

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HANWHA SOLUTIONS CORPORATION,
Petitioner,

v.

MAXEON SOLAR PTE. LTD.,
Patent Owner.

IPR2024-01199
Patent 8,878,053 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 All 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 1–20 of U.S. Patent No. 8,878,053 B2 (Ex. 1001, “the ’053 patent” or “challenged patent”). Maxeon Solar Pte. Ltd. (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 9. 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.

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 October 12, 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 1–20 of the ’053 patent are 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 '053 patent:

Maxeon Solar Pte. Ltd. v. Canadian Solar Inc. 2-24-cv-00210 (E.D. Tex.) (“Canadian Solar”)

Maxeon Solar Pte. Ltd. v. Hanwha Solutions Corp., 2-24-cv-00262 (E.D. Tex.) (“parallel litigation”)

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 IPR2024-01040 (U.S. Patent No. 8,878,053) as a related matter. Paper 6, 2.

C. The '053 Patent

The '053 patent, titled “Front Contact Solar Cell with Formed Emitter,” issued on November 4, 2014. Ex. 1001, codes (45), (54). The '053 patent discloses “structures for a relatively efficient and cost-effective front contact solar cell and processes for manufacturing [the] same.” Ex. 1001, 1:47–49. The '053 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, 1:26–29. 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, 1:32–36. 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, 1:37–41. The '053 patent shows one embodiment of its solar cell in Figure 1, reproduced below.

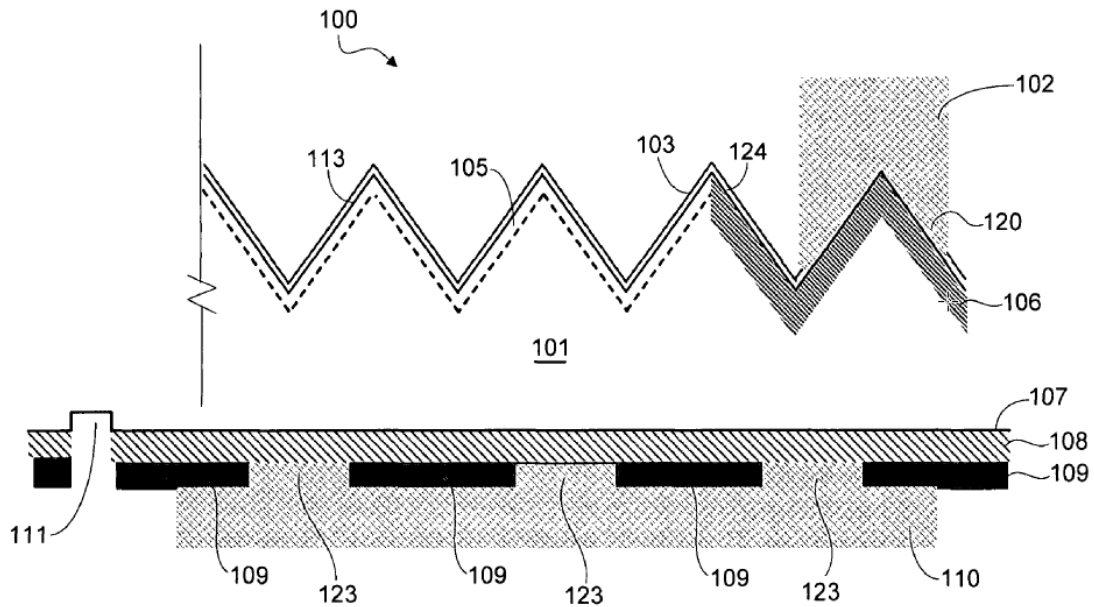


Figure 1 shows a cross-section of a front contact solar cell 100 having metal contact 102 on its front side, which faces the sun during normal operation, and metal contact 110 on its backside. Ex. 1001, 2:29–34. Solar cell 100 also includes N-type silicon substrate 101, tunnel oxide layer 107, polysilicon emitter 108, silicon dioxide layer 109, contact holes 123, and edge isolation trench 111. Ex. 1001, 2:35–39, 2:64–65, 3:6–3:9, 3:30–33. 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, 2:43–45, 2:59–64.

D. Illustrative Claims

Petitioner challenges claims 1–20 of the '053 patent. Independent claims 9 and 16 are representative of the challenged claims and are reproduced below with Petitioner's annotations¹:

¹ For convenience, we adopt Petitioner's annotated claim format.

[9. pre] A method of fabricating a solar cell comprising:

[9.a] forming a layer of polysilicon over a back surface of a silicon substrate;

[9.b] forming a first dopant source layer over the layer of polysilicon;

[9.c] diffusing dopants from the first dopant source layer to the layer of polysilicon to form a backside junction with the silicon substrate;

[9.d] diffusing dopants into a front surface of the silicon substrate, the front surface of the silicon substrate facing the sun during normal operation; and

[9.e] forming a metal contact on the front surface of the silicon substrate, wherein the metal contact is electrically coupled to the silicon substrate.

Ex. 1001, 6:52–67.

[16. pre] A method of fabricating a solar cell comprising:

[16.a] forming an oxide layer over a back surface of a silicon substrate;

[16.b] forming a layer of polysilicon over the oxide layer;

[16.c] diffusing dopants into the layer of polysilicon to form a backside junction with the silicon substrate;

[16.d] diffusing dopants into a front surface of the silicon substrate, the front surface of the silicon substrate facing the sun during normal operation; and

[16.e] forming a metal contact on the front surface of the silicon substrate, wherein the metal contact is electrically coupled to the silicon substrate.

Ex. 1001, 7:19–8:6.

E. The Asserted Unpatentability Challenges

Petitioner asserts that claims 1–20 would have been unpatentable based on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
9–12, 14, 16–20	103	Froitzheim, ² Gan ³
1–20	103	Froitzheim, Gan, Smith ⁴
9–20	103	Li, ⁵ Gan, Smith

Pet. 6. Petitioner also relies on declaration testimony of Dr. Zachary Holman. Exs. 1003, 1077. Patent Owner relies on the declaration testimony of Dr. Douglas Ruby. 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

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 Patent No. 6,998,288 B1, issued Feb. 14, 2006 (Ex. 1007, “Smith”).

⁵ CN 1949545 A, published April 18, 2007 (Ex. 1008 (translation), “Li”).

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.⁶ *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

⁶ Neither Petitioner nor Patent Owner raises issues of objective indicia of nonobviousness.

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 designing, developing, or researching the design and/or manufacture of solar cells or related technologies. Alternatively, a POSITA [i.e., 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. 16 (citing Ex. 1003 ¶¶ 36–41).

