

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RUNERGY ALABAMA INC., RUNERGY USA INC.,
and CANADIAN SOLAR (USA) INC.,
Petitioners,¹

v.

TRINA SOLAR CO., LTD.,
Patent Owner.

IPR2025-00007
Patent 9,722,104 B2

Before GRACE KARAFFA OBERMANN, AVELYN M. ROSS, and
DEBRA L. DENNETT, *Administrative Patent Judges*.

ROSS, *Administrative Patent Judge*.

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

¹ Canadian Solar (USA) Inc. was joined as a petitioner in this proceeding based on a petition and motion for joinder filed in IPR2025-00918, which was granted.

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 1–11 of U.S. Patent No. 9,722,104 B2 (Ex. 1001, “the ’104 patent”). Trina Solar Co., Ltd. (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 8. We instituted *inter partes* review. Paper 11 (“DI” or “Decision on Institution”).

Thereafter, Patent Owner filed a Response (Paper 16, “PO Resp.”), Petitioner filed a Reply (Paper 20, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 25, “Sur-reply”). The Final Hearing was held on December 3, 2025, and a transcript of the Final Hearing is in the record. Paper 37 (“Tr.”).

For the reasons set forth below, upon considering the Petition, Patent Owner’s Response, Petitioner’s Reply, Patent Owner’s Sur-reply, and evidence of record, we determine that Petitioner has established by a preponderance of the evidence that claims 1–11 of the ’104 patent are unpatentable.

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 and Evervolt Green Energy Holdings Pte Ltd. as the real parties-in-interest. Paper 31, 1.

B. *Related Proceedings*

The parties identify the following legal proceedings as involving the ’104 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-07694-MCS (C.D. Cal.).

Pet. 2; Paper 5, 1.

Petitioner also identifies the following legal proceeding as involving
the '104 patent:

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

Pet. 3.

Petitioner further identifies IPR2025-00006, relating to U.S. Patent
No. 10,230,009, as a related matter. *Id.*

C. The '104 patent

The '104 patent, titled “Solar Cell and Method for Manufacturing the
Same,” issued on August 1, 2017. Ex. 1001, codes (45), (54). The '104 patent
describes a solar cell as an alternative energy source that generates electric power
from solar energy. Ex. 1001, 1:22–29. 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.” Ex. 1001, 1:30–35. A “p-n junction is formed at the
interface of the substrate and the second conductive type semiconductor region.”
Ex. 1001, 1:35–37. When light strikes the solar cell, “a plurality of electron-hole
pairs are generated from the semiconductors.” Ex. 1001, 1:38–41. 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. Ex. 1001, 1:41–47. “The electrodes are connected by lines, thereby obtaining power.” Ex. 1001, 1:47–48.

Figure 2 of the '104 patent is illustrative and reproduced below.

FIG. 2

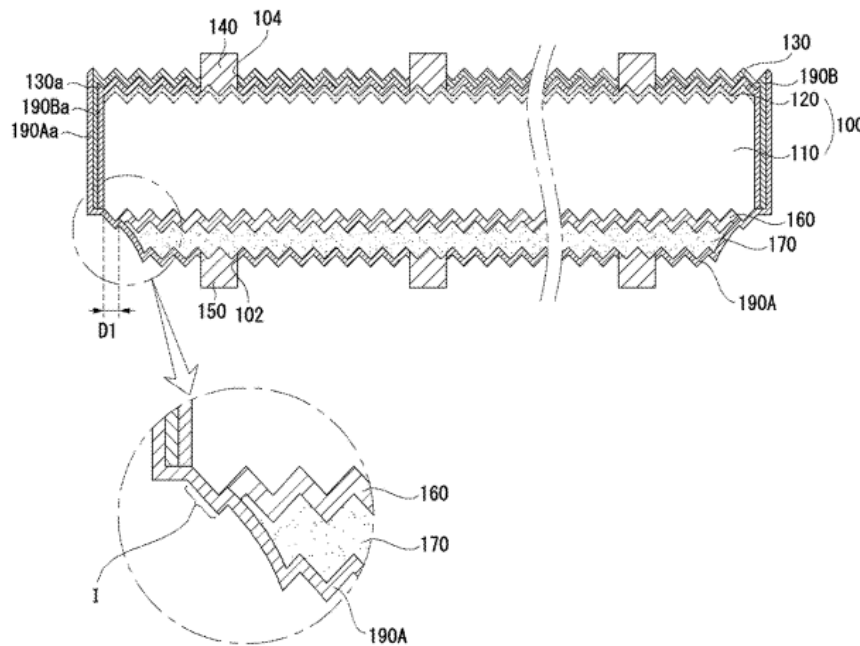


Figure 2 “illustrat[es] a solar cell according to a first embodiment of the present invention.” Ex. 1001, 4:66–67. Figure 2 shows substrate 100 that includes base region 110 doped with impurities (“dopants”) of a first or second conductive type at a low doping concentration. Ex. 1001, 7:31–35. On the back surface of the substrate (bottom side in Figure 2), tunnel layer 160 may be formed, and first conductive type semiconductor region 170 (having the same conductive type as the substrate) may be formed on the tunnel layer. Ex. 1001, 7:42–48. “[T]unnel layer **160** may function as a kind of barrier for electrons and holes,” and may include oxides. Ex. 1001, 7:49–51, 7:60–62. 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. Ex. 1001, 10:10–16. 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 p-n junction along with the base region. Ex. 1001, 10:13–20. 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. Ex. 1001, 10:61–65.

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, 4:36–41. 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. Ex. 1001, 14:22–28. 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**.” Ex. 1001, 13:16–35.

D. Illustrative Claim

Petitioner challenges claims 1–11 of the ’104 patent. Independent claim 1 is representative of the challenged claims and is reproduced below with Petitioner’s annotations²:

² For convenience, we adopt Petitioner’s annotated claim format.

Claim 1:

[1.a] A solar cell comprising:

[1.b] a semiconductor substrate;

[1.c] a tunnel layer on a first surface of the semiconductor substrate;

[1.d] a first conductive type semiconductor region on the tunnel layer and containing impurities of a first conductive type;

[1.e] a second conductive type semiconductor region on a second surface opposite to the first surface of the semiconductor substrate and containing impurities of a second conductive type opposite to the first conductive type;

[1.f] a first passivation film on the first conductive type semiconductor region;

[1.g] a first electrode formed on the first passivation film and connected to the first conductive type semiconductor region through an opening formed in the first passivation film;

[1.h] a second passivation film on the second conductive type semiconductor region;

[1.i] a second electrode formed on the second passivation film and connected to the second conductive type semiconductor region through an opening formed in the second passivation film; and

[1.j] an isolation portion for preventing a contact between the first conductive type semiconductor region and the second conductive type semiconductor region, wherein the isolation portion excludes the tunnel layer and the first conductive type semiconductor region, and is in an edge portion of the first surface of the semiconductor substrate, and

[1.k] wherein the first passivation film covers the first surface of the semiconductor substrate and the isolation portion together.

Ex. 1001, 37:66–38:32.

E. The Asserted Unpatentability Challenges

Petitioner asserts that claims 1–11 would have been unpatentable based on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–6, 9, 10	103	Jin, ³ Feldmann ⁴
1–6, 9, 10	103	Chang, ⁵ Jin
7, 8	103	Jin, Feldmann, Seo ⁶
7, 8	103	Chang, Jin, Seo
11	103	Jin, Feldmann, Watabe ⁷
11	103	Chang, Jin, Watabe

Pet. 3–4. Petitioner also relies on declaration testimony of Dr. Sanjay Banerjee (Ex. 1003; Ex. 1037). Patent Owner relies on the declaration testimony of Dr. Martin Peckerar (Ex. 2001).

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*

³ US 2013/0056051 A1, published Mar. 7, 2013 (Ex. 1009, “Jin”).

⁴ 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”).

⁵ US 2014/0299187 A1, published Oct. 9, 2014 (Ex. 1013, “Chang”).

⁶ US 8,647,914 B2, issued Feb. 11, 2014 (Ex. 1015, “Seo”).

⁷ JP 2010-186862 A, published Aug. 26, 2010 (Ex. 1014, “Watabe”).

Inc. v. Avid Tech., Inc., 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (2012) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to the patent owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

Obviousness is a question of law based on underlying determinations of fact. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966); *Richardson-Vicks, Inc. v. Upjohn Co.*, 122 F.3d 1476, 1479 (Fed. Cir. 1997). A claim is unpatentable as obvious, under 35 U.S.C. § 103, if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time of the invention to a person having ordinary skill in the art. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness.⁸ *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.

⁸ Petitioner asserts that the objective factors in the record support a conclusion of obviousness. Pet. 90–91. Patent Owner does not address objective indicia of nonobviousness. *See generally* PO Resp.

Pfizer, Inc. v. Apotex, Inc., 480 F.3d 1348, 1361 (Fed. Cir. 2007). “Obviousness does not require absolute predictability of success . . . all that is required is a reasonable expectation of success.” *In re O’Farrell*, 853 F.2d 894, 903–04 (Fed. Cir. 1988) (citations omitted). But, a petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

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

B. Level of Ordinary Skill in the Art

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

Petitioner contends that a person of ordinary skill in the art would have 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. *See generally* PO Resp; Sur-reply.

