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Paper 36
Entered: January 5, 2016

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 IPR2014-01089[1]
Patent 6,806,652 B1

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

MITCHELL, *Administrative Patent Judge.*

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

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[1] Case IPR2014-01004 has been joined with the instant *inter partes* review.

I. INTRODUCTION

We have jurisdiction under 35 U.S.C. § 6(c). This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons set forth below, we determine that Petitioners have shown, by a preponderance of the evidence, that claim 35 of U.S. Patent No. 6,806,652 B1 (Ex. 1201[2], "the '652 patent") is unpatentable under 35 U.S.C. § 103(a).

A. Procedural History

GlobalFoundries U.S., Inc., GlobalFoundries Dresden Module One LLC & Co. KG, and GlobalFoundries Dresden Module Two LLC & Co. KG (collectively, "GlobalFoundries") filed a revised Petition (Paper 4, "Pet.") seeking *inter partes* review of claim 35 ("the challenged claim") of the '652 patent. GlobalFoundries included a Declaration of Dr. Uwe Kortshagen (Ex. 1202) to support its positions. Patent Owner Zond, LLC ("Zond") filed a Preliminary Response (Paper 10, "Prelim. Resp."). Pursuant to 35 U.S.C. § 314(a), on January 6, 2015, we instituted an *inter partes* review of the challenged claim to determine if the claim is unpatentable under 35 U.S.C. § 103 as obvious over various combinations of Mozgrin, Kudryavtsev, Fahey, and Iwamura. Paper 13 ("Dec.").

Subsequent to institution, we granted a revised Motion for Joinder filed by the Gillette Company, joining Case IPR2014-01004 with the instant

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[2] Petitioners filed a revised version for each of Exhibits 1201–1214, on July 11, 2014. All citations are to the revised Exhibits, unless otherwise indicated.

trial (IPR2014-01004, Paper 14). Zond filed a Patent Owner Response (Paper 23, "PO Resp."), along with a Declaration of Larry D. Hartsough, Ph.D. (Ex. 2002) to support its positions. GlobalFoundries filed a Reply (Paper 24, "Reply") to the Patent Owner Response, along with a supplemental Declaration of Dr. Kortshagen (Ex. 1216). An oral hearing[3] was held on August 13, 2015. A transcript of the hearing is included in the record. Paper 35 ("Tr.").

B. Related Matters

GlobalFoundries indicates that the '652 patent was asserted in seven patent infringement actions in the District of Massachusetts, naming many of the Petitioners as defendants. Pet. 1; Paper 7, 1; Ex. 1214. GlobalFoundries also identifies Petitions for *inter partes* review that are related to this proceeding. Pet. 1; Paper 7, 2–3.

C. The '652 Patent

The '652 patent notes several problems with known magnetron sputtering systems, such as poor target utilization resulting from a relatively high concentration of positively charged ions in the region that results in a non-uniform plasma. Ex. 1201, 4:23–28. The '652 patent states that while increasing the power applied to the plasma may increase the uniformity and density of the plasma, doing so may significantly increase the probability of establishing an electrical breakdown condition of arcing. *Id.* at 4:31–37. The invention set forth in the '652 patent involves a plasma generation

[3] The oral arguments for the instant review and IPR2014-00861 and IPR2014-01088 were consolidated.

method that provides independent control of two or more co-existing plasmas in a system. *Id.* at 4:62–64.

One embodiment of the ’652 patent is shown in Figure 2A set forth below.

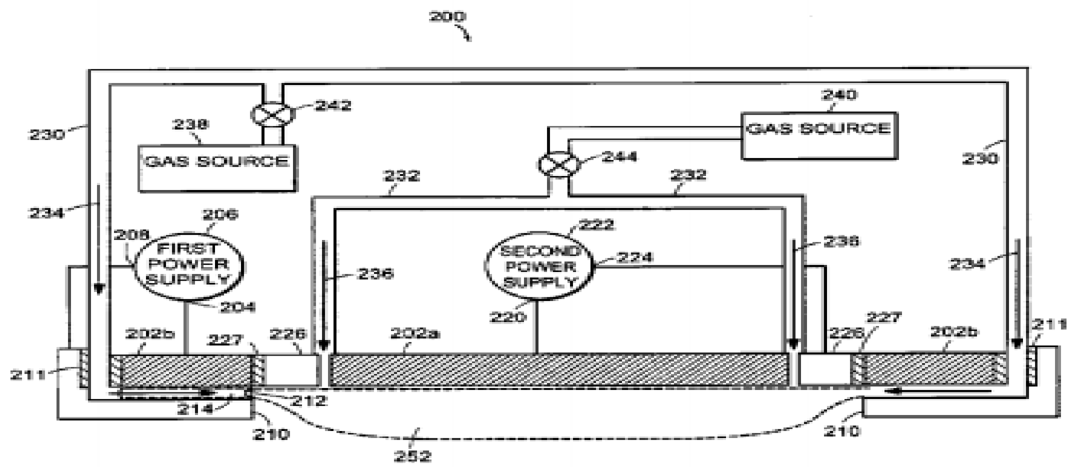

Figure 2A, reproduced above, shows a cross-sectional view of plasma generating apparatus 200 with segmented cathode 202. *Id.* at 5:43–45. Such segmented cathode has inner cathode section 202*a* and outer cathode section 202*b*. *Id.* at 5:45–47. Outer cathode 202*b* is coupled to first output 204 of first power supply 206, which can operate in a constant power mode or a constant voltage mode. *Id.* at 5:56–67. Second output 208 of first power supply 206 is coupled to first anode 210 that has insulator 211 to isolate it from outer cathode section 202*b*. *Id.* at 6:5–7.

Gap 212 is formed between first anode 210 and outer cathode section 202*b* that is sufficient to allow current to flow through region 214 within gap 212. *Id.* at 6:34–38. Gap 212 can be a plasma generator where plasma is ignited in gap 212 from feed gas 234, such as argon, fed from gas line 230. *Id.* at 6:59–61, 8:1–3, 10–11. Such an ignition condition and plasma development in the gap can be optimized by crossed electric and magnetic fields in gap 212 that trap electrons and ions improving the efficiency of the ionization process. *Id.* at 6:61–67. Gap 212 can be configured to generate excited atoms, which can increase the density of plasma, from ground state atoms. *Id.* at 6:44–46. "Since excited atoms generally require less energy to ionize than ground state gas atoms, a volume of excited atoms can generate higher density plasma than a similar volume of ground state feed gas atoms for the same input energy." *Id.* at 6:46–50.

Gap 212 facilitates high input power by having additional feed gas supplied to gap 212 that displaces some of the already developing plasma and absorbs any excess power applied to the plasma. *Id.* at 7:1–6. Such absorption prevents the plasma from contracting and terminating. *Id.* at 7:6–9. Feed gases 234, 236 are introduced into the chamber from more than one feed source, such as feed sources 238, 240, through gas lines 230, 232 that may include in-line gas valves 242, 244 to control gas flow to the chamber. *Id.* at 8:1–5. Pulsing the feed gas can help generate excited atoms, including metastable atoms, by increasing the instantaneous pressure in gap 212, while the average pressure in the chamber is unchanged. *Id.* at 8:23–28.

Second power supply 222 applies high power pulses between inner cathode section 202*a* and second anode 226 after an appropriate volume of initial plasma is present in region 252. *Id.* at 12:1–5. "The high-power pulses create an electric field 254 between the inner cathode section 202*b* and the second anode 226 that strongly-ionizes the initial plasma thereby creating a high-density plasma in the region 252." *Id.* at 12:5–9. These high power pulses from second power supply 222, which add additional power to an already strongly-ionized plasma, super-ionizes the high-density plasma in region 252. *Id.* at 11:54–57. The ’652 patent defines “super-ionized” to mean that “at least 75% of the neutral atoms in the plasma are converted to ions.” *Id.* at 5:8–10.

