UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

THE GILLETTE COMPANY,
Petitioner
v.
ZOND, LLC,
Patent Owner

Case No. IPR2014-00477
Patent 8,125,155 B2

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

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 2014-00477, concerning U.S. Patent 8,125,155 ("the '155 patent"), entered on September 4, 2015, attached hereto as Appendix A.

ISSUES TO BE ADDRESSED ON APPEAL

A. Whether the PTAB erred when construing, according to its broadest reasonable interpretation in light of the specification of the '155 patent as understood by one of ordinary skill in the art at the time of the invention, the term "without forming an arc," as recited in the claims of the '155 patent, as "substantially eliminating the possibility of arcing?"

B. Whether the PTAB erred when construing, according to its broadest reasonable interpretation in light of the specification of the '155 patent as understood by one of ordinary skill in the art at the time of the invention, the term "a voltage pulse having at least one of a controlled amplitude and a controlled rise time," as recited in the claims of the '155 patent, as "generating at the output a voltage pulse whose amplitude and/or rise time are directed or restrained?"

C. Whether the PTAB erred in finding claims 1-5 and 7-16 unpatentable as being obvious under 35 U.S.C. § 103(a) 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 (1983) ("Kudryavtsev")?

D. Whether the PTAB erred in finding claim 6 unpatentable as being obvious under 35 U.S.C. § 103(a) in view of Wang, Kudryavtsev and Yoon, U.S. Patent 6,740,585?

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 5, 2015

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APPENDIX A

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Paper 52
Entered: September 4, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

THE GILLETTE COMPANY,
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ZOND, LLC,
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Case IPR2014-00477
Patent 8,125,155 B2

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

MITCHELL, *Administrative Patent Judge.*

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

I. INTRODUCTION

The Gillette Company ("Gillette") filed a Petition requesting *inter partes* review of claims 1–16 of U.S. Patent No. 8,125,155 B2 ("the '155 patent"). Paper 2 ("Pet."). Zond, LLC ("Zond") filed a Preliminary Response. Paper 13 ("Prelim. Resp."). We instituted the instant trial on September 8, 2014, pursuant to 35 U.S.C. § 314. Paper 14 ("Dec."). Subsequent to institution, Zond filed a Response (Paper 37 ("PO Resp."), and Gillette filed a Reply (Paper 42 ("Reply")). Oral hearing[1] was held on May 28, 2015, and a transcript of the hearing was entered into the record. Paper 51 ("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 Gillette has shown, by a preponderance of the evidence, that claims 1–16 of the '155 patent are unpatentable under 35 U.S.C. § 103(a).

A. Related Matters

Gillette indicates that *Zond, LLC v. The Gillette Co.*, No.1:13-cv-11567-DJC (D. Mass. 2013) would affect or be affected by a decision in this proceeding. Pet. 1. Gillette also identifies other petitions for *inter partes* review that are related to this proceeding. *Id*.

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[1] The hearings for this review and the following *inter partes* reviews were consolidated: IPR2014-00479, involving the '155 patent; and IPR2014-00799 and IPR2014-00803, involving U.S. Patent No. 7,808,184, the parent of the '155 patent.

B. The '155 Patent

The '155 patent relates to methods and apparatus for generating strongly-ionized plasmas in a plasma generator. Ex. 1001, Abs. When creating a plasma in a chamber, a direct current ("DC") electrical discharge, which is generated between two electrodes in the presence of a feed gas, generates electrons in the feed gas that ionize atoms to create the plasma. *Id.* at 1:20–24. For an application, such as magnetron plasma sputtering, a relatively high level of energy must be supplied, which may result in overheating the electrodes or the work piece. *Id.* at 1:25–29. Such overheating may be addressed by complex cooling mechanisms, but such cooling can create temperature gradients in the chamber, causing a non-uniform plasma process. *Id.* at 1:30–34. Such temperature gradients may be reduced by pulsing the DC power, but high-power pulses may result in arcing at plasma ignition and termination. *Id.* at 1:35–40. Arcing is problematic because it can cause the release of undesirable particles in the chamber, contaminating the work piece. *Id.* at 1:40–42, 4:10–14.

According to the '155 patent, a pulsed power supply may include circuitry that minimizes or eliminates the probability of arcing in the chamber by limiting the plasma discharge current to a certain level and dropping the generated voltage for a certain period of time if the limit is exceeded. *Id.* at 4:8–17. Figure 2, reproduced below, shows measured data of discharge voltage as a function of discharge current for admitted prior art, low-current plasma 152, and high-current plasma 154 created by the claimed methods using the pulsed power supply. *Id.* at 1:65–67.

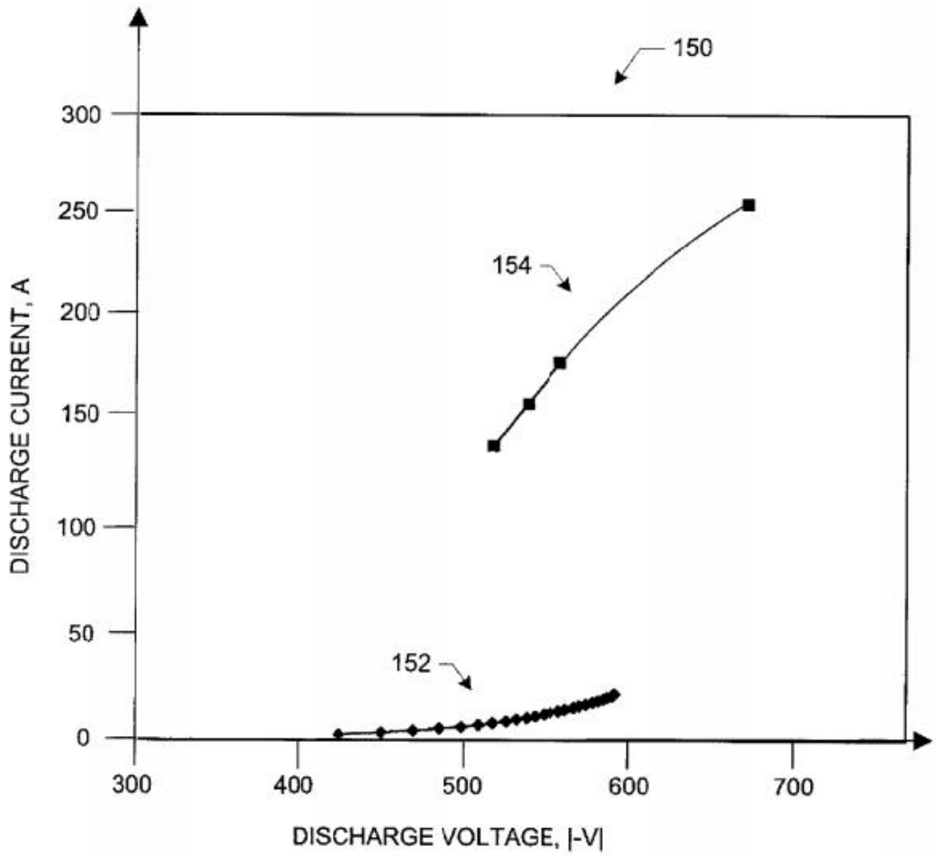

FIG. 2

Figure 2 shows current-voltage characteristic 154 that represents actual data for plasma generated by the pulsed power supply in the plasma sputtering system depicted in Figure 1 (not reproduced here). *Id.* at 5:31–33. The current-voltage characteristic 154 is in a high-current regime that generates a relatively high plasma density (greater than 10^{12}–10^{13} cm^{-3}). *Id.* at 5:43–46. The pulsed power supply generates waveforms that create and sustain the high-density plasma with current-voltage characteristics in the high-current regime. *Id.* at 5:58–62. The '155 patent explicitly defines the term "high-current regime" as "the range of plasma discharge currents that are greater than about 0.5 A/cm^2 for typical sputtering voltages of between about -300V to -1000V. The power density is greater than about 250 W/cm^2 for plasmas in the high-current regime." *Id.* at 5:46–51.

