

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RUNERGY ALABAMA INC. and RUNERGY USA INC.,
Petitioner,

v.

TRINA SOLAR CO., LTD.,
Patent Owner.

IPR2025-00006
Patent 10,230,009 B2

Before SHERIDAN K. SNEDDEN, AVELYN M. ROSS, and
DEBRA L. DENNETT, *Administrative Patent Judges*.

DENNETT, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Runergy USA Inc. and Runergy Alabama Inc. (collectively “Runergy U.S.”) (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–17 of U.S. Patent No. 10,230,009B2 (Ex. 1001, “the ’009 patent”). Trina Solar Co., Ltd. (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 8 (“Prelim. Resp.”).

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314 (2012); 37 C.F.R. § 42.4(a). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted “unless the Director determines . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least [one] of the claims challenged in the petition.”

For the reasons set forth below, upon considering the Petition, Preliminary Response, and evidence of record, we determine that Petitioner has established a reasonable likelihood of prevailing with respect to at least one challenged claim. Accordingly, we grant the Petition and institute an *inter partes* review.

A. *Real Parties-in-Interest*

Petitioner identifies Runergy USA Inc., Runergy Alabama Inc., and Jiangsu Runergy New Energy Technology Co. Ltd. as the real parties-in-interest. Pet. 2.

Patent Owner identifies itself as the real party-in-interest. Paper 5, 1.

B. *Related Proceedings*

The parties identify the following legal proceedings as involving the ’009 patent:

Trina Solar Co., Ltd. v. Runergy USA Inc. and Runergy Alabama Inc.,
1:24-cv-00557-JCG (D. Del.); and

*Trina Solar Co., Ltd. v. Jiangsu Runergy New Energy Technology Co.,
Ltd.*, 2:24-cv-007694-MCS (C.D. Cal.).

Pet. 2; Paper 5, 1.

Petitioner also identifies the following legal proceeding as involving the
'009 patent:

*Certain TOPCon Solar Cells, Modules, Panels, Components Thereof,
and Products Containing Same*, Inv. No. 337-TA-3773.

Pet. 3.

Petitioner further identifies IPR2025-00007 (U.S. Patent No. 9,722,104) as a
related matter. *Id.*

C. The '009 patent

The '009 patent, titled "Solar Cell and Method for Manufacturing the
Same," issued on March 12, 2019. Ex. 1001, codes (45), (54). The '009 patent
describes a solar cell as an alternative energy source that generates electric power
from solar energy. *Id.* 1:28–29. A solar cell "includes substrates made of
semiconductors having different conductive types, such as a p type and an n type, a
second conductive type semiconductor region (or emitter layer), and electrodes
respectively connected to the substrates and the second conductive type
semiconductor region." (*Id.*, 1:33-8). A "p-n junction is formed at the interface of
the substrate and the second conductive type semiconductor region." (*Id.* 1:38-40).
When light strikes the solar cell, "a plurality of electron-hole pairs are generated
from the semiconductors." (*Id.*, 1:41-42). The electrons and holes move toward
the n type and p type semiconductor regions, respectively, and are collected by
electrodes electrically connected to the substrates and the second conductive type

semiconductor region. (*Id.* 1:42-50). “The electrodes are connected by lines, thereby obtaining power.” (*Id.* 1:50-51).

Figure 2 of the '009 patent is reproduced below.

FIG. 2

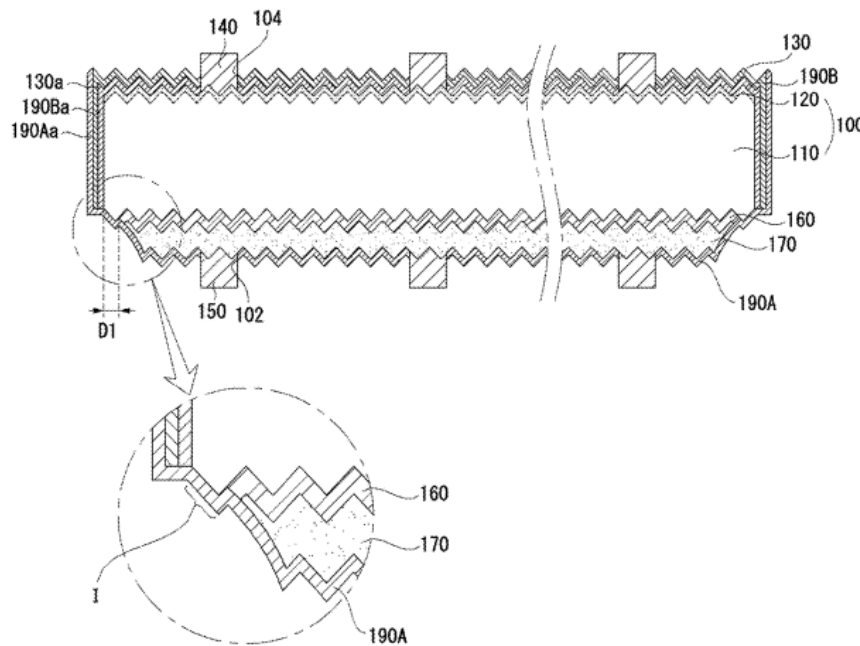


Figure 2 shows the entire cross-sectional view of a solar cell of an embodiment of the invention. The substrate 100 includes a base region 110 doped with impurities (“dopants”) of a first or second conductive type at a low doping concentration. *Ex. 1001, 7:33–36.* On the back surface of the substrate (bottom side in Figure 2), a tunnel layer 160 may be formed, and the first conductive type semiconductor region 170 (having the same conductive type as the substrate) may be formed on the tunnel layer. *Id. 7:44-50.* “[T]he tunnel layer 160 may function as a kind of barrier for electrons and holes,” and may include oxides. *Id. 7:47–53, 62–64.* If the base region 110 has the first conductive type, the first conductive type semiconductor region 170 may form a back surface field (BSF) region, which has a higher doping concentration than the semiconductor substrate 100. *Id.*

10:13–18. The second conductive type semiconductor region 120, having a conductive type different from that of the base region may form an emitter region, forming a pn junction along with the base region. *Id.*, 10:18–22. Passivation films 190A and 190B are formed on the first and second conductor regions 170 and 120, other than opening portions 102 and 104, corresponding to the first and second electrodes 150 and 140. *Id.*, 10:63–67.

