UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

Petitioners

v.

ZOND, LLC
Patent Owner

Case No. IPR2014-01099[1]

Patent 7,604,716 B2

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

[1] Case IPR 2014-00972 has been joined with the instant proceeding.

Pursuant to 37 C.F.R. § 90.2(a), Patent Owner, Zond, LLC, hereby provides notice of its appeal to the United States Court of Appeals for the Federal Circuit for review of the Final Written Decision of the United States Patent and Trademark Office ("USPTO") Patent Trial and Appeals Board ("PTAB") in *Inter Partes* Review 2014-01099, concerning U.S. Patent 7,604,716 ("the '716 patent"), entered on September 23, 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 '716 patent as understood by one of ordinary skill in the art at the time of the invention, the term "without developing an electrical breakdown condition in the chamber," as recited in the claims of the '716 patent, as "substantially eliminating the possibility of developing an electrical breakdown condition in the chamber?"

B. Whether the PTAB erred in finding claims 1-11 and 33 unpatentable as being anticipated under 35 U.S.C. § 102 in view by U.S. Pat. 6,413,382 to Wang ("Wang")?

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 19, 2015

/Tarek N. Fahmi/
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APPENDIX A

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Paper 40
Entered: September 23, 2015

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

ZOND, LLC,
Patent Owner.

Case IPR2014-01099[1]
Patent 7,604,716 B2

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

CHAGNON, *Administrative Patent Judge*.

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

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[1] Case IPR2014-00972 has been joined with the instant proceeding.

I. INTRODUCTION

We have jurisdiction to hear this *inter partes* review under 35 U.S.C. § 6(c). This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed herein, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–11 and 33 of U.S. Patent No. 7,604,716 B2 (Ex. 1001, "the '716 patent") are unpatentable.

A. Procedural History

GLOBALFOUNDRIES U.S., Inc., GLOBALFOUNDRIES Dresden Module One LLC & Co. KG, and GLOBALFOUNDRIES Dresden Module Two LLC & Co. KG (collectively, "GlobalFoundries") filed a Petition (Paper 2, "Pet.") seeking *inter partes* review of claims 1–11 and 33 ("the challenged claims") of the '716 patent. GlobalFoundries included a Declaration of Uwe Kortshagen, Ph.D. (Ex. 1002) to support its positions. Zond ("Patent Owner") filed a Preliminary Response (Paper 7, "Prelim. Resp."). Pursuant to 35 U.S.C. § 314, on October 14, 2014, we instituted an *inter partes* review of the challenged claims to determine if the claims are unpatentable under 35 U.S.C. § 102 as anticipated by Wang.[2] Paper 9 ("Inst. Dec.").

Subsequent to institution, we granted a revised Motion for Joinder filed by The Gillette Company ("Gillette"), joining Case IPR2014-00972

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[2] U.S. Patent No. 6,413,382 B1, issued July 2, 2002 (Ex. 1004, "Wang").

with the instant trial (Paper 12).[3] Patent Owner filed a Patent Owner Response (Paper 24, "PO Resp."), along with a Declaration of Larry D. Hartsough, Ph.D. (Ex. 2004) to support its positions. Petitioner filed a Reply (Paper 30, "Reply") to the Patent Owner Response, along with a supplemental Declaration of Dr. Kortshagen (Ex. 1025). An oral hearing[4] was held on June 12, 2015. A transcript of the hearing is included in the record. Paper 39.

B. Related Proceedings

The parties indicate that the '716 patent was asserted against Petitioner, as well as other defendants, in seven district court lawsuits pending in the District of Massachusetts. Pet. 1; Paper 5; Ex. 1023.

C. The '716 Patent

The '716 patent relates to a method and apparatus for generating a strongly-ionized plasma, for use in various plasma processes. Ex. 1001, Abstract, 7:30–47. For example, at the time of the invention, plasma sputtering was a widely used technique for depositing films on substrates. *Id.* at 1:24–25. As discussed in the '716 patent, prior art magnetron sputtering systems deposited films having low uniformity and poor target utilization (the target material erodes in a non-uniform manner). *Id.* at 3:20–

[3] We refer to GlobalFoundries and Gillette, collectively, as "Petitioner" throughout this Decision.
[4] The oral hearings for IPR2014-00807, IPR2014-00808, IPR2014-00818, IPR2014-00819, IPR2014-00821, IPR2014-00827, IPR2014-01098, IPR2014-01099, and IPR2014-01100 were consolidated.

33. The '716 patent discloses that increasing the power applied to the plasma, in an attempt to increase the plasma uniformity and density, can also "increase the probability of generating an electrical breakdown condition leading to an undesirable electrical discharge (an electrical arc) in the chamber." *Id.* at 3:34–40.

The '716 patent further discloses that using pulsed DC power can reduce the probability of establishing such an electrical breakdown condition, but that large power pulses still can result in undesirable electrical discharges. *Id.* at 3:42–52. According to the '716 patent, however, first 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 the anode." *Id.* at 6:16–19. The "probability of establishing a breakdown condition is substantially eliminated because the weakly-ionized plasma . . . has a low-level of ionization that provides electrical conductivity through the plasma. This conductivity substantially prevents the setup of a breakdown condition, even when high power is applied to the plasma." *Id.* at 6:20–25.

D. Illustrative Claims

Of the challenged claims, claims 1 and 33 are independent. Claims 2–11 depend from claim 1. Claims 1 and 33 are illustrative, and are reproduced as follows:

> 1. An apparatus for generating a strongly-ionized plasma, the apparatus comprising:
>
> a. an ionization source that generates a weakly-ionized plasma from a feed gas contained in a chamber, the

> weakly-ionized plasma substantially eliminating the probability of developing an electrical breakdown condition in the chamber; and
>
> b. a power supply that supplies power to the weakly-ionized plasma th[r]ough an electrical pulse that is applied across the weakly-ionized plasma, the electrical pulse having at least one of a magnitude and a rise-time that is sufficient to transform the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber.

Ex. 1001, 20:14–27.

> 33. An apparatus for generating a strongly-ionized plasma, the apparatus comprising:
>
> a. means for ionizing a feed gas in a chamber to form a weakly-ionized plasma that substantially eliminates the probability of developing an electrical breakdown condition in the chamber; and
>
> b. means for supplying an electrical pulse across the weakly-ionized plasma to transform the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber.

Id. at 22:41–50.

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 In re Cuozzo Speed Techs., LLC*, 793 F.3d 1268, 1275–79 (Fed. Cir. 2015). Claim terms generally 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). 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).

An inventor may provide a special definition of the term in the specification, as long as this is done so "with reasonable clarity, deliberateness, and precision." *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). In the absence of such a definition, however, limitations are not to be read from the specification into the claims. *In re Van Geuns*, 988 F.2d 1181, 1184 (Fed. Cir. 1993).

Claim Terms

"weakly-ionized plasma" and "strongly-ionized plasma"

Each of claims 1 and 33 recites supplying an electrical pulse to "transform [a] weakly-ionized plasma to a strongly-ionized plasma." Ex. 1001, 20:25–27, 22:48–50. Prior to institution, the parties submitted proposed constructions for the claim terms "a weakly-ionized plasma" and "a strongly-ionized plasma." Pet. 12–13; Prelim. Resp. 11–13. In our Institution Decision, we adopted Patent Owner's proposed constructions, in light of the Specification, as the broadest reasonable interpretations. Inst. Dec. 6–8; *see, e.g.*, Ex. 1001, 6:22–24 ("the weakly-ionized plasma 232 has a low-level of ionization"), 7:16–18 ("high-power pulses generate a

highly-ionized or a strongly-ionized plasma 238 from the weakly-ionized plasma 232").

