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Paper 47
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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

ZOND, LLC,
Patent Owner.

Case IPR2014-00821[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*.

Opinion for the Board filed by *Administrative Patent Judge Turner*.

Opinion Dissenting-in-Part filed by *Administrative Patent Judge Stephens*.

TURNER, *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] Cases IPR2014-00863, IPR2014-01013, and IPR2014-01057 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 2, 11, 13, 14, and 16 of U.S. Patent No. 6,853,142 B2 (Ex. 1101, "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 IPR2014-00863, IPR2014-01013, and IPR2014-01057 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 2, 11, 13, 14, and 16 of the '142 Patent are unpatentable under 35 U.S.C. § 103(a).

[2] The hearings for this review and the following *inter partes* reviews were consolidated: IPR2014-00807, IPR2014-00808, IPR2014-00818, IPR2014-00819, 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 4.

B. The '142 Patent

The '142 Patent relates to methods and apparatus for generating high-density plasma. Ex. 1101, 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, all are dependent and all depend from one of claim 1 or 10. Claims 10 and 11, reproduced below, are illustrative:

> 10. A method for generating a strongly-ionized plasma in a chamber, the method comprising:
>
> ionizing a feed gas to form a weakly-ionized plasma that reduces the probability of developing an electrical breakdown condition in the chamber;
>
> supplying power to the weakly-ionized plasma by applying an electrical pulse across the weakly-ionized plasma, *the electrical pulse having a magnitude and a rise-time that is sufficient to increase the density of the weakly-ionized plasma to generate a strongly-ionized plasma*; and
>
> diffusing the strongly-ionized plasma with additional feed gas thereby allowing the strongly-ionized plasma to absorb additional energy from the power supply.
>
> 11. The method of claim 10 wherein the applying the electrical pulse across the weakly-ionized plasma excites atoms in the weakly-ionized plasma and *generates secondary electrons*, the secondary electrons ionizing the excited atoms, thereby creating a strongly-ionized plasma.

Ex. 1101, 21:13–31 (emphases added).

D. Prior Art Relied Upon

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

Lantsman	US 6,190,512 B1	Feb. 20, 2001	(Ex. 1104)
Wang	US 6,413,382 B1	July 2, 2002	(Ex. 1105)

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. 1106) (hereinafter, "Kudryavtsev").

D.V. Mozgrin, *High-Current Low-Pressure Quasi-Stationary Discharge in a Magnetic Field: Experimental Research*, Thesis at Moscow Engineering Physics Institute (1994) (Ex. 1119) (hereinafter "Mozgrin Thesis").[3]

E. Grounds of Unpatentability

We instituted the instant trial based on the following grounds of unpatentability (Dec. 32):

Claims	**Basis**	**References**
13 and 14	§ 103(a)	Wang and Lantsman
2 and 11	§ 103(a)	Wang, Lantsman, and Kudryavtsev
16	§ 103(a)	Wang, Lantsman, and Mozgrin Thesis

[3] The Mozgrin Thesis is a Russian-language reference. The citations to the Mozgrin Thesis are to the certified English-language translation submitted by GlobalFoundries (Ex. 1118).

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,"[4] 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 1 recites "the electrical pulse having a magnitude and a rise-time that is sufficient to increase the density of the weakly-ionized

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

plasma to generate a strongly-ionized plasma," with independent claim 10 reciting a similar limitation. All of the challenged claims depend from claim 1 or 10. 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. 14–15; Prelim. Resp. 20–22. In our Decision on Institution, we adopted Zond's proposed constructions, in light of the Specification, as the broadest reasonable interpretation. Dec. 8–10.

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 grounds of unpatentability in accordance with the above-stated principles.

C. Claims 2, 11, 13, 14, and 16—Obviousness over Wang and Lantsman, or Wang, Lantsman and Kudryavtsev, or Wang, Lantsman, and Mozgrin Thesis

GlobalFoundries asserts that claims 13 and 14 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Wang and Lantsman. Pet. 31–44. GlobalFoundries also asserts that claims 2 and 11 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Wang, Lantsman, and Kudryavtsev, and that claim 16 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Wang, Lantsman, and Mozgrin Thesis. Pet. 52–55, 58–60. 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. 1102). GlobalFoundries also submitted a Declaration of Dr. Overzet (Ex. 1129) to support its Reply to Zond's Patent Owner Response.