Patent Owner also states that the Patent Owner “applies the level of ordinary skill in the art Petitioner proposed.” PO Resp. 24.

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 ’053 patent and the prior art of record, we determine that the definition offered by Petitioner and applied by Patent Owner comports with the

qualifications a person would have needed to understand the '053 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. 17 (citing Ex. 1003 ¶¶ 102–105).

Patent Owner states that its Patent Owner Response “adopts petitioner’s proposal to apply the plain and ordinary meaning of the claims.” PO Resp. 24.

Accordingly, we need not expressly 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.*, 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 9–12, 14, and 16–20 of the '053 patent would have been obvious over the combination of Froitzheim and Gan. Pet. 5–6, 24–50.

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. 1004 ¶¶ 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. 1004 ¶ 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. 1004 ¶ 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. 1004 ¶ 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 Smith (1007)*

Smith relates to methods and apparatus for fabricating solar cells. Ex. 1007, 1:21–23; 2:16–17. More specifically, Smith discloses a series of in-situ steps to drive dopants into the substrate of the solar cell being fabricated, resulting in the simplification of the fabrication process. Ex. 1007, 3:40–4:2. At baseline, Smith teaches the use of atmospheric pressure chemical vapor deposition (“APCVD”) to deposit boron-doped silicon dioxide 104 on the back side of wafer 102, which again, is an N-type FZ silicon wafer that serves as the substrate of the solar cell. Ex. 1007, 2:32–35, 2:44–55. APCVD is also used to deposit undoped silicon dioxide 106 over the boron-doped silicon dioxide 104, which in combination, advantageously allows for one-sided deposition. Ex. 1007, 2:53–60. Smith also discloses, as illustrated in Fig. 5, a phosphorous-doped silicon dioxide 501 which is deposited over the sample of Fig. 5. Ex. 1007, 3:19–20. Again, undoped silicon dioxide 502 is deposited over the phosphorous-doped silicon dioxide. Ex. 1007, 3:20–21.

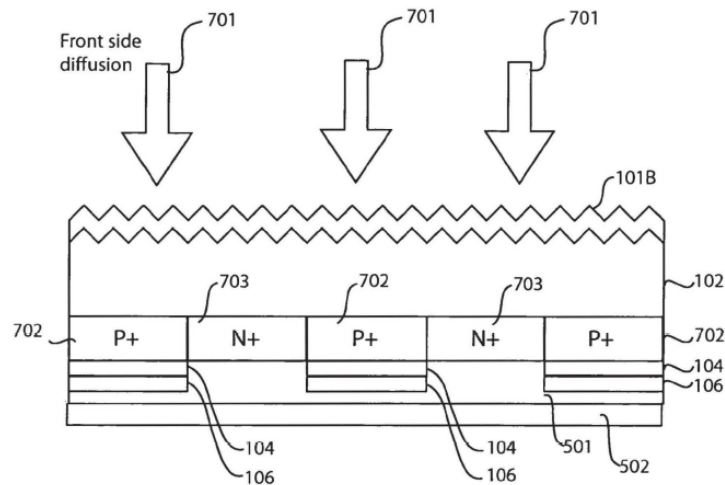


FIG. 7

Figure 7 illustrates a method of fabricating a solar cell through in-situ steps.

Ex. 1007, 1:65–67, 3:40–4:11, Fig. 7. In the present embodiment of

Figure 7, in-situ steps are performed in a furnace heated to about 1000°C.

Ex. 1007, 3:40–44. There are two in-situ steps disclosed in Smith.

Ex. 1007, 3:40–4:2. Step one starts with the loading of wafer 102 into the wafer processing tool and heating the wafer 102 for one hour in the furnace to diffuse dopants from boron-doped silicon dioxide 104 and phosphorous-doped silicon dioxide 501 into wafer 102. Ex. 1007, 3:40–46. This results in the formation of P+ regions 702 and N+ regions 703 in wafer 102.

Ex. 1007, 3:47–49. In the second in-situ step, the furnace is decreased to 750°C with an atmosphere containing phosphorus oxychloride, then increased to about 975°C with an atmosphere containing oxygen to diffuse phosphorus as an N-type dopant into wafer 102 from its front side and to grow a thin layer of silicon dioxide on both sides of wafer 102. Ex. 1007, 3:56–61. The thin layer of silicon dioxide 101B “advantageously leads to better passivation of the front side and back side surfaces of wafer 102.”

Ex. 1007, 3:63–66.

4. *Analysis of Claim 9*

Petitioner alleges that the combination of Froitzheim and Gan renders claim 9 of the '053 patent obvious. Pet. 36–44. According to Petitioner, Froitzheim describes a method of fabricating a rear junction solar cell that includes “arranging [i.e., *forming*] a non-alloyed p-type doped region at the rear side [i.e., *back surface*] of an n-type Silicon body layer [i.e., *silicon substrate*].” Pet. 36–37 (citing Ex. 1004 ¶¶ 11, 22, 24–26, 33, 38–48, Fig. 1, Abstr.; Ex. 1003 ¶¶ 146–151). Petitioner states that “Gan teaches *forming a layer of polysilicon* by a ‘[p]olysilicon deposition’ step” and that “Gan also teaches replacing a diffused emitter (as in Froitzheim) with a P-type polysilicon emitter.” Pet. 37–38 (citing Ex. 1005, 245–246; Ex. 1003 ¶¶ 155–151). Petitioner alleges that the combination of Froitzheim and Gan describes forming a dopant source over the layer of silicon. Pet. 38 (citing Ex. 1004 ¶¶ 22, 40–41, Fig. 3; Ex. 1005, 246, 248; Ex. 1003 ¶¶ 153–156). In addition, Petitioner contends that

[t]he combination of Froitzheim and Gan teaches diffusing dopants from the first dopant source layer to the layer of polysilicon to form a backside junction with the silicon substrate” because “Froitzheim teaches manufacturing an emitter that forms a backside junction with the silicon substrate” and “diffusing dopants from a first dopant source layer onto the back of the n-doped silicon wafer (i.e., substrate)” and “Gan teaches driving-in dopants from a first dopant source layer to the layer of **polysilicon**.

Pet. 39–41 (citing Ex. 1004 ¶¶ 10–13, 24–16, 33, 41–42, Fig. 1, Fig. 3, Abstr.; Ex. 1005, 246; Ex. 1003 ¶¶ 157–162). Petitioner also asserts that “Froitzheim teaches diffusing phosphorous, a well-known dopant, into the sun-facing, front surface of the silicon substrate (N-type silicon layer) to form N⁺ regions.” Pet. 42 (citing Ex. 1004, Fig. 3; Ex. 1003 ¶ 165); *see*

Ex. 1004 ¶¶ 24, 32–33, 43–44, Fig. 1, Fig. 3; Ex. 1003 ¶¶ 163–165. And lastly, Petitioner states that Froitzheim forms metal contacts on the front surface of the substrate that are coupled to the substrate. Pet. 42–43 (citing Ex. 1004 ¶¶ 15–18, 20, 22, 49, Fig. 3; Ex. 1003 ¶¶ 166–169; Ex. 1045, 234–239).