The solar cell has an “isolation portion I” (shown magnified in Figure 2’s inset) formed by removing the tunnel layer 160 placed on one side of the semiconductor substrate and an edge portion of the first conductive type semiconductor region 170. Ex. 1001, 4:40–43. Also as shown in the inset, the first passivation film 190A may cover the first surface of the semiconductor substrate along with the isolation portion, and also as the white space along the solar cell’s periphery in Figure 3. The isolation portion I may block a short circuit between the first conductive type semiconductor region 170 and the second conductive type semiconductor region 120 that may have resulted when “impurities of the second conductive type may be diffused into the side or the edge of the back surface of the semiconductor substrate 100.” *Id.*, 13:20–39.

D. Illustrative Claim

Petitioner challenges claims 1–17 of the ’009 patent. Independent claim 1 is representative of the challenged claims and is reproduced below with Petitioner’s annotations¹:

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

- [1.a] A solar cell comprising:
- [1.b] a silicon semiconductor substrate having a first conductive type;
- [1.c] an oxide layer on a first surface of the silicon semiconductor substrate;
- [1.d] a polysilicon layer on the oxide layer and having the first conductive type;
- [1.e] an emitter region at a second surface of the silicon semiconductor substrate opposite to the first surface and having a second conductive type opposite to the first conductive type;
- [1.f] a first passivation film on the polysilicon layer;
- [1.g] a first electrode connected to the polysilicon layer through an opening formed in the first passivation layer;
- [1.h] a second passivation film on the emitter region;
- [1.i] a second electrode connected to the emitter region through an opening formed in the second passivation film; and
- [1.j] an isolation portion for preventing a contact between the polysilicon layer and the emitter region, wherein the isolation portion excludes the oxide layer and the polysilicon layer, and is in an edge portion of the first surface of the silicon semiconductor substrate; and
- [1.k] the first passivation film covers the first surface of the silicon semiconductor substrate and the isolation portion together.

Ex. 1001, 37:65–38:26.

E. The Asserted Unpatentability Challenges

Petitioner asserts that claims 1–17 would have been unpatentable based on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–8, 11–13, 15, 17	103	Jin, ² Feldmann ³
16	103	Jin, Feldmann, Chang ⁴
1–8, 11–13, 15–17	103	Chang, Jin
9, 10	103	Jin, Feldmann, Seo ⁵
9, 10	103	Chang, Jin, Seo
14	103	Jin, Feldmann, Watabe ⁶
14	103	Chang, Jin, Watabe

Pet. 3–4. Petitioner also relies on declaration testimony of Dr. Sanjay Banerjee (Ex. 1003).

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

² US 2013/0056051 A1, published Mar. 7, 2013 (Ex. 1009, “Jin”).

³ F. Feldmann et al., *Passivated rear contacts for high-efficiency n-type Si solar cells providing high interface passivation quality and excellent transport characteristics*, Solar Energy Materials & Solar Cells, Vol. 120, pp. 270–274 (Ex. 1012, “Feldmann”).

⁴ US 2014/0299187 A1, published Oct. 9, 2014 (Ex. 1013, “Chang”).

⁵ US 8,647,914 B2, issued Feb. 11, 2014 (Ex. 1015, “Seo”).

⁶ JP 2010-186862 A, published Aug. 26, 2010 (Ex. 1014, “Watabe”).

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.

⁷ Petitioner asserts that the objective factors in the record support a conclusion of obviousness. Pet. 90–91. Patent Owner, at this time, does not address objective indicia of nonobviousness. *See generally* Prelim. Resp.

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 been someone with an advanced degree involving the disciplines of electrical engineering, applied physics, chemistry, or materials science, and at least two years of experience designing, developing, or researching in the field. Alternatively, that person would have had a bachelor’s degree in electrical engineering, applied physics, or materials science, and at least three years of experience designing, developing, or researching in the field.

Pet. 4 (citing Ex. 1003 ¶ 49).

Patent Owner does not address the level of ordinary skill in the art at this stage of the proceeding. *See generally* Prelim. Resp.

In light of the record before us, and for purposes of this Decision, we adopt Petitioner’s proposal regarding the level of ordinary skill in the art. Based on our review of the ’009 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 ’009 patent and the prior art. We will make any final determination pertaining to the level of ordinary skill in the art, however, on the full trial record.

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 “[n]o claim construction is believed to be necessary to resolve this Petition.” Pet. 24. And, Patent Owner does not address claim construction at this stage of the proceeding. *See generally* Prelim. Resp.

For purposes of this Decision, 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 Jin and Feldmann

Petitioner alleges that claims 1–8, 11–13, 15, and 17 of the ’009 patent would have been obvious over the combination of Jin and Feldmann. Pet. 3, 24–50. Petitioner also alleges that claims 9 and 10 of the ’009 patent would have been obvious over the combination of Jin, Feldmann, and Seo. Pet. 3, 77–90. Lastly Petitioner alleges that claim 14 of the ’009 patent would have been obvious over the combination of Jin, Feldmann, and Watabe. Pet. 4, 91–96.

1. Overview of Jin (Ex. 1009)

Jin describes a solar cell 100 that includes a silicon semiconductor substrate 110 of a first conductive type; an emitter layer 120 having a second conductive type opposite the first conductive type and formed on a first surface of the silicon semiconductor substrate; a back surface field layer 150 having the first conductive type and formed on a second surface of the silicon semiconductor substrate opposite to the first surface. Ex. 1009 ¶ 8. The emitter layer includes at least a first shallow doping area 122 and the back surface field layer includes at least a second shallow doping area 152. *Id.*

Figure 3 of Jin, annotated to identify substrate 110, is reproduced below:

FIG. 3

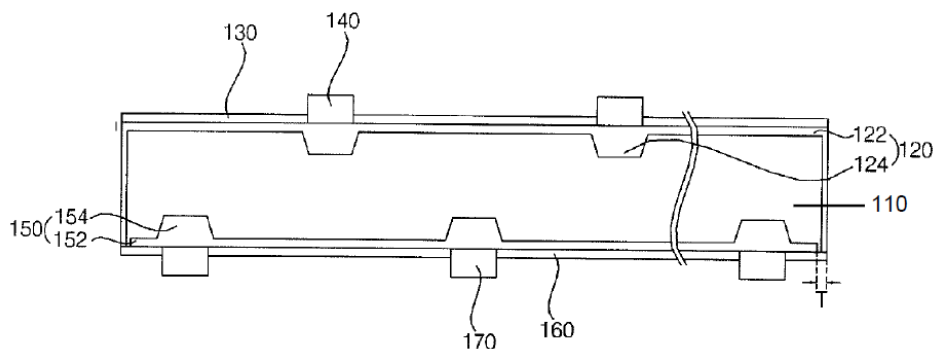


Figure 3 is a cross-sectional view of a solar cell of Jin's invention. Ex. 1009 ¶ 13. In addition to the elements described above, the solar cell may include a first anti-reflection film 130 on the emitter layer 120 (comprised of first area 124 and second area 122), a second anti-reflection film 160 on the back surface field layer 150, a plurality of front finger electrodes 140 connected to the emitter layer, and a plurality of rear finger electrodes 170 connected to the back surface field layer. Ex. 1009 ¶¶ 8, 26.

