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Paper 49
Date: January 12, 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.

IPR2020-01206
Patent 9,905,691 B2

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

McNAMARA, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
Dismissing Patent Owner's Motion to Exclude
35 U.S.C. § 31]8(a)

I. BACKGROUND

On January 13, 2021, we instituted an *inter partes* review of claims 1–4, 6, 8, 10–13, 15–20, 22, and 25–30[1] of U. S. Patent No. 9,905,691 B2 ("the '691 Patent"). Paper 22 ("Dec. to Inst."). Patent Owner filed a Patent Owner Response (Paper 29, "PO Resp.") and a Notice of Jury Verdict in related district court litigation (Paper 31, "Notice"; Ex. 2121 "Jury Verdict"). Petitioner filed a Petitioner Reply (Paper 34, "Pet. Reply") and Patent Owner filed a Sur-reply (Paper 40, "PO Sur-reply"). Patent Owner also filed a Motion to Exclude some of the testimony its expert witness, Dr. Kelin J. Kuhn (Paper 41 "Mot."), Petitioner filed an Opposition to Patent Owner's Motion to Exclude (Paper 43, "Opp. to Mot."), and Patent Owner filed a Reply to Petitioner's Opposition to Patent Owner's Motion to Exclude (Paper 44, "Reply") a transcript of an oral hearing held on October 13, 2021 (Paper 48, "Hr'g. Tr.") has been entered into the record.

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. §318(a). We base our decision on the preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

Having reviewed the arguments of the parties and the supporting evidence, we conclude that Petitioner has demonstrated by a preponderance of the evidence that challenged claims 1–4, 13, 20, 22, and 25 are unpatentable. Petitioner has not demonstrated that the remaining challenged claims (claims 6, 8, 10–12, 15–19 and 26–29) are unpatentable.

II. THE '691 PATENT

The '691 patent "relates to a process for depinning the Fermi level of a semiconductor at a metal-interface layer-semiconductor junction and to

[1] Claim 30 has been disclaimed and is not addressed in this Decision.

devices that employ such a junction." Ex. 1001, 1:27–29. The '691 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 contact between the metal and the semiconductor). *Id*. at 1:33–48. As 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 3:4–10.

The '691 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 barrier height with work function than implied by this model. *Id.* at 1:49–2:3.

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 2:4–18, Fig. 1 (showing dangling bonds that may be responsible for surface states that trap electrical charges). 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 2:19–25.

Further, according to the '691 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 aluminum/silicon junction), depends upon a barrier at the surface of the semiconductor that become populated with metal. *Id.* at 2:35–44. 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 2:44–48.

> 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 2:48–56. The '691 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 2:63–67.

According to the '691 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." *Id.* at 2:67–3:3. "Before one can tune the barrier height, however, one must depin the Fermi level of the semiconductor." *Id.* at 3:10–12. The '691 patent seeks to depin the Fermi level of the semiconductor while still permitting substantial current flow between the metal and the semiconductor. *Id.* at 3:12–15. The ’691 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 3:30–35.

The ’691 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” whose thickness varies with a corresponding minimum specific contact resistance, which depends on the materials used and allows for depinning the Fermi level while permitting current to flow when the junction is appropriately biased. *Id.* at 3:19–30; *see also id.* at 12:59–14:17, 14:29–52, Figs. 6, 8. “Minimum specific contact resistances of less than or equal to approximately 10 Ω-μm^2 or even less than or equal to approximately 1Ω-μm^2 may be achieved for such junctions in accordance with the present invention.” *Id.* at 3:36–39. 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 5:19–23. Figure 8 of the ’691 patent is reproduced below.

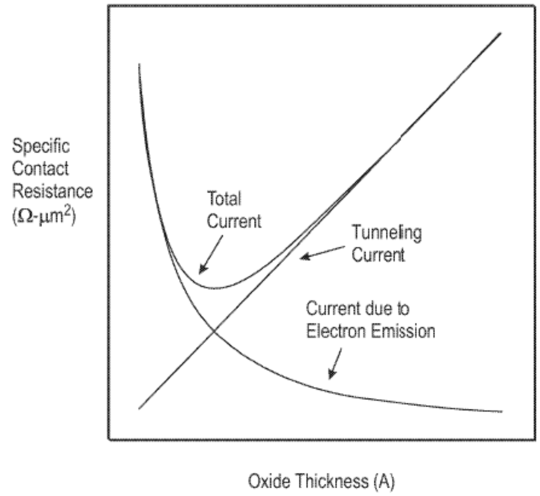


Figure 8 of the '691 patent

Figure 8 of the '691 patent 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. *Id.* at 14:29–35. According to the '619 patent, Figure 8 shows that at large thicknesses, the interface layer poses significant resistance to current, but as interface layer thickness decreases, resistance falls due to increased tunneling current. *Id.* at 14:29–38. 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 14:38–42. 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-m^2, 1000 Ω-m^2, 100 Ω-m², 50 Ω-m², 10 Ω-m², or less than 1 Ω-m² can be achieved. *Id.* at 14:45–52,

In one embodiment, the interface layer 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, the specific contact resistance of the electrical device is less than 10 Ω-μm². *Id.* at 3:40–53; *see also* 10:43–54. In another embodiment, the interface layer is made up 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) and while heating the semiconductor in a vacuum chamber. *Id.* at 3:44–61. Another embodiment uses an interface layer of passivating material disposed between the surface of a semiconductor and a conductor in which the interface is of 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 3:62–4:8. 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. *Id.* at 4:8–18. Specific contact resistances of less than or equal to approximately 2500 Ω-m², 1000 Ω-m², 100 Ω-m^2, 50 Ω-m^2, 10 Ω-m^2, or less than 1 Ω-m^2 reportedly can be achieved. *Id.* at 4:19–22, 14:45–52.

III. ILLUSTRATIVE CLAIM

Independent claim 1, reproduced below to include the subject matter of a certificate of correction issued on May 15, 2018 (Ex. 1001, 21), and including claim element designations (i) through (vii) used in the Petition, is representative of the subject matter of the '691 patent:

> 1. (i) A structure, comprising (ii) a semiconductor region in a substrate, (iii) a metal electrical contact to said semiconductor region, (iv) a metal oxide layer, (v) a passivating dielectric tunnel barrier layer between said semiconductor region and said metal electrical contact, (vi) said semiconductor region being electrically connected to said metal electrical contact through said passivating dielectric tunnel barrier layer and said metal oxide layer, (vii) wherein said passivating dielectric tunnel barrier layer comprises a semiconductor oxide.