According to Petitioner, Froitzheim and Gan are analogous art because “[b]oth are in the same field as the Challenged Claims (fabricating 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. 25–26 (citing Ex. 1005, 245–246; Ex. 1003 ¶ 123); *see also id.* at 51 (arguing Smith 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 by “implementing manufacturing steps to incorporate Gan’s oxide layer and polysilicon emitter in Froitzheim’s solar cell to obtain a more efficient solar cell.” Pet. 26. 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. 26 (citing Ex. 1003 ¶ 124) (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. 27–29 (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. 30 (citing Ex. 1005, 249). 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. 30 (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 fabricating similar and compatible solar cells” (Pet. 31 (citing Ex. 1004 ¶¶ 10–11, 42; Ex. 1005, 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 32 (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 33 (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. 34. 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. 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. 34–35 (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. 34 (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 (1) a person of ordinary skill in the art would not have had a reasonable expectation of success in the combination of Froitzheim and Gan, (2) the combination of Froitzheim and Gan requires undue experimentation, and (3) in order to achieve the benefits of Gan, the combination must include Gan's oxide layer, and Petitioner fails to provide a reason why the person of ordinary skill in the art would have included Gan's oxide layer. PO Resp. 24–41.

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 Petitioner has shown a reasonable expectation of success in the combination of Froitzheim and Gan*

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,⁷ 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. 26. 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. 26–27 (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 can be made”), 69 (expressing that “it is possible for polysilicon SIS emitter to have 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. 27 (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. 34. 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

⁷ Jon-Yiew Gan, Polysilicon Emitters for Silicon Concentrator Solar Cells (July, 1990) (Ph.D. dissertation, Stanford University) (Ex. 2003, “the Gan Thesis”).

ordinary skill in the art] would instead follow the manufacturing technique taught by Gan.

Pet. 34 (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. 35 (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. 35 (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. 26, 27 (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 Å 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, Inc. v.*

Apotex, Inc., 480 F.3d 1348, 1364 (Fed. Cir. 2007); *see also In re Longi*, 759 F.2d 887, 896 (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, it 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 7), 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. 30. 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. 31), (2) the tunnel oxide layer in Borden requires contact holes but “contact holes do not exist in the Froitzheim-Gan combination” (*id.* at 32), (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 ’053 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 33).

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 ’053 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 ’053 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 shows that the skilled artisan would have had a reasonable expectation of success in combining the teachings of Froitzheim and Gan.

b) Whether a person of ordinary skill in the art would have had to engage in undue experimentation to successfully combine Froitzheim and Gan

Patent Owner argues that a person of ordinary skill in the art would not have combined Froitzheim and Gan because an undue amount of experimentation would have been necessary to accomplish the combination. PO Resp. 33. In support of its argument, Patent Owner applies the *Wands* factors. *In re Wands*, 858 F.2d 731 (Fed. Cir. 1988). The *Wands* factors include “(1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.” *Id.* at 737. Applying factors 2, 3, 5, 6, and 7, Patent Owner argues that “Petitioner has not identified any prior art disclosing the ability to form tunnel oxide layer successfully and consistently on polysilicon emitters” because, as the “Gan Thesis explains, this is due to the difficulty of controlling the thickness and degree of breakup of the interfacial oxide.” PO Resp. 34–35 (citing Ex. 1005, Abstr., 53, 56, 69, 107, 110–112, 114–117; Ex. 1006 ¶ 5; Ex. 2027 ¶¶ 133–135, 160–168). Patent Owner asserts that Gan has failed to provide any working examples and “merely discloses steps to fabricate a polysilicon emitter and an interfacial oxide layer on test devices.” PO Resp. 35. Patent Owner also reasons that the author of the Gan Thesis, despite holding a Ph.D., “could

not identify a solution to the problem of controlling the thickness and breakup of the interfacial oxide layer.” PO Resp. 35–36.

Patent Owner’s argument simply reframes its argument, which we rejected above, that the ordinarily skilled artisan would not have been successful in the combination of Froitzheim and Gan because of inconsistent interfacial oxide growth. Patent Owner’s use of the *Wands* factors here is inapplicable to an obviousness inquiry. Indeed, the *Wands* factors are employed in determining enablement, which is not at issue here. *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988); *Amgen Inc. v. Sanofi, Aventisub LLC*, 987 F.3d 1080, 1084 (Fed. Cir. 2021) (stating that enablement requires a showing that the person of ordinary skill in the art would not have been able to practice the claimed invention without undue experimentation, which is a factual determination informed by the *Wands* factors).

Further, Patent Owner’s application of the *Wands* factors results in a heightened standard of proof not required for an obviousness analysis. By way of example, Patent Owner argues that the lack of guidance, absence of working examples, and unpredictability of results indicates a person of ordinary skill in the art would not have been successful in combining Gan and Froitzheim’s teachings. PO Resp. 35. But, a reasonable expectation of success requires only a reasonable belief and not certainty of success. *Endo Pharmaceuticals Inc. v. Actavis LLC*, 922 F.3d 1365, 1379 (Fed. Cir. 2019) (stating that “[a]s we have repeatedly held, obviousness requires only a reasonable expectation of success, not proof of actual success”); *Pfizer Inc. v. Sanofi Pasteur Inc.*, 94 F.4th 1341, 1349 (Fed. Cir. 2024) (explaining that “[w]e have previously explained that ‘a rule of law equating unpredictability to patentability . . . cannot be the proper standard since the expectation of

success need only be reasonable, not absolute.” (quoting *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007)). That some experimentation maybe required does not negate a reasonable expectation of success. *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1368 (Fed. Cir. 2007) (clarifying that “many techniques that require extensive time, money, and effort to carry out may nevertheless be arguably ‘routine’ to one of ordinary skill in the art [and] our conclusion here relies on the fact that one skilled in the art would have had a reasonable expectation of success at the time the invention was made, and merely had to verify that expectation.”). Patent Owner fails to direct our attention to any record evidence that suggests the expense, time, and effort exceeds that “routinely” required of the person of ordinary skill in the art. *See generally* PO Resp.; Sur-reply.