Jin describes a situation in which the back surface field layer 150 is formed separated from the edge of the rear surface of the substrate 110 by a distance or a

“gap T,” keeping the back surface field layer 150 and the emitter layer 120 (including second area 122 of the emitter layer) from being shorted. Ex. 1009 ¶¶ 30, 57–58. According to Jin, in such instance, an additional process of edge isolation for preventing the front and the rear surfaces of the substrate 110 from being shorted may be omitted. *Id.* ¶ 58.

2. Overview of Feldmann (Ex. 1012)

Feldmann is a paper directed to using “passivated rear contacts . . . to replace point contact passivation schemes for high-efficiency n-type crystalline silicon solar cells.” Ex. 1012, 270 (Abstract). Feldmann describes a structure called “TOPCon” (Tunnel Oxide Passivated Contact) that consists of an ultra-thin tunnel oxide and a phosphorus doped silicon layer and is said to “significantly reduce the surface recombination at the metal-semiconductor interface.” *Id.* Feldmann’s TOPCon solar cell is shown in Figure 3, reproduced below.

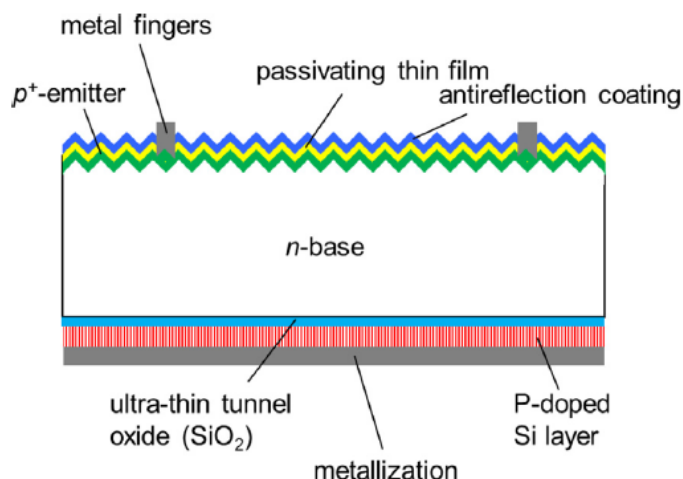
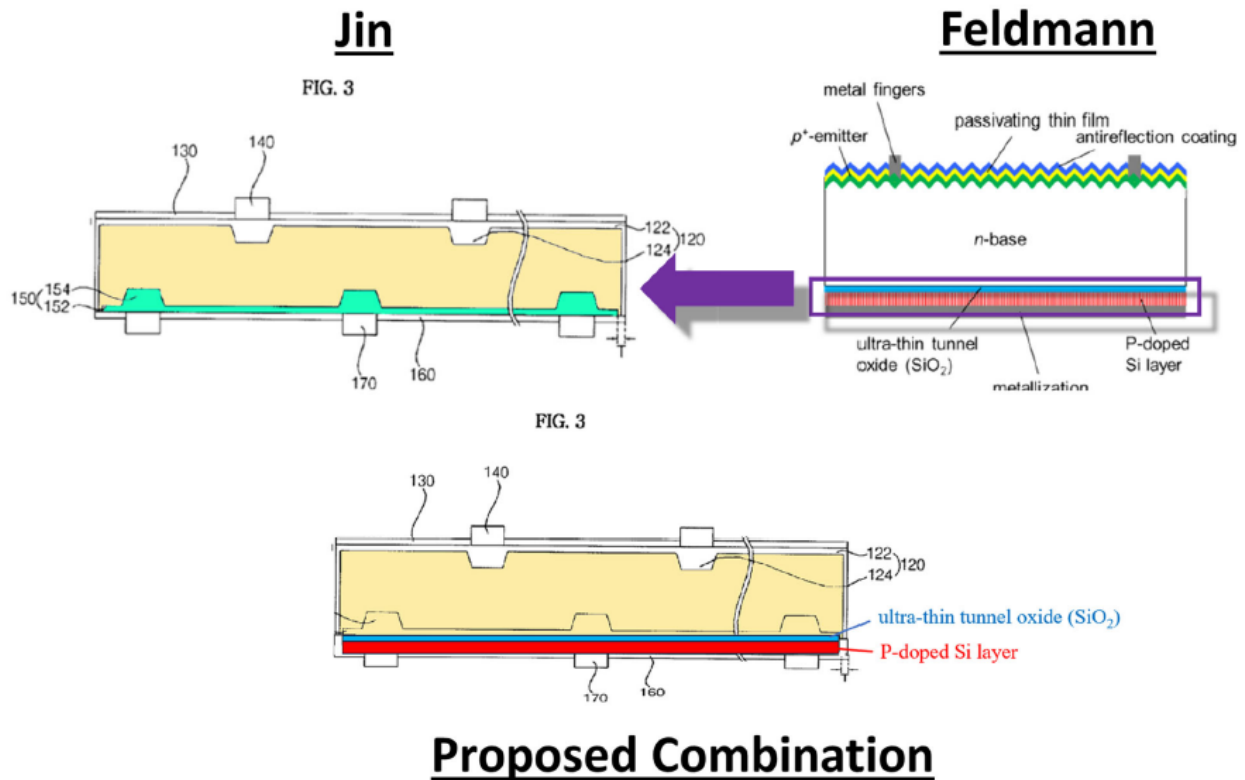


Figure 3 is a cross-section view of a solar cell structure with an n-type substrate with a “p+-emitter” (green), a passivation film (yellow), and an antireflection coating (blue) on the front sun-facing side of the substrate, and the TOPCon structure on the backside. Ex. 1012, Fig. 3 (coloring in original). The TOPCon structure consists of a tunnel oxide (SiO₂) (light blue) and a phosphorus-

doped polysilicon layer (red). *Id.* A metallization layer is on the TOPCon structure. *Id.*