Subsequent to institution, notwithstanding that neither Patent Owner, nor its expert witness, expressly challenged our claim constructions as to these terms (*see, e.g.*, Ex. 2004 ¶ 21), Patent Owner improperly attempts to import extraneous limitations into the claim by arguing that a specific magnitude for the peak density of ions is required to disclose a strongly-ionized plasma, i.e., "equal to or greater than 10^{12} [cm^{-3}]" (PO Resp. 3–4, 21). It is well settled that if a feature is not necessary to give meaning to a claim term, it would be "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).

Patent Owner relies only on testimony from Petitioner's declarant, Dr. Kortshagen, to support this construction requiring a specific magnitude for the peak density of ions. PO Resp. 3 (citing IPR2014-00818, Ex. 2010, 44:13–58:12). Patent Owner, however, does not direct us to where the Specification provides an explicit definition for this claim term, nor do we discern one. *See Paulsen*, 30 F.3d at 1480. Moreover, Patent Owner's newly proposed construction, requiring a specific ion density range, would render at least the limitation recited in dependent claim 24 superfluous. Ex. 1001, 21:45–47 (Claim 24 states "[t]he method of claim 14 wherein the peak plasma density of the strongly-ionized plasma is greater than about 10^{12} cm^{-3}."). It is well settled that "claims are interpreted with an eye toward

giving effect to all terms in the claim." *Bicon, Inc. v. Straumann Co.*, 441 F.3d 945, 950 (Fed. Cir. 2006); *see also Stumbo v. Eastman Outdoors, Inc.*, 508 F.3d 1358, 1362 (Fed. Cir. 2007) (denouncing claim constructions which render phrases in claims superfluous). Further, "[i]t is improper for courts to read into an independent claim a limitation explicitly set forth in another claim." *Envtl. Designs, Ltd. v. Union Oil Co. of Cal.*, 713 F.2d 698, 699 (Fed. Cir. 1983).

For the foregoing reasons, we decline to adopt Patent Owner's newly proposed construction that requires a specific ion density. Rather, upon consideration of the parties' explanations and supporting evidence before us, we discern no reason to change our claim constructions set forth in the Institution Decision with respect to these claim terms, which adopted Patent Owner's originally proposed constructions. Inst. Dec. 8. Therefore, 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," and the claim term "a strongly-ionized plasma" as "a plasma with a relatively high peak density of ions."

"weakly-ionized plasma substantially eliminating the probability of developing an electrical breakdown condition in the chamber"

Claim 1 recites generating a weakly-ionized plasma, "the weakly-ionized plasma *substantially eliminating the probability of developing an electrical breakdown condition* in the chamber." Ex. 1001, 20:16–20 (emphasis added). Claim 33 includes a similar limitation. *See id.*

at 22:44–46. During the pre-trial stage of this proceeding, Patent Owner argued that this claim term requires the weakly-ionized plasma be

> plasma having a level of ionization that is low enough and sufficiently conductive to substantially eliminate the setup of a breakdown condition *when the plasma is formed* **and** *when an electrical pulse is applied across the plasma to thereby generate a strongly ionized plasma*.

Prelim. Resp. 14–16 (emphasis added). In our Institution Decision, we construed this claim term as "weakly-ionized plasma that substantially eliminates the probability of developing a breakdown condition when an electrical pulse is applied across the plasma thereby to generate a strongly-ionized plasma." Inst. Dec. 9–10.

Subsequent to institution, notwithstanding that neither Patent Owner, nor its expert witness, expressly challenged our construction as to this term (*see, e.g.*, Ex. 2004 ¶ 22), Patent Owner again improperly attempts to import extraneous limitations into the claim by arguing repeatedly that the claims require that arcing[5] is avoided, *even on plasma ignition*. *See, e.g.*, PO Resp. 4, 17. Patent Owner's interpretation, however, is not consistent with the language of the claims, or the Specification. The Specification of the '716 patent describes the weakly-ionized plasma only as substantially eliminating the setup of a breakdown condition *when the high-power pulses are applied across the weakly-ionized plasma* to generate a strongly-ionized plasma; the Specification does not support Patent Owner's assertion that the

[5] Patent Owner often uses the term "arcing" when discussing the claim term "electrical breakdown condition." *See, e.g.*, PO Resp. 9, 16–20.

setup of a breakdown condition be substantially eliminated *when the weakly-ionized plasma itself is formed*. *See, e.g.*, Ex. 1001, 6:16–25 ("Forming the weakly-ionized or pre-ionized plasma . . . substantially eliminates the probability of establishing a breakdown condition in the chamber *when high-power pulses are applied between the cathode . . . and the anode*.") (emphasis added); *id*. at 11:39–47, 12:65–13:4, 16:59–63, 17:48–54; *see also id.* at 5:41–46 ("[A] direct current (DC) power supply . . . is used in an ionization source to generate and maintain the weakly-ionized . . . plasma . . . . In this embodiment, the DC power supply is adapted to generate a voltage that is large enough *to ignite the weakly-ionized plasma*.") (emphasis added); *id.* at 11:51–54 ("[T]he power from the pulsed power supply . . . is continuously applied *after the weakly-ionized plasma . . . is ignited* in order to maintain the weakly-ionized plasma . . . .") (emphasis added). The additional claim language of claims 1 and 33, which recites "transform[ing] the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber," also supports our claim construction set forth in the Institution Decision. Ex. 1001, 20:25–27, 22:48–50.

Upon consideration of the parties' explanations and supporting evidence, we discern no reason to change our claim construction set forth in the Institution Decision with respect to this term. Inst. Dec. 10. Therefore, we construe, in light of the Specification, the claim term "weakly-ionized plasma substantially eliminating the probability of developing an electrical breakdown condition in the chamber" as "weakly-ionized plasma that

substantially eliminates the probability of developing a breakdown condition when an electrical pulse is applied across the plasma thereby to generate a strongly-ionized plasma."

"without developing an electrical breakdown condition"

Claims 1 and 33 recite "transform[ing] the weakly-ionized plasma to a strongly-ionized plasma *without developing an electrical breakdown condition in the chamber*." Ex. 1001, 20:25–27, 22:48–50 (emphasis added). Neither the Specification nor the original disclosure of the '716 patent recites the claim term "without developing an electrical breakdown condition in the chamber." Rather, they disclose a process that *reduces or substantially eliminates the possibility of* developing an electrical breakdown condition in the chamber.

For instance, the Specification of the '716 patent discloses:

> Forming the weakly-ionized or pre-ionized plasma 232 *substantially eliminates the probability* of establishing a breakdown condition in the chamber when high-power pulses are applied between the cathode 204 and the anode 216. The *probability of establishing a breakdown condition is substantially eliminated* because the weakly-ionized plasma 232 has a low-level of ionization that provides electrical conductivity through the plasma. This conductivity *substantially prevents the setup of a breakdown condition*, even when high power is applied to the plasma.