Furthermore, Patent Owner’s argument that the author of the Gan Thesis, who holds a Ph.D., “could not identify a solution to the problem,” is also misleading. PO Resp. 35–36. In fact, the Gan Thesis, discussed above, identifies both the cause and probable solutions to the problem of controlling interfacial oxide thickness and breakup. Ex. 2003, 112 (identifying explanations as resulting from oxidation during the ramp-up stage and the stand-by period and stating that “thin oxide growth can be improved by performing the oxidation at lower temperature such that the oxidation rate can be controlled more precisely”). As a result, the skilled artisan would have had a reasonable expectation of success and be equipped to routinely trouble shoot should the need arise.

c) *Whether Petitioner has shown a reason to combine Froitzheim and Gan without Gan’s oxide layer*

Patent Owner argues that the “benefit of Gan, which allegedly would have motivated a [person of ordinary skill in the art] to combine it with

Froitzheim, is derived from the combination of Gan’s polysilicon emitter and oxide layer.” PO Resp. 38. But, according to Patent Owner, “Petitioner appears to propose an alternative Froitzheim-Gan combination without Gan’s oxide layer,” when discussing claims 9–12 and 14. PO Resp. 36. Therefore, “[t]o the extent Petitioner proposes an alternative Froitzheim-Gan combination without Gan’s oxide layer, Petitioner is silent on why a [person of ordinary skill in the art] would have been motivated to do so.” PO Resp. 36 (emphasis added). Patent Owner criticizes Petitioner stating that “[i]t is improper for Petitioner and its expert’ to stay intentionally vague on what Froitzheim-Gan combination they propose on pages 36 to 48 of the Petition.” PO Resp. 40. Patent Owner further argues that “[i]t is even more improper for Petitioner to introduce an alternative Froitzheim-Gan combination in an attempt to evade its burden of demonstrating motivation to combine and a reasonable expectation of success.” PO Resp. 41.

Patent Owner’s concerns in this regard are unfounded. The Petition makes clear that Petitioner intends to replace Froitzheim’s diffused emitter with Gan’s polysilicon emitter *and* oxide layer. Pet. 24–35. For example, Petitioner states,

The combination of Froitzheim’s fabrication of a back-junction solar cell and Gan’s fabrication of a polysilicon emitter and oxide layer amounts to use of a known feature (Gan’s polysilicon emitter and oxide layer) to improve a similar device (Froitzheim’s back-junction solar cell) to achieve goals common to both references and the industry (increasing efficiency). [Pet. 24–25].

A POSITA would have been motivated to implement manufacturing steps to incorporate Gan’s oxide layer and

polysilicon emitter in Froitzheim’s solar cell to obtain a more efficient solar cell. [Pet. 26].

A POSITA would have been motivated to further improve the efficiency of Froitzheim’s solar cell by including fabrication steps to incorporate Gan’s polysilicon emitter and oxide layer. [Pet. 27].

[A] POSITA would have been motivated to modify Froitzheim’s solar cell to incorporate a polysilicon emitter and oxide layer structure to obtain a more efficient solar cell. Gan specifically teaches that replacing a diffused emitter (as taught by Froitzheim) with a polysilicon emitter and oxide layer structure would improve the efficiency of a solar cell. [Pet. 30].

A POSITA would have also been motivated to fabricate a solar cell with a polysilicon emitter and oxide structure in Froitzheim because doing so was simply substituting one known element for another to obtain predictable results. [Pet. 32].

Petitioner also clarifies in its Reply that:

[Patent Owner’s]assertion that the Petition “proposes an alternative Froitzheim-Gan combination without Gan’s oxide layer” for claims 9–12 and 14 is a strawman. POR, 36. The Petition did not specifically discuss the oxide layer in the element-by-element analysis for claims 9–12 and 14 because those claims do not recite an oxide layer. Pet., 36–47. The Petition instead addresses an oxide layer in its motivation to combine and reasonable expectation of success analysis (*which applies to claims 9 and 16*) and claim 16’s element-by-element analysis. Pet., 24–35, 48–49; Ex.1003-Decl., ¶¶121–145, 186–192.

Pet. Reply 17 (emphasis added); *see also id.* (stating that “[t]he Petition properly discussed Gan’s oxide layer at length in the motivation to combine section for all of Ground I because motivations specific to narrower claim 16 equally apply to broader claim 9”). That Petitioner did not discuss the oxide

layer when detailing the features of the prior art in comparison to the limitations of claim 9 is of no consequence. As Petitioner explains (Pet. Reply 16–17), claim 9 does not require an oxide layer and because claim 9 uses the transitional term “comprising,” it may include additional features not claimed, including an interfacial oxide layer.

Therefore, we need not decide whether Petitioner has shown obviousness or provided a reason to combine Froitzheim and Gan in the absence of Gan’s oxide layer because Petitioner proposes no such alternatives.

* * *

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. *Remaining Claims 10–12, 14, and 16–20*

Petitioner asserts that claims 10–12, 14, and 16–20 would have been obvious over the combination of Froitzheim and Gan. Pet. 4, 42–50. Patent Owner does not separately address remaining claims 10–12, 14, and 16–20 beyond what is argued for independent claim 9. *See generally* PO Resp. Upon review of the full trial record, and arguments and evidence therein, we determine that Petitioner has demonstrated by a preponderance of the evidence that each of the limitations recited in claims 10–12, 14, and 16–20 are suggested by the above-identified prior art 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, Gan, and Smith

Petitioner contends that claims 1–20 of the '053 patent would have been obvious over the combination of Froitzheim and Gan in further view of Smith. Pet. 6–7, 50–72.

1. Analysis

Petitioner contends that the combination of Froitzheim and Gan renders claim 9 of the '053 patent obvious. Pet. 50–72. Petitioner rests on much of the argument and evidence relied upon for the ground based on Froitzheim and Gan alone, and additionally asserts that Smith satisfies the following limitations. Pet. 80–72. According to Petitioner, Smith describes a method of fabricating a solar cell that includes “forming a *first dopant source layer and diffusing dopants from the first dopant source layer*,” as claimed. Pet. 57–58 (citing Ex. 1007, Abstr., 1:43–3:55, Fig. 2; Ex. 1003 ¶¶ 217–220). In addition, Petitioner contends that Smith teaches “diffusing dopants into the front surface of the silicon substrate” because “Smith teaches a ‘[w]afer 102 [that] serves as the substrate of the solar cell being fabricated,’ which has ‘a front side 101 and a back side 103[,]’ and the ‘[f]ront side 101 is the side of the solar cell . . . faces the sun in operation’” and “diffusing a second dopant into the substrate by way of a front side [(i.e., *the front surface of the silicon substrate facing the sun during normal operation*)] of the substrate.” Pet. 58 (citing Ex. 1007, Abstr., 1:43–3:61, Fig. 7; Ex. 1003 ¶¶ 221–225).