3. *Analysis of Claim 1*

Petitioner alleges that the combination of Jin and Feldmann renders claim 1 of the '009 patent obvious. Pet. 28–39. Petitioner contends that at least Jin alone teaches all limitations of claim 1 except [1.c] “an oxide layer on a first surface of the silicon semiconductor substrate,” and [1.d] “a polysilicon layer on the oxide layer and having the first conductive type.” *Id.* Petitioner relies on Feldmann for the oxide layer and the polysilicon layer on the oxide layer recited in claim 1. *Id.* at 29–31. Specifically, Petitioner alleges that “[i]n the Jin/Feldmann combination, Jin’s diffused BSF layer 150 is replaced with the TOPCon structure of Feldmann, i.e., the tunnel oxide . . . and phosphorous-doped polysilicon . . . layers” that “has a phosphorus-doped polysilicon BSF . . . formed on the tunnel oxide layer.” *Id.* at 28–30 (citing Ex. 1009 ¶47, Fig. 3; Ex. 1012, Fig. 3). The illustration below, reproduced from page 30 of the Petition, shows Jin’s solar cell, Feldmann’s solar cell, and the resultant combination of the two as proposed by Petitioner:

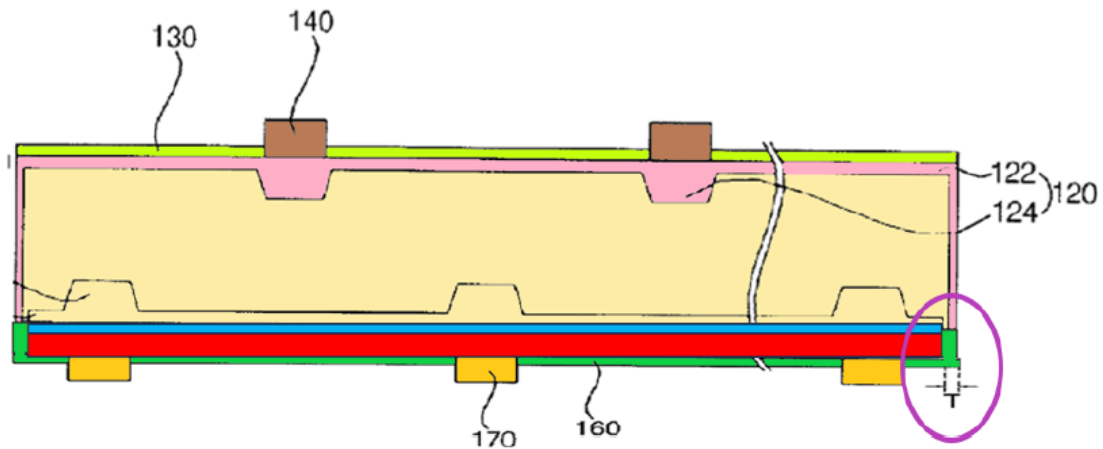


The illustration shows Jin's Figure 3 on the left with BSF layer 150 highlighted in light green (*see* § D.1., *supra*). Feldmann's Figure 3 is shown on the right with a blue tunnel oxide layer and red p-doped Si layer (*see* § D.2, *supra*). The modified version of Jin that Petitioner proposes is shown at the bottom of the illustration, in which Jin's green BSF layer is replaced by Feldmann's ultra-thin tunnel oxide layer (blue) and p-doped Si layer (red) (*see* Pet. 25).

Petitioner's proposed combination retains Jin's first (130) and second (160) anti-reflection films. Pet. 32, 34; *see* Ex. 1003 ¶¶ 33, 35–36. Dr. Banerjee, Petitioner's expert, testifies that "[i]n the Jin/Feldmann combination . . . an anti-reflection film 160 . . . would be placed on the phosphorous-doped polysilicon layer," and that "Jin teaches that when the substrate 110 is n-type . . . the anti-reflection film 160 . . . 'performs the function of a passivation layer.'" Ex. 1003 ¶ 138 (citing Ex. 1009 ¶ 50, Fig. 3).

Petitioner’s proposed combination also retains Jin’s plurality of rear finger electrodes 170: “[i]n the Jin/Feldmann combination, the rear finger electrodes 170 . . . would be formed on the anti-reflection film 160 . . . and connected to the polysilicon layer . . . through gaps in the anti-reflection film, for example, by screen printing on the second anti-reflection film.” Pet. 33 (citing Ex. 1003 ¶¶ 136–138, Ex. 1009 ¶¶ 26, 52, 53, 99, 101).

The illustration below, reproduced from page 33 of the Petition, shows Jin’s anti-reflection film (160) in bright green, identified by Petitioner as the “first passivation film on the polysilicon layer” in the Jin/Feldmann combination (*see* Pet. 32, Ex. 1003 ¶ 138), and rear finger electrodes (170) in orange, identified by Petitioner as the “first the electrode connected to the polysilicon layer through an opening formed in the first passivation film” (*see* Pet. 33, Ex. 1003 ¶ 140).



Petitioner argues that in the Jin/Feldmann combination, Jin’s gap T (circled in purple in the above illustration), “separates the BSF 150 from the edge of the silicon substrate 110, and thus isolates and inhibits electrical shorting between the BSF 150 and the emitter 120 caused by diffusion of dopants along the edge of the substrate 110 when forming BSF 140.” Pet. 37 (citing Ex. 1003 ¶ 148, Ex. 1009 ¶¶ 57–60). Thus, asserts Petitioner, the gap T would separate the edge of the

polysilicon BSF and tunnel oxide layer from the edge of the silicon substrate 110, thereby preventing contact with the emitter layer 120. *Id.*

Citing the testimony of its expert, Dr. Sanjay Banerjee, Petitioner argues that it would have been obvious to one of ordinary skill in the art to replace Jin's diffused BSF layer 150 with Feldmann's TOPCon structure because Feldmann and others taught that making this substitution would reduce surface recombination and improve solar cell efficiency. Pet. 25–26 (citing Ex. 1003 ¶¶ 110–12). Dr. Banerjee testifies that it was known for decades that heavily-doped polysilicon, like that in Feldmann, could be used to replace a BSF layer, like that in Jin, with resulting improvements in red spectral response and open-circuit voltage due to a decrease in effective surface recombination velocity. Ex. 1003 ¶ 111. In addition, Dr. Banerjee testifies that it was known for decades that an interfacial oxide layer in between the polysilicon and the substrate could be used to improve solar cells by impeding the flow of holes and improving energy conversion efficiency for solar cells. *Id.* ¶¶ 112-13 (discussing exhibits supporting that incorporating a tunnel oxide with a polysilicon layer reduces recombination).