Figure 2B, reproduced below, shows a more detailed cross-sectional view of the segmented cathode of Figure 2A.

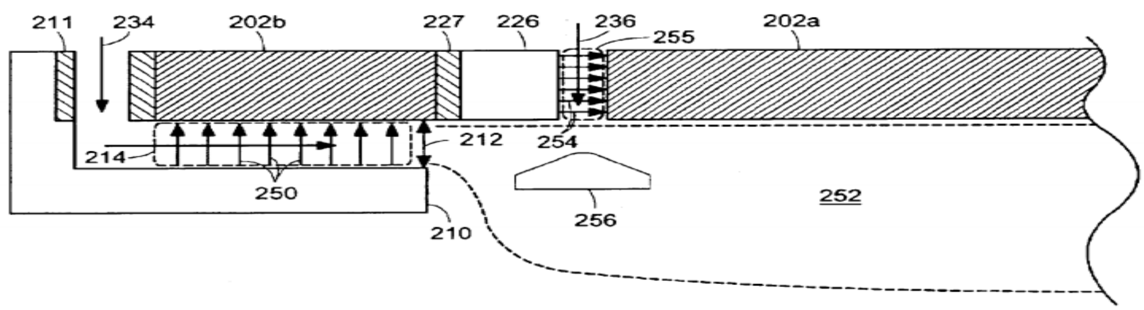

FIG. 2B

Figure 2B shows that electric fields 250, 254, which enhance the formation of ions in the plasma, can facilitate a multi-step ionization process of feed gases 234, 236, respectively, that substantially increases the rate at which the high-density plasma is formed. *Id.* at 12:50–56.

Figure 12, set forth below with GlobalFoundries’s annotations, Pet. 8, shows another embodiment of the ’652 patent.

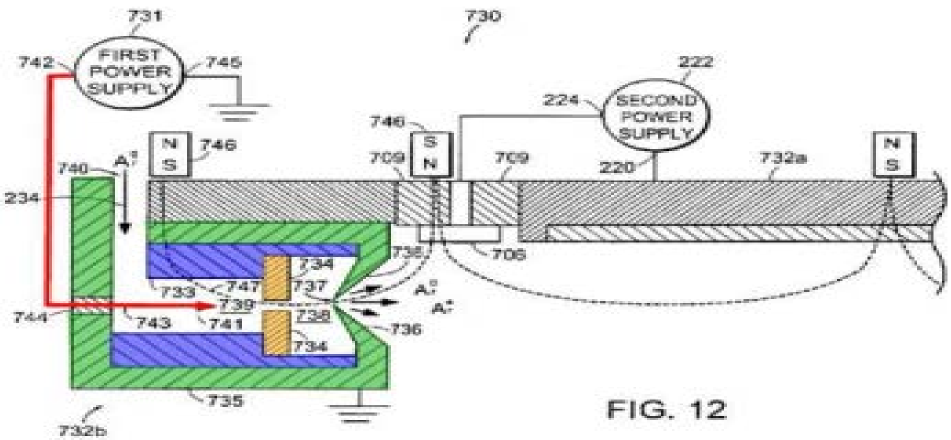

FIG. 12

Excited atom source 732*b* generates an initial plasma and excited atoms, which include metastable atoms, from ground state atoms from feed gas 234. Ex. 1201, 25:35–38. Nozzle chamber 738 traps a large fraction of ions and electrons, while excited atoms and ground state atoms flow through aperture 737 of skimmer 736. *Id.* at 27:18–21. The ’652 patent further provides:

> After a sufficient volume of excited atoms including metastable atoms is present proximate to the inner cathode section 732*a* of the cathode assembly 732, the second power supply 222 generates an electric field (not shown) proximate to the volume of excited atoms between the inner cathode section 732*a* and the second anode 706. The electric field super-ionizes the initial plasma by raising the energy of the initial plasma including the volume of excited atoms which causes collisions between neutral atoms, electrons, and excited atoms including metastable atoms in the initial plasma. The high-density collisions generate the high-density plasma proximate to the inner cathode section 732*a*. The high-density plasma includes ions, excited atoms and additional metastable atoms. The efficiency of this multi-step ionization process increases as the density of excited atoms and metastable atoms increases.

Id. at 27:22–37.

D. Challenged Claim

The single challenged claim 35 is an independent claim. Claim 35 is reproduced below.

> 35. A high-density plasma source comprising:
>
> a) means for generating an initial plasma and excited atoms from a volume of feed gas;
>
> b) means for transporting the initial plasma and excited atoms proximate to a cathode assembly; and
>
> c) means for super-ionizing the initial plasma proximate to the cathode assembly, thereby generating a high-density plasma.

Ex. 1201, 36:15–22.

E. Prior Art Relied Upon

GlobalFoundries relies upon the following prior art references:

Iwamura et al.	US 5,753,886	May 19, 1998	(Ex. 1208)

D.V. Mozgrin, et al., *High-Current Low-Pressure Quasi-Stationary Discharge in a Magnetic Field: Experimental Research*, 21 PLASMA PHYSICS REPORTS 400–409 (1995) (Ex. 1203) (“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 (Jan. 1983) (Ex. 1206) (“Kudryavtsev”).

D. W. Fahey, W. F. Parks, and L. D. Schearer, *High Flux Beam Source of Thermal Rare-Gas Metastable Atoms*, 13 J. PHYS. E: SCI. INSTRUM. 381–383 (1980) (Ex. 1205) (“Fahey”).

F. Asserted Grounds of Unpatentability

We instituted the instant trial based on the following grounds of unpatentability (Dec. 30–31):

Claim	Basis	References
35	§ 103(a)	Mozgrin, Kudryavtsev, Fahey, and Iwamura
35	§ 103(a)	Mozgrin, Iwamura, and Fahey

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). 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).

In the instant proceeding, GlobalFoundries proposed constructions for the following claim elements from challenged claim 35 that GobalFoundries construed as means-plus-function elements, invoking 35 U.S.C. 112, ¶ 6:[4] (1) "means for generating an initial plasma and excited atoms from a volume of feed gas"; (2) "means for transporting the initial plasma and excited atoms proximate to a cathode assembly"; and (3) "means for super-ionizing the initial plasma proximate to the cathode assembly." Pet. 12–17.

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 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).

We agreed that the three claim elements identified by GlobalFoundries were written in means-plus-function form and fall under 35 U.S.C. § 112, ¶ 6. Dec. 9–10. Upon review of the parties' contentions

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[4] Section 4(c) of the Leahy-Smith America Invents Act (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 '652 patent has a filing date before September 16, 2012 (effective date), we will refer to the pre-AIA version of § 112.