Petitioner asserts that Smith is analogous art “because its goals include decreasing the cost to fabricate an efficient solar cell, which is also a goal of the '053 patent.” Pet. 51 (citing Ex. 1007, 1:15–40, 1:47–49, 3:40–4:2; Ex. 1003 ¶ 198). Petitioner alleges that a person of ordinary skill in the

art would have had reason to combine the teachings of Froitzheim, Gan, and Smith because “Smith specifically teaches ‘techniques for simplifying the fabrication of solar cells,’ and a person of ordinary skill in the art “would have considered Smith’s simplified manufacturing teachings to obtain the benefits of Froitzheim’s and Gan’s solar cells at a lower cost to make.” Pet. 53 (citing Ex. 1007, 1:36–40; Ex. 1003 ¶ 203). Specifically, “[s]olar cell fabrication requires numerous manufacturing steps . . . [and] [e]ach manufacturing step (e.g., each separate doping and heating step) increases costs, and reducing cell manufacturing costs is important, especially for commercial cells.” Pet. 52 (citing Ex. 1003 ¶ 201). For example, “Smith teaches that dopants can be deposited on the substrate using ‘APCVD,’” which Petitioner alleges “advantageously allow[] for one-sided deposition.” Pet. 54 (citing Ex. 1007, 2:44–62). And, one-sided deposition “would make fabrication more efficient and less costly because dopants could be placed on just the desired side.” Pet. 54 (citing Ex. 1003 ¶¶ 205–207). In addition, Petitioner states that Smith’s in-situ steps would additionally simplify the fabrication process. Pet. 55 (citing Ex. 1007, 3:40–4:2; Ex. 1003 ¶ 209). Petitioner reasons that a person of ordinary skill in the art “would have understood that Smith’s APCVD, diffusion barrier, and in-situ diffusion processes applied to Froitzheim’s and Gan’s methods would have been desirable because the front side and the back side of the wafers could be doped at the same time, decreasing cost and the number of required steps.” Pet. 55 (citing Ex. 1003 ¶ 210).

Patent Owner does not challenge Petitioner’s allegations regarding the additional teachings of Smith. *See generally* PO Resp. 42–50. In addition to reasserting the arguments discussed above for the combination of Froitzheim

and Gan, Patent Owner argues that (1) a person of ordinary skill in the art would not have had reason to apply Smith’s one-sided deposition process to the combined Froitzheim/Gan structure and (2) Petitioner fails to detail how to apply Smith’s in-situ steps to the combined Froitzheim/Gan structure. PO Resp. 42–48.

Petitioner’s arguments and evidence that are unchallenged by Patent Owner are supported by the record. We address Patent Owner’s additional arguments below.

a) Whether Petitioner has shown that a person of ordinary skill in the art would have had reason to combine Froitzheim, Gan, and Smith

Patent Owner argues that “Smith discloses that its one-sided deposition ‘is particularly useful in the manufacture of back side contact solar cells.’” PO Resp. 43 (citing Ex. 1007, 60–62). Patent Owner also explains that “Smith describes one-sided APCVD deposition as depositing both boron-doped silicon dioxide 104 and phosphorus-doped silicon dioxide 501 on the back side of the wafer” which are then heated to diffuse the dopants into respective p⁺ and n⁺ regions, 702 and 703. PO Resp. 44 (citing Ex. 1007, 2:45–3:50). Patent Owner states that “the doped regions are coupled to metal contacts on the back side of the solar cell to allow an external electrical circuit to be coupled and be powered by the solar cell.” PO Resp. 45 (citing Ex. 1007, 4:3–5; Ex. 1003 ¶ 66; Ex. 2027 ¶ 179). Patent Owner asserts that “Froitzheim’s solar cell . . . does not have both P⁺ and N⁺ regions on its back side, or all metal contacts on its backside” and “is simply not a back contact solar cell.” PO Resp. 45 (citing Ex. 1004, Fig. 3 (featuring front and rear contacts), ¶ 34; Ex. 2027 ¶ 80). Thus, Patent Owner reasons that a person of ordinary skill in the art would not have had reason to

combine Froitzheim, Gan, and Smith because “Smith limited the benefit of its APCVD technique to back contact solar cells” and “Petitioner’s motivation to employ Smith’s APCVD technique rests on this benefit.” Sur-reply 14.

We do not read Petitioner’s allegations or Smith as narrowly as Patent Owner urges. Petitioner offers two reasons to combine the teachings of Froitzheim and Gan with Smith.

First, Petitioner argues that “Smith teaches that dopants can be deposited on the substrate using ‘APCVD’” and that “[a]fter APCVD, ‘an undoped silicon dioxide’ layer can be placed on the dopant source” where this “undoped silicon dioxide layer acts as a barrier to diffusion, meaning that the *dopants are diffused only in the intended target region.*” Pet. 54 (emphasis added) (citing Ex. 1007, 2:44–62; Ex. 1003 ¶¶ 205–206). Petitioner states that processes, like Smith, make fabrication efficient and less costly because “[i]n processes where this is not possible, the doping process requires additional steps (and thus costs) because dopants are also placed on undesired sides and must be removed, such as by etching them off.” Pet. 54 (citing Ex. 1003 ¶ 207). Smith also states that “[j]ust like most manufacturing processes, each step employed in the manufacture of solar cells has an associated cost. Thus, techniques for simplifying the fabrication of solar cells are generally desirable.” Ex. 1007, 1:36–40. Dr. Holman’s testimony is consistent with Smith’s teachings. For example, Dr. Holman further testifies that a person of ordinary skill in the art would have understood that each deposition, heating, and removal step would have increased the manufacturing costs of the solar cells and “would have considered ways to decrease the number of manufacturing steps and thus

costs.” Ex. 1003 ¶ 202; *see also id.* ¶¶ 207–208 (explaining that because dopants can be more precisely placed, additional processes such as etching may be avoided).

Though Petitioner explains that Smith states APCVD is “particularly useful in the manufacture of back side contact solar cells,” Petitioner notes that a person of ordinary skill in the art “would have understood that Smith’s fabrication techniques are not limited to one structure and are advantageous and applicable to manufacture a combined structure of Froitzheim and Gan.” Pet. 53–54 (citing Ex. 1007, 2:7–13, 2:58–62 (not limiting Smith to back side contact solar cells), 4:11–16, claims 9 and 17 (not claiming a back contact solar cell); Ex. 1003 ¶¶ 204–206)).