In light of the complete trial record before us, we adopt Petitioner’s proposal regarding the level of ordinary skill in the art. Based on our review of the ’104 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 ’104 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 “[n]o claim construction is believed to be necessary to resolve this Petition.” Pet. 23. And, Patent Owner does not address claim construction. *See generally* PO Resp.

As neither party proposes an express construction for our consideration and because we determine that an express claim construction is not necessary for us to render a decision in this matter, we do not 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 1–6, 9, and 10 of the ’104 patent would have been obvious over the combination of Jin and Feldmann. Pet. 3, 23–48. Petitioner also alleges that claims 7 and 8 of the ’104 patent would have been obvious over the combination of Jin, Feldmann, and Seo. Pet. 3, 70–78. Lastly Petitioner

alleges that claim 11 of the '104 patent would have been obvious over the combination of Jin, Feldmann, and Watabe. Pet. 3–4, 84–89.

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. Ex. 1009 ¶ 8.

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

FIG. 3

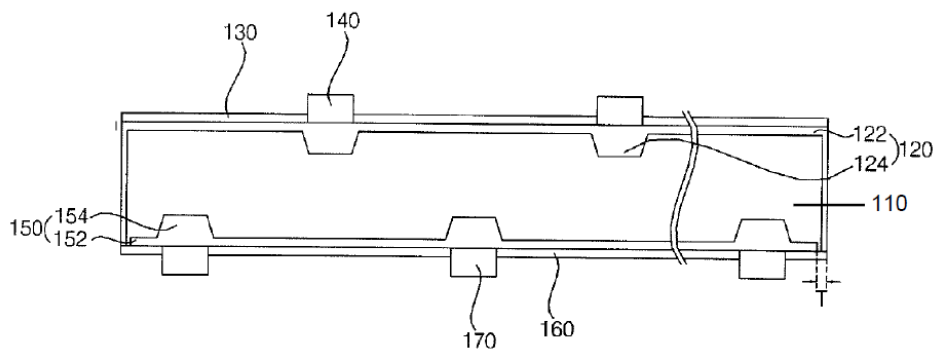


Figure 3 is a cross-sectional view of a solar cell of Jin's invention. Ex. 1009 ¶ 13. In addition to the elements described above, the solar cell may include a first anti-reflection film 130 on the emitter layer 120, a second anti-reflection film 160 on the back surface field layer 150, a plurality of 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 from being shorted. Ex. 1009 ¶¶ 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. Ex. 1009 ¶ 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.” Ex. 1012, 270 Feldmann’s TOPCon solar cell is shown in Figure 3, reproduced below.

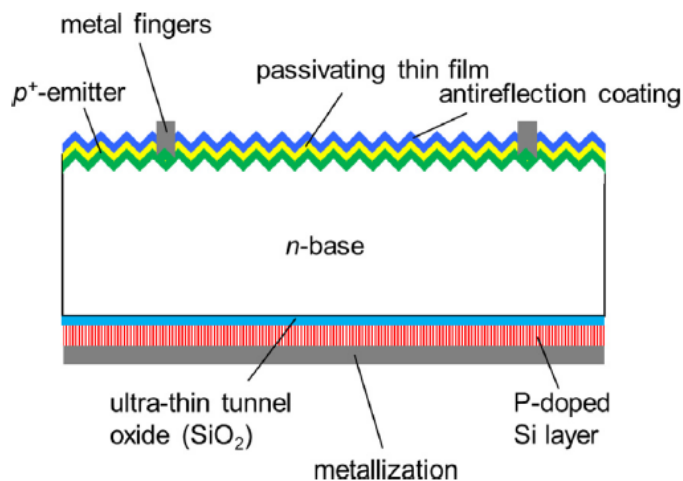


Figure 3 is a cross-section view of a solar cell structure with an n-type substrate with a “p+-emitter” (green), a passivation film (yellow), and an antireflection coating (blue) on the front sun-facing side of the substrate, and the TOPCon structure on the backside. Ex. 1012, Fig. 3 (coloring in original).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

structure consists of a tunnel oxide (SiO₂) (light blue) and a phosphorus-doped polysilicon layer (red). Ex. 1012, Fig. 3. A metallization layer is on the TOPCon structure. Ex. 1012, Fig. 3.

3. *Analysis of Claim 1*

Petitioner alleges that the combination of Jin and Feldmann renders claim 1 of the '104 patent obvious. Pet. 27–40. Petitioner contends that Jin and Feldmann both describe the limitations [1.a], [1.b], [1.e], [1.h], and [1.i], that Jin describes the limitations [1.f], [1.g], [1.j], and [1.k], and that Feldmann describes the limitations [1.c] and [1.d]. According to Petitioner, Jin and Feldmann both describe a solar cell with a silicon semiconductor substrate of a first conductive type that is implemented as an N-type semiconductor, and as well as the formation of a P-N junction. Pet. 27–28, 30–31 (citing Ex. 1009 ¶¶ 26–27, 29, Fig. 3; Ex. 1012, 271–272, Fig. 3). Petitioner contends that both Jin and Feldmann describe a passivation layer between an emitter layer and anti-reflection film or coating, as well as electrodes on the passivation film connected to the emitter layer through the passivation film. Pet. 33–36 (citing Ex. 1009 ¶¶ 26, 37–40, 99, Figs. 3, 11; Ex. 1012, Fig. 3). 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.” Pet. 28–30 (citing Ex. 1009 ¶ 47, Fig. 3; Ex. 1012, Fig. 3).

Petitioner, through testimony of Dr. Banerjee, alleges 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.’” Pet. 31–32 (citing Ex. 1003 ¶ 134; Ex. 1009 ¶ 50, Fig. 3).

Petitioner also alleges that “[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. 32–33 (citing Ex. 1003 ¶¶ 136–138; Ex. 1009 ¶¶ 26, 52, 53, 99, 101). Petitioner alleges that Jin’s “gap T” “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,” “would separate the edge of the polysilicon BSF . . . and tunnel oxide layer . . . from the edge of the silicon substrate 110, ‘preventing contact’ with the emitter layer 120. Pet. 37 (citing Ex. 1003 ¶ 148; Ex. 1009 ¶¶ 57–60, Fig. 3).

Petitioner asserts that a person of ordinary skill in the art “would have been motivated to replace Jin’s BSF layer 150 with a tunnel oxide layer and polysilicon BSF because Feldmann and others taught that making this substitution would reduce surface recombination and improve solar cell efficiency,” and “to follow Feldmann and specifically replace Jin’s BSF 150 with a polysilicon BSF layer and an intervening oxide layer to reduce surface recombination and improve solar cell efficiency.” Pet. 24–25 (citing Ex. 1003 ¶¶ 107–111). Petitioner also asserts that

Feldmann itself provides motivation to incorporate the disclosed TOPCon structure in Jin’s isolated n-type solar cell by reporting that the TOPCon structure ‘significantly reduce[s] the surface recombination at the metal-semiconductor interface,’ making the tunnel oxide ‘a vital part of this passivated contact and that it is required to achieve excellent interface passivation.

Pet. 25 (citing Ex. 1003 ¶¶ 111, 113; Ex. 1012, Abstr.). According to Petitioner, “because Feldmann’s emitter, like Jin’s, is formed by diffusion, it is susceptible to

shorting and would benefit from Jin's gap-T isolation region." Pet. 25. (citing Ex. 1003 ¶ 113).

Patent Owner does not challenge Petitioner's allegations regarding the teachings of Jin and Feldmann or that Jin and Feldmann suggest each limitation of claim 1 of the '104 patent. *See generally* PO Resp. Instead, Patent Owner argues that (1) the combination of Jin and Feldmann is based on impermissible hindsight (PO Resp. 19–28), (2) a person of ordinary skill in the art would not have had a reasonable expectation of success in the combination of Jin and Feldmann (*id.* at 29–35), and (3) a person of ordinary skill in the art would not have had a reason to combine the teachings of Jin and Feldmann (*id.* at 35–39). After review of the complete trial record, we determine Petitioner has shown by a preponderance of the evidence that the combination of Jin and Feldmann discloses limitations [1.a]–[1.k]. But, because we agree with Patent Owner's contentions that Petitioner's combination is rooted in impermissible hindsight, we focus our analysis below on this argument.

Patent Owner argues that that because Petitioner's combination "eliminated Jin's back surface field layer, [it] also eliminated the need to include Jin's gap (or distance) T in its current form." PO Resp. 17. Patent Owner explains that Jin's emitter and back surface field layers are formed directly in the solar cell's silicon substrate by doping "via 'a heat diffusion method, a laser doping method or an ion implantation method.'" PO Resp. 20. Jin uses a mask when forming the back surface layer to cover the edge, or distance T, to "(1) 'prevent[] contact' between the back surface field layer 150 and emitter layer 120, and (2) inhibit[] the impurities used during the doping from 'diffus[ing]' into a portion of the substrate between layers." PO Resp. 20 (internal citations omitted). As a result, "[t]his . . . allows the 'back surface field layer 150 and the emitter layer 120' to 'be kept from

being shorted.” PO Resp. 20. But, Petitioner’s combination removes Jin’s back surface field layer 150 and instead “successively deposit[s] a tunnel oxide layer and then a polysilicon layer on top of the substrate.” PO Resp. 21. Therefore, “there is no longer a doped layer in the backside of the substrate” and “a layer of tunnel oxide interposed between Jin’s substrate and the doped polysilicon layer.” PO Resp. 22. According to Patent Owner, the “tunnel oxide physically separates the two layers” and “operates as a diffusion barrier.” PO Resp. 22; *see also id.* at 23 (stating that “it was also known in the art that tunnel oxides operate to ‘passivate[]’ the rear surface to prevent unwanted combination”) (citing Ex. 1013 ¶¶ 10, 57; Ex. 1012, 270; Ex. 2001 ¶¶ 136–137; Ex. 2002, 13:19–14:7). “Put another way, because the back side of the substrate is no longer doped via ion implantation, the modified version of Jin proposed by Petitioner is **no longer in need** of the same type of gap (or distance) T shown in Jin’s figures.” PO Resp. 22–23. Patent Owner further argues that Feldmann’s passivation layer is depicted as covering the entirety of the substrate surface and further that Feldman does not describe a peripheral gap or discuss masking. PO Resp. 21–23. Patent Owner reasons, that there is no reason to apply Jin’s gap-T isolation region to Feldmann’s tunnel oxide layer in the absence of hindsight. PO Resp. 28.

