Trials@uspto.gov
571-272-7822

Paper 49
Date: February 9, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

ACORN SEMI, LLC,
Patent Owner.

IPR2020-01207
Patent 10,090,395 B2

Before BRIAN J. McNAMARA, JOHN R. KENNY, and AARON W. MOORE, *Administrative Patent Judges.*

KENNY, *Administrative Patent Judge*.

DECISION
Final Written Decision
Determining Some Challenged Claims Unpatentable
Dismissing Patent Owner's Motion to Exclude
35 U.S.C. § 318(a)

I. INTRODUCTION

Samsung Electronics Co., Ltd. ("Petitioner") filed a Petition, Paper 2 ("Petition" or "Pet."), to institute an *inter partes* review of claims 1–6, 8–12, and 14–16 ("challenged claims") of U.S. Patent No. 10,090,395 B2 (Ex. 1001, "'395 patent"). Acorn Semi, LLC ("Patent Owner") filed a Preliminary Response, Paper 11 ("Prelim. Resp."), contending that the Petition should be denied as to all challenged claims.

On February 10, 2021, we instituted an *inter partes* review of all challenged claims. Paper 21 ("Institution Decision" or "Inst. Dec."). Patent Owner filed a Patent Owner Response (Paper 29, "PO Resp.") and an Updated Mandatory Notice reporting a jury verdict in a related district court litigation (Paper 31; Ex. 2121). Petitioner filed a Reply (Paper 34, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 39, "PO Sur-reply"). Patent Owner also filed a Motion to Exclude certain cross-examination testimony of its expert witness, Dr. Kelin J. Kuhn (Paper 40 "Mot. Excl."). Petitioner filed an Opposition to Patent Owner's Motion to Exclude (Paper 42, "Opp. Mot. Excl."), and Patent Owner filed a Reply to Petitioner's Opposition to Patent Owner's Motion to Exclude (Paper 44, "Reply Mot. Excl."). A transcript of an oral hearing held on October 13, 2021 (Paper 48, "Tr.") has been entered into the record.

We have jurisdiction under 35 U.S.C. § 6. For the reasons discussed below, we determine that Petitioner has shown, by a preponderance of the evidence, that claims 1–6, 8–10, 15, and 16 are unpatentable. Petitioner, however, has not shown, by a preponderance of the evidence, that claims 11, 12, and 14 are unpatentable.

A. Related Matters

The Petition states that the '395 patent is asserted in *Acorn Semi, LLC v. Samsung Electronics Co. Ltd.*, Civil Action No. 2:19-cv-347 (E.D. Tex.) ("Related Litigation"), and that the complaint was served on October 24, 2019. Pet. 3 (citing Ex. 1039).

Patent Owner identifies IPR2020-01282 ("'1282 IPR") as also concerning the '395 patent. Paper 5, 2. Petitioner and Patent Owner identify other *inter partes* reviews concerning patents related to the '395 patent that may be affected by the outcome of this proceeding. *See* Pet. 3, Paper 5, 2. Petitioner also identifies patents and patent applications that are related to the '395 patent. *See* Pet. 4.

B. The '395 Patent

The '395 patent "relates to a process for depinning the Fermi level of a semiconductor at a metal-interface layer-semiconductor junction and to devices that employ such a junction." Ex. 1001, 1:32–35. The '395 patent explains that Schottky's theory concerning the ability of a junction to conduct current in one direction more favorably than in the other direction, i.e., the rectifying behavior of a metal/semiconductor junction (e.g., an aluminum/silicon junction) depends upon a barrier at the surface of the contact between the metal and the semiconductor. *Id.* at 1:52–64. Because the barrier height at the metal/semiconductor interface determines the electrical properties of the junction, controlling the barrier height is an important goal. *Id.* at 3:10–21.

The '395 patent further explains that Schottky's theory postulates the height of the barrier, as measured by the potential necessary for an electron to pass from the metal to the semiconductor, is the difference between the work function of the metal (i.e., the energy required to free an electron at the

Fermi level (the highest occupied energy state of the metal at T=0)) and the electron affinity of the semiconductor (i.e., the difference between the energy of a free electron and the conduction band of the semiconductor); but experimental results indicate a weaker variation of the barrier height with the work function than implied by this model. Ex. 1001, 1:55–2:9. To explain the discrepancy between the predicted and observed behavior, Bardeen introduced the concept of semiconductor surface states, i.e., energy states within the bandgap between the valence and conduction bands at the edge of the semiconductor crystal that arise from incomplete covalent bonds, impurities, and other effects of termination. *Id.* at 2:10–24, Fig. 1 (showing dangling bonds 120). Although Bardeen's model assumes that surface states are sufficient to pin the Fermi level in the semiconductor at a point between the valence and conduction bands, such that the barrier height should be independent of the metal's work function, in experiments, this condition is observed rarely. *Id.* at 2:25–31.

According to the '395 patent, Tersoff proposed that the Fermi level of a semiconductor is pinned near an effective "gap center" due to metal induced gap states (MIGS), which are energy states in the bandgap of the semiconductor that become populated with metal. Ex. 1001, 2:41–47. Thus, the wave functions of electrons in the metal do not terminate abruptly at the surface of the metal, but decay in proportion to the distance from the surface, extending inside the semiconductor. *Id.* at 2:50–54.

> To maintain the sum rule on the density of states in the semiconductor, electrons near the surface occupy energy states in the gap derived from the valence band such that the density of states in the valence band is reduced. To maintain charge neutrality, the highest occupied state (which defines the Fermi level of the semiconductor) will then lie at the crossover point from states derived from the valence band to those derived from

> the conduction band. This crossover occurs at the branch point of the band structure.

Id. at 2:54–63. The '395 patent also notes one further surface effect on diode characteristics is inhomogeneity, i.e., "if factors affecting the barrier height (e.g., density of surface states) vary across the plane of the junction, the resulting properties of the junction are found not to be a linear combination of the properties of the different regions." *Id.* at 3:2–6.

According to the '395 patent, "a classic metal-semiconductor junction is characterized by a Schottky barrier, the properties of which (e.g., barrier height) depend on surface states, MIGS and inhomogeneities." Ex. 1001, 3:6–9. "Before one can tune the barrier height, however, one must depin the Fermi level of the semiconductor." *Id.* at 3:16–18. The '395 patent seeks to depin the Fermi level of the semiconductor while still permitting substantial current flow between the metal and the semiconductor. *Id.* at 3:18–21. The '395 patent describes depinning the Fermi level as follows:

> By depinning the Fermi level, the present inventors mean a condition wherein all, or substantially all, dangling bonds that may otherwise be present at the semiconductor surface have been terminated, and the effect of MIGS has been overcome, or at least reduced, by displacing the semiconductor a sufficient distance from the metal.

Id. at 3:36–41. The '395 patent achieves this goal using thin interface layers disposed between a metal and a silicon-based semiconductor to form a "metal-interface layer-semiconductor junction" with minimum specific contact resistances. *Id.* at 3:25–29. "The interface layer thickness corresponding to this minimum specific contact resistance will vary depending on the materials used." *Id.* at 3:29–36. That corresponding thickness "allows for depinning the Fermi level while permitting current to flow when the junction is appropriately biased." *Id.* "Minimum specific

contact resistances of less than or equal to approximately 10 Ω-μm^2 or even less than or equal to approximately 1 Ω-μm^2 may be achieved for such junctions in accordance with the present invention." *Id.* at 3:42–45. Such low contact resistances are achieved by selecting a metal with a work function near the conduction band of the semiconductor for n-type semiconductors, or a work function near the valence band for p-type semiconductors. *Id.* at 5:30–34.

Figure 8 of the '395 patent is reproduced below:

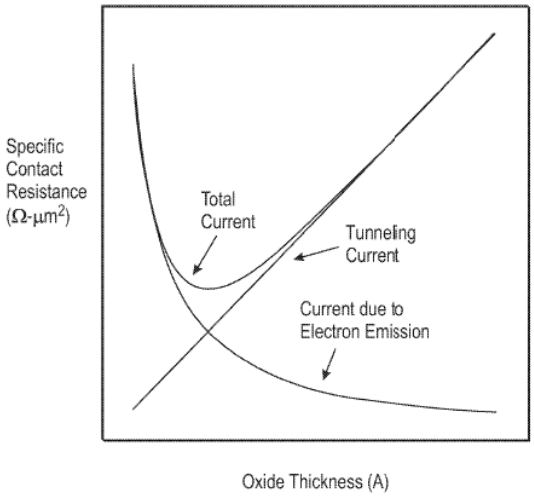


Figure 8 of the '395 patent

Figure 8 above is a graph of interface specific contact resistance versus interface thickness for a structure where the work function of the metal is the same as the electron affinity of the semiconductor, such that the Fermi level of the metal lines up with the conduction band of the semiconductor. Ex. 1001, 14:42–48. According to the '395 patent, Figure 8 shows that, at large thicknesses, the interface layer poses significant resistance to current, but as the interface layer thickness decreases, resistance falls due to increased tunneling current. *Id.* at 14:48–51. However, at some point, as the interface layer gets thinner, the effect of MIGS increasingly pulls the Fermi

level of the metal down towards the mid-gap of the semiconductor, creating a Schottky barrier and increasing resistance. *Id.* at 14:51–55. Thus, there is an optimum thickness where the resistance is at a minimum and the effect of MIGS has been reduced to depin the metal and lower the Schottky barrier, but the layer is sufficiently thin to allow significant current across the interface layer, such that specific contact resistances of less than or equal to approximately 2500 Ω-μm^2, 1000 Ω-μm^2, 100 Ω-μm^2, 50 Ω-μm^2, 10 Ω-μm^2, or less than 1 Ω-μm^2 reportedly can be achieved. *Id.* at 14:56–65.

In one embodiment, an electrical device has an interface layer that may be a monolayer or several monolayers of passivating material (e.g., a nitride, oxide, oxynitride, arsenide, hydride and/or fluoride) and may include a separation oxide layer. Ex. 1001, 3:46–59. The specific contact resistance for this electrical device is reported to be less than 10 Ω-μm^2. *Id.* at 3:52–53. In another embodiment, the interface layer consists of a passivation layer fabricated by exposing the semiconductor to nitrogenous material (e.g., ammonia (NH_3), nitrogen (N_2) or unbound gaseous nitrogen (N) generated from a plasma process). *Id.* at 3:60–64. Another embodiment uses an interface layer of passivating material disposed between the surface of a semiconductor and a conductor in which the interface layer is of a sufficient thickness to reduce the effect of MIGs in the semiconductor and passivates the semiconductor but, because the thickness of the interface layer is chosen to provide minimum, or near minimum, specific contact resistance for the junction, significant current may flow between the conductor and the semiconductor. *Id.* at 4:1–14.