The '155 patent also describes a multi-stage ionization process wherein a multi-stage voltage pulse that is generated by the pulsed power supply creates a strongly-ionized plasma. *See id.* at 2:4–6, 7:4–8 (describing Figure 4 (not reproduced here) as such an example), 14:49–15:44 (describing Figure 5C (not reproduced here) as an illustrative multi-stage voltage pulse). Such a multi-stage voltage pulse initially generates a weakly-ionized plasma in a low-current regime (shown as 152 in Figure 2 above), and then eventually generates a strongly-ionized or high-density plasma in a high-current regime. *Id.* at 7:11–15. "Weakly ionized plasmas are generally plasmas having plasma densities that are less than about 10^{12}–10^{13} cm^{-3} and strongly-ionized plasmas are generally plasmas having plasma densities that are greater than about 10^{12}–10^{13} cm^{-3}." *Id.* at 7:15–18.

C. Illustrative Claim

Of the challenged claims, claim 1 is the only independent claim. Challenged claims 2 through 16 depend, either directly or indirectly, from claim 1. Claim 1, reproduced below, is illustrative:

1. A strongly-ionized plasma generator comprising:
a) a chamber for confining a feed gas;
b) an anode that is positioned inside the chamber;
c) a cathode assembly that is positioned adjacent to the anode inside the chamber; and
d) a pulsed power supply having an output that is electrically connected between the anode and the cathode assembly, the pulsed power supply generating at the output *a voltage pulse having at least one of a controlled amplitude and a*

> *controlled rise time that increases an ionization rate of sputtered material atoms so that a rapid increase in electron density and a formation of a strongly-ionized plasma occurs without forming an arc between the anode and the cathode assembly*.

Ex. 1001, 22:40–53 (emphasis added).

D. Prior Art Relied Upon

Gillette relies upon the following prior art references:

Wang	US 6,413,382 B1	July 2, 2002	(Ex. 1002)
Yoon	US 6,740,585 B2	May 25, 2004	(Ex. 1012)
Kouznetsov	US Pat. Pub. 2005/0092596	May 5, 2005	(Ex. 1003)

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. 1004) (“Mozgrin”).

A. A. Kudryavtsev and V.N. Skrebov, *Ionization Relaxation in a Plasma Produced by a Pulsed Inert-Gas Discharge*, 28(1) SOV. PHYS. TECH. PHYS. 30–35 (Jan. 1983) (Ex. 1008) (“Kudryavtsev”).

E. Grounds of Unpatentability

We instituted the instant trial based on the following grounds of unpatentability (Dec. 26):

Claims	Basis	References
1–5 and 7–16	§ 103(a)	Wang and Kudryavtsev
6	§ 103(a)	Wang, Kudryavtsev, and Yoon

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, 1279 (Fed. Cir. 2015) ("Congress implicitly approved the broadest reasonable interpretation standard in enacting the AIA,"[2] 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 . . . .") (citations omitted). 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).

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

1. "strongly-ionized plasma"

Independent claim 1 recites "strongly-ionized plasma." Prior to institution, Zond submitted a construction of the term "strongly-ionized plasma" (Prelim. Resp. 14–15), while Gillette did not propose an express construction of any claim term. Pet. 5–6. In the Decision on Institution, we adopted Zond's proposed construction, in light of the Specification, as the broadest reasonable interpretation. Dec. 8–9; Ex. 1001, 7:15–19. We construed the claim term "strongly-ionized plasma" as "a plasma with a relatively high peak density of ions." Dec. 9.

Subsequent to institution, notwithstanding that neither Zond, nor its expert witness, expressly challenged our claim construction as to this term (PO Resp. 17–26; Ex. 2015 ¶ 21), Zond improperly attempts to import extraneous limitations into the claim by arguing that the measure of the peak density of ions is necessary to determine whether a strongly-ionized plasma is formed. *See* PO Resp. 47–48. It is well settled that if a feature is not necessary to give meaning to a claim term, it is "extraneous" and should not be read into the claim. *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998); *E.I. du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1433 (Fed. Cir. 1988).

We observe that the claim terms "*weakly*-ionized plasma" and "*strongly*-ionized plasma" are relative terms, and that the cross-examination testimony of Gillette's declarant, Mr. Richard DeVito, in which he discusses our construction, confirms that Mr. DeVito agrees the terms are relative (Ex. 2014, 166:21–24) and that three to four orders of magnitude difference in the peak density of ions between the initial ionized state and a plasma density that may be considered strongly-ionized is sufficient (*id.* at 166:25–170:25). Gillette's second declarant, Dr. John C. Bravman, also confirms that weakly-ionized and strongly-ionized plasma are relative terms, as the '155 patent uses overlapping ranges of plasma density to describe them (*see* Ex. 1026 ¶¶ 30–31 (citing Ex. 1001, 7:15–19)), and that one of ordinary skill in the art would not understand strongly-ionized plasma to require any specific magnitude in the peak density of ions. *Id.* ¶ 29. Dr. Bravman also notes that strongly-ionized plasma is the same as high-density plasma. *Id.* ¶ 32 (citing Ex. 1001, 7:11–14).

For the foregoing reasons, we decline to adopt Zond's assertion that the measure of the peak density of ions is necessary to determine whether a strongly-ionized plasma is formed. Rather, upon review of the parties' explanations and supporting evidence before us, we discern no reason to modify our claim construction set forth in the Decision on Institution with respect to this claim term, which adopted Zond's originally proposed construction. Dec. 8–9. Therefore, for purposes of this Final Written Decision, we construe, in light of the Specification, the claim term "a strongly-ionized plasma" as "a plasma with a relatively high peak density of ions."

