Trials@uspto.gov
571-272-7822

Paper 52
Date: February 24, 2026

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HANWHA SOLUTIONS CORPORATION,
Petitioner,

v.

MAXEON SOLAR PTE. LTD.,
Patent Owner.

IPR2024-01203
Patent 8,822,516 B2

Before JO-ANNE M. KOKOSKI, KRISTINA M. KALAN, and AVELYN M. ROSS, *Administrative Patent Judges*.

ROSS, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

ORDER
Denying Patent Owner's Motion to Exclude
37 C.F.R. § 42.64(c)

I. INTRODUCTION

Hanwha Solutions Corporation ("Petitioner") filed a Petition (Paper 3, "Pet.") requesting an *inter partes* review of claims 1–12 of U.S. Patent No. 8,222,516 B2 (Ex. 1001, "the '516 patent" or "challenged patent"). Maxeon Solar Pte. Ltd. ("Patent Owner") filed a Preliminary Response to the Petition. Paper 9 ("Prelim. Resp."). With Board authorization, Petitioner filed a Preliminary Reply (Paper 10), and Patent Owner filed a Preliminary Sur-reply (Paper 11). We instituted *inter partes* review. Paper 17 ("DI" or "Decision on Institution").

Thereafter, Patent Owner filed a Response (Paper 29, "PO Resp."), Petitioner filed a Reply (Paper 37, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 40, "Sur-reply"). Patent Owner also filed a Motion to Exclude Evidence (Paper 46, "PO MTE"), Petitioner filed an Opposition (Paper 47, "Pet. MTE Opp."), and Patent Owner filed a Reply to Petitioner Opposition (Paper 48, "MTE Reply"). The Final Hearing was held on December 3, 2025, and a transcript of the Final Hearing is in the record. Paper 51 ("Tr.").

For the reasons set forth below, upon considering the Petition, Patent Owner's Response, Petitioner's Reply, Patent Owner's Sur-reply, and evidence of record, we determine that Petitioner has established by a preponderance of the evidence that claims 1–11 of the '516 patent are unpatentable, and claim 12 has not been shown to be unpatentable.

A. Real Parties-in-Interest

Petitioner identifies itself as the real parties-in-interest. Pet. 2. Patent Owner identifies itself as the real party-in-interest. Paper 6, 2.

B. Related Proceedings

The parties identify the following legal proceedings as involving the ’516 patent:

> *Maxeon Solar Pte. Ltd. v. Canadian Solar Inc.*, 2-24-cv-00210 (E.D. Tex.)
> *Maxeon Solar Pte. Ltd. v. Hanwha Solutions Corp.*, 2-24-cv-00262 (E.D. Tex.)
> *Maxeon Solar Pte. Ltd. v. REC Solar Holdings AS*, 2-24-cv-00260 (E.D. Tex.)

Pet. 2–3; Paper 6, 2.

Patent Owner further identifies IPR2024-01039 (U.S. Patent No. 8,222,516) as a related matter. Paper 6, 2.

C. The ’516 Patent

The ’516 patent, titled “Front Contact Solar Cell with Formed Emitter,” issued on July 17, 2012. Ex. 1001, codes (45), (54). The ’516 patent discloses “structures for a relatively efficient and cost-effective front contact solar cell and processes for manufacturing [the] same.” Ex. 1001, 1:40–42. The ’516 patent explains that a solar cell includes P-type and N-type diffusion regions that form a junction, and metal contacts that allow an external circuit to be coupled to and powered by the solar cell. Ex. 1001, 1:22–30. In a backside solar cell, both the diffusion regions and the metal contacts coupled to them are on the backside of the solar cell. Ex. 1001, 1:26–28. In a front contact solar cell, at least one of the metal contacts is on the front side of the solar cell, which is the side that faces the sun to collect solar radiation. Ex. 1001, 1:31–35. The ’516 patent shows one embodiment of its solar cell in Figure 1, reproduced below.

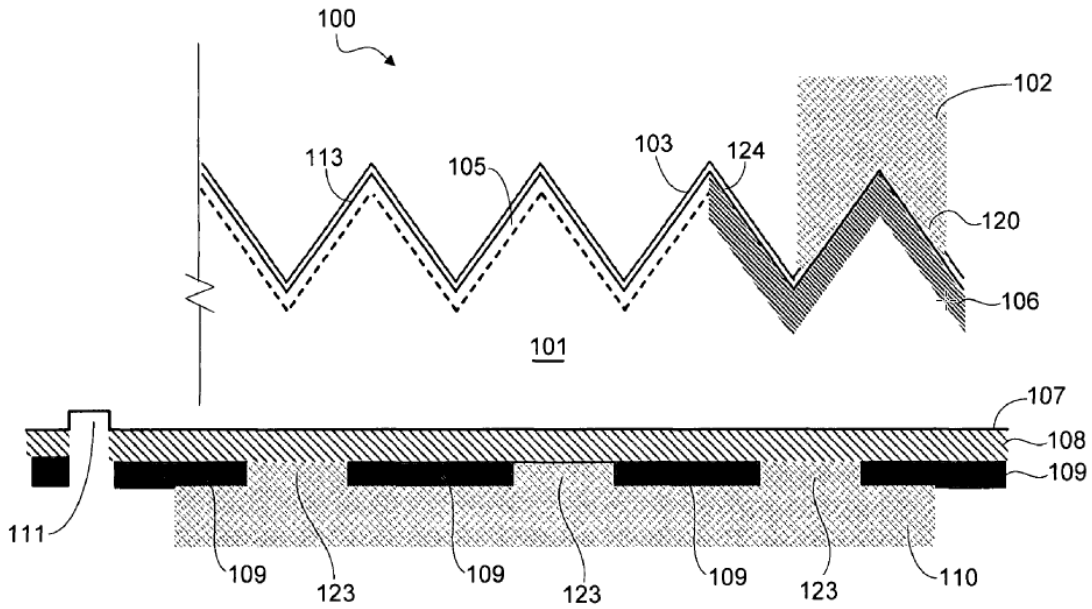


Figure 1 shows a cross-section of a front contact solar cell 100 having metal contact 102 on its front side, which faces the sun during normal operation, and metal contact 110 on its backside. Ex. 1001, 2:22–27. Solar cell 100 also includes N-type silicon substrate 101, tunnel oxide layer 107, polysilicon emitter 108, silicon dioxide layer 109, contact holes 123, and edge isolation trench 111. Ex. 1001, 2:28–31, 2:57–58, 2:66–3:2, 3:22–25. The front side of silicon substrate 101 is randomly textured (labeled as 113) and includes N-type doped regions 105 and 106, contact hole 120, and passivating oxide layer 124. Ex. 1001, 2:36–38, 2:53–56, 3:28–30.

D. Illustrative Claim

Petitioner challenges claims 1–12 of the ’516 patent. Independent claims 1 and 9 are representative of the challenged claims and are reproduced below with Petitioner’s annotations[1]:

[1] For convenience, we adopt Petitioner’s annotated claim format.

> 9. [pre] A solar cell having a front side facing the sun to collect solar radiation during normal operation and a backside opposite the front side, the solar cell comprising:
>
> [9.a] a substrate having a textured front surface;
>
> [9.b] an emitter layer formed over a back surface of the substrate, the emitter layer forming a backside junction with the substrate;
>
> [9.c] an oxide layer formed between the back surface of the substrate and the emitter layer;
>
> [9.d] a first metal contact making an electrical connection to the substrate on the front side of the solar cell; and
>
> [9.e] a second metal contact making an electrical connection to the emitter layer on the backside of the solar cell,
>
> [9.f] the first metal contact and the second metal contact being configured to allow an external electrical circuit to be powered by the solar cell.

Ex. 1001, 6:42–57.

> 1. [pre] A solar cell having a front side facing the sun to collect solar radiation during normal operation and a backside opposite the front side, the solar cell comprising:
>
> [1.a] an N-type silicon substrate;
>
> [1.b] a textured surface on the N-type silicon substrate on the front side of the solar cell;
>
> [1.c] an antireflective layer over the textured surface of the N-type silicon substrate;
>
> [1.d] a P-type polysilicon emitter formed over the N-type silicon substrate and forming a backside junction with the N-type silicon substrate;

> [1.e] an oxide layer formed between the P-type polysilicon emitter and the N-type silicon substrate;
>
> [1.f] a negative polarity metal contact making an electrical connection to the N-type silicon substrate from the front side of the solar cell; and
>
> [1.g] a positive polarity metal contact making an electrical connection to the P-type polysilicon emitter from the backside of the solar cell.

Ex. 1001, 6:4–22.

E. The Asserted Unpatentability Challenges

Petitioner asserts that claims 1–12 would have been unpatentable based on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–4, 6–12	103	Froitzheim,[2] Gan[3]
5	103	Froitzheim, Gan, Sheats[4]
1–4, 6–12	103	Froitzheim, Borden-575[5]
5	103	Froitzheim, Borden-575, Sheats
1, 2, 8–11	103	Li,[6] Gan

[2] EP 1732142 A1, published Dec. 13, 2006 (Ex. 1004, "Froitzheim").
[3] J.Y. Gan et al., *Polysilicon Emitters for Silicon Concentrator Solar Cells*, The Conference Record of the Twenty First IEEE Photovoltaic Specialists Conference–1990, Vol. 1, pp. 245–250 (Ex. 1005, "Gan").
[4] US Pub. No. US 2006/0157103 A1, issued July 20, 2006 (Ex. 1012, "Sheats").
[5] WO 2009/094575 A2, published July 30, 2009 (Ex. 1006, "Borden-575"). Petitioner alleges that Borden-575 claims priority to a provisional application and is prior art as of January 24, 2008. Pet. 6.
[6] CN 1949545 A, published April 18, 2007 (Ex. 1008 (translation), "Li").

Pet. 7. Petitioner also relies on the testimony of Dr. Zachary Holman. Ex. 1003; Ex. 1077; Ex. 2029. Patent Owner relies on the testimony of Dr. Douglas Ruby. Ex. 1075; Ex. 2027.

II. ANALYSIS

A. Principles of Law

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) (2012) (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 the 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).

Obviousness is a question of law based on underlying determinations of fact. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966); *Richardson-Vicks, Inc. v. Upjohn Co.*, 122 F.3d 1476, 1479 (Fed. Cir. 1997). A claim is unpatentable as obvious, under 35 U.S.C. § 103, if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time of the invention to a person having ordinary skill in the art. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence

of nonobviousness.[7] *Graham*, 383 U.S. at 17–18. Consideration of the *Graham* factors "helps inform the ultimate obviousness determination." *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1048 (Fed. Cir. 2016) (en banc), *cert. denied*, 138 S. Ct. 420 (2017). Subsumed within the *Graham* factors are the requirements that all claim limitations be found in the prior art references and that the skilled artisan would have had a reasonable expectation of success in combining the prior art references to achieve the claimed invention. *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1361 (Fed. Cir. 2007). "Obviousness does not require absolute predictability of success . . . all that is required is a reasonable expectation of success." *In re O'Farrell*, 853 F.2d 894, 903–04 (Fed. Cir. 1988) (citations omitted). But, a petitioner cannot satisfy its burden of proving obviousness by employing "mere conclusory statements." *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

We review the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art at the time of the invention. *Graham*, 383 U.S. at 17.

Petitioner contends that a person of ordinary skill in the art would have had

> (i) an advanced degree in electrical engineering, mechanical engineering, applied physics, chemistry, materials science, or a related discipline and (ii) at least one year of experience

[7] Neither Petitioner nor Patent Owner raises issues of objective indicia of nonobviousness.

> designing, developing, or researching the design and/or manufacture of solar cells or related technologies. Alternatively, a POSITA [i.e., a person of ordinary skill in the art] would have had (i) a bachelor's degree in the aforementioned disciplines and (ii) at least two years of experience designing, developing, or researching the design and/or manufacture of solar cells or related technologies. Less work experience may be compensated by a higher level of education, and vice versa.

Pet. 17 (citing Ex. 1003 ¶¶ 36–41).

Patent Owner also states that, in its Patent Owner Response, it "applies the level of ordinary skill in the art proposed by Petitioner." PO Resp. 27.

In light of the record before us, we adopt Petitioner's proposal regarding the level of ordinary skill in the art. Based on our review of the '516 patent and the prior art of record, we determine that the definition offered by Petitioner comports with the qualifications a person would have needed to understand the '516 patent and the prior art.

C. Claim Construction

We construe claim terms according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc); 37 C.F.R. § 42.100(b). Under *Phillips*, we give claim terms "their ordinary and customary meaning." *Phillips*, 415 F.3d at 1312. "[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention." *Id.* at 1313. "Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." *Id.*

Petitioner contends that "[t]he claims should be given their plain and ordinary meaning to resolve the issues in this proceeding." Pet. 18 (citing Ex. 1003 ¶¶ 99–102).