In other embodiments, the interface layer is configured to allow a Fermi level of the conductor to (i) align with a conduction band of the semiconductor, (ii) align with a valence band of the semiconductor, and (iii)

to be independent of the Fermi level of the semiconductor, allowing current to flow between the conductor and the semiconductor when the junction is biased because the thickness of the interface layer corresponds to a minimum or near minimum contact resistance for the junction. Ex. 1001, 4:15–26. Specific contact resistances of less than or equal to approximately 2500 Ω-μm^2, 1000 Ω-μm^2, 100 Ω-μm^2, 50 Ω-μm^2, 10 Ω-μm^2, or less than 1 Ω-μm^2 reportedly can be achieved. *Id.* at 4:27–30.

C. Claims

As mentioned, Petitioner challenges claims 1–6, 8–12, and 14–16. Claim 1 is independent and reads:

> 1. An electrical junction, comprising a region in a semiconductor substrate, a metal electrical contact to said region, and an interface layer between said region and said metal electrical contact, said region being electrically connected to said metal electrical contact through said interface layer and said interface layer comprising a metal oxide and a semiconductor oxide, and being in contact with said region in the semiconductor substrate and said metal electrical contact.

Ex. 1001, 18:45–52.

D. Asserted Ground

Petitioner asserts that the challenged claims would have been unpatentable based on the following ground:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–6, 8–12, and 14–16	102(b)	Grupp '483[1]

Pet. 6, 27.

E. Level of Ordinary Skill in the Art

Petitioner describes an ordinarily skilled artisan as having any of the following combinations of education and experience:

[1] U.S. Patent No. 7,176,483 B2, issued Feb. 13, 2007 (Ex. 1021).

> [i] a Ph.D. in electrical engineering, physics, materials science, or chemical engineering, with two years of practical experience with semiconductor research and design;
>
> [ii] a Master's degree in electrical engineering, physics, materials science, or chemical engineering, with four years of practical experience with semiconductor research and design; or
>
> [iii] a Bachelor's degree in electrical engineering, physics, materials science, or chemical engineering, with six to eight years of practical experience with semiconductor research and design.

Pet. 13–14 (citing Ex. 1022, Schubert Decl. ¶¶ 70–71).

The Patent Owner Preliminary Response did not comment on the level of ordinary skill in the art. In our Institution Decision, we were persuaded that Petitioner's description of the level of ordinary skill is appropriate for the subject matter of the '395 patent and applied it in that Institution Decision. Inst. Dec. 9–10. The Patent Owner Response does not comment on the level of ordinary skill in the art. *See generally* PO Resp. Thus, we apply the description of the level of ordinary skill set forth in the Petition in this Decision. Ex. 1022, Schubert Decl. ¶¶ 70–71.

II. CLAIM CONSTRUCTION

For petitions filed after November 13, 2018, we interpret claim terms using "the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b)." 37 C.F.R. § 42.100(b) (2019). In this context, claim terms "are generally given their ordinary and customary meaning" as understood by a person of ordinary skill in the art in question at the time of the invention. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the

prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17). Extrinsic evidence is "less significant than the intrinsic record in determining 'the legally operative meaning of claim language.'" *Phillips*, 415 F.3d at 1317.

Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

We construe only those claim terms that require analysis to determine whether to institute *inter partes* review. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that "only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy").

A. Specific Contact Resistivity

Petitioner argues that the term "specific contact resistivity," recited in claim 6, should be construed to be interchangeable with the term "specific contact resistivity." Pet. 15. Petitioner asserts that the Specification of the '395 patent and claim 6 use those terms interchangeably. *Id.* (citing Ex. 1001, 3:25–29, 3:42–45, 3:52–53, 4:22–30). Petitioner further asserts that ordinarily skilled artisans commonly used those terms interchangeably. *Id.* (citing Ex. 1133, 2; Ex. 1022, Schubert Decl. ¶¶ 74–76). Patent Owner's Preliminary Response did not respond explicitly to Petitioner's proposed construction. *See generally* Prelim. Resp. Our Institution Decision construed the terms "specific contact resistivity" and "specific contact resistance" to be interchangeable. Inst. Dec. 11. The Patent Owner Response does not request that we alter this construction. *See generally* PO Resp.

Upon review of the record, we construe the terms "specific contact resistivity" and "specific contact resistance" to be interchangeable.

III. ANALYSIS

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring inter partes review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

Anticipation is a question of fact, as is the question of what a prior art reference teaches. *In re NTP, Inc.*, 654 F.3d 1279, 1297 (Fed. Cir. 2011). "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. Inc., v. Union Oil Co.*, 814 F.2d 628, 631 (Fed. Cir. 1987); *see also Finisar Corp. v. DirecTV Grp., Inc.*, 523 F.3d 1323, 1334 (Fed. Cir. 2008) (to anticipate a patent claim under 35 U.S.C. § 102, "a single prior art reference must expressly or inherently disclose each claim limitation"). Moreover, "[b]ecause the hallmark of anticipation is prior invention, the prior art reference—in order to anticipate under 35 U.S.C. § 102—must not only disclose all elements of the claim within the four corners of the document, but must also disclose those elements 'arranged as in the claim.'" *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983)).

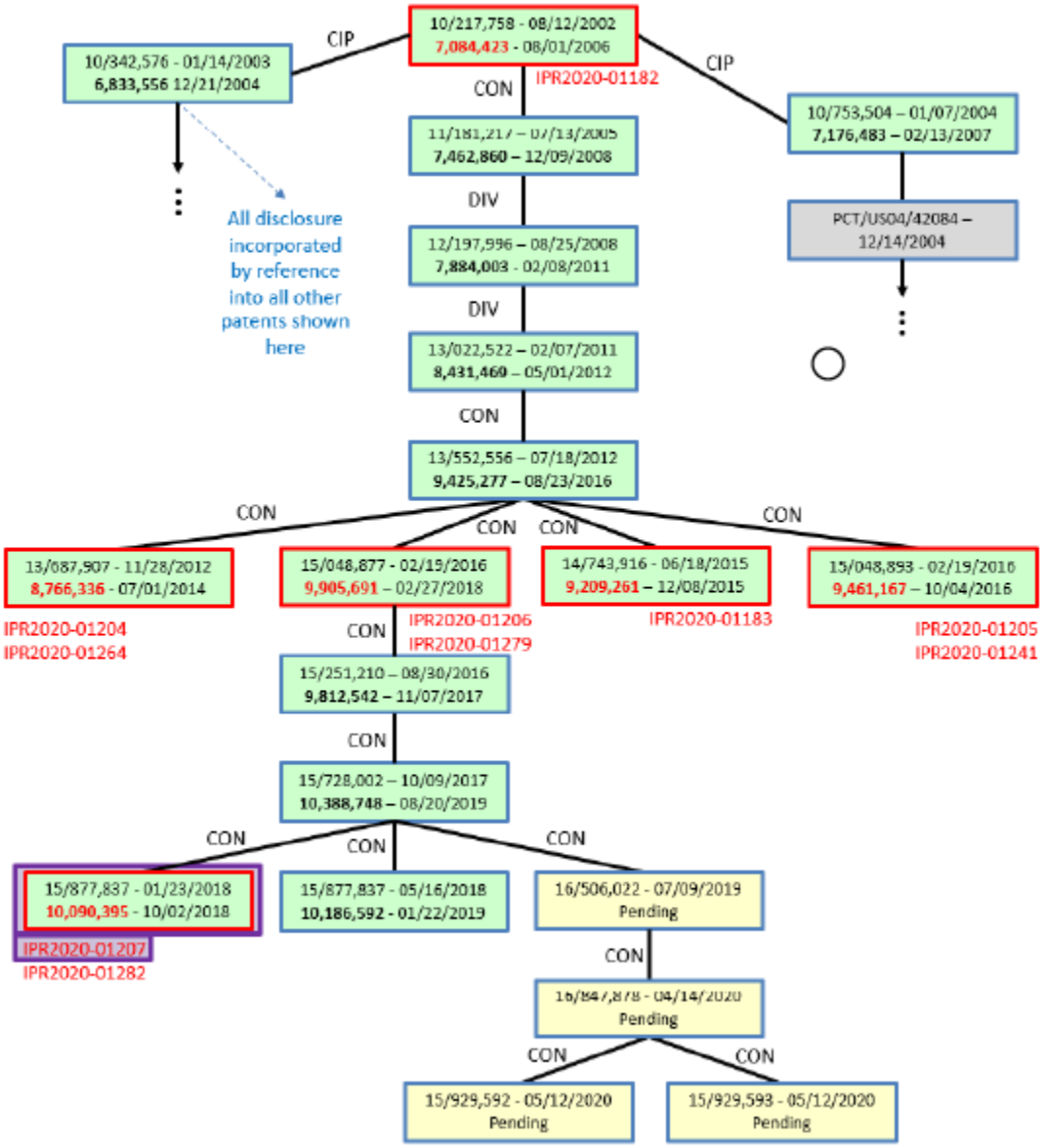
Whether a reference anticipates is assessed from the perspective of an ordinarily skilled artisan. *See Dayco Prods., Inc. v. Total Containment, Inc.*, 329 F.3d 1358, 1368 (Fed. Cir. 2003) ("'[T]he dispositive question regarding anticipation [i]s whether one skilled in the art would reasonably understand or infer from the [prior art reference's] teaching' that every claim element was disclosed in that single reference." (quoting *In re Baxter Travenol Labs.*, 952 F.2d 388, 390 (Fed. Cir. 1991))) (second two alterations in original).

Additionally, under the principles of inherency, if the prior art necessarily functions in accordance with, or includes, the claimed limitations, it anticipates. *MEHL/Biophile Int'l Corp. v. Milgraum*, 192 F.3d 1362, 1365 (Fed. Cir. 1999); *In re Cruciferous Sprout Litig.*, 301 F.3d 1343, 1349–50 (Fed. Cir. 2002).

A. Priority Issue

Petitioner contends the challenged claims are not entitled to any priority date before February 7, 2011, rendering Grupp '483, a member of the patent family that includes the '395 patent, prior art to the '395 patent. Pet. 16–22.

A chart provided in the Patent Owner Preliminary Response showing a partial patent family tree for the '395 patent, with annotations by Patent Owner, is provided below.



