UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioners

v.

ZOND, LLC
Patent Owner

Case No. IPR2014-00819[1]

Patent 6,853,142 B2

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

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[1] Cases IPR 2014-00867, IPR 2014-01014, and IPR 2014-01046 have been joined with the instant proceeding.

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 2014-00819, concerning U.S. Patent 6,853,142 ("the '142 patent"), entered on September 25, 2015, attached hereto as Appendix A.

ISSUES TO BE ADDRESSED ON APPEAL

A. Whether the PTAB erred in finding claims 21, 24, 26-28, 31, 32, 37, and 38 unpatentable as being obvious under 35 U.S.C. § 103 in view of U.S. Pat. 6,413,382 to Wang ("Wang") and 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) ("Kudryavetsev")?

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: November 23, 2015

/Tarek N. Fahmi/
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APPENDIX A

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Paper 47
Entered: September 25, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

ZOND, LLC,
Patent Owner.

Case IPR2014-00819[1]
Patent 6,853,142 B2

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

TURNER, *Administrative Patent Judge*.

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

[1] Cases IPR2014-00867, IPR2014-01014, and IPR2014-01046 have been joined with the instant *inter partes* review.

I. INTRODUCTION

Taiwan Semiconductor Manufacturing Company, Ltd. and TSMC North America Corporation (collectively, "TSMC") filed a Petition requesting an *inter partes* review of claims 21, 24, 26–28, 31, 32, 37, and 38 of U.S. Patent No. 6,853,142 B2 (Ex. 1201, "the '142 Patent"). Paper 2 ("Pet."). Patent Owner Zond, LLC ("Zond") filed a Preliminary Response. Paper 8 ("Prelim. Resp."). We instituted the instant trial on October 20, 2014, pursuant to 35 U.S.C. § 314. Paper 9 ("Dec.").

Subsequent to institution, we granted the revised Motions for Joinder filed by other Petitioners (collectively, "GlobalFoundries") listed in the Caption above, joining Cases IPR2014-00867, IPR2014-01014, and IPR2014-01046 with the instant trial (Papers 12–14), and also granted a Joint Motion to Terminate with respect to TSMC (Paper 32). Zond filed a Response (Paper 26 ("PO Resp.")), and GlobalFoundries filed a Reply (Paper 39 ("Reply")). Oral hearing[2] was held on June 12, 2015, and a transcript of the hearing was entered into the record. Paper 46 ("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) and 37 C.F.R. § 42.73. For the reasons set forth below, we determine that GlobalFoundries has shown, by a preponderance of the evidence, that claims 21, 24, 26–28, 31, 32, 37, and 38 of the '142 Patent are unpatentable under 35 U.S.C. § 103(a).

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[2] The hearings for this review and the following *inter partes* reviews were consolidated: IPR2014-00807, IPR2014-00808, IPR2014-00818, IPR2014-00821, IPR2014-00827, IPR2014-01098, IPR2014-01099, and IPR2014-01100.

A. Related District Court Proceedings

The parties indicate that the '142 Patent was asserted in numerous proceedings in Massachusetts: 1:13-cv-11570-RGS (*Zond v. Intel*); 1:13-cv-11577-DPW (*Zond v. AMD, Inc.*); 1:13-cv-11581-DJC (*Zond v. Toshiba Am. Elec. Comp. Inc.*); 1:13-cv-11591-RGS *(Zond v. SK Hynix, Inc.)*; 1:13-cv-11625-NMG (*Zond v. Renesas Elec. Corp.*); 1:13-cv-11634-WGY (*Zond v. Fujitsu*); and 1:13-cv-11567-DJC (*Zond v. The Gillette Co.*). Pet. 1; Paper 5.

B. The '142 Patent

The '142 Patent relates to methods and apparatus for generating high-density plasma. Ex. 1201, Abs. At the time of the invention, sputtering was a well-known technique for depositing films on semiconductor substrates. *Id*. at 1:16–24. The '142 Patent indicates that prior art magnetron sputtering systems deposit films having low uniformity and poor target utilization (the target material erodes in a non-uniform manner). *Id*. at 3:32–36. To address these problems, the '142 Patent discloses that increasing the power applied between the target and anode can increase the uniformity and density in the plasma. *Id*. at 3:37–44. However, increasing the power also "can increase the probability of generating an electrical breakdown condition leading to an undesirable electrical discharge (an electrical arc) in the chamber 104." *Id*.