2. "a voltage pulse having at least one of a controlled amplitude and a controlled rise time"

Independent claim 1 recites the feature of "generating at the output a voltage pulse having at least one of a controlled amplitude and a controlled rise time" to achieve increasing an ionization rate of sputtered material atoms so that a rapid increase in electron density and a formation of a strongly-ionized plasma occurs without forming an arc between the anode and the cathode assembly. During the pretrial stage of this proceeding, Gillette did not proffer an explicit construction for this feature, but Zond offered a construction, focusing on the meaning of the term "control." Prelim. Resp. 13. In our Decision on Institution, we adopted Zond's proposed construction, in light of the '155 patent Specification, as the broadest reasonable interpretation, which is "generating at the output a voltage pulse whose amplitude and/or rise time are directed or restrained" to achieve the increased ionization rate of sputtered material atoms for a rapid increase in electron density and a formation of a strongly-ionized plasma without arcing. Dec. 9–10; *see, e.g.,* Ex. 1001, 6:11–12 (stating the pulsed power supply "can be programmed to generate voltage pulses having various shapes"), 8:41–60 (referring to Fig. 4, describing specific, relatively fast rise time of the voltage shifts the electron energy distribution to higher energies for formation of the strongly-ionized plasma).

Subsequent to institution, Zond seeks a further clarification of our construction in light of our application of our construction to the prior art. PO Resp. 17–20.[3] Zond takes issue with our claim construction as not

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[3] Zond complains that our use of Figure 3 of the '155 patent in the Decision on Institution to show control of a voltage pulse is misplaced because Figure 3 shows only weakly-ionized plasma. PO Resp. 17–20. We relied on the description of Figure 3 to illustrate the difference between a desired or idealized square pulse and an actual voltage pulse that shows oscillations. Dec. 20–21. As Gillette acknowledges, both Figure 3 and Figure 8 of the '155 patent, which Zond asserts describes "the compelling advantages of

encompassing the broadest reasonable interpretation. *Id.* at 20. Zond asserts that we "concluded that the claimed pulse control encompasses any change in voltage amplitude that is incidental to directing a pulse to a target *power* level (or set point) as in Wang, regardless of whether the voltage amplitude is the parameter under control." *Id.*

Zond asserts that Mr. DeVito agrees that this limitation requires a target *voltage* level or set point. *Id.* at 21 (citing Ex. 2102, 173:14–174:20). Zond also utilizes the Eronini[4] reference to explain how a desired value or "set point," also known as a "controlled variable," is achieved in a closed loop system using a feedback signal to control the manipulated variable, here the voltage pulse. PO Resp. 21–23. Zond concludes that:

> [T]he proper interpretation of the claim language—"voltage pulse having at least one of a *controlled* amplitude and a *controlled* rise time"—requires controlling these voltage parameters to target levels or set points as shown in the specification, and not to any uncontrolled variation or manipulation that may occur incidental to controlling a different parameter, such as power. In other words, any variations or manipulations in voltage that may occur as a supply controls power to a target level do not equate with a control of voltage.

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combining *voltage amplitude* control with *voltage rise time* control," PO Resp. 16, show an idealized square pulse showing a target voltage level versus the actual output voltage amplitude and rise time showing numerous fluctuations. *See* Ex. 1001, Figs. 3, 8; Reply 5–7. The difference in the attainment of a strongly-ionized plasma in Figure 8 is explained not by how the voltage pulse was "controlled," but by use of the high-power voltage mode that "supplies a sufficient amount of uninterrupted power" to drive the plasma to a strongly-ionized state. Ex. 1001, 13:44–56, 18:40–50; Reply 7.

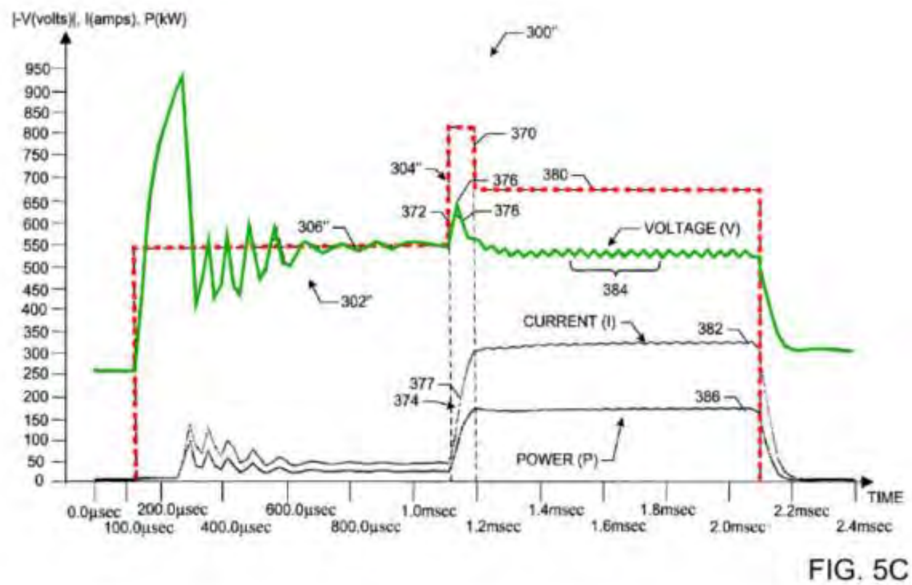
[4] Eronini Umez-Eronini, SYSTEM DYNAMICS AND CONTROL 10–13 (1999) (Ex. 2010).

Id. at 23. Zond points to Figure 5C of the '155 patent as exemplary of a power supply programmed to direct the voltage amplitude to successive target levels or set points 306, 370, 380. *Id.* at 24–26 (citing Ex. 1001, 14:49–15:44). Zond concludes that "[t]his example shows that the specification describes a power supply that achieves the claimed conditions (of a rapid increase in electron density without arc) by controlling the voltage amplitude and rise times to target levels." *Id.* at 26. Therefore, according to Zond, "generating at the output a voltage pulse having at least one of a *controlled* amplitude and a *controlled* rise time that increases an ionization rate of sputtered ion material atoms so that a rapid increase in electron density and a formation of a strongly ionized plasma occurs without forming an arc" should be construed as "generating at the output a voltage pulse whose amplitude and/or rise time *are controlled variables that are* directed or restrained *to a target voltage level and/or a rise time level* to increase an ionization rate of sputtered ion material atoms so that a rapid increase in electron density and a formation of a strongly ionized plasma occurs without forming an arc." *Id.* at 24.

Gillette counters that Zond's new proposed construction is unsupported by the Specification of the '155 patent. Reply 1. For instance, Gillette asserts that the '155 patent teaches that "the *actual output* voltage amplitude and rise time . . . is not 'directed or restrained' to the *target* value because there are numerous fluctuations that exceed and/or undershoot the *target* voltage level, and a lag in rise time is observed as compared to the *target* value." Reply 6. We agree with Gillette and decline to adopt Zond's newly proposed construction.

Dr. Bravman testifies that Figure 5C of the ’155 patent, which is annotated by Dr. Bravman as shown below,

> shows a difference between a *desired* voltage pulse (annotated in red) and an *actual* voltage pulse (annotated in green). The ’155 patent states with respect to Fig. 5A–5C: “The desired pulse shapes requested from the pulsed power supply 102 are superimposed in dotted lines 304, 304’, and 304” onto each of the respective multi-stage voltage pulses 302, 302’, and 302”.



Annotated Figure 5C of the ‘155 patent (Ex. 1001): Target voltage pulse is shown in dotted red line and the actually generated voltage pulse is shown in green.