Partial Patent Family Tree

Prelim. Resp. 7. Petitioner contends that patentee did not describe the genus of the "metal oxide layer" recited in the challenged claims until the patentee filed the claims of U.S. application 13/022,522 ("the '522 application") on February 7, 2011. Pet. 17 (citing Ex. 1010, 48; Ex. 1022, Schubert Decl. ¶¶ 89–90). Petitioner further contends that no priority application enables the full scope of the recitation in claim 6 of a specific contact resistivity less

than 10 Ω-μm^2. *Id.* Thus, according to Petitioner, the priority date for claim 6 is no earlier than its filing date, i.e., January 23, 2018 and the filing date for the other challenged claims is no earlier than February 7, 2011. *Id.*

Patent Owner disputes Petitioner's contentions. PO Resp. 11–50. According to Patent Owner, the priority date of the '395 patent is the filing date of U.S. Patent No. 7,048,423 (Ex. 1002) ("'423 patent")) (August 12, 2002), and Grupp '483 is not prior art to the '395 patent. *Id.* at 1.

As mentioned above, Petitioner makes two sets of priority challenges: (i) challenges based on a purported lack of written description for the challenged claims in the pre-2011 priority applications and (ii) challenges based on a lack of enablement of claim 6 in all priority applications. We address these sets of challenges separately.

1. Written Description in the Priority Applications

We address Petitioner's priority challenges due to a purported lack of written description for two separate groups of challenged claims: (i) claims 1–6, 8–10, 15, and 16, which recite an "interface layer comprising a metal oxide," and (ii) claims 11, 12, and 14, which more narrowly recite "an oxide of titanium."

a. Claims 1–6, 8–10, 15, and 16

Claim 1 recites an "interface layer comprising a metal oxide." Ex. 1001, 18:45–52. Claim 2–6, 8–10, 15, and 16 each depend directly or indirectly from claim 1. *Id.* at 18:53–19:30.

1. Parties' Arguments

According to Petitioner, the first time any of the priority applications "arguably disclosed a generic 'metal oxide' interface layer is in the originally filed claims of U.S. Patent App. No. 13/022,522 filed on February 7, 2011." Pet. 19 (citing Ex. 1010, 48 [*see* claims 15, 16]; Ex. 1022,

Schubert Decl. ¶ 89). Petitioner acknowledges that the earlier-filed priority applications (those filed before 2011—"pre-2011 priority applications") describe a "possible example of a metal oxide interface layer" in the form of a TiO_2 [titanium dioxide] spacer layer. *Id.* (citing Ex. 1001, 18:6–8; Ex. 1022, Schubert Decl. ¶ 90). In fact, Petitioner relies on this description when arguing that Grupp '483 anticipates claim 1. *Id.* at 29–30 (citing Ex. 1022, Schubert Decl. ¶¶ 114–117). At the same time, Petitioner argues that Grupp '483 can be applied as a prior art reference because the same language in the pre-2011 priority applications fails to provide a written description of the genus of the recited "metal oxide layer." *Id.* at 18–22.

Petitioner asserts that the relevant question for this written description/priority issue is whether the pre-2011 priority applications' statement that "[s]pacer layers may be used with lower barriers (e.g., TiO_2 has a barrier of less than 1 eV)" provides a written description of the entire genus of metal oxide interface layers. Pet. 20 (citing Ex. 1001, 18:6–8) (alteration by Petitioner). Petitioner contends that the answer is no, arguing some metal oxides present considerably higher barriers than the "barrier of less than 1 eV" ascribed to TiO_2. *Id.* In particular, Petitioner argues "hafnium oxide and zirconium oxide are metal oxides with barriers to aluminum of 2 eV and 2.43 eV, respectively." *Id.* (citing Ex. 1035, 4; Ex. 1036, 1;[2] Ex. 1022, Schubert Decl. ¶ 94).

Patent Owner does not dispute that hafnium oxide and zirconium oxide have considerably higher barriers to metals than TiO_2. *See generally* PO Resp. Patent Owner, however, argues that the '423 patent (a pre-2011

[2] For Exhibits 1035 and 1036, we cite to the page numbers added by Petitioner.

priority application), as originally filed in 2002, nevertheless supports the genus of "metal oxide" in two ways. *Id.* at 43. First, Patent Owner argues that the specification discloses TiO_2 as a species. *Id.* (citing Ex. 1003, '423 patent, 17:59–61). Second, Patent Owner argues that the specification discloses oxide spacer/separation layers as a more general genus. *Id.* at 43–44 (citing Ex. 1003, '423 patent, 10:49–50). Patent Owner argues that these two disclosures demonstrate that the Acorn inventors possessed the "metal oxide" genus or subgenus. *Id.* at 44 (citing Ex. 2070, Kuhn Decl. ¶¶ 97–113). Patent Owner provides an analysis by Dr. Kuhn to support its argument that an ordinarily skilled artisan would have envisaged the metal oxide genus based on these disclosures. *Id.* at 43–46 (citing Ex. 2070, Kuhn Decl. ¶¶ 97–113).

Patent Owner also argues that the disclosure in the pre-2011 priority applications of the use of TiO_2 as material with a lower barrier does not teach away from the use of materials with higher barriers. PO Resp. 44–45 (citing Ex. 1003, '423 patent, 17:61–64; Ex. 2070, Kuhn Decl. ¶ 111). Further, Patent Owner argues that in an unrelated application Petitioner sought a claim to a metal oxide genus after disclosing only three species of metal oxides. *Id.* at 47 (citing Ex. 2099, claim 2, ¶¶ 8, 33, 39, 86, 96, 99, 100, 111, 140, 156, 161).

In its Reply, Petitioner argues that there are countless materials that contain metal oxides with just one metal. Pet. Reply 3. Further, Petitioner asserts that a metal oxide can include multiple metals. *Id.* (citing Ex. 1048, 211:8–212:3 (Kuhn deposition transcript); Ex. 1053, Schubert Reply Decl. ¶¶ 18–20). Petitioner also argues that metal oxides have varying properties. *Id.* at 4–5 (citing Ex. 1053, Schubert Reply Decl. ¶¶ 24–51). Further, Petitioner asserts that the claims of the '395 patent encompass metal oxides

that were invented after the priority applications were filed. *Id.* at 6–7 (citing Ex. 1048, 99:6–23).

In its Sur-reply, Patent Owner argues that the purpose of the written description requirement is to prevent over-claiming. PO Sur-reply 11–12. Patent Owner asserts that the pre-2011 priority applications describe the broader genus of oxides and, because the patentee could have claimed that genus, in this case, there is no concern of the patentee over-claiming metal oxides. *Id.*

Patent Owner also asserts that the disclosure of TiO_2 is sufficient to support the genus of metal oxides because it discloses structural features common to members of the genus so that an ordinarily skilled artisan can recognize the member of the genus. PO Sur-reply 12. Patent Owner asserts that, here, the metal oxide is in the spacer layer and a common structural feature of metal oxides used for such a purpose is that they are dielectrics. *Id.* Further, Patent Owner argues that Petitioner argued for its own patent application that the genus "metal oxide having a small conduction band offset with respect to the source/drain area" was supported by just TiO_2, Ta_2O_5, and ZnO. *Id.* at 13 (citing Ex. 2099, claims 2–3).

2. Analysis

We agree with Petitioner that the pre-2011 priority applications do not describe the recited genus.

To support a claim to a genus, a specification must disclose "either a representative number of species falling within the scope of the genus or structural features common to the members of the genus so that one of skill in the art can 'visualize or recognize' the members of the genus." *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1350 (Fed. Cir. 2010) (en banc). Here, the recited genus is an interface layer comprising a metal

oxide. Ex. 1001, 18:45–52. It is undisputed that the only species the pre-2011 priority applications disclose is TiO_2, as set forth in the following passage:

> Two other properties of the dielectric deserve mention. First is the property of the height of the barrier compared to the semiconductor conduction band (for electrons). In making the barrier thinner than a silicide barrier, the tradeoff may be a higher tunnel barrier (e.g., 2 eV for nitride, compared with about half the gap of 0.6 eV for silicide). *Spacer layers may be used with lower barriers (e.g., TiO_2 has a barrier of less than 1 eV).* Nevertheless, even with the higher barrier to electrons, the present inventors have determined that the resistance can still be one hundred times lower than a contact to silicon with a silicide barrier.

Id. at 18:1–11 (emphasis added).

The pre-2011 priority applications incorporate by reference U.S. Patent No. 6,833,556 ("'556 patent"), which describes the use of metal oxides to isolate a transistor's gate from its channel. Ex. 1005, 7:60–8:22, 13:44–14:20; *see, e.g.*, Ex. 1001, 1:24–27, Ex. 1022, Schubert Decl. ¶¶ 91–93. It is undisputed, however, that this description in the '556 patent of metal oxides used to isolate a gate from its channel does not describe the recited genus. Ex. 1022, Schubert Decl. ¶¶ 91–93. The recited genus constitutes an interface layer that is conductive ("said region being *electrically connected* to the said metal interface layer *through said interface layer*"). Ex. 1001, 18:45–52 (emphasis added); Ex. 1022, Schubert Decl. ¶¶ 91–93.

The disclosure in the pre-2011 priority applications that "spacer layers may be used with lower barriers (e.g., TiO_2 has a barrier of less than 1 eV)" does not describe structural features common to the members of the genus so that one of skill in the art can visualize or recognize the members of the

genus. *See* Ex. 1022, Schubert Decl. ¶¶ 89–90, 93–97. The disclosure describes one property of TiO_2—it has a lower barrier of less than 1 eV, which is not a property of the recited genus as a whole. Hafnium oxide and zirconium oxide are metal oxides with barriers to the metal aluminum of 2 eV and 2.43 eV, respectively. *Id.* ¶ 94; Ex. 1035, 4; Ex. 1036, 1.

As mentioned, Patent Owner argues that the pre-2011 priority applications do not teach away from using materials with barriers of more than 1 eV, noting that the pre-2011 priority applications teach the disclosed techniques may be beneficial for such materials even if they are not as preferred as lower barrier materials. PO Resp. 44–45 (citing Ex. 1003, '423 patent, 17:61–64; Ex. 2070, Kuhn Decl. ¶ 111). That argument, however, misses the point. Although the pre-2011 priority applications may not teach away from higher barrier materials, the desirable property that those priority applications teach for TiO_2 is that it has a barrier of less than 1 eV, and that is not a property shared by metal oxides as a class.

As mentioned, Patent Owner also argues that the structural feature that is common to the members of the genus of metal oxides to be used for spacer layers is that they are dielectrics. PO Sur-reply 12 (citing Ex. 2070, Kuhn Decl. ¶¶ 107, 109). Even if we were to accept that argument, however, Patent Owner cites no evidence that an ordinarily skilled artisan would envision the recited genus merely from the fact that all metal oxides to be used as spacer layers are purportedly dielectrics. *See* Ex. 2070, Kuhn Decl. ¶¶ 107, 109. The cited testimony from Dr. Kuhn does not support such a contention, as Dr. Kuhn merely testifies that the '423 patent describes a MIGS separation layer as a dielectric and that dielectrics that do not passivate or only weakly passivate the semiconductor would be desirable. *Id.* Further, the '556 patent, which, as mentioned, is incorporated by

reference into the '395 patent and the pre-2011 priority applications, teaches that dielectrics are a broader class than metal oxides. Ex. 1005, 7:60–8:5. The '556 patent describes that dielectrics can be made from oxides of *semiconductors* as well as from metals: "the insulator 280 (which may be made of a dielectric such as an oxide of the metal gate or an oxide of a semiconductor)." *Id.* at 7:60–8:5. Thus, the disclosed use of a dielectric by itself is not the disclosure of a property that would lead an ordinarily skilled artisan to envision the recited genus of metal oxides.