Patent Owner states that it "applies the 'plain and ordinary meaning' to all terms, which Petitioner proposed." PO. Resp. 27.

Based on our review of the complete trial record and the arguments raised by the parties, we determine that it is not necessary to construe any claim terms. *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"); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Matal*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs.* in the context of an *inter partes* review).

D. Challenges Based on Froitzheim and Gan

Petitioner alleges that claims 1–4 and 6–12 of the '516 patent would have been obvious over the combination of Froitzheim and Gan. Pet. 7, 27–60. In addition, Petitioner contends that claim 5 of the '516 patent would have been obvious over the combination of Froitzheim and Gan in further view of Sheats. Pet. 7, 60–63.

1. Overview of Froitzheim (Ex. 1004)

Froitzheim is directed to solar cells and a method of manufacturing solar cells that addresses light induced degradation of boron doped base layers in solar cells. Ex. 1006 ¶¶ 1, 3. Froitzheim discloses a solar cell comprising an Si layer of n-type bulk doping having a front side and a rear side, a non-alloyed p-type doped region at the rear side of the body layer and forming a p/n-junction with the rear side, a rear side contact in electrical

connection with the p-type doped region, and a front side contact in electrical connection with the n-type silicon body layer. Ex. 1006 ¶ 10. According to Froitzheim, "the use of n-type Si as [the] body layer overcomes the degradation problem of conventional solar cells with a boron doped body layer." Ex. 1006 ¶ 13. Froitzheim also teaches that "etching can be used to texture the surface in order to improve the geometry of incidence of light in order to prevent reflection." Ex. 1006 ¶ 39.

2. Overview of Gan (Ex. 1005)

Gan is directed to a study of polysilicon emitters with a thermally grown interfacial oxide layer. Ex. 1005, 245. Gan explains that the oxide is not thermally stable, and "tends to break up during high temperature anneals," which has a "direct impact on both majority and minority carrier transport in the polysilicon emitter." Ex. 1005, 245. Gan is interested in the performance of polysilicon emitters "when only a small fraction of the interfacial oxide is broken," and determines that "the cell performance can be improved" under certain circumstances. Ex. 1005, 245. Gan concludes that polysilicon emitters with improved performance "can be obtained with a very small fraction of interfacial oxide breakup," and that "polysilicon emitters with these qualities can be quite useful for silicon concentrator solar cells." Ex. 1005, 249.

3. Overview of Sheats (Ex. 1012)

Sheats is directed to an optoelectronic device, such as a solar cell, developed with electrically isolated conductive contacts. Ex. 1012 ¶ 2. Sheats teaches a solar cell having "an isolation trench 516" "formed through the transparent conductive layer and the active layer to the bottom electrode 506." Ex. 1012 ¶ 59. Isolation trenches are taught to electrically

isolate undesirable short circuits formed on an outside wall of the trench. Ex. 1012 ¶ 59. The isolation trench surrounds the closed-loop trench and electrically isolates the short circuits on the outside wall of the trench from the rest of the structure. Ex. 1012 ¶ 59.

4. Analysis of Claim 9

Petitioner alleges that the combination of Froitzheim and Gan renders claim 9 of the '516 patent obvious. Pet. 27–54. According to Petitioner, Froitzheim "teaches a solar cell with a front and rear side opposite one another," and "that '[d]uring normal operation of the solar cell 1 the front side 6 faces the sun and light is received through the area of the front surface that is not covered by the front contact 16.'" Pet. 38 (citing Ex. 1004 ¶¶ 24, 32–33, Figs. 1, 3, Abstr., claim 1; Ex. 1003, ¶¶ 146–147). Petitioner alleges that Froitzheim "includes 'a silicon body layer 3 of n-type bulk doping' that 'is made from crystalline silicon'" and that "alkaline crystal-oriented etching can be used to texture the surface [of the n-type silicon layer] in order to improve the geometry of incidence of light in order to prevent reflection." Pet. 38–39 (citing Ex. 1004 ¶¶ 10–13, 23–24, 39, 56, 87, Abstr.; Ex. 1003 ¶¶ 148–152) (emphasis omitted). Petitioner further contends that "Froitzheim teaches a 'rear junction solar cell' that contains a 'p-doped layer 10' on the rear side of the n-type silicon layer to form 'a p/n-junction'" and that a person of ordinary skill in the art "would have understood that the p-type doped region is the emitter, including because it forms 'a p/n-junction' with the n-type silicon layer." Pet. 40 (citing Ex. 1004 ¶¶ 10–13, 24–26, 33, Figs. 1, 3, Abstr., claim 1; Ex. 1003 ¶¶ 153–157). Petitioner further contends that Gan also teaches "a P-type polysilicon emitter that is formed over a silicon substrate to create a junction" and replacing "a diffused

emitter with a P-type polysilicon emitter" to improve performance. Pet. 41 (citing Ex. 1005 ¶¶ 245–246; Ex. 1003 ¶ 156). Petitioner asserts that Gan describes "a solar cell structure that includes a 'polysilicon emitter with a thermally grown interfacial oxide' (i.e., *oxide layer*) over a silicon substrate" located "between a p-type emitter and silicon substrate" to improve efficiency. Pet. 42 (citing Ex. 1005 ¶¶ 245–246, 249; Ex. 1003 ¶¶ 158–160). Petitioner also argues that "Froitzheim's solar cell includes 'screen-printed front side contacts 16 [(purple) (i.e., first metal contact) that are] in electrical connection with the n-type silicon body layer'" and "screen-printed 'rear side contact 35 [(red)]' (i.e., second metal contact) that is 'arranged in electrical connection with the p-doped layer 10' (i.e., emitter)." Pet. 43–44 (citing Ex. 1004 ¶¶ 10, 27–28, 33–34, 48–49, 60, Figs. 1, 3, Abstr.; Ex. 1003 ¶¶ 102–166) (emphasis omitted). Petitioner explains that a person of ordinary skill in the art would understand that Froitzheim's screen-printed front and backside contacts are metal contacts formed of a paste that contains silver and aluminum. Pet. 45 (citing Ex. 1004 ¶¶ 20, 49; Ex. 1003 ¶ 167; Ex. 1045, 234–239). Lastly, Petitioner alleges that "[a]s Froitzheim explains, its '[f]ront and rear side contacts are arranged that are in electrical connection with the n-doped layer and the p-doped base layer, respectively, to **withdraw a photocurrent from both sides of the p/n-junction**' and thus power an external electrical circuit." Pet. 46 (citing Ex. 1004 ¶¶ 2, 61–93; Ex. 1003 ¶¶ 169–172; Ex. 1016, 14).

According to Petitioner, Froitzheim and Gan are analogous art because "[b]oth are in the same field as the Challenged Claims (solar cells) and are reasonably pertinent to solving the problems addressed in the Challenged Claims (increasing efficiency) with the same types of solutions

(optimizing solar cell configuration)." Pet. 28 (citing Ex. 1004 ¶¶ 1–9; Ex. 1005, 245–249; Ex. 1003 ¶ 123); *see also id.* at 62 (arguing Sheats is analogous art for similar reasons). Petitioner alleges that a person of ordinary skill in the art would have had reason to combine the teachings of Froitzheim and Gan to achieve a more efficient solar cell, even if additional manufacturing steps or components were needed to incorporate Gan's oxide layer and polysilicon emitter in Froitzheim's solar cell. Pet. 35. Specifically, Petitioner contends that "Gan teaches that a solar cell's 'performance can be improved if [a] diffused-emitter [(like Froitzheim's diffused-emitter)] is replaced with [a] polysilicon emitter." Pet. 30 (citing Ex. 1005, 245) (emphasis omitted). According to Petitioner, Gan "observes that the combination of a polysilicon emitter and oxide layer structure had lower recombination and contact resistance as compared to diffused-emitters," and, therefore, solar cell efficiency is improved, which is "quite useful for silicon solar cells." Pet. 30–31 (citing Ex. 1005, 245–246, 248–249, Fig. 6; Ex. 1003 ¶¶ 127–128, 131). Petitioner explains that Gan states its teachings are applicable to p-type emitters and silicon substrates as well as backside PN junctions like Froitzheim. Pet. 32 (citing Ex. 1005, 246, 248–249; Ex. 1004 ¶¶ 10–11; Ex. 1003 ¶ 130). Therefore, a person of ordinary skill in the art "would have understood that replacing Froitzheim's diffused emitter with a polysilicon emitter and oxide layer structure as taught by Gan was simply applying a known technique to a similar device ready for improvement to yield predictable results." Pet. 33 (citing Ex. 1005, 246, 248–249; Ex. 1003 ¶¶ 130–132).

Additionally, Petitioner contends that the ordinarily skilled artisan would have had reason to combine Froitzheim and Gan because: (1) both

"teach similar and compatible solar cells" (Pet. 34 (citing Ex. 1004 ¶¶ 10–11, 42; Ex. 10005, 246; Ex. 1003 ¶ 135)); (2) including the polysilicon emitter and oxide structure of Gan in Froitzheim would have been a "simpl[e] substitut[ion of] one known element for another to obtain predictable results" (*id.* at 34, 36 (citing Ex. 1005, 246; Ex. 1006 ¶¶ 26–27; Ex. 1004 ¶ 30; Ex. 1015, 2:50–53; Ex. 1003 ¶ 136)); (3) "implementing a polysilicon emitter and oxide structure in Froitzheim was a simple design choice" (*id.* at 35 (citing Ex. 1003 ¶ 137)); and (4) "numerous prior art references similarly teach the benefits of using an oxide layer with a polysilicon emitter" (*id.* (citing Ex. 1006 ¶16, 22; Ex. 1034; Ex. 1046, 1125; Ex. 1023, 3:61–64; Ex. 1042 ¶ 46; Ex. 1039, 463; Ex. 1003 ¶¶ 138–141)).

Petitioner asserts that a reasonable expectation of success exists in the combination of Froitzheim and Gan. Pet. 36. In particular, Petitioner states that a person of skill in the art would have known how to replace the diffused emitter in Froitzheim with the polysilicon emitter and oxide layer described in Gan using known methods. Pet. 37. For example, Petitioner contends that a person of ordinary skill in the art

> would have understood that instead of diffusing boron into the substrate's back side as taught by Froitzheim, a POSITA would instead follow the manufacturing technique taught by Gan. That is, a POSITA would have grown an interfacial oxide layer on the substrate's back side, created a polysilicon layer over the oxide layer on the substrate's back side, and then doped the polysilicon layer instead of the substrate to form the polysilicon emitter.

Pet. 37 (citing Ex. 1005, 246; Ex. 1003 ¶ 142; Ex. 1006 ¶ 22; Ex. 1046, Abstr., 1121). Petitioner explains that because both Froitzheim and Gan describe a "thermal drive-in diffusion process and overlapping ranges," a person of ordinary skill in the art "would have thus appreciated the

references have compatible manufacturing steps." Pet. 36 (citing Ex. 1004 ¶ 42; Ex. 1005, 246; Ex. 1003 ¶ 143).

Patent Owner does not challenge many of Petitioner's allegations regarding the teachings of Froitzheim and Gan. *See generally* PO Resp. 24–41. Instead, Patent Owner argues that a person of ordinary skill in the art would not have had a reasonable expectation of success in the combination of Froitzheim and Gan. PO Resp. 29–37. On this record, the arguments and evidence put forth by Petitioner regarding the teachings of Froitzheim and Gan, and largely unchallenged by Patent Owner, are supported by the record. We address Patent Owner's reasonable expectation of success challenge below.

Patent Owner asserts that the person of ordinary skill in the art would not have had a reasonable expectation of success in the combination of Froitzheim and Gan because the Gan Thesis,[8] a publication by the same author as Gan, "repeatedly attempted Petitioner's proposal—to implement Gan's polysilicon emitter and interfacial oxide structure on a real solar cell—[and repeatedly] failed." PO Resp. 30. Patent Owner contends that "[a]t best, the Gan Thesis posits that making a concentrator solar cell with polysilicon emitter and interfacial oxide is theoretically possible." PO Resp. 30–31 (citing Ex. 2003, Abstr., 53 (stating that "[t]heoretically, it is possible to make a polysilicon SIS emitter with an intact inter-facial oxide"), 107 (explaining that "[t]he polysilicon emitter with low J_0 and ρ_c <u>can be made</u>"), 69 (expressing that "it is <u>possible</u> for polysilicon SIS emitter to have

[8] Jon-Yiew Gan, Polysilicon Emitters for Silicon Concentrator Solar Cells (July, 1990) (Ph.D. dissertation, Stanford University) (Ex. 2003, "the Gan Thesis").

both low J_0 and ρ_c“)). Patent Owner argues that a person of ordinary skill in the art “would recognize these musings in the Gan Thesis were theories that fell short of being reproducibly put in to practice, and fell even shorter of supporting a reasonable expectation of success.” PO Resp. 31 (citing Ex. 2027 ¶¶ 135, 158, 166, 168).