Moreover, according to Petitioner, Feldmann itself provides motivation to incorporate the TOPCon structure in Jin's isolated n-type solar cell in stating that the tunnel oxide is “a vital part of this passivated contact” and “is required to achieve excellent interface passivation.” Pet. 26 (quoting Ex. 1012, Abst.). Dr. Banerjee testifies that Feldmann's emitter, like Jin's is formed by diffusion, thus is susceptible to shorting, and would benefit from Jin's gap-T isolation region. Ex. 1003 ¶ 116. Petitioner contends that the combination of Feldmann's TOPCon structure with Jin's solar cell is merely an arrangement of known elements, each performing the same function it was known to perform, and yielding no more than expected results. Pet. 26–27.

At this time, Patent Owner does not challenge many of Petitioner's allegations regarding the teachings of Jin and Feldmann. *See generally* Prelim. Resp. We address below those arguments raised by Patent Owner.

Patent Owner argues that “[t]he purpose of Jin’s invention is to include shallow doping areas in the emitter and back surface field [sic] layer,” and then suggests that Jin achieves improvement in the efficiency of solar cells by having “the emitter [region] include[] at least a first shallow doping area and the back surface field layer include[] at least a second shallow doping area.” Prelim. Resp. 8–9. According to Patent Owner, Jin teaches the central importance of the shallow regions in the back surface field layer is reinforced by Jin’s claims requiring “at least a second shallow doping area.” *Id.* at 10.

Regarding Feldmann, Patent Owner contends that the reference teaches a solar cell based on an ultra-thin oxide and a phosphorus-doped silicon layer, and depicts a p⁺-emitter that is completely separate from the p-doped silicon layer, thus the doped layer are not short-circuited. Prelim. Resp. 11–12. Thus, Patent Owner argues, Feldmann’s solar cell has “no need for an additional isolation portion.” *Id.* at 12.

Patent Owner also argues that Feldmann’s metallization layer across the backside—as opposed to metal finger contacts—increases the cell’s efficiency. Prelim. Resp. 13. According to Patent Owner, “Feldmann explicitly criticizes earlier approaches such as PERL cells ‘which feature a thick dielectric layer with a low index of refraction’ with openings through which metal contacts connect to the doped region.” *Id.*

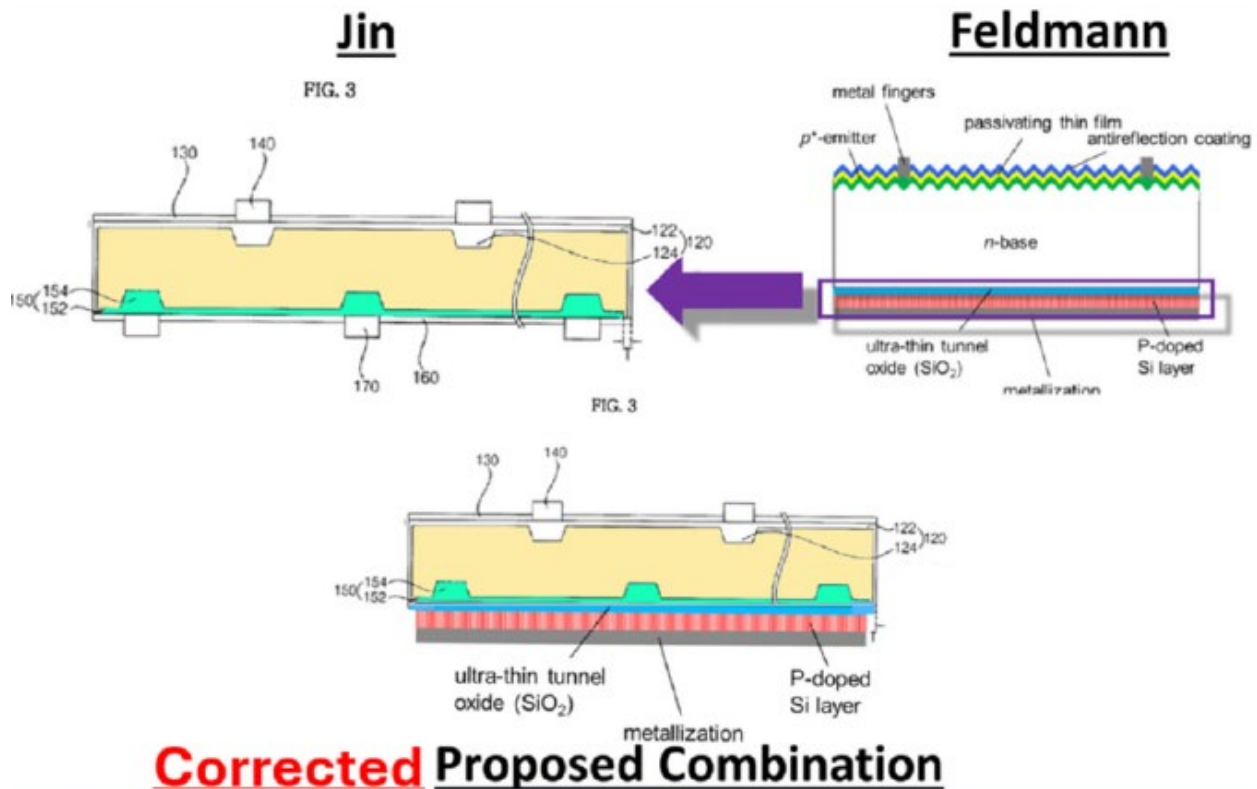
As to the combination of Jin and Feldmann, Patent Owner contends that “Jin is an old-fashioned, non-TOPCon solar cell,” . . . “lack[ing] at least the tunnel oxide and polysilicon layers” of TOPCon solar cells. Prelim. Resp. 14. Patent

Owner describes Jin’s invention as the inclusion of shallow doped regions that increase efficiency. *Id.* Patent Owner argues that “a central part of Feldmann’s invention is the use of a metallization layer that excludes a passivating film,” and notes that Feldmann does not disclose the isolation portion in the ’009 patent’s claims. *Id.* Arriving at the ’009 patent’s invention requires, according to Patent Owner, picking and choosing pieces of Jin and Feldmann to combine. *Id.* Patent Owner argues that the “combination is nothing more than hindsight that ignores the express teachings of both Jin and Feldmann.” *Id.* at 15; *see also id.* at 18–19.