Ex. 1026 ¶ 56. We also agree that for every figure in the ’155 patent that shows the target and actual voltage pulses, such as Figure 8, which Zond asserts “demonstrates the compelling advantages of combining *voltage amplitude* control with *voltage rise time* control” (PO Resp. 16), the actually generated voltage pulse deviates significantly from the desired target voltage pulse. *See* Ex. 1026 ¶¶ 55–57. Therefore, based on the Specification of the ’155 patent, we agree with Dr. Bravman that “control as construed using the broadest reasonable interpretation includes direction and restraint of a voltage pulse's amplitude and rise time that do or do not exactly follow the target voltage amplitude and/or rise time." Ex. 1026 ¶ 58.

We continue to construe the claim phrase "generating at the output a voltage pulse having at least one of a controlled amplitude and a controlled rise time" as "generating at the output a voltage pulse whose amplitude and/or rise time are directed or restrained" to achieve the increased ionization rate of sputtered material atoms for a rapid increase in electron density and a formation of a strongly-ionized plasma without arcing.

3. "without forming an arc"

Neither party offers an explicit construction of the claim phrase "without forming an arc," but Zond asserts arguments based on an incorrect interpretation of this claim phrase. Therefore, we construe the claim phrase "without forming an arc."

Specifically, Zond asserts that a key claim limitation missing from the teachings of the prior art, is the *absence* of arcing in the transition from a weakly-ionized plasma to a highly-ionized plasma. PO Resp. 4. Zond describes Figure 4 as set forth in the '155 patent as showing no arcing, as evidenced by the relatively steep continuous rise in current to achieve "controlled rapid growth to a strongly-ionized plasma without arcing." *Id.* at 10, 12 ("By carefully controlling the target pulse voltage amplitude and voltage rise times at selected moments and by selected amounts, the system increases the electron density to quickly transition a plasma to a strongly-ionized condition, while still restraining the plasma from arcing."); *id.* at 14 (stating Figs. 5A–5C show rapidly achieving a strongly-ionized plasma without arcing).

Finally, Zond identifies Figure 8 of the '155 patent as evidencing a single-stage voltage pulse that ignites and grows a plasma to high density without arcing. Zond concludes that:

> Thus, this example demonstrates that compelling advantages of combining *voltage amplitude* control with *voltage rise time* control: Dr. Chistyakov was able to find a controlled voltage level coupled with a controlled rise time for his programmable supply that could both ignite a plasma and stably grow it into a plasma that was dense enough for sputtering, but without arcing.

PO Resp. 16.

First, although Zond acknowledges that "Wang's teachings of arc reduction during ignition are inapposite to the '155 patent's requirement of avoiding arcing during the rapid increase in electron density and a formation of the strongly-ionized plasma" (*id.* at 2), Zond faults Wang's alleged teaching that arcing was unavoidable upon plasma ignition (*id*. at 16). Zond is attempting to import improperly a limitation not in the claims. Independent claim 1 requires formation of a strongly-ionized plasma without an arc, but does not require that the ignition or the formation of a weakly-ionized plasma occur without an arc. *See* Ex. 1001, 22:45–53; *Renishaw*, 158 F.3d at 1249; *E.I. du Pont de Nemours*, 849 F.2d at 1433.

The Specification of the '155 patent contains only a few references to arcing. For instance, the Specification of the '155 patent, in describing Figure 1, which illustrates a cross-sectional view of a plasma sputtering apparatus having a pulsed direct current (DC) power supply according to one embodiment of the invention, discloses the following:

> The pulsed power supply 102 can include circuitry that minimizes or eliminates the *probability* of arcing in the chamber 104. Arcing is generally undesirable because it can damage the anode 124 and cathode assembly 116 and can contaminate the wafer or work piece being processed. In one embodiment, the circuitry of the pulse supply 102 limits the plasma discharge current up to a certain level, and if this limit is exceeded, the voltage generated by the power supply 102 drops for a certain period of time.

Ex. 1001, 4:9–18 (emphasis added). In describing Figure 2, the Specification of the '155 patent states that "[s]puttering with discharge voltages greater than –800V can be undesirable because such high voltages can increase the probability of arcing and can tend to create sputtered films having relatively poor film quality." Ex. 1001, 5:25–30.

The Specification of the '155 patent also describes other ways to reduce arcing. For instance, '155 patent discusses Figure 9, which depicts a plasma sputtering apparatus according to the invention and describes the gap between the anode and the cathode assembly. The Specification of the '155 patent states that "[t]he gap 514 can reduce the probability that an electrical breakdown condition (i.e., arcing) will develop in the chamber 104." *Id.* at 19:31–33, 20:36–37 ("The geometry of the gap 514 can be chosen to minimize the probability of arcing . . . .").

Zond does not explain adequately why *one with ordinary skill in the plasma art* would have interpreted the claim term "without forming an arc," *in light of the Specification*, to require the ionization of excited atoms be performed *completely* free of arcing. *See* Tr. 22–29; *In re NTP, Inc.*, 654 F.3d 1279, 1288 (Fed. Cir. 2011) (stating that the Board's claim construction "cannot be divorced from the specification and the record evidence"); *see also In re Cortright*, 165 F.3d 1353, 1358 (Fed. Cir. 1999) (stating that the Board's claim construction "must be consistent with the one that those skilled in the art would reach"). Nor does Zond direct our attention to credible evidence that would support its attorney's arguments regarding the disputed claim term at issue. *See* PO Resp. 2–4, 10–16.

Here, nothing in the Specification indicates that *no* arcing occurs in the formation of the strongly-ionized plasma. Rather, it explicitly states that such a *probability* may be minimized or eliminated. Ex. 1001, 4:8–10. Given the disclosure in the Specification, we decline to adopt Zond's implicit construction—absolutely no arcing—because it would be unreasonable to exclude the disclosed embodiments. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1315 (Fed. Cir. 2005) (en banc) (stating that the Specification is "the single best guide to the meaning of a disputed term"). Instead, we construe the claim term "without forming an arc" as "substantially eliminating the possibility of arcing," consistent with an interpretation that one of ordinary skill in the art would reach when reading the claim term in the context of the Specification.

B. Principles of Law

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

In that regard, an obviousness analysis "need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 550 U.S. at 418; *see Translogic*, 504 F.3d at 1259. A prima facie case of obviousness is established when the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art. *In re Rinehart*, 531 F.2d 1048, 1051 (CCPA 1976). The level of ordinary skill in the art may be 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 1–5 and 7–16 — Obviousness over Wang and Kudryavtsev

Gillette asserts that claims 1–5 and 7–16 are unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Wang and Kudryavtsev. Pet. 12–29. As support, Gillette provides detailed explanations as to how each claim limitation is met by the references and rationales for combining the references (*id.*), as well as a Declaration of Mr. Richard DeVito (Ex. 1005) in support of its Petition, and a Declaration of Dr. John C. Bravman (Ex. 1026) in support of its Reply.

Zond responds that the combination of Wang and Kudryavtsev does not disclose every claim element. PO Resp. 27–51, 56–60. Zond also argues that there is insufficient reason to combine the technical disclosures of Wang and Kudryavtsev. *Id*. at 52–55. To support its contentions, Zond proffers a Declaration of Dr. Larry D. Hartsough (Ex. 2015). Zond also asserts that secondary considerations mitigate against a determination of obviousness, but does not provide support for this contention from its declarant.