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. 11–19. For convenience, our claim constructions are reproduced in the table below:

Means-Plus-Function Claim Elements	**Corresponding Structures**
"means for generating an initial plasma and excited atoms from a volume of feed gas"	A chamber or gap structure containing the feed gas and a power source that applies a voltage to the feed gas. *See* Ex. 1201, 6:34–7:9 (describing Fig. 2 that includes gap 212 or region 214 defined by an outer cathode section and an anode spaced apart from the cathode sufficient to allow current to flow through region 214, and first power supply 206, which is separate from a second power supply used to super-ionize the plasma); *Id.* at 25:30–26:15 (describing Fig. 12 that includes an excited atom source 732b (cathode assembly) that has tube 733, which is surrounded by enclosure 735, that defines electrode chamber 739, in which is positioned electrode 741 connected to first power supply 731); *id.* 25:60–26:15 (describing excited atom source 732b); Dec. 11–13.
"means for transporting the initial plasma and excited atoms proximate to a cathode assembly"	A gas source with controlled flow in a contained area to achieve the transportation of the initial plasma and excited atoms. Dec. 15–16 (describing structure for transporting function as gas exchange system 238, 242 that flows gas through the outer cathode sections 202b/656b/702b/722b/732b (shown, e.g., in Figures 2, 3, 5, 6, and 12), through gap 214, toward inner cathode assembly 202a/732a); *see, e.g.*, Ex. 1201, 8:1–5 (stating in relation to Figure 2A of the '652 patent, that feed gases 234, 236 are introduced into the chamber from more than one feed source, such as feed source 238, 240, through gas lines 230, 232 that may include in-line gas valves 242, 244 to control gas flow to the chamber); 8:36–52 (describing feed gas 234 is supplied into gap 212 between outer cathode section 202*b* and first anode 210, which defines region 214, by controlling gas valve 242).

Means-Plus-Function Claim Elements	**Corresponding Structures**
"means for super-ionizing the initial plasma proximate to the cathode assembly, thereby generating a high-density plasma"	A second power supply 222 that generates an electric field across inner cathode 202a (e.g., Fig. 2A, 2B, 3, 5, and 6) or inner cathode 732a (Fig. 12); and inner anode 226 or 658 (e.g., Fig. 2A, 2B, 3, 5 and 6) or inner anode 703 (Fig. 12). Dec. 18.

Although Zond applied these constructions that we adopted in the Decision on Institution in its Patent Owner Response, PO Resp. 10, it noted some areas of disagreement with how we construed the functions associated with the means elements set forth above that we will address here.[5]

1. *"means for generating an initial plasma and excited ions from a volume of feed gas"*

Claim 35 recites "means for generating an initial plasma and excited ions from a volume of feed gas." Ex. 1201, 34:45–36:14. In its Preliminary Response, Zond proposes that the function of this claim element should be construed as "generation of both an initial plasma and excited atoms from the same volume of feed gas, wherein a feed gas is a gas that is a flowing gas." Prelim. Resp. 11. In its Patent Owner Response, Zond reiterates this

[5] Zond asserts that although it uses the constructions adopted in the Decision on Institution, it is "not waiving its right to challenge these interpretations on Appeal or in other forums." PO Resp. 10. Zond had the opportunity in its Patent Owner Response to address our tentative claim constructions set forth in the Decision on Institution, but chose not to do so, except to challenge our construction of "volume of a feed gas."

construction stating that it disagrees with our construction of "from a volume of feed gas" because our construction reads out the word "feed," and states that "the patent's pulsed gas pressure embodiment changes nothing since it too causes the gas to flow." PO Resp. 10, n.20.

Zond asserts in its Preliminary Response that the recitation of a "*volume* of feed gas" requires that both ionization and excitation occur in the *same* volume of feed gas, and that "feed gas" implies a flow of gas. Prelim. Resp. 9. In its Patent Owner Response, Zond reiterates this understanding of the meaning of "generating an initial plasma and excited ions from a volume of feed gas," by asserting as follows regarding Kudryavtsev.

> *Kudryavtsev* says that the "studied effects" are characteristic of a system in which a **field is applied** to a **pre-existing** weak plasma, i.e. an initial plasma has already been created when the electric field is applied. In the claims at issue, excited atoms are formed from a volume of feed gas at the same time as an initial plasma is being formed from the same volume of feed gas. *Kudryavtsev* does not consider this situation. The analysis deals only with the reaction of an existing plasma when an electric field is suddenly applied.

PO Resp. 17–18 (citations omitted) (emphasis added); *see also* PO Resp. 16 ("*Kudryavtsev* deals with the **reaction of an existing plasma** when an electric field is suddenly applied, and the formation of ions and excited atoms as a result of that pulse.").

As we stated in our Decision on Institution, *see* Dec. 9–10, the recitation of "feed gas" in claim 35 does not imply necessarily the flow of gas. Dec. 11.

We previously noted that the Specification of the '652 patent describes the use of in-line gas valves 242, 244 that can control the flow of gas to the chamber (Ex. 1201, 8:3–5), and also describes pulsing feed gases 234, 236 to help generate excited atoms, including metastable atoms, in gap 212 (Ex. 1201, 8:3–5, 8:23–25). *See* Dec. 10–11. Therefore, we concluded that such control of the feed gas supports the notion that "feed gas" does not necessitate a "gas that is a flowing gas." *Id.* Although we agree with Zond that this pulsed gas pressure embodiment can cause the gas to flow, it does not necessitate that the gas flow.

We also previously stated that the Specification of the '652 patent further states that feed gases may be introduced from multiple locations into the chamber. *Id.* (citing Ex. 1201, 8:1–3). We also stated that having multiple sources for feed gases does not support a construction that "a volume of feed gas" requires that the initial plasma and excited ions are generated from the *same* volume of feed gas, assuming that a particular volume of feed gas may be identified in such a process. *Id.* We discern no reason to modify our conclusions that the claim limitation does not imply necessarily the flow of gas nor does it require that the initial plasma and excited ions are generated from the same volume of feed gas.

2. "means for transporting the initial plasma and excited atoms proximate to a cathode assembly"

GlobalFoundries asserts that a plain reading of this function means that "the initial plasma with excited atoms is generated in one location (. . . in a gap or with an 'excited atom source'), and moved to another location near a cathode assembly where the plasma is super-ionized." Pet. 15. Because the structure for the previous element, "means for generating," includes a cathode, GlobalFoundries asserts that the cathode assembly which is recited in this element must be a different cathode. *Id.* at 16. GlobalFoundries notes that all embodiments shown in the figures of the ’652 patent have an “outer” and an “inner” cathode to which initial plasma is transported. *Id.*

In its Preliminary Response, Zond proposes that the function means to “transport the initial plasma and excited atoms to a region that is proximate to a cathode assembly.” Prelim. Resp. 16. Zond asserts that the claim language does not require that the cathode assembly in this element be distinct from the cathode structure that corresponds to the “means for generating” element. *Id.* at 17. Zond did not reiterate these arguments in its Patent Owner Response.

In our Decision on Institution, we noted that if the cathode assembly in this element is not distinct, however, the “means for transporting” element would appear superfluous; there would be no need to transport the initial plasma and excited atoms if the cathode assembly were the same. Dec. 14. In fact, the ’652 patent describes a plasma generation method that provides independent control of two or more co-existing plasmas in a system. *Id.* at 14–15 (citing Ex. 1201, 4:62–64). Without the two cathode assemblies, we found there would be no such independent control. *Id.* at 15. As GlobalFoundries indicates, all figures show segmented cathode assemblies with an inner and outer cathode. *See* Ex. 1201, Figures 2–12. We agreed in our Decision on Institution that the cathode assembly in the “means for transporting” element is distinct from the cathode assembly corresponding structure for the “means for generating” element. *See* Dec. 15. Neither party subsequently challenged this construction, and we see no reason to change our construction based on review of the entire record now before us.

3. "means for super-ionizing the initial plasma proximate to the cathode assembly, thereby generating a high-density plasma"

GlobalFoundries notes that the Specification of the '652 patent defines super-ionizing to mean that "at least 75% of the neutral atoms in the plasma are converted to ions." Pet. 16 (citing Ex. 1201, 5:8–10; Ex. 1202 ¶ 47). From this definition, GlobalFoundries concludes that the function should be construed as "converting at least 75% of the neutral atoms *in the initial plasma* into ions near the cathode assembly." *Id*. (emphasis added). Zond asserts that the function should be construed to mean "ionizing the plasma that is proximate to the cathode so that at least 75% of the neutrals in the original feed gas have been converted to ions." Prelim. Resp. 19.