Zond responds that the combinations of prior art do not disclose every claim element. PO Resp. 41–53. Zond also argues that there is insufficient reason to combine the technical disclosures of Wang, Lantsman, and Kudryavtsev. *Id*. at 19–41. Zond also argues that GlobalFoundries has failed to demonstrate that Mozgrin Thesis was available prior to the filing date of the '142 Patent. *Id*. at 53–55. To support its contentions, Zond proffers a Declaration of Dr. Larry D. Hartsough (Ex. 2005). Zond does not argue that elements of claims 2, 11, or 16 are not taught or suggested by the combinations of Wang, Lantsman, Kudryavtsev, and Mozgrin Thesis, only that there is insufficient reason to combine the references, and that Mozgrin Thesis has not been shown to be prior art. PO Resp. 41–55.

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, Lantsman, and Kudryavtsev, address their combination with respect to the instant grounds, 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. 1105, 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:

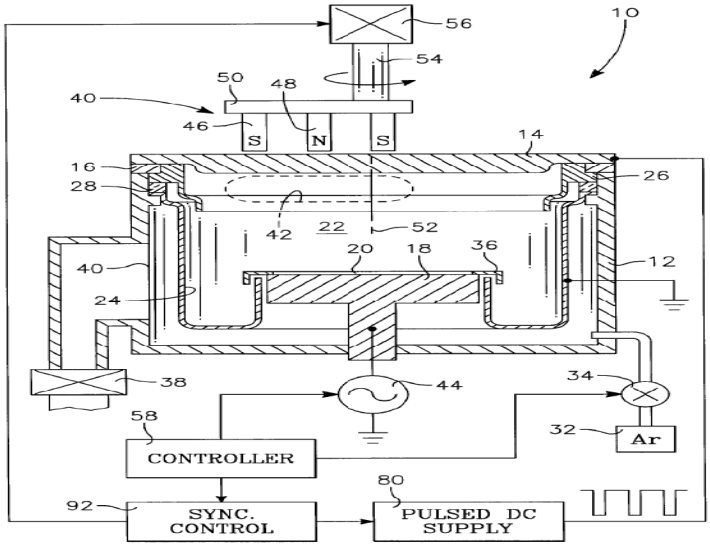


FIG. 1

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:

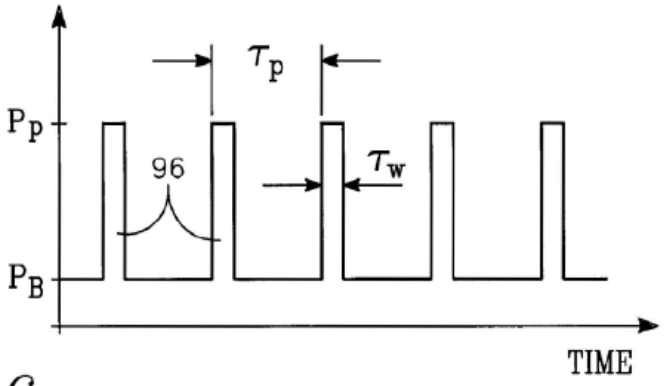


FIG. 6

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. 1102 ¶¶ 123–127, 129; *see* Pet. 31–32.

Lantsman

Lantsman discloses a plasma ignition system for plasma processing chambers having primary and secondary power supplies, used to generate a plasma current and a process initiation voltage, respectively. Ex. 1104, Abs. The primary power supply provides the primary power to electrically drive the cathode during the plasma process, and the secondary power supply supplies an initial plasma ignition voltage to "pre-ignite" the plasma so that when the primary power supply is applied, the system smoothly transitions to final plasma development and deposition. *Id*. at 2:48–51.

The system is applicable to magnetron and non-magnetron sputtering and radio frequency (RF) sputtering systems. *Id*. at 1:6–8. Lantsman also provides that "arcing which can be produced by overvoltages can cause local overheating of the target, leading to evaporation or flaking of target material into the processing chamber and causing substrate particle contamination and device damage," and "[t]hus, it is advantageous to avoid voltage spikes during processing wherever possible." *Id*. at 1:51–59.

Lantsman also discloses that "at the beginning of processing . . . gas is introduced into the chamber" and "[w]hen the plasma process is completed, the gas flow is stopped." *Id*. at 3:10–13. This is illustrated in Figure 6 of Lantsman reproduced below:

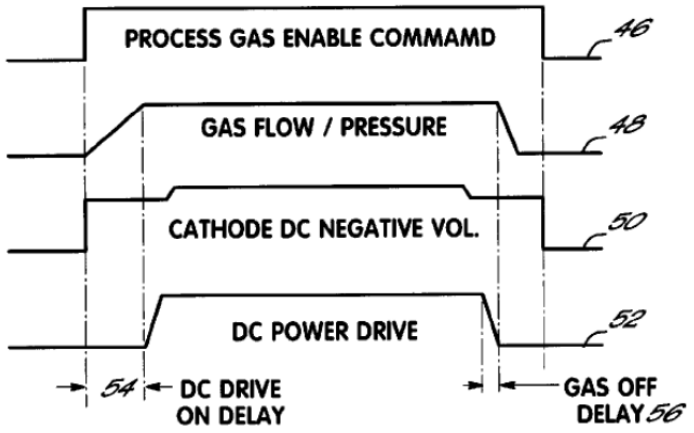


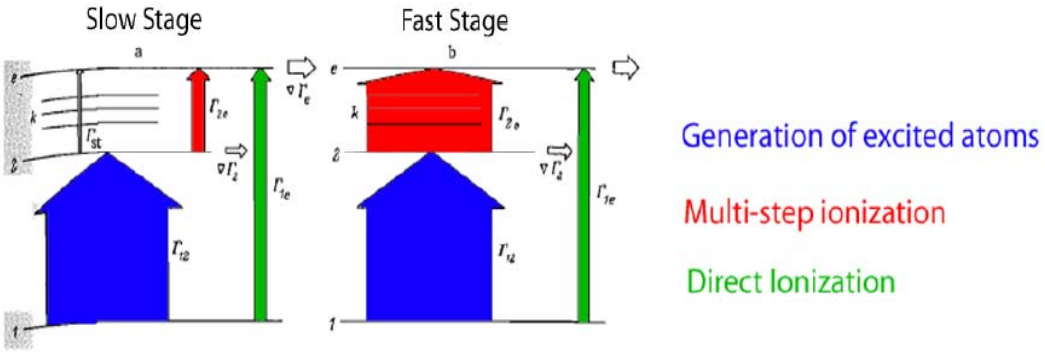
FIG. 6

Fig. 6 of Lantsman illustrates the timing of its processes. Figure 6 illustrates that the gas flow is initiated, and the gas flow and pressure begin to ramp upwards toward normal processing levels for the processing stage. *Id*. at 5:39–42.

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. 1106, 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. 1102 ¶¶ 137–138; Pet. 47–48.

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. 1106, 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.

Rationale to Combine References

GlobalFoundries asserts that it would have been obvious to have combined Wang and Lantsman to render the claims obvious. Pet. 38–40 (citing Ex. 1002 ¶¶ 113–115). GlobalFoundries discusses the suggestion of continuing to supply the feed gas in the process of Wang, and argues that this continuance is likely to occur during that disclosed process, although not expressly recited. Pet. 36–39; Ex. 1102 ¶ 111. GlobalFoundries also argues that even if Wang does not disclose maintaining the flow of the feed gases,

"[i]t would have been obvious to one of ordinary skill to continue to exchange the feed gas during Wang's application of background power and high peak power, as taught by Lantsman." Pet. 38–39. GlobalFoundries submits an ordinarily skilled artisan would have been motivated to combine Wang and Lantsman because both are directed to sputtering and both employ two power supplies, one for pre-ionization and the other for deposition. *Id*. In addition, both Wang and Lantsman are concerned with generating plasma while avoiding arcing. *Id*. GlobalFoundries also cites to the testimony of Dr. Kortshagen that the continuous flow of gas would allow for diffusion of the strongly-ionized plasma and allow for additional power to be absorbed by the plasma. *Id*. at 39–40; Ex. 1102 ¶ 114.

Additionally, with respect to Kudryavtsev, GlobalFoundries asserts that the combination of Wang and Kudryavtsev teaches the generation of excited atoms in the weakly-ionized plasma. Pet. 52–55 (citing Ex. 1102 ¶¶ 134–145). GlobalFoundries 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 52 (citing Ex. 1102 ¶ 149). GlobalFoundries also 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*. at 53. 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.* at 54.

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 55 (citing Ex. 1102 ¶¶ 154–155). 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, with respect to motivation to combine, 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, Lantsman, and Kudryavtsev, to achieve the claimed invention with reasonable expectation of success or predictable results. PO Resp. 19–41.

In particular, Zond contends that it would not have been obvious how to combine Wang and Kudryavtsev, arguing that Wang's sputtering apparatus differs significantly from Kudryavtsev's experimental apparatus. *Id*. at 33–41. 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 34–35 (citing Ex. 1106, 34)), that GlobalFoundries' characterization of Kudryavtsev is incorrect and cannot serve as a rationale to combine (*id*. at 35–36), 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 36–41 (citing Ex. 2005 ¶¶ 66, 89–91; Ex. 1101, 1:19–20, 4:10–12, 5:38–39; Ex. 1106, 32, Fig. 3; Ex. 1105, 3:60–61, 4:35–37, 7:32–34, 57–61, Fig. 1; Ex. 2004, 14:37–50).