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, and then we address the parties' contentions in turn.

<u>Wang</u>

Wang discloses a power pulsed magnetron sputtering apparatus for generating a very high plasma density. Ex. 1002, 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:

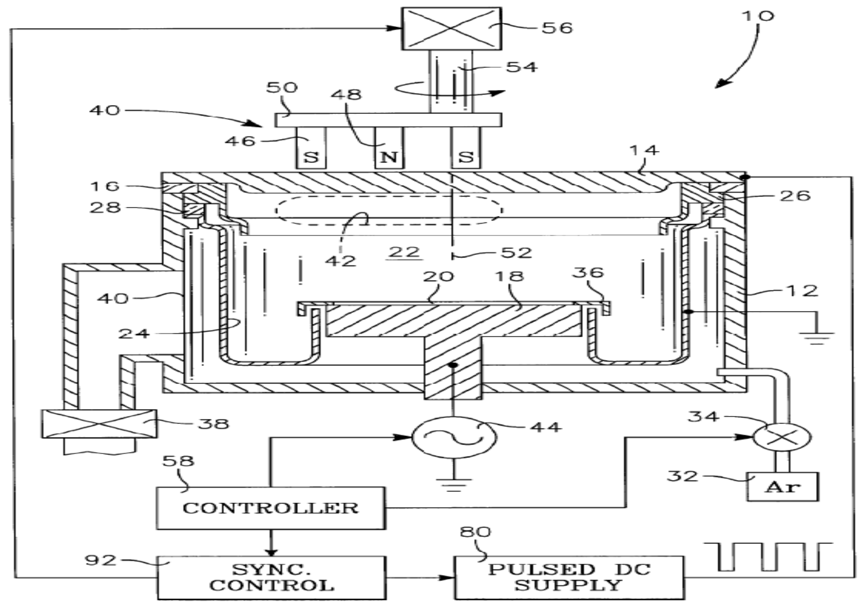


FIG. 1

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, 4:35–36. According to Wang, the apparatus is capable of creating high density plasma in region 42, which ionizes a substantial fraction of the sputtered particles into positively charged metal ions and also increases the sputtering rate. *Id*. at 4:13–34. 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:

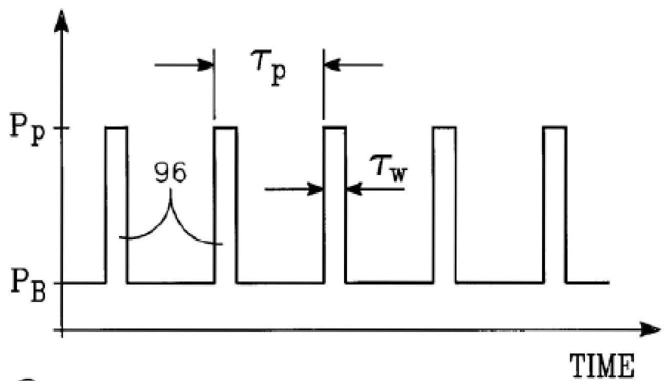


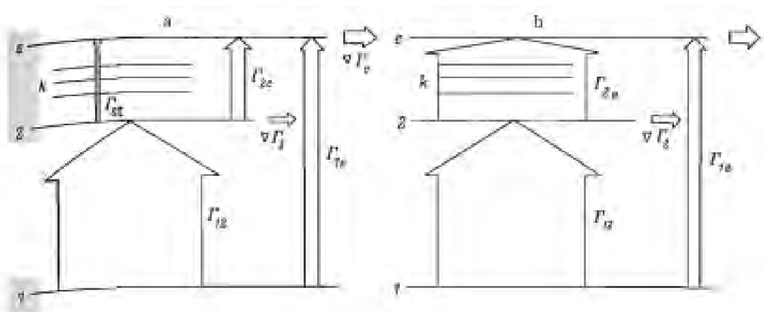
FIG. 6

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 Mr. DeVito, 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. 1005 ¶¶ 86, 99; *see* Pet. 9.

<u>Kudryavtsev</u>

Kudryavtsev discloses a multi-step ionization plasma process, comprising the steps of exciting the ground state atoms to generate excited atoms and then ionizing the excited atoms. Ex. 1008, Abs., Figs. 1, 6.

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



As shown in Figure 1 of Kudryavtsev, ionization occurs with a "slow stage" (Fig. 1a) followed by a "fast stage" (Fig. 1b). During the initial slow stage, direct ionization provides a significant contribution to the generation of plasma ions (arrow Γ_{1e} showing ionization (top line labeled "e") from the ground state (bottom line labeled "1")). Mr. DeVito explains that Kudryavtsev pre-ionized a gas and then applied a voltage pulse. Ex. 1005 ¶ 106; Pet. 16. Under these conditions, Kudryavtsev discloses:

> *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. 1005 ¶ 106 (quoting Ex. 1008, 31). 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." Ex. 1008, 30, Abs., Fig. 6.

Voltage Pulse Having a Controlled Amplitude or Rise Time

Gillette relies upon Wang to disclose all of the limitations recited in claims 1–5 and 7–16. Pet. 12–29; Ex. 1005 ¶¶ 103–136. Gillette relies on Kudryavtsev to provide further support for teaching "the pulsed power supply generating at the output a voltage pulse having at least one of a controlled amplitude and a controlled rise time that increases an ionization rate of sputtered material atoms so that a rapid increase in electron density and a formation of a strongly-ionized plasma occurs." Pet. 15–18. Gillette asserts:

> Like Wang, Kudryavtsev pre-ionizes a gas and applies a voltage pulse. . . . Under these conditions, Kudryavtsev observed a fast stage, corresponding to "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*."

Id. at 16 (quoting Ex. 1008, 31, right col., ¶ 6). Citing to Mr. DeVito's testimony, Gillette asserts that if such an "explosive increase" in density in Wang is not experienced, it would have been obvious to adjust the operating parameters like pulse length or pressure to trigger Kudryavtsev's fast stage of ionization. *Id.* at 16–17 (citing Ex. 1005 ¶ 106). Gillette concludes that:

> One of ordinary skill would have been motivated to use Kudryavtsev's explosive ionization in Wang so as to increase plasma density and thereby increase the sputtering rate. Use of Kudryavtsev's teaching in Wang would have been a combination of old elements that yielded the predictable results of rapidly increasing the ionization rate and electron density, which is known to be a desirable result.

Id. at 17 (citing Ex. 1005 ¶ 107).

Zond argues that neither Wang nor Kudryavtsev teaches the claimed voltage control or the avoidance of arcing during the rapid increase in electron density and formation of a strongly-ionized plasma. For instance, citing Dr. Hartsough's testimony in support, Zond asserts that:

> Wang is not *controlling voltage* rise time so as to achieve the claimed objectives, and he never suggests *controlling* rise time of either voltage or of power: He is controlling *power level* only to obtain as fast a rise time in power as he can, and the actual rise time of power that results is an *uncontrolled* variation that occurs incidental to his attempt to control power to a constant target level.