According to the '142 Patent, forming a weakly-ionized plasma substantially eliminates the probability of establishing a breakdown condition in the chamber when high-power pulses are applied between the cathode and anode. *Id*. at 6:21–30. Once the weakly-ionized plasma is formed, high-power pulses are applied between the cathode and anode to generate a strongly-ionized plasma from the weakly-ionized plasma. *Id*. at 7:23–36. The '142 Patent also discloses that the provision of the feed gas to the plasma allows for homogeneous diffusion of the feed gas in the weakly-ionized plasma and allows for the creation of a highly uniform strongly-ionized plasma. *Id*. at 6:31–35.

C. Illustrative Claims

Of the challenged claims, claims 21 and 31 are the only independent claims. Claims 24, 26–28, 32, 37, and 38 depend, directly or indirectly, from claim 21 or 31. Claims 21 and 31, reproduced below, are illustrative:

> 21. An apparatus for generating a strongly-ionized plasma, the apparatus comprising:
>
> an anode;
>
> a cathode that is positioned adjacent to the anode and forming a gap there between;
>
> an ionization source that generates a weakly-ionized plasma proximate to the cathode, the weakly-ionized plasma reducing the probability of developing an electrical breakdown condition between the anode and the cathode; and
>
> a power supply that produces an electric field across the gap, the electric field generating excited atoms in the weakly-ionized plasma and generating secondary electrons from the cathode, the secondary electrons ionizing the excited atoms, thereby creating the strongly-ionized plasma.
>
> 31. A method for generating a strongly-ionized plasma, the method comprising:
>
> ionizing a feed gas to generate a weakly-ionized plasma proximate to a cathode, the weakly-ionized plasma reducing the

> probability of developing an electrical breakdown condition proximate to the cathode; and
>
> applying an electric field across the weakly-ionized plasma in order to excite atoms in the weakly-ionized plasma and to generate secondary electrons from the cathode, the secondary electrons ionizing the excited atoms, thereby creating the strongly-ionized plasma.

Ex. 1201, 21:61–22:9, 22:40–50.

D. Prior Art Relied Upon

Based on the instituted ground, GlobalFoundries relies upon the following prior art references:

Wang US 6,413,382 July 2, 2002 (Ex. 1205)

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. 1204) (hereinafter, "Kudryavtsev").

E. Ground of Unpatentability

We instituted the instant trial based on the following ground of unpatentability (Dec. 22):

Claims	Basis	References
21, 24, 26–28, 31, 32, 37, and 38	§ 103(a)	Wang and Kudryavtsev

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,"[3] 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).

Independent claim 21 recites "the electric field generating excited atoms in the weakly-ionized plasma and generating secondary electrons from the cathode, the secondary electrons ionizing the excited atoms, thereby creating the strongly-ionized plasma," with independent claim 31 reciting a similar limitation. During the pre-trial stage of this proceeding, the parties submitted their constructions for the claim terms "a weakly-ionized plasma" and "a strongly-ionized plasma." Pet. 13–15; Prelim. Resp.

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

18–19. In our Decision on Institution, we adopted Zond's proposed constructions, in light of the Specification, as the broadest reasonable interpretation. Dec. 6–8.

Upon review of the parties' explanations and supporting evidence before us, we discern no reason to modify our claim constructions set forth in the Decision on Institution with respect to these claim terms. *Id*. Therefore, for purposes of this Final Written Decision, we construe, in light of the Specification, the claim term "a weakly-ionized plasma" as "a plasma with a relatively low peak density of ions," the claim term "a strongly-ionized plasma" as "a plasma with a relatively high peak density of ions."

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; *Translogic*, 504 F.3d at 1259. The level of ordinary skill in the art 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 ground of unpatentability in accordance with the above-stated principles.

C. Claims 21, 24, 26–28, 31, 32, 37, and 38 Obviousness over Wang and Kudryavtsev

GlobalFoundries asserts that claims 21, 24, 26–28, 31, 32, 37, and 38 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Wang and Kudryavtsev. Pet. 39–56. 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 a declaration of Dr. Kortshagen (Ex. 1202). GlobalFoundries also submitted a Declaration of Dr. Overzet (Ex. 1224) to support its Reply to Zond's Patent Owner Response.