In its Reply, GlobalFoundries responds that Zond's arguments apply statements directed to different embodiments of Wang together and attempt to physically incorporate Lantsman into Wang. Reply 2–4. GlobalFoundries also responds that one of ordinary skill in the art would have viewed Lantsman's teachings as applicable to Wang's system, based on the ordinary level of skill in the art and the similarities between Wang and Lantsman. *Id*. Additionally, GlobalFoundries continues that Zond's arguments with respect to the combination of Wang and Kudryavtsev "focus on bodily incorporat[ion]," and that "[d]ifferences in such systems are routine and a person of ordinary skill in the art would work with such differences on a regular basis, and would consider it routine to make any necessary changes to accommodate for any and all such variables." *Id*. at 4–6. Upon consideration of the evidence before us, we are persuaded by GlobalFoundries' contentions.

We are not persuaded by Zond's argument that Lantsman's, Wang's, and Kudryavtsev's apparatuses would have been viewed as significantly different, 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).

"It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical

substitution of elements." *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012); *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (en banc) (noting that the criterion for obviousness is not whether the references can be combined physically, but whether the claimed invention is rendered obvious by the teachings of the prior art as a whole). In that regard, one with ordinary skill in the art is not compelled to follow blindly the teaching of one prior art reference over the other without the exercise of independent judgment. *Lear Siegler, Inc. v. Aeroquip Corp.*, 733 F.2d 881, 889 (Fed. Cir. 1984); *see also KSR*, 550 U.S. at 420–21 (stating that a person with ordinary skill in the art is "a person of ordinary creativity, not an automaton," and "in many cases . . . will be able to fit the teachings of multiple patents together like pieces of a puzzle").

Dr. Overzet testifies that Kudryavtsev's model on plasma behavior is not intended to be limited to a particular type of plasma apparatus. Ex. 1129 ¶ 61. Indeed, Kudryavtsev discloses a study of the ionization relaxation in plasma when the external electric field suddenly increases. Ex. 1106, 30. Specifically, Kudryavtsev discloses that "the *electron density increases explosively* in time due to accumulation of atoms in the lowest excited states." *Id*. at Abs. (emphasis added). Kudryavtsev also describes the experimental results that confirm the model. *Id*. at 32–34. Moreover, Kudryavtsev expressly explains that "the effects studied in this work are characteristic of ionization *whenever a field is suddenly applied to a weakly ionized gas*." *Id*. at 34 (emphasis added).

Dr. Overzet also testifies that a person having ordinary skill in the art "would have looked to Kudryavtsev to understand how plasma would react to a quickly applied voltage pulse, and how to achieve an explosive increase

in electron density" when generating a strongly-ionized plasma for improving sputtering and manufacturing processing. Ex. 1129 ¶ 62. Dr. Overzet further explains that such an artisan would have known how to apply Kudryavtsev's model to Wang's system by making any necessary changes to accommodate the differences through routine experimentation. *Id*. ¶¶ 63–65. On this record, we credit Dr. Overzet's testimony (*id*. ¶¶ 61–65) because his explanations are consistent with the prior art of record.

As well, Dr. Overzet testifies, Lantsman states that its techniques can be applied to any plasma process, including DC magnetron sputtering, where Wang is directed to DC magnetron sputtering. Ex. 1129 ¶¶ 66–67 (citing Ex. 1104, 6:14–17). Additionally, Dr. Overzet testifies that the different processing conditions in Wang and Lantsman are routine variables that ordinarily skilled artisans would understand need to be changed to accommodate different systems and processing conditions. *Id*. ¶ 68. In addition, Dr. Overzet points out that both Lantsman and Wang "teach two stage plasma systems." *Id*. ¶ 69. Indeed, Lantsman discloses both "limited" and "substantial" plasma stages (Ex. 1104, 2:48–51, 4:58–61, 5:6), and Wang discloses plasma states that vary with the application of pulses (Ex. 1105, 7:13–39). As noted above, Wang discloses background power P_B of 1 kW (falling within the range of 0.01–100 kW, as disclosed in the '142 Patent, for generating a weakly-ionized plasma), and pulse peak power P_P of 1 MW (falling within the range of 1 kW–10 MW, as disclosed in the '142 Patent, for generating a strongly-ionized plasma). Ex. 1105, 7:19–25; Ex. 1101, 11:34–38, 12:1–8, Fig. 5. On this record, we credit Dr. Overzet's testimony (Ex. 1129 ¶¶ 66–69) because his explanations are consistent with the prior art of record.

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

Feed Gas from a Gas Line Diffusing the Strongly-ionized plasma

Claim 1 recites, in part, "a gas line that supplies feed gas to the strongly-ionized plasma, the feed gas diffusing the strongly-ionized plasma, thereby allowing additional power from the pulsed power supply to be absorbed by the strongly-ionized plasma," with independent claim 10 reciting similar subject matter. All of the challenged claims depend from either claim 1 or 10.