Patent Owner contends that the proposed combination eliminates Jin’s benefit of reduced or prevented recombination by replacing Jin’s back surface field having shallow areas and more highly doped areas with Feldmann’s P-doped silicon layer that has a uniform thickness. Prelim. Resp. 15. Patent Owner also contends that Petitioner fails to explain why one of ordinary skill in the art would import Feldmann’s ultra-thin tunnel oxide and P-doped silicon layer, but not Feldmann’s metallization layer, into Jin. *Id.* at 15–16, 19–20. Patent Owner asserts that a skilled artisan would not have included an insulating dielectric layer with Feldmann’s back surface structure in the face of Feldmann’s teaching that application of an insulating dielectric layer would contradict the TOPCon structure. *Id.* at 16; *see also id.* at 20. And Patent Owner disputes that one of ordinary skill in the art would have excluded Feldmann’s tunnel layer from a portion of the substrate. *Id.* at 16–17.

Patent Owner concludes that, “to the extent a POSITA would have been motivated to attempt to combine Jin and Feldmann, he or she would have included Feldmann’s metallization layer, . . . would not have included an insulating dielectric layer, . . . and would not have excluded any portion of Feldmann’s ‘vital’

tunnel oxide layer.” Prelim. Resp. 20. Patent Owner provides what it terms a “correction” to Petitioner’s proposed combination illustration:



In contrast to Petitioner’s illustration of the proposed combination (supra at page 14), in Patent Owner’s “corrected” version as illustrated, the tunnel oxide (shown in blue) extends to the side walls of the semiconductor, and the P-doped silicon layer (shown in red stripes) and metallization layer (shown in gray) stop at the gap T, i.e., short of the side walls of the semiconductor. *See* Prelim. Resp. 21. Confusingly, as illustrated, Patent Owner’s version includes Jin’s varying-depth back surface field (having shallow areas and more highly doped areas) 150 in addition to the P-doped silicon layer of Feldmann.

We disagree with Patent Owner’s interpretation of Jin as disclosing that the shallow region in the back surface field layer is the focus of Jin or of central importance in the reference. Patent Owner presents unsupported attorney argument, and it is well settled that arguments of counsel cannot take the place of

factually supported objective evidence. *See, e.g., In re Huang*, 100 F.3d 135, 139–40 (Fed. Cir. 1996); *In re De Blauwe*, 736 F.2d 699, 705 (Fed. Cir. 1984); *Icon Health & Fitness, Inc. v. Strava, Inc.*, 849 F.3d 1034, 1043 (Fed. Cir. 2017) (“Attorney argument is not evidence.”).

Patent Owner attacks the disclosures of Jin and of Feldmann separately, but we do not look at Jin individually and separately from Feldmann, because “[t]he question in an obviousness inquiry is whether it would have been obvious to a person of ordinary skill in the art to combine the relevant disclosures of the two references, not whether each individual reference discloses all of the necessary element.” *Palo Alto Networks, Inv. v. Centripetal Networks LLC*, 122 F.4th 1378, 1385–86 (Fed. Cir. 2024) (quoting *Game & Tech. Co. v. Wargaming Grp. Ltd.*, 942 F.3d 1343, 1352 (Fed. Cir. 2019); *Bradium Techs. LLC v. Iancu*, 923 F.3d 1032, 1050 (Fed. Cir. 2019) (quoting *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986)) (“A finding of obviousness . . . cannot be overcome by ‘attacking references individually where the rejection is based upon the teachings of a combination of references.’”). We note that the requirement to address the combined disclosures of the references does not relieve Petitioner of the burden of persuasion to show obviousness. *See Dynamic Drinkware, LLC*, 800 F.3d at (discussing the burden of proof in inter partes review).

Patent Owner also suggests elements of Feldmann could not have or would not have been incorporated into Jin successfully. Prelim. Resp. 15–17, 19–21. But “[t]he test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art.” *In re Keller*, 642 F.2d 413, 425

(CCPA 1981). It is well established that the obviousness inquiry does not ask “whether the references could be physically combined but whether the claimed inventions are rendered obvious by the teachings of the prior art as a whole.” *In re Etter*, 756 F.2d 852, 859 (Fed. Cir. 1985) (en banc); *In re Nievelt*, 482 F.2d 965, 968 (CCPA 1973) (“Combining the *teachings* of references does not involve an ability to combine their specific structures.”). To justify combining reference teachings it is not necessary that a device shown in one reference can be physically inserted into the device shown in the other. *Keller*, 642 F.2d at 425.

Based on the record before us, we are persuaded that Petitioner has shown sufficiently at this stage of the proceeding that an ordinarily skilled artisan would have had a reasonable expectation of success in the combination of Jin and Feldmann.

4. *Remaining Claims 2–17*

Petitioner asserts that claims 2–17 would have been obvious over the combination of Jin and Feldmann alone or in combination with either Seo or Watabe. Pet. 3, 39–50, and 77–90. Patent Owner does not separately address remaining claims 2–17 beyond what is argued for independent claim 1. *See generally* Prelim. Resp. Having determined that Petitioner meets the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to at least one challenged claim of the ’009 patent, we order that trial shall proceed on all claims and all challenged grounds. *SAS Institute Inc. v. Iancu*, 584 U.S. 357, 360–361 (2018).

E. *Challenges Based on Chang and Jin*

Petitioner alleges that claims 1–8, 11–13, and 15–17 of the ’009 patent would have been obvious over the combination of Chang and Jin. Pet. 3–4, 52–77.

Petitioner also alleges that claims 9 and 10 would have been obvious over the combination of Chang, Jin, and Seo. *Id.* at 3–4, 77–90. Lastly, Petitioner alleges that claim 14 of the '009 patent would have been obvious over the combination of Chang, Jin, and Watabe. Pet. 3, 91–96.