Zond responds that the combination of prior art does not disclose every claim element. PO Resp. 36–53. Zond also argues that there is insufficient reason to combine the technical disclosures of Wang and Kudryavtsev. *Id*. at 18–36. To support its contentions, Zond proffers a Declaration of Dr. Larry D. Hartsough (Ex. 2005). Zond does not argue that elements of claim 31 are not taught or suggested by the combination of Wang and Kudryavtsev, only that there is insufficient reason to combine the references. PO Resp. 36–53.

We have reviewed the entire record before us, including the parties' explanations and supporting evidence presented during this trial. We begin our discussion with a brief summary of Wang and Kudryavtsev, address their combination with respect to the instant ground, and then we address the parties' contentions about specific claims in turn.

Wang

Wang discloses a power pulsed magnetron sputtering apparatus for generating a very high plasma density. Ex. 1205, Abs. Wang also discloses a sputtering method for depositing metal layers onto advanced semiconductor integrated circuit structures. *Id.* at 1:4–15.

Figure 1 of Wang, reproduced below, illustrates a cross-sectional view of a power pulsed magnetron sputtering reactor:

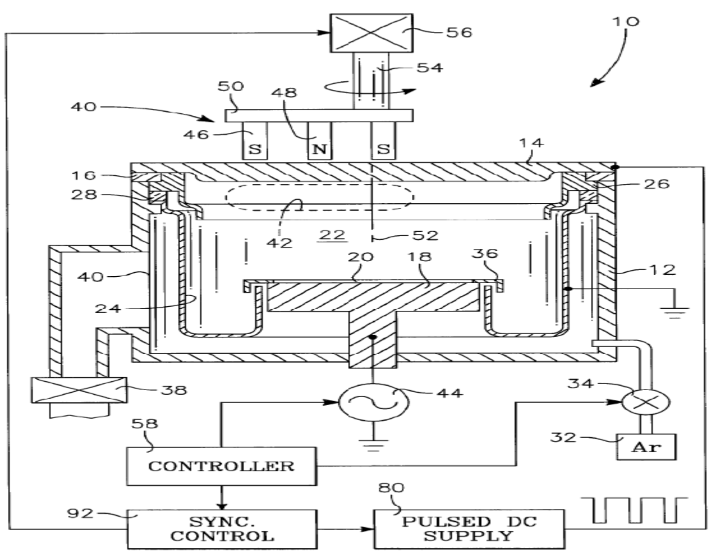


FIG. 1

Fig. 1 of Wang illustrates its magnetron sputtering apparatus.

As shown in Figure 1 of Wang, magnetron sputtering apparatus 10 has pedestal 18 for supporting semiconductor substrate 20, anode 24, cathode 14, magnet assembly 40, and pulsed DC power supply 80. *Id.* at

3:57–4:55. According to Wang, the apparatus is capable of creating high density plasma in region 42, from argon gas feed 32, through mass flow controller 34, which ionizes a substantial fraction of the sputtered particles into positively charged metal ions and also increases the sputtering rate. *Id.* at 4:5–34. Wang further recognizes that, if a large portion of the sputtered particles are ionized, the films are deposited more uniformly and effectively—the sputtered ions can be accelerated towards a negatively charged substrate, coating the bottom and sides of holes that are narrow and deep. *Id.* at 1:24–29.

Figure 6 of Wang, reproduced below, illustrates how the apparatus applies a pulsed power to the plasma:

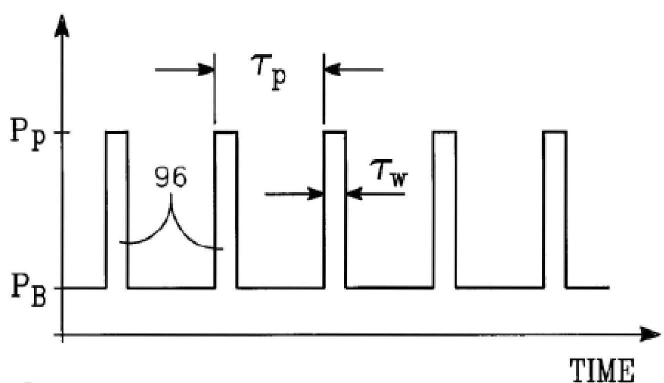


FIG. 6

Fig. 6 of Wang illustrates a representation of applied pulses.