Furthermore, Dr. Ruby, Patent Owner’s declarant, does not opine that the skilled artisan would have understood the benefits of Smith’s teachings to be limited to back contact solar cells. *See generally* Ex. 2027 ¶¶ 177–181. In fact, Dr. Ruby testifies that that he used APCVD to deposit oxide on both the front and rear surface of a wafer and that the resulting solar cell included both front and rear contacts. Ex. 1075, 158:18–159:20; *see also* Ex. 1074, 172–173, Fig 1 (describing a process using APCVD on the front and rear surfaces of a solar cell). Nor does Dr. Ruby dispute that Smith’s teachings, when combined with Froitzheim and Gan, would improve efficiency and reduce cost of the resulting solar cell. *See generally* Ex. 2027 ¶¶ 177–181; Ex. 1075, 198:20–199:3. Thus, the skilled artisan would have understood that APCVD is useful for depositing dopants into targeted locations and not necessarily limited to “back contact solar cells,” as Patent Owner alleges.

Second, Petitioner alleges that applying Smith’s in-situ steps simplifies the solar cell fabrication process and reduces manufacturing costs,

providing a separate reason to modify the combination of Froitzheim and Gan to include the process steps of Smith. Pet. 55 (citing Ex. 1007, 3:40–4:2; Ex. 1003 ¶ 209). Smith explains that “in-situ” means that the steps are “performed in one loading of wafer 102 into the wafer processing tool.” Ex. 1007, 3:41–42. Thus, “the use of in-situ steps to drive in dopants into wafer 102 simplifies the fabrication process.” Ex. 1007, 3:67–4:2. This is consistent with Dr. Holman’s testimony that “a person of ordinary skill in the art would have known that if both sides of the subject wafer (i.e., Froitzheim’s silicon substrate) could be doped after the wafer is loaded one single time in a furnace, it would decrease the number of required steps and thus fabrication costs.” Ex. 1003 ¶ 210; *see also id.* ¶ 209 (identifying exemplary references demonstrating co-diffusion) (citing Ex. 1019; Ex. 1054). Dr. Holman further explains that absent an in-situ process

the wafer would have to be subjected to multiple additional steps, including being (1) removed from the machine, (2) prepared for the next loading (for instance, by the application of masking layers to protect doped surfaces that were already doped), reloaded into the machine, and (3) then further processed (for instance, removing the masking layers).

Ex. 1003 ¶ 210. And, Dr. Ruby agrees that “each step employed in the manufacture of solar cells has an associated cost” and “simplifying the fabrication of solar cells are generally desirable.” Ex. 1075, 198:7–19; *see also* Ex. 1073, 5:38–40) (stating that “the fewer discrete operations required, the lower . . . the cost of the final product”).

Therefore, we are persuaded that Petitioner has shown that the ordinarily skilled artisan would have had reason to combine the teachings of Froitzheim, Gan, and Smith in the manner proposed by Petitioner.

b) Whether Petitioner has established that a person of ordinary skill in the art would have had reason to apply Smith’s in-situ method to Froitzheim and Gan

Patent Owner contends that “Smith’s ‘in-situ steps’ are used in Smith’s APCVD process . . . [but] the proposed Froitzheim-Gan-Smith combination is not a back contact solar cell, and has no use for Smith’s one-sided APCVD deposition process.” PO Resp. 46–47. Therefore, Patent Owner reasons that Smith’s “in-situ steps” are inapplicable. PO Resp. 47. Patent Owner asserts that Petitioner does not sufficiently support its position, and that Petitioner improperly incorporated arguments of its expert. PO Resp. 47. Patent Owner further asserts that “Petitioner’s expert relied on other references to show that in-situ diffusion would have applied to diffusion on opposite sides of a wafer,” but “made no attempt to combine those other references with Froitzheim or Gan.” PO Resp. 47–48.

As discussed above in Section II.D.1.a, we are convinced that one of ordinary skill in the art would have had at least one reason to combine the teachings of Froitzheim, Gan, and Smith. Though Smith states that its process is “particularly useful in the manufacture of back side contact solar cells,” Smith does not limit itself to back side contact solar cells. Ex. 1007, 2:58–62, claims 9 and 17. We also find Patent Owner’s argument that Dr. Holman improperly relies on “other references” in support of his opinions unpersuasive. Dr. Holman provided testimony from the perspective of the person of ordinary skill in the art. Dr. Holman testifies that the ordinarily skilled artisan “would have found in-situ diffusion (and the simultaneous diffusion from multiple dopant sources, or ‘co-diffusion,’ in general) advantageous because it would simplify fabrication by reducing processing steps, thereby reducing costs.” Ex. 1003 ¶ 209. As evidence of

that understanding, Dr. Holman cites to exemplary prior art references. *See* Ex. 1019 ¶ 1; Ex. 1054, 12:39–42. Such reliance on secondary prior art is entirely appropriate under these circumstances.

* * *

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

2. *Remaining Claims 1–8, 10–20*

Petitioner asserts that that claims 1–8 and 10–20 would have been obvious over the combination of Froitzheim and Gan with Smith. Patent Owner relies on the same arguments raised for independent claim 9 for remaining claims 1–8 and 10–20. PO Resp. 48. Patent Owner does not separately argue claims 1, 6–8, 10, or 15–20. *See generally* PO Resp. Therefore, for the same reasons above, we determine that claims 1, 6–8, and 15–20 would have been obvious in view of the above-identified prior art and that the ordinarily skilled artisan would have had reason to make the combination with a reasonable expectation of success.

But, Patent Owner additionally contends that Petitioner failed to provide a reason to combine for claims 2–5 and 11–14. PO Resp. 49. Specifically, Patent Owner argues that

absent from Petitioner’s wish-list are the following components and techniques: (a) use of Smith’s own dopant layers, Paper 3, 60 (asserting that Smith’s first doped oxide layer 104 satisfies limitations in claim 11); *id.* at 61–62 (asserting that Smith’s layer of glass with phosphorous dopants at the silicon surface satisfies limitations in claims 12 and 13), and (b) use of Smith’s texturing

technique, *id.* at 63 (asserting that Smith’s wet etch process satisfies limitations in claim 14).

PO Resp. 49. Patent Owner asserts that for the same reason, claims 2–5—which incorporate arguments for claims 11–14—must also fail. PO Resp. 49.

We are not persuaded by Patent Owner’s position. The Petition relies on the teachings of Froitzheim and Gan to satisfy the limitations of claims 2–5 and 11–14. Pet. 60–63 (each referring back to details in the Froitzheim/Gan combination). Patent Owner does not dispute that Froitzheim and Gan satisfy each limitation of claims 2–5 and 11–14. *See generally* PO Resp. That Petitioner chose to note that Smith *also* teaches the limitations of claims 2–5 and 11–14 does not replace the undisputed teachings of Froitzheim and Gan.