PO Resp. 44; Ex. 2014 ¶¶ 104–105.

In its Reply, Gillette asserts that Zond concedes that all the limitations in claim 1 are met by the prior art except for control of the voltage amplitude or rise time to avoid arcing when rapidly forming a strongly-ionized plasma. Reply 2 (citing Dr. Hartsough's deposition testimony, Ex. 1023, 80:23–81:18, 84:25–86:23, 87:15–21, 82:17–23, 196:19–197:1, 200:19–21). Gillette points to Dr. Hartsough's testimony admitting that Figure 10 in the '155 patent shows a prior art power supply that can generate voltage pulses according to the invention described in the '155 patent. *Id.* at 3–4 ("Again, Dr. Chistyakov says that these pulses are *according to the present invention*, and – so I will use my understanding of what he said there, since *a controlled rise time is part of his present invention, that these power supplies could do that*.") (quoting Ex. 1023, 84:25–86:23).

We start our analysis with where the parties appear to agree on what the prior art teaches. For instance, referring to Figure 1 of Wang set forth above, Wang discloses a pulsed magnetron sputtering device having an anode 24, a cathode 14, a movable magnet assembly 40, a DC power supply 100 (shown in Figure 7), and a pulsed DC power supply 80. Ex. 1005 ¶ 85 (citing Ex. 1002, Figs. 1 and 7, 3:57–4:55, 7:56–8:12).

We find Zond's contention that Wang focuses on *power* pulses throughout its disclosure, not a *voltage* pulse, is misplaced. As Gillette indicates in its Petition, Wang discloses a pulsed DC power supply connected to the target that produces "*a train of negative voltage pulses*." Pet. 14 (citing Ex. 1002, 7:61–62 (emphasis added), Fig. 7). Mr. DeVito explains that "[a]pplication of those voltage pulses to Wang's cathode/target 14, with respect to the grounded anode 24, produces Wang's peak power pulses, P_P." Ex. 1005 ¶ 103.

Also, Dr. Bravman explains that "[g]enerally, a pulsed power supply outputs a voltage pulse. The current responds to the applied voltage pulse, depending on the impedance of the load, leading to an increase in the current and concomitant lowering of the voltage." Ex. 1026 ¶ 71. Therefore, to generate a power pulse, a power supply first provides a voltage pulse with a specific amplitude and rise time. *Id.* ¶ 72. Dr. Bravman demonstrates how Wang shows such behavior by noting Wang's teaching that a typical "pulsed power supply will output relative high voltage and almost no current in the ignition phase and a lower voltage and substantial current in the maintenance phase." *Id.* ¶ 73 (quoting Ex. 1002, 5:32–35).

Dr. Bravman points to Dr. Hartsough's testimony that Figure 5 of U.S. Patent No. 6,896,775, assigned to Zond, illustrates a typical power supply also as described in Wang. *Id.* ¶ 74 (citing Ex. 1024, 149:22–150:20). Dr. Bravman testifies that, in his opinion, Figure 5 of the '775 patent behaves in nearly identical manner as Figure 8 of the ’155 patent, reproduced below with annotations by Dr. Bravman.

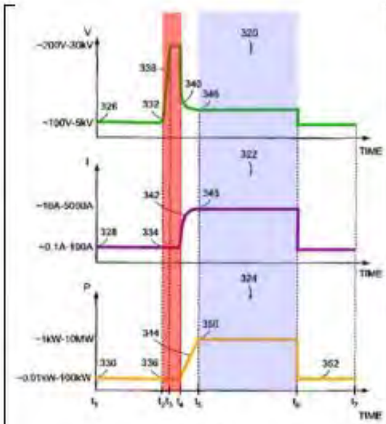


FIG. 5

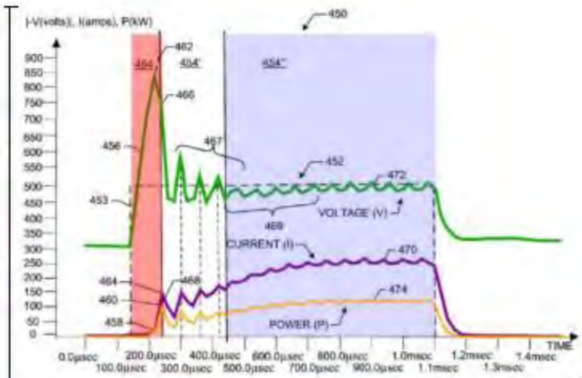


FIG. 8

Annotated Figure 5 of the ‘775 patent (Ex. 1027): Voltage is shown in green, current is shown in purple, and power is shown orange. This figure also illustrates how the typical power supply described by Wang operates.	**Annotated Figure 8 of the ‘155 patent (Ex. 1001):** Voltage is shown in green, current is shown in purple, and power is shown orange.

Id. ¶ 76. Dr. Bravman explains that “[i]n both cases, when the voltage pulse is initially applied (red region), voltage (green) is initially higher with low current (purple). Then, when the strongly-[ionized] plasma is generated (blue region), the voltage (green) becomes lower with the corresponding rise in current (purple).” *Id.* We credit Dr. Bravman’s testimony, which is consistent with the Specification of the ’155 patent and the prior art as set forth above, in addition to Dr. Hartsough’s statements concerning the similarity of Figure 5 of the ’775 patent to the teachings in Wang.

Based on the evidence before us, we are persuaded that Gillette has demonstrated, by a preponderance of evidence, that the combination of Wang and Kudryavtsev discloses a voltage pulse having at least one of a controlled amplitude and a controlled rise time.

Without Forming an Arc Between the Anode and Cathode Assembly

Zond also asserts Wang fails to teach a critical claim limitation of a lack of arcing during the formation of a strongly-ionized plasma through control of pulse voltage. *See* PO Resp. 45–47. Zond argues that, because Wang admits arcing occurs upon plasma ignition with his power control technique and that Figure 6 of Wang demonstrates the use of a background power so arcing would be significantly *reduced*, but not eliminated, Wang does not teach the "lack of arcing" limitation. This particular argument of Zond is not persuasive because, as we have stated in our claim construction, given the disclosure in the Specification, we decline to construe the claims to require the transformation of the weakly-ionized plasma to a strongly-ionized plasma occur with a *guarantee* of eliminating *all possibility* of an electrical breakdown condition or arcing, because it would be unreasonable to exclude the disclosed embodiments, all of which stop short of such a guarantee. *See Phillips*, 415 F.3d at 1315 (stating that the Specification is "the single best guide to the meaning of a disputed term").

Zond also argues that Kudryavtsev's teaching of an "explosive" build–up of electron density would transition into an arc as evidenced by the resultant measured voltage and current waveforms shown in Figure 2 of Kudryavtsev. PO Resp. 48–52 (citing Ex. 2015 ¶¶ 122–135). Therefore, according to Zond, Kudryavtsev does not teach "that the applied voltage amplitude or voltage rise time were controlled in the manner claimed to achieve a rapid increase in electron density without arcing." *Id.* at 49.