In sum, the only disclosed property for the TiO_2 species—a lower barrier of less than 1 eV—would not cause an ordinarily skilled artisan to envision the recited genus.

TiO_2 is also not representative of the recited genus of metal oxides. The metal oxide genus encompasses many underlying species because there are many different metals that can form metal oxides, for example, alkali metals, alkaline earth metals, transition metals, ferrous metals, non-ferrous metals, noble metals, refractory metals, and common metals. Ex. 1053, Schubert Reply Decl. ¶ 18. Further, metal oxides can be formed from more than one metal species. *Id.* ¶¶ 19, 20. Significantly, important properties for the various metal oxides, such as conductivity,[3] vary significantly. *Id.* ¶¶ 19, 20, 27–51.[4]

[3] The electrical conductivity of a metal oxide is an important property for the recited genus because electrical conductivity directly affects the specific contact resistance of a junction, which is important property for the '395 patent's disclosure. *See* Ex. 1001, 3:25–4:30; Ex. 1053, Schubert Reply Decl. ¶ 30.

[4] Dr. Schubert characterizes TiO_2 as a semiconductor. Ex. 1053, Schubert Reply Decl. ¶ 51. Patent Owner argues that instead it is a dielectric. PO Sur-reply 7. Even if we were to find that TiO_2 is a dielectric, however, important properties of metal oxides would still vary significantly. *See*

As discussed above, Patent Owner nevertheless argues that the pre-2011 priority applications describe the recited genus due to the disclosure of oxide spacer/separation layers combined with the disclosure of an interface layer with TiO_2. PO Resp. 43. To support that argument, Patent Owner provides an analysis by Dr. Kuhn of how an ordinarily skilled artisan would purportedly envision the recited genus from these disclosures. *Id.* at 44–46 (citing Ex. 2070, Kuhn Decl. ¶¶ 97–113). We do not credit this analysis by Dr. Kuhn, however, because it relies on unsupported contentions regarding the knowledge of an ordinarily skilled artisan and on the premise that an ordinarily skilled artisan would take a series of mental steps that are not taught or suggested by the pre-2011 priority applications.

Dr. Kuhn begins her analysis with the disclosure in the '423 patent that TiO_2 is an example of a "spacer layer" or "separation layer" (the terms being used synonymously) with Ti as a possible metal for the metal-semiconductor junction. Ex. 2070, Kuhn Decl. ¶ 97. Referring to the spacer layer as the "MIGS separation layer," Dr. Kuhn asserts that an ordinarily skilled artisan would recognize from the TiO_2 layer example that an oxide of whatever metal is used as the metal in the metal-semiconductor junction would be desirable. *Id.* ¶ 98. Dr. Kuhn cites no teaching in the '423 patent or in any other reference, but further states that an ordinarily skilled artisan would recognize the value of a configuration in which the placement of a metal next to an oxide of that metal "is very likely to be more stable than having the metal adjacent to some other oxide." *Id.*

Ex. 1053, Schubert Reply Decl. ¶ 51; *see also id.* ¶¶ 27–50; Ex. 1022, Schubert Decl. ¶ 94. For example, HfO_2 is an insulator, whereas InSnO is a relatively good conductor. Ex. 1053, Schubert Reply Decl. ¶ 51.

According to Dr. Kuhn, the fact that the "'423 patent states the separation layer may be an oxide in general, would have directed [an ordinarily skilled artisan] to metal oxides in particular for reasons I will next explain." Ex. 2070, Kuhn Decl. ¶ 100. Nevertheless, after stating that metals other than titanium are disclosed in the patent, Dr. Kuhn acknowledges that "not all of these metals have oxides that would be acceptable as a spacer layer, many of them do have such oxides the details of which I describe in paragraphs 101-110." *Id.* ¶ 99. Noting that the interface layer may be a passivation layer or a single or compound layer including both a passivating material and an additional separation material, Dr. Kuhn states the layers should be well-behaved materials not displaying deleterious effects that would prevent their use in electrical devices. *Id.* ¶¶ 101–102.

Dr. Kuhn next notes that the '423 patent states "the interface layers serves to (i) chemically passivate the semiconductor surface . . . and (ii) to displace the semiconductor sufficiently to eliminate or at least reduce the effect of MIGS." Ex. 2070, Kuhn Decl. Ex. ¶ 103 (quoting Ex. 1003, '423 patent, 9:50–53). According to Dr. Kuhn, because the '423 patent explains that the passivation layer alone may not be sufficient to provide MIGS separation, an additional MIGS separation layer may be required. *Id.* ¶ 104. Dr. Kuhn states "[f]rom this description, [an ordinarily skilled artisan] would understand that the separation layer, when paired with a passivation layer, does not itself perform a passivation function, but is solely intended to provide the proper thickness and band structure so that the MIGS states arising in the metal cannot pin the Fermi level of the junction." *Id.* (emphasis omitted).

Dr. Kuhn next notes that the '423 patent discloses that passivation layers using N and/or O may not require distinct separation layers and

asserts that "[f]rom this [an ordinarily skilled artisan] would understand that a passivation material that is also an oxide (such as silicon dioxide or silicon oxy-nitride) would not be considered the distinct separation layers recited in the challenged claims, but rather a passivation layer." Ex. 2070, Kuhn Decl. ¶ 105 (citing Ex. 1003, '423 patent, 10:5–7) (emphasis omitted). Based on the '423 patent's disclosure that "in some cases such passivation layers are combined with separation layers (e.g., made of an oxide) to complete the interface layer" (Ex. 1003, 10:48–50), Dr. Kuhn asserts that "[an ordinarily skilled artisan] would understand that the separation layer is intended to be an oxide, but not one with the function of passivation" (Ex 2070, Kuhn Decl. ¶ 106).

Testifying that "the patent provides extensive teachings on metals versus non-metals" and the relationship between metals, conductive materials, and conductors, (Ex. 2070, Kuhn Decl. ¶ 108), Dr. Kuhn posits that an ordinarily skilled artisan would have understood or recognized that:

> (i) "using a metal for MIGS separation would *not* provide MIGS separation (the metal would simply make more MIGS states)";
>
> (ii) "using metal-like materials for the MIGS separation layer (i.e., metals, semi-metals (metalloids), and semiconductors would carry a similar risk of not fully suppressing MIGS states due the band structure of the materials";
>
> (iii) "the desired embodiments for the MIGS separation layer in a two-layer (passivation layer + separation layer) arrangement would be dielectrics and additionally would include (as per the patent's clarification that a passivation layer is distinct from a separation layer) dielectrics that do not passivate or only weakly passivate the semiconductor";
>
> (iv) "the position of the MIGS separation layer (always between the metal and the passivation layer) suggests metal oxides of the parent metal to improve chemical stability";

> (v) looking to "the complete list of metals provided in the patent (Al, In, Ti, Cr, Ta, Cs, Mg, Er, Yb, Mn, Pb, Ag, Y, Zn, Pt, Au, W, Ni, Mo, Cu, Co and Pd) . . . the most appropriate metal oxides would be conventional insulators with significant preexisting data due to the world-wide emphasis on high-k dielectrics at the time of the patent (families such as aluminum oxide, titanium oxide, and tantalum oxide)";
>
> (vi) there was "the possibility of using insulators from materials well-established in the semiconductor industry, although perhaps not as well researched as the high-k materials (families such indium oxide, magnesium oxide, zinc oxide, tungsten oxide, molybdenum oxide and yttrium oxide)";
>
> (vii) "certain materials might have appropriate insulating properties but would not be appropriate for semiconductor fabrication due either to well-known mismatches between materials properties and typical semiconductor processing conditions (e.g. families such as silver oxide and gold oxide) or environmental issues (e.g. families such as lead oxide)"; and
>
> (viii) "[t]he remaining oxides would be recognized as inappropriate choices as they are semiconductors or semimetals (metalloids)."

Ex. 2070, Kuhn Decl. ¶¶ 109–110.

Much of Dr. Kuhn's analysis is premised on her assessment of the mental steps that an ordinarily skilled artisan theoretically might have taken after reviewing the minimal disclosure in the '423 patent. The '423 patent does not discuss any properties of metal oxides (other than the lower barrier of the metal oxide TiO_2) or design considerations concerning the selection of particular oxides to use in the claimed structure, particularly in the context of MIGS separation. And Dr. Kuhn cites very little, if any, evidence to support her testimony regarding the knowledge of an ordinarily skilled artisan. Thus, we do not credit this analysis as showing that an ordinarily skilled artisan would have found that the inventors of the pre-2011 priority applications possessed the recited genus. *See Ariad*, 593 F.3d at 1352 (a

description that merely renders the invention obvious does not satisfy the written description requirement); *Power Oasis Inc. v. T-Mobile USA*, 522 F.3d 1299, 1306 (Fed. Cir. 2008) ("Entitlement to a filing date does not extend to subject matter which is not disclosed, but would be obvious over what is expressly disclosed.") (quoting *In re Huston*, 308 F.3d 1267, 1277 (Fed. Cir. 2002), quoting *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1571–72 (Fed. Cir. 1997)); *Martin v. Mayer*, 823 F.2d 500, 505 (Fed. Cir. 1987) (holding that the written description requirement is "not a question of whether one skilled in the art *might* be able to construct the patentee's device from the teachings of the disclosure . . . . Rather, it is a question whether the application necessarily discloses that particular device") (emphasis original).

As for Patent Owner's argument that the policy concern for the written description requirement does not apply here because the patentee purportedly had written description support for even broader subject matter than the recited genus, we disagree. PO Sur-reply 11. First, the written description for priority is a statutory requirement that cannot be avoided based merely on policy arguments. 35 U.S.C. § 120. Second, even with respect to the concern of over-claiming, the mere fact that the patentee purportedly had written description support for subject matter broader than claim 1 would not alleviate that concern. Written description support is only one of a number of requirements for patentability, and it would still be over-claiming for a patentee to obtain a claim that it did not describe to avoid a prior art rejection for a broader claim that it did describe.

As mentioned, Patent Owner argues that because Petitioner sought claims to a "metal oxide having a small conduction band offset with respect to the source/drain area" while purportedly only disclosing TiO_2, Ta_2O_5, and ZnO, Petitioner's position in that case is inconsistent with its position here.