Upon review of the full trial record, and the arguments and evidence therein, we further determine that Petitioner has demonstrated by a preponderance of the evidence that each of the limitations recited in claims 2–5 and 11–14 would have been rendered obvious by the combination of Froitzheim, Gan, and Smith, and that the ordinarily skilled artisan would have had reason to make the combination with a reasonable expectation of success.

F. Challenges Based on Li, Gan, and Smith

Petitioner alleges that claims 9–20 of the ’053 patent would have been obvious over the combination of Li, Gan, and Smith. Pet. 6–7, 73–88.

1. Overview of Li (Ex. 1008)

Li is directed to “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.

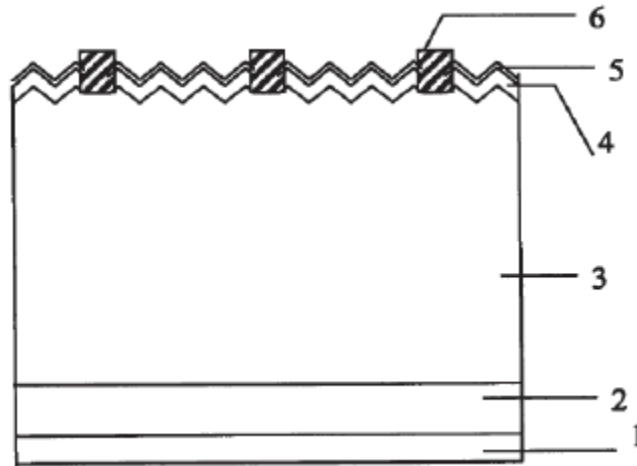


Figure 1 is a schematic diagram of a solar cell with a novel structure.

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, Gan, and Smith renders claim 9 of the '053 patent obvious. Pet. 73–82. Petitioner contends that Li “teaches a method of manufacturing a solar cell.” Pet. 76 (citing Ex. 1008,

4, Abstr., claims 1–6, Fig. 1; Ex. 1003 ¶¶ 298, ¶ 290 (stating Gan and Smith also teach the preamble)). Petitioner asserts that “Li teaches depositing (i.e., *forming*) ‘[a] layer of silicon thin film [2] [i.e., a *layer of silicon*] . . . on a back surface of N-type monocrystalline silicon [i.e., *silicon substrate*] to form an emitting region,” “Gan teaches *forming a layer of polysilicon*,” and a person of ordinary skill in the art would have had reason to modify Li to replace the silicon thin film with the polysilicon emitter of Gan. Pet. 77 (citing Ex. 1008, 4, Abstr., claims 1, 3, and 5, Fig. 1; Ex. 1005, 245–249; Ex. 1003 ¶¶ 291–293). Petitioner states that “Li teaches that ‘[a] layer of [P-type] silicon thin film is deposited on a back surface of N-type monocrystalline silicon to form an emitting region’” and “Gan and Smith both teach forming a dopant source layer.” Pet. 78 (citing Ex. 1008, 4; Ex. 1005, 246, 248; Ex. 1007, 1:43–3:55, Fig. 2; Ex. 1003 ¶¶ 217–220, 294–296). According to Petitioner, the combination of Li, Gan, and Smith teaches “diffusing dopants from the first dopant source layer to the layer of polysilicon to form a backside junction with the silicon substrate” because “Li teaches forming a backside junction between a layer of silicon and a silicon substrate” and Gan “teaches diffusing dopants from a first dopant source layer to a layer of polysilicon.” Pet. 79–80 (citing Ex. 1008, 3, Fig. 1; Ex. 1005, 246; Ex. 1003 ¶¶ 297–300). Petitioner also asserts that both Li and Smith teach “diffusing dopants into a front surface of the silicon substrate,” as claimed. Pet. 80–81 (citing Ex. 1008, 4, Abstr., Fig. 1, claims 1–3; Ex. 1005, 246, 248; Ex. 1007, 1:43–3:61, Fig. 2, Fig. 7, claims 1–2, 4, 8–9, 12, 14–19; Ex. 1003 ¶¶ 221–225, 301–304). And lastly, Petitioner states “Li’s solar cell includes a front ‘electrode’” electrically coupled to the silicon substrate and that the electrodes are metal. Pet. 81–82

(citing Ex. 1008, 3, 4, Fig. 1; Ex. 1003 ¶¶ 305–309; Ex. 1005, 246; Ex. 1007, 1:20–35, 1:44–57, 2:4–3:10).

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. 73 (citing 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. 73 (citing Sections X.A.1 and X.B.1; Ex. 1008, Fig. 1; Ex. 1005, 245–249; Ex. 1003 ¶¶ 280–281). Petitioner further explains the ordinarily skilled artisan would have had reason to include Smith in combination with Gan and Li because “doing so would improve the efficiency of Li’s cell and simplify the manufacturing process.” Pet. 75 (citing Section X.B.1; Ex. 1003 ¶¶ 287–288). Petitioner alleges that a person of ordinary skill in the art would have had a reasonable expectation of success in the combination of Li, Gan, and Smith 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 and others regarding the benefits of a polysilicon emitter and tunnel oxide layer, as applied to a backside configuration.” Pet. 74 (citing Sections

X.A.1 and X.B.1; Ex. 1008, 4; Ex. 1005, 249, 248–249; Ex. 1003 ¶¶ 282–286). Petitioner further alleges that a reasonable expectation of success exists for incorporating “Smith’s manufacturing method for the Li and Gan combination for the reasons discussed in Sections X.A.1 and X.B.1, including because Li has a similar structure to Froitzheim and Gan.” Pet. 75 (citing Sections X.A.1 and X.B.1; Ex. 1003 ¶ 288).

Patent Owner does not challenge Petitioner’s allegations regarding the teachings of Li, Gan, and Smith. PO Resp. 50–54. 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. 50), (2) Li teaches away from Gan and Smith (*id.* at 51), and (3) a person of ordinary skill in the art would not have been motivated to combine Li, Gan, and Smith (*id.* at 53).

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

a) Whether Petitioner has shown a reasonable expectation of success in the combination of Li, Gan, and Smith

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 Li and Gan for the same reasons discussed above for the Froitzheim and Gan combination. PO Resp. 50. In particular, “the Gan Thesis teaches that Gan’s interfacial oxide could not be reliabl[y] grown.” PO Resp. 50. And, because Petitioner allegedly fails to provide a motivation to combine with a reasonable expectation of success, Petitioner has allegedly failed to establish “forming a layer of polysilicon”(recited in claims 1, 9, and 16) and “forming

an oxide layer over a back surface of a silicon substrate” (required by claims 1 and 16).