We noted in our Decision on Institution that the recited function for the claim element at issue requires "super-ionizing the *initial* plasma," Dec. 17 (citing Ex. 1201, 36:20) (emphasis added), and that Zond's construction does not reflect this claim language. *Id.* We also noted that Zond's construction introduces a term "original feed gas" that does not appear to be used or defined in the Specification of the '652 patent; therefore, Zond's construction introduces an unnecessary ambiguity into the construction. *Id.* We also stated that GlobalFoundries's proposed construction reflects the explicit definition of "super-ionized" provided in the '652 patent Specification, and therefore, construed the recited function as "converting at least 75% of the neutral atoms in the initial plasma into ions near the cathode assembly." *Id*. Neither party challenges our construction, and we discern no reason to modify our construction based on the complete record now before us. Therefore, we construe the recited function "super-ionizing the initial plasma proximate to the cathode assembly" as "converting at least 75% of the neutral atoms in the initial plasma into ions near the cathode assembly."

B. Principles of Law

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).

In that regard, an obviousness analysis "need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 550 U.S. at 418; *see Translogic*, 504 F.3d at 1259. A prima facie case of obviousness is established when the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art. *In re Rinehart*, 531 F.2d 1048, 1051 (CCPA 1976). Notwithstanding that Dr. Hartsough provides a definition of "a person of ordinary skill in the art" in the context of the ’652 patent,[6] 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 asserted grounds of unpatentability in accordance with the above-stated principles.

C. Obviousness over, in Whole or in Part, the Combination of Mozgrin, Kudryavtsev, Fahey, and Iwamura

GlobalFoundries asserts that claim 35 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Mozgrin, Kudryavtsev, Fahey, and Iwamura, Pet. 38–42, and as obvious over the combination of Mozgrin, Fahey, and Iwamura, Pet. 50–52.

As support, GlobalFoundries provides detailed explanations as to how each claim limitation is met by the references and rationales for combining the references, as well as an initial declaration and a supplemental declaration of Dr. Kortshagen to support GlobalFoundries’s Petition and Reply, respectively. Pet. 38–42; Ex. 1202; Reply 17-25; Ex. 1216. Zond responds that these combinations do not disclose every claim element. PO Resp. 29–41.

We have reviewed the entire record before us, including the parties’ explanations and supporting evidence presented during this trial. We begin

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[6] “[A] person of ordinary skill in the art at the time of filing of the ’652 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. 2002 ¶ 17.

our discussion with a brief summary of Mozgrin, Kudryavtsev, Fahey, and Iwamura.

Mozgrin

Mozgrin discloses experimental research conducted on high-current, low-pressure, quasi-stationary discharge in a magnetic field. Ex. 1203, 400, Title. In Mozgrin, pulse or quasi-stationary regimes are discussed in light of the need for greater discharge power and plasma density. *Id.* Mozgrin discloses a planar magnetron plasma system having cathode 1, anode 2 adjacent and parallel to cathode 1, and magnetic system 3, as shown in Figure 1(a). *Id.* at 400–01. Mozgrin also discloses a power supply unit that includes a pulsed discharge supply unit and a system for pre-ionization. *Id.* at 401–02, Fig. 2. For pre-ionization, an initial plasma density is generated when the square voltage pulse is applied to the gas. *Id.*

Figure 3(b) of Mozgrin is reproduced below.

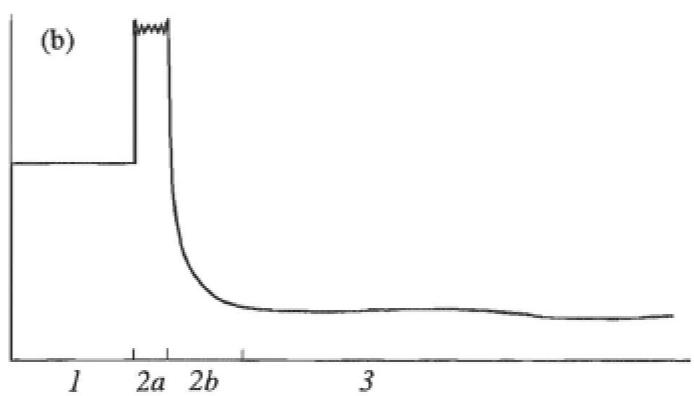


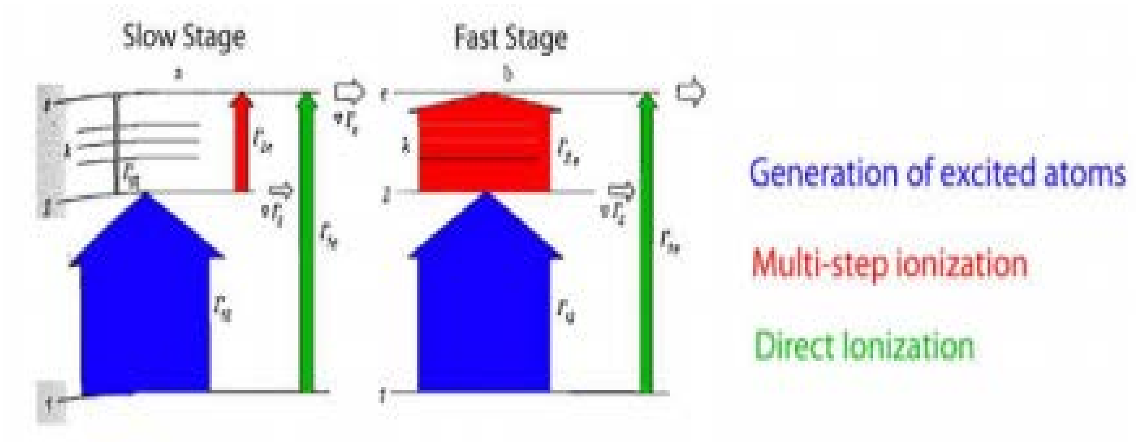
Figure 3(b) of Mozgrin illustrates an oscillogram of voltage of the quasi-stationary discharge. *Id.* at 402. In Figure 3(b), Part 1 represents the voltage of the stationary discharge (pre-ionization stage); Part 2 displays the square voltage pulse application to the gap (Part 2a), where the plasma density grows and reaches its quasi-stationary value (Part 2b); and Part 3 displays the voltage as the discharge current grows and both the voltage and discharge current attain their quasi-stationary value. *Id*. More specifically, the power supply generates a square voltage with rise times of 5–60 μs and durations of as much as 1.5 ms. *Id.* at 401.

Mozgrin further discloses the current-voltage characteristic of the quasi-stationary plasma discharge that has four different stable forms or regimes: (1) pre-ionization stage, *id*. at 401–02; (2) high-current magnetron discharge regime, in which the plasma density exceeds 2 x 10^{13} cm^{-3}, appropriate for sputtering, *id*. at 402–04, 409; (3) high-current diffuse discharge regime, in which the plasma density produces large-volume uniform dense plasmas $\eta_1 \approx 1.5 \times 10^{15}$ cm^{-3}, appropriate for etching, *id*.; and (4) arc discharge regime, *id*. at 402–04. *Id*. at 402–409, Figs. 3–7.

<u>Kudryavtsev</u>

Kudryavtsev discloses a multi-step ionization plasma process, comprising the steps of exciting the ground state atoms to generate excited atoms, and then ionizing the excited atoms. Ex. 1206, Abs., Figs. 1, 6.