PO Resp. 47 (citing Ex. 2099, claim 2, ¶¶ 8, 33, 39, 86, 96, 99, 100, 111, 140, 156, 161); PO Sur-reply 13 (citing Ex. 2099, claims 2–3). On this record, we do not reach such a conclusion. Patent Owner cites to the publication of the involved application (Ex. 2099), which shows that Petitioner has filed such claims and that the involved application discloses TiO_2, Ta_2O_5, and ZnO, but Patent Owner provides no analysis of how the purported support for a genus based on the disclosure of three species would conflict with an alleged lack of a support for a genius based on one species. PO Resp. 47; PO Sur-reply 13. Patent Owner further does not set forth any arguments that have been made in the prosecution of the involved application (Ex. 2099). PO Resp. 47; PO Sur-reply 13.

As for Patent Owner's argument that Petitioner's decision not to challenge claims 17 and 23 indicates that the pre-2011 priority applications support the recited genus, we disagree. PO Sur-reply 11. Petitioner challenged those claims in IPR2020-01282. *See* IPR2020-01282, Paper 2, 5. We cannot speculate as to why Petitioner chose not to challenge claims 17 and 23 of the '395 patent here. Whatever unexpressed reason Petitioner had for not challenging those claims in that proceeding is not in the record and is not evidence for consideration.

In sum, after considering all the arguments and evidence, we find that the pre-2011 priority applications do not describe the recited genus. Thus, Patent Owner is not entitled to the benefit of any pre-2011 priority applications for claims 1–6, 8–10, 15, and 16, and Grupp '483 is prior art for those claims.

b. Claims 11, 12, and 14

Claim 11 recites "wherein said metal oxide comprises an oxide of titanium." Ex. 1001, 19:20–21. Claim 12 depends from claim 11, and claim 14 depends from claim 12. *Id.* at 19:22–26.

The Petition does not address whether the pre-2011 priority applications describe the breadth of the oxide-of-titanium limitation. *See* Pet. 18–22. Instead, the Petition argues that the pre-2011 priority applications do not describe the breadth of the broader genus of metal oxides. *Id.* The Patent Owner Response asserts that the mere fact that the pre-2011 priority applications may not describe the broader class of metal oxides does not mean they fail to describe the breadth of the class of a metal oxide comprising an oxide of titanium. PO Resp. 38–42. In its Reply, Petitioner does not dispute this argument by Patent Owner, but instead presents substantive arguments as to why the pre-2011 priority applications purportedly fail to describe the breadth of the recited oxides of titanium. Pet. Reply 7–12. In its Sur-reply, Patent Owner argues that Petitioner's reply arguments are belated and should not be considered. PO Sur-reply 5–7.

We agree with Patent Owner. "[A p]etitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g., to make out a prima facie case of unpatentability." Consolidated Trial Practice Guide[5] 73; *see also* 37 C.F.R. § 42.23(b). Here, Petitioner's breadth challenge to the written description support for the genus of "the metal oxide of the interface layer comprises an oxide of

[5] Consolidated Office Trial Practice Guide (Nov. 2019), available at https://www.uspto.gov/about-us/news-updates/consolidated-trial-practice-guide-november-2019.

titanium" recited in claims 6, 8, 10, 11, and 14–16, was part of Petitioner's prima facie case, which could have, and should have, been presented with the Petition. Thus, Petitioner could not properly wait until its Reply to specifically challenge the description support for the breadth of that class in the pre-2011 priority applications. *See Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1330–31 (Fed. Cir. 2019); *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369–70 (Fed. Cir. 2016); *Ariosa Diagnostics v. Verinata Heath, Inc.*, 805 F.3d 1359, 1368 (Fed. Cir. 2015). Accordingly, we will not consider the breadth challenge to a metal oxide comprising an oxide of titanium that Petitioner presented for the first time in its Reply.

As for the breadth challenge presented in the Petition—that the pre-2011 priority applications do not describe the breadth of the class of metal oxides, that challenge is inapplicable here because claims 11, 12, and 14 narrow the recited class to comprising an oxide of titanium, which is a far narrower class. Dr. Schubert provides examples of numerous metal oxides that do not comprise oxides of titanium. Ex. 1022, Schubert Decl. ¶ 94 (hafnium oxide and zirconium oxide); Ex. 1053, Schubert Reply Decl. ¶¶ 18, 19 (*see* the compounds identified in that paragraph beyond titanium dioxide), 20.

Petitioner does not dispute that the pre-2011 priority applications disclose a species within the scope of the recited genus. Pet. 18–22. To the contrary, Petitioner relies on one of the pre-2011 priority applications (Grupp '483) as disclosing a species (with TiO_2) as proof that claims 11, 12, and 14 are anticipated. *See id.* at 40–44.

Thus, we determine that Petitioner has not proven that the pre-2011 priority applications fail to describe the genus of the metal oxide of the

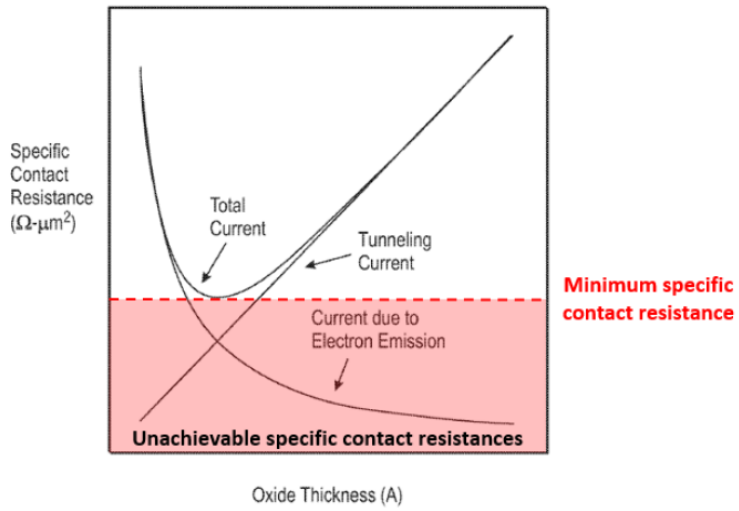
interface layer comprises an oxide of titanium. Therefore, Petitioner has not proven that Patent Owner is not entitled to the benefit of the pre-2011 priority applications for claims 11, 12, and 14 due to a lack of written description support. Accordingly, Petitioner has not proven that Grupp '483 is prior art for those claims.

2. Enablement of Claim 6 in the Priority Applications

Claim 6 recites "said interface layer is configured to provide a specific contact resistivity between the metal electrical contact and the region in the semiconductor of less than 10 Ω-μm^2." Ex. 1001, 19:4–7.

Petitioner argues that Patent Owner is not entitled to the filing dates of its priority applications for claim 6 because none of the priority applications enable the recited range of a specific contact resistivity in claim 6.

To illustrate the point, Petitioner offers an annotated version of Figure 8 of the '395 patent, as shown:



Petitioner's Annotated Version of Figure 8

Pet. 23. Petitioner argues that this figure shows how "the nadir of [the] 'total current' curve indicates a range of specific contact resistances down to and including approximately zero that an ordinarily skilled artisan could not

have attained by following the teachings of the '395 Patent and its parent applications." *Id.* at 24. Petitioner argues that claim 6 encompasses a range of specific contact resistivity down to and including approximately zero that cannot be achieved and thus cannot be enabled by the priority applications. *Id.*

Petitioner relies on *MagSil Corp. v. Hitachi Global Storage Techs., Inc.*, 687 F.3d 1377 (Fed. Cir. 2012). In that case, the claims recited that "applying a small magnitude of electromagnetic energy to the junction . . . causes a change in the resistance by at least 10% at room temperature." *Id.* at 1381 (alteration in original). The patent owner in *MagSil* offered testimony of an expert, who opined that "a person of ordinary skill in the art could work from the [] patent and make tunneling junctions with a resistive change between 100% and 120% without undue experimentation." *Id.* at 1382. The Federal Circuit, however, found that the testimony suggesting a resistive change up to 120% "only reaches a lower-end of the claimed scope," as "[t]he invention claims resistive changes from at least 10% up to infinity." *Id.* The Federal Circuit held that "the asserted claims are invalid for lack of enablement because their broad scope is not reasonably supported by the scope of enablement in the specification." *Id.* at 1384.

Patent Owner asserts that "[t]he vertical axis in Figure 8 has neither a scale nor numbers and therefore cannot be meaningfully compared to the numerical values recited in the claims"; that Petitioner "failed to establish that the '[u]nachievable' region in Figure 8 is an appreciable portion of the claimed range"; and that "[an ordinarily skilled artisan] would understand that the resistivity values achievable with the invention are quite low, perhaps even negligible or too low to measure." PO Resp. 14 (citing Ex. 2070, Kuhn Decl. ¶¶ 75, 77) (second alteration by Patent Owner).

Next, Patent Owner argues that "Figure 8 should not be understood, and would not have been understood by [an ordinarily skilled artisan], to imply zero specific contact resistivity as the petition asserts" because "[an ordinarily skilled artisan] would understand from the shapes of the curves on Figure 8 that the vertical scale is logarithmic and therefore does not extend down to zero." PO Resp. 15–16 (citing Ex. 2070, Kuhn Decl. ¶¶ 76–77, 91).

Patent Owner also argues that "Figure 8 is a 'conceptual' diagram meant to illustrate the principles of the physics involved, not any absolute values," that "[t]he particular curves illustrated on Figure 8 are for one set of materials (semiconductor, interface, and metal), and that "[i]f one or more of those materials is changed, then the curves would change." PO Resp. 16 (citing Ex. 2070, Kuhn Decl. ¶¶ 80–82). Patent Owner contends that "even if there is an unachievable region for one combination of materials, another set of materials would almost certainly have a minimum that is less (i.e., in the so-called 'unachievable' region)." *Id.* at 18.

Patent Owner then argues that "[t]he fact that some values of specific contact resistance may not be possible would simply mean that there is an inherent lower limit, below which Acorn's specification need not teach how to achieve." PO Resp. 18 (emphasis omitted). According to Patent Owner, "[t]he issue of enablement of open-ended ranges is a well-developed area of the law, and the controlling rule is that the specification need not enable the entirety of an open-ended range when there is an 'inherent' limit on the open end of the range." *Id.* at 18–19. Patent Owner relies on *Andersen Corp. v. Fiber Composites, LLC*, 474 F.3d 1361 (Fed. Cir. 2007), *Rimfrost AS v. Aker Biomarine Antarctic AS*, PGR2018-00033, Paper 9 (Aug. 29, 2018), and *Ex parte Smith*, Appeal No. 2017-010042, 2019 WL 6173250 (PTAB Sept. 30, 2019). Patent Owner also asserts that its position "is a corollary to the

related principle that a patentee need not show that non-operable embodiments are enabled." PO Resp. 21.