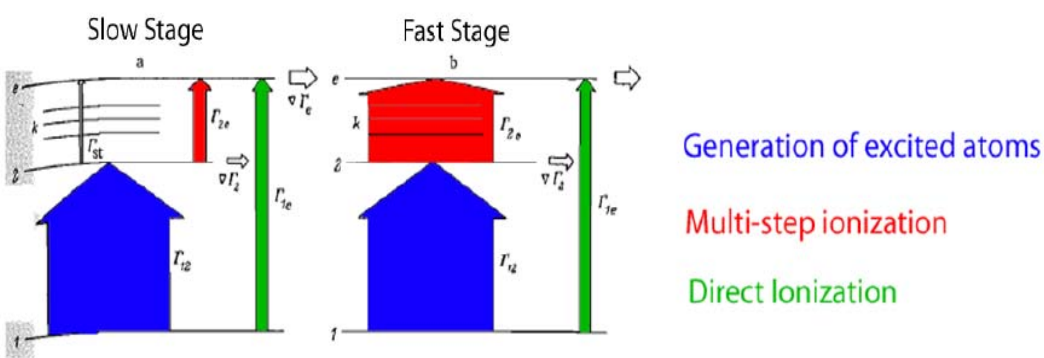
As shown in Figure 6 of Wang, the target is maintained at background power level P_B between high power pulses 96 with peak power level P_P. *Id.* at 7:13–39. Background power level P_B exceeds the minimum power necessary to support a plasma in the chamber at the operational pressure (e.g., 1kW). *Id.* Peak power P_P is at least 10 times (preferably 100 or 1000 times) background power level P_B. *Id.* The application of high peak power

P_P causes the existing plasma to spread quickly, and increases the density of the plasma. *Id*. According to Dr. Kortshagen, Wang's apparatus generates a low-density (weakly-ionized) plasma during the application of background power P_B, and a high-density plasma during the application of peak power P_P. Ex. 1202 ¶¶ 125–130; *see also* Pet. 41–43.

Kudryavtsev

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. 1204, Abs., Figs. 1, 6.

Figure 1 of Kudryavtsev (annotations added) illustrates the atomic energy levels during the slow and fast stages of ionization. Annotated Figure 1 is reproduced below:



As shown in annotated 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 ¶¶ 70–72; Pet. 22–24.

Specifically, 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. 1204, 31 (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 Abs., Fig. 6.

<u>Rationale to Combine Wang and Kudryavtsev</u>

GlobalFoundries asserts that the combination of Wang and Kudryavtsev teaches generation of excited atoms in the weakly-ionized plasma. Pet. 45–47 (citing Ex. 1202 ¶¶ 122–124). GlobalFoundries also contends that Kudryavtsev teaches that ionization proceeds in a slow stage followed by a fast stage and that excited atoms are produced in both stages, such that excited atoms would be produced in Wang's weakly-ionized plasma in response to the applied electrical pulse. *Id*. at 45–46 (citing Ex. 1202 ¶ 122). GlobalFoundries submits that it would have been obvious to one with ordinary skill in the art to adjust Wang's operating parameters (e.g., to increase the pulse length of the power and/or the pressure of the gas inside the chamber) to trigger a fast stage of ionization. *Id*. According to GlobalFoundries, triggering such a fast stage of ionization in Wang's apparatus would increase plasma density and, thereby, would increase the sputtering rate, and reduce the time required to reach a given plasma density. *Id*.

In addition, GlobalFoundries notes that the ’142 Patent admits that secondary electrons are produced in a sputtering process by collisions between ions and the cathode and those secondary electrons form ions. *Id*. at 47–48 (citing Ex. 1202 ¶ 125). As such, GlobalFoundries argues, the combination of Wang and Kudryavtsev teaches the generation of excited atoms in the weakly-ionized plasma, and the production of secondary electrons.