1. Overview of Chang (Ex. 1013)

Chang describes “a solar cell including a semiconductor substrate, a first tunneling layer entirely formed over a surface of the semiconductor substrate, a first conductive type area disposed on the surface of the semiconductor substrate, and an electrode including a first electrode connected to the first conductive type area.” Ex. 1013, code (57). Chang’s solar cell is “capable of maximizing efficiency.” *Id.* ¶ 8. Chang’s solar cell includes a substrate, conductive type areas including an emitter area and a back surface field area, electrodes connected to the conductive type areas, and a tunneling layer that may be interposed between the semiconductor substrate and at least one of the conductive type areas. *Id.* ¶ 36. “The tunneling layer 40 may be included with a first passivation film 21, a first anti-reflective film 22, a second passivation film 31, a second anti-reflective film 32 and the like.” *Id.*

1. Analysis of Claim 1

Petitioner alleges that the combination of Chang and Jin renders claim 1 of the '009 patent obvious. Pet. 52–68. Petitioner contends that Chang expressly describes each of the limitations of claim 1. *Id.* Petitioner, however, explains that Jin provides additional details for limitation 1.j, that is, “an isolation portion for preventing a contact between the polysilicon layer and the emitter region” (*id.* at 53–56), and Jin is used to provide an alternative theory of obviousness for

limitation 1.k, i.e., “the first passivation film covers the first surface of the silicon semiconductor substrate and the isolation portion together” (*id.* at 66–68).

With respect to limitation 1.j, Petitioner alleges that Chang describes an “isolation region,” which is synonymous with the “isolation portion,” as claimed. Pet. 62–63 (citing Ex. 1003 ¶ 240; Ex. 1013 ¶¶ 56, 62). Petitioner states that “Chang discloses that the ‘tunneling layer 44 is **entirely formed** over’ the back surface of the substrate 10, and the back surface field area 30 ‘may be **entirely formed** over the second tunneling layer,’” but that peripheral and isolation regions contemplated within the definition of “entirely formed.” *Id.* at 63 (citing Ex. 1003 ¶ 240; Ex. 1013 ¶¶ 56, 62). Petitioner contends that an isolation region that electrically isolates a conductive front emitter from a conductive back surface field was a well-known method for preventing shorting. *Id.* at 63 (citing Ex. 1003 ¶¶ 241–242). Petitioner explains that Jin “discloses additional details and illustrates the isolation region” and peripheral region of Chang. *Id.* at 65 (citing Ex. 1003 ¶¶ 246; Ex. 1009 ¶¶ 57–58, Figs. 3; Ex. 1013, Fig. 3).

With respect to limitation 1.k, Petitioner contends that “Chang’s ‘passivation film 31’ is the *first passivation* film,” and “[i]n Chang, the passivation film 31 ‘may be formed in a substantially entire region over the front surface of the back surface field area 30, excluding a region corresponding to the second electrode 34.’” Pet. 66 (citing Ex. 1013 ¶ 63, Fig. 1). Petitioner explains that unlike the tunneling layer and back surface field area, “Chang does **not** use the especially defined expression of ‘entirely formed’ to describe its passivation film 31’s coverage over the silicon back surface,” and therefore does not “exclude” the peripheral regions or isolation regions described above. *Id.* at 67 (citing Ex. 1013 ¶ 63; Ex. 1003 ¶¶ 251–254). Said another way, Petitioner asserts that passivation film 31 is “formed in a substantially entire region” over the back area and “does

not have any such exclusions except for electrode locations.” *Id.* at 67 (citing Ex. 1013 ¶ 63).

Alternatively, Petitioner contends that “[t]o the extent [Patent Owner] argues that Chang does not disclose this element, it would have been obvious as expressly taught by Jin.” *Id.* at 67 (citing Ex. 1003 ¶¶ 254–55). Petitioner alleges that “[i]t was well known that a bare silicon surface provides recombination sites, and the isolation region constitutes an area of bare silicon surface that was well known to likewise need passivation and removal of recombination sites” and that “the Skilled Artisan would be motivated to passivate the isolation region, as shown in Jin.” *Id.* at 67–68 (citing Ex. 1003 ¶¶ 253–238).

Petitioner asserts that

[t]he Skilled Artisan would have considered the Chang/Jin combination to be merely an arrangement of old elements with each performing the same function it had been known to perform (the solar cell of Chang having an isolation region at the periphery, made using the details of the isolation and ‘gap T’ spacing disclosed by Jin) and yielding no more than what one would expect from such an arrangement (a solar cell with improved performance).

Id. 55 (citing Ex. 1003 ¶ 219). According to Petitioner, “[c]ombining Chang and Jin would not have resulted in any unpredictable results and could have been readily accomplished with a reasonable expectation of success,” and the “combination would employ well-known prior art steps in solar cell and semiconductor fabrication to yield predictable results.” *Id.* at 55–56 (citing Ex. 1003 ¶ 227). Petitioner alleges “[i]mplementing Chang’s isolation region as taught by Jin would have been a simple use of a known technique to improve similar devices (Chang’s solar cell) in the same way,” which is “nothing more than applying known techniques to a known device ready for improvement to yield predictable results.” *Id.* at 56.

Patent Owner, at this time, does not challenge many of Petitioner’s allegations regarding the teachings of Chang and Jin. *See generally* Prelim. Resp. Instead, Patent Owner argues that “Petitioners do not meet their burden to prove that this combination renders claim 1 obvious.” *Id.* at 22. We address Patent Owner’s arguments below.

Patent Owner contends that “Petitioner’s Ground 3 is confusing.” *Id.* at 24. In particular, Patent Owner asserts that Petitioner argues that the combination does not require any modification to Chang’s device but “admits” that Chang does not show an isolation portion as claimed. *Id.* Patent Owner contends that because emitter 20 and back surface field area 30 “are ‘disposed at different sides’ of the substrate, they cannot form a short circuit and, thus, Chang has no need for an isolation portion, as required by claim 1 of the ’009 Patent.” *Id.* at 26. Patent Owner also disputes Petitioner’s argument that Chang describes an isolation portion as claimed. *Id.* And lastly, Patent Owner argues that Petitioner’s reason to include isolation portions in Chang, i.e., to prevent the emitter and back surface field from being shorted, “is perplexing because the ‘isolation regions’ and gap ‘T’ . . . have nothing to do with preventing emitter (20) from being shorted with BSF (30).” *Id.* at 28–29. This is because

Chang specifically teaches (i) that its emitter and BSF regions are “not adjacent to each other” (and, thus, cannot short), (ii) the need for “performing an isolation process is eliminated,” and (iii) not performing an (unnecessary) isolation process results in a “simplified” manufacturing process and “reduced” cost, (Ex. 1013, [0076]), there is no motivation for a POSITA to modify Chang and add an unnecessary, complicated, and expensive isolation step.

