev's Equation 2. *Id*. ¶ 159 (citing Ex. 1104, 30–31). We credit Dr. Kortshagen's testimony as it is consistent with the prior art of record.

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. Ex. 1115 ¶ 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, 6, 18, and 22.

Rationale to combine

Zond further argues 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. 23–26. To that end, Zond advances several arguments. *Id*. at 23–26, 31–36.

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. 1106, 1:36–41;

Ex. 1105 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. 1115 ¶ 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. 52–55. 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. 1101, 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. 23–25. 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. 55; Ex. 1104, 30, 34; Ex. 1102 ¶ 143. 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. 1105, 2:31–36; Ex. 1106, 2:45–56; Ex. 1101, 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. 1105, 2:43–48, Ex. 1106, 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 gas 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. 32–36. 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 ¶ 62.

Zond's argument and expert testimony, however, improperly rest on the notion that *all of the electrons*, in Angelbeck, are loss 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. 1106, 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 generator of the '779 patent" if it were modified by Angelbeck and Pinsley. PO Resp. 23–26 (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. 23–26. 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 using a magnet for generating a magnetic field to trap electrons in a plasma apparatus was well-known in the art at the time of the invention. Pet. 52–55. 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. 1105, 2:43–48; Ex. 1106, 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. 1117, 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. 1101, 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 substantially trap electrons, in order to increase the efficiency of excitation of ground state atoms. Ex. 1102 ¶¶ 142, 159. 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 predicable 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 5, 6, 8, 19, 22, and 23 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 5, 6, 8, 19, 22, 23, and 43 are unpatentable based on the following grounds:

Claims	**Basis**	**References**
43	§ 102(b)	Iwamura
5, 6, 8, 19, 22, and 23	§ 103(a)	Iwamura, Angelbeck, and Pinsley

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 5, 6, 8, 19, 22, 23, and 43 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:

PATENT OWNER'S NOTICE OF APPEAL

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as required under 37 C.F.R. § 90.2(a).

Respectfully submitted,

Dated: December 28, 2015

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