The parties’ dispute mainly centers on whether GlobalFoundries has articulated a reason with rational underpinning why one with ordinary skill in the art would have combined the prior art teachings. Zond argues that GlobalFoundries fails to demonstrate that one with ordinary skill in the art would have combined the systems of Wang and Kudryavtsev, to achieve the claimed invention with reasonable expectation of success or predictable results. PO Resp. 18–36.

In particular, Zond contends that it would not have been obvious to combine Wang and Kudryavtsev, arguing that Wang’s sputtering apparatus differs significantly from Kudryavtsev’s experimental apparatus. *Id*. at 27–36. Zond argues that “Kudryavtsev’s theoretical work is targeted for ‘emission mechanisms in pulsed gas lasers, gas breakdown, laser sparks, etc,’” with no magnet, but Wang discloses a pulsed magnetron sputter reactor (*id*. at 28–29 (citing Ex. 1204, 34)), that GlobalFoundries’ characterization of Kudryavtsev is incorrect and cannot serve as a rationale to combine (*id*. at 29–30), and that GlobalFoundries does not take into consideration the substantial, fundamental structural differences between the systems of Wang and Kudryavtsev—e.g., pressure, chamber geometry, gap dimensions, and magnetic fields. *Id*. at 30–34 (citing Ex. 2005 ¶¶ 67, 89–91; Ex. 1201, 1:19–20, 4:15–17, 5:38–39; Ex. 1204, 32, Fig. 3; Ex. 1205, 3:60–61, 4:35–37, 7:32–34, 57–61, Fig. 1; Ex. 2004, 14:37–50). Those arguments are not persuasive.

"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). 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." *KSR*, 550 U.S. at 420–21.

We are not persuaded by Zond's argument that applying Kudryavtsev's model on plasma behavior to Wang's sputtering apparatus would have been beyond the level of ordinary skill, or that one with ordinary skill in the art would not have had a reasonable expectation of success in combining the teachings. Obviousness does not require absolute predictability, only a reasonable expectation that the beneficial result will be achieved. *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986).

In addition, GlobalFoundries relies on Kudryavtsev for the express teaching of excitation of atoms. Pet. 46–47 (citing Ex. 1202 ¶¶ 122–124; Ex. 1204, Abs.). Kudryavtsev states that because "the effects studied in this work are characteristic of ionization *whenever a field is suddenly applied to a weakly ionized gas*, they must be allowed for when studying emission mechanisms in pulsed gas lasers, gas breakdown, laser sparks, etc." Ex. 1204, 34 (emphasis added). Wang applies pulses that suddenly generate an electric field. Ex. 1205, 7:61–63; *see* Ex. 1202 ¶ 122–123. Dr. Kortshagen testifies that performing a fast stage of ionization (as disclosed by Kudryavtsev) in Wang's apparatus would have been a combination of known techniques yielding the predictable results of increasing the ionization rate and the degree of multi-step ionization. *See* Ex. 1202 ¶ 122.

Zond has not explained persuasively why triggering a fast stage of ionization in Wang's magnetron sputtering apparatus (e.g., resulting in excitation of atoms in the weakly-ionized plasma) would have been beyond the level of ordinary skill, or why one with ordinary skill in the art would not have had a reasonable expectation of success in combining the teachings. In fact, as GlobalFoundries points out, Mozgrin[4] applied Kudryavtsev's teachings of an "explosive increase" in plasma density to a magnetron sputtering system similar to Wang's.[5] Pet. 21–26; Reply 5–6; Ex. 1203, 401. Mozgrin cites to Kudryavtsev and discloses that in "[d]esigning the unit, we took into account the dependences which had been obtained in [Kudryavtsev] of ionization relaxation on pre-ionization parameters, pressure, and pulse voltage amplitude." Ex. 1203, 401. This illustrates that one with ordinary skill in the art at the time of the invention was capable of

[4] 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).

[5] GlobalFoundries "identifies Mozgrin as an example of a person of ordinary skill in the art looking to Kudryavtsev's teachings in designing a plasma sputtering system." Reply 4; *see also Okajima*, 261 F.3d at 1355 (indicating the level of ordinary skill in the art also is reflected by the prior art of record).

applying the teachings of Kudryavtsev to magnetron sputtering systems, such as Wang's.

