

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RUNERGY USA INC. AND RUNERGY ALABAMA INC.

Petitioners