We are persuaded that Petitioner has shown a reasonable expectation of success in the combination of Froitzheim and Gan. Petitioner explains that the combination of Froitzheim and Gan simply replaces one emitter, i.e., Froitzheim’s diffused emitter, with the polysilicon emitter of Gan. Pet. 36. According to Petitioner, a person of ordinary skill in the art

> would have also readily understood how to replace a diffused emitter with a polysilicon emitter and oxide layer [and] would have understood that instead of diffusing boron into the substrate’s back side as taught by Froitzheim, a [person of ordinary skill in the art] would instead follow the manufacturing technique taught by Gan.

Pet. 37 (citing Ex. 1005, 246). Petitioner explains that the Gan processes are well-known and routine, and Dr. Holman states that “modifying Froitzheim in view of Gan simply involves using Gan’s known technique of a polysilicon emitter and oxide layer with Froitzheim’s known solar cell to improve Froitzheim’s solar cell in a similar way.” Pet. 37 (citing Ex. 1003 ¶ 144). For example, Petitioner directs our attention to “multiple instances” in which oxide layers and polysilicon emitters have been implemented successfully in the art. Pet. 37 (citing Ex. 1005, 246; Ex. 1006 ¶ 22; Ex. 1046, Abstr., 1121; Ex. 1003 ¶ 145). Furthermore, Gan’s statement that “cell performance can be improved if the diffused-emitter is replaced with the polysilicon emitter” and “polysilicon emitters with low J_0 and ρ_c can be obtained with a very small fraction of interfacial oxide breakup” indicate a

reasonable expectation of success. Ex. 1005, 245, 249. Gan also states that "polysilicon emitters with these qualities can be quite useful for silicon concentrator solar cells." Ex. 1005, 249. Thus, we are persuaded that Petitioner has demonstrated that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Froitzheim and Gan.

Patent Owner's arguments do not persuade us otherwise. Patent Owner's assertions are based primarily on the Gan Thesis—a *different* Gan reference—which, according to Patent Owner should be read together with Gan; Patent Owner argues that a person of ordinary skill in the art "would need to consider both references because they speak about the same experiment. . . . [I]t's the same oxide layer. It's grown on the same test device. It's made with the same steps. And, thus it has the same problems." Tr. 26:7–20. Patent Owner, however, does not direct our attention to any precedent that would require, or even permit, reading Gan together with the Gan Thesis as a unified work. *See* generally PO Resp.; Tr. 26:21–27:14. Instead, Patent Owner asks that we lean on the principle that a person skilled in the art is imputed with all relevant knowledge. Tr. 26:21–27:14. We reject Patent Owner's invitation to treat the Gan Thesis as an extension of Gan. In our view, the Gan Thesis has value in that it reflects the contemporaneous state of the art, but the Gan Thesis does not supplant Gan's teachings.

We acknowledge that the Gan Thesis, by way of example, states that:

> [T]he breakup process is difficult to control. On several occasions, we have encountered reproducibility problems. [Ex. 2003, 107].

> [S]olar cells that were made in this study all suffered high contact resistance. The problem is primarily due to insufficient oxide breakup, and is caused by the fluctuation of the thickness of the interfacial oxide. [Ex. 2003, 107].
>
> [W]e found that a consistent result of ρc is difficult to reproduce for the polysilicon emitter with a thermally grown interfacial oxide. [Ex. 2003, 116].
>
> [O]ur thin-oxide growth recipe is not reliable. . . . In order to have predictable results, it appears that a precise control of the oxide thickness is necessary. [Ex. 2003, 117].
>
> It appears that the oxide breakup depends critically on the interfacial oxide thickness. The thin-oxide growth recipe used in this work was not reliable. [Ex. 2003, 119].
>
> It is clear that a more reliable way of growing the thin oxide is needed. [Ex. 2003, 119].

However, these statements and others identified by Patent Owner do not suggest, as Patent Owner asserts, that a person of ordinary skill in the art would have concluded that "[a]t best, the Gan Thesis posits that making a concentrator solar cell with polysilicon emitter and interfacial oxide is theoretically possible," and "these musings in the Gan Thesis were theories that fell short of being reproducibly put into practice, and fell even shorter of supporting a reasonable expectation of success." PO Resp. 30, 31 (citing Ex. 2027 ¶¶ 135, 158, 166, 168). In fact, the Gan Thesis states that even though "the oxide growth recipe is not reliable, it was ignored because the results are *still good enough* for emitters to be used in the concentrator solar cells." Ex. 2003, 108 (emphasis added). Moreover, Gan itself suggests a level of success in interfacial oxide growth. For example, Gan states:

> Polysilicon emitters with a thermally grown interfacial oxide are examined in great detail. [Ex. 1007, Abstr.].

> In this paper, detailed calibrations for the polysilicon emitter with a thermally grown interfacial oxide is presented. Compared with the chemical oxide, the thermal oxide appears to be more robust to the high temperature anneal. Consequently, this lends more controllability on the oxide breakup process. [Ex. 1007, 245].
>
> In addition, two separate anneal steps were used in order to avoid any possible interference from the dopant diffusion. It has been reported that the interfacial oxide tends to break up more rapidly with the existence of dopant. [Ex. 1007, 245].
>
> The process sequence is shown as followings: . . . 3. Thin thermal oxide growth at 800 °C (10-minute oxygen flow). [Ex. 1007, 246].
>
> The growth of thin oxide was carried out with 200 sccm oxygen and 5 slm argon mixture. Typically, oxide thickness less than 20 A was measured with ellipsometer. [Ex. 1007, 246].

Gan does not complain about oxide thickness or identify unreliable oxide growth as a barrier that precludes success. *See generally* Ex. 1007. Furthermore, that there may be some level of unpredictability, as reflected in the Gan Thesis, does not defeat obviousness, because "obviousness cannot be avoided simply by a showing of some degree of unpredictability in the art so long as there was a reasonable probability of success." *Pfizer*, 480 F.3d at 1364; *see also In re Longi*, 759 F.2d 887, 897 (Fed. Cir. 1985) ("Only a reasonable expectation of success, not absolute predictability, is necessary for a conclusion of obviousness."). In addition, "[w]hen prior art contains apparently conflicting references, the Board must weigh each reference for its power to suggest solutions to an artisan of ordinary skill" and, in so doing, "consider the degree to which one reference might accurately discredit another." *In re Young*, 927 F.2d 588, 591 (Fed. Cir. 1991).

Although we do not view the Gan Thesis as a "reference" that forms the basis of Petitioner's challenge, the Gan Thesis describes known techniques that the skilled artisan could have employed to improve thin oxide growth. According to the Gan Thesis, "oxide growth was also found to depend on the furnace condition" and

> [o]ne possible explanation for such variations is that it may result from the fact that the oxidation proceeded when the furnace was still at the ramp-up stage. Consequently, the oxide growth depends on the final temperature of the furnace, which in turn i[s] determined by how long the boat has been pulled out from the furnace before the wafer loading.
>
> The other place that the oxide thickness can go wrong is at the polysilicon deposition step. In the polysilicon deposition step, the system is set at 600 °C; however, the actual deposition does not take place until the system temperature is stabilized. It is possible that further oxidation may occur in this stand-by period.

Ex. 2003, 112. The Gan Thesis then states that "it appears that the variation of the oxide thickness results mainly from the oxide-growth step. If this is the case, it is possible that the thin-oxide growth can be improved by performing the oxidation at a lower temperature such that the oxidation rate can be controlled more precisely." Ex. 2003, 112. Though Patent Owner characterizes this disclosure as "an unproven assumption" or "speculation at best" (Sur-reply 5), Gan teaches that as the temperature increases the value of J_0 also increases, which leads to recombination and reduced efficiency of the solar cell. Therefore, Gan itself states that reducing temperature, as suggested by the Gan Thesis, improves results. Ex. 1005, 245, 249; *see also* Ex. 2027 ¶ 119 (Dr. Ruby testifying that both Gan and the Gan Thesis discuss controlling temperatures and annealing times to regulate interfacial oxide breakup).

Patent Owner also argues that "Petitioner's assertion that fabricating Froitzheim's solar cell with Gan's polysilicon emitters and interfacial oxide 'was simply substituting one known element for another to obtain predictable results' is incurably infected with hindsight bias, mischaracterizations of the state of the art, and references that do not adequately support the assertion." PO Resp. 34. In particular, Patent Owner alleges that the cited references do not show how to add an interfacial oxide layer because (1) "Gan does not teach the fabrication of a solar cell, but rather, the fabrication of test devices" (PO Resp. 36), (2) the tunnel oxide layer in Borden-575 requires contact holes "which do not exist[] in the Froitzheim-Gan combination" (*id.*), (3) Froitzheim does not mention interfacial or tunnel oxide (*id.*), (4) "Swanson mentions adjusting the thickness of a back side tunnel oxide, but does not teach a [person of ordinary skill in the art] how to add one" (*id.*), and (5) the fact that the '516 patent is silent about how to make a tunnel oxide layer does not suggest that the skilled artisan would have known how to do so (*id.* at 37).

We are not persuaded by Patent Owner's position. Dr. Holman testifies that a person of ordinary skill in the art "at the time of the '516 patent's priority date would have understood how to successfully manufacture an oxide layer." Ex. 1077 ¶ 31; Ex. 1003 ¶ 144 (citing Ex. 1005; Ex. 1006; Ex. 1046; Ex. 1023; Ex. 1031; Ex. 1050). Dr. Ruby agrees. For example, Dr. Ruby testifies that solar cells having a doped polysilicon layer and oxide layer were known to provide excellent passivation and carrier selectivity as of 2008. Ex. 1075, 107:16–109:7. Dr. Ruby further testifies that Gan teaches an oxide layer formed between the back surface of the substrate and the emitter layer. Ex. 1075, 180:12–

181:1; Ex. 2027 ¶ 120. Furthermore, Patent Owner's argument that the cited references do not teach how to add an interfacial oxide layer requires a greater level of particularity from the prior art than is provided in the '516 patent. *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1570 (Fed. Cir. 1997) (stating that "the '359 patent itself does not disclose the level of detail that Lockwood would have us require of the prior art."). Accordingly, the evidence of record suggests that the skilled artisan, at the time of invention, would have known how to replace Froitzheim's diffused emitter with the polysilicon emitter and oxide layer of Gan.

Therefore, we are persuaded that Petitioner has shown that the skilled artisan would have had a reasonable expectation of success in combining the teachings of Froitzheim and Gan.

Accordingly, we determine Petitioner has demonstrated by a preponderance of the evidence that the combination of Froitzheim and Gan would have rendered claim 9 obvious.

5. Claim 5

Claim 5 depends from claim 3 and further requires "a trench cutting through the dielectric layer and the P-type polysilicon emitter and into a portion of the N-type silicon substrate on the backside of the solar cell." Ex. 1001, 6:29–32. Petitioner alleges that Sheats teaches isolation trench 516 that is formed through the transparent conductive layer (corresponding to the front contact) and the active layer (corresponding to the emitter/substrate). Pet. 60–61 (citing Ex. 1012 ¶¶ 3–4, 58–59, Fig. 5D; Ex. 1002, 81–82; Ex. 1003 ¶¶ 214–215). Petitioner asserts that "[i]t was well known that solar cells could short circuit, and one known way to address short circuits in solar cells was to include a trench near the edge of

the cell." Pet. 62 (citing Ex. 1063, 1739; Ex. 1065, 6:11–7:16; Ex. 1066, 7:23–40; Ex. 1020, 290). Petitioner explains that "Sheats teaches this well-known concept, as it teaches a trench for 'electrically isolate[ing] undesirable short circuits 511 formed on an outside wall 513.'" Pet. 62 (citing Ex. 1012 ¶ 59, Fig. 5D).

Patent Owner argues that a person of ordinary skill in the art would not have combined Froitzheim and Gan with Sheats because (1) Sheats is superfluous to Froitzheim, (2) a trench, as described in Sheats, is not the most common or popular technique for edge isolation, and (3) Sheats is directed to protecting against short circuiting between the solar cells in a solar array and not the layers of a single solar cell as proposed by Petitioner. PO Resp. 42. Finally, Patent Owner argues that "Sheats' trench is cut up 'to' the substrate layer, not 'into' the substrate as claim 5 recites."[9] PO Resp. 42. We address Patent Owner's arguments below.

a) Whether Petitioner has shown a reason to modify the combination of Froitzheim and Gan with Sheats

Patent Owner argues that Froitzheim already teaches an optional edge isolation technique and a person of ordinary skill in the art "would not have made an unnecessary modification that requires additional manufacturing steps (edge isolation) to resolve." PO Resp. 43. In addition, Patent Owner

[9] Patent Owner also argues that "[t]he applicant's lack of response to the Examiner's findings during an *ex parte* proceeding does not constitute a waiver" in an *inter partes* review. PO Resp. 50. Patent Owner's argument is in response to Petitioner's statement in its Petition that "the Examiner found and the applicant did not dispute, that Sheats describes a solar cell having 'an isolation trench 516.'" Pet. 60. We do not understand Petitioner statement to raise the issue of waiver here and therefore, do not decide the issue of waiver here. Petitioner has persuasively shown that Sheats describes an isolation trench to prevent short circuits. Pet. 60–63.

contends that if edge isolation was desirable, a person of ordinary skill in the art would have selected a more common technique, such as plasma etching. PO Resp. 44 (citing Ex. 1063, 1739, 1742; Ex. 1066, 7:40–41; Ex. 1004 ¶ 47 (Froitzheim describing edge isolation "in a plasma"). Lastly, Patent Owner argues that because Sheats is concerned with "prevent[ing] short circuit between two or more solar cells in an array formation," a person of ordinary skill in the art would not have looked to Sheats in modifying Froitzheim with a trench to prevent short circuit within a single solar cell. PO Resp. 45.