Id. at 6:16–25 (emphases added).

> The partially ionized gas is also referred to as a weakly-ionized plasma or a pre-ionized plasma 232 (FIG. 2B). The formation of weakly-ionized plasma 232 *substantially eliminates the possibility of* creating a breakdown condition when high-power

> pulses are applied to the weakly-ionized plasma 232 as described herein.

Id. at 11:41–47 (emphasis added).

> As described herein, the formation of weakly-ionized plasma 232 *substantially eliminates the possibility of creating a breakdown condition* when high-power pulses are applied to the weakly-ionized plasma 232. The suppression of this breakdown condition *substantially eliminates the occurrence of undesirable arcing* between the anode 216 and the cathode 204.

Id. at 12:65–13:4 (emphases added).

In its Response, Patent Owner argues that "[r]educing, but not eliminating, arcing . . . is not the same as transforming a weakly-ionized plasma to a strongly-ionized plasma *without developing an electrical breakdown condition* because it still admits of some arcing." PO Resp. 20–21 (citing Ex. 2004 ¶ 91). Patent Owner's arguments, attempting to distinguish the claims from Wang, focus on this distinction—reducing versus eliminating. *See id.* at 1–4, 13–21. Patent Owner, however, does not explain adequately why *one with ordinary skill in the plasma art* would have interpreted the claim term "without developing an electrical breakdown condition," *in light of the Specification*, to require the transformation of the weakly-ionized plasma to a strongly-ionized plasma with a guarantee of eliminating *all possibility* of arcing. *See 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").

One with ordinary skill in the art would have recognized that electrical arcing in a real-world plasma sputtering apparatus occurs naturally under certain processing conditions. In this regard, Dr. Kortshagen testifies that

> *[t]he probability of arcing can never be completely eliminated in a realistic sputtering system application.* This stems from arcs being the potential result of stochastic electron density fluctuations that may trigger an instability feedback mechanism capable of creating a short circuit. Such density fluctuations can result from the inherent stochastic motion of electrons, but also from external factors such as cathode and anode erosion over time or the flaking of deposited films from the chamber walls, which all can lead to local enhancements of the electric field. *Because of the unpredictable nature of such events, there is always a chance that a local electron density fluctuation can become sufficiently high to create a short circuit and result in an arc discharge*.

Ex. 1025 ¶ 76 (emphases added). During his cross-examination, Dr. Hartsough also recognized that "[o]ne can't say that an arc would never occur . . . ." Ex. 1029, 188:14–189:3. We credit this testimony of Dr. Kortshagen and Dr. Hartsough as it is consistent with the Specification of the '716 patent. Ex. 1001, 6:16–25, 11:41–47, 12:65–13:4.

It is well settled that "[a] claim construction that excludes the preferred embodiment is rarely, if ever, correct and would require highly persuasive evidentiary support." *Adams Respiratory Therapeutics, Inc. v. Perrigo Co.*, 616 F.3d 1283, 1290 (Fed. Cir. 2010) (internal quotations

omitted). A construction that excludes all disclosed embodiments, as urged by Patent Owner here, is especially disfavored. *MBO Labs., Inc. v. Becton, Dickinson & Co.*, 474 F.3d 1323, 1333 (Fed. Cir. 2007). In short, claim construction requires claim terms to be read so that they encompass the very preferred embodiment they describe. *On-Line Techs., Inc. v. Bodenseewerk Perkin-Elmer GmbH*, 386 F.3d 1133, 1138 (Fed. Cir. 2004).

Here, nothing in the Specification indicates that the possibility of arcing is *completely eliminated* when the weakly-ionized plasma is transformed to a strongly-ionized plasma. Rather, it explicitly states that "the formation of weakly-ionized plasma 232 *substantially eliminates* the possibility of creating a breakdown condition when high-power pulses are applied to the weakly-ionized plasma 232," and "[t]he suppression of this breakdown condition *substantially eliminates* the occurrence of undesirable arcing between the anode 216 and the cathode 204." Ex. 1001, 12:65–13:4 (emphases added).

Given the disclosure in the Specification and the consistent testimony of Dr. Kortshagen and Dr. Hartsough, 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 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

developing an electrical breakdown condition in the chamber" as "substantially eliminating the possibility of developing an electrical breakdown condition in the chamber," 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.

Means-Plus-Function Claim Elements

Petitioner identifies two claim elements recited in claim 33 as means-plus-function elements, invoking 35 U.S.C. § 112, ¶ 6[6]: "means for ionizing a feed gas" and "means for supplying an electrical pulse." Pet. 13–15. We agree that those claim elements are written in means-plus-function form and fall under 35 U.S.C. § 112, ¶ 6, because: (1) each claim element uses the term "means for"; (2) the term "means for" in each claim element is modified by functional language; and (3) the term "means for" is not modified by any structure recited in the claim to perform the claimed function. *See Personalized Media Commc'ns LLC v. Int'l Trade Comm'n*, 161 F.3d 696, 703–04 (Fed. Cir. 1998) (using the term "means for" in a claim creates a rebuttable presumption that the drafter intended to invoke § 112, ¶ 6); *Sage Prods., Inc. v. Devon Indus., Inc.*, 126 F.3d 1420, 1427–28 (Fed. Cir. 1997) (the presumption is not rebutted if the term "means for" is

[6] Section 4(c) of the Leahy-Smith America Invents Act ("AIA") re-designated 35 U.S.C. § 112, ¶ 6, as 35 U.S.C. § 112(f). Pub. L. No. 112-29, 125 Stat. 284, 296 (2011). Because the '716 patent has a filing date before September 16, 2012 (effective date), we will refer to the pre-AIA version of § 112.

modified by functional language and is not modified by any structure recited in the claim to perform the claimed function); *see also Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1349 (Fed. Cir. 2015) (confirming that "use of the word 'means' creates a presumption that § 112, ¶ 6 applies" (citing *Personalized Media*, 161 F.3d at 703)).

The first step in construing a means-plus-function claim element is to identify the recited function in the claim element. *Med. Instrumentation & Diagnostics Corp. v. Elekta AB*, 344 F.3d 1205, 1210 (Fed. Cir. 2003). The second step is to look to the specification and identify the corresponding structure for that recited function. *Id.* A structure disclosed in the specification qualifies as "corresponding" structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim. *B. Braun Med., Inc. v. Abbott Labs.*, 124 F.3d 1419, 1424 (Fed. Cir. 1997). "While corresponding structure need not include all things necessary to enable the claimed invention to work, it must include all structure that actually performs the recited function." *Default Proof Credit Card Sys., Inc. v. Home Depot U.S.A., Inc.*, 412 F.3d 1291, 1298 (Fed. Cir. 2005).

In our Institution Decision, we provided constructions for the means-plus-function elements identified by the Petitioner. Inst. Dec. 11–14. Neither party expressly challenges any aspect of our claim constructions as

to these claim elements. Reply 2; *see generally* PO Resp.[7] Based on the entire record now before us, we discern no reason to modify our claim constructions for purposes of this Final Written Decision. For convenience, our claim constructions are reproduced in the table below:

Means-Plus-Function Claim Element	**Corresponding Structure**
"means for ionizing a feed gas in a chamber to form a weakly-ionized plasma that substantially eliminates the probability of developing an electrical breakdown condition in the chamber"	A power supply electrically connected to a cathode, an anode, and/or an electrode. *See, e.g.*, Ex. 1001, 3:53–4:6, 5:1–43, 16:10–52, 17:24–18:15–27, Figs. 2A, 2B, 6A; Inst. Dec. 12–14.