IV. GROUNDS OF INSTITUTION

We instituted trial on the following ground:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–4, 6, 8, 10–13, 15–20, 22, and 25–30[2]	102	Grupp '483[3]

V. CLAIM CONSTRUCTION

In the Decision to Institute, we noted that the term "specific contact resistivity" appears in challenged claims 18 and 25–29, but is not used in the '691 patent Specification. Dec. to Inst. 12. Recognizing that a person of

[2] Claim 30 was disclaimed on October 14, 2020 and is no longer before us. *See* Ex. 2004.

[3] U.S. Patent No. 7,176,483 B2, issued Feb. 13, 2007 (Ex. 1015).

ordinary skill would have understood "specific contact resistivity" in claim 18 and 25–29 to refer to "specific contact resistance," we construed the terms "specific contact resistivity" and "specific contact resistance" to be interchangeable.

VI. ANALYSIS OF PRIOR ART CHALLENGES

A. Priority Issue

Patent Owner characterizes the invention as recognizing "that satisfactorily depining the Fermi level in a metal-semiconductor junction involves both satisfying dangling bonds on the surface of the semiconductor (*i.e.*, passivation) and reducing the effects of metal-induced gap states (MIGS)." PO Resp. 4 (citing Ex. 1001, 3:30–35). According to Patent Owner "the Acorn inventors found that the thickness of an appropriate interface layer could be optimized to result in minimum total resistivity/resistance, as illustrated in Figure 8 of the Acorn patents." *Id.* (citing Ex. 1001, Fig. 8)

Petitioner contends that Grupp '483 discloses each of the limitations of claim 1. Pet. 26–32. Patent Owner does not dispute Petitioner's assertion that Grupp '483 discloses all of the limitations of claim 1, but Patent Owner asserts that Grupp '483 cannot be applied as a prior art reference because the '691 patent is entitled to priority over Grupp '483 based on U.S. Patent No. 7,084,423 ("the '423 patent") filed on August 12, 2002. PO Resp. 38.

1. The district court litigation

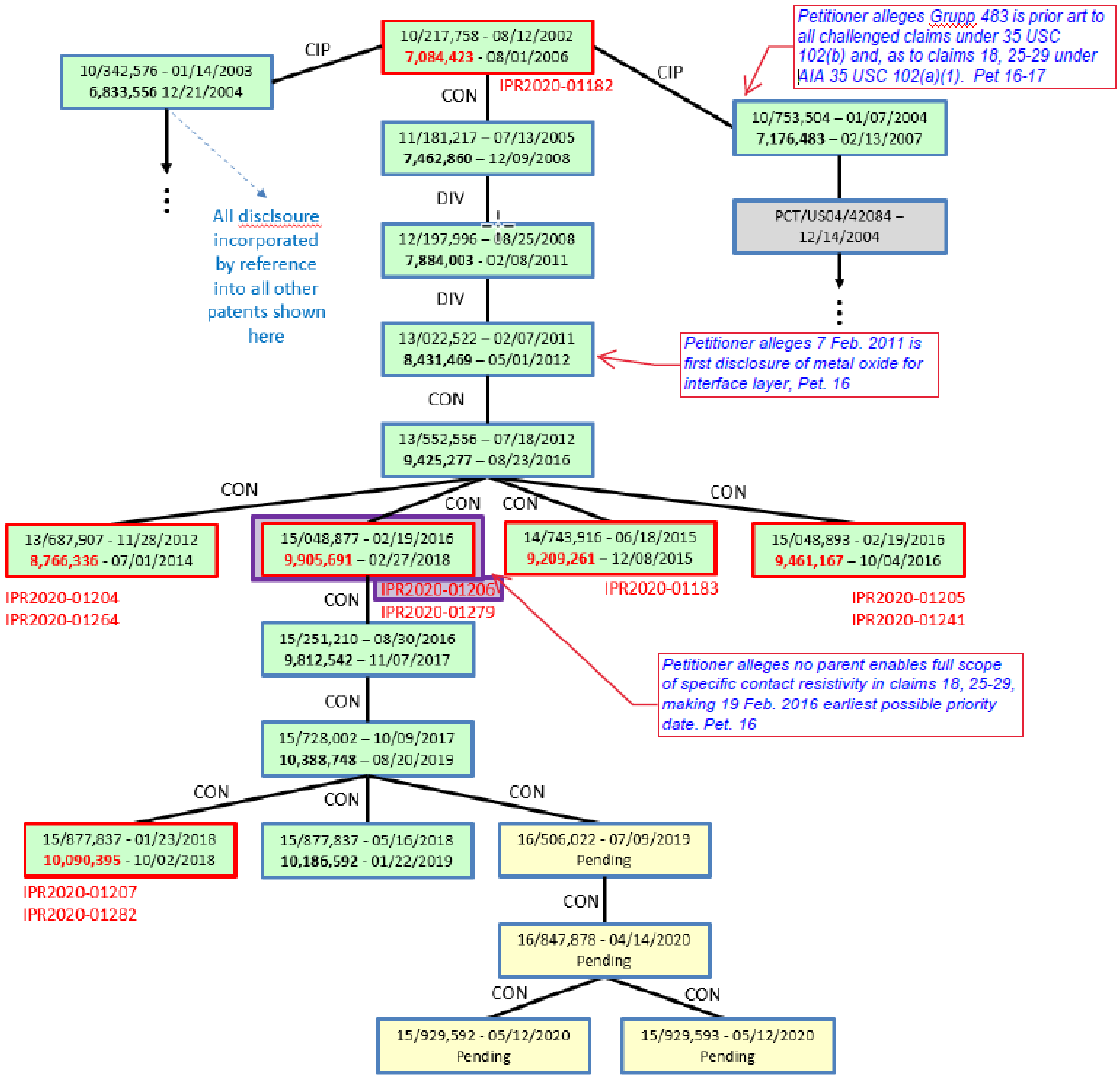
Patent Owner argues that Petitioner abandoned its inadequate written description of a generic metal oxide arguments as an invalidity defense in *Acorn Semi, LLC v. Samsung Electronics Co. Ltd.*, Civil Action No. 2:19-cv-347 (E.D. Tex.) ("the Acorn Litigation"). PO Resp. 2–3, 38 (citing Ex. 2067, 2). As this issue was not tried in the district court, there was no verdict or finding of invalidity. *See*, Ex. 2121. Petitioner has not withdrawn this challenge ground or abandoned the contest in this forum. We draw no inferences from how Petitioner conducted its district court litigation, recognizing that Petitioner may adopt strategies it considers appropriate in the context of procedural and substantive matters that may be different in each forum. Therefore, we accord no weight to Petitioner's withdrawal of its invalidity defense in the district court.