On this full trial record, we are persuaded that Petitioner has shown a reason to modify the combined teachings of Froitzheim and Gan with Sheats. Froitzheim expressly contemplates an optional edge isolation step. Ex. 1004 ¶ 47. Both Drs. Holman and Ruby testify that edge isolation using a trench was known in the art. For example, Dr. Holman states "[e]dge isolation was . . . used by the industry to prevent a solar cell from short-circuiting, typically achieved by adding trenches, sometimes with insulating materials, near the edge of a solar cell" and "Sheats is another example that used this well-known edge isolation technique for its thin film structure." Ex. 1003 ¶ 219 (citing Ex. 1065; Ex. 1066; Ex. 1020; Ex. 1012 ¶ 59); Ex. 1077 ¶¶ 69–73. Dr. Ruby testifies that one of ordinary skill in the art, in 2008, would have known that trenches were a known edge-isolation technique to prevent short-circuits in solar cells. Ex. 1075, 190:4–192:10. Sheats teaches an edge isolation method that includes laser trenching. Ex. 1012 ¶¶ 58–59, Fig. 5D; *see also* Ex. 1075, 196:18–197:3 (Dr. Ruby testifying that Sheats discloses that laser machining is one example of a technique to form a trench). We reject Patent Owner's contention that Sheats is superfluous because, as Dr. Holman testifies,

> Froitzheim acknowledges that edge isolation is applicable to its solar cell, [and] a POSITA would have been motivated to incorporate a trench as taught by Sheats, as Sheats provides additional details regarding an edge isolation feature (i.e., a trench) that Froitzheim does not expressly disclose but were known by POSITAs.

Ex. 1077 ¶ 70.

We acknowledge Patent Owner's position that trenching is not the most common edge isolation technique, but we are not persuaded by Patent Owner's argument. Patent Owner fails to direct our attention to any conclusive evidence of record identifying the "most common or popular" edge isolation technique; indeed, what the record evidence shows is that there are many techniques available to the skilled artisan including trenching (Ex. 1012), plasma etching (Ex. 1007; Ex. 1066), grinding (Ex. 1063), and cleaving (Ex. 1020). Moreover, the law does not require the ordinarily skilled artisan to select the "most common or popular" alternative, only that "a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does" is identified. *KSR*, 550 U.S. at 418; *see also id*. at 417 (stating that "when a patent claims a structure already known in the prior art that is altered by the mere substitution of one element for another known in the field, the combination must do more than yield a predictable result"). Petitioner has satisfied this requirement. We also dismiss Patent Owner's contention that because Sheats discusses edge isolation between solar cells in an array and not within a single solar cell, as proposed by Petitioner, there is no reason to combine Sheats with Froitzheim and Gan. PO Resp. 45–50. "[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the

same way, using the technique is obvious unless its actual application is beyond his or her skill." *KSR*, 550 U.S. at 417. Dr. Holman testifies that a person of ordinary skill in the art "would have understood that a trench to prevent a short circuit in a single cell is physically and functionally similar to a trench for solar cells in an array because short circuits are a potential problem in either scenario." Ex. 1077 ¶ 72; *see also* Ex. 1075, 188:10–190:9 (Dr. Ruby testifying that short circuits are problems existing in both solar cells and solar cell arrays alike). And, Patent Owner does not direct our attention to any record evidence that the proposed modification would have been beyond the skill-set of the ordinarily skilled artisan at the time of invention.

Therefore, we are persuaded that Petitioner has shown that the skilled artisan would have had a reasonable expectation of success in combining the teachings of Froitzheim and Gan with Sheats.

b) Whether Petitioner established that the trench of Sheats meets the limitation recited in claim 5

Patent Owner also argues that "the patchwork of Froitzheim-Gan/Borden-575-Sheats, does not disclose all elements of claim 5 of the '516 patent. Sheats' trench is cut up 'to' the substrate layer, not 'into' the substrate as claim 5 recites." PO Resp. 42.

Patent Owner's brief argument is unconvincing. Specifically, Sheats itself explains that "an isolation trench 516 is ***formed through the transparent conductive material and the active layer*** to the bottom of the electrode 506 as shown in FIG. 5D." Ex. 1012 ¶ 59 (emphasis added); Ex. 1077 ¶ 73. Thus, Sheats describes a trench "through" the substrate, contrary to Patent Owner's assertions. In the absence of further explanation

or citation from Patent Owner, the basis for Patent Owner's contentions is unclear.

* * *

Accordingly, we determine Petitioner has demonstrated by a preponderance of the evidence that the combination of Froitzheim, Gan, and Sheats would have rendered claim 5 obvious.

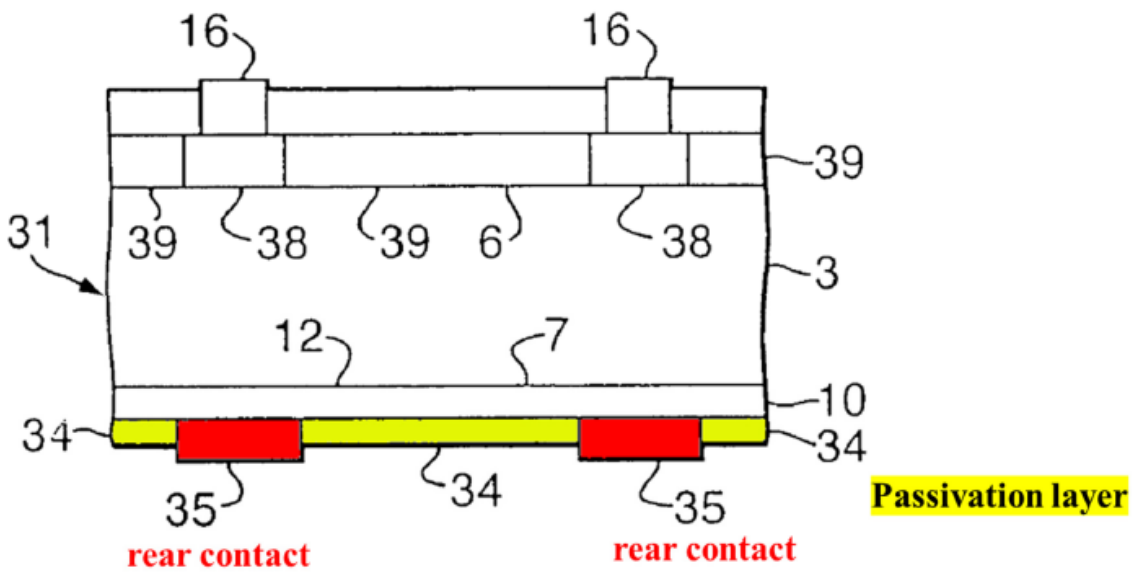
6. Claim 12

Claim 12 depends from claim 9 and further requires that "the second metal contact comprises silver formed over a layer of silicon dioxide." Ex. 1001, 6:63–65. Petitioner argues that "Froitzheim teaches that its screen-printed metal contacts (e.g., rear contact) contained silver particles and aluminum, and that its structure resulted in less silver (Ag) or aluminum (Al) required for the contacts." Pet. 50 (citing Ex. 1004 ¶¶ 20, 49). Petitioner explains that the passivation layer in Froitzheim may be applied before the metal contact formation. Pet. 51 (citing Ex. 1004 ¶ 50). Petitioner reasons that "because the rear contacts are applied after the passivation layer, a POSITA would have understood Froitzheim teaches that the second metal contact (e.g., rear contacts 35) includes silver and is formed over a layer of silicon dioxide (e.g., passivation layer 34)," as claimed. Pet. 51 (citing Ex. 1004, Fig. 3; Ex. 1003 ¶ 184).

Patent Owner argues that "[t]he proposed Froitzheim-Gan combination does not include backside contacts with 'silver formed over a layer of silicon dioxide,' as recited in claim 12 of the '516 patent." PO Resp. 37. Instead, Patent Owner contends "Froitzheim discloses forming metal contacts <u>between</u> the passivation layer." PO Resp. 38 (citing Ex. 2027 ¶ 183).

Neither party proposes an express claim construction of "formed over" or "over." *See, e.g.*, Pet. 18; PO Resp. 27 (Patent Owner "applies the plain and ordinary meaning of claim terms"). We agree that no express claim construction is required. Applying the plain and ordinary meaning of "formed over," we find that Froitzheim does not disclose the formation of a second, silver metal contact over a layer of silicon dioxide.[10]

In particular, Petitioner has not shown that Froitzheim's third embodiment has metal contacts that are "formed over" a layer of silicon dioxide. Petitioner relies on Froitzheim's annotated Figure 3, reproduced below.



Petitioner's annotated Figure 3 of Froitzheim, shown above, depicts rear contacts 35 (highlighted in red) and passivation layer 34 (highlighted in yellow) on the rear surface of solar cell 31. Pet. 51 (citing Ex. 1004 Fig. 3; Ex. 1003 ¶ 184). Petitioner argues that passivation layer 34 may be silicon

[10] Patent Owner does not allege that Petitioner fails to establish a motivation to combine Froitzheim and Gan with a reasonable expectation of success beyond what is argued above. *See generally* PO Resp.

dioxide and rear contacts may be a metal and contain silver particles and aluminum. Pet. 50–51 (citing Ex. 1006 ¶¶ 19, 20, 30, 33, 50). However, Froitzheim provides that "rear contacts 35 are arranged in a finger structure covering only part of the rear side." Ex. 1006 ¶ 33. Importantly, Froitzheim also provides: "Between the fingers a passivation layer 34 is arranged." Ex. 1006 ¶ 33. These disclosures, together with the depiction in Froitzheim's Figure 3, clearly position the passivation layer 34 between the rear contacts 35 and, correspondingly, position the rear contacts 35 between the passivation layer 34. According to these disclosures, neither is "over" or "formed over" the other.

Petitioner also argues that Froitzheim provides "that its rear contacts are formed by screen printing the contacts over the silicon dioxide passivation layer," and that "'firing through' does not, as [Patent Owner] asserts, result in the metal contact completely etching away the passivation layer so the metal contacts are 'between' the passivation layer." Pet. Reply 15–16 (citing Ex. 1004 ¶¶ 19, 30, 33, 48, 50). Petitioner alleges that "[t]he process instead results in metal 'filaments' reaching through the passivation layer but 'most' of the metal would remain 'on top of' or 'over' the passivation layer." Pet. Reply 16 (citing Ex. 2029, 84:13–85:16).

Patent Owner argues that screen printing may involve a process of placing metal over a solar cell, but it "does not satisfy the limitation of 'formed over,'" which importantly relates to a product claim. Sur-reply 9–10. Patent Owner further argues that "Froitzheim's broader context discredits Petitioner's argument" because "Froitzheim discloses that its front side contacts are screen printed as well," and "[i]f, as Petitioner argues, screen printing leaves 'most of the' metal paste on the front surface of the

cell, then light absorption would be compromised, and the efficiency of the solar cell would be reduced." Sur-reply 12 (citing Ex. 1004 ¶¶ 28, 49; Ex. 2027 ¶ 62).

We agree with Patent Owner. Although Froitzheim provides generally that a passivation coating can be applied "before or after contact formation" (Ex. 1006 ¶ 50) and that the metal contacts are formed by screen printing over the silicon dioxide (*Id.* ¶¶ 19, 20, 30, 33, 48, 50), this does not persuasively contravene the specific disclosures of Froitzheim's Figure 3 and paragraph 33, which place the rear contacts 35 *between* the passivation layer 34, not over. Ex. 1004 ¶ 33. Patent Owner, through the testimony of Dr. Ruby, describes the process of Froitzheim's metal contact formation using squeegee paste, which also supports that Froitzheim's process does not result in metal contacts "formed over" a layer of silicon dioxide because the paste is "fired through" the passivation layer. Ex. 2029 ¶¶ 183–187. This is consistent with the depiction in Froitzheim's Figure 3 and the "between" language in Froitzheim paragraph 33. We acknowledge Dr. Holman's testimony that "most of the paste resides on top of or over the antireflection coating" (Ex. 2029, 85:2–16), but that testimony cannot be easily reconciled with Froitzheim's teaching that "[*b*]*etween the fingers* a passivation layer 34 is arranged, for which the same type of layers can be used as for the front side" (Ex. 1004 ¶ 33 (emphasis added)). It is Petitioner's burden to establish facts supporting its challenge that claim 12 would have been obvious over the combined teachings of Froitzheim and Gan by a preponderance of the evidence. 35 U.S.C. § 316(e); *see also Harmonic, Inc.*, 815 F.3d at 1363. After considering the parties' arguments and evidence of record, and weighing the testimony, we are not persuaded that Petitioner meets its

burden of establishing, by a preponderance of the evidence, that the proposed combination of Froitzheim and Gan teaches or suggests the limitations of claim 12.