Patent Owner contends that the Board and courts regularly decline to follow *MagSil* where, as here, there is an inherent limit on the open end of a range. PO Resp. 21–22 (citing *Snap-on Inc. v. Milwaukee Electric Tool Corp.*, IPR2015-01242, Paper 10 (PTAB Dec. 2, 2015); *Thermo Fisher Scientific Inc. v. Regents of Univ. of California*, IPR2018-01347, Paper 10 (Jan. 22, 2019); *PerkinElmer Health Scis., Inc. v. Agilent Techs., Inc.*, 962 F. Supp. 2d 304 (D. Mass. 2013)). Patent Owner additionally argues that "[an ordinarily skilled artisan] would have understood there to be an inherent lower limit for specific contact resistivity for a given set of materials," and that "Figure 8 . . . clearly illustrates that lower limit," as "the minimum of the 'Total' curve." PO Resp. 24.

Patent Owner further cites testimony from Dr. Kuhn that "Figure 8 conveys to [an ordinarily skilled artisan] a simple experiment to find a minimum or near-minimum specific contact resistivity for a given set of materials" and that "[an ordinarily skilled artisan] could have run simple experiments on 'test chip[s]' in a 'development fab' to vary the thickness of the interface layer, measure the specific contact resistance by well-known methods, and thereby determine the minimum or a near-minimum specific contact resistance and corresponding interface layer thickness." PO Resp. 26 (citing Ex. 2070, Kuhn Decl. ¶¶ 83–87) (last alteration in original). Patent Owner argues that "[an ordinarily skilled artisan] could have repeated that experiment with different materials, aided by the teachings (materials and interface layer thickness ranges) in the . . . patents, until an acceptably low specific contact resistance was found" and that "[t]he amount of

experimentation to do so would not have been undue." *Id.* (citing Ex. 2070, Kuhn Decl. ¶¶ 87–88).

Petitioner responds that Patent Owner "asks the Board to rewrite the claims to include some unspecified 'inherent lower limit'" and that if the Patent Owner "wanted the claims to include some lower limit," it "could have attempted to remedy the claims via Motion to Amend." Pet. Reply 18. Petitioner argues that the disclosures "fail to even hint at what that purported 'inherent lower limit' may be or how achieve it" and that "[n]either Figure 8 nor anything else in the specification discloses exemplary materials, thicknesses, or any other means for achieving the full range of claimed SCRs [specific contact resistivities] (e.g., lower than 1 Ω-μm^2 and approaching 0 Ω-μm^2)." *Id.* at 19–20 (emphasis omitted).

We begin our analysis by noting that Petitioner has the burden of proving that Patent Owner is not entitled to the benefit of its priority applications. *Dynamic Drinkware*, 800 F.3d at 1378.

Neither party asks for a construction of the subject claim language, and we determine that the plain meaning of "a specific contact resistivity . . . of less than 10 Ω-μm^2" would encompass all specific contact resistances below 10 Ω-μm^2 and down to zero.

As noted above, the parties both focus on Figure 8. Petitioner argues that it shows a region below the minimum of the Total Current curve that is not enabled. *See* Pet. 22–26; Ex. 1022, Schubert Decl. ¶ 104 (explaining that the sum of the resistance to tunneling current with and resistance to current due to electron emission depicted in Fig. 8 "leaves a range of specific contact resistances that cannot be achieved using the techniques in the '395 Patent"); *see also id.* ¶ 105 ("[T]he claims encompass something

that cannot be achieved according to the '395 Patent: specific contact resistances all the way down to and including approximately zero").

Patent Owner argues that the figure is not meaningful because it does not have scales on the axes, because it may be logarithmic, and because it may show resistivity values that are negligible or too low to measure. PO Resp. 14–16. We find these arguments somewhat off the mark, because the issue we need to resolve is whether the disclosure enables the specific numerical range recited in the claims. As Dr. Kuhn observes, Figure 8 merely illustrates how the tunneling resistivity increases as the thickness of the interface layer increases, the electron emission resistivity decreases as the thickness increases, and the how those behaviors affect the total current. *See* Ex. 2070, Kuhn Decl. ¶¶ 73–75. We agree that one cannot discern any "numerical values of specific contact resistance" from Figure 8. *See id.* ¶ 75.

As for the recited range, Patent Owner does not dispute, and the evidence shows, that the disclosure does not enable specific contact resistance down to zero. Ex. 1022, Schubert Decl. ¶¶ 99–106. Instead, Patent Owner argues that an ordinarily skilled artisan would have understood there to be an "inherent lower limit" and that the claims are enabled because one of skill in the art could achieve that lower limit through experimentation based on the disclosure of patent. PO Resp. 18–25. We are not persuaded by Patent Owner's argument, for two main reasons.

First, we do not agree that the cases cited by Patent Owner establish that the enablement requirement is satisfied if an ordinarily skilled artisan could experiment in accordance with the disclosure to find a practical end of an open-ended range recited in a claim. Patent Owner principally relies on *Andersen Corp. v. Fiber Composites*, but the Federal Circuit in that case

affirmed the jury verdict of enablement because "the upper limit of the Young's modulus of the structural member would lie somewhere between the Young's modulus of the wood fiber and that of the polymer used in the composition." 474 F.3d at 1377. In other words, there were two known quantities that provided a fixed range. That is not the case here, where Patent Owner does not point to any such predefined limits. Patent Owner also cites a district court case, *PerkinElmer Health Sciences, Inc. v. Agilent Technologies., Inc.*, 962 F. Supp. 2d 304, 310 (D. Mass. 2013). That case is not directly on point, because it was considering claim construction and not enablement, but that court also found an existing practical upper limit to the claimed range of molecular weights, explaining that "the largest known proteins at the time of patenting had a high, but definite, mass."[6] *Id.*

We also disagree with Patent Owner's suggestion that its position is supported by the principle that "a patentee need not show that non-operable embodiments are enabled." PO Resp. 21. It would be both circular and contrary to the important policy underlying the enablement requirement to allow it to be avoided by argument that subject matter within the scope of the claims that is not enabled may simply be disregarded as "inoperable." *See Alcon Research, Ltd. v. Apotex Inc.*, 687 F.3d 1362, 1368 (Fed. Cir. 2012) ("This is not how patent law works. When you claim a concentration range of 0.0001–5% w/v (as claim 2), you can't simply disavow the invalid portion and keep the valid portion of the claim. If everything up to 0.001%

[6] Patent Owner additionally cites several Board decisions in *inter partes* reviews and an *ex parte* appeal. They are not binding on us, and we find them unpersuasive because they are based on different facts. *See Scripps Clinic & Research Found. v. Genentech, Inc.*, 927 F.2d 1565, 1572 (Fed. Cir. 1991) (explaining the "appropriateness [of open-ended claims] depends on the particular facts of the invention, the disclosure, and the prior art").

w/v is admittedly not enabled, then the entire claim is invalid."). *In re Cook*, 439 F.2d 730 (CCPA 1971), cited by Patent Owner, explains that the presence of inoperative embodiments within the claim scope is permissible "so long as it would be obvious to [a skilled artisan] how to make the embodiment operative rather than inoperative." *Id.* at 734–35. *In re Cook* is inapplicable here because neither party has argued or offered any evidence that it would have been obvious to a skilled artisan how to make the lower part of the recited range operative or enabled.

Second, even if Patent Owner could rely on experiments based on the disclosure to find an "inherent lower limit," it has not alleged that the results would reveal a lower bound that would fall into the claimed range. Instead, Patent Owner and its expert assert that "Figure 8 conveys to [an ordinarily skilled artisan] a simple experiment to find a minimum or near-minimum specific contact resistivity for a given set of materials" and that "[i]f desired, [an ordinarily skilled artisan] could have repeated that experiment with different materials, aided by the teachings (materials and interface layer thickness ranges) in the Acorn patents, until an acceptably low specific contact resistance was found" or, as described by Dr. Kuhn, until "an acceptably low specific contact resistance was found." PO Resp. 26; Ex. 2070, Kuhn Decl. ¶¶ 83, 88. But even if we accept those assertions as true, they show only that the disclosure enables experimentation to determine a resistance that was "suitable" or "acceptably low," and we fail to see how that identifies a specific contact resistance that would form an inherent lower end of the claimed range of less than 10 Ω-μm^2.

We also find Dr. Kuhn's "inherent lower limit" analysis flawed. We agree that the minimum of the "Total Current" curve in Figure 8 represents an inherent lower limit of the contact resistance for a specific set of

materials. *See* Ex. 2070, Kuhn Decl. ¶ 89. However, Dr. Kuhn asserts, with reference to the annotated version of Figure 8 below, that "'specific contact resistivity less than X' really means X > SCR ≥ Y, where *Y is an inherent lower limit*." *Id.* ¶ 90 (emphasis added).

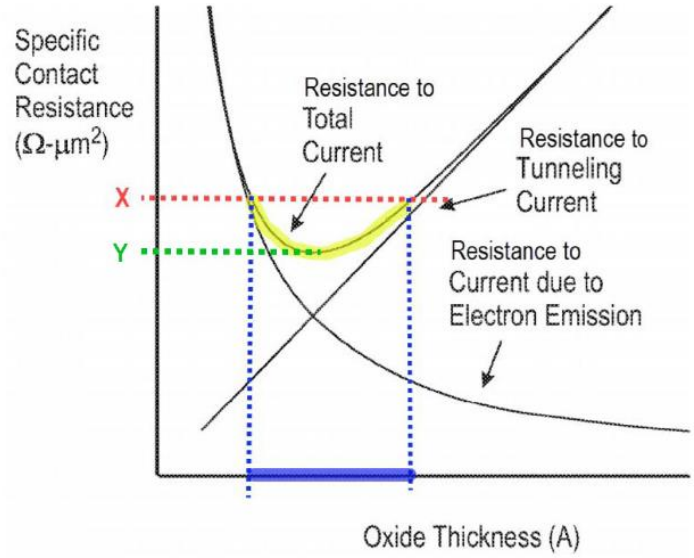


Figure 8 as Annotated by Dr. Kuhn (Ex. 2070 ¶ 90).

We find Dr. Kuhn's interpretation of the claim language to present a claim construction issue that was not raised in the Patent Owner Response and is now waived. (*See* Paper 25, 8 ("Patent Owner is cautioned that any arguments not raised in the response may be deemed waived.").) But we also disagree with Dr. Kuhn's interpretation, at least to the extent it is represented in annotated Figure 8, because that figure considers only one physical system, where the claims are not so limited. We read the claim language—"interface layer configured to provide a specific contact resistivity between the contact metal and the semiconductor of less than 1 Ω-μm²"—to mean that the claims encompass devices with interface layers that are otherwise within their scope and in which the minimum of the "Total Current" curve falls between 1 Ω-μm² and zero. This means that any

"inherent lower limit" would be the lowest resistance that could be achieved for an interface layer in *any physical device that meets the other limitations of the claims*. *See* Ex. 2070, Kuhn Decl. ¶¶ 81–82 (describing and illustrating different curves for different physical systems).