Figure 1 of Kudryavtsev illustrates the atomic energy levels during the slow and fast stages of ionization. Figure 1 of Kudryavtsev is reproduced below (with annotations added by GlobalFoundries, Pet. 17).



As shown in Figure 1 of Kudryavtsev, ionization occurs with a "slow stage" (Fig. 1a) followed by a "fast stage" (Fig. 1b). During the initial slow stage, direct ionization provides a significant contribution to the generation of plasma ions (arrow Γ_{1e} showing ionization (top line labeled "e") from the ground state (bottom line labeled "1")). Dr. Kortshagen explains that Kudryavtsev shows the rapid increase in ionization once multi-step ionization becomes the dominant process. Ex. 1202 ¶ 60; Pet. 21–22.

Indeed, Kudryavtsev discloses:

> For nearly stationary n_2 [excited atom density] values . . . *there is an explosive increase in n_e* [plasma density]. The subsequent increase in n_e then reaches its maximum value, equal to the rate of excitation . . . which is several orders of magnitude greater than the ionization rate during the initial stage.

Ex. 1206, 31, right col., ¶ 6 (emphasis added). Kudryavtsev also recognizes that "in a pulsed inert-gas discharge plasma at moderate pressures . . . [i]t is shown that the electron density increases explosively in time due to accumulation of atoms in the lowest excited states." *Id.* at 30, Abs., Fig. 6.

Fahey

Fahey discloses a high-flux beam source that produces a beam of helium, neon, and argon metastable atoms. Ex. 1205, Abs. Figure 1, reproduced below, shows a beam source schematic showing Pyrex tube (A), boron nitride nozzle (B), skimmer (C), and needle or needle array (D). *Id.* at 381, right col.

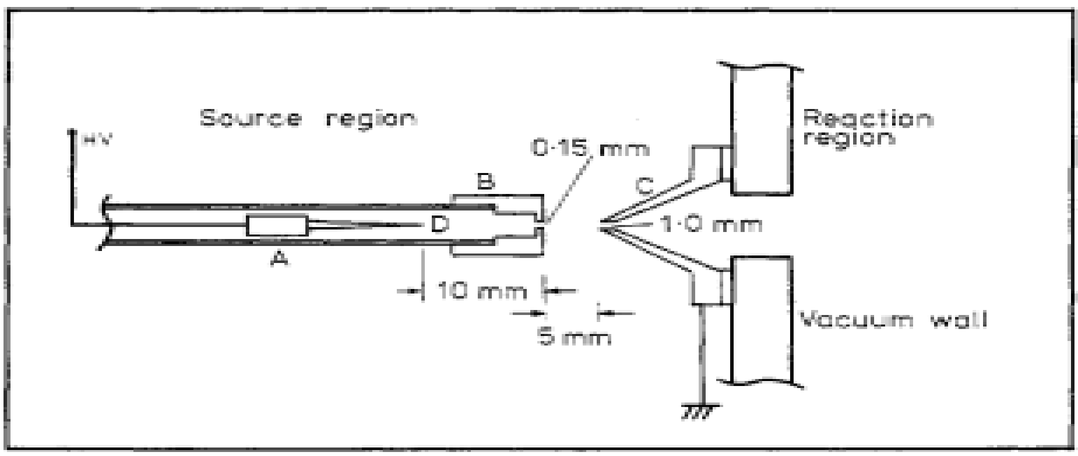
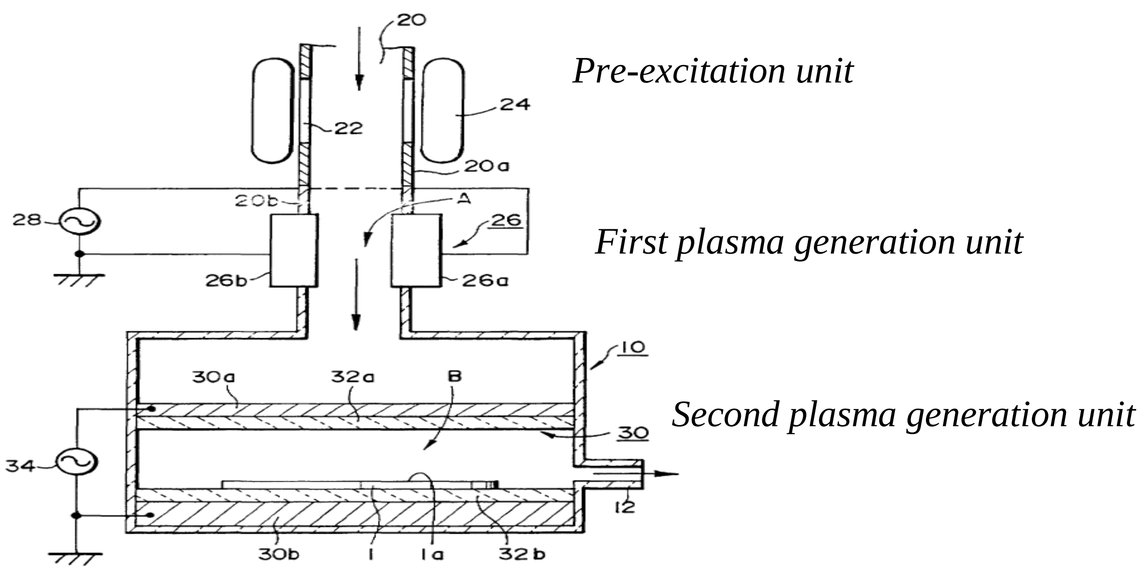


Figure 1 above shows a source that produces a low-voltage discharge between sharp needle D, which is a cathode maintained at a negative potential, and cone-shaped skimmer electrode C, which is kept at ground potential. *Id.* at 381, right col., ¶ 4; 382, left col., ¶ 2. Skimmer piece C is attached with an aluminum gasket to a vacuum wall to allow differential pumping of the source. *Id.* at 382, left col., ¶ 1. For all diagnostic measurements, a set of parallel sweep plates, maintained at an adequate voltage, is mounted after the skimmer to keep the beam free of charged species. *Id.* at 382, left col., ¶ 5. The source can provide very stable thermal energy beams of helium, neon, and argon metastable atoms. *Id.* at 381, right col., ¶ 3.

Iwamura

Iwamura discloses a plasma treatment apparatus for generating a stable plasma with a multi-step ionization process, to treat a semiconductor wafer. Ex. 1208, 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. *Id*. at 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.

“Means for Generating an Initial Plasma and Excited Atoms from a Volume of Feed Gas”

In the two grounds involved in this proceeding, GlobalFoundries relies on Fahey and Iwamura to teach alternative structures for the “means for generating an initial plasma and excited atoms from a volume of feed gas.” For instance, GlobalFoundries relies on Fahey for teaching the same functions and substantially the same structures that correspond to the “means for generating” and “means for transporting” functions as shown in Figure 12 of the ’652 patent. *See* Pet. 25–26, 38, 41; Ex. 1202 ¶¶ 68–77.

Zond asserts that GlobalFoundries improperly uses hindsight “to assemble the claimed plasma source from four prior art references that were selected with the guidance of the teachings in the ’652 patent,” PO Resp. 29, and Zond notes deficiencies in the references for what each teaches alone, *see* PO Resp. 11–28. Zond argues that Fahey does not teach or suggest “means for generating an initial plasma and excited atoms from a feed gas,” *see* PO Resp. 29–34. References must be read, however, not in isolation, but for what each fairly teaches in combination with the prior art as a whole. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). Zond does not address what the combination of references asserted by GlobalFoundries teaches, but only addresses the references individually.