Given the evidence before us, we determine that GlobalFoundries has demonstrated, by a preponderance of the evidence, that combining the technical disclosures of Wang and Kudryavtsev would be merely a predictable use of prior art elements according to their established functions—an obvious improvement. *See KSR*, 550 U.S. at 417 ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond [his or her] skill.").

For the foregoing reasons, we are persuaded that GlobalFoundries has articulated a reason with rational underpinning why one with ordinary skill in the art would have combined Wang and Kudryavtsev as indicated in the Petition, and we are persuaded that GlobalFoundries' reason to combine Wang and Kudryavtsev is supported by a preponderance of evidence.

Forming a Gap Between Cathode and Adjacent Anode

Claim 21 recites, in part, "a cathode that is positioned adjacent to the anode and forming a gap there between." Zond argues that because "*Wang* does not teach that any plasma is positioned between its cathode 14 and grounded shield anode 24," Wang cannot teach the claimed gap. PO Resp. 38. Zond also argues that the floating shield precludes a finding that the cathode is positioned adjacent to the anode, as required by claim 21. *Id*. at 38–40. Zond continues that the position taken by Dr. Kortshagen relies on impermissible hindsight by asserting the obviousness of rearranging components in Wang and that Dr. Kortshagen took an entirely different position during his deposition. *Id*. at 40–42 (citing Ex. 1202 ¶ 110; Ex. 2011, 130:9–15).

GlobalFoundries, in response, counters that the testimony of Zond's expert, Dr. Hartsough, is inconsistent. Reply. 7–8. Dr. Hartsough suggests that because Wang teaches an intermediate feature, namely the floating shield, it does not disclose a gap between the anode and the cathode (Ex. 2005 ¶ 128). However, during his deposition testimony (Ex. 1228, 74:7–76:8), Dr. Hartsough acknowledged that a partially introduced electrode between a cathode and an anode *would* still allow for the cathode and anode to meet the meaning of "adjacent," and have a gap there between. *Id*. The modified figure presented to Dr. Hartsough is reproduced below.

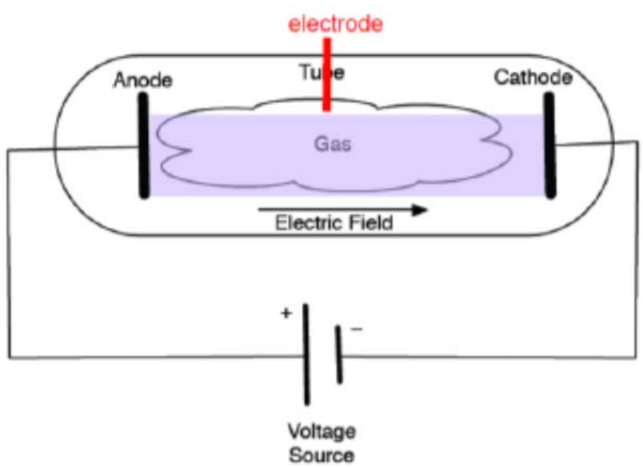


Figure 3: Simplified plasma system

Modified Fig. 3 from Dr. Hartsough's Declaration.

We find that the '142 Patent provides no specific definition for "adjacent." Additionally, even if we adopt Dr. Hartsough's definition of "adjacent," we are not persuaded that the partial imposition of the grounding shield in Wang renders the cathode and anode non-adjacent in Wang. We further concur with GlobalFoundries that Wang discloses an anode and a cathode having a gap formed there between that comports with claim 21.

Based on the evidence before us, we are persuaded that GlobalFoundries has demonstrated, by a preponderance of evidence, that the combination of Wang and Kudryavtsev discloses a cathode that is positioned adjacent to the anode and forming a gap there between.

"Quasi-Static" Electric Field

Claims 24 and 32 recite, in part, that the electric field is a quasi-static electric field. Zond argues that GlobalFoundries fails to make a proper comparison between the characteristic time of electric field variation and collision time, because GlobalFoundries instead compares the pulse width of a power pulse with a collision time. PO Resp. 42–43. Zond argues that "Wang is silent with regards to both quantities [i.e., characteristic time of electric field variation and collision time]," which is in sharp contrast to the Specification of the '142 Patent which provides ranges for the specific variables. *Id*. at 44 (citing Ex. 2005 ¶ 130; Ex. 1201, 5:21–22, 7:19–20).