On this complete trial record, we agree with Patent Owner. It is improper to base a conclusion of obviousness upon facts gleaned only through hindsight. “The invention must be viewed not after the blueprint has been drawn by the inventor, but as it would have been perceived in the state of the art that existed at the time the invention was made.” *Sensonics, Inc. v. Aerosonic Corp.*, 81 F.3d 1566, 1570 (Fed. Cir. 1996) (citing *Interconnect Planning Corp. v. Feil*, 774 F.2d 1132, 1138 (Fed. Cir. 1985)). Therefore, “to establish a prima facie case of obviousness based on a combination of elements disclosed in the prior art, the [Petitioner] must

articulate the basis on which it concludes that it would have been obvious to make the claimed invention.” *Id.* Impermissible hindsight is inferred when the specific understanding or principle within the knowledge of one of ordinary skill in the art that would motivate one (with no knowledge of the claimed invention) to make the proposed combination has not been explained. *In re Rouffet*, 149 F.3d 1350, 1358 (Fed. Cir. 1998).

Here, Petitioner states that the ordinarily skilled artisan would have had reason to replace Jin’s back surface field layer with Feldmann’s tunnel oxide layer and polysilicon layer because it was known that “heavily-doped polysilicon, like disclosed in Feldmann, could be used to beneficially replace a [back surface field] layer, like that used by Jin.” Pet. 24–25 (citing Ex. 1003 ¶ 108). Petitioner argues that a person of ordinary skill in the art would also have had reason to include Feldmann’s oxide layer “to reduce surface recombination and improve solar cell efficiency.” Pet. 25 (citing Ex. 1003 ¶ 111). Petitioner further explains that because “Feldmann’s emitter, like Jin’s, is formed by diffusion, it is susceptible to shorting and would benefit from Jin’s gap-T isolation region.” Pet. 25 (citing Ex. 1003 ¶ 113).

Feldmann stresses the import of its tunnel oxide layer to provide passivation. For example, Feldmann states “that ***the tunnel oxide is a vital part*** of this passivated contact and that it is required to achieve excellent interface passivation.” Ex. 1012, 270 (emphasis added); *see also id.* at 271 (“the tunnel oxide is crucial to obtain very high passivation quality”), 274 (“our TOPCon structure based on ***a tunnel oxide*** and phosphorus doped Si layer ***passivates the surface effectively***” (emphasis added)). This passivation between layers was Petitioner’s reason to include the tunnel oxide layer in the first instance. Pet. 25. Specifically, Petitioner explains that “it has been known for decades that tunnel

oxides in between a polysilicon layer and substrate could be used to improve solar cells by reducing recombination.” Pet. 25 (citing Ex. 1003 ¶ 109). Feldmann depicts its tunnel oxide layer as extending across the entirety of the substrate. Ex. 1012, 272, Fig. 3. Patent Owner, relying on the testimony of Dr. Peckerar, states that a person of ordinary skill in the art, like the author of Feldmann, would have maximized the size of the tunnel oxide layer because doing so would have improved solar cell efficiency by ensuring “(1) that the new polysilicon backside layer does not contact the emitter layer 120 and (2) that dopant from the polysilicon does not diffuse into the substrate.” PO Resp. 24 (citing Ex. 2001 ¶¶ 138–139); *see* Ex. 2001 ¶¶ 140–141.

However, Petitioner proposes to remove the tunnel oxide layer from the edge and offers little explanation of why the skilled artisan would apply Jin’s gap-T isolation region to both of Feldmann’s polysilicon and tunnel oxide layers. As noted above, Petitioner states that the skilled artisan would have included Jin’s gap-T isolation region in order to prevent shorting. Pet. 25. Petitioner’s reasoning is questionable—supported only by the conclusory testimony of Dr. Banerjee. Dr. Banerjee’s testimony offers no more evidentiary support than provided in the Petition. *Compare* Ex. 1003 ¶ 113, *with* Pet. 25. Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *Magnum Oil*, 829 F.3d at 1380.

We acknowledge Dr. Banerjee’s testimony that the combination of Jin’s gap-T isolation region would prevent shorting and that extending the tunnel oxide layer the edge “*could* trap impurities and create negative fixed oxide charges, which *could* then create a p-type inversion in the n-type base substrate, leading to a leakage path to the p-type emitter on the front of the solar cell” (Ex. 1003 ¶ 113 (emphasis added)) but are not convinced by his equivocal testimony. Notably too,

neither Jin nor Feldmann discuss issues relating to trapped impurities and Petitioner, as well as Dr. Banerjee, fail to direct our attention to any record evidence to support their contentions. Rather, we are persuaded by Dr. Peckerar's testimony that

as a general rule in semiconductor process technology, a bare silicon surface should not be left unpassivated after processing. Elemental silicon is highly chemically reactive. As such, the bare surface is a "magnet" for defects and contamination. Leaving the tunnel oxide in place across the entire substrate backside would reduce this problem.

Ex. 2001 ¶ 142. Dr. Peckerar further explains that a person of ordinary skill in the art would have known how to avoid shorting and leakage. In particular, he testifies that

the manner by which charge is transported through a tunnel oxide can be controlled by adjusting manufacturing parameters such as time, temperature, thickness, and ambient impurities. A POSITA would plainly have adjusted these parameters to ensure that the tunnel oxide operates as intended (*i.e.*, minimizes recombinant losses while transporting charge carriers to the backside of the solar cell) while avoiding undesirable leakage current. Because unwanted leakage charge can be avoided via other means during manufacture, there would have been no reason to reduce the physical extent of the tunnel oxide.

Ex. 2001 ¶ 152 (referring to Ex. 2001 ¶¶ 149–151). Moreover, Dr. Peckerar testifies that "Dr. Banerjee also appears to be arguing that incorporation of impurities into the oxide will produce a MOSFET-like structure, with the contaminated oxide acting as a MOS gate leading to enhanced leakage," but, for that to occur, "the source and drain areas would need to be of the same type."

Ex. 2001 ¶ 159. Here however, "the tunnel oxide layer is located between an n-type polysilicon layer and p-type frontside emitter layer" so "[n]o MOSFET-like structure can form because the source and drain are of different types." Ex. 2001

¶ 159. Neither Petitioner nor Dr. Banerjee address or dispute this testimony. *See generally* Pet. Reply; Ex. 1037. We credit Dr. Peckerar’s testimony in this regard.

In short, Petitioner’s allegations with respect to the combination of Jin and Feldmann suffer from a failure of proof. Thus, without an apparent reason to modify the teachings of Jin and Feldmann to include a tunnel oxide layer but exclude that oxide layer from an “isolation portion,” we determine that Petitioner’s contentions rest on impermissible hindsight and that the skilled artisan would not have had a reason to combine the teachings of Jin and Feldman. Accordingly, on this complete trial record, we find that Petitioner has failed to establish by a preponderance of the evidence that the combination of Jin and Feldmann would have rendered claim 1 of the ’104 patent obvious.

4. Remaining Claims 2–11

Petitioner asserts that claims 2–11 would have been obvious over the combination of Jin and Feldmann alone or in combination with either Seo or Watabe. Pet. 3, 40–48, 73–79, and 84–89. Claims 2–11 each depend from independent claim 1 and incorporate each of the limitations of claim 1. Therefore, for the same reasons given in connection with claim 1, we determine that Petitioner has not met its burden of demonstrating that a person of ordinary skill in the art would have had reason to combine the above-identified references in the manner suggested by Petitioner. Accordingly, Petitioner has not demonstrated by a preponderance of the evidence that the combination of Jin and Feldman alone, or in combination with either of Seo or Watabe, would have rendered claims 2–11 obvious.

E. Challenges Based on Chang and Jin

Petitioner alleges that claims 1–6, 9, and 10 of the '104 patent would have been obvious over the combination of Chang and Jin. Pet. 3, 48–70. Petitioner also alleges that claims 7 and 8 of the '104 patent would have been obvious over the combination of Chang, Jin, and Seo. Pet. 3, 79–83. Lastly, Petitioner alleges that claim 11 of the '104 patent would have been obvious over the combination of Chang, Jin, and Watabe. Pet. 3–4, 84–89.

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.” Ex. 1013 ¶ 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. Ex. 1013 ¶ 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.” Ex. 1013 ¶ 36 (emphasis omitted).