Zond argues that Lantsman fails to disclose generating a strongly-ionized plasma, or disclose any activity of the feed gas and plasma diffusion. PO Resp. 42–43 (citing Ex. 2005 ¶ 94). Additionally, Zond argues that Wang does not teach "the feed gas diffusing the strongly-ionized plasma" because Wang's chamber is significantly different in design from that of the '142 Patent and the feed gas in Wang "'could not possibly diffuse the strongly ionized plasma because it enters the chamber far from the strongly ionized plasma and is directed away from the strongly ionized plasma.'" *Id*. at 43–47 (citing Ex. 2005 ¶¶ 94–101). Also, Zond argues that the only motivation to diffuse the strongly-ionized plasma and allow additional power to be absorbed comes from the '142 Patent. *Id*. at 47–48. We do not find Zond's arguments to be persuasive.

First, we note that it is not essential for Lantsman to disclose a strongly-ionized plasma because Wang discloses a strongly-ionized plasma, and the specified ground of unpatentability relies on the combination of Lantsman and Wang. Second, as GlobalFoundries notes, Dr. Hartsough concedes that "the gas will tend to diffuse throughout the whole volume," including areas containing the high-density plasma. Reply 7–8; Ex. 1130, 87:22–88:9, 88:22–89:2, 92:18–93:7. Additionally, Dr. Overzet testifies that due to random thermal motion and the pressure gradient in the reaction chamber, Wang's argon gas will diffuse into the plasma near the target. Ex. 1129 ¶ 77. Lastly, Dr. Hartsough acknowledges that a feed gas was commonly used to diffuse a strongly-ionized plasma (Ex. 1130, 32:18–33:5), such that ordinarily skilled artisans would have used such a process without resort to the disclosure of the '142 Patent.

Given the evidence in this record, we determine that GlobalFoundries has demonstrated, by a preponderance of evidence, that the combination of Wang and Lantsman would have suggested to one with ordinary skill in the art at the time of the invention the provision of a feed gas to a strongly-ionized plasma, to diffuse the plasma and allow for greater absorption of power, as required by claims 1 and 10, with the challenged claims dependent thereon.

Electrical Pulse with Magnitude and Rise-Time to Generate Strongly-Ionized Plasma

Claim 1 recites, in part, "an electrical pulse having a magnitude and a rise-time that is sufficient to increase the density of the weakly-ionized

plasma to generate a strongly-ionized plasma," with claim 10 reciting similar subject matter. All of the challenged claims depend from either claim 1 or 10.

Zond argues that Wang does not teach that the magnitude and rise time of its pulses are sufficient to increase the density of weakly-ionized plasma to generate strongly-ionized plasma, as required by independent claims 1 and 10 of the '142 Patent. PO Resp. 48–49. GlobalFoundries argues that one of ordinary skill in the art would have recognized from the teachings of Wang that certain parameters, such as the magnitude or the rise time of a voltage pulse, could be chosen to generate a strongly-ionized plasma. Reply 10–11. We agree with GlobalFoundries.

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 selects pulse characteristics and reactors with the goal of "producing a high fraction of ionized sputter[ed] particles," which "has long been exploited in high-density plasma." Ex. 1105, 1: 7–8, 30–37. Therefore, we are persuaded that one of ordinary skill in the art would have understood that the parameters of the magnitude and the rise time of a voltage pulse could be controlled to achieve the desired plasma processes, and that it would have been obvious to select the magnitude and the rise time to achieve the goals of the cited references.

In addition, claim 1 is an apparatus claim and 10 is a method claim. With respect to claim 1, we are persuaded that the claim recites an intended use that will not limit the scope of the claim, such that the obviousness of claim 1 is based on whether the elements of that claim are obvious, not on

their intended use. With respect to claim 10, the method does not require an optimization of magnitude or rise time to achieve the strongly-ionized plasma, but simply that the generated electric pulse achieve that plasma state, which Wang does, as discussed above.

Based on the evidence before us, we are persuaded that GlobalFoundries has demonstrated, by a preponderance of evidence, that the combination of Wang and Lantsman renders obvious the selection of a magnitude and a rise time of the voltage pulses to generate a strongly-ionized plasma, per claims 1 and 10, with the challenged claims dependent thereon.

"Quasi-Static" Electric Field

Claim 13 recites, in part, the application of "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. 49–50. 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 quantities. *Id*. at 51 (citing Ex. 2005 ¶ 122; Ex. 1101, 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. 1105, 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. 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. 42–44.