We further note that claims 6, 8, and 19 of the '691 patent were the subject of a verdict in the Acorn Litigation. *See* Notice; Jury Verdict. The jury found claims 6, 8, and 19 of the '691 patent were infringed. Jury Verdict, 4.

2. Priority claims and written description

Petitioner contends the challenged claims are not entitled to any priority date before February 7, 2011, rendering Grupp '483, which is a member of the family of patents that includes the '691 patent, prior art to the '691 patent. Pet. 15–17.

A chart showing a partial view of the family tree including the '691 patent and further annotated with italicized text boxes that identify some of Petitioner's contentions is provided below.



Partial Family of Patent Including ’691 Patent

Dec. to Inst. 15. Petitioner contends that patentee did not describe the genus of the “metal oxide layer” as recited in the claims of the ’691 patent until the patentee filed the claims of U.S. application 13/022,522 (“the ’522 application”) on February 7, 2011. Pet. 16 (citing Ex. 1010, 48; Ex. 1016, Schubert Decl. ¶¶ 89–90). Petitioner further contends that in no priority application did the patentee enable the full scope of the recitation in claims 18 and 25–29 of a specific contact resistivity less than 1Ω-m^2. Thus, according to Petitioner, the priority date of the '691 patent is no earlier than its filing date, i.e., February 19, 2016. *Id.*

Patent Owner disputes Petitioner's contentions: (i) that the priority applications filed before 2011 (pre-2011 priority applications) do not support the recited metal-oxide layer and (ii) that none of the priority applications support the recited specific contact resistance range. According to Patent Owner, the priority date of the '691 patent is August 1, 2006 (the filing date of the '473 patent), and Grupp '483 is not prior art to the '691 patent. *Id.*

3. Metal Oxide Layer and Oxide of Titanium Claims

Patent Owner contends that Petitioner's initial challenge, based on a lack of written description of a metal oxide, did not address the claims individually and did not distinguish claims drawn to "a metal oxide" (challenged claims 1–4, 13, 20, 22, 25) from narrower claims drawn to a structure in which "the metal oxide comprises an oxide of titanium" (claims 6, 8, 10–12, 15–19) and "the metal oxide separation layer comprises an oxide of titanium" (claims 26–29). PO Resp. 2, 37–43; PO Sur-reply 5–7 (citing Pet. 17–20). Patent Owner states that its Patent Owner Response "simply pointed out the petition's failure to specifically address these 'oxide of titanium' dependent claims," but "did not open the door for the petitioner to present new theories directed at these dependent claims or to fill the identified gap in the petition." PO Sur-reply 6. According to Patent Owner "[i]t is unfair for the reply to belatedly make those arguments now that it is too late for Acorn to respond with rebuttal evidence, as due process and the APA require." *Id.* at 7 (citing 5 U.S.C. § 556(d)).

Patent Owner emphasizes that claims 1–4, 13, 20, 22, and 25 (the metal oxide claims) do not specifically recite "an oxide of titanium." PO Resp. 44. The Petition states that every claim of the '691 patent recites a metal oxide interface layer. Pet. 18. As the language of all of the oxide of titanium claims begins with “the metal oxide comprises” or “the metal oxide separation layer comprises,” the oxide of titanium claims recite a further limitation on the metal oxide feature. Patent Owner relies on the disclosure of TiO_2, itself an oxide of titanium, as support for its arguments that the priority applications provide an adequate written description of both the metal oxide claims (PO Resp. 44–48) and the oxide of titanium claims (*id.* at 33–43). The Petition states the “relevant question is whether the earlier parent 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 written description of the entire genus of metal oxide interface layers. (’691 Patent at 14:45-52.) And the answer is no: some metal oxides present considerably higher barriers than the ‘barrier of less than 1 eV’ ascribed to TiO_2.

Pet. 19.

We address the priority issues concerning metal oxide claims and the oxide of titanium claims separately below..

4. The Metal Oxide Claims (Claims 1–4, 13, 20, 22, 25)

According to Petitioner, the first time any of the 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.” *Id.* (citing Ex. 1010, 48 [*see* claims 15, 16]; Ex. 1016, Schubert Decl. ¶¶ 89–91). Petitioner acknowledges that earlier applications described a “possible example of a metal oxide interface layer” in the form of a TiO_2 spacer layer. *Id.* (citing Ex. 1001, 14:45–52; Ex. 1016, Schubert Decl. ¶ 90; *see, e.g.,* Ex. 1002 ¶¶ 82–85). According to Petitioner, however, the disclosed TiO_2 spacer layer fails to describe the genus of the recited metal oxide interface layer even though that same description anticipates the challenged claims. *See In re Curtis*, 354 F.3d 1347, 1358 (Fed. Cir. 2004) ("A patentee will not be deemed to have invented species sufficient to constitute the genus by virtue of having disclosed a single species.").

Referring to limitation (iv) of claim 1 ("a metal oxide layer") Petitioner argues that Grupp '483 anticipates claim 1 because, among other things, it discloses a separation layer that can be an oxide (Pet. 29 (citing Ex. 1015, 11:35–38 ("in some cases [such] passivation layers are combined with separation layers (e.g., made of an oxide) to complete the interface layer")) and the separation can be a spacer layer of TiO_2 (*id.* (citing Ex. 1015, 18:65–67 ("[s]pacer layers may be used with lower barriers (e.g., TiO_2 has a barrier of less than 1eV))"). Thus, according to Petitioner, "Grupp '483 discloses an interface layer that includes a metal oxide layer; titanium dioxide." *Id.* (citing Ex. 1016, Schubert Decl. ¶¶ 116–117). At the same time, Petitioner argues that Grupp '483 can be applied as a reference because the exact same language in the pre-2011 priority applications fails to provide a written description of the genus of the recited "metal oxide layer." Pet. 18–19. *See, e.g., Yeda Research and Dev. V. Abbot GmbH & Co. KG*, 837 F.3d 1341, 1344–45 (Fed. Cir. 2016).