Gillette counters that Wang teaches the avoidance of arcing because the impedance changes relatively little between the two power levels P_B and P_P indicating no arcing, which Gillette asserts Dr. Hartsough admits. Reply 2–3 (citing Ex. 1002, 7:49–51; Ex. 1024, 89:8–24). Gillette also disagrees that Kudryavtsev causes an arc condition. *See* Ex. 1026 ¶¶ 83–84.

A preponderance of the evidence before us supports Gillette's position that the combination of Wang and Kudryavtsev discloses the claim feature. *See* Pet. 18–19 (citing Ex. 1005 ¶¶ 112–113). As Gillette notes, Wang explains that arcing may occur during plasma ignition before the first pulse shown in Figure 6. *Id*. at 19 (citing Ex. 1002, 7:3–6). Indeed, Wang recognizes that plasma ignition in a sputtering reactor has a tendency to generate arcing, dislodging large particles from the target or chamber. Ex. 1002, 7:3–8. This is because plasma ignition is an electronically noisy process, and each power pulse would need to ignite the plasma (as illustrated in Figure 4 of Wang) if background power level P_B is not maintained between the high power pulses. *Id*. at 7:8–12.

Figure 6 of Wang (reproduced previously in our initial discussion of Wang) is reproduced again below:

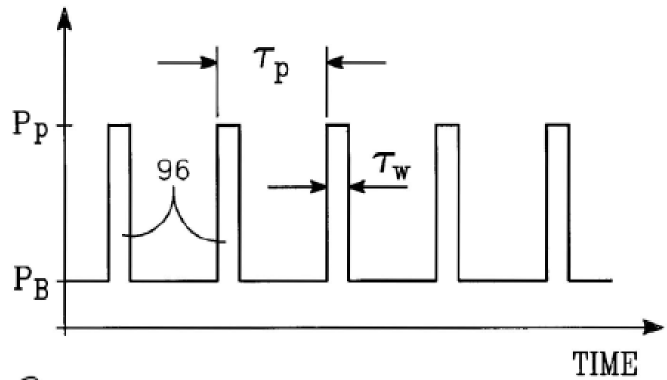


FIG. 6

As shown in Figure 6 of Wang, the target is maintained at background power level P_B between power pulses 96, rising to peak level P_P. Ex. 1002, 7:13–25. Background level P_B is chosen to exceed the minimum power necessary to support a plasma with little, if any, actual sputter deposition. *Id*. The initial plasma ignition needs to be performed only once, and at a very low power level, so that particulates produced by arcing are much reduced. *Id*. at 7:26–55. According to Mr. DeVito, because "the plasma need not be reignited thereafter, the likelihood of arcing would be significantly reduced during subsequent applications of the background and peak power levels, P_B and P_P." Ex. 1005 ¶ 113.

We agree with Gillette that Wang teaches the avoidance of arcing (as Dr. Hartsough admits), and, in contrast to Zond's assertions, we further agree with Gillette that Kudryavtsev does not teach arcing. *See* Ex. 1008, 34 (discussing uniformity of ionization across cross section of discharge tube). Based on the evidence before us, we are persuaded Gillette has demonstrated, by a preponderance of evidence, that the combination of Wang and Kudryavtsev discloses a voltage pulse having at least one of a controlled amplitude and a controlled rise time that increases an ionization rate of sputtered material atoms so a rapid increase in electron density and a formation of a strongly-ionized plasma occurs *without forming an arc* between the anode and the cathode assembly.

Rationale to Combine Wang and Kudryavtsev

Finally, Zond points to the physical differences between Kudryavtsev's and Wang's systems, concluding "[c]ombining the teachings of Kudryavtsev's flash tube with no magnet with Wang's pulsed magnetron sputter reactor would not have lead one of ordinary skill in the art to an expected result." PO Resp. 53. For instance, Zond asserts that Kudryavtsev's system does not use magnets or magnetic fields in contrast to Wang's magnetron, Wang's and Kudryavtsev's reactors have very different dimensions, and the location of the application of the voltage pulse in Kudryavtsev's system is substantially different from Wang's. *Id.* at 54–55.[5]

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[5] Zond also asserts alleged secondary considerations. PO Resp. 55–56. Zond's arguments, however, are unsupported attorney argument to which we give little weight. *See Meitzner v. Mindick*, 549 F.2d 775, 782 (CCPA 1977) (finding argument of counsel cannot take the place of evidence lacking in the record); *see also* PO Resp. 56 n.113 (cited excerpts of Mr. DeVito's deposition concerning experimentation to combine the teachings of Kudryavtsev with Wang do not support a conclusion that the experimentation is undue; Mr. DeVito simply testifies to the time that it would take to build the appropriate chamber to perform the testing); Reply 13 (citing Ex. 2014, 306:2–6; Ex. 1026 ¶ 90) (supporting conclusion that experimentation to combine teachings of Wang and Kudryavtsev is unnecessary, and if done, is not undue).

Gillette supports its conclusion that one of ordinary skill in the art would have been motivated to use Kudryavtsev's explosive ionization in Wang to increase plasma density, concomitantly increasing the sputtering rate, with testimony from Mr. DeVito and Dr. Bravman. Reply 10 (citing Ex. 1005 ¶¶ 106–111; Ex. 1026 ¶¶ 85–90; Pet. 16–18). Gillette concludes that "[a]s Dr. Bravman explains, a person of ordinary skill in the art would have combined the teachings of Wang with Kudryavtsev, despite the physical differences that may exist, just as Mozgrin had done in applying Kudryavtsev in designing his magnetron sputtering system." Reply 12 (citing Ex. 1026 ¶¶ 85–90).

Upon consideration of the evidence before us, we are persuaded by Gillette's contentions. Gillette merely relies upon Kudryavtsev's teaching that an "explosive increase" in plasma density is achieved by applying a voltage pulse to a weakly-ionized plasma. Pet. 16–17. Zond's arguments concerning the differences between Wang's and Kudryavtsev's systems 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) (citation omitted); *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").

More importantly, Wang discloses that application of the high peak power P_P to the background power P_B "*quickly* causes the already existing plasma to spread and increases the density of the plasma" to form a strongly-ionized plasma. Ex. 1002, 7:29–30 (emphasis added); Ex. 1005 ¶ 104. Mr. DeVito testifies that "[l]ike Kudryavtsev's voltage pulse, application of Wang's voltage pulse (which produces the peak power P_P) to the initial or pre-ionized plasma rapidly increases the plasma density and the density of the free electrons." Ex. 1005 ¶ 106; *see also id.* ¶ 105 ("[B]ecause Wang applies voltage pulses that suddenly generate an electric field, the increase in Wang's electron and plasma densities is 'rapid.'").

On this record, we credit Mr. DeVito's testimony, as it is consistent with the prior art disclosures. Moreover, we are persuaded by Mr. DeVito's testimony that if one of ordinary skill did not experience Kudryavtsev's "explosive increase" in plasma density in Wang, triggering 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 rapidly increasing the ionization rate and electron density. *See id.* ¶ 107.

We further 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. PO Resp. 27–55. 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). As Dr. Bravman testifies, Kudryavtsev's theoretical framework on plasma behavior is not intended to be limited to a particular type of plasma apparatus. Ex. 1026 ¶ 85. Indeed, Kudryavtsev discloses a study of the ionization relaxation in plasma when the external electric field suddenly increases. Ex. 1008, 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); *see* Ex. 1026 ¶ 85.