Petitioner provides evidence that "[e]ven two years after the earliest Priority Application was filed, [Patent Owner] had not achieved—and, accordingly, had not enabled—the full range of the claimed SCRs," as "the lowest reported SCR values that [Patent Owner] was able to achieve was approximately 300 Ω-μm^2," and that "those values were achieved with a silicon nitride interface layer (not the claimed metal oxide)." Pet. Reply 20–21 (citing Ex. 1057, Fig. 3; Ex. 1053, Schubert Reply Decl. ¶¶ 80–81) (emphasis omitted). Petitioner provides further evidence that "after over a decade of additional research and innovation, researchers in 2013 finally reported achieving an SCR value of about 0.1 Ω-μm^2 using an interface layer material—ZnO—not disclosed or contemplated by the Priority Applications." *Id.* at 22 (citing Ex. 1052, 2). Patent Owner responds that it "was not required to demonstrate the full range of its invention's possibilities" and "[t]hat [it] did not continue to optimize its invention is irrelevant." PO Sur-reply 19. We agree that Patent Owner had no obligation to optimize, or even practice, the patented inventions, but this evidence does tend to suggest that achieving at least some of the claimed range was not a simple matter of trying various combinations of disclosed materials. *Cf. MagSil*, 687 F.3d at 1382 (relying on the patent owner's post-filing activities when assessing enablement).

Patent Owner also argues that "[r]eferring to a resistivity or resistance range with an unspecified lower end is 'common in this art.'" PO Resp. 26 (quoting Ex. 2070, Kuhn Decl. ¶ 91 and citing, *e.g.*, Ex. 2034, 3:27–39;

Ex. 2035, 3:23–24). We conclude that unrelated patents, with entirely different disclosures and claims, are not pertinent to our analysis, particularly given that it has not been established that they do not also have enablement problems.

Finally, Patent Owner argues that a Primary Patent Examiner "having deep familiarity with this technology in general and [Patent Owner's] patents in particular, recently allowed nine Acorn claims reciting 'a specific contact resistivity of less than 1 [or 10] $\Omega \cdot \mu^2$' after considering the arguments made in the petition." PO Resp. 30 (emphasis omitted). The record does show that the Examiner initialed the IDS entries for ten IPR petitions in this family and ten copies of the Schubert Declaration. *See* Ex. 2062, 349–355. However, we are unable to discern the extent to which she considered the enablement issue and, as such, we will reach our own result from our substantially more developed record on this issue.

For the reasons given above, we conclude that (1) the plain language of the challenged claims encompasses specific contact resistances down to zero, (2) Petitioner has proven with *undisputed* evidence that the disclosures of the priority applications do not enable resistances down to zero, (3) the record does not indicate there is an "inherent lower limit" for specific contact resistances that would satisfy the requirement that the full scope of the claims be enabled in the priority applications, and (4) because Petitioner has shown that the subject matter of the challenged claims is not enabled in the priority applications, claim 6 is not entitled to the benefit of the filing dates of the priority applications due to a lack of the enablement of that claim in the priority applications. Thus, for this additional reason, Grupp '483 is prior art for claim 6.

B. Anticipation

1. Claims 1–6, 8–10, 15, and 16

Petitioner contends that Grupp '483 discloses every element of claims 1–6, 8–10, 15, and 16. Pet. 26–44. Patent Owner does not dispute this contention. PO Resp. 50 ("There are no disputes in this IPR regarding whether the 'prior art' reference (Acorn's own Grupp '483 patent) teaches any of the claim limitations.").

As set forth below, we find that Petitioner has proven that Grupp '483 anticipates claims 1–6, 8–10, 15, and 16.

a. Claim 1

Petitioner argues that Grupp '483 discloses an electrical junction, citing Grupp 483's disclosure that "the present invention provides an electrical junction." Pet. 27 (citing Ex. 1021, Grupp '483, 3:44–47). Petitioner further argues that Grupp '483 discloses a region in a semiconductor substrate by describing a source or drain of a transistor. *Id.* at 28 (citing Ex. 1022, Schubert Decl. ¶ 110). According to Petitioner, Grupp '483 discloses a metal electrical contact to said region by describing "an electrical device in which an interface layer is disposed between and in contact with a metal and a semiconductor." *Id.* (quoting Ex. 1021, Grupp '483, 4:21–23) (emphasis omitted). Petitioner asserts that Grupp '483 discloses "said region being electrically connected to said metal electrical contact through said interface layer" by describing "the present invention provides an electrical device in which an interface layer is disposed between and in contact with a metal and a semiconductor and is configured to depin the Fermi level of the semiconductor while still permitting current flow between the metal and the semiconductor . . . ." *Id.* at 29 (quoting Ex. 1021, Grupp '483, 4:21–26) (emphasis omitted).

Petitioner further argues that Grupp '483 discloses "said interface layer comprising a metal oxide and a semiconductor oxide" by describing an interface layer that includes (1) a passivation layer, which can be a semiconductor oxide; and (2) a separation layer, which can be titanium dioxide, a metal oxide. Pet. 29 (citing Ex. 1022, Schubert Decl. ¶ 114). Petitioner further asserts that Grupp '483 discloses "being in contact with said region in the semiconductor substrate and said metal electrical contact" by describing "an interface layer is disposed between and in contact with a metal and a semiconductor." *Id.* (quoting Ex. 1021, Grupp '483, 4:21–23) (emphasis omitted). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 1.

b. Claim 2

Claim 2 recites the electrical junction of claim 1, "wherein the semiconductor oxide comprises an oxide of the region in the semiconductor substrate." Ex. 1001, 18:53–55. Petitioner argues that Grupp '483 discloses this wherein limitation by describing: the use of oxygen in a passivation layer, that oxygen that can form a compound of silicon, and the use of silicon dioxide as a passivating material. Pet. 31 (citing Ex. 1021, Grupp '483, 8:64–9:10, 10:60–63, 11:35–38; Ex. 1022, Schubert Decl. ¶ 125). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 2.

c. Claim 3

Claim 3 recites the electrical junction of claim 2, "wherein the semiconductor oxide has a thickness of approximately 0.1 nm to 5 nm." Ex. 1001, 18:56–58. Petitioner argues that Grupp '483 discloses this wherein limitation by describing: "the interface layer 520 includes or is made up of a passivation layer with a thickness of between approximately

0.1 nm and about 5 nm." Pet. 32 (quoting Ex. 1021, Grupp '483, 10:66–11:1). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 3.

d. Claim 4

Claim 4 recites the electrical junction of claim 1, "wherein said region in the semiconductor substrate comprises a source or drain of a transistor." Ex. 1001, 18:59–61. Petitioner argues Grupp '483 discloses this wherein limitation by describing source or drain semiconductor regions of a transistor. Pet. 33 (citing Ex. 1021, Grupp '483, 18:19–20, 19:11–15). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 4.

e. Claim 5

Claim 5 recites the electrical junction of claim 1, "wherein said interface layer has a thickness sufficient to depin a Fermi level of the metal electrical contact in a vicinity of the junction." Ex. 1001, 18:62–64. Petitioner argues that Grupp '483 describes this wherein limitation by describing "[a]t this thickness the effect of MIGS has been sufficiently reduced to depin the metal and lower the Schottky barrier, and the layer is still sufficiently thin to allow significant current flow across the interface layer." Pet. 33 (quoting Ex. 1021, Grupp '483, 15:50–54).

Claim 5 further recites:

> yet thin enough to provide the junction with a specific contact resistivity that is generally dependent on: a workfunction of the metal electrical contact, a Fermi energy of the semiconductor in the region, or both the workfunction of the metal electrical contact and the Fermi energy of the semiconductor in the region.

Ex. 1001, 18:64–19:3. Petitioner argues that Grupp '483 describes this wherein limitation by describing an interface layer thin enough to provide

the junction with a specific contact resistivity that is generally dependent on a workfunction of the metal electrical contact. Pet. 34–36 (citing Ex. 1021, Grupp 483, 3:3–5, 17:28–45; Ex. 1022, Schubert Decl. ¶¶ 138–141). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 5.

f. Claim 6

Claim 6 recites the electrical junction of claim 1, "wherein said interface layer is configured to provide a specific contact resistivity between the metal electrical contact and the region in the semiconductor of less than 10 Ω-μm^2." Ex. 1001, 19:4–7. Petitioner argues that Grupp '483 describes this wherein limitation by describing: "Indeed, minimum specific contact resistances of less than or equal to approximately 10 Ω-μm^2 or even less than or equal to approximately 1 Ω-μm^2 may be achieved for such junctions in accordance with the present invention." Pet. 37 (quoting Ex. 1021, Grupp '483, 6:1–5).

Patent Owner does not dispute that Grupp '483 discloses all of the limitations of claim 6 and is an enabling prior art reference. Patent Owner argues, however, that it would be inconsistent to use Grupp '483 as prior art to anticipate claim 6 while denying Patent Owner the benefit of priority applications due to a lack of enablement in the priority applications of the recited range of specific contact resistivity. PO Resp. 28–30. We disagree.

"The standard for what constitutes proper enablement of a prior art reference for purposes of anticipation under section 102 . . . differs from the enablement standard under section 112." *Rasmusson v. SmithKline Beecham Corp.*, 413 F.3d 1318, 1325 (Fed. Cir. 2005). Enablement under section 112, which is required for priority under section 120, requires enablement of the full breadth of a claim. *Wyeth & Cordis Corp. v. Abbott Labs.*, 720 F.3d

1380, 1384 (Fed. Cir. 2013); *MagSil*, 687 F.3d at 1384; 35 U.S.C. § 120. Enablement for anticipation does not; rather it requires only enablement of an embodiment or embodiments that fall within the scope of the claim. *Chester v. Miller*, 906 F.2d 1574, 1577 (Fed. Cir. 1990) ("a CIP's claim for a genus might not be enabled by a parent's disclosure, but that parent may enable a species that anticipates the CIP's claim for a genus . . . . the Court of Custom and Patent Appeals [] made clear the differences between the requirements for claim-anticipating disclosures and for claim-supporting disclosures") (citing *In re Lukach*, 442, F.2d 967, 969–970 (CCPA 1971)).