2. Claim 1

Petitioner alleges that the combination of Chang and Jin renders claim 1 of the '104 patent obvious. Pet. 52–65. Petitioner contends that Chang expressly describes each of the limitations of claim 1. Pet. 52–65. Petitioner, however, explains that Jin provides additional details for limitation [1.j], that is, “an isolation

portion for preventing a contact between the first conductive type semiconductor region and the second conductive type semiconductor region” (Pet. 59–63), 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 63–64 (emphasis omitted)).

With respect to limitation 1.j, Petitioner alleges that Chang describes an “isolation region,” which is synonymous with the “isolation portion,” as claimed. Pet. 59 (citing Ex. 1003 ¶ 223; 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.” Pet. 59–60 (citing Ex. 1003 ¶ 223; 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. Pet. 60 (citing Ex. 1003 ¶¶ 224–225). Petitioner explains that Jin “discloses additional details and illustrates the isolation region” and peripheral region of Chang. Pet. 61–62 (citing Ex. 1003 ¶¶ 229–231; Ex. 1009 ¶¶ 57–58, Fig. 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. 63 (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. Pet. 63–64 (citing Ex. 1013 ¶ 63; Ex. 1003 ¶¶ 234–237). 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.” Pet. 64 (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.” Pet. 64 (citing Ex. 1003 ¶¶ 237–238). 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.” Pet. 64 (citing Ex. 1003 ¶¶ 236–238).

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).

Pet. 51–52 (citing Ex. 1003 ¶ 202). 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.” Pet. 52 (citing Ex. 1003 ¶ 210). 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.” Pet. 52.

Patent Owner does not challenge many of Petitioner’s allegations regarding the teachings of Chang and Jin. *See generally* PO Resp. Instead, Patent Owner argues that Chang fails to teach the claimed “isolation portion,” i.e., limitation [1.j] (PO Resp. 41–45), and that a person of ordinary skill in the art would not have had a reason to combine the teachings of Chang and Jin (*id.* at 45–47). After considering the parties’ arguments and the evidence of record, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Chang and Jin discloses the limitations [1.a]–[1.i] for the reasons discussed in the Petition, Dr. Banerjee’s testimony, and the Institution Decision. Therefore, we turn our attention to consideration of Patent Owner’s arguments relating to the “isolation portion,” below.

a) The “isolation portion”

Limitation [1.j] requires “an isolation portion for preventing a contact between the first conductive type semiconductor region and the second conductive type semiconductor region, wherein the isolation portion excludes the tunnel layer and the first conductive type semiconductor region, and is in an edge portion of the first surface of the semiconductor substrate,” followed by limitation [1.k], which requires “the first passivation film covers the first surface of the semiconductor substrate and the isolation portion together.” Ex. 1001, 38:23–32.

Petitioner argues that Chang describes the claimed isolation portion for preventing a contact between the polysilicon layer and the emitter region, and Jin provides additional details. Pet. 59–65; Reply 3–10. Specifically, Petitioner argues that Chang expressly discloses that the “tunneling layer 44” (corresponding

to the claimed “oxide layer”) is “entirely formed” over the back surface of the substrate and defines “entirely formed” to exclude a peripheral isolation portion:

[A] second tunneling layer 44 is entirely formed. . . [T]he 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 in an entire area excluding pre-designated or inevitably formed regions such as periphery region, isolation region or the like.

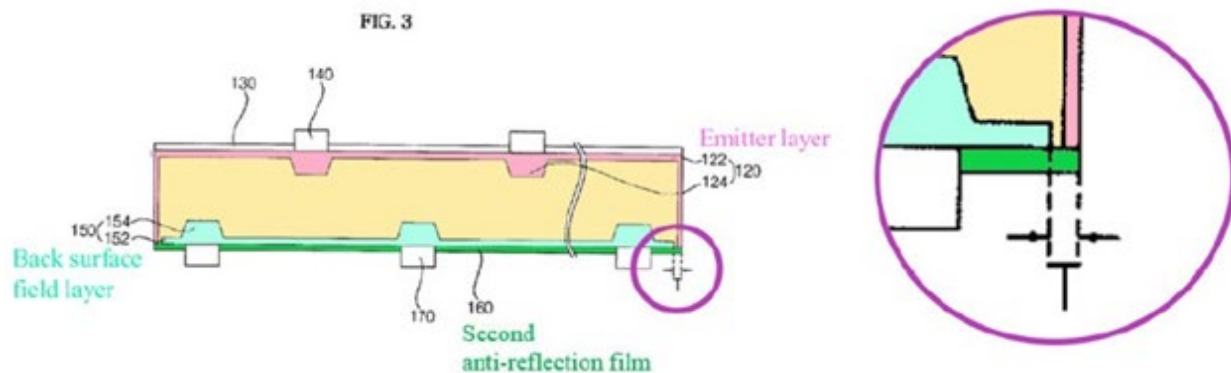
Pet. Reply 3 (emphasis in original) (quoting Ex. 1013 ¶ 56); *see* Pet. 59–60.

According to Petitioner, Chang also discloses that the “the back surface field area 30 [corresponding to the claimed “polysilicon layer”] may be entirely formed over the second tunneling layer 44,” where “entirely formed” is again defined to exclude a periphery isolation portion. Pet. Reply 3; *see* Pet. 59.

Petitioner contends that

Chang’s periphery isolation region electrically isolates Chang’s BSF [back surface field] 30 from the front emitter area 20, which *is formed by thermal diffusion* resulting in dopants diffusing into both (1) the front and (2) *down the lateral sides* of Chang’s substrate—the same problem and solution identified by both Jin and the ’009 Patent.

Reply 5 (emphasis is Petitioner’s); *see* Pet. 62. Petitioner provides a colorized and annotated version of Jin’s Figure 3, reproduced below, to illustrate its argument regarding thermal diffusion of dopants into the front and lateral side surfaces of the substrate:



Pet. 62; Reply 5. Jin's Figure 3 is a cross-sectional view of a solar cell according to Jin's invention. Ex. 1009 ¶ 13. In Annotated Figure 3, substrate 110 (yellow) is covered on the front and lateral sides by emitter layer 120 (pink), and on the back by base surface field layer 150 (mint green), which further covered by second anti-reflection film 160 (bright green). Ex. 1009 ¶ 26; *see* Pet. 65, Reply 5. Petitioner provides an enlargement of the lower right portion of Jin's Figure 3 to emphasize the physical gap existing between Jin's back surface field layer 150 and emitter layer 120 on lateral sides of the substrate, that is, Jin's gap-T isolation region.

According to Petitioner, Chang discloses that the front emitter area may be formed by thermal diffusion or ion implantation. Pet. Reply 6 (citing Ex. 1013 ¶ 98). Formation by thermal diffusion results in dopants diffused down the lateral sides of the substrate, and when the tunnel oxide layer and back surface field layer are thereafter deposited on the back side of the substrate using thermal diffusion, the back surface field layer is "adjacent to"—and is subject to shorting to—the doped lateral sides of the emitter. Pet. Reply 6 (citing Ex. 1037 ¶¶ 8, 25); *see* Pet. 62; Ex. 1003 ¶ 230; Ex. 1045, 150:10–20 (Patent Owner's declarant testifying that using a diffusion process "would contaminate the sidewall" of Chang). Petitioner argues that the peripheral isolation portion of Chang and Jin's gap-T are needed to avoid shorting, i.e., "prevent[] a contact between the polysilicon layer and the emitter region." Pet. Reply 6 (citing Ex. 1013 ¶¶ 56, 61; Ex. 1009 ¶¶ 58–59); Pet. 62.

Patent Owner contends that a person of ordinary skill in the art would have had no reason to apply Jin's gap-T to Chang, as Jin's gap-T is meant to address issues arising when doping the backside of a solar cell substrate, which Chang does not do. PO Resp. 41. Patent Owner argues that Chang disposes conductive regions emitter area and back surface field layer on different sides of the substrate,

thus they cannot form a short-circuit and Chang would have had no need for the claimed isolation portion to prevent a contact between the polysilicon layer and the emitter region. PO Resp. 42 (citing Ex. 2001 ¶¶ 265–271).

Patent Owner criticizes Petitioner and Dr. Banerjee, for ignoring the disclosure in paragraph 76 of Chang. PO Resp. 42–43. Paragraph 76 states that

[i]n this instance, the emitter area 20 and the back surface field area 30 may be disposed at different sides of the semiconductor substrate 10 to form a double-surface light-receiving type structure. . . . Because 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.

Ex. 1013 ¶ 76 (emphasis omitted). Patent Owner posits that “while Chang’s ‘entirely formed’ language could potentially exclude ‘pre-designated or inevitably formed regions,’ Chang does not ‘predesignate’ the isolation portion claimed by the ’104 patent and such an isolation portion is not ‘inevitably formed.’” PO Resp. 42–43. Moreover, according to Patent Owner, “Chang’s ‘isolation region or the like’ is not even necessarily located at the substrate edge. . . . There is nothing in Chang that precludes [an isolation portion not in an edge portion] type of structure.” PO Resp. 44.

Patent Owner points out that “Chang also states that the layers formed on its front surface can be ‘exclude[ed]’ from ‘pre-designated or inevitably formed regions such as periphery region, isolation region or the like.’” PO Resp. 44 (citing Ex. 1013 ¶¶ 45, 51). From this disclosure—which Patent Owner interprets as meaning “both the front and backside layers are not present in the edge regions of the substrate”—Patent Owner concludes that “Chang’s reference to ‘inevitably formed regions’ means that no layers are located in a region around the edge of the

substrate, none of Chang's layers will be located in the substrate's edge regions." PO Resp. 44.