Id. at 29. Patent Owner explains that “[e]ven if a [person of ordinary skill in the art] were motivated to ignore Chang’s teachings . . . Petitioners provide no

explanation or support for their argument that . . . a [person of ordinary skill in the art] would exclude Chang’s tunnel layer from the isolation portion.” *Id.* at 30.

On this record, we are persuaded that Petitioner has established that claim 1 of the ’009 patent would have been rendered obvious by the combination of Chang and Jin. As an initial matter, we find Petitioner’s proposed ground is sufficiently clear. For example, Petitioner states “[t]he Chang/Jin combination requires no modification to Chang’s device; Jin supplies details about Chang’s isolation region and its covering by the rear passivation film that Chang presumed was already known.” Pet. 54. Thus, Petitioner reaches to Jin, not to supply a missing limitation, but rather to further detail what is already described in Chang. *Id.* (“A skilled artisan would have been motivated to look to Jin to understand the details missing from Chang regarding Chang’s isolation region, because others taught and understood that the isolation region was an important tool for preventing the emitter and BSF from being shorted.”).

We are also persuaded that Petitioner adequately shows that Chang describes an isolation region. Petitioner argues that “Chang’s ‘isolation region’ is synonymous with the claimed ‘*isolation portion*’ (‘*tunnel layer*’) and ‘back surface field area 30’ (‘*first conductive type semiconductor region*’).” *Id.* at 62–63. In particular, “Chang discloses that the ‘tunneling layer 44 is **entirely formed** over’ the back surface of the substrate 10, and the back surface field area 30 ‘may be **entirely formed** over the second tunneling layer.’” *Id.* at 63 (quoting Ex. 1013 ¶¶ 56, 62). But, according to Petitioner, Chang expressly defines the phrase “entirely formed” to exclude an isolation portion as claimed. In particular, Chang states

[a]s used herein, the expression “entirely formed” means that an element such as a layer is formed over an entire surface without an empty area or a non-coverage area, or is formed over in an entire area

excluding pre-designated or inevitably formed regions such as periphery region, isolation region or the like.

Ex. 1013 ¶¶ 56, 62. Petitioner, through the testimony of Dr. Banerjee, states that a person of ordinary skill in the art would have understood Chang’s isolation region to be an area that “electrically isolates, and thus prevents contact between, the conductive front emitter area 20 from the conductive BSF 30” and that including an isolation region “was a well-known to prevent shorting of the front emitter and BSF.” Pet. 63 (citing Ex. 1003 ¶¶ 241–242). Therefore, Chang’s solar cell includes a tunnel oxide layer and back surface field that are entirely formed over the surface of the solar cell substrate, but excludes the peripheral region of the substrate. *Id.* at 63–64 (citing Ex. 1013 ¶¶ 56, 62; Ex. 1003 ¶¶ 240–242; Ex. 1027, 865; Ex. 1029, 1020).

We acknowledge Patent Owner’s argument that the combination fails because there is no need to isolate the emitter from the back surface field. Prelim. Resp. 26. In particular, Patent Owner directs our attention to a portion of Chang that states that “the emitter area 20 and the back surface field area may be disposed at different sides of the semiconductor substrate 10 to form a double-surface light-receiving type system,” and in that case, “[b]ecause the emitter area 20 and the back surface field area 30 are not adjacent to each other, the necessity of performing an isolation process when the emitter area 20 and the back surface field area 30 are formed to be adjacent to each other is eliminated.” *Id.* (citing Ex. 1013 ¶ 76). But, that paragraph in Chang begins with “[i]n *this* instance” and states that the components “*may* be disposed at different sides” of the substrate indicating multiple and differing embodiments are contemplated by Chang. Ex. 1013 ¶ 76 (emphasis added); *see also id.* ¶¶ 12–29 (describing the figures as including “an embodiment,” a “modified embodiment,” “another embodiment,” and “another modified embodiment.”)

Furthermore, Patent Owner dismisses Chang’s express statement that “entirely formed” excludes certain regions such as the periphery and isolation regions. “It is well settled that a prior art reference is relevant for all that it teaches to those of ordinary skill in the art.” *In re Fritch*, 972 F.2d 1260, 1265 (Fed. Cir. 1992). And Petitioner, relying on the testimony of Dr. Banerjee, explains why the skilled artisan would have considered an isolation region advantageous. Pet. 65–66 (citing Ex. 1003 ¶¶ 247–248). In particular, Petitioner and its declarant explain that because the emitter layers of Jin and Chang are formed in the same manner (i.e., “heat diffusion” or “thermal diffusion”) “dopants diffuse into the front and *lateral side surfaces* of the substrate” and Chang’s isolation region, like Jin’s “gap T” acts to isolate the emitter and back surface field to prevent electrical shorting. *Id.* (emphasis added) (citing Ex. 1003 ¶¶ 248).

Accordingly, we are persuaded that Petitioner has shown sufficiently at this stage of the proceeding that an ordinarily skilled artisan would have had a reason to combine the teachings of Chang and Jin and have had a reasonable expectation of success in the combination.

2. *Remaining Claims 2–17*

Petitioner asserts that claims 2–17 would have been obvious over the combination of Chang and Jin alone or in combination with either Seo or Watabe. Pet. 3–4, 77–97. Patent Owner does not separately address remaining claims 2–17 beyond what is argued for independent claim 1. *See generally* Prelim. Resp. Having determined that Petitioner satisfies the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to at least one challenged claim of the ’009 patent, we order that trial shall proceed on all claims and all challenged grounds. *SAS*, 584 U.S. at 360–361.

III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has demonstrated a reasonable likelihood that it would prevail with respect to at least one of the claims challenged in the Petition. Accordingly, we institute an *inter partes* review of the '009 patent.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 1–17 of U.S. Patent No. 10,230,009 B2 is instituted with respect to all grounds set forth in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which will commence on the entry date of this Decision.

IPR2025-00006
Patent 10,230,009 B2

FOR PETITIONER:

Samuel Tiu
Joseph Micallef
Tung Nguyen
Michael Roberts
SIDLEY AUSTIN LLP
stiu@sidley.com
jmicallef@sidley.com
tnguyen@sidley.com
mlroberts@sidley.com

FOR PATENT OWNER:

Bas de Blank
K. Herman
ORRICK, HERRINGTON & SUTCLIFFE LLP
m2bptabdocket@orrick.com
p52ptabdocket@orrick.com