[7] Patent Owner does not address our construction of the means-plus-function claims elements in its Patent Owner Response, but Dr. Hartsough indicates he disagrees with the construction. *See* Ex. 2004 ¶ 23. To the extent Patent Owner relies on arguments presented only in Dr. Hartsough's Declaration, however, such incorporation by reference is impermissible under our rules. *See* 37 C.F.R. § 42.6(a)(3) ("Arguments must not be incorporated by reference from one document into another document."); *Cisco Sys., Inc. v. C-Cation Techs., LLC*, Case IPR2014-00454, slip op. at 7–10 (PTAB Aug. 29, 2014) (Paper 12) (informative). In any case, we are not persuaded that Dr. Hartsough's proposed construction, which requires the corresponding structure include a particular "gap" between the cathode and anode, is the broadest reasonable interpretation.

Means-Plus-Function Claim Element	Corresponding Structure
"means for supplying an electrical pulse across the weakly-ionized plasma to transform the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber"	A pulsed power supply electrically connected to a cathode, an anode, and/or an electrode. *See, e.g.*, Ex. 1001, 6:52–7:24, 8:9–19, 11:39–12:6, 12:65–13:44, 13:52–60, 16:16–26, 16:59–17:18, 17:48–54, 18:50–61, 19:1–11; Inst. Dec. 14–16.

B. Principles of Law

To prevail in its challenges to the patentability of the claims, Petitioner must prove unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). A claim is unpatentable under 35 U.S.C. § 102 if a single prior art reference expressly or inherently describes each and every limitation set forth in the claim. *See Perricone v. Medicis Pharm. Corp.*, 432 F.3d 1368, 1375 (Fed. Cir. 2005); *Verdegaal Bros., Inc. v. Union Oil Co.*, 814 F.2d 628, 631 (Fed. Cir. 1987).

"To anticipate a claim reciting a means-plus-function limitation, the anticipatory reference must disclose the recited function identically." *Transclean Corp. v. Bridgewood Services, Inc.*, 290 F.3d 1364, 1372 (Fed. Cir. 2002). With respect to anticipatory structure, a means-plus-function limitation "cover[s] the corresponding structure, material, or acts described in the specification and equivalents thereof." 35 U.S.C. § 112, ¶ 6. We analyze the asserted ground of unpatentability in accordance with the above-stated principles.

C. Anticipation by Wang

Petitioner asserts that each of the challenged claims is unpatentable under 35 U.S.C. § 102 as anticipated by Wang. Pet. 39–60. Petitioner explains how each claim limitation is disclosed in Wang. *Id.* Petitioner also relies on the Declarations of Dr. Kortshagen (Ex. 1002; Ex. 1025) to support its Petition and Reply. Patent Owner responds that Wang does not disclose every claim element, relying on the Declaration of Dr. Hartsough (Ex. 2004) to support its Response. PO Resp. 13–29.

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 then we address the parties' contentions in turn.

Wang

Wang discloses a power pulsed magnetron sputtering method for generating a very high plasma density. Ex. 1004, Abstract. 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 magnetron sputtering reactor:

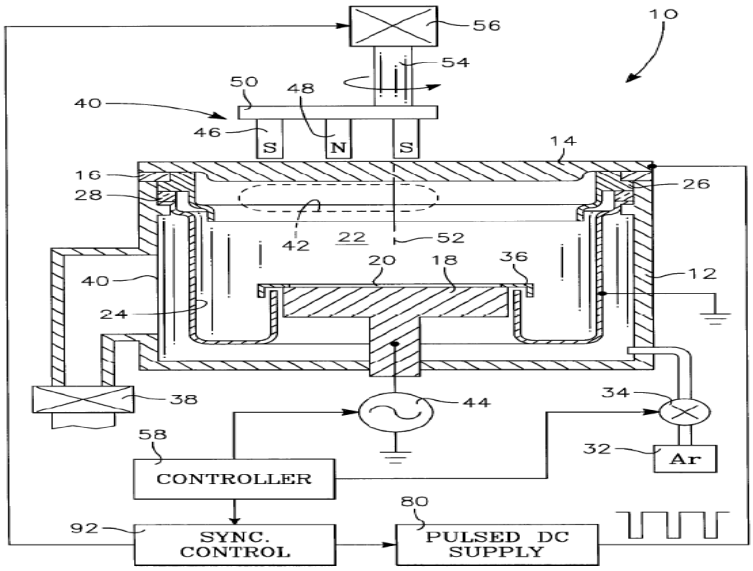


FIG. 1

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. Ex. 1004, 3:57–4:55. According to Wang, the apparatus creates 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. Magnet assembly 40 creates a magnetic field near target 14, which traps electrons from the plasma to increase the electron density. *Id.* at 4:23–27. Wang further recognizes that, if a large portion of the sputtered particles are ionized, the films are deposited more uniformly and effectively. *Id.* at 1:24–29.

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

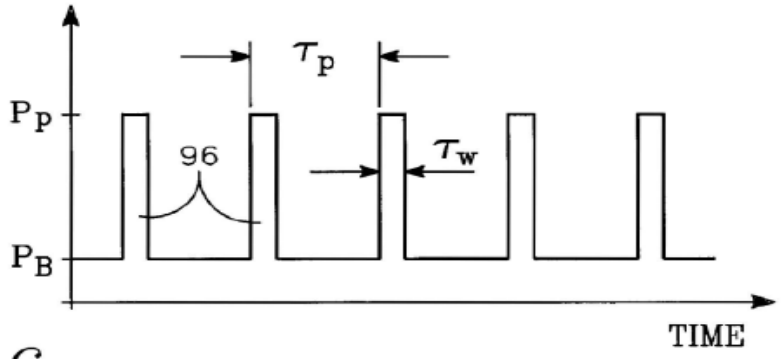


FIG. 6

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. Ex. 1004, 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., 1 kW). *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. 1002 ¶ 122; *see* Pet. 40. In Wang, background power P_B may be generated by DC power supply 100 and peak power P_P may be generated by pulsed power supply 80. Ex. 1004, 7:56–64, Fig. 7; Ex. 1002 ¶ 43.

Independent Claims 1 and 33

As indicated above, Petitioner explains how each claim limitation is disclosed in Wang. Pet. 39–60. For example, with respect to claims 1 and 33, Petitioner contends that DC power supply 100 of Wang discloses the claimed ionization source (claim 1) and means for ionizing (claim 33), which supplies background power P_B that generates a weakly-ionized plasma from a gas, such as an argon feed gas. *Id.* at 41–45, 49; Ex. 1004, 7:56–61, 4:5–8, Figs. 6, 7. Petitioner further contends that pulsed DC power supply 80 of Wang discloses the claimed power supply, which supplies pulses (high power pulses P_P) to the weakly-ionized plasma, to generate a strongly-ionized plasma. Pet. 45–50; Ex. 1004, 7:19–30, 7:61–62, Figs. 6, 7.