Patent Owner notes that independent claim 1 recites "a metal oxide layer" distinct from "a passivating dielectric tunnel layer" and that independent claim 25 recites "the interface layer comprising a metal oxide separation layer and a semiconductor oxide passivation layer." PO Resp. 44. According to Patent Owner, the '423 patent Specification filed in 2002 supports the subgenus "metal oxide" in two ways: (1) by its disclosure of titanium dioxide (TiO_2) as a species and (2) by its disclosure of oxide spacer/separation layers in more general terms. *Id.* (citing Ex. 1003, 17:59–61).

Patent Owner argues that a person of ordinary skill would understand that the spacer layer is adjacent to the metal and would recognize that a desirable embodiment for the spacer layer (i.e., the MIGs separation layer) is an oxide of whatever metal is used as the metal in the metal-semiconductor junction. PO Resp. 44–45 (citing Ex. 2070, Declaration of Dr. Kelin Kuhn ("Kuhn Decl.") ¶ 98). As Patent Owner notes, claim 1 recites distinct passivation and metal oxide layers. PO Resp. 44, 46. According to Patent Owner, a person of ordinary skill would understand from the Specification that the oxide/separation layer, when present, is distinct from the passivation layer (citing Ex. 2070, Kuhn Decl. ¶¶ 107–109). According to Patent Owner, the placement of a metal adjacent to an oxide of that metal is very likely to be chemically more stable than having the metal adjacent to some other oxide that is not an oxide of the same metal. *Id.* (quoting Ex. 2070, Kuhn Decl. ¶ 98). Patent Owner asserts that (1) the metal-metal oxide relationship of Ti-TiO_2 and (2) the fact the metal and the space layer are adjacent are structural features common to the metal oxide genus such that a person of ordinary skill would visualize and recognize members of the genus. *Id.* at 45. Patent Owner also argues that a person of ordinary skill would understand from the Specification that the oxide spacer/separation layer should be a dielectric and that, from the list of metals in the patent, a person of ordinary skill would realize "appropriate dielectrics that do not passivate semiconductors and are oxides are metal oxides in the families such as aluminum oxides, titanium oxides, tantalum oxides, and zinc oxides." PO Resp. 46 (citing Ex. 2070, Kuhn Decl. ¶ 110).

Petitioner notes that the priority applications disclose only one species (TiO_2) of the titanium oxide genus, which includes at least the following species: TiO, Ti_2O, Ti_3O, TiO_2, Ti_2O_3, Ti_3O_5, and Ti_4O_7. Pet. Reply 3, 7–8 (citing Ex. 1042, Transcript of Deposition of Dr. Kelin Kuhn ("Kuhn Tr.") 114:10–18 (testifying that she did not know how many chemical compounds exist in the titanium oxide family)). Petitioner asserts that the single disclosed species TiO_2 is not representative of the entire genus of metal oxides and does not describe features common to all members of the claimed genus. *Id.* at 3. Petitioner further argues that its position is even more compelling when the number of metal oxides is compounded to include multiple metals. *Id.* at 3–4. Petitioner compares the characteristics of three metal oxides commonly used in semiconductor devices as illustrating disparate bandgap, melting point, and electron affinity properties, *id.* at 4–5 (citing Ex. 1047, Second Declaration of Dr. Fred Schubert ("Schubert Decl. 2") ¶ 51). Petitioner cites the testimony of Dr. Kuhn confirming that such characteristics are not discussed in the patent, as evidence that the patent fails to explain which properties one should consider when determining what would be encompassed by the claimed structures (*see, id.* at 4, citing Ex. 1042, Kuhn Tr., 108:5–19 (concerning conductivity), 109:9–11, 110:12–15 (concerning melting point), 110:17–20 (concerning bandgap energy), 112:16–113:7 (concerning electron affinity), 111:20–112:1 (concerning diffusivity); 112:2–9 (concerning hardness), 112:10–15 (concerning optical properties), 51:15–24 (concerning crystal structure).

Patent Owner argues that the patent's disclosure of TiO_2 supports claiming the metal oxide genus because "the metal oxide is the spacer layer in the claimed arrangement, and one important structural feature common to metal oxides in that role is that they are dielectrics, according to the specification." PO Sur-reply 12 (citing Ex. 2070, Kuhn Decl. ¶¶ 107, 109 as "concluding that Acorn specification teaches POSITA to use a dielectric as the spacer layer"). Stating that Petitioner "does not dispute that fact," Patent Owner contends that Petitioner's arguments concerning the many possible metal oxides lacks "any analysis narrowing those metal oxides to relevant ones that are solid non-passivating dielectrics." *Id.* (citing *In re Smythe*, 480 F.2d 1376, 1385 (CCPA 1973); *In re Myers*, 410 F.2d 420, 426 (CCPA 1969)).

Patent Owner further cites four "blazemarks" in addition to the TiO_2 example in the Specification as "sufficient for a POSITA to recognize from the disclosure that the oxide spacer layer could be (most likely is) a metal oxide.)" According to Patent Owner:

> the patent teaches that the MIGS separation layer [1] is an optional layer added in addition to the passivation layer, [2] is sandwiched between the metal and the passivation layer, [3] is not itself a passivation layer, and [4] has the function of providing the proper thickness and band structure so that the MIGS states arising in the metal cannot pin the Fermi level of the junction. A POSITA would recognize that insulating metal oxides in families such as aluminum oxide, titanium oxide, tantalum oxide, and zinc oxide, which are generally considered to be non-passivating, would be appropriate choices for the MIGS separation layer that the inventors had contemplated as part of a two-layer (passivation layer + separation layer) interface.

PO Resp. 46–47 (quoting Ex. 2070, Kuhn Decl. ¶ 112). As Petitioner notes, however, these four purported blazemarks are not found in the Specification. Moreover, Petitioner points out that under cross-examination, Dr. Kuhn conceded that she has not opined on whether the metal oxide separation layer cannot have a passivation function. Pet. Reply 14–15 (citing Ex. 1042, Kuhn Tr. 47:15–22; Ex. 1047, Schubert Decl. ¶¶ 52–57).

Petitioner contends that allowing Patent Owner to claim priority back to 2002 based on the disclosure of TiO_2 "would result in the challenged claims impermissibly encompassing metal oxide interface layers in metal-semiconductor junctions that were only later invented" and "***to this day*** have not yet been invented and could not have been in the inventors' possession in 2002." *See* Pet. Reply 6–7 (citing Ex. 1042, Kuhn Tr. 99:6–23, 82:15–21 (asserting the claims would cover a newly invented species of titanium oxide or a gold oxide currently though to be unsuitable)).