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 Lantsman discloses the use of a quasi-static electric field in an etching system.

Selecting the Pulse Width / Amplitude

Claim 14 recites, in part, that "selecting at least one of a pulse amplitude and a pulse width of the electrical pulse in order to increase an ionization rate of the strongly-ionized plasma." Zond argues that GlobalFoundries' arguments with respect to claim 14 are conclusory and not supported by Wang. PO Resp. 51–53. Zond continues that it does not necessarily follow that ionization rate increases when the plasma density increases, because the density can increase even if the ionization rate is decreasing, constant, or increasing. *Id*.

We are not persuaded by Zond's arguments. Wang selects pulse characteristics and reactors with the goal of "producing a high fraction of ionized sputter[ed] particles," which "has long been exploited in high-density plasma." Ex. 1105, 1:7–8, 30–37. Given this disclosure, we are persuaded that one of ordinary skill in the art would have understood that the parameters of the width and the amplitude of a voltage pulse could be controlled to increase the ionization rate, and that it would have been obvious to select the width and the amplitude 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 Lantsman discloses controlling the voltage pulses and selecting the width and the amplitude of the voltage pulses to increase an excitation rate of ground state atoms, per claim 14.

Printed Publication under 35 U.S.C. § 102 – Mozgrin Thesis

We address the issue of whether the Mozgrin Thesis is available as prior art under 35 U.S.C. § 102(b)[5] for purposes of this Final Written Decision. The determination of whether a given reference qualifies as a prior art "printed publication" involves a case-by-case inquiry into the facts and circumstances surrounding the reference's disclosure to members of the public. *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). "Because

[5] Paragraph (b) of 35 U.S.C. § 102 was replaced with newly designated § 102(a)(1) when § 3(b)(1) of AIA took effect on September 16, 2012. Because the application that issued as the '142 Patent was filed before that date, we refer to the pre-AIA version of § 102.

there are many ways in which a reference may be disseminated to the interested public, 'public accessibility' has been called the touchstone in determining whether a reference constitutes a 'printed publication' bar under 35 U.S.C. § 102(b)." *In re Hall*, 781 F.2d 897, 898–99 (Fed. Cir. 1986). To qualify as a prior art printed publication, the reference must have been disseminated or otherwise made accessible to persons interested and ordinarily skilled in the subject matter to which the document relates prior to the critical date. *Kyocera Wireless Corp. v. Int'l Trade Comm'n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008).

GlobalFoundries asserts that the Mozgrin Thesis is a doctoral thesis at Moscow Engineering Physics Institute, published in 1994, and, thus, it is prior art under § 102(b). Pet. 4. To support its assertion, GlobalFoundries proffers a copy of the catalog entry for the Mozgrin Thesis at the Russian State Library, and a certified English-language translation thereof. Ex. 1120. GlobalFoundries also alleges that the Mozgrin Thesis was cataloged by the Russian State Library either by the imprint date of 1994, or at least by 1995, as shown on the catalog entry ("Catalog of Dissertations in Russian (since 1995)"). Reply 6–7. GlobalFoundries further asserts that the Russian State Library is an institution "by definition established to share the information that it houses with any interested person." *Id*. Dr. Kortshagen testifies that Mozgrin—an article that was published in 1995 (Ex. 1103)—summarizes the research presented in the Mozgrin Thesis, and contains figures created from the photographs in the Mozgrin Thesis. Ex. 1102 ¶ 161.

In its Response, Zond counters that GlobalFoundries fails to demonstrate that the Mozgrin Thesis is prior art under § 102. PO Resp. 53–

55. Zond contends that GlobalFoundries provides no evidence that the phrase "Imprint Moscow 1994" appearing on the catalog entry means that the Mozgrin Thesis was cataloged on that particular date. *Id*.

Upon consideration of the facts in the present record, we are persuaded by GlobalFoundries's contentions and supporting evidence. Although evidence establishing a *specific* date of cataloging and shelving before the critical date would have been desirable, it is not required in a public accessibility determination. *See Hall*, 781 F.2d at 899. Here, the critical date is *November 4, 2002*—the filing date of the application that issued as the '142 Patent. Ex. 1101, at (22).