Patent Owner further asserts that person of ordinary skill in the art would have had no reason to apply Jin's gap-T to Chang because Jin forms both its emitter layer and back surface field layer by doping the front and backside of the same substrate, and needs the gap-T isolation region to prevent the layers from contacting each other. PO Resp. 45. Patent Owner argues that Chang, in contrast, does not employ a back surface field layer that is formed by doping the substrate. PO Resp. 45. Instead, Patent Owner argues, Petitioner points to tunnel oxide and polysilicon layers that are deposited on top of the substrate's back surface field layer. PO Resp. 45. And Chang's "emitter and back surface field regions are 'not adjacent to each other' (and, thus, cannot short), eliminating the need for 'performing an isolation process is eliminated,' and not performing an unnecessary isolation process results in a 'simplified' manufacturing process and reduced cost." PO Resp. 45 (internal numbering omitted) (citing Ex. 1013 ¶ 76). Patent Owner reasons that a person of ordinary skill in the art would not have been motivated to modify Chang and add an unnecessary, complicated, and expensive isolation step because Chang does not have the problems the gap-T isolation region is meant to address. PO Resp. 45–46 (citing Ex. 2001 ¶¶ 287–294). Patent Owner further argues that even if a person of ordinary skill in the art were to exclude Chang's polysilicon layer from the gap-T isolation region, there would have been no reason to also exclude the tunnel oxide from this area because "[d]oing so would be entirely unnecessary (as the tunnel oxide is passivating and acts as a diffusion barrier), non-sensical (as the space occupied this layer would later be filled with an oxide in any event), and give rise to manufacturing difficulties and device performance issues." PO Resp. 46. Thus, Patent Owner reasons there is no

motivation to combine Chang with Jin and Petitioner has not met its burden. PO Resp. 46.

In its Reply, Petitioner asserts that Patent Owner's characterization of paragraph 76 of Chang as eliminating the need for any isolation in Chang's solar cell is flawed. Pet. Reply 6; *see* PO Resp. 41–43. Specifically, Petitioner argues that

paragraph 76 of Chang begins with “[i]n *this* instance” and states only that the emitter and BSF “*may* be disposed at different sides” of the substrate, indicating that ¶ 76 is not describing all embodiments, such as those in which in emitter and BSF are formed “adjacent” to one another.

Pet. Reply 8 (citing Ex. 1013 ¶ 76; Ex. 1037 ¶¶ 23–28). According to Petitioner, paragraph 76 is applicable under certain instances, such as when ion implantation is used, and “does not blanketly eliminate the need for edge isolation.” Pet. Reply 8 (citing Ex. 1045, 146:20–149:12 (Patent Owner's declarant testifying that paragraph 76 describes the ion implantation process)).

Petitioner also asserts that Patent Owner's argument that Chang's “‘isolation region or the like’ is not even necessarily located at the substrate edge” (PO Resp. 44), is an attempt apply the standard for inherent anticipation; but, Petitioner's challenge is based on an express disclosure in Chang, referring to the backside peripheral isolation region, and obviousness based on the combination of Chang and Jin, not anticipation. Pet. Reply 8–9 (citing Pet. 60–61; Ex. 1003 ¶ 227–228). Petitioner stresses that it has met the requisite showing that it would have been obvious to a person of ordinary skill in the art for Chang's isolation portion to be at the backside edge portion of the substrate in view of Jin, whose gap-T region isolation region is at the peripheral edge. Pet. Reply 9.

Petitioner argues that neither Patent Owner nor its declarant contend that Chang in combination with Jin does not disclose an isolation portion at the periphery of the substrate. Pet. Reply 9. Petitioner contends that the “Chang/Jin combination uses Jin to supply further detail about what is already described in Chang—that the isolation portion disclosed in Chang at the periphery of the substrate corresponds to the location of the gap-T in Jin.” Pet. Reply 9. (citing Pet. 59–63; Ex. 1003 ¶¶ 223–229).

In response to Patent Owner’s argument that a person of ordinary skill in the art would have had no reason to apply Jin’s gap-T isolation region to Chang because Jin’s gap-T only applies to solar cells in which the *backside* is formed by doping rather than deposition (*see* PO Resp. 45), Petitioner contends that “it is the formation of the *emitter* by thermal diffusion that causes dopants to diffuse down the lateral sides of the substrate, and it is the dopants on the sides of the substrate that would short to the BSF in the absence of an isolation portion” (Pet. Reply 9–10).

Challenging Patent Owner’s argument that the peripheral isolation portion does not “prevent a contact” between the emitter and the back surface field layer because there is peripheral isolation of both the emitter on the front side and the back surface field layer, Petitioner points out that “Chang discloses that the isolation region on the front surface is optional.” Pet. Reply 10 (citing Ex. 1013 ¶ 51 (“the first portion 20a of the emitter area 20 *may* be entirely formed . . .”)) (emphasis in original). Petitioner argues that the Petition does not rely on embodiments in Chang that have a front isolation portion. Pet. Reply 10 (citing Pet. 50). According to Petitioner, in its “proposed combination without the peripheral isolation region on the back side, the [back surface field layer] would

electrically contact and short with the emitter diffusion down the lateral sides of the substrate.” Pet. Reply 10 (citing Pet. 59–60, Ex. 1003 ¶¶ 224–226, 230–231).

Petitioner further contends that Chang expressly teaches excluding the tunnel oxide at the peripheral edge portion in reply to Patent Owner’s argument that there would be no reason to exclude the tunnel oxide in the edge portion in Chang. Pet. Reply 11 (citing PO Resp. 45–46; Ex. 1013 ¶ 56). Petitioner cites *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1372–73 (Fed. Cir. 2019) as holding that there is no requirement for finding a reason or motivation to include a claimed limitation when the prior art reference discloses the claimed limitation. Pet. Reply 11.

In response to Patent Owner’s argument that not only is there no reason to exclude the tunnel oxide from the gap-T isolation area because the tunnel oxide’s role as an insulator and diffusion barrier indicates that it should be maintained across the entire substrate backside, Petitioner contends that “a ‘tunnel oxide’ is a thin oxide layer that allows charge carriers (i.e., electrons or holes) to ‘tunnel’ through to the other side, and thereby leak current.” Pet. Reply 11–12 (citing Ex. 2001 ¶¶ 295–296). According to Petitioner, any alleged ability of the tunnel oxide to block dopant diffusion does not stop shorting, which is the purpose of the isolation portion, because electrons/holes can readily transport across the tunnel oxide due to the tunneling effect. Pet. Reply 12.

Patent Owner argues in its Sur-reply that Petitioner fails to explain why a person of ordinary skill in the art would have employed thermal diffusion and a mask when forming Chang’s tunnel oxide. Sur-reply 14–15. Patent Owner argues that Chang does not disclose a figure with an isolation portion or an embodiment employing thermal diffusion, and paragraph 76 of Chang states that “its solar cell is intend to be structured such that the ‘necessity of performing an isolation process

... is eliminated.” Sur-reply 14; *see* PO Resp. 41–43. Patent Owner argues that Petitioner never explains why a person of ordinary skill in the art (1) would have chosen thermal diffusion in the first place; (2) would not use thermal methods on the backside surface; (3) would have chosen to exclude layers from a “periphery region” or “isolation portion” at the very edge of the backside surface; (4) would not have excluded layers from a “periphery region” or “isolation portion” of both the front and backside surfaces of the solar cell; (5) would have excluded Chang’s tunnel oxide and polysilicon layers from the solar cell periphery, but then ignored Chang’s teaching that the passivation film should be coextensive with these two backside field layers; and (6) would have attempted to use a mask. Sur-reply 15–18. Patent Owner contends that Petitioner simply points to separate, distinct portions of the prior art without providing any meaningful explanation of why the art would be assembled in the way the claims require. Sur-reply 18.

b) Analysis

After considering the parties’ arguments and the cited evidence of record, we determine that Petitioner has shown by a preponderance of the evidence that the combination of Chang and Jin discloses limitations [1.a]–[1.i] for the reasons elaborated in the Petition and Dr. Banerjee’s testimony, and discussed in the Decision to Institute. Pet. 52–68; Ex. 1003 ¶¶ 190–238. Therefore, we turn to consideration of limitation [1.j], the “isolation portion” limitation.

Based on the entire trial record, we are persuaded that Petitioner has shown that the ordinarily skilled artisan would have combined the teachings of Chang and Jin to include an “isolation portion” as claimed and have a reason to modify Chang in view of Jin with a reasonable expectation of success. We credit Petitioner’s evidence and argument, as reviewed above. As discussed below, Patent Owner’s arguments and evidence do not convince us otherwise.