With respect to the independent claims, the parties' dispute mainly centers on: (1) whether Wang discloses the "transform[ing] . . . without developing an electrical breakdown condition" limitation; and (2) whether Wang discloses the claimed "electrical pulse." We address each of these issues in turn.

Transforming a weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition

Petitioner asserts that Wang discloses "transform[ing a] weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition," as recited in each of claims 1 and 33. Pet. 45–50. According to Petitioner, "Wang teaches that maintaining the weakly-ionized plasma between the pulses reduces arcing, or breakdown conditions." *Id.* at 42 (citing Ex. 1004, 7:3–49; Ex. 1002 ¶ 128). An

annotated version of Figure 6 of Wang is reproduced below (annotations by Petitioner, Pet. 10):

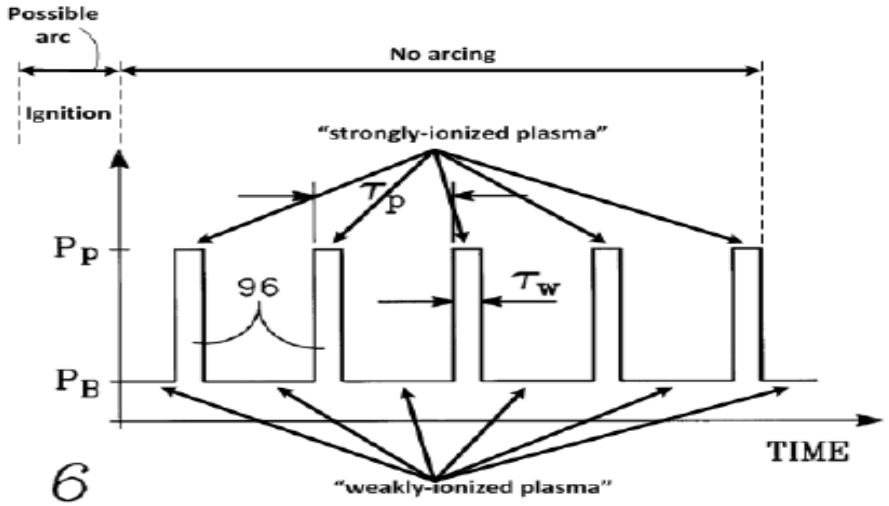


FIG. 6

As shown in annotated Figure 6, the target is maintained at background power level P_B between power pulses 96, rising to peak power level P_P. Ex. 1004, 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. Petitioner asserts "Wang teaches that arcing may occur during ignition, i.e., prior to the first pulse shown in Fig. 6, and that since the plasma need not be reignited thereafter, arcing will not occur during subsequent applications of the background and peak power levels, P_B and P_P." Pet. 47 (citing Ex. 1002 ¶ 139); *see* Ex. 1002 ¶ 129; *see also* Ex. 1004, 7:25–28 ("As a result, once the plasma has been ignited at the beginning of sputtering prior to the illustrated waveform [Fig. 6], no more plasma ignition occurs.").

In its Response, Patent Owner argues that Wang does not disclose eliminating arcing. PO Resp. 1, 17–22. In this regard, Patent Owner draws a distinction between *reducing* electrical breakdown conditions and *eliminating* electrical breakdown conditions. *Id.* Patent Owner argues that "[e]lectrical breakdown conditions such as arcing are still possible when a pulse is applied across a pre-existing plasma, particularly when there is a large, abrupt increase in the electrical field as would occur upon the sudden application of a power pulse, such as in the transition from P_B to P_P [of Wang]." *Id.* at 17–18 (citing Ex. 2004 ¶ 65). To support Patent Owner's contention, Dr. Hartsough testifies "Wang views arcing as a problem that can be improved, but not eliminated, by having the plasma maintained with a background fixed power. Note that even this does not stop the plasma from arcing, but merely reduces arcing." Ex. 2004 ¶ 64. Dr. Hartsough continues, "Wang's use of pre-ionization did not eliminate arcing for his power pulses, it only reduced the likelihood of the same." *Id.* ¶ 65.

Based on the evidence before us, we are not persuaded by Patent Owner's arguments and expert testimony. As noted in our claim construction above, we do not construe claims 1 and 33 to require a guarantee of eliminating *all possibility* of an electrical breakdown condition or arcing. Wang discloses that the on-and-off pulsing in the first embodiment (shown in Figure 4), where arcing admittedly occurs, can be improved further by maintaining a background power level P_B between pulses to avoid arcing, as illustrated by Wang's second embodiment in Figure 6. *See* Ex. 1004, 7:1–8:14. Notably, Wang recognizes that, in the

first embodiment (shown in Figure 4), because the plasma is ignited with a high power pulse in each pulse cycle, the chamber impedance dramatically changes between the on-and-off phases, and large particles are dislodged from the target or chamber. *Id*. at 5:28–32, 7:1–13. By contrast, in Wang's second embodiment (as shown in Figure 6), the plasma is ignited only once at a much lower power level P_B. *Id*. at 7:47–55. Because the weakly-ionized plasma exists in the chamber after ignition, the "chamber impedance changes relatively little between the two power levels P_B, P_P," and "particulates produced by arcing are much reduced." *Id*.

Dr. Kortshagen testifies that

> Wang's disclosure of the impedance changing relatively little between the two power levels indicates to a person of ordinary skill in the art that no arcing occurs when the high-power pulse P_P is applied to the weakly-ionized plasma (maintained by P_B), since any arcing would cause a drastic change in chamber impedance as the plasma current short circuits.

Ex. 1025 ¶ 75; *see* Reply 4. Given the prior art disclosures and the evidence before us, we credit Dr. Kortshagen's testimony (Ex. 1002 ¶¶ 136–145; Ex. 1025 ¶¶ 74–79). Further still, the power supply operation parameters disclosed in Wang fall within the broad ranges disclosed in the '716 patent. *See* Ex. 1025 ¶¶ 29–30, Fig. 3; *compare* Ex. 1001, 6:55–64, Fig. 4, *with* Ex. 1004, 7:13–25, 5:66–65, Fig. 6. We, thus, agree with Dr. Kortshagen that one of ordinary skill in the art would recognize the embodiment of Figure 6 of Wang discloses "how to create a strongly-ionized plasma (through application of P_P pulses) from a weakly-ionized plasma (maintained by P_B) without forming an arc." Ex. 1025 ¶ 75; *see id.* ¶ 79.

Patent Owner also attempts to distinguish this limitation of claims 1 and 33 based on several arguments that import extraneous limitations into the claims. For example, Patent Owner argues that the embodiment of Figure 6 of Wang "does not solve the problem of arcing *during plasma ignition*. Instead, it only reduc[es] the amount of arcing by keeping the plasma maintained so as not to require re-ignition with each pulse." PO Resp. 17 (citing Ex. 1004, 7:47–55) (emphasis added). Patent Owner additionally argues that because Wang does not disclose a magnitude for the peak density of ions, Wang does not teach a strongly-ionized plasma at all. *Id.* at 4 (citing IPR2014-00818, Ex. 2010, 212:20–22, 216:2–217:21, 154:23–155:15). The claims, however, do not require either of these limitations. *See supra* Section II.A. As discussed in our claim construction above, the claims do not require "no arcing," or "no electrical breakdown condition," at ignition. *See* Reply 3–4 ("Wang's discussion of arcing during plasma ignition is irrelevant to whether arcing occurs when Wang energizes its weakly-ionized plasma into a strongly-ionized plasma."). There also is no requirement in the claims that the strongly-ionized plasma have a particular magnitude.