Zond's arguments focus on the teachings of Fahey. GlobalFoundries asserts the following concerning Fahey.

> While many of the charged species are skimmed by Fahey's skimmer, some of the charged species will pass through the skimmer, as is said to occur in the '652 Patent. *See, e.g.*, '652 Patent at 27:18–21 ("a large fraction of the ions and electrons are trapped in the nozzle chamber 738 while the excited atoms and ground state atoms flow through the aperture 737 of the skimmer 736.") (Ex. 1201). Kortshagen Decl. ¶ 70 (Ex. 1202). Therefore, like the '652 Patent, Fahey generates both an initial plasma and excited atoms from a volume of feed gas. Kortshagen Decl. ¶70 (Ex. 1202).

Pet. 26.

Zond's argument with respect to the teachings of Fahey focuses on a lack of teaching of generation of an initial plasma and excited atoms from a volume of feed gas by pointing out that Fahey "describes a device for generating a beam of 'metastable atoms,'" where the beam is kept free from charged species because ions are removed by a set of parallel plates mounted after the skimmer. PO Resp. 19–20 (citing Ex. 1205, 382, left col., penultimate paragraph). This does not detract, however, from the teaching that Fahey's source generates plasma containing charged species, such as electrons and ions. Pet. 26; Reply 2–3; Ex. 1216 ¶¶ 54–62; Ex. 1202 ¶ 69; Ex. 1205, Introduction (describing metastable beam source, simplified by Fahey's modifications, which design employed a "weak, high-voltage *corona* discharge between a sharp needle and a cone-shaped anode") (emphasis added).

Zond also argues that Fahey was never intended as a plasma source, and "[t]o the contrary, in Fahey's metastable atom source, a plasma is in fact an undesirable by-product that Fahey's source removes from the gas flow." PO Resp. 29. As Dr. Kortshagen points out, however, Fahey discloses a high-flux beam source design *and* a diagnostic measurement setup to characterize the performance of the beam using two different detection methods. Ex. 1216 ¶ 57. It is only for the diagnostic measurements, however, that Fahey states that the beam was kept free of charged species by using parallel sweep plates mounted after the skimmer. *Id.* ¶ 59 (citing Ex. 1205, 382, left col., ¶ 5). Therefore, Dr. Kortshagen concludes that the use of the parallel sweep plates in Fahey is irrelevant to the combination that he proposes where "one of ordinary skill in the art would look to apply Fahey's high-flux beam source disclosed in Section 2, and as shown in Fig. 2.3, to generate an initial plasma and excited atoms that are then transported to Mozgrin's discharge assembly where the high-density plasma is generated from the initial plasma." *Id.* ¶ 60 (citing Ex. 1202 ¶ 78).

We agree with GlobalFoundries that Fahey's beam source, which has substantially the same structure as an embodiment in the '652 patent, teaches generating an initial plasma and excited atoms from a volume of feed gas. *See* Pet. 25–26 (citing Ex. 1202 ¶¶ 68–70; Ex. 1205).[7] Figure 12 of the '652

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[7] Zond also appears to assert that the combination does not teach "generating an initial plasma and excited ions from a volume of feed gas" because Kudryavtsev does not address circumstances where excited atoms are formed from a volume of feed gas at the same time as an initial plasma is being formed from the same volume of feed gas. PO Resp. 17–18; *see also* PO Resp. 16 (stating Kudryavtsev does not disclose details of pre-ionization process "such as whether the gas was flowing during the ionization"). As we indicated in our claim construction section above, a construction of "generating an initial plasma and excited ions from a volume of feed gas"

patent and Figure 1 of Fahey (with GlobalFoundries's annotations, Pet. 25) are reproduced below.

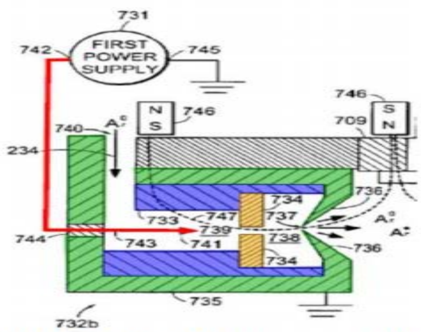

Fig. 12 of '652 Patent (partially reproduced) (Ex. 1101)

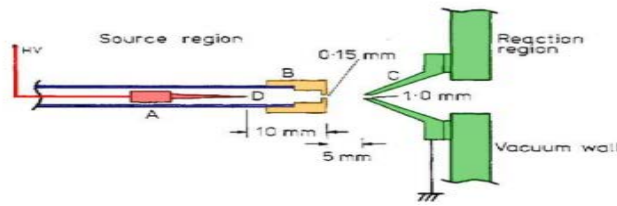

Fig. 1 of Fahey (Ex. 1105)

Figure 12 of the '652 patent shows a cross-sectional view of the plasma generating apparatus, and Figure 1 of Fahey shows a very similar beam source.

GlobalFoundries also relies on Iwamura's teaching of "a plasma device that makes use of multi-step ionization, where ultraviolet (UV) or microwave energy followed by RF energy is used as a 'pre-excitation unit' to excite the ground state gas into an excited state and then form an initial plasma in plasma region A." Pet. 43 (citing Ex. 1202 ¶ 108); Ex. 1208 1:14–19, 2:34–39. GlobalFoundries notes that Iwamura provides several embodiments for providing exciting atoms and an initial plasma (e.g., UV and RF energy, or microwave and RF energy), and "Fahey would just be a substitution of one known method and structure for providing an initial plasma and excited atoms, for another method and structure for providing an initial plasma and excited atoms." Pet. 50. Zond does not dispute that

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that requires creation of the initial plasma and excited ions from the *same* volume of feed gas that is flowing is not supported by the record. *See supra* Section II.A.1.

Iwamura teaches generating an initial plasma and excited atoms from a volume of feed gas, and we agree with GlobalFoundries that Iwamura teaches "means for generating an initial plasma and excited atoms from a volume of feed gas." *See* Ex. 1202 ¶¶ 126–128; Ex. 1208, 7:1–16; 9:39–47; Pet. 50–52.

<u>"Means for Transporting the Initial Plasma and Excited Atoms Proximate to a Cathode Assembly"</u>

Zond argues that Fahey does not teach or suggest "transporting the initial plasma and excited atoms proximate to a cathode assembly" where the initial plasma is super-ionized. PO Resp.29–31. Zond asserts that Fahey actually teaches against this claim feature. Specifically, Zond states:

> One of ordinary skill in the art would know that electrons in the region between *Fahey's* nozzle B and skimmer C would be attracted to the skimmer, and any ions in the resultant positive space charge in the region would repel each other and thus expand in the unbounded region between nozzle B and skimmer C. Ex. 2002 ¶ 64. Thus, all charged particles tend to be blocked by the skimmer, whereas the neutral metastable atoms tend to remain on-axis and pass through the skimmer into the reaction region. Any ions that make it through the skimmer are removed by a set of parallel plates mounted after the skimmer . . . .

PO Resp. 30–31.

We agree with GlobalFoundries that Fahey and Iwamura each teaches "means for transporting the initial plasma and excited atoms proximate to a cathode assembly." *See* Pet. 25–29, 38, 42–47, 50–52. For example, regarding Fahey GlobalFoundries asserts that

> Like the excited atom source in the '652 Patent, Fahey's almost identical excited atom source uses a gas exchange system to

> transport the initial plasma and excited atoms. In particular, Fahey's excited atom source admits additional gas that pushes the initial plasma and excited atoms out of the excited atom source. Additionally, Mozgrin has a ring anode and a circular cathode spaced apart to define a discharge gap. When Fahey is combined with Mozgrin, this results in a beam of excited/metastable atoms of helium, neon, or argon that would be directed to Mozgrin's cathode assembly.