Patent Owner’s arguments with respect to Li, Gan, and Smith are similar to those Patent Owner advances for Froitzheim, Gan, and Smith—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, Gan, and Smith in the manner suggested by Petitioner with a reasonable expectation of success.

b) Whether Li teaches away from Gan and Smith

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. 51. 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. 51–52 (citing Ex. 1008, 3–4). As a result, Patent Owner argues, a person of ordinary skill in the art would not have had reason “to implement Gan’s polysilicon emitter and oxide layer, and Smith’s in-situ diffusion because both necessitate high temperature diffusion,” and therefore, Li teaches away from a combination including Gan and Smith. PO Resp. 52–53 (citing Ex. 1005, 246; 1007, 3:42–61; Ex. 2027 ¶ 192; Ex. 2029, 216:16–217:7).

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., Ltd. 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. 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.

c) Whether Petitioner has shown a reason to combine or a reasonable expectation of success in the combination of Li, Gan, and Smith

Patent Owner asserts that because “the proposed Li-Gan-Smith combination is not a back contact solar cell,” a person of ordinary skill in the art would not have reason to combine Li, Gan, and Smith. PO Resp. 53–54. Patent Owner argues that Li, “like Froitzheim’s structure, includes metal contacts on both sides of the solar cell,” and therefore, for the same reasons asserted for the Froitzheim combinations, discussed above, Petitioner has not shown a motivation to combine. PO Resp. 54.

Patent Owner’s arguments with respect to Li, Gan, and Smith are similar to its arguments for Froitzheim, Gan, and Smith—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 are also persuaded, on this complete record, that Petitioner has shown that a person of ordinary skill in the art would have had a reasonable expectation of success in combining the teachings of Li, Gan, and Smith in the manner proposed by Petitioner.

* * *

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

3. *Remaining Claims 10–20*

Petitioner asserts that claims 10–20 would have been obvious over the combination of Li, Gan, and Smith. Pet. 6–7, 73–88. Patent Owner does not separately address remaining claims 10–20 beyond what is argued for independent claim 9. *See generally* PO Resp. Upon review of the full trial record, and arguments and evidence therein, we determine that Petitioner has demonstrated by a preponderance of the evidence that each of the limitations recited in claims 10–20 are suggested by the above-identified prior art 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 2 (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, 1078–1080, 1085, and 1086. PO MTE 2.

A. *Uncited Exhibits (Exs. 1071 and 1072)*

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 3.

Patent Owner contends that Exhibits 1071 and 1072 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 Exhibit 1072, Patent Owner argues that because Exhibit 1072 "does not include any indicia indicating that it was published or otherwise made available to the public," it should be excluded. PO MTE 6. 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 Exhibit 1072 is prior art or relevant. PO MTE 7.

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. 3. 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. 5.

We are not persuaded that Exhibits 1071 and 1072 must be excluded from the record. Both Exhibit 1071 and 1072 were introduced during Dr. Ruby's deposition, without objection, and Dr. Ruby was questioned about both exhibits. Ex. 1075, 3:19–20, 21:4–22:9, 109:10–133:4. Although Dr. Holman does "consider" Exhibits 1071 and 1072 (Ex. 1077, App'x D4), neither Dr. Holman nor Petitioner relies on either exhibit 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 or 1072, we do not consider these exhibits in rendering our Decision. Accordingly, we deny Patent Owner’s motion to exclude Exhibits 1071 and 1072 as moot.

B. Authentication and Hearsay (Exs. 1074, 1078, 1079, 1080, 1085, and 1086)

Patent Owner also moves to exclude Exhibits 1074, 1078–1080, 1085, and 1086. PO MTE 5, 7–11. Exhibits 1074, 1078, 1079, and 1080 include technical papers published in various IEEE proceedings or publications. Ex. 1074, 172 (authored by Dr. Ruby), 177; Ex. 1078, 1308; Ex. 1079, 1375; Ex. 1080, 283; Ex. 1089 ¶¶ 4–7. Exhibits 1085 and 1086 include papers authored by Dr. Ruby and published by Sandia National Laboratories. Ex. 1085, 1; Ex. 1086, 1; Ex. 1089 ¶¶ 8–9.

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, 10, 11. Patent Owner further contends that “Petitioner has provided no credible information as to when or how this exhibit was actually available to the public,” and therefore fails to establish the exhibits are prior art or relevant. PO MTE 8, 9, 10, 11.

Petitioner argues that Exhibits 1074, 1078–1080, 1085, and 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. 5. Petitioner asserts that these exhibits are “undisputably relevant” because they describe aspects of solar cell manufacturing and design. Pet. MTE Opp. 5–6.

We are not persuaded that Exhibits 1074, 1078–1080, 1085, and 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 ¶¶ 44, 74 (citing Ex. 1074), ¶¶ 31–32 (citing Exs. 1078–1080)) or to refute testimony offered by Dr. Ruby (Ex. 1077 ¶ 27 (citing Ex. 1085), ¶ 32 (citing Ex. 1086)). Furthermore, at least three of the identified exhibits (Exs. 1074, 1085, and 1086) were authored by Dr. Ruby, two of which were identified in his “Partial List of Publications and Presentations” that accompanied his declaration in support of Patent Owner’s Response (Ex. 1074; Ex. 1086; *see* Ex. 2027, Technical Publications, 1, 2 (listing the titles of Exhibits 1074 and 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, and publishers, and Exhibits 1085 and 1086 themselves 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 1074, 1078–1080, 1085, and 1086, we are persuaded that these exhibits are authenticated at least under Federal Rule of Evidence 901(b)(4) and we accept Exhibits 1074, 1078–1080, 1085, and 1086 for what they purport and are alleged to be. Patent Owner does not show otherwise. Further, we see no reason why Exhibits 1074, 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 7. But, as explained above, Petitioner relies on Exhibits 1074, 1078–1080, 1085, and 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 1074, 1078–1080, 1085, and 1086 are not hearsay when relied upon for these purposes. “A prior art document submitted as a ‘printed publication’ . . . is 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 (D.D.C 1990), *aff’d*, 959 F.2d 226 (Fed. Cir. 1992). Moreover, we see no reason why Exhibits 1074, 1078–1080, 1085, and 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 1074, 1078–1080, 1085, and 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 1–20 of the '053 patent is unpatentable.⁸

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
9–12, 14, 16–20	103	Froitzheim, Gan	9–12, 14, 16–20	
1–20	103	Froitzheim, Gan, Smith	1–20	
9–20	103	Li, Gan, Smith	9–20	
Overall Outcome			1–20	

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–20 of U.S. Patent No. 8,878,053 B2 are unpatentable; and

⁸ 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).

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.

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