Given the evidence before us in the entire record, we determine that Petitioner has demonstrated, by a preponderance of evidence, that Wang discloses "transform[ing a] weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition," as recited in each of claims 1 and 33.

Electrical pulse

Petitioner asserts that Wang discloses an "electrical pulse having at least one of a magnitude and a rise-time that is sufficient to transform the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber," as recited in claim 1, and "means for supplying an electrical pulse across the weakly-ionized plasma to transform the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber," as recited in claim 33. Pet. 47–51. According to Petitioner,

> pulsed DC supply 80 [of Wang] . . . generates a train of voltage pulses. . . . Application of these voltage pulses to Wang's cathode 14 and anode 24 produces Wang's peak power pulses, P_P, which are applied to Wang's weakly-ionized plasma . . . . When one of Wang's voltage pulses is applied, an electric field is produced between the cathode 14 and the grounded anode 24.

Id. at 45 (citing Ex. 1004, 7:61–62, Fig. 7; Ex. 1002 ¶ 136). Petitioner further asserts that "Wang generates a strongly-ionized plasma with the peak power pulses, P_P." *Id.* at 46 (citing Ex. 1002 ¶ 137); *see also* Ex. 1004, 7:29–31 ("[T]he application of the high peak power P_P . . . quickly causes the already existing [weakly-ionized] plasma to spread and increases the density of the plasma."). According to Petitioner, "[t]he electrical pulses disclosed in Wang . . . have both a magnitude and a rise time and are applied to the weakly-ionized plasma." Pet. 50 (citing Ex. 1004, 5:23–27; Ex. 1002 ¶ 152).

In its Response, Patent Owner argues that Wang "fails to teach or suggest controlling *voltage* during [sputtering material from a target] or

when generating a high-density plasma." PO Resp. 1; *see id.* at 14–16. Patent Owner further argues that Wang "does not *control voltage* (or the resulting electric field) rise time for any purpose, and certainly not for the purpose of achieving an increase in ionization rate." PO Resp. 15–16 (citing Ex. 2004 ¶ 60) (emphasis added). These arguments are not commensurate with the scope of the challenged claims, none of which recite a *voltage* pulse, let alone *controlling* such a pulse, as asserted by Patent Owner. *See In re Self*, 671 F.2d 1344, 1348 (CCPA 1982) (stating that limitations not appearing in the claims cannot be relied upon for patentability). Although Patent Owner argues that Wang does not disclose a voltage pulse, the claims recite only an "electrical pulse"; as admitted by Dr. Hartsough, both power pulses and voltage pulses are electrical pulses. *See* Reply 7 (citing Ex. 1028, 43:11–15). In any case, Petitioner relies on "pulsed DC supply 80 [of Wang] that generates a train of *voltage pulses*" as disclosing the claimed "electrical pulse." Pet. 45 (citing Ex. 1004, 7:61–62, Fig. 7) (emphasis added).

As to the result that the claimed "electrical pulse . . . *is sufficient to transform the weakly-ionized plasma to a strongly-ionized plasma*," Petitioner notes that Wang specifically discloses the peak power pulses P_P have a magnitude of 1 MW (Pet. 50 (citing Ex. 1004, 7:19–25; Ex. 1002 ¶ 153)) and a rise time (*id.* at 50–51 (citing Ex. 1004, 5:23–26; Ex. 1002 ¶ 154)). Petitioner asserts that "[b]ecause Wang's pulse produces a strongly-ionized plasma, the magnitude and rise time of the pulse 'is sufficient to transform the weakly-ionized plasma to a strongly-ionized

plasma' as required by claim 1." *Id.* at 51 (citing Ex. 1002 ¶ 155). Because claim 1 does not require any particular magnitude or rise time of the electrical pulse, we, thus, are persuaded that Wang discloses an electrical pulse "having at least one of a magnitude and a rise-time that is sufficient to transform the weakly-ionized plasma to a strongly-ionized plasma," as claimed.

As discussed in the "transforming" section above, we also are persuaded that Wang discloses an electrical pulse "transform[ing a] weakly-ionized plasma to a strongly-ionized plasma *without developing an electrical breakdown condition*."

Given the evidence before us in the entire record, we determine that Petitioner has demonstrated, by a preponderance of evidence, that Wang discloses an "electrical pulse having at least one of a magnitude and a rise-time that is sufficient to transform the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber," as recited in claim 1, and "means for supplying an electrical pulse across the weakly-ionized plasma to transform the weakly-ionized plasma to a strongly-ionized plasma without developing an electrical breakdown condition in the chamber," as recited in claim 33.

For the reasons discussed, we determine that Petitioner has demonstrated, by a preponderance of evidence, that claims 1 and 33 are anticipated by Wang.

Claims 4, 5: constant power/constant voltage

Claims 4 and 5 depend from claim 1, and recite "wherein the power supply generates a constant power," and "wherein the power supply generates a constant voltage," respectively. Ex. 1001, 20:37–40. Figure 4 of the '716 patent is reproduced below.

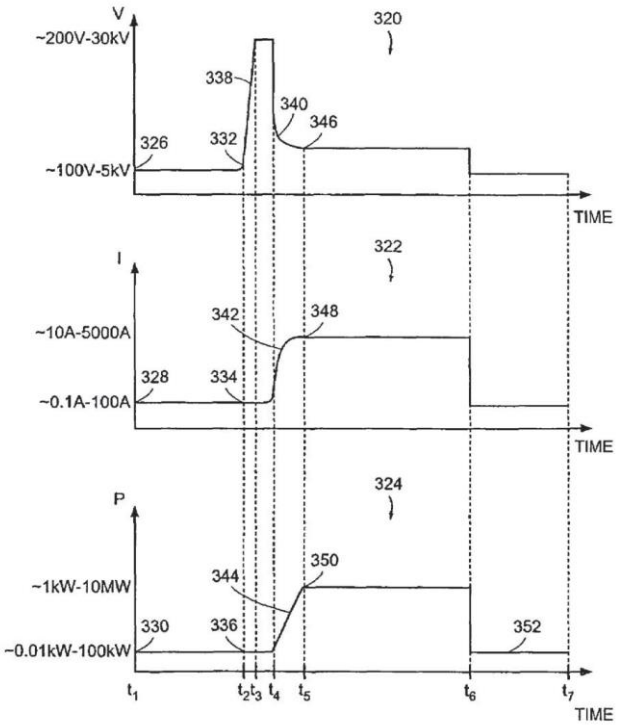


FIG. 4

Figure 4 illustrates a "graphical representation of the applied voltage, current, and power as a function of time for periodic pulses applied to the plasma in the plasma generating apparatus" of Figure 2A. Ex. 1001, 2:1–4.