Pet. 29–30 (citations omitted), 38–42; *see* Ex. 1202 ¶ 78; Ex. 1216 ¶¶ 54–62. We also note as GlobalFoundries explained, *see* Pet. 26, like Fahey's excited atom source, the similar excited atom source of Figure 12 of the '652 patent also has a "nozzle chamber 738 [that] traps a large fraction of ions and electrons, while excited atoms and ground state atoms flow through aperture 737 of skimmer 736." Ex. 1201, 27:18–21.

Dr. Kortshagen notes in his Supplemental Declaration that it is immaterial that for diagnostic purposes the beam of Fahey was kept free of charged species by using parallel sweep plates mounted after the skimmer. Ex. 1216 ¶ 60. Dr. Kortshagen did not propose combining the teaching of the diagnostic equipment of Fahey with Mozgrin's teachings (*see* Ex. 1202 ¶¶ 61, 68–77); Dr. Kortshagen opines that "one of ordinary skill in the art would look to apply Fahey's high-flux beam source disclosed in Section 2, and as shown in Fig. 2.3 [of Fahey], to generate an initial plasma and excited atoms that are then transported to Mozgrin's discharge assembly where the high-density plasma is generated from the initial plasma," (Ex. 1216 ¶ 60 (citing Ex. 1202 ¶ 78)).

We agree with GlobalFoundries and credit Dr. Kortshagen's testimony in which he relies on Fahey's teaching of a gas exchange system to transport the initial plasma and excited atoms. Given the evidence before us, we do not discern that Fahey criticizes, discredits, or otherwise discourages transporting an initial plasma and excited atoms proximate to a cathode assembly. *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."). We agree that Fahey teaches "means for transporting the initial plasma and excited atoms proximate to a cathode assembly."

Zond states that Iwamura teaches using an activated gas species, rather than a super-ionized plasma, to treat a substrate to avoid damage to the substrate. PO Resp. 27–28. Such a teaching, Zond asserts, suggests the opposite of what GlobalFoundries contends Iwamura teaches. *Id*.

> In fact, rather than increase the density of ions in an initial plasma, *Iwamura* proposes an embodiment that removes ions so that "only neutral activated gas species are directed toward the object to be treated. This prevents charging and damage to the object to be treated cause by exposure to ions." Thus, *Iwamura* does not suggest the desirability of transporting an initial plasma and excited atoms to a cathode assembly (or other region) for super-ionizing the initial plasma to thereby generate a high-density plasma. Indeed, if anything *Iwamura* appears to suggest the opposite inasmuch as *Iwamura* specifically indicates that the power supplied to the plasma in region B should be lower than that supplied in region A (where the initial plasma is generated), and that it is desirable to remove ions

> from the activated gas transported to region B so that "only neutral activated gas species are directed toward the object to be treated."

PO Resp. 28–29 (citing Ex. 2002 ¶ 81; Ex. 1208, 4:50–53, 9:11–12, 25–26).

We additionally agree with GlobalFoundries, however, that Iwamura also teaches this limitation. *See* Pet. 52 (citing Ex. 1202 ¶ 129). Zond's argument concerning Iwamura is based on one embodiment of Iwamura that teaches using ion capture electrodes in situations where an object to be treated is sensitive to damage by ions (Ex. 2003, 61:15–63:11; *see also* Ex. 1217, 130:8–132:15 (acknowledging Figure 9, which has ion captured electrodes, is a separate embodiment in Iwamura from Figure 1, which does not have such electrodes)), but the improved uniformity of the downstream plasma formed by Iwamura's methods "is caused by the activated species or the activated gas which is in an ionized or near ionized state and derives from the upstream plasma generation unit" (*see* Ex. 1208, Abs., 1:6–14, 234–41; Ex. 2003, 63:6–65:3).

Referring to Figure 1, Iwamura teaches moving the initial plasma and excited atoms from where they were generated in the pre-excitation unit and the first plasma generation unit to a location near a cathode assembly in the second plasma generation unit in treatment chamber 10. *See* Ex. 1202 ¶¶ 116–117, 129; Ex. 1208, 2:5–7; 7:48–50; 7:66–8:9. Therefore, Iwamura, as well as Fahey, teaches the limitation of "means for transporting the initial plasma and excited atoms proximate to a cathode assembly."

“Means for Super-Ionizing the Initial Plasma Proximate to the Cathode Assembly, Thereby Generating a High-Density Plasma”

Zond asserts that neither combination of Mozgrin, Kudryavtsev, Fahey, and Iwamura, or Mozgrin, Iwamura, and Fahey teaches or suggests “means for super-ionizing an initial plasma proximate to the cathode assembly, thereby generating a high-density plasma” as required by the challenged claim. PO Resp. 1. Specifically, Zond states that Dr. Kortshagen’s testimony, at best, only shows “the percentage of ions in the *final, high-density* plasma of *Mozgrin* without regard to the percentage of neutral atoms in the initial plasma that are ionized.” *Id.* at 2; *see id*. at 32–33. Zond’s argument relies on Dr. Hartsough’s explanation that

> The initial neutral gas (the volume of feed gas) is acted upon by “an excited atom source that generates an initial plasma and excited atoms from [that] volume of feed gas.” As a result, there are fewer neutral atoms remaining in the initial plasma than in the original volume of feed gas. It is 75% of these, fewer in number, neutral atoms that are then converted into ions, through super-ionization, so as to generate the high-density plasma as claimed. Dr. Kortshagen’s computations fail to address this requirement and, instead, address only the ionization degree of the high-density plasma, without regard to the percentage of neutrals in the initial plasma that are converted.

Ex. 2002 ¶ 85; *see* PO Resp. 34. Notably, Zond does not disagree that Mozgrin discloses super-ionization of a plasma. *See* Reply 11; PO Resp. 13 (stating “the pre-ionized gas created by *Mozgrin*’s DC voltage apparently remains in the same location when *Mozgrin’s* High-Voltage component superimposes the voltage pulse across the electrodes to thereby grow the density of the pre-ionized gas”).

GlobalFoundries responds that the number of ions present in the initial plasma is so much less than the number of ions present in the high-density plasma, some six to eight orders of magnitude less, as to make the initial plasma's ion contribution negligible when calculating the degree of ionization of the high-density plasma. Reply 12 (citing Ex. 1202 ¶ 88; Ex. 1216 ¶ 37–38); Ex. 1216 ¶¶ 35–40. For instance, Mozgrin explicitly states that a degree of ionization approaching 1 was observed, wherein ~100 percent of the neutral gas atoms are ionized (*see* Reply 5 (citing Ex. 1216 ¶¶ 32–34; Ex. 1217, 124:12–23)), indicating a super-ionized plasma. Reply 22. GlobalFoundries further asserts that Mozgrin discloses the same two-step process for generating a high-density plasma as disclosed in the '652 patent, specifically, power pulse characteristics that fall within the ranges in the '652 patent. *Id.* at 22 (citing Ex. 1216 ¶¶ 19–30, 88).