The certified English-language translation of the catalog entry is reproduced below with green annotations added (Ex. 1120, 1):

Logotype of RSL **Catalog of Dissertations in Russian (since 1995)**

Full View of Record

Global Holdings	All items
Holdings	Department of dissertations (Khimki) 61 95-1/593-2
Author	**Mozgrin** Dmitriy Vitalievich
Title	High-current low-pressure quasi-stationary discharge in a magnetic field: experimental research: ph.d. thesis in physics and mathematics: 01.04.08
Imprint	Moscow 1994
Description	122 pages, illustrations
Language	Russian
Bibliography	Bibliography: pages 111-122
Subject – Other	Plasma physics and chemistry
Electronic Location	http://dlib.rsl.ru/rsl01000000000/rsl01000165000/rsl01000165287/rsl01000165287.pdf ;
Parallel record	Synopsis of a thesis

As depicted above, the catalog entry shows that it is an entry from the Russian State Library's catalog of dissertations in Russian. Ex. 1120, 2. As

we determined previously in the Decision on Institution (Dec. 6–7), the catalog entry clearly shows a publication date of 1994 ("Imprint Moscow 1994"), well before the critical date of November 4, 2002. *Id*.

Zond had the opportunity, during this trial, to object to evidence and file a motion to exclude the evidence submitted by GlobalFoundries. Zond, however, did not object under 37 C.F.R. § 42.64(b) to the admissibility of the catalog entry or the Mozgrin Thesis. Notably, Zond does not challenge the authenticity of these documents, nor allege that they constitute inadmissible hearsay. Therefore, the information set forth in the catalog entry can be relied upon by GlobalFoundries as evidence supporting its contention that Mozgrin Thesis was sufficiently accessible to the public before the critical date and it is printed publication within the meaning of § 102. Furthermore, Zond does not provide sufficient explanation or credible evidence to rebut the information disclosed in the Russian State Library's catalog entry, including the 1994 publication date. For instance, Zond does not explain why a library, such as the Russian State Library here, would take more than seven years to catalog and index a thesis.

Zond further alleges that the Mozgrin Thesis was not sufficiently accessible to be considered a printed publication under § 102. PO Resp. 53–55. According to Zond, even if the thesis had been cataloged in a library in Russia, GlobalFoundries "would not have demonstrated that the thesis could have been obtained by any interested person outside of Russia or the countries under Russia's control." *Id*. at 54.

Zond's argument is misplaced, as it is predicated on the notion that a cataloged thesis available in Russia, a foreign country, does not constitute sufficient accessibility to interested persons exercising reasonable diligence.

Zond does not cite, nor do we discern, any authority that requires a cataloged thesis to be located physically in this country. Notably, the Federal Circuit has rejected the argument that a cataloged thesis shelved at a university library in Germany does not constitute sufficient accessibility to those interested in the art exercising reasonable diligence. *Hall*, 781 F.2d at 899–900. The Federal Circuit also has held that an Australian patent application—classified and laid open to public inspection by the Australian Patent Office—was sufficiently accessible to interested persons to qualify as a prior art printed publication under § 102. *In re Wyer*, 655 F.2d 221, 225–26 (Fed. Cir. 1981). Zond does not proffer any specific explanation as to why we should treat Russia differently than any other foreign country.

Based on the evidence before us, we observe that the Mozgrin Thesis was cataloged and indexed in a meaningful way, by the author's name, the title of the thesis ("High-Current Low-Pressure Quasi-Stationary Discharge in a Magnetic Field"), and the subject matter of the thesis ("Plasma Physics and Chemistry"). Ex. 1120. As such, the catalog entry demonstrates that the Mozgrin Thesis was made available to interested persons by virtue of its title and "Subject" characterization. Upon consideration of the facts before us, we determine that the Russian State Library's catalog entry is credible evidence to establish that the Mozgrin Thesis was made sufficiently accessible to the public interested in the art before the critical date of November 4, 2002.

Based on the totality of the circumstances, we are persuaded that GlobalFoundries has established, by a preponderance of the evidence, that the Mozgrin Thesis is a printed publication under § 102.

Conclusion

GlobalFoundries does not provide additional arguments with respect to claims 2, 11, and 16. We have reviewed GlobalFoundries' arguments and evidence regarding these claims (Pet. 52–55, 58–60), and, given the evidence in the record before us, we determine that GlobalFoundries has demonstrated, by a preponderance of evidence, the unpatentability of those claims. For the foregoing reasons, we conclude that GlobalFoundries has demonstrated, by a preponderance of evidence, that claims 2, 11, 13, 14, and 16 are unpatentable over the asserted combinations of Wang, Lantsman, Kudryavtsev, and Mozgrin Thesis.

III. CONCLUSION

For the foregoing reasons, we conclude that GlobalFoundries has demonstrated, by a preponderance of the evidence, that claims 2, 11, 13, 14, and 16 of the '142 Patent are unpatentable based on the following grounds of unpatentability:

Claims	Basis	References
13 and 14	§ 103(a)	Wang and Lantsman
2 and 11	§ 103(a)	Wang, Lantsman, and Kudryavtsev
16	§ 103(a)	Wang, Lantsman, and Mozgrin Thesis

IV. ORDER

In consideration of the foregoing, it is

ORDERED that claims 2, 11, 13, 14, and 16 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.