As shown in Figure 7 of Wang, pulsed DC power supply 80 produces a series of voltage pulses, and portions of the voltage pulses are constant. Ex. 1205, 7:57–61. It is clear from Figure 7 of Wang that Wang's system is designed to maintain the amplitude of the voltage pulses. Based on the evidence in this record, we are persuaded that one with ordinary skill in the art would have recognized that Wang discloses portions of voltage pulses are constant. Given that it is the voltage pulses that provide the electric field, the constant portion necessarily would be quasi-static if it is longer than the collision time. *See* Ex. 1201, 7:16–19. As was explained in the Petition, the pulse width (i.e., 5 μs) is greater than the calculated collision time (i.e., 1.88 μs). Pet. 51–53.

Additionally, even if Wang presented only idealized pulses with constant voltage periods, we remain persuaded that this would be sufficient to guide one of ordinary skill in the art to maintain the constant voltage period for sufficient time to be considered quasi-static. Based on the evidence before us, we are persuaded that GlobalFoundries has demonstrated, by a preponderance of evidence, that the combination of Wang and Kudryavtsev discloses the use of a quasi-static electric field in an etching system.

Choosing the Rise Time

Claim 26 recites, in part, that "a rise time of the electric field is chosen to increase an ionization rate of the excited atoms in the weakly-ionized plasma." Zond argues that GlobalFoundries' arguments with respect to claim 26 are conclusory and not supported by Wang. PO Resp. 45–46. Zond continues that merely because an applied voltage pulse has an associated rise time, as in Wang, that does not mean that the rise time was somehow chosen to increase the ionization rate of the excited atoms in the weakly-ionized plasma, as required by claim 26.

We are not persuaded by Zond's arguments. Wang selects pulse characteristics and reactors with the goal of "producing a high fraction of ionized sputtered particles," which "has long been exploited in high-density plasma." Ex. 1205, 1:7–8, 30–37. As discussed above, Kudryavtsev discloses that, when applying a voltage pulse to generate a strongly-ionized plasma from a weakly-ionized plasma, the ionization rate will increase. Ex. 1204, 31–32. Given these disclosures, we are persuaded that one of ordinary skill in the art would have understood that the parameter of the rise time of a voltage pulse could be controlled to increase the ionization rate, and that it would have been obvious to select the rise time to achieve the goals of the cited references.

Based on the evidence before us, we are persuaded that GlobalFoundries has demonstrated, by a preponderance of evidence, that the combination of Wang and Kudryavtsev discloses controlling the voltage pulses and selecting a rise time of the voltage pulses to increase an excitation rate of ground state atoms.

Location of Strongly Ionized Plasma

Claims 27 and 38 recite, in part, that "the strongly-ionized plasma [is] substantially uniform proximate to the cathode," and claim 37 recites similarly causing "the strongly-ionized plasma to be substantially uniform in an area adjacent to a surface of the cathode." Zond argues that Wang teaches that its strongly-ionized plasma is confined to the high density plasma ("HDP") region adjacent the sputtering target, which is considerably distant from the substrate and will not result in plasma that is uniform throughout. PO Resp. 46–51. We do not agree.

Zond does not dispute that Wang's strongly-ionized plasma located in region 42, as shown in Figure 1 of Wang, is substantially uniform. *Id*. at 46–47. Zond also does not dispute that "the unbalanced magnetic field will cause the HDP region to extend into the processing space 22," thus potentially making it proximate to the substrate. *See The Gillette Co. v. Zond, LLC*, Case IPR2014-00578, Paper 39 (Patent Owner's Response), at 55. Rather, Zond's argument attempts to construe the claim term "proximate to the sputtering target" to require the plasma to be generated across *the entire area* of the sputtering target at all times. PO Resp. 46–47.

Zond's arguments are not commensurate with the scope of the claims. *See In re Self*, 671 F.2d 1344, 1348 (CCPA 1982) (stating that limitations not appearing in the claims cannot be relied upon for patentability). Zond and its expert do not direct us to where the Specification sets forth a special definition, let alone explain why such a construction would be the broadest reasonable interpretation. PO Resp. 46–51; Ex. 2005 ¶ 136. Based on our review of the Specification, we discern nothing in claims 27, 37, and 38 that would require the strongly-ionized plasma to be generated across the entire surface area of the substrate at all times.