As noted by Petitioner, Figure 4 of the '716 patent "shows constant power segments between (a) t_1 and t_2 (b) t_5 and t_6 and (c) t_6 and t_7." Pet. 53 (citing Ex. 1002 ¶ 162). Relying on testimony from Dr. Kortshagen,

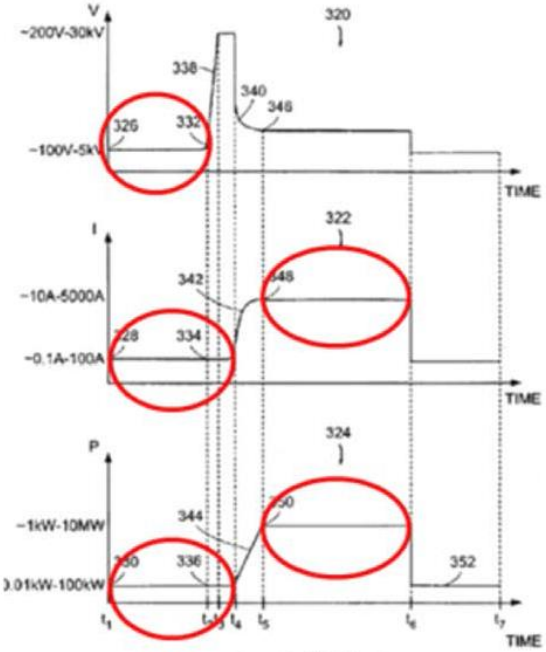
Petitioner further asserts that "Wang's pulsed DC power supply 80 . . . generates a peak level power, P_P, which is constant for the duration of the pulse τ_w . . . ." *Id.* (citing Ex. 1002 ¶ 162); *see* Ex. 1004, Fig. 6. Because application of the train of negative voltage pulses produces Wang's peak power pulses P_P, "[o]ne of ordinary skill would have understood that Wang's voltage would be constant for at least a portion of the duration of the pulse τ_w so as to produce pulse P_P of constant power." Pet. 53 (citing Ex. 1002 ¶ 164).

Patent Owner argues Wang does not disclose a power supply that generates a constant power or a constant voltage. PO Resp. 22–26. According to Patent Owner, and its expert Dr. Hartsough, Wang's Figure 6 shows only an *idealized* power pulse, and the actual shape of Wang's power pulse is "most likely to be described as rounded (e.g., Gaussian, or the like), not having any constant power portion." *Id.* at 23 (citing Ex. 2004 ¶ 94). Patent Owner also argues that, even "[i]f . . . power is constant during the pulse τ_w taught by Wang, then the product of voltage and current must be constant for that period," and thus, due to Wang's "admitted drop in plasma impedance during the pulse, current will rise and voltage will drop," rather than be constant. *Id.* at 24–25 (citing Ex. 2004 ¶¶ 34, 95).

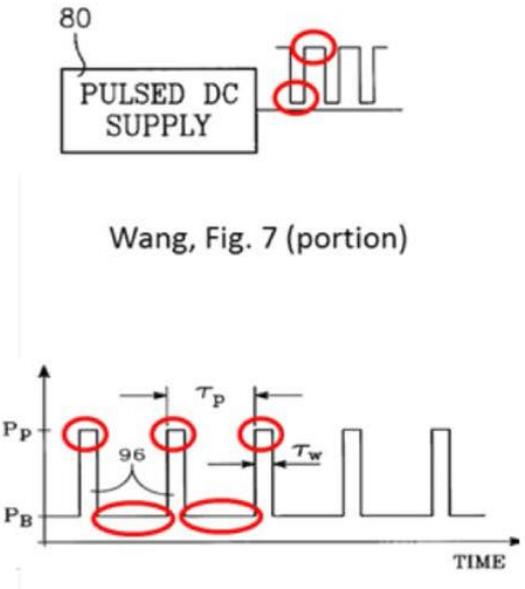
Upon consideration of the parties' contentions and supporting evidence, we are not persuaded by Patent Owner's argument and expert testimony. As Petitioner explains, although the illustrated waveforms in Wang may be idealized, even if one were to account for some rise and fall times, one of ordinary skill in the art would still understand Wang to

disclose constant power for a period close to τ_w. Reply 9. Further, Dr. Kortshagen notes that Figure 4 of the '716 patent is idealized as well. Ex. 1025 ¶ 96. Indeed, the '716 patent explicitly states that Figure 4 illustrates *graphical representations*, and not the actual shape of the voltage and power pulses. Ex. 1001, 12:37–41.

In addition, a side-by-side comparison of annotated versions of Figures 6 and 7 of Wang provided by Dr. Kortshagen, with an annotated version of Figure 4 of the '716 patent (annotations added by Dr. Kortshagen, Ex. 1025 ¶ 95 (Kortshagen, Figure 9)), reproduced below, reveals that Wang and the Specification of the '716 patent disclose similar waveforms.



'716 patent, FIG. 4



Wang, Fig. 6

In Figure 4 of the '716 patent, reproduced above, voltage, current, and power are shown as a function of time. As shown in Figure 7 of Wang, also reproduced above, pulsed DC power supply 80 produces a series of voltage

pulses, and portions of the voltage pulses are constant. Ex. 1004, 7:57–61. Figure 6 of Wang, reproduced above, depicts that portions of the power pulses are constant. Moreover, it is clear from Figures 6 and 7 of Wang that Wang's system is designed to maintain both the amplitude of the voltage pulses and the amplitude of the power pulses constant during the entire process. Dr. Kortshagen testifies that "[w]hile Wang's voltage and power curves will include rise and fall times, there will also be portions of the pulses in which the voltage and/or power are substantially constant, as illustrated." Ex. 1025 ¶ 97.

Further, Patent Owner's argument premised on "Wang's admitted drop in plasma impedance during the pulse" (PO Resp. 25) conflates the two separate embodiments of Wang. As discussed above, in Wang's second embodiment (shown in Figure 6), the "chamber impedance changes relatively little between the two power levels P_B, P_P," (e.g., during the pulse). Ex. 1004, 7:47–55; *see* Reply 10–11.

Lastly, Patent Owner and Dr. Hartsough argue that Wang controls the power pulse, and not the voltage pulse. PO Resp. 25–26; Ex. 2004 ¶¶ 96–97. We have already addressed that argument and supporting evidence in the "electrical pulse" section above, and determined that they are unavailing.

Based on the evidence in this record, we are persuaded that one with ordinary skill in the art would have recognized that Wang discloses that portions of voltage and power are constant, respectively, as required by claims 4 and 5. We, thus, determine that Petitioner has demonstrated, by a preponderance of evidence, that claims 4 and 5 are anticipated by Wang.

Claim 6: supplying power between about 50 microseconds and five seconds after the ionization source generates the weakly-ionized plasma

Claim 6 depends from claim 1, and recites "wherein the power supply supplies power to the weakly-ionized plasma at a time that is between about fifty microsecond and five second after the ionization source generates the weakly-ionized plasma." Ex. 1001, 20:41–44. Petitioner provides calculations showing that, in Wang, the "duration of the weakly-ionized plasma, i.e., during the background power P_B," (between pulses of peak power P_P) is between 450 µs and 4,950 µs. Pet. 53–54 (citing Ex. 1002 ¶¶ 166–167; Ex. 1004, 5:43–46, 5:55–56, Fig. 6).