Patent Owner focuses on Chang's description in paragraph 76 of a single configuration in which the emitter area and back surface field area are not adjacent to each other, thus eliminating "the necessity of performing an isolation process when the emitter area [] and the back surface field are [] are formed to be adjacent to each other." PO Resp. 42–43 (citing Ex. 1013 ¶ 76). But, in so doing, Patent Owner side steps Chang's unambiguous definition that "'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 an entire area *excluding pre-designated or inevitably formed regions such as periphery region, isolation region or the like.*" Ex. 1013 ¶¶ 45, 51, 56, 62 (emphasis added). Chang discloses that a first tunneling layer, a first portion of an emitter area, a second tunneling layer, and a back surface field area may each be "formed over an entire area excluding pre-designated or inevitably formed regions such as periphery region, isolation region or the like." Ex. 1013 ¶¶ 45, 51, 56, 62. Chang's definition of "entirely formed" ("excluding pre-designated or inevitably formed regions such as periphery region, isolation region or the like") implies use of a mask. *See* Ex. 1013 ¶ 62; Tr. 15:20–17:11. Dr. Banerjee testifies that the need to electrically isolate the emitter region from the back surface field was well known in the field, and both Chang and Jin teach backside isolation regions. Ex. 1003 ¶¶ 70–81, 91–96, 200 (citing Ex. 1026 § 1 and stating that "[b]oth Chang and Jin likewise teach backside isolation regions").

Chang also discloses that the emitter area may be formed by "thermal diffusion, ion implantation or the like." Ex. 1013 ¶ 98. Petitioner persuasively argues that Chang's disclosure of thermal diffusion of the emitter layer would result in dopants diffused into not only the top surface of the substrate, but also the exposed lateral surfaces, a problem also noted in Jin. *See* Pet. 11–12; Pet.

Reply 6–7; Ex. 1003 ¶ 71; Ex. 1009 ¶¶ 57–58. Jin discloses avoiding shorting of the emitter layer and back surface field layer by edge isolation on the back surface field layer using a mask to create a “gap-T.” Ex. 1009 ¶¶ 57–58, 83. Chang discloses excluding the second tunneling layer and a base surface field area from periphery region and isolation portion. Ex. 1013 ¶¶ 56, 62. Using a mask, as implied in Chang and explicitly disclosed in Jin, would “pre-designate” and/or “inevitably form” the regions where the tunneling layer and back surface field area are excluded. We credit Dr. Banerjee’s testimony that one of ordinary skill in the art “reviewing Chang would therefore understand the importance of implementing the isolation region in Chang’s device, and would therefore be motivated to look to other references, such as Jin (which was assigned to the same original assignee as Chang, LG Electronics, EX1009-Jin, face; EX1013-Chang, face) to understand details regarding Chang’s isolation region.” Ex. 1003 ¶ 201.

We disagree with Patent Owner’s argument that Petitioner and Dr. Banerjee ignore Chang’s paragraph 76 (PO Resp. 42–45), and note that Petitioner directly addresses the issue in the Reply (Pet. Reply 6), stating that paragraph 76 addresses a different embodiment⁹ than that which Petitioner relies.

We are also unpersuaded by Patent Owner’s contentions that Chang’s Figures 1 and 8 do not show an isolation portion. PO Resp. 43–44; Sur-reply 14. We know of no caselaw that requires every claimed element or even all embodiments to be illustrated in a drawing. Moreover, for purposes of § 103, a reference is prior art for all that it discloses. *Symbol Techs., Inc. v. Opticon, Inc.*,

⁹ Although Petitioner and Dr. Banerjee refer to “embodiments,” Chang uses the term “configurations.” We understand Petitioner to be discussing one or more configurations when using the word “embodiment,” and do not find that it invites error.

935 F.2d 1569, 1578 (Fed. Cir. 1991); *see also Beckman Instruments Inc. v. LKB Produkter AB*, 892 F.2d 1547, 1551 (Fed. Cir. 1989) (“Even if a reference discloses an inoperative device, it is prior art for all that it teaches.”).

In addition, we are not convinced by Patent Owner’s arguments that Chang’s “‘isolation region or the like’ is not even *necessarily* located at the substrate edge” (PO Resp. 43 (emphasis added)), and “thermal diffusion does not even *necessarily* result in dopant in the sides of a solar cell” (Sur-reply 15 (emphasis added)), as Patent Owner appears to be applying the standard for inherent anticipation. *See In re Montgomery*, 677 F.3d 1375, 1379–80 (Fed. Cir. 2012) (“A reference may anticipate inherently if a claim limitation that is not expressly disclosed ‘is necessarily present, or inherent, in the single anticipating reference.’”) (citing *Verizon Servs. Corp. v. Cox Fibernet Va., Inc.*, 602 F.3d 1325, 1336–37 (Fed. Cir. 2010)). Patent Owner also appears to be applying the law of anticipation in arguing that Chang fails to teach the isolation portion as claimed. PO Resp. 40. And again, when Patent Owner complains that Petitioner picks and chooses from Chang (Sur-reply 18), Patent Owner invokes the law of anticipation. “[P]icking and choosing may be entirely proper in the making of a [§] 103, obviousness rejection.” *In re Arkley*, 455 F.2d 586, 587–88 (CCPA 1972). To all of these arguments, we note that Petitioner’s ground is obviousness, not anticipation. Petitioner need not show that Chang’s isolation region is *necessarily* always located at the periphery of the substrate, or that Chang alone discloses the entirety of claim 1, or that no picking and choosing was involved in citing the disclosures in Chang. As stated by our Supreme Court, “[t]he combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007). Petitioner has met this showing.

Further, Patent Owner’s interpretation of Chang’s disclosure that the front layers (tunnel layer and emitter portion) “can be ‘exclude[ed]’ from “pre-designated or inevitably formed regions . . .” means that “no layers are located in a region around the edge of the substrate” (i.e., front and back), thus the isolation portion cannot “prevent[] a contact between the polysilicon layer and the emitter region” as required by claim 1, because “there can be no contact between the layers” is flawed. PO Resp. 44. Nothing in Chang suggests that *all* of the first tunneling layer, first portion of an emitter area, second tunneling layer, and back surface field area must be excluded if any one of them is excluded. *See generally* Ex. 1013.

Patent Owner unconvincingly argues that Jin employs a gap-T isolation region “because it forms both its emitter layer [] and back surface field layer [] by doping the front and backside of the same substrate,” but Chang “does not employ a back surface field layer [] that is formed by doping the substrate,” and instead deposits tunnel oxide and polysilicon layers on top of the substrate’s back surface, thus the emitter and back surface field layer are not adjacent to each other. PO Resp. 44–45. This argument is unpersuasive because thermal diffusion of the emitter layer would contaminate the lateral sides of the substrate, irrespective of how the back surface field layer is applied, making the emitter layer and back surface field layer adjacent, resulting in shorting. *See* Pet. 61–62; Ex. 1003 ¶ 230.

In arguing that Chang does not have the problems that Jin’s gap-T was meant to address (PO Resp. 45–46), Patent Owner relies on Chang’s disclosure in paragraph 76 that in one configuration the emitter layer and back surface field area are not adjacent (*see id.*; *see also* Ex. 1013 ¶ 76). We have addressed above the flaws in the basis of this argument and do not repeat our analysis here.

In its Reply to Patent Owner’s argument that there is no reason to exclude both the second tunneling layer and the back surface field area from the periphery (PO Resp. 45–46), but, as Petitioner has aptly shown, Chang describes exclusion of both the second tunneling layer and the back surface field area (Pet. Reply 11–12; Ex. 1013 ¶¶ 56, 62)). Thus, there is no requirement for finding a reason or motivation to include that limitation. *Gen. Elec. Co. v. Raytheon Tech. Corp.*, 983 F.3d 1334, 1352 (Fed. Cir. 2020) (holding that it is error to “require a motivation to combine each element of the claim—even those present together in a reference”). Our precedent does not require Petitioner to show that combining these disclosures is “the *best* option, only that it be a *suitable* option from which the prior art did not teach away.” *Par Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014).

Patent Owner contends that excluding *both* the tunnel oxide layer and back surface field area from the periphery “would be entirely unnecessary (as the tunnel oxide is passivating and acts as a diffusion barrier), non-sensical (as the space occupied this layer would later be filled with an oxide in any event), and give rise to the very same manufacturing difficulties and device performance issues discussed in connection with Ground 1.” PO Resp. 46 (citing Ex. 2001 ¶¶ 295–299); *see* Sur-reply 17. Review of the cited portions of Dr. Peckerar’s testimony, and the testimony referenced within the cited paragraphs, indicates that “non-sensical,” “manufacturing difficulties,” and “device performance” issues are based on combining Jin and Feldmann, which is not the basis of this ground of obviousness. *See* Ex. 2001 ¶¶ 126–132, 295–299 (discussing the issues “in connection with Ground 1”). Therefore, Patent Owner’s contention is inapplicable here.

According to Patent Owner, even if the back surface field area is excluded from a peripheral isolation portion, the tunneling layer would have been applied over the entire surface of the backside of the substrate, i.e., not excluded from the isolation portion, because it acts as a diffusion barrier. PO Resp. 45–46. However, Chang explicitly teaches that the tunnel oxide layer may be excluded from periphery regions or isolation regions. *See* Ex. 1013 ¶ 56. Patent Owner’s argument is unpersuasive. *See Realtime Data*, 912 F.3d at 1372–73 (no motivation is required for combinations of elements in a single reference).