Even if the claim requires the plasma to be substantially uniform across *the entire area* across the surface of the substrate, as urged by Zond, the combination of Wang and Kudryavtsev would have rendered such a limitation obvious. Zond's argument narrowly focuses on Wang's Figure 1 that shows the situation where the magnetron is *not rotating*. PO Resp. 47–48. In fact, Wang discloses another embodiment in which the *magnetron rotates* behind the target and moves the strongly-ionized plasma over the entire surface of the sputtering target, generating a substantially uniform plasma across the entire area proximate to the sputtering target. Ex. 1205, 4:46–51. Dr. Overzet's Declaration indicates that over time, the plasma would be uniform across the surface of the substrate based on the rotation of the magnetron. Ex. 1224 ¶ 107. We credit Dr. Overzet's testimony as it is consistent with Wang's disclosure.

Given the evidence in this record, we determine that GlobalFoundries has demonstrated, by a preponderance of evidence, that the combination of Wang and Kudryavtsev would have suggested to one with ordinary skill in the art at the time of the invention generating a substantially uniform strongly-ionized plasma proximate to the cathode, as required by claims 27, 37, and 38.

<u>Chosen Dimension of the Gap between Anode and Cathode</u>

Claim 28 requires that the dimension of the gap between the anode and cathode be chosen to increase the ionization rate of excited atoms in the weakly-ionized plasma. Zond argues that none of the cited references discusses the impact of choosing that dimension of the gap, and the equations in Kudryavtsev do not permit the selection of a dimension of the gap based on its model. PO Resp. 51–53. Additionally, Zond argues that even if a volume were specifically chosen, the cited references would suggest a preference for longer gaps between anodes and cathodes, contrary to the disclosure of the '142 Patent. *Id*. We do not agree.

Similarly to that discussed above, we are persuaded that one of ordinary skill in the art would have recognized from the teachings of Wang that certain parameters, such as the dimension of the gap between the anode and cathode, could be chosen to achieve the purpose of higher plasma density. We are also persuaded that claim 28 recites an intended use that will not limit the scope of the claim, and that nothing in claim 28 requires a specific spacing between the anode and cathode, nor does the claim require a specific ionization rate.

We are not persuaded by Zond's arguments because "a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of elements." *Mouttet*, 686 F.3d at 1332. Wang, incorporating Chiang by reference, recognizes that it was common to optimize certain parameters, including the volume between the anode and cathode, to achieve high-density plasma and desired sputtering results—e.g., depositing metals uniformly into high aspect-ratio via holes in advanced integrated circuits. Ex 1205, 1:42–51; Ex. 2004, 14:37–50 ("A series of tests were used to determine the combined effects of throw [which is the spacing between the target and substrate] and chamber pressure."). As discussed above, Kudryavtsev discloses that, when applying a voltage pulse to generate a strongly-ionized plasma from a weakly-ionized plasma, the ionization rate will increase. Ex. 1204, 31–32.

Given the evidence before us, we are persuaded that GlobalFoundries has demonstrated, by a preponderance of evidence, that it would have been obvious, in light of Kudryavtsev, to adjust Wang's anode and cathode assembly to increase the ionization rate of the excited atoms in the weakly-ionized plasma.

Conclusion

For the foregoing reasons, we conclude that GlobalFoundries has demonstrated, by a preponderance of evidence, that claims 21, 24, 26–28, 31, 32, 37, and 38 are unpatentable over the asserted combination of Wang and Kudryavtsev.

III. CONCLUSION

For the foregoing reasons, we conclude that GlobalFoundries has demonstrated, by a preponderance of the evidence, that claims 21, 24, 26–28, 31, 32, 37, and 38 of the ’142 Patent are unpatentable based on the following ground of unpatentability:

Claims	**Basis**	**References**
21, 24, 26–28, 31, 32, 37, and 38	§ 103(a)	Wang and Kudryavtsev

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 21, 24, 26–28, 31, 32, 37, and 38 of the ’142 Patent are held *unpatentable*; and

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

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing

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

Respectfully submitted,

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