Patent Owner argues that, in the embodiment of Figure 6 of Wang, "the weakly-ionized plasma is generated sometime ***before*** the curve depicted in the figure," and that, because "Wang says nothing about the time between the generation of the weakly-ionized plasma (which is not shown in the figure) and the application [of] first power pulse P_P," it cannot anticipate claim 6. PO Resp. 27–28. Patent Owner argues that during the time between power pulses P_P the weakly-ionized plasma is maintained, but not generated. *Id.* Patent Owner's arguments are premised on an alleged distinction between *generating* and *maintaining* the weakly-ionized plasma. *See id.* This argument, however, is mere semantics, and attempts to incorporate a temporal limitation not present into the claim. Claim 6 does not require the claimed time-frame occur before the *first* time the power supply supplies power to the weakly-ionized plasma.

Regarding "generation" of the weakly-ionized plasma, Dr. Kortshagen testifies that

> [a] person of ordinary skill in the art understands that weakly-ionized plasma is "generated" multiple times during pulsed sputtering systems. The weakly-ionized plasma can be generated from feed gas following ignition and also from the combination of feed gas and strongly-ionized plasma following application of a pulse. Weakly-ionized plasma formed from strongly-ionized plasma is generated when negatively charged electrons and positively charged ions recombine (in the discharge gap or at the chamber walls). As a result, weakly-ionized plasma can be generated at any point in time, whether after ignition (from feed gas) or after application of an electrical pulse (from feed gas and strongly-ionized plasma).

Ex. 1025 ¶ 102. Upon consideration of the parties' contentions and supporting evidence, we are persuaded by Petitioner's argument and evidence that, one of ordinary skill in the art would understand that the weakly-ionized plasma is generated at both ignition, as well as after application of an electrical pulse. Reply 14 (citing Ex. 1025 ¶¶ 100–103).

Patent Owner does not provide persuasive evidence supporting its contention that one of skill in the art would consider Wang in view of an alleged distinction between *generating* and *maintaining* a weakly-ionized plasma. In its Motion on Observations, Patent Owner argues that Dr. Kortshagen's testimony regarding claim 6 is inconsistent with his testimony regarding claim 1, because the "ionization source," and not the "strongly-ionized plasma," must generate the weakly-ionized plasma. Paper 32, 1–3. We do not find this argument persuasive, as Dr. Kortshagen testified that during the time between the electrical pulses, weakly-ionized

plasma can be generated from feed gas (by the claimed "ionization source") *and* from strongly-ionized plasma (by recombination of negatively charged atoms and positively charged atoms). Ex. 1025 ¶ 102. This is consistent with the language of claim 6, which requires the ionization source generate weakly-ionized plasma.

Given the evidence in the record before us, we determine that Petitioner has demonstrated, by a preponderance of evidence, that Wang discloses a power supply that supplies power to the weakly-ionized plasma at a time that is between about fifty microseconds and five seconds after the ionization source generates the weakly-ionized plasma, as required by claim 6. We, thus, determine that Petitioner has demonstrated, by a preponderance of evidence, that claim 6 is anticipated by Wang.

Claim 7: quasi-static electric field

Claim 7 depends from claim 1, and recites "wherein the power supply supplies power to the weakly-ionized plasma for a duration that is sufficient to generate a quasi-static electric field across the weakly-ionized plasma." Ex. 1001, 20:45–48. The Specification of the '716 patent describes a "quasi-static electric field" as "an electric field that has a characteristic time of electric field variation that is much greater than the collision time for electrons with neutral gas particles." *Id.* at 7:9–12. Dr. Kortshagen testifies that this means "the pulse width of the electric field must be much greater than the collision time for electrons." Ex. 1025 ¶ 106.

Petitioner provides calculations showing that Wang's longest collision time is 0.188 microseconds (μs). Pet. 55 (citing Ex. 1002 ¶¶ 169–170;

Ex. 1004, 4:5–7, 7:31–40; Ex. 1010, 1:36–48; Ex. 1011). Petitioner then compares this value to the disclosed pulse width τ_w of the peak power P_P of "at least 50 μs," concluding that "50 μs is much greater than 0.188 μs," and, thus, "Wang's electric field is quasi-static as required by claim 7." *Id.* at 55–56 (citing Ex. 1002 ¶ 172; Ex. 1004, 5:45–48).

Patent Owner argues that, because Petitioner does not provide a value for "a characteristic time of electric field variation," it has not made a comparison between this value and collision time, and, thus, has not made a sufficient showing regarding whether Wang discloses a quasi-static electric field. PO Resp. 28–29. We agree with Petitioner, however, that the claim does not require an actual "comparison between the characteristic time of electric field variation and collision time," as asserted by Patent Owner (*id.* at 29), but instead requires only that the power be supplied "*for a duration that is sufficient* to generate a quasi-static electric field across the weakly-ionized plasma." Reply 17.

Patent Owner's expert, Dr. Hartsough admitted, with respect to Figure 5 of related U.S. Patent No. 6,896,775,[8] that, "so long as the period between T5 and T6—*i.e.*, a period of constant voltage and power—is longer than the collision time for electrons and neutral atoms, a quasi-static electric field would be produced." Reply 17–18 (citing Ex. 1027, 137:25–138:8). As seen in the comparison of Figure 4 of the '716 patent and Figures 6 and 7 of Wang, reproduced above in the discussion of claims 4 and 5, the period

[8] Figure 4 of the '716 patent is the same as Figure 5 of the '775 patent. *Compare* Ex. 1001, Fig. 4, *with* IPR2014-00578, Ex. 1001, Fig. 5.

between t_5 and t_6 corresponds to the pulse width τ_w of the peak power P_P of Wang. We, thus, are persuaded that Petitioner's showing regarding the pulse width τ_w of the peak power P_P of Wang being greater than Wang's longest collision time, is sufficient to show Wang discloses a quasi-static electric field.

Patent Owner also argues Wang does not disclose that voltage is constant during any part of the power pulse. We have already addressed that argument and its supporting evidence in our discussion of claim 5 above, and determined that it is unavailing.

Given the evidence in the record before us, we determine Petitioner has demonstrated, by a preponderance of evidence, that Wang discloses a power supply that supplies power to the weakly-ionized plasma for a duration sufficient to generate a quasi-static electric field across the weakly-ionized plasma, as required by claim 7. We, thus, determine that Petitioner has demonstrated, by a preponderance of evidence, that claim 7 is anticipated by Wang.

Claims 2, 3, and 8–11

Patent Owner does not provide arguments with respect to any additional limitations added by dependent claims 2, 3, and 8–11. We have reviewed Petitioner's arguments and evidence regarding these claims (Pet. 51–52, 56–60; Ex. 1002 ¶¶ 158, 160, 174–175, 177, 179–180, 182–183; Ex. 1004, 3:4–8, 4:19–31, 7:22–25, 7:36–39, 7:57–63, Fig. 7; Ex. 1001, 1:39–41), and, given the evidence in the record before us, we determine that

Petitioner has demonstrated, by a preponderance of evidence, that each of claims 2, 3, and 8–11 is anticipated by Wang.

III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claims 1–11 and 33 of the '716 patent are unpatentable under 35 U.S.C. § 102 as anticipated by Wang.

IV. ORDER

Accordingly, it is:

ORDERED that claims 1–11 and 33 of U.S. Patent No. 7,604,716 B2 are held *unpatentable*; and

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

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing

PATENT OWNER'S NOTICE OF APPEAL

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The parties have agreed to electronic service in this matter.

An additional copy was served on

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

Respectfully submitted,

Date: November 19, 2015

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