We also acknowledge Patent Owner’s contention that Petitioner fails to explain explains why the skilled artisan (1) would have chosen thermal diffusion in the first place; (2) would not use thermal methods on the backside surface; (3) would have chosen to exclude layers from a “periphery region” or “isolation portion” at the very edge of the backside surface; (4) would not have excluded layers from a “periphery region” or “isolation portion” of both the front and backside surfaces of the solar cell; (5) would have excluded Chang’s tunnel oxide and polysilicon layers from the solar cell periphery, but then ignored Chang’s teaching that the passivation film should be coextensive with these two backside field layers; and (6) would have attempted to use a mask. Sur-reply 14–18. But, Petitioner need not explain why a person of ordinary skill in the art would have made choices because Chang itself teaches each of these elements. *See Gen. Elec. Co.* 983 F.3d at 1352. Patent Owner relies on *Virtek Vision Int’l ULC v. Assembly Guidance Sys., Inc.*, but this case does not hold that motivation is required to combine elements found within a single reference. 97 F.4th 882, 888 (Fed. Cir. 2024). As the Federal Circuit explained, motivation is required when combining elements from different prior art references. *Gen. Elec. Co.* 983 F.3d at 1352. Combining elements of a claim present together in a reference “unduly dissects

prior art references into collections of individual elements, requiring a party showing obviousness to re-do the work already done in the prior art reference. *Id.* Further, Chang discloses excluding layers from a “periphery region” or “isolation portion,” but does not specifically define “periphery region” or “isolation portion.” See Ex. 1013 ¶¶ 56, 62. We credit Dr. Banerjee’s testimony that the skilled artisan would have understood that

Chang’s “periphery region” refers to the solar cell/substrate’s perimeter or edge portion, as seen for example in peripheral white space of Figure 3 of the 104 Patent. Thus, the Skilled Artisan would understand that the electrically isolated region (or “isolation region”) where the tunneling layer 44 and back surface field are not formed is in the “edge portion” of the substrate, just as in Figure 3 of the 104 Patent. *Id.* And since the tunneling layer 44 in Chang formed on the back surface of the substrate, and the back surface field 30 is formed on the tunneling layer 44, the Skilled Artisan would further understand that the isolation region in Chang is “*in an edge portion of the first surface of the silicon semiconductor substrate,*” as claimed by Claim 1 of the 104 Patent.

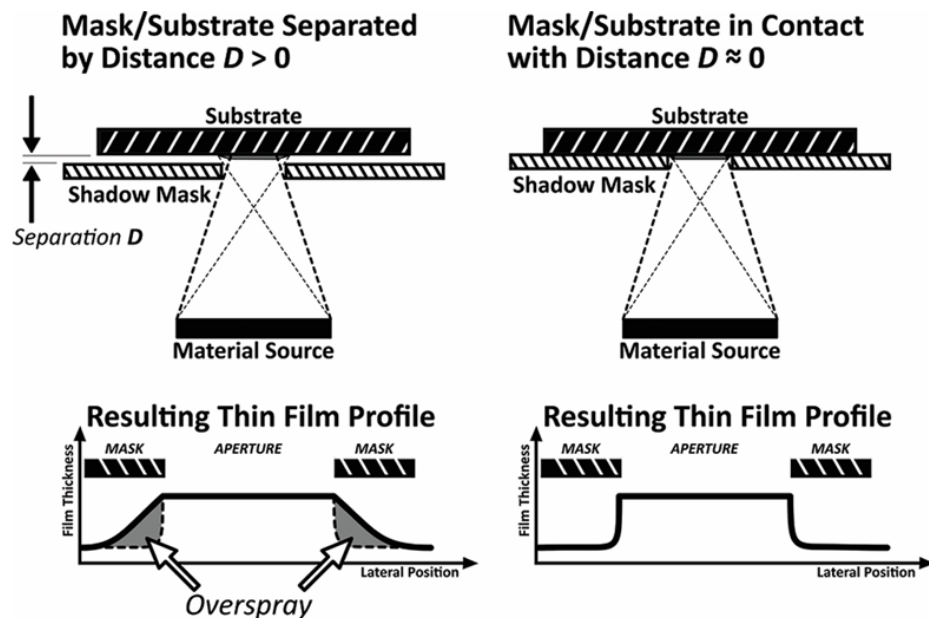
Ex. 1003 ¶ 228; Ex. 1037 ¶¶ 34–39. In addition, Petitioner and Dr. Banerjee persuasively explain that, to the extent not expressly disclosed in Chang, a person of ordinary skill in the art would have looked to Jin to understand the details of Chang’s isolation region, not to modify Chang. Pet. 50; Ex. 1003 ¶¶ 194–195. We are also persuaded by Petitioner’s argument, based on Dr. Banerjee’s testimony, that when referring to the second passivation film, Chang does not use the specifically defined term “entirely formed,” but instead describes the passivation film 31 as being formed “in a substantially entire region” excluding only the regions corresponding to the rear electrodes, but not any periphery region or isolation region. Pet. 63–64; Ex. 1003 ¶ 211. Thus, we do not agree that Chang discloses that the passivation film should be coextensive with the second tunneling

layer and the back surface field area, or that Petitioner fails to explain why this is the case.

3. *Claim 6*

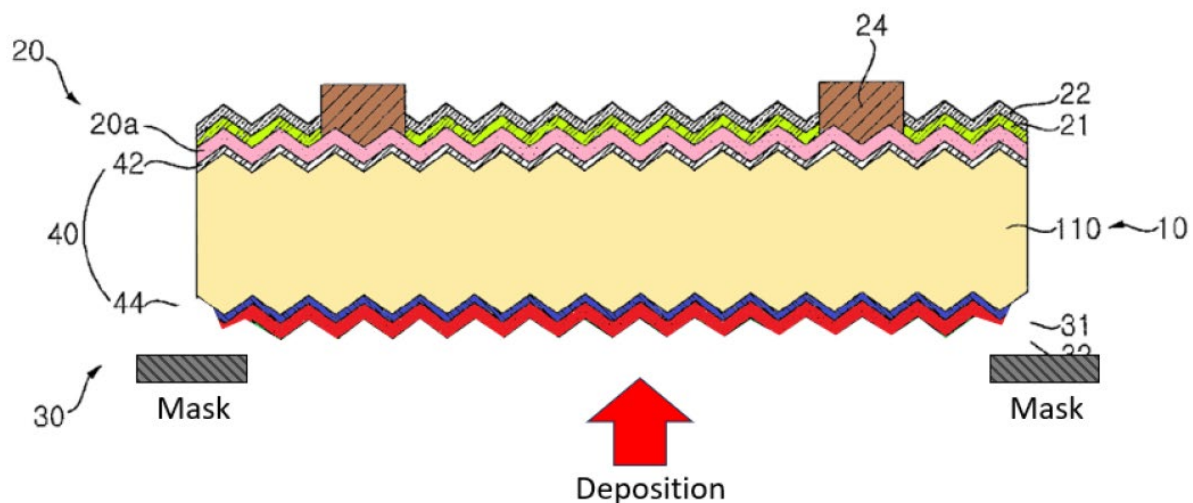
Claim 6 depends from claim 1 and further recites “wherein a thickness of the edge region in the first conductive type semiconductor region progressively decreases toward the isolation portion.” Ex. 1001, 38:52–54. Petitioner argues “[i]n the Chang/Jin combination, ‘*a thickness of the edge portion in the conductive type semiconductor region progressively decreases toward the isolation portion.*’” Pet. 67. Petitioner contends that a common way to form Chang’s back surface field area would be to use a “shadow” mask configured like Jin’s Fig. 9, to cover the periphery of the substrate before depositing the back surface field area. *Id.* (citing Ex. 1003 ¶ 243 (citing Ex. 1031 §§ 1–2)). According to Petitioner, this process would result in ““overspray””—small amounts of polysilicon that deposit beneath the edge of the mask—resulting in a taper of the polysilicon as depicted below,” and this phenomenon was well known to the prior art. Pet. 67–68 (citing Ex. 1003 ¶¶ 243–247). Petitioner includes the following figure reproduced from Decker.¹⁰ Pet. 67–68.

¹⁰ Decker, et al., *Novel Low Pressure Sputtering Source and Improved Vacuum Deposition of Small Patterned Features Using Precision Shadow Masks*, Society of Vacuum Coaters 59th Annual Technical Conference Proceedings 95 (May 2016).



Ex. 1032, Fig. 4. Decker Figure 4 shows a thin film height profile for deposition with shadow mask separated by a distance D from substrate (left) and shadow mask in close contact with substrate (right). Ex. 1032, 97.

Petitioner argues that a person of ordinary skill in the art would have found it obvious that the base surface field area in Chang, in view of Jin, would have decreased in thickness toward Chang's periphery isolation region. Pet. 68. Petitioner provides a revision of Chang Figure 1 to illustrate its point.