We agree with GlobalFoundries that Mozgrin does indeed disclose "means for super-ionizing the initial plasma proximate to the cathode assembly, thereby generating a high-density plasma." In addition to the detailed explanation of how Mozgrin teaches creating a high density plasma by super-ionizing the initial plasma, *see* Pet. 4–17, 20–22; Ex. 1202 ¶¶ 84–97, Dr. Kortshagen further explains in his Supplemental Declaration, in response to Zond's arguments, that Mozgrin discloses power levels and pulse characteristics that fall within the ranges disclosed in the '652 patent for first generating an initial plasma and then applying a high-power pulse to increase the plasma density. Reply 9 (citing Ex. 1216 ¶¶ 24–28). Dr. Kortshagen summarized his comparison of the '652 patent and Mozgrin in the table below.

	'652 Patent	Mozgrin
Generating the **initial plasma**	Applied Power: 10W to 100kW. '652 Patent at 17:67-18:1. Resulting Plasma Density: 10^7 to 10^{12} cm^{-3}. '652 Patent at 8:60-62.	Applied Power: 52W to 56W. Mozgrin at p. 402, right col. ¶ 3. Resulting Plasma Density: 10^9 – 10^{11} cm^{-3}. Mozgrin at p. 402, right col. ¶ 2.
Generating the **high-density plasma**	High-Power Pulse: 1kW to 1MW. '652 Patent at 18:10-12. Pulse Rise Time: 0.1μs to 10s. '652 Patent at 18:16-18. Pulse Duration: 0.1μs to 10s. '652 Patent at 18:22-24. Resulting Plasma Density: Greater than 10^{12} cm^{-3}. '652 Patent at 10:57-63.	High-Power Pulse: 100kW. Mozgrin at p. 404, right col. ¶ 2. Pulse Rise Time: 5μs to 60μs. Mozgrin at p. 401, right col. ¶ 1. Pulse Duration: 50μs. Mozgrin at Fig. 3; p. 401, right col. ¶ 1. Resulting Plasma Density: 1.5 x 10^{15} cm^{-3}. Mozgrin at p. 404, right col. ¶ 2.

Ex. 1216 ¶ 29.

From this comparison of the applied power and resulting plasma density for the generation of an initial plasma and the comparison of the high-power pulse, including the pulse rise time and duration, and the resulting plasma density for the generation of the high-density plasma as shown in the table above, Dr. Kortshagen concludes that "Mozgrin expressly teaches generating a high-density plasma from an initial plasma under the conditions and parameters that the '652 patent discloses will super-ionize the initial plasma to generate a high-density plasma." Ex. 1216 ¶ 30; *see also* Ex. 1202 ¶ 87 (explaining that Mozgrin discloses embodiments and parameters that result in at least 75% of the neutral atoms in the plasma being converted to ions as required by claim 35).

We also agree with GlobalFoundries, as Dr. Kortshagen explains, that Mozgrin *expressly* confirms super-ionizing the initial plasma to create a high density plasma. *See* Ex. 1216 ¶¶ 31–34. Dr. Kortshagen explains that Mozgrin discloses an ionization degree that approaches 100 percent for the transition between regime 2 and 3, an assessment with which Dr. Hartsough agrees. *Id.*; Ex. 1217, 112:12–124:23. At a level of ionization approaching 100 percent, Mozgrin discloses super-ionization of an initial plasma.[8] *See* Ex. 1202 ¶ 88 (concluding "if Mozgrin's neutral gas density were about 2.0×10^{15} atoms cm^{-3}, then at least 75% of the neutral argon gas would have been ionized").

Rationale to Combine

In providing a rationale to combine the references for the combinations of Mozgrin, Kudryavtsev, Fahey, and Iwamura, GlobalFoundries states that

> To summarize, Mozgrin and Kurdyavtsev teach the step of super-ionizing, including teaching desirability of achieving high plasma density with multi-step ionization of a gas, such as argon, that would be considered "super-ionized". Fahey provides a structure that is substantially the same as the disclosed embodiment in the '652 patent at Figure 12, and thus discloses the steps of generating and transporting an initial plasma that includes an enhanced level of excited atoms. Iwamura teaches the desirability of providing an initial plasma

[8] Dr. Hartsough questions Dr. Kortshagen's computations concerning Mozgrin, asserting that "*Mozgrin* does not control pressure of his fill gas, so as temperature rises, pressure will rise." Ex. 2002 ¶ 13. We credit Dr. Kortshagen's testimony (*see* Ex. 1202 ¶¶ 84–97; Ex. 1216 ¶¶ 35–53) and agree with GlobalFoundries, however, that Mozgrin does control its sputtering chamber pressure, but even if Mozgrin does not, Dr. Kortshagen's analysis demonstrates that Mozgrin teaches super-ionizing its initial plasma. *See* Reply 11–15.

> with excited atoms using one of several methods. The method of Fahey would have been just another method that could have been used rather than the ones shown specifically in Iwamura. Iwamura does not indicate that the methods disclosed (UV, microwave, and/or RF) are particularly critical or necessary, so a person of ordinary skill would have understood that other approaches like Fahey could have been implemented. Thus, the combination of Mozgrin, Kudryavtsev, Fahey, and Iwamura would have been obvious because it was nothing more than the combination of familiar elements according to known methods to achieve predictable results.

Pet. 41–42 (citing Ex. 1202 ¶¶ 105–106); *see also* Pet. 51–52 (addressing the reasons to combine Mozgrin, Fahey, and Iwamura).

Zond takes issue with GlobalFoundries's conclusion that Iwamura suggests the desirability of a two-step process in which an initial plasma is super-ionized. PO Resp. 34–36. Specifically, Zond asserts that Iwamura's second energy step is to *reduce* the power supplied to the plasma and proposes to remove charged particles in the second stage, and would not suggest combining the teachings of Fahey with Mozgrin to suggest "means for providing an initial plasma (mixed with excited atoms) to a super-ionization means, wherein 75% of the neutrals in the transported initial plasma are converted to ions." PO Resp. 35–36.

GlobalFoundries notes that Zond's argument is based on the teaching of a single embodiment in Iwamura that includes an ion capture electrode, which should not be read to limit what is taught in Iwamura. *See* Reply 23. GlobalFoundries also argues that a lower power in a second power-supplying step does not teach away from an energy-providing second step where super-ionization occurs, because it is generally understood that excited atoms, such as found in an initial plasma, require less energy to ionize than ground state atoms. *Id.* at 24 (citing Ex. 1201, 27:55–60; Ex. 1217, 69:22–25; Ex. 1216 ¶¶ 73–74).

Given the evidence before us, we do not discern that Iwamura criticizes, discredits, or otherwise discourages investigation into using a two-step process in which an initial plasma with excited atoms is formed in a first step, followed by an energy-providing second step. *See In re Fulton*, 391 F.3d at 1201 (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 at446 n.3 ("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 Mozgrin, Kudryavtsev, and Fahey with Iwamura or Mozgrin and Fahey with Iwamura. We agree with GlobalFoundries that Iwamura suggests to a person or ordinary skill in the art the combination of Mozgrin (and Kudryavtsev) with Fahey to create an initial plasma and then to super-ionize the initial plasma to create a high density plasma as required by claim 35.

<u>Conclusion</u>

For the foregoing reasons, we determine that GlobalFoundries has demonstrated by a preponderance of the evidence that claim 35 is unpatentable over the combination of Mozgrin, Kudryavtsev, Fahey, and Iwamura, and the combination of Mozgrin, Fahey, and Iwamura.

III. CONCLUSION

For the foregoing reasons, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that claim 35 is *unpatentable* based on the following grounds:

Claim	**Basis**	**References**
35	§ 103(a)	Mozgrin, Kudryavtsev, Fahey, and Iwamura
35	§ 103(a)	Mozgrin, Iwamura, and Fahey

IV. ORDER

For the foregoing reasons, it is

ORDERED that claim 35 of the ’652 patent is 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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