STEPHENS, *Administrative Patent Judge, dissenting-in-part.*

I respectfully disagree with the Majority's determination that the Mozgrin Thesis is prior art under 35 U.S.C. § 102(b). For a reference to qualify as a printed publication within the meaning of § 102, "the reference must have been sufficiently accessible to the public interested in the art," before the critical date. *In re Cronyn*, 890 F.2d 1158, 1160 (Fed. Cir. 1989) (quoting *Constant v. Adv. Micro–Devices, Inc.*, 848 F.2d 1560, 1568 (Fed. Cir. 1988)).

Zond argues GlobalFoundries failed to show the Mozgrin Thesis was disseminated or otherwise made available to interested persons as a printed publication more than one year prior to the filing date of the '142 Patent. Prelim. Resp. 56–58. Specifically, Zond argues the catalog entry does not indicate the Mozgrin Thesis was available prior to the filing date of the '142 Patent. *Id.* at 57 (citing Exhibit 1120).

"Because there are many ways in which a reference may be disseminated to the interested public, 'public accessibility' has been called the touchstone in determining whether a reference constitutes a 'printed publication' bar under 35 U.S.C. § 102(b)." *In re Hall*, 781 F.2d 897, 898–99 (Fed. Cir. 1986).

I am not persuaded GlobalFoundries has shown the Mozgrin Thesis was publicly accessible *more than one year prior to the date of the application* for patent. Specifically, GlobalFoundries relies on a catalog entry from the Russian State Library's catalog of dissertations, which shows an "Imprint" of 1994. Ex. 1120, 1. GlobalFoundries asserts the Russian Library is an institution established to share information it houses with interested persons and the imprint date of 1994 and "Catalog of Dissertations

in Russian (since 1995))" on the catalog entry as evidence the Mozgrin Thesis is prior art under 35 U.S.C. § 102. Reply 6–7. However, nothing in the catalog entry speaks to the date on which the Mozgrin Thesis was incorporated into the Russian State Library's catalog of dissertations, or even that the Russian State Library catalog of dissertations existed at the time of invention. As our reviewing court has stated, "[a]lthough 'evidence establishing a *specific* date of cataloging' was not required in *Hall*, in that case we held that 'competent evidence of the general library practice' of cataloging and shelving established that the thesis became accessible prior to the critical date." *In re Lister*, 583 F.3d 1307, 1316 (Fed. Cir. 2009) (vacating and remanding the Board of Patent Appeals and Interferences' decision that a prior art reference registered with the U.S. Copyright Office and included in the Westlaw and Dialog databases was publicly accessible for the purposes of 35 U.S.C. § 102(b)). Here, neither the imprint date nor the labeling indicates the Mozgrin Thesis was publicly accessible prior to the critical date. Further, GlobalFoundries "has not identified any evidence of the general practice" of the Russian State Library with regard to catalog updates. *See id.* at 1316–17. Therefore, absent any evidence pertaining to when the Russian State Library received the Mozgrin Thesis, when the publicly accessible catalog was available, and what the general practices of the Russian State Library between receipt of a thesis and subsequent incorporation into a publicly accessible catalog are, the presumption the Mozgrin Thesis was publicly accessible more than one year prior to the date of the application for patent is pure speculation. *See id.* at 1316.

Furthermore, I respectfully disagree Zond was required to object under 37 C.F.R. § 42.64(b). Significantly, Zond does not contend that the

Mozgrin Thesis is inadmissible under any Federal Rule of Evidence. Instead, Zond argues the Mozgrin Thesis is not prior art under 35 U.S.C. § 102(b) because GlobalFoundries has not shown the Mozgrin Thesis was publicly accessible — a challenge to the sufficiency or weight to be given to the Mozgrin Thesis. Such argument is not proper in a motion to exclude, which is a challenge to the admissibility of evidence, not a challenge to sufficiency. *See* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,767 (August 14, 2012) (stating that a motion to exclude may not be used to challenge the sufficiency of the evidence to prove a particular fact).

Zond properly provided arguments in the preliminary response and response asserting GlobalFoundries has not sufficiently demonstrated that the Mozgrin Thesis is prior art under 35 U.S.C. § 102(b). Accordingly, I am not persuaded GlobalFoundries has established, by a preponderance of the evidence, that the Mozgrin Thesis is a printed publication under 35 U.S.C. § 102(b). It follows, I am not persuaded claim 16 is unpatentable under § 103(a) as obvious over the combination of Wang, Lantsman, and the Mozgrin Thesis.

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