"The goal [of] the written description doctrine [is to] giv[e] the incentive to actual invention and not 'attempt[s] to preempt the future before it has arrived." *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1353 (Fed. Cir. 2010) (*en banc*). It is undisputed that the priority applications disclose only a single metal oxide species, i.e., TiO_2. As Petitioner points out, the first mention of a metal oxide was in U.S. Patent Application No. 13/022,522, filed on Feb. 7, 2011. Pet. 16; Ex. 1010, 48 (*see* claim 15, depending from independent claim 3). Patent Owner has identified no discussion of using a metal oxide in the entire Specification or the specification of any other priority application. As detailed above, Patent Owner relies solely on its assertions about what a person of ordinary skill would have understood in the relevant context.

A review of Dr. Kuhn's Declaration testimony that forms the basis for Patent Owner's responsive arguments concerning written description in the '423 patent (the patent issuing from the first application submitted in August 2002) is illustrative of the extent to which Patent Owner relies on the understanding of a person of ordinary skill, rather than actual written description in the '423 patent. Dr. Kuhn begins her analysis with the disclosure in the '423 patent that TiO_2 as 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 a person of ordinary skill 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 supporting this assertion, but states that a person of ordinary skill 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 chemically stable than having the metal adjacent to some other oxide." *Id.*

According to Dr. Kuhn, the fact that the "'423 patent states that the separation layer may be an oxide in general, would have directed a person of ordinary skill to metal oxides in particular for reasons I will next explain." *Id.* ¶ 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 patent states "the interface layers serve to (i) chemically passivate the semiconductor from the metal surface 540 and (ii) to displace the semiconductor sufficiently to eliminate or at least reduce the effect of MIGS." *Id.* (quoting Ex. 9:50–53). According to Dr. Kuhn, because the patent explains that the passivation layer alone may not be sufficient to provide MIGS separation, an additional MIGS separation may be required. *Id.* ¶ 104. Dr. Kuhn states: "From this description, a POSITA 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.*

Dr. Kuhn next notes that the '423 patent discloses passivation layers using N and/or O may not require distinct separation layers and asserts that "[f]rom this a POSITA 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." *Id.* ¶ 105 (citing Ex. 10:5–7). 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. 10:48–50), Dr. Kuhn asserts that "a POSITA would understand that the separation layer is intended to be an oxide, but not one with the function of passivation." *Id*. ¶ 106.

Noting that "the patent provides extensive teachings on metals versus non-metals" and the relationship between metals, conductive materials, and conductors (*id*. ¶ 108), Dr. Kuhn posits that a person of ordinary skill would have understood or recognized the following:

> (i) that "using a metal for MIGS separation would ***not*** provide MIGS separation (the metal would simply make more MIGS states)";
>
> (ii) that "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) that "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) that "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) that 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) that 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) that "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) that "[t]he remaining oxides would be recognized as inappropriate choices as they are semiconductors or semimetals (metalloids)."

Ex. 2070, Kuhn Decl. ¶¶ 109–110.

Petitioner's expert, Dr. Schubert, identifies a large number of metal oxides and multiple metal oxides that is expanded by multiple equilibrium species and notes that the metal oxide genus would be even further expanded to include non-equilibrium species. Ex. 1047, Schubert Decl. 2 ¶¶ 18–22. Dr. Schubert further emphasizes the significant variation in physical and chemical properties of such metal oxides. *Id.* at ¶¶ 27–51.

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. 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 in original).

Patent Owner also argues that policy "concerns about overclaiming – the policy concerns that animate the written description requirement" are inapplicable here because the patentee purportedly had written description support for claiming even broader subject matter than the recited genus, i.e., the broader "oxide" genus. *See* PO Sur-reply 11–12. We disagree. 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. The requirement for written description support is only one of a number of requirements for patentability, and it would still be over-claiming for a patentee to seek a claim that it did not describe to avoid a prior art rejection for a broader claim that it described.

Patent Owner further argues that because in a similar patent application Petitioner sought claims reciting that a "low resistance insulating layer comprises a metal oxide," while purportedly only disclosing TiO_2, Ta_2O_5, and ZnO, Petitioner's position in that case is inconsistent with its position here and that it takes "just a very few species to enable the full scope of 'metal oxide' in this particular arrangement." PO Resp. 48 (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. Patent Owner further does not set forth any arguments that have been made in the prosecution of the involved application (Ex. 2099). *See* PO Resp. 47; PO Sur-reply 13.

As for Patent Owner's argument that Petitioner's decision not to challenge claims 17 and 23 of the '395 patent indicates that the pre-2011 priority applications support the recited genus, we disagree. PO Sur-reply 11. Petitioner filed petitions challenging the '395 patent in IPR2020-01207 and IPR2020-01282. Petitioner did not challenge claims 17 and 23 of the '395 patent in IPR2020-01207. *See* IPR2020-01207, Paper 2, 6. Petitioner, however challenged those claims in IPR2020–01282. *See* IPR2020-1282, Paper 2, 5. We cannot speculate as to why Petitioner chose not to challenge claims 17 and 23 of the '395 patent in IPR2020-01207. 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 1–4, 13, 20, 22, and 25, and Grupp '483 is prior art for those claims.

5. The Oxide of Titanium Claims (claims 6, 8, 10–12, 15–19, 26–29)

The Petition does not address whether the pre-2011 priority applications describe the breadth of the oxide-of-titanium limitation. *See* Pet. 18–26. Instead, the Petition argues that the pre-2011 priority applications do not describe the breadth of the broader genus of "the metal oxide of the interface layer." *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 oxides of titanium. PO Resp. 39–43.

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. According to Petitioner, the wide range of different characteristics, and the different crystalline structures that affect the electrical and other characteristics of each titanium oxide, is evidence that the disclosure of TiO_2 in the priority applications is insufficient to represent the full scope of even the claimed titanium oxide subgenus. Pet. Reply 9 (citing Ex. 1047, Schubert Decl. ¶ 68 (contrasting, e.g., TiO_2 as an oxide of titanium that behaves as a semiconductor and has a high electron affinity with TiO as an oxide of titanium that behaves as a conductor and has no electron affinity)). Noting the existence of superconducting and nonequilibrium compounds in the metal oxide genus, Petitioner further argues that the disclosure of TiO_2 in the priority applications is insufficient to represent the full scope of the claimed metal oxide genus. Pet. Reply 5–6.