Dr. Bravman 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 in view of Wang's application for the benefit of improved sputtering and manufacturing processing capabilities. Ex. 1026 ¶ 86. Dr. Bravman further explains that such an artisan would know how to apply the teachings of Kudryavtsev to Wang's system for performing sputtering, by making any necessary changes to accommodate the differences of pressures, dimensions, sizes, magnets, or other features through routine experimentation. *Id.* ¶ 87. On this record, we credit Dr. Bravman's testimony because his explanations are consistent with the prior art of record. Gillette has articulated a reason with rational underpinning why one with ordinary skill in the art would have combined the technical teachings of Wang and Kudryavtsev.

Remaining Limitations of Challenged Claims

Zond does not address whether the references teach or suggest a "strongly-ionized plasma generator" comprising (a) "a chamber for confining a feed gas"; (b) "an anode that is positioned inside the chamber"; (c) "a cathode assembly that is positioned adjacent to the anode inside the chamber"; and (d) "a pulsed power supply having an output that is electrically connected between the anode and the cathode assembly." *See* Prelim Resp. 27–28; Reply 2, Ex. 1001, 22:40–47. We are persuaded on this record that Gillette has shown sufficiently that Wang teaches these features. *See* Pet. 12–14; Ex. 1005 ¶¶ 99–103.

In addition to the limitations discussed above found in independent claim 1, dependent claims 2–5, 7, 8, and 10–14 add limitations that Gillette asserts are taught by the combination of Wang and Kudryavtsev. Zond does not address these limitations. *See* Reply 2. We are persuaded on the record before us that Gillette has demonstrated by a preponderance of the evidence that the combination of Wang and Kudryavtsev would have suggested the additional limitations of the dependent claims to one with ordinary skill in the art at the time of the invention. *See* Pet. 19–29; Ex. 1005 ¶¶ 114–136.

<u>Dependent Claims 9, 15, and 16</u>

Dependent claim 9 recites "an energy storage device that is electrically coupled to the cathode assembly, the energy storage device discharging energy into the plasma to enhance the rapid increase in electron density and the formation of the strongly-ionized plasma." Zond asserts that the additional required energy storage device coupled to the cathode assembly, must be a separate storage device from any found in the power supply. PO Resp. 56–58. Mr. DeVito testifies that it would have been obvious to use capacitors, which are a well-known way to apply energy. Ex. 1005 ¶¶ 122–123. Gillette points out that the Specification of the '155 patent teaches that "the energy storage device 147 includes a capacitor bank" and the described power supplies shown in Figures 10–13 teach a bank of capacitors with switches to release stored energy. *See* Ex. 1001, 3:46–47, 21:15–24, 45–53. Dr. Bravman testifies that:

> The claimed pulsed power supply can be considered to include any number of these capacitors and switches and the energy storage device can be considered to include the remaining capacitors and switches found in or outside the pulsed power supply. One skilled in the art would have found it obvious to use any number of capacitors, either in the same or separate power supplies, as well-known ways to apply energy.

Ex. 1026 ¶ 105. We agree with Mr. DeVito and Dr. Bravman and credit their testimony as consistent with the Specification of the '155 patent and the prior art. It follows that Gillette has shown by a preponderance of the evidence that claim 9 is unpatentable over Wang and Kudryavtsev.

Zond also asserts that claim 15's added requirement that the voltage pulse "sustain" the strongly ionized plasma, and claim 16's added requirement that the voltage pulse have a lifetime greater than about 200 μsecs, are not taught by Wang because Wang does not show the current and, thus, no way exists to determine whether Wang's pulses sustain the plasma for the pulse duration. PO Resp. 58–60. Gillette asserts that Wang teaches the added limitations of claims 15 and 16 because Dr. Hartsough admits that Wang's typical power supplies can be schematically represented by Figure 5 of the '755 patent as set forth above.

As shown in Figure 5, Wang's typical power supply sustains the current throughout the duration of Wang's power pulse. Ex. 1026 ¶ 109. Also, as Mr. DeVito notes, Wang teaches that the pulse width can be as high as 1 ms, which is five times longer than the claim's 200 μsecs. Ex. 1002, 5:45–48; Ex. 1005 ¶¶ 133, 136. We agree with Gillette's arguments and credit the testimony of Dr. Hartsough, Mr. DeVito, and Dr. Bravman as consistent with the Specification of the '155 patent and the knowledge of one of skill in the art. Therefore, we determine that Gillette has shown by a preponderance of the evidence that claims 15 and 16 are unpatentable over Wang and Kudryavtsev.

<u>Conclusion</u>

For the foregoing reasons, we determine that Gillette has demonstrated, by a preponderance of evidence that claims 1–5 and 7–16 are unpatentable over the combination of Wang and Kudryavtsev.

D. *Claim 6 — Obviousness Over Wang, Kudryavtsev, and Yoon*

Gillette asserts that claim 6 is unpatentable under 35 U.S.C. § 103(a) as obvious over the combination of Wang, Kudryavtsev, and Yoon. Pet. 29–30. Claim 6, which depends from claim 1, states "further comprising a substrate support comprising a temperature controller that controls a temperature of the substrate." Ex. 1001, 22:65–67. Gillette asserts that "[c]ontrolling the temperature of a substrate is very well known." Pet. 29 (citing Ex. 1006, 1:28); *see* Ex. 1005 ¶¶ 137–139. Gillette relies on Yoon, which discloses a magnetron sputtering system, for teaching that a pedestal for supporting a substrate can have sensors, such as a thermocouple with a feedback loop, to maintain a desired temperature for the substrate. *Id.* at 29–30 (citing Ex. 1005 ¶ 138). Because both Yoon and Wang involve magnetron sputtering systems, Gillette concludes, relying on Mr. DeVito's testimony, that one of ordinary skill in the art would have combined their teachings, which are no more than a combination of old elements, "to control substrate temperature in Wang, and also to provide controlled temperature for an annealing process as Yoon describes." *Id.* at 30; Ex. 1005 ¶ 139. Zond does not address the additional limitation set forth in claim 6.

We have reviewed Gillette's contentions and supporting evidence, and we agree with Gillette's conclusions about the teachings of the combination of Wang, Kudryavtsev, and Yoon. For the foregoing reasons, we conclude that Gillette has demonstrated, by a preponderance of evidence, that claim 6 is unpatentable over the combination of Wang, Kudryavtsev, and Yoon.

III. CONCLUSION

For the foregoing reasons, we conclude that Gillette has demonstrated, by a preponderance of the evidence, that claims 1–16 are unpatentable based on the following grounds of unpatentability:

Claims	**Basis**	**References**
1–5 and 7–16	§ 103(a)	Wang and Kudryavtsev
6	§ 103(a)	Wang, Kudryavtsev, and Yoon

IV. ORDER

For the foregoing reasons, it is

ORDERED that claims 1–16 of the ’155 patent are held *unpatentable*;

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,

Dated: November 5, 2015

/Tarek N. Fahmi/
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