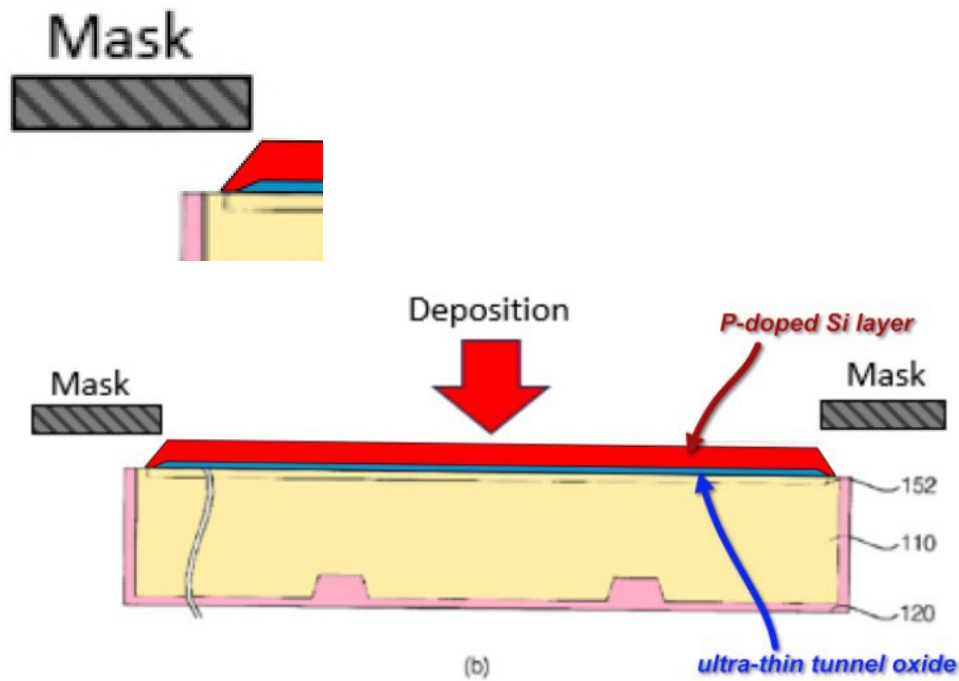


Ex. 1013, Fig. 1. Petitioner’s revision of Chang Figure 1 shows a mask positioned over the back surface of the substrate and deposition of a tunneling layer (blue), then a back surface field area (red). *See* Ex. 1013 ¶ 36. In Petitioner’s revision of Chang Figure 1, the deposited layers decrease in thickness toward the peripheral region as a result of the mask.

Patent Owner argues that the combination of Chang and Jin fails to teach “thickness of the edge portion in the polysilicon” that “progressively decreases toward the isolation portion.” PO Resp. 46–47. Patent Owner argues that “Jin explains that the mask shown in Figure 9 ‘covers or overlaps a distance T measured from the edge part of the rear surface of the substrate 110.’” PO Resp. 46 (citing *id.* at 40; Ex. 1009 ¶ 85). Patent Owner further argues that “[b]ecause the mask ‘covers’ Jin’s gap (or distance) T, to the extent there is any tapering of polysilicon as alleged by the Petition, the tapered polysilicon will be present *within* the gap T.” PO Resp. 40. Patent Owner contends that tapered polysilicon within Jin’s gap (or distance) T does not “*progressively decrease toward the isolation portion,*” and does not satisfy claim 1’s requirement that the “*polysilicon layer*” be “*exclude[d]*” from the “*isolation portion,*” which means that there be no polysilicon within the isolation portion at all and the polysilicon progressively decrease as it gets closer to the bounds of the isolation portion. PO Resp. 40. Patent Owner argues that Petitioner’s version extends the polysilicon layer into the isolation portion. PO Resp. 40.

In its Reply, Petitioner argues that Patent Owner’s arguments attempt to redefine or misapply the claimed isolation portion. Pet. Reply 20 (citing *id.* at 13). Petitioner argues that the ’104 patent defines the isolation portion as the region where *both* the polysilicon layer and the underlying tunnel layer are absent. Pet. Reply 13 (citing Ex. 1001, Fig. 2, 13:10–16 (defining “isolation portion I” as the

region “in which the tunnel layer 160 and the first conductive type semiconductor region 170 . . . are not formed”). Petitioner contends that the isolation portion “does not include the region where the polysilicon thickness decreases.” Pet. Reply 14 (citing Ex. 1001, Fig. 2). “Nor is the “*isolation portion*” defined by the width of the mask used to create the isolation gap” (Pet. Reply 14), as supported by Patent Owner’s own illustration of the “more likely result” of the polysilicon overspray using Jin’s mask, showing that even when the polysilicon tapers, there is still a gap/isolation region where both the polysilicon and the tunnel oxide are absent. Pet. Reply 14 (citing PO Resp. 35). Petitioner provides the following version of Jin Figure 9(b), revised to show a mask and the effects of the mask.



Ex. 1009, Fig. 9(b) (modified). Modified Jin Figure 9(b) shows that by using a mask to cover or overlap the edge part of the rear surface of substrate 110, fourth area 152 of back surface field layer 150 is formed. Ex. 1009 ¶ 83. Petitioner revised Figure 9(b) to add tunneling layer (blue) and a back surface field layer.

Pet. Reply 15. According to Petitioner, the gap is what prevents contact between the polysilicon (red) and the oppositely doped diffused region (pink) on the substrate's lateral sides, and thus satisfies the claimed isolation portion. Pet.

Reply 15. Further according to Petitioner, the polysilicon thickness is shown to progressively decrease toward this gap or isolation portion where both polysilicon and tunnel oxide are absent. Pet. Reply 15.

Patent Owner in its Sur-reply argues that “Petitioner does not dispute that a solar cell's layers will form in the manner discussed in the Response (with polysilicon accumulating under the mask and on the substrate surface in what the Petition labeled as the ‘isolation portion’),” but instead in the Reply “abandons its original argument and proceeds to identify a different portion of the solar cell as the claimed ‘isolation portion.’” Sur-reply 20. According to Patent Owner, “Petitioner posits that the claimed ‘isolation portion’ is now just whatever substrate area remains uncovered by polysilicon.” Sur-reply 20. (citing Pet. Reply 13–16). Patent Owner contends that “[t]his change in position was improper,” characterizing Petitioner's position as a “new invalidity argument[] in reply.” Sur-reply 20.

Patent Owner further argues that Petitioner's new arguments are substantively deficient, in that the claims require an isolation portion, not just an area where both tunnel oxide and polysilicon are absent. Sur-reply 20–21. Patent Owner criticizes Petitioner for failure to provide a discussion of how far apart the polysilicon is from adjacent conductive structure, or whether this separation is sufficient to effect “isolation.” Sur-reply 21. Patent Owner asserts that “[s]imply labeling structure an ‘isolation portion’ with no other explanation—which is all Petitioner does—falls well short of the required showing.” Sur-reply 21.

We are persuaded by Petitioner’s showing that the combination of Jin and Chang suggest a tapering of the of the polysilicon layer as meets the isolation region. The ’104 patent describes the “isolation portion” as excluding the tunnel layer and the conductive type semiconductor region. Ex. 1001, 2:24–30. Petitioner provides evidence in the form of Decker (Ex. 1032, 97), Okuyama¹¹ (Ex. 1033, 2890), and Dr. Banerjee’s testimony (Ex. 1003 ¶¶ 159–163) to explain how the use of a shadow mask would result in a tapering of the back surface field area material at the edges of the mask through a process called “overspray,” and how far the overspray reaches depends on how far away from the surface the mask is located. Pet. 67–69.

Patent Owner’s contention that the overspray would result in polysilicon encroaching on the isolation region, “[b]ecause the mask ‘covers’ Jin’s gap (or distance) T, to the extent there is any tapering of polysilicon as alleged by the Petition, the tapered polysilicon will be present *within* the gap T” is unpersuasive. PO Resp. 40 (citing Ex. 2001 ¶ 261). Patent Owner’s position depends on limiting the isolation region to the area under a mask *when the mask in direct contact with the masked-off surface*. See, e.g., Ex. 1032, 97 and Ex. 1033, 2890. However, nothing in the record other than Dr. Peckerar’s unsupported testimony (Ex. 2001 ¶ 261) suggests that this is the case.

We do not agree with Patent Owner’s contention that Petitioner’s Reply identifies a different portion of the solar cell as the claimed isolation region. See Sur-reply 20. Petitioner discussed overspray in the Petition. See Pet. 71–73 (citing Ex. 1003 ¶ 258–264); see Ex. 1032, 97 and Ex. 1033, 2890. We find no difference

¹¹ Okuyama, et al., *Position-selective Growth of Carbon Nanotubes on Ni Catalysts/Mo Underlayers by Thermal Chemical Vapor Deposition*, 21 J. MATER. RES. 11, 2888 (2006).

in Petitioner's identification of the isolation region in the Petition and in the Reply. Petitioner consistently identified the isolation region the same way the '104 patent does—i.e., the portion on the periphery of the solar cell free of the tunnel oxide layer and the back surface field area material.

Based on the above analysis, on our complete review of the evidence and argument of record, we determine that Petitioner has shown by a preponderance of the evidence that claim 6 is unpatentable under 35 U.S.C. § 103(a) over Chang in view of Jin.

* * *

Therefore, based on our complete review of the parties' arguments and consideration of the evidence presented, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–11 would have been rendered obvious over Chang in view of Jin.

III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that the subject matter of claims 1–11 is unpatentable.¹²

In summary:

¹² Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding after this decision issues, we draw Patent Owner's attention to the April 2019 Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. §§ 42.8(a)(3), (b)(2).

Claim(s) Challenged	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–6, 9, 10	103	Jin, Feldmann		1–6, 9, 10
1–6, 9, 10	103	Chang, Jin	1–6, 9, 10	
7, 8	103	Jin, Feldmann, Seo		7, 8
7, 8	103	Chang, Jin, Seo	7, 8	
11	103	Jin, Feldmann, Watabe		11
11	103	Chang, Jin, Watabe	11	
Overall Outcome			1–11	

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–11 of U.S. Patent No. 9,722,104 B2 are unpatentable; 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.

IPR2025-00007
Patent 9,722,104 B2

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