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 petitioner "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 73[4]; *see also* 37 C.F.R. § 42.23(b). Here,

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

Petitioner's breadth challenge to the written description support for the genus of "the metal oxide of the interface layer comprises an oxide of 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 Ariosa Diagnostics v. Verinata Heath, Inc.*, 805 F.3d 1359, 1368 (Fed. Cir. 2015); *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369–70 (Fed. Cir. 2016); *Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324, 1330–31 (Fed. Cir. 2019). Accordingly, we will not consider the breadth challenge to oxides 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 to claims 6, 8, 10–12, 15–19, 26–29 because they narrow the recited class to 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. 1016, Schubert Decl. ¶ 94 (hafnium oxide and zirconium oxide); Ex. 1047, Schubert Decl. 2 ¶ 19 (*see* the compounds identified in that paragraph beyond titanium dioxide).

Petitioner does not dispute that the pre-2011 priority applications disclose a species within the scope of the recited genus. Pet. 20–25. 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 6, 8, 10–12, 15–19, and 26–29 are anticipated. *See* Pet. 38–45, 52–54.

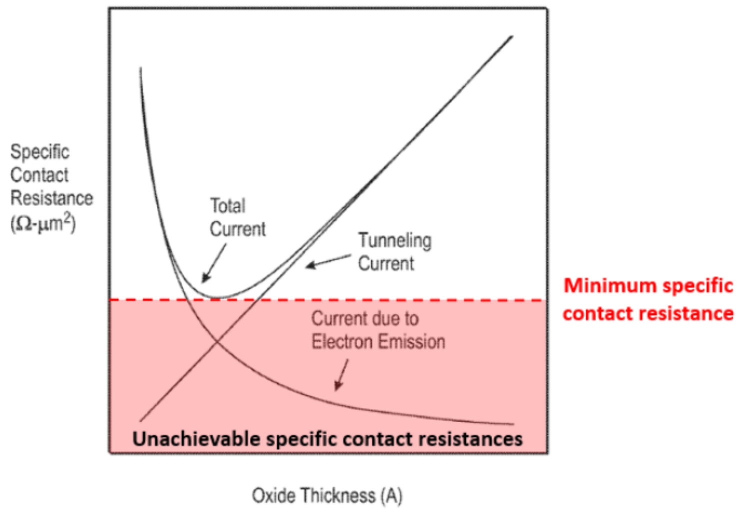
Thus, we determine that Petitioner has not proven that the pre-2011 priority applications fail to describe the genus in which the metal oxide of the interface layer comprises an oxide of titanium. Thus, Petitioner has not proven that Patent Owner is not entitled to the benefit of the pre-2011 priority applications for claims 6, 8, 10–12, 15–19, and 26–29 due to a lack of written description support.

6. Specific Contact Resistivity – Claims 18, 25–29

We now turn to Petitioner's argument that claims 18 and 25–29[5] are not entitled to the benefit of any of the priority applications for the '691 patent because none of those priority applications enable the full range of specific contact resistivity recited or included by dependence by those claims. Pet. 21–26. Petitioner argues the involved limitation—"a specific contact resistivity . . . less than 1Ω-µm2," has no lower bound. *Id.* at 22. Petitioner argues that this limitation encompasses specific contact resistivities down to and including approximately zero, which Petitioner argues that the challenged patent and priority applications teach cannot be achieved. *Id.* at 22–26.

To illustrate the point, Petitioner offers an annotated version of Figure 8 of the '691 patent, as shown:

[5] Petitioner also challenged claim 30, but claim 30 has been disclaimed and we do not consider it.



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 resistivities down to and including approximately zero that an ordinarily skilled artisan could not have attained by following the teachings of the '691 Patent and its parent applications." *Id.* at 23–24. Petitioner argues that the challenged claims encompass a range of specific contact resistivities down to and including approximately zero that cannot be achieved and thus cannot be enabled by the priority applications. *Id.* at 22.

Petitioner relies on *MagSil Corp. v. Hitachi Global Storage Techs., Inc.*, 687 F.3d 1377 (Fed. Cir. 2012). *See* Pet. 22, 24. In *MagSil*, 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." *MagSil,* 687 F.3d at 1381. The patent owner 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 ‘unachievable’ 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. 15–16 (citing Ex. 2070, Kuhn Decl. ¶¶ 75, 77).

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. 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. 17–19 (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 19.

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. 19 (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*. 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 "is a corollary to the related principle that a patentee need not show that non-operable embodiments are enabled." PO Resp. 21–22.

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. 22 (citing *Snap-on Inc. v. Milwaukee Electric Tool Corp.*, IPR2015-01242, Paper 10 (Dec. 2, 2015); *Thermo Fisher Scientific Inc. v. Regents of University of California*, IPR2018-01347, Paper 10 (Jan. 22, 2019); *PerkinElmer Health Sciences, Inc. v. Agilent Technologies, Inc.*, 962 F. Supp. 2d 304 (D. Mass. 2013)). Patent Owner additionally claims 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. 26–27 (citing Ex. 2070, Kuhn Decl. ¶¶ 83–87). 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*. at 27 (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 [to] 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 (e.g., lower than 1 Ω-μm^2 and approaching 0 Ω-μm^2)." *Id*. at 19–20.

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 1375, 1378 (Fed. Cir. 2015).

Neither party asks for a construction of the subject claim language, and we determine that the plain meaning of "a specific contact resistance of less than or equal to approximately X" would encompass all specific contact resistances below X 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. 21–23; Ex. 1016, Schubert Decl. ¶ 106 (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 '336 Patent"); *see also id*. ¶ 107 ("[T]he claims encompass something that cannot be achieved according to the '336 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. 16–19. We find these arguments somewhat off the mark, because the issue we need to resolve is whether the disclosure enables the specific numerical ranges 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 ranges, Patent Owner does not dispute, and the evidence shows, that the disclosure does not enable specific contact resistance down to zero. Ex. 1016, Schubert Decl. ¶¶ 105–108. Instead, Patent Owner argues that one of skill in the art 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. 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 one of skill in the art 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 Scis., Inc. v. Agilent Techs., 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." *Id*. at 310.[6]

[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.

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% 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 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 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 ranges. 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

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Cir. 1991) (explaining the "appropriateness [of open-ended claims] depends on the particular facts of the invention, the disclosure, and the prior art").

> 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" or, as described by Dr. Kuhn, until one reached "a suitable low SCR.

PO Resp. 26–27 (citing Ex. 2070 ¶ 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 ranges, which are less than or equal to approximately 1000 $\Omega\cdot\mu m^2$, less than or equal to approximately 10 $\Omega\cdot\mu m^2$, and less than or equal to approximately 1 $\Omega\cdot\mu m^2$.

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).

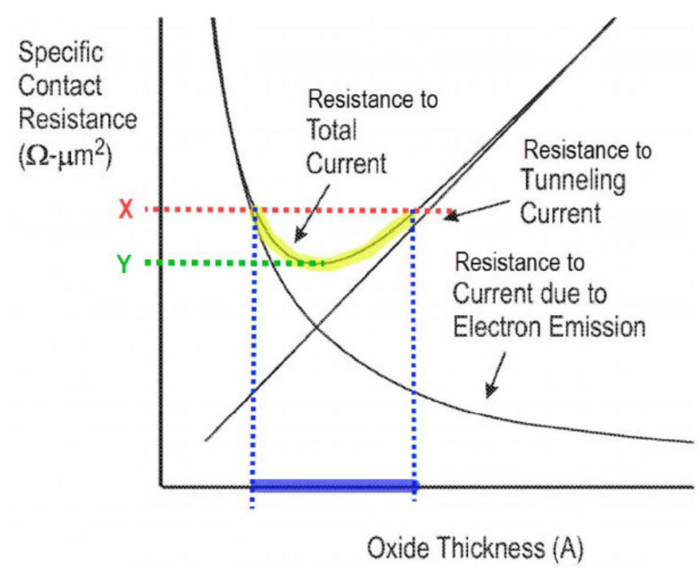

Figure 8 as Annotated by Dr. Kuhn (Ex. 2070 ¶ 90).

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 22, 8 ("Patent Owner is cautioned that any arguments not raised in the response may be deemed waived."). But we also disagree with it, at least to the extent it is represented in the Figure, because it considers only one physical system, where the claims are not so limited. For example, we read the language in claim 25—"interface layer comprising a metal oxide separation layer and a semiconductor oxide passivation layer configured to provide a specific contact resistivity between the contact metal and the semiconductor of less than 1 $\Omega\cdot\mu m^2$"—to mean that the claims encompass systems with interface layers that are otherwise within their scope and in which the minimum of the "Total Current" curve falls between 1 $\Omega\cdot\mu m^2$ and zero. This means that any "inherent lower limit" would be the lowest resistance that could be achieved for any 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. 1046, Fig. 3; Ex. 1047, Schubert Decl. 2 ¶¶ 80–81). 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." Pet. Reply 22 (citing Ex. 1041, 2). Patent Owner responds that it "was not required to demonstrate the full range of its invention's possibilities." PO Sur-Reply 19. We agree that Patent Owner had no obligation to practice the patented inventions, but this evidence does tend to suggest that achieving at least some of the claimed ranges 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. 27 (quoting Ex. 2070 ¶ 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 . . . claims reciting 'a specific contact resistivity of less than 1 [or 10] Ω·μ^2' after considering the arguments made in the petition." PO Resp. 31. 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 the Examiner 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

"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 and Cordis Corp. v. Abbott Laboratories*, 720 F.3d 1380 (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 $1\Omega\text{-}\mu m^2$) is not enabled by either the priority applications or Grupp '483. *See, e.g.*, Pet. 21–26; PO Resp. 12–32; Pet. Reply 17–28; Sur-reply 14–19. Enablement by a prior art patent is presumed. *See 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). For this reason, 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 purposes of anticipation. Thus, Grupp '483 is prior art for each of challenged claims 18, and 25–29.

B. Anticipation

1. Claim 1

As discussed above, claim 1 recites a structure that comprises a semiconductor region in a substrate, a metal electrical contact to that semiconductor region, a passive aiding dielectric tunnel barrier layer between the semiconductor region and the metal electrical contact. The semiconductor region is electrically connected to the metal electrical contact through the passive aiding dielectric tunnel barrier layer. Claim 1 further recites that the passive aiding dielectric tunnel layer comprises a metal oxide and a semiconductor oxide. Claim 1 is among the metal oxide claims discussed above. Having reviewed the arguments in the Petition and having determined that Grupp '483 is prior art to the metal oxide claims, we find the Petitioner has demonstrated that claim 1 is anticipated by Grupp '483.

2. Claim 2

Claim 2 depends from claim 1 and recites that "the semiconductor oxide comprises an oxide of the semiconductor region." Claim 2 is among the metal oxide claims discussed above. Having reviewed the arguments in the Petition and having determined that Grupp '483 is prior art to the metal oxide claims, we find the Petitioner has demonstrated that claim 2 is anticipated by Grupp ’483.

3. Claim 3

Claim 3 depends from claim one and recites that “the semiconductor oxide of the dielectric tunnel barrier layer has a thickness of approximately 0.1 nm to 5 nm.” Claim 3 is among the metal oxide claims discussed above. Having reviewed the arguments in the Petition and having determined that Grupp ’483 is prior art to the metal oxide claims, we find the Petitioner has demonstrated that claim 3 is anticipated by Grupp ’483.

4. Claim 4

Claim 4 depends from claim 1 and recites that “the semiconductor region comprises an n-type doped source or drain of a transistor.” Claim 4 is among the metal oxide claims discussed above. Having reviewed the arguments in the Petition and having determined that Grupp ’483 is prior art to the metal oxide claims, we find the Petitioner has demonstrated that claim 4 is anticipated by Grupp ’483.

5. Claim 6

Claim 6 depends from claim 3 and recites that “the metal oxide of the dielectric tunnel barrier layer comprises an oxide of titanium.” Claim 6 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp ’483, we find that Petitioner has not demonstrated claim 6 is anticipated by Grupp ’483.

6. Claim 8

Claim 8 depends from claim 6 and recites that “the semiconductor region comprises an n-doped source or drain of a transistor.” Claim 8 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 8 is anticipated by Grupp '483.

7. Claim 10

Claim 10 depends from claim 6 and recites that "the semiconductor oxide comprises an oxide of silicon." Claim 10 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 10 is anticipated by Grupp '483.

8. Claim 11

Claim 11 depends from claim 6 and recites that "the semiconductor oxide of the dielectric tunnel barrier layer is adjacent the semiconductor region." Claim 11 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 11 is anticipated by Grupp '483.

9. Claim 12

Claim 12 depends from claim 6 and recites that "the metal electrical contact comprises titanium." Claim 12 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 12 is anticipated by Grupp '483.

10. Claim 13

Claim 13 depends from claim 3 and recites that "the semiconductor oxide comprises an oxide of silicon." Claim 13 is among the metal oxide claims discussed above. Having reviewed the arguments in the Petition and having determined that Grupp ’483 is prior art to the metal oxide claims, we find the Petitioner has demonstrated that claim 13 is anticipated by Grupp ’483.

11. Claim 15

Claim 15 depends from claim 13 and recites that “the metal oxide of the dielectric tunnel barrier layer comprises an oxide of titanium.” Claim 15 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp ’483, we find that Petitioner has not demonstrated claim 15 is anticipated by Grupp ’483.

12. Claim 16

Claim 16 depends from claim 15 and recites that “the metal electrical contact comprises titanium.” Claim 16 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp ’483, we find that Petitioner has not demonstrated claim 16 is anticipated by Grupp ’483.

13. Claim 17

Claim 17 depends from claim 15 and recites that “the semiconductor comprises an n-type doped source or drain of a transistor.” Claim 17 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp ’483, we find that Petitioner has not demonstrated claim 17 is anticipated by Grupp ’483.

14. Claim 18

Claim 18 depends from claim 17 and recites that "a specific contact resistivity between the n-type doped source or drain and the metal electrical contact is less than 1 $\Omega \cdot \mu m^2$." Claim 18 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 18 is anticipated by Grupp '483.

15. Claim 19

Claim 19 depends from claim 1 and recites that "the semiconductor region comprises silicon, the semiconductor oxide comprises an oxide of silicon, the metal oxide of the dielectric tunnel barrier comprises an oxide of titanium, and the metal electrical contact comprises titanium." Claim 19 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 19 is anticipated by Grupp '483.

16. Claim 20

Claim 20 depends from claim 1 and recites that "the dielectric tunnel barrier layer is configured to reduce a height of the Schottky barrier between the metal electrical contact and the semiconductor region from that which would exist at a contact junction between the metal electrical contact and the semiconductor region without the dielectric tunnel barrier layer disposed therebetween." Claim 20 is among the metal oxide claims discussed above. Having reviewed the arguments in the Petition and having determined that Grupp '483 is prior art to the metal oxide claims, we find the Petitioner has demonstrated that claim 20 is anticipated by Grupp '483.

17. Claim 22

Claim 22 depends from claim 1 and recites that "the dielectric tunnel barrier layer is configured to reduce contact resistivity between the metal electrical contact and the semiconductor region from that which would exist at a contact junction between the metal electrical contact and the semiconductor region without the dielectric tunnel barrier layer disposed therebetween." Claim 22 is among the metal oxide claims discussed above. Having reviewed the arguments in the Petition and having determined that Grupp '483 is prior art to the metal oxide claims, we find the Petitioner has demonstrated that claim 22 is anticipated by Grupp '483.

18. Claim 25

Claim 25 recites an electrical junction comprising an interface layer disposed between a contact metal and a semiconductor, the semiconductor comprising a source or drain of a transistor. The interface layer comprises a metal oxide separation layer and a semiconductor oxide passivation layer. The interface layer is configured to provide a specific contact resistivity between the contact metal and the semiconductor of less than 1 $\Omega \cdot \mu m^2$. Claim 25 is among the metal oxide claims and, as discussed above, we have determined that Grupp '483 is prior art to the metal oxide claim limitations. Claim 25 also recites the specific resistivity limitation. As discussed above, Petitioner has shown that that the challenged claims are not entitled to the benefit of the filing dates of the priority applications and Grupp '483 is prior art to the specific resistivity claim limitations. *See* Section VI.A.6. Therefore, Petitioner has demonstrated that all of the limitations of claim 25 are in the prior art, and we find that Petitioner has demonstrated claim 25 is anticipated.

19. Claim 26

Claim 26 depends from claim 25 and recites "the metal oxide separation layer comprises an oxide of titanium." Claim 26 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 26 is anticipated by Grupp '483..

20. Claim 27

Claim 27 depends from claim 26 and recites "the semiconductor oxide passivation layer comprises an oxide of the semiconductor." Claim 27 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 27 is anticipated by Grupp '483.

21. Claim 28

Claim 28 depends from claim 27 and recites "the semiconductor oxide passivation layer has a thickness of approximately 0.1 nm to 5 nm." Claim 28 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp '483, we find that Petitioner has not demonstrated claim 28 is anticipated by Grupp '483.

22. Claim 29

Claim 29 depends from claim 27 and recites that "the semiconductor oxide passivation layer is adjacent the semiconductor." Claim 29 is among the oxide of titanium claims discussed above. Having determined that Petitioner has failed to demonstrate that the oxide of titanium claims are not entitled to the priority date of Grupp ’483, we find that Petitioner has not demonstrated claim 29 is anticipated by Grupp ’483.

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

Patent Owner's Motion to Exclude is 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 6, 8, 10–12, 15–19, 26–29. 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 oxide of titanium class recited by those claims. Pet. Reply7–12. Because we decided not to consider that belated challenge (*see* Section III.E.1.b), the Motion to Exclude is moot.

VIII. OTHER ISSUES

A. 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 '336 Patent is not eligible)." PO Resp. 51.

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." Pet. 51–52. 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 52.

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 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. *See 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 support for the challenged claims in the earlier filed application. *See id*. at 1381–1382.

B. Appointments Clause

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

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

C. 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 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. 53–54.

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

D. 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 57.

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]

IX. CONCLUSION[8]

In consideration of the above, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claims 1–4, 13, 18, 20

[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 July 18, 2020 and October 16, 2020, respectively).

[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

and 22, and 25 are anticipated by Grupp ’483. Petitioner has not demonstrated that claims 6, 8, 10–12, 15–19 and 26–29 are anticipated by Grupp ’483.

In summary:

Claims	35 U.S.C. §	Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–4, 6, 8, 10–13, 15–20, 22, 25–29	102	Grupp ’483	1–4, 13, 20, 22 25	6, 8, 10–12, 15–19, 26–29
Overall Outcome			1–4, 13, 20, 22, 25	6, 8, 10–12, 15–19, 26–29

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).

X. ORDER

In consideration of the above it is:

ORDERED that claims 1–4, 13, 20, 22 are unpatentable;

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

FURTHER ORDERED that 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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