* * *

Accordingly, we determine Petitioner has *not* demonstrated by a preponderance of the evidence that the combination of Froitzheim and Gan would have rendered claim 12 obvious.

7. Remaining Claims 1–4, 6–8, 10, and 11

Petitioner asserts that claims 1–4, 6–8, 10, and 11 would have been obvious over the combination of Froitzheim and Gan. Pet. 7, 47–63. Patent Owner does not separately address remaining claims 1–4, 6–8, 10, and 11 beyond what is argued for independent claim 9 or dependent claims 5 and 12. *See generally* PO Resp.

Upon review of the full trial record, and the arguments and evidence therein, we determine that Petitioner has demonstrated by a preponderance of the evidence that each of the limitations recited in claims 1–4, 6–8, 10, and 11 are suggested by the combination of Froitzheim and Gan and that the ordinarily skilled artisan would have had reason to make the combination with a reasonable expectation of success.

E. Challenges Based on Froitzheim and Borden-575

Petitioner alleges that claims 1–4 and 6–12 of the ’516 patent would have been obvious over the combination of Froitzheim and Borden-575. Pet. 7, 64–77. In addition, Petitioner contends that claim 5 of the ’516 patent would have been obvious over the combination of Froitzheim and Borden-575 in further view of Sheats. Pet. 7, 77–78.

We incorporate our overview of Froitzheim and Sheats here.

1. Overview of Borden-575 (Ex. 1006)

Borden-575 is directed to an improved structure for solar cells that includes forming a masking oxide layer on the front and back of the cell and patterning holes in the oxide layer. Ex. 1006, Abstract. The invention in Borden-575 places a buried oxide under the emitter of a polysilicon emitter solar cell. Ex. 1006 ¶ 7. Borden-575 teaches the use of oxide to "[p]rovide passivation between the substrate 200 and the polysilicon emitter 210." Ex. 1006 ¶ 22. Borden-575 discloses the use of holes in the oxide layer to provide contact areas and increase current density to enhance efficiency by "allow[ing] current flow therethrough." Ex. 1006 ¶¶ 7–8.

2. Analysis of Claim 9

Petitioner alleges that the combination of Froitzheim and Borden-575 renders claims 1–4 and 6–12 of the '516 patent obvious. For this challenge, similar to its challenge based on Froitzheim and Gan, Petitioner contends Froitzheim discloses all elements of these claims except for the oxide layer formed between the back surface of the substrate and the polysilicon emitter layer. Pet. 67. According to Petitioner, Froitzheim and Borden-575 are analogous art because "[b]oth are in the same field as the Challenged Claims (solar cells) and are reasonably pertinent to solving the problems addressed in the Challenged Claims (increasing efficiency) with the same types of solutions (optimizing solar cell fabrication and resulting configuration)." Pet. 64 (citing Ex. 1006, Abstract, ¶¶ 2–8, 16–33; § X.A.1.; Ex. 1003 ¶ 223). Petitioner contends that Borden-575 discloses additional teachings, such as, "adding an oxide layer between a substrate and polysilicon emitter [which] 'provides passivation between the substrate and the polysilicon, while

allowing for tunnel current flow.'" Pet. 66 (citing Ex. 1006 ¶ 22) (emphasis omitted).

Petitioner argues that a person of ordinary skill in the art would have been motivated to "[i]mplement Borden's polysilicon emitter and tunnel oxide layer to the backside configuration taught by Froitzheim," in addition to the considerations taken from the teachings of Gan and others regarding the benefits of a polysilicon emitter and tunnel oxide layer, as applied to a backside configuration. Pet. 65 (citing *id.* at 27–36 (Section X.A.i). Additionally, Petitioner contends Borden-575, like Gan, teaches that solar cell efficiency can be increased through the use of oxide layers which reduces recombination and contact resistance. Pet. 66 (citing Ex. 1003 ¶¶ 228–229).

Petitioner contends a person of ordinary skill in the art would have been motivated to implement the polysilicon emitter and oxide layer structure of Borden-575 with the solar cell of Froitzheim with a reasonable expectation of success because of the similarity and compatibility of solar cells, and disclosure of the basic configuration of a solar cell. Pet. 67. As discussed above, Petitioner contends a person of ordinary skill in the art would have been motivated to modify Froitzheim to implement a P-type polysilicon emitter and oxide layer as taught by Borden-575 with a reasonable expectation of success; the addition of the P-type emitter as taught by Borden-575 implemented with Froitzheim's design would align such that the rear contact of Froitzheim would be connected to the P-type emitter. Pet. 68–71.

Patent Owner does not dispute that Froitzheim and Borden-575 teach or suggest all limitations of claim 9. *See generally* PO Resp. Instead, Patent

Owner argues that (1) Borden-575 is not prior art (PO Resp. 20, 65), (2) Petitioner's combination is "impermissibly vague" (PO Resp. 51), (3) Petitioner fails to show that a person of ordinary skill in the art would have had reason to implement Borden-575's buried oxide (*id.* at 54), and (4) a person of ordinary skill in the art would not have had reason to combine the teachings of Froitzheim and Borden-575 with a reasonable expectation of success (*id.* at 55).

On this record, the arguments and evidence put forth by Petitioner and unchallenged by Patent Owner are supported by the record. We address Patent Owner's challenges below.

a) Whether Borden-575 is prior art to the '516 patent

Petitioner argues that Borden-575 "claims priority to U.S. Provisional Appl. 61/023,354 . . . filed on January 24, 2008" ("Borden-575 Provisional," Ex. 1011). Pet. 21. Petitioner alleges that "Borden-575 is prior art as of Borden-575 Provisional's filing date because Borden-575 Provisional (1) includes the relevant subject matter of Borden-575 and (2) supports at least one claim in Borden-575." Pet. 21. Petitioner supports its position by providing a chart that outlines the relevant disclosures in Borden-575 and where the subject matter of each disclosure may be found in the Borden-575 Provisional. Pet. 22–24.

Patent Owner argues that Petitioner's challenges including Borden-575 must fail because Borden-575 is not prior art to the '516 patent. PO Resp. 20–24. Patent Owner first argues that the Borden-575 Provisional does not provide support for claim 1 which recites a "semiconductor substrate." PO Resp. 21. Instead, Patent Owner explains that the Borden-575 Provisional describes only a "semiconductor device" and a "substrate."

PO Resp. 21. Second, Patent Owner asserts that certain portions of Borden-575 that Petitioner relies upon are not disclosed in the Borden-575 Provisional, and therefore cannot support the grounds based on Borden-575. PO Resp. 2. These purportedly missing disclosures include: (1) the formula in paragraph 17 of Borden-575 (PO Resp. 22 (citing Ex. 1006 ¶ 17; Ex. 1011 ¶ 14)); (2) Borden-575's statement that "contact holes 212 are provided in the insulating layer 212 to allow for photocurrent flow" (*id.* (citing Ex. 1006 ¶ 19; Ex. 1011 ¶¶ 16–17)); (3) "an entire paragraph containing additional details on substrate 200 and contact holes" (*id.* at 23 (citing Ex. 1006 ¶ 20; Ex. 1011 ¶¶ 16–17)); and (4) Borden-575's "disclosure that a thin tunnel oxide '[allows] for tunnel current flow'" (*id.* (citing Ex. 1006 ¶ 22; Ex. 1011 ¶ 18)). According to Patent Owner, each of these unsupported disclosures are used by Petitioner "particularly in support of its motivation to combine arguments, where Petitioner cited Borden-575's disclosure that its tunnel oxide provides 'passivation between the substrate and the polysilicon, <u>while allowing for tunnel current flow.</u>'" PO Resp. 23.

On this record, we agree with Petitioner that the Borden-575 Provisional provides written description support for at least one claim, i.e., claim 1 of Borden-575. Patent Owner's argument that the term "semiconductor substrate" is not used in the Borden-575 Provisional incorrectly requires word-for-word correspondence, i.e., identical language, between the issued patent and the provisional. *Vas-Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1562–1563 (Fed. Cir. 1991). Instead, the written description "must clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed." *Id.* at 1563 (quoting *In re. Gosteli*, 872 F.2d 1008, 1012 (Fed. Cir. 1989). The touchstone for written description is

whether the earlier disclosure demonstrates with reasonable clarity to a person of ordinary skill in the art that the inventor, at that time, was *in possession* of the later-claimed subject matter. *Id.*

Here, the Borden-575 Provisional states that "[t]he present invention relates to forming contacts in a semiconductor device, and more particularly to methods and apparatuses for providing a buried insulation isolation for solar cell contacts." Ex. 1011 ¶ 1. The Borden-575 Provisional further states that "oxide isolates the contacts from the substrate, achieving the advantage of a selective emitter structure without requiring deep diffusions." Ex. 1011 ¶ 6; *see also id*. ¶¶ 13, 16 ("This insulating layer isolates the contact from the substrate."). Therefore, the "semiconductor device" described by the Borden-575 Provisional includes a substrate. The testimony of Dr. Ruby, Patent Owner's declarant, is consistent with this understanding. For example, Dr. Ruby testifies that solar cells are a type of semiconductor device, "so the principles of semiconductor physics which apply to all semiconductor devices also apply to solar cells" (Ex. 1075, 27:8–20), and that solar cells as of 2008 would have included a silicon substrate (*id.* at 89:4–22). Moreover, Patent Owner does not allege or direct our attention to any record evidence that establishes the inventor of the Borden-575 Provisional was not "in possession" of a "semiconductor substrate" at the time of its disclosure. *See* PO Resp, 21 (arguing only that the term "semiconductor substrate" is not found in the Borden-575 Provisional). Accordingly, when Borden-575 describes a "semiconductor substrate," it is describing the substrate of the "semiconductor device" described in the Borden-575 Provisional.

We are also not persuaded by Patent Owner's contention that several disclosures, purportedly required to support Petitioner's reason to include Borden-575's tunnel oxide, lack support in the Borden-575 Provisional. *See* PO Resp. 22–24. Patent Owner, as it argues above for "semiconductor substrate," demands identity of language as opposed to *possession* of the later-claimed subject matter. *Vas-Cath*, 935 F.2d at 1563. Patent Owner first identifies an equation for the open circuit voltage Voc that is present in Borden-575 but missing in the Borden-575 Provisional. PO Resp. 22 (comparing Ex. 1006 ¶ 17 with Ex. 1011 ¶ 14). The identified paragraphs (as well as the following paragraphs, Ex. 1006 ¶ 18 and Ex. 1011 ¶ 15) of Borden-575 and the Borden-575 Provisional are *nearly identical* except for equation $V_{oc} = kT/q \ln (J_l/J_0 = 1)$, *which is absent* from the Borden-575 Provisional. Specifically, the language from the Borden-575 Provisional, reproduced below, states:

> [0014] The present inventors recognize that a point contact solar cell provides improved efficiency. This is because the current flow is concentrated into a small region, providing a higher current density. The open circuit voltage is given by the equation:
>
> **Error! Objects cannot be created from editing field codes.**
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> [0015] where k is Boltzmann's constant, T the temperature, q the electron charge, J_l the short circuit current density, and J_0 the diode saturation current. Therefore, an increase in short circuit current density provides an increase in voltage and, hence, efficiency.

Ex. 1011 ¶¶ 14–15 (the Borden-575 Provisional includes "error" language in place of the V_{oc} equation found in Borden-575). The remaining disclosures of paragraphs 14 and 15 clearly explain what is detailed in the equation and, critically, that the equation shows the relationship between short circuit

current density and open circuit voltage. Ex. 1011 ¶¶ 14–15. Further, according to Dr. Ruby, the V_{oc} equation would have been known to the person of ordinary skill in the art as of 2008. Ex. 1075, 130:6–17, 132:13–133:4.

The other paragraphs Patent Owner contends are missing from the Borden-575 Provisional include disclosures relating to "contact holes" and "tunnel oxide" (PO Resp. 22–24)—concepts which are, in fact, described elsewhere in the Borden-575 Provisional. *See e.g.*, Ex. 1011 ¶¶ 14–23; Fig. 2. We also observe that Dr. Ruby testifies that both concepts were well-known and that tunnel oxides were known to permit current to "tunnel" through the oxide layers with very low resistance. Ex. 2027 ¶¶ 77–84; *see also id.* ¶¶ 71, 77–84; Ex. 106:5–108:5, 109:1–9.