Here, the enablement challenge for priority is for a lack of enablement of the full breadth of the recited range, and, in particular, a lack of enablement of the lower part of the recited range (that which is at or near zero). No party has argued that the upper part of the recited range (just below 10 Ω-μm^2) is not enabled by either the priority applications or Grupp '483. *See, e.g.*, Pet. 22–26; PO Resp. 1–2; Pet. Reply 27–28; PO Sur-reply 17–18. And enablement by a prior art patent is presumed. *In re Antor Media Corp.*, 689 F.3d 1282, 1287 (Fed. Cir. 2012) *Impax Labs., Inc. v. Aventis Pharm., Inc.*, 545 F.3d 1312, 1316 (Fed. Cir. 2008); *Amgen, Inc. v. Hoechst Marion Roussel, Inc.*, 314 F.3d 1313, 1355 (Fed. Cir. 2003). Thus, the record does not reflect an inconsistency in holding the priority applications as not enabling the breadth of the recited range while treating Grupp '483 as enabling the upper part of the range for anticipation.

After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 6.

g. Claim 8

Claim 8 recites the electrical junction of claim 1, "wherein said metal oxide comprises an oxide of said metal electrical contact." Ex. 1001, 19:10–

11. Petitioner asserts that Grupp '483 discloses this wherein limitation by describing titanium as a metal electrical contact and titanium dioxide. Pet. 39 (citing Ex. 1021, Grupp '483, 4:13–20, 14:58–15:2, 18:65–67, claim 7; Ex. 1022, Schubert Decl. ¶ 148). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 8.

h. Claims 9 and 10

Claims 9 and 10 are identical. Ex. 1001, 19:12–17. Both claims recite the electrical junction of claim 8, "wherein said semiconductor oxide comprises an oxide of the region in the semiconductor substrate." *Id.* Petitioner argues that Grupp '483 discloses this wherein limitation by describing: the use of oxygen in a passivation layer, that oxygen that can form a compound of silicon, and the use of silicon dioxide as a passivating material. Pet. 31, 40 (citing Ex. 1021, Grupp '483, 8:64–9:10, 10:60–63, 11:35–38; Ex. 1022, Schubert Decl. ¶¶ 125, 151). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claims 9 and 10.

j. Claim 15

Claim 15 recites the electrical junction of claim 1, "wherein said metal electrical contact comprises titanium." Ex. 1001, 19:27–28. Petitioner argues that Grupp '483 discloses this wherein limitation by describing the use of titanium as a metal electrical contact. Pet. 44 (citing Ex. 1021, Grupp '483, 4:13-20, 14:58-15:2, claim 7). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 15.

k. Claim 16

Claim 16 recites the electrical junction of claim 1, "wherein said metal electrical contact comprises tungsten." Ex. 1001, 19:29–30. Petitioner argues that Grupp '483 discloses this wherein limitation by describing the use of tungsten (W) as a metal electrical contact. Pet. 44 (citing Ex. 1021, Grupp '483, 4:13–20, 14:58–15:2, claim 8). After reviewing Petitioner's arguments and evidence, we find that Petitioner has proven that Grupp '483 anticipates claim 16.

2. Claims 11, 12, and 14

As set forth in Section III.A.1.b above, Petitioner has not proven that Patent Owner is not entitled to the benefit of its priority applications for claims 11, 12, and 14. Thus, Petitioner has not proven that Grupp '483 is prior art to these claims. Accordingly, Petitioner has not proven that Grupp '483 anticipates claims 11, 12, and 14.

C. Motion to Exclude

Patent Owner seeks to exclude the following portion of the cross-examination testimony of Dr. Kuhn: page 114, line 10 through page 123, line 14 of her deposition transcript (Exs. 1042, 1043). Mot. Excl. 1, 5. Patent Owner argues that the testimony at issue concerns the scope of claims that recite "an oxide of titanium." *Id.* at 1. According to Patent Owner, however, the oxide-of-titanium limitation was not substantively addressed in the Petition and Dr. Kuhn did not address it in her declaration. *Id.* Further, Patent Owner argues that it timely objected to the testimony at issue and thus the testimony should be excluded for exceeding the scope of Dr. Kuhn's direct testimony. *Id.* at 1–2.

Petitioner disagrees, arguing that Dr. Kuhn expressly opined on the "oxide of titanium" limitation. Opp. Mot. Excl. 1. Petitioner asserts:

> First, Dr. Kuhn opined that "nothing in the petition or Dr. Schubert's declaration specifically address[ed] the written-description support of those dependent claims or an oxide of titanium." Ex. 2070, Kuhn Decl. at ¶114. Second, Dr. Kuhn opined that "the metal oxide comprises an oxide of titanium" claims are "clearly narrower than 'metal oxide.'" *Id.*

Id. at 1–2 (emphasis omitted). Petitioner argues that it was entitled to explore Dr. Kuhn's understanding of why she believes those claim limitations are "clearly narrower" and to challenge Dr. Kuhn's assertion that they were not addressed in the petition or in Dr. Shubert's declaration. *Id.* at 2.

Patent Owner responds that Dr. Kuhn merely stated that the class of oxides of titanium is clearly narrower than the class of metal oxides and did not provide an opinion on that issue. Reply Mot. Excl. 1. Patent Owner further argues that statement did not open the door to Petitioner's questioning regarding the titanium oxide genus. *Id.* at 2.

We dismiss Patent Owner's Motion to Exclude as moot in light of our determination regarding Petitioner's written description challenge to Patent Owner's benefit of its pre-2011 priority applications for claims 11, 12, and 14. In particular, Petitioner relies on the testimony at issue to support its belated challenge to the breadth of written description support in the pre-2011 priority applications for the class of comprising an oxide of titanium that is recited by those claims. Reply Br. 7–12. Because we decided not to consider that belated challenge (*see* Section III.A.1.b above), the Motion to Exclude is moot.

D. Other Issues

1. 35 U.S.C. § 311(b)

Patent Owner argues that "[t]here are no disputes in this IPR regarding whether the 'prior art' reference ([Patent Owner]'s own Grupp

'483 patent) teaches any of the claim limitations" and that "[f]or all intents and purposes, this IPR is a § 112 battle, just as if it were a PGR (for which the pre-AIA '395 Patent is not eligible)." PO Resp. 50.

Patent Owner further argues that "there is no priority dispute here regarding enablement" because "the petition does not assert that any subsequent developments after the filing of the earliest priority/benefit application (resulting in the '423 Patent) has changed the enablement issue," meaning that "either all of the specifications are enabling of the specific contact resistance ranges recited in the claims, or none of them are." PO Resp. 50–51 (emphasis omitted). Patent Owner concludes that "[e]ntertaining the enablement challenge here would open the door for enablement challenges to a broad class of continuation patents in IPRs that Congress never intended." *Id.* at 51.

We remain unpersuaded by Patent Owner's argument that an *inter partes* review may not address whether priority applications enable or have written description support for challenged claims. Although the issue of whether challenged claims are enabled by or have written description support in the specification of the challenged patent is beyond the scope of an *inter partes* review (35 U.S.C. § 311), whether a patent is entitled to the benefit of earlier filed applications under 35 U.S.C. §§ 119 or 120 is properly an issue to be addressed in an *inter partes* review. *Indivior UK Ltd. v. Dr. Reddy's Lab'ys S.A.*, 18 F.4th 1323, 1326–1330 (Fed. Cir. 2021). And the benefit of an earlier filed application requires written description and enablement support for the challenged claims in the earlier filed application. 35 U.S.C. § 120.

2. Appointments Clause

Patent Owner argues that "[t]he AIA as written by Congress violates the Appointments Clause." PO Resp. 52–53.

The Supreme Court resolved this issue in *United States v. Arthrex, Inc.*, 141 S. Ct. 1970 (2021).

3. Alleged Structural Bias

Patent Owner argues that "[t]he Board's handling of this IPR is structurally biased in a way that has violated Acorn's due-process rights" because the Director's delegation of the authority to determine whether to institute and try this case "results in an improper structural bias because the Board has a strong financial incentive to institute trials." PO Resp. 53.

This argument was rejected by the Federal Circuit in *Mobility Workx, LLC v. Unified Patents, LLC*, 15 F.4th 1146 (Fed. Cir. 2021).

4. Stipulation

Patent Owner argues that "[t]he Board's eleventh-hour invitation to the petitioner to revise its stipulation regarding parallel validity challenges in the district court . . . violated *SAS Institute Inc. v. Iancu*, 138 S. Ct. 1348 (2018), due-process, and fundamental notions of fairness." PO Resp. 56. Patent Owner contends that "Acorn invested its limited resources in these IPRs and the related litigation and chose which arguments to make based on the petition and the stipulation therein" but "after Acorn had made those significant investments, the Board allowed the petitioner to alter its case, indeed the Board invited and encouraged such revision." *Id.* at 56 (emphasis omitted).

This argument is unpersuasive. The stipulation did not change the contours of, or "curate," the Petition; instead, in accordance with the precedential case of *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019,

Paper 12 (December 1, 2020), Petitioner simply stipulated not to bring the same arguments in the District Court.[7]

IV. CONCLUSION

As set forth in the following table, Petitioner has proven that claims 1–6, 8–10, 15, 16 are unpatentable, but has not proven that claims 11, 12, and 14 are unpatentable:

Claims	35 U.S.C. §	Reference	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–6, 8–12, 14–16	102	Grupp '483	1–6, 8–10, 15, 16	11, 12, 14

V. ORDER

It is:

ORDERED that claims 1–6, 8–10, 15, and 16 of the '395 patent have been shown, by a preponderance of the evidence, to be unpatentable;[8]

[7] *Sotera Wireless* issued and was designated precedential (on December 1, 2020 and December 17, 2020, respectively) after the Petition and Petitioner's Preliminary Reply were filed (on June 29, 2020 and November 30, 2020, respectively). Papers 2, 14.

[8] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

FURTHER ORDERED that claims 11, 12, and 14 of the '395 patent have not been shown, by a preponderance of the evidence, to be unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude is dismissed as moot; and

FURTHER ORDERED that because this is a Final Written Decision, the 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.

For PETITIONER:

Yung-Hoon Ha
Theodore Konstantakopoulos
John Desmarais
Cosmin Maier
Christian Dorman
DESMARAIS LLP
yha@desmaraisllp.com
tkonstantakopoulous@desmaraisllp.com
jdesmarais@desmaraisllp.com
cmaier@desmaraisllp.com
cdorman@desmaraisllp.com

For PATENT OWNER:

Matthew Phillips
Kevin Laurence
Derek Meeker
Rachel Slade
LAURENCE & PHILLIPS IP LAW
mphillips@lpiplaw.com
klaurence@lpiplaw.com
dmeeker@lpiplaw.com
rslade@lpiplaw.com

Tarek Fahmi
ASCENDA LAW GROUP, PC
Tarek.fahmi@ascendalaw.com