Therefore, we are satisfied that the portions of the Borden-575 relied upon by Petitioner to support its motivation to combine are adequately supported by the Borden-575 Provisional. Thus, we determine Borden-575 is prior art.

b) Whether Petitioner's challenge based on Froitzheim and Borden-575 is impermissibly vague

Patent Owner argues that "Petitioner's proposal to implement 'Borden-575's polysilicon emitter and tunnel oxide to the backside configuration taught by Froitzheim' is impermissibly vague" because "[o]n the one hand, Petitioner appears to propose implementing Borden-575's tunnel oxide, which is not disclosed as a layer" and "[o]n the other hand, Petitioner repeatedly refers to a to a tunnel oxide 'layer' and labels its proposed combination with an 'oxide layer' . . . while also referencing Borden-575's buried oxide." PO Resp. 51–52. According to Patent Owner, "Petitioner's intentional vagueness shifts the burden on the Patent Owner

and the Board to guess which components would be included in the proposed Froitzheim-Borden-575 combination." PO Resp. 53.

Patent Owner raised this issue in its Patent Owner Preliminary Response (Prelim. Resp. 20–26), prompting us to state that "[c]larification or further explanation of Borden's disclosure of masking oxides and tunnel oxides would be helpful to the resolution of this challenge, to the extent Petitioner maintains it." DI 39.

Petitioner explains that though "Borden-575's 'buried oxide' and 'tunnel oxide' each meet the challenged claims' oxide limitation," the "motivation to combine analysis properly focuses on why a POSITA would have been motivated to obtain benefits by 'implementing Borden-575's polysilicon emitter and ***tunnel oxide layer*** to the backside configuration taught by Froitzheim.'" Pet. Reply 20 (citing Pet. 65). Further, at the Oral Hearing, Petitioner clarified its position.

> JUDGE KALAN: So my question to you, Mr. Cavanaugh, is: you are not relying on the buried oxide layer alone as a basis for the Froitzheim-Borden-575 combination, correct?
>
> MR. CAVANAUGH: Correct.
>
> JUDGE KALAN: Okay. And so there is no reason to combine that because you're not relying on it.
>
> MR. CAVANAUGH: Correct, that's our position.
>
> JUDGE KALAN: So I can just ignore everything to the left-hand side of [Patent Owner's] slide [22]?
>
> MR. CAVANAUGH: Yes. That's a succinct way of articulating what I was trying to use more words to articulate. And I think that that is -- like, in the interest of time, I'll move on. But, you know, I think looking at kind of the particular position grounds

> is really important and the particular combination. And to the extent that the Patent Owner considers it impermissibly vague, in our view and the view of Dr. Holman as he testified in the reply declaration, that's not so.

Tr. 51, 47:1–16; *see also id*. at 18:26–19:18 (stating that Petitioner relies on Borden-575's tunnel oxide layer), 45:26–46:5 (stating that "the claim doesn't require buried oxide. It requires an oxide layer and that is supplied by the tunnel oxide. And that's clear from the petition. And so the claim itself is satisfied by the tunnel oxide. . . . [W]e are relying on the tunnel oxide.").

Therefore, the Petition and the Reply, as well as the argument at the hearing, make clear that Petitioner relies on the tunnel oxide, and not the buried oxide layer, to support its contentions.

We acknowledge Patent Owner's argument that "Petitioner solely relies on Borden-575's buried oxide to satisfy the claim limitations 9[c] and 1[e]" and that Petitioner's argument that the tunnel oxide satisfies these limitations is new, as it was "not present in the Petition, and is therefore waived and should not be considered." Sur-reply 13–14. We disagree. The Petition expressly states that "Borden-575 also teaches creating contact holes 212 in the **buried oxide,** and a **tunnel oxide 212** layer between the **polysilicon emitter** and **substrate** in the contact holes "provides passivation between the **substrate** and the **polysilicon**." Pet. 69 (citing Ex. 1006 ¶ 22) (emphasis and coloring in original) (labeling the buried oxide, yellow, tunnel oxide 212, orange, the polysilicon emitter, blue, and the substrate, green). Petitioner then states that "a POSITA would have been motivated to modify Froitzheim to implement a **P-type polysilicon emitter** and **oxide layer** formed between the back surface of the **substrate** and the **emitter layer** as

taught by Borden-575 with a reasonable expectation of success as shown in modified Figure 3 of Froitzheim." Pet. 70 (emphasis and coloring in original) (labeling the oxide layer orange, the P-type polysilicon emitter blue, and the substrate green). Petitioner consistently uses orange to denote the tunnel oxide layer. *See* Pet. 69–70 (Petitioner's annotated Borden-575 Figs. 2 and 3, coloring the tunnel oxide layer 212, orange, and the buried oxide layer, yellow). Therefore, the record evidence indicates Petitioner relies on the tunnel oxide to support its allegations with respect to claim limitations 9[c] and 1[e].

c) Whether Petitioner has shown a reason to combine the teachings of Froitzheim and Borden-575 based on the buried oxide layer

Patent Owner also asserts that "[t]o the extent Petitioner proposes implementing Borden-575's buried oxide, Petitioner is silent on why a POSITA would have been motivated to do so, and silent on whether a POSITA could have reasonably expected the implementation to be successful." PO Resp. 54. Patent Owner notes that "Petitioner's expert did not discuss a POSITA's motivation to incorporate Borden-575's buried oxide layer." PO Resp. 54. As a result, Patent Owner contends that Petitioner has failed to meet its burden of establishing obviousness based on the combination of Froitzheim and Borden-575 using a buried oxide layer. PO Resp. 55.

As discussed above, Petitioner does not base its Froitzheim-Gan challenge on the buried oxide layer. Therefore, we need not decide whether Petitioner has shown obviousness or provided a reason to combine Froitzheim and Borden-575 using Borden-575's buried oxide layer because Petitioner proposes no such combination.

d) Whether Petitioner has shown a reason to combine the teachings of Froitzheim and Borden-575

Patent Owner argues:

> Regardless of whether the proposed Frotizheim-Borden-575 combination uses Borden-575's tunnel oxide, or buried oxide, or both, any of those combinations would be fatally flawed. Without the buried oxide, Borden-575's polysilicon emitter would not work. But with the buried oxide, Froitzheim's rear metal contacts would not receive current flow because Petitioner omitted contact holes from its proposed implementation.

PO Resp. 55. Specifically, Patent Owner alleges that a person of ordinary skill in the art would not have had a reason to combine Froitzheim and Borden-575 because (1) of the difficulty in reliably growing thin oxide layers as discussed in the Gan Thesis (PO Resp. 56), (2) "Gan is clear that using a temperature of 1000°C provided unsatisfactory results and Borden-575 teaches annealing at the even higher temperature of 1050°C" (*id.* at 58), (3) a person of ordinary skill in the art would not have had a reasonable expectation of success "using Borden-575's polysilicon emitter without its complimentary buried oxide" (*id*. at 59), and (4) "no reasonable expectation of success [exists] because Petitioner's proposed combination omits contact holes" (*id.* at 63). Because we agree with Patent Owner that Petitioner has failed to carry its burden to show that the ordinarily skilled artisan would have had a reasonable expectation of success, we confine our discussion below to addressing that issue.

According to Patent Owner, "Borden-575 emphasizes the importance of isolating contacts in solar cells" which Borden-575 achieves by placing buried oxide under each metal contact. PO Resp. 59–61. Thus, the "polysilicon emitter 210 functions properly in Borden-575 because of the buried oxide 214." PO Resp. 62. But Patent Owner asserts that

"Petitioner's proposed Froitzheim-Borden-575 combination does not include consideration of the buried oxide" and "[w]ithout the buried oxide, Borden-575's thin emitter would need a 'sophisticated contact process,' such as the deep diffusion of prior art figure 1 of Borden-575, to reach the metal contact." PO Resp. 62. Patent Owner further asserts that Petitioner fails to propose "a solution to fill this gap," and, as a result, a person of ordinary skill in the art "would not have reasonably expected to succeed in implementing Borden-575's barebone emitter with Froitzheim." PO Resp. 62. Patent Owner argues that "[t]o the extent Petitioner proposes to utilize Borden-575's buried oxide, there would still be no reasonable expectation of success because Petitioner's proposed combination omits contact holes." PO Resp. 63. Patent Owner explains that "[t]his omission is fatal" "because contact holes are a crucial feature; they 'allow current flow' between the emitter and the substrate." PO Resp. 63–64. In particular, Patent Owner explains that "this is because the buried oxide is an 'insulating (e.g., oxide) layer 214 under the doped region 210 and the contact 202 . . . [and] the insulating layer 214 isolates the contact 202 from the substrate 200.' Thus, contact holes are needed to permit current flow from the substrate to reach the metal contacts." PO Resp. 64 (citing Ex. 1006 ¶ 19; Ex. 2027 ¶ 262). And without current flow, the expectation of success would be zero. PO Resp. 65.

Petitioner, in its Reply, concedes that its combination does not include Borden-575's buried oxide or contact holes. Pet. Reply 23. Instead, Petitioner responds that a person of ordinary skill in the art "would have understood how to implement Borden-575's oxide layer without a buried oxide layer" and "would have been motivated to apply the known benefits of

Borden-575's polysilicon emitter and ***tunnel oxide*** to Froitzheim." Pet. Reply 23. We do not disagree. However, the question Patent Owner raises is *not* whether a reason to modify the teachings Froitzheim to include the tunnel oxide of Borden-575 exists; instead, the question is whether the skilled artisan would have had a reasonable expectation of success in implementing the tunnel oxide layer without Borden-575's buried oxide and contact holes—which Petitioner admittedly excludes. Petitioner does not address this issue raised by Patent Owner. And, as a result, we cannot say, that Petitioner has shown, by a preponderance of the evidence, that the skilled artisan would have a reason to combine the teachings of Froitzheim and Borden-575 *with a reasonable expectation of success in the combination.*

* * *

Accordingly, we determine Petitioner has not demonstrated by a preponderance of the evidence that the combination of Froitzheim and Borden-575 would have rendered claim 9 obvious.

3. Remaining Claims 1–8 and 10–12

Petitioner asserts that claims 1–4, 6–8, 10, and 11 would have been obvious over the combination of Froitzheim and Borden-575, and that claims 5 and 12 would have been obvious over the combination of Froitzheim, Borden-575, and Sheats. Pet. 7, 72–78. Patent Owner does not separately address claims 1–4, 6–8, 10, and 11 beyond what is argued for claim 9. *See generally* PO Resp. Though Patent Owner does separately address claims 5 and 12, Petitioner's arguments do not overcome the issues identified above with respect to claim 9.

Therefore, for the same reasons given in connection with claim 9, discussed above, we determine that Petitioner has not met its burden to demonstrate that person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Froitzheim and Borden-575. Accordingly, we determine that Petitioner has not demonstrated by a preponderance of the evidence that the combination of Froitzheim and Borden-575 would have rendered claims 1–8 and 10–12 obvious.

F. Challenges Based on Li and Gan

Petitioner alleges that claims 1, 2, and 8–11 of the ’516 patent would have been obvious over the combination of Li and Gan. Pet. 7, 78–93.

1. Overview of Li (Ex. 1008)

Li is directed to a “crystalline silicon solar cell with novel structure.” Ex. 1008, Title. Li explains that its purpose “is to overcome the disadvantages of existing cell structures so as to obtain a crystalline silicon solar cell having an emitting region on a back surface with a high conversion efficiency and a simple manufacturing process.” Ex. 1008, 4. One embodiment of Li, Figure 1, is reproduced below.

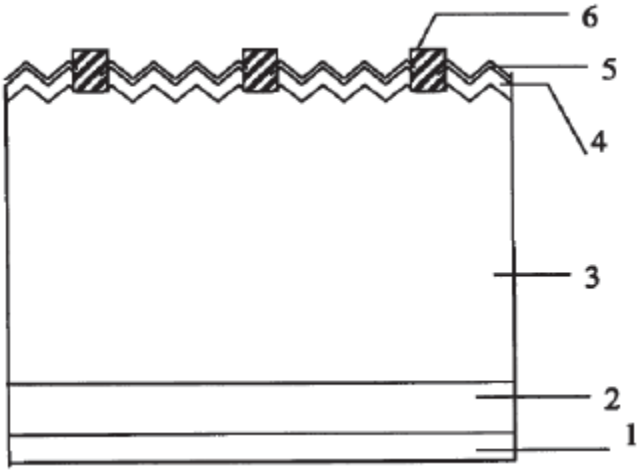

Figure 1 is a schematic diagram of a solar cell with a novel structure. Ex. 1008, 4. Figure 1 depicts "(1) back electrode; (2) silicon thin film prepared by a deposition method; (3) N-type crystalline silicon; (4) highly doped N+ layer; (5) anti-reflection layer; [and] (6) positive electrode." Ex. 1008, 4. According to Li, "[b]y adopting the cell structure of the present invention, cell efficiency can reach 20% or above." Ex. 1008, 4. Li states that "the silicon thin film deposited on the back surface of the silicon wafer, whether it is amorphous silicon, microcrystalline silicon, or nanocrystalline silicon, can achieve a passivation effect on the back surface, thereby improving the cell efficiency." Ex. 1008, 4.

2. Analysis of Claim 9

Petitioner alleges that the combination of Li and Gan renders claim 9 of the '516 patent obvious. Pet. 78–93. Petitioner contends that Li "teaches a solar cell having a front side facing the sun to collect solar radiation during normal operation and a backside opposite." Pet. 81 (citing Ex. 1008, 4, Abstr., claims 1–6, Fig. 1; Ex. 1003 ¶¶ 290, 298). Petitioner contends that "Li teaches that the surfaces of the 'high-quality N-type monocrystalline [substrate] 3…[are] textured by a standard industrial process' and "that the 'texturing treatment [is used] to reduce light reflection and improve a light trapping effect, which is conducive to improving the photoelectric conversion efficiency of the cell.'" Pet. 82 (citing Ex. 1008, 4, Fig. 1 (jagged edges), claim 2; Ex. 1003 ¶¶ 280–282). According to Petitioner, Li teaches a backside emitter where it describes "[a p-type] layer of silicon thin film [2] is deposited on a back surface of N-type monocrystalline silicon to form an emitting region" and that a person of ordinary skill in the art would have understood "that depositing the emitter region on the 'back surface'

forms a *backside junction*" with the substrate. Pet. 83–84 (citing Ex. 1008, 3–4, Fig. 1, Abstr., claims 1, 3, 5, 6; Ex. 1003 ¶¶ 283–284). Petitioner contends that "Gan teaches a solar cell that includes a 'polysilicon emitter with a thermally grown interfacial oxide' over a silicon substrate." Pet. 84–85 (citing Ex. 1005, 245–246, 249; Ex. 1003 ¶¶ 285–287). In addition, Petitioner argues that Li describes a front electrode that is "electrically connected to the N-type crystalline silicon substrate (i.e., *substrate*) via the highly doped N+ layer 4" and includes a "rear electrode 1 on the back of a silicon thin film (i.e., *emitter layer*)." Pet. 85 (citing Ex. 1008, Figs. 1, 4; Ex. 1003 ¶ 288). Petitioner alleges that the first and second contacts are metal because Li states that its "*metal* electrode layer [1] on the back surface can re-reflect light that penetrates the cell back into the cell" and because a person of ordinary skill in the art would have understood that "metal electrodes were common because conductive electrodes like metal are required to transfer generated energy to external circuits." Pet. 86 (citing Ex. 1008, 3, 4; Ex. 1003 ¶ 289). Further, Petitioner asserts that Gan describes use of metal contacts. Pet. 86 (citing Ex. 1005, 246; Ex. 1003 ¶ 289). And lastly, Petitioner asserts that Li "explains that its solar cell pertains to 'solar energy applications'" and that "its design sought to improve 'efficiency' over other cells, reaching efficiency of '20% or above,'" which "is an indicator of how much power a solar cell can deliver to an external electrical circuit." Pet. 87 (citing Ex. 1008, 2–4; Ex. 1016, 14, 154–155; Ex. 1006 ¶¶ 291–292).

According to Petitioner, Li is analogous art for the same reasons discussed above—i.e., because "it is in the same field as the Challenged Claims (solar cells) and is reasonably pertinent to solving the problems

addressed in the Challenged Claims (increasing efficiency) with the same types of solutions (optimizing solar cell configuration)." Pet. 78–79 (citing Pet. 27–36 (Section X.A.1); Ex. 1008, 1–4; Ex. 1003 ¶ 279). Petitioner further alleges that the skilled artisan would have had reason to combine the teachings of Li and Gan because the combination "amounts to use of a known technique and feature (Gan's polysilicon emitter and oxide layer between the PN junction) to improve a similar device (Li's backside junction solar cell) to achieve goals common to both references and the industry (increasing efficiency)." Pet. 79; *see also id.* at 79–80 (citing Sections X.A.1 and X.C.1; Ex. 1008, Fig. 1; Ex. 1005, 245–249; Ex. 1003 ¶¶ 270–277). Petitioner alleges that a person of ordinary skill in the art would have had a reasonable expectation of success in the combination of Li and Gan because "Li teaches fabricating solar cell structures having a backside PN junction with an n-type substrate and p-type emitter to improve a cell's efficiency," like Froitzheim, and a person of ordinary skill in the art "would have considered and applied the teachings of Gan, [Borden-575], and others regarding the benefits of a polysilicon emitter and tunnel oxide layer, as applied to a backside configuration." Pet. 80 (citing Ex. 1008, 4; Pet. 27–36 (Section X.A.1)).

Patent Owner does not challenge Petitioner's allegations regarding the teachings of Li and Gan. PO Resp. 66–69. Instead, Patent Owner argues that (1) a person of ordinary skill in the art would not have had a reasonable expectation of success in the combination of Li and Gan (PO Resp. 66) and (2) Li teaches away from Gan (*id.* at 67).

We find that Petitioner's arguments that are unchallenged by Patent Owner are supported by the record evidence. We address Patent Owner's arguments below.

a) Whether Petitioner has shown a reason to combine the teachings of Li and Gan with a reasonable expectation of success

Patent Owner contends that a person of ordinary skill in the art "would not have been motivated to implement Gan's polysilicon emitter and interfacial oxide structure in an actual solar cell because the Gan Thesis teaches that Gan's interfacial oxide could not be reliably grown" and "[r]eplacing Li with Froitzheim does not remedy those problems." PO Resp. 66. Patent Owner states that "because a POSITA would not have been motivated to combine Li and Gan for the same reasons discussed [with respect to the Froitzheim-Gan combination], Petitioner failed to show obviousnessness of the limitation of (1) forming "a P-type polysilicon emitter" (claim 1) or forming "an emitter layer" (claim 9) using Gan's polysilicon emitter, and (2) forming "an oxide layer" (claims 1 and 9) using Gan's interfacial oxide. PO Resp. 66.

Patent Owner's arguments with respect to Li and Gan are similar to those Patent Owner advanced for Froitzheim and Gan—which we found unpersuasive in the face of Petitioner's evidence and testimonial support from Dr. Holman. Therefore, for the same reasons discussed above, we reject Patent Owner's argument that a person of ordinary skill in the art would not have had reason to combine the teachings of Li and Gan in the manner suggested by Petitioner with a reasonable expectation of success.

b) Whether Li teaches away from of Gan

Patent Owner additionally contends that Li teaches away from modifying its method to incorporate Gan's use of a polysilicon emitter and oxide layer to obtain manufacturing efficiencies. PO Resp. 67. Patent Owner argues that Li's invention "is prepared by a low-temperature deposition method, which avoids a conventional diffusion process at 800–1000°C," which allows for "fewer defects and contamination in silicon materials, improved efficiency, and reduced manufacturing cost." PO Resp. 67–68 (citing Ex. 1008, 3–4). As a result, a person of ordinary skill in the art would not have had reason "to implement Gan's polysilicon emitter and oxide layer" because "Gan's polysilicon emitter and oxide layer would repeatedly require the kind of high temperature processes that Li teaches should be avoided." PO Resp. 68 (citing Ex. 1005, 246; Ex. 2027 ¶ 247; Ex. 2029, 216:16–217:7, 237:13–18, 238:4–239:7).

We are not persuaded the record evidence rises to the level of a teaching away. "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re Gurley,* 27 F.3d 551, 553 (Fed. Cir. 1994). And "teaching away" requires more than the mere expression of a general preference." *Galderma Labs., L.P., v. Tolmar, Inc.,* 737 F.3d 731, 738 (Fed. Cir. 2013). Notably, our reviewing court has determined that a reference can distinguish prior art in order to show the novelty of an invention without teaching away from combining the prior art with the invention disclosed in the reference. *See Ricoh Co. v. Quanta Computer Inc.,* 550 F.3d 1325, 1332 (Fed. Cir. 2008).

Here, Li prefers a "heterogeneous PN junction" and states that "a PN junction is prepared by a low-temperature deposition method, which avoids a conventional diffusion process at 800–1000°C. Such high-temperature process will cause more defects or contamination in silicon material, which will affect the improvement of cell efficiency." Ex. 1008, 4. But, Li's preference for lower temperature diffusion processes does not amount to a teaching away from the broader disclosure. In fact, Li acknowledges that "[t]he silicon thin film can be prepared by *any* deposition method," including conventional processes at higher temperatures. Ex. 1008, 4 (emphasis added). And, while Patent Owner asserts that "[d]eposition methods are not relevant to the parties' dispute, which is over deposition temperature" (Sur-reply 17), the deposition method employed includes its deposition temperature. *See* Ex. 1008, 4 (Li describing "conventional" diffusion processes at temperatures of 800–1000° C). Thus, just because Li teaches ***one way*** of depositing its silicon thin film using a low-temperature deposition method does not mean that Li teaches ***away*** from high-temperature processes. Li's teachings do not discredit or discourage high-temperature processes in a manner that may be said to teach away.

* * *

Accordingly, we determine Petitioner has demonstrated by a preponderance of the evidence that the combination of Li and Gan would have rendered claim 9 obvious.

3. Remaining Claims 1, 2, 8, 10, and 11

Petitioner asserts that claims 1, 2, 8, 10, and 11 would have been obvious over the combination of Li and Gan. Pet. 7, 88–93. Patent Owner does not separately address remaining claims 1, 2, 8, 10, and 11 beyond

what is argued for independent claim 9. *See generally* PO Resp. Upon review of the full trial record, and the arguments and evidence therein, we determine that Petitioner has demonstrated by a preponderance of the evidence that each of the limitations recited in claims 1, 2, 8, 10, and 11 are suggested by the combination of Li and Gan and that the ordinarily skilled artisan would have had reason to make the combination with a reasonable expectation of success.

G. Arguments Relating to the Weight of Dr. Ruby's Testimony

Petitioner contends that the Board should give no weight to Dr. Ruby's testimony because "Dr. Ruby applied the wrong legal standard for reasonable expectation of success—he believed the probability of success must be 'close to 100 percent.'" Pet. Reply 3. Petitioner asserts "[h]is declaration with respect to the grounds is also entirely conclusory (perhaps due to having worked only 20 hours on this IPR) . . . and unsupported by evidence." Pet. Reply 3–4 (citing Ex. 1075, 10:16, 6:7–12). Further, Petitioner alleges that Dr. Ruby's "declaration and deposition testimony conflict in multiple instances." Pet. Reply 4.

Patent Owner asserts that Dr. Ruby's testimony clarifies that "he was not familiar with legal terminology and only provided his understanding of the term 'reasonable expectation of success' in plain English, not in the legal context." Sur-reply 1 (citing Ex. 1075, 165:22–166:1). Patent Owner explains that Dr. Ruby's testimony is not "at odds with the legal standard" because "'close to 100 percent' is not requiring 'conclusive proof' or 'absolute predictability;' that would be 100 percent, not close to it." Sur-reply 1 (citing Ex. 2027 ¶¶ 18–20).

Petitioner does not seek to exclude Dr. Ruby's testimony and only asks that we give no weight to Dr. Ruby's testimony regarding reasonable expectation of success. Though Dr. Ruby did testify that his understanding of "a reasonable expectation of success" was "close to 100 percent," he also clarified his understanding was based on "the plain English meaning." Ex. 1075, 165:17–166:8. Whether Dr. Ruby's opinions are conclusory, mischaracterize evidence, or are not adequately based on record evidence, in this case, goes to the weight we should give to his testimony. Accordingly, as necessary, we appropriately weigh Dr. Ruby's testimony.

III. PATENT OWNER'S MOTION TO EXCLUDE

Patent Owner filed a Motion to Exclude Exhibits 1071, 1072, 1074, and 1078–1086. PO MTE 2.

A. Uncited Exhibits (Exs. 1071, 1072, and 1074)

Exhibit 1071 is the deposition testimony of Dr. Ruby in separate inter partes review proceedings (IPR2024-01039 and IPR2024-01040) challenging the '053 patent and the '516 patent. Ex. 1071; PO MTE 3. Exhibit 1072 is a document titled "Sandia Report: Fundamental Understanding and Developments of Low Cost High-Efficiency Silicon Solar Cells," and is described as an "Annual Progress Report: Sept 1998 – Aug. 1999." Ex. 1072; PO MTE 9–10. And, Exhibit 1074 is an article published by the IEEE as part of conference proceedings. Ex. 1074, 172. Ex. 2028, 13 (Dr. Ruby's Partial List of Publications and Presentations); PO MTE 10–11.

Patent Owner contends that Exhibits 1071, 1072, and 1074 should be excluded. *See generally* PO MTE. With respect to Exhibit 1071, Patent Owner argues that

> after it deposed Patent Owner's expert in this proceeding, Dr. Ruby, and after it had its own expert, Dr. Holman, prepare a supplemental declaration, Petitioner scoured the record of other proceedings hoping to find some snippet that it could argue fills the gaps left by the evidence in this proceeding.

PO MTE 3. According to Patent Owner "[n]o hearsay exception applies to Exhibit 1071." PO MTE 3. With respect to Exhibits 1072 and 1074, Patent Owner argues that because Exhibits 1072 and 1074 "do[] not include any indicia indicating that it was published or otherwise made available to the public," they should be excluded. PO MTE 9–11. According to Patent Owner, "Petitioner has provided no credible information as to when or how this exhibit was actually available to the public," and therefore fails to establish Exhibits 1072 and 1074 are prior art or relevant. PO MTE 9–11.

Relevant to Exhibit 1071, Petitioner explains that Dr. Ruby was "questioned about his prior testimony at his deposition for this proceeding (Ex. 1075, 21:4–22:9), and Petitioner filed all deposition exhibits in this proceeding for completeness." Pet. MTE Opp. 4. Petitioner contends that "Exhibit 1072 contains relevant information about the importance of reducing the number of processing steps in solar cell manufacturing." Pet. MTE Opp. 12. Petitioner contends that Exhibit 1074 "provides relevant information about the use of APCVD on the front and rear sides of a cell with front and back metal contacts." Pet. MTE Opp. 12–13.

We are not persuaded that Exhibits 1071, 1072, and 1074 must be excluded from the record. Exhibit 1071, 1072, and 1074 were introduced during Dr. Ruby's deposition, without objection, and Dr. Ruby was questioned about each exhibit. Ex. 1075, 3:19–4:2, 21:4–22:9, 109:10–133:4, 156:13–159:20. Although Dr. Holman does "consider" Exhibits

1071, 1072, and 1074 (Ex. 1077, App'x D4), neither Dr. Holman nor Petitioner relies on any of these exhibits to support Petitioner's arguments or positions in this matter. *See generally* Pet., Pet. Reply; Ex. 1077. Because Petitioner does not rely on Exhibits 1071, 1072, and 1074, we do not consider these exhibits in rendering our Decision.

Accordingly, we deny Patent Owner's motion to exclude Exhibits 1071, 1072, and 1074 as moot.

B. Prior Art/Printed Publication (Ex. 1081)

Exhibit 1081 is a scientific article that purports to have been presented at the 22nd European Photovoltaic and Solar Energy Conference and Exhibition. Ex. 1081, 1. Patent Owner objects to Exhibit 1081 because "Petitioner has not provided sufficient evidence to show that Exhibit 1081 qualifies as a printed publication" and that "Petitioner must 'produce sufficient proof of its dissemination or that it has otherwise been available and accessible to persons concerned with the art to which the document relates.'" PO MTE 5–6. Therefore, Patent Owner reasons that Exhibit 1081 should be excluded.

We are not persuaded that Exhibit 1081 should be excluded from the record. Patent Owner conflates whether a reference qualifies as a prior art printed publication for a patentability purposes with admissibility under the Federal Rules of Evidence ("FRE"). Under FRE 901, a proponent must make a showing "sufficient to support a finding that the item is what the proponent claims it is." Fed. R. Evid. 901(a). The evidence showing "that the items is what the proponent claims it is" may include "[t]estimony that an item is what it is claimed to be," or "[t]he appearance, contents, substance, internal patterns, or other distinctive characteristics of the item,

taken together with all the circumstances," among other things. Fed. R. Evid. 901(b). Here, Petitioner refers to the presentation date (September 2006) and identifies the proceedings in which the article was presented. Ex. 1089 ¶ 8. In addition, Petitioner provides evidence that Exhibit 1081 was published in 2007 as part of the *Proceedings of the 22nd European Photovoltaic Solar Energy Conference*. Ex. 1089 ¶ 8; Ex. 1090, 8, item 26 (citing Ex. 1081). Based on our review of Exhibit 1081, we are persuaded that it is authenticated under Federal Rule of Evidence 901(b)(4) and we accept Exhibit 1081 for what it purports and is alleged to be. Patent Owner does not show otherwise.

We acknowledge Patent Owner's further contention that the presentation dates and conference are hearsay. PO MTE 7. But, Exhibit 1081 is offered to support Dr. Holman's testimony of what the ordinarily skilled artisan would have understood. Ex. 1077 ¶ 43. Exhibit 1081 is not hearsay when relied upon for this purpose. "A prior art document submitted as a 'printed publication' . . . [and] offered simply as evidence of what it describes, not for proving the truth of the matters addressed in the document. Therefore, it is not hearsay under Fed. R. Evid. 801(c)." *See Joy Techs., Inc. v. Manbeck*, 751 F.Supp. 225, 233 n.2 (DDC 1990), aff'd, 959 F.2d 226 (Fed. Cir. 1992). Furthermore, even if the document were hearsay, experts like Dr. Holman are permitted to rely on hearsay if experts in the same field would reasonably rely on such materials in forming opinions and inferences based on the subject. *See* Fed. R. Evid. 703.

Accordingly, we deny Patent Owner's Motion to Exclude with respect to Exhibit 1081.

C. Relevance (Ex. 1083)

Exhibit 1083 is a scientific article published in the Journal of Applied Physics on March 18, 2009. Ex. 1089 ¶ 10; Ex. 1083, 2. Patent Owner argues that because Exhibit 1083 is not prior art to the '516 patent, it is not relevant. PO MTE 8.

We are not persuaded by Patent Owner's argument. Here, Exhibit 1083 is relevant evidence under FRE 401 because it tends to make a fact of consequence more probable; that is, to support Dr. Holman's testimony about screen printing and that "only a portion of the metal will 'fire through' the silicon dioxide layer to contact the emitter" (Pet. MTE Opp. 10; Ex. 1077 ¶ 44), and Patent Owner fails to establish any prejudice, waste of time, or other reason to exclude this evidence under FRE 403. Fed. R. Evid. 401–403.

Thus, we are not persuaded that Exhibit 1083 should be excluded as irrelevant.

D. Authentication and Hearsay (Exs. 1078–1080, 1082, and 1084–1086)

Patent Owner also moves to exclude Exhibits 1078–1080, 1082, and 1084–1086. PO MTE 5, 7–11. Exhibits 1078, 1079, and 1080 include various papers published in various IEEE proceedings or publications. Ex. 1078, 1308; Ex. 1079, 1375; Ex. 1080, 283; Ex. 1089 ¶¶ 4–7. Exhibits 1082 and 1084 are technical articles published in Semiconductor Science and Technology or the Journal of Applied Physics. Ex. 1082, 164; Ex. 1084, 1; Ex. 1089 ¶¶ 9–11. Exhibits 1085 and 1086 include papers authored by Dr. Ruby and published by Sandia National Laboratories. Ex. 1085, 1; Ex. 1086, 1; Ex. 1089 ¶¶ 12–13.

For each exhibit, Patent Owner alleges that the exhibit "does not include any indicia indicating that it was published or otherwise made available to the public." PO MTE 7, 9–11. Patent Owner further contends that "Petitioner fails to show that a [person of ordinary skill in the art] would know of" these exhibits, and therefore fails to establish relevance. PO MTE 11–14 (stating instead that "Petitioner has provided no credible information as to when or how this exhibit was actually made available to the public").

Petitioner argues that Exhibits 1078–1080, 1082, and 1084–1086 "corroborate Dr. Holman's testimony" and "are not relied on as themselves being pieces of prior art, and it is therefore immaterial whether they were publicly available." Pet. MTE Opp. 12. Petitioner asserts that these exhibits are "undisputably relevant" because they describe aspects of solar cell manufacturing and design. Pet. MTE Opp. 12–13.

We are not persuaded that Exhibits 1078–1080, 1082, and 1084–1086 should be excluded. These exhibits, for the most part, are offered to support Dr. Holman's testimony of what the ordinarily skilled artisan would have understood (Ex. 1077 ¶¶ 32, 34, 55, 57, 60 (citing Exs. 1078–1080), ¶ 43 (citing Ex. 1082), ¶ 44 (citing Ex. 1084)) or to refute testimony offered by Dr. Ruby (Ex. 1077 ¶ 28 (citing Ex. 1085), ¶¶ 32, 66 (citing Ex. 1086)). Furthermore, at least two of the identified exhibits (Exs. 1085 and 1086) were authored by Dr. Ruby, one of which was identified in his "Partial List of Publications and Presentations" that accompanied his declaration in support of Patent Owner's Response (Ex. 1086; *see* Ex. 2027, Technical Publications, 1, 2 (listing the title of Exhibit 1086)). We note that a proponent's "burden of proof for authentication is slight." *Lexington*

Insurance Co. v. Western Pennsylvania Hospital, 423 F.3d 318, 328 (3rd Cir. 2015). Under FRE 901, the proponent must make a showing "sufficient to support a finding that the item is what the proponent claims it is." Fed. R. Evid. 901(a). Here, Petitioner refers to the copyright dates, publication dates, publishers, and Exhibits 1085 and 1086 indicate that the distribution of the documents is "unlimited." Ex. 1089 ¶¶ 4–9; Ex. 1085, 1; Ex. 1086, 1. Based on our review of Exhibits 1078–1080, 1082, and 1084–1086, we are persuaded that these exhibits are authenticated at least under Federal Rule of Evidence 901(b)(4) and we accept Exhibits 1078–1080, 1082, and 1084–1086 for what they purport and are alleged to be. Patent Owner does not show otherwise. Further, we see no reason why Exhibits 1078–1080 and 1086 would not fall under the ancient document exception under the Federal Rules of Evidence. FRE 901(b)(8).

We acknowledge Patent Owner's further contention that the copyright dates and publication dates are "at best (hearsay) evidence as to when the document was prepared, not published." PO MTE 11–13. But, Petitioner relies on Exhibits 1078–1080, 1082, and 1084–1086 to support Dr. Holman's testimony of what the ordinarily skilled artisan would have understood and to rebut testimony offered by Dr. Ruby. Exhibits 1078–1080, 1082, and 1084–1086 are not hearsay when relied upon for these purposes. *See Joy Techs.* 751 F.Supp. at 233 n.2. Moreover, we see no reason why Exhibits 1078–1080, 1082, and 1084–1086 would not fall under the statements in a learned treatises, periodical, or pamphlets exception to hearsay. FRE 803(18). Furthermore, even if the disputed exhibits were hearsay, experts like Dr. Holman are permitted to rely on hearsay if experts

in the same field would reasonably rely on such materials in forming opinions and inferences based on the subject. *See* Fed. R. Evid. 703.

Therefore, we deny Patent Owner's motion to exclude Exhibits 1078–1080, 1082, and 1084–1086.

IV. CONCLUSION

For the foregoing reasons, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that the subject matter of claims 1–11 is unpatentable, but Petitioner has not shown that the subject matter of claim 12 is unpatentable. [11]

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–4, 6–12	103	Froitzheim, Gan	1–4, 6–11	12
5		Froitzheim, Gan, Sheats	5	
1–4, 6–12	103	Froitzheim, Borden-575		1–4, 6–12
5		Froitzheim, Borden-575, Sheats		5

[11] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding after this decision issues, 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).

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–2, 8–11	103	Li, Gan	1–2, 8–11	
Overall Outcome			1–11	12

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–11 of U.S. Patent No. 8,222,516 B2 are unpatentable; and

FURTHER ORDERED that Petitioner has not shown by a preponderance of the evidence that claim 12 of U.S. Patent No. 8,222,516 B2 is unpatentable; and

FURTHER ORDERED that Patent Owner's Motion to Exclude is DENIED; and

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

FOR PETITIONER:

David Cavanaugh
John Hobgood
Gilbert Smolenski
Alexander Nemtzow
Jungyeon Kim
Bobby Hampton
WILMER CUTLER PICKERING HALE AND DORR LLP
david.cavanaugh@wilmerhale.com
john.hobgood@wilmerhale.com
gilbert.smolenski@wilmerhale.com
alex.nemtzow@wilmerhale.com
john.kim@wilmerhale.com
bobby.hampton@wilmerhale.com

FOR PATENT OWNER:

Eric Klein
Jeffrey Swigart
Corbin Cessna
VINSON & ELKINS LLP
eklein@velaw.com
jswigart@velaw.com
ccessna@velaw.com

Jeremy Peterson
Bradford Cangro
Jacob Snodgrass
Jing Zhao
PV LAW LLP
jeremy.peterson@pvuslaw.com
bradford.cangro@pvuslaw.com
jacob.snodgrass@pvuslaw.com
jing.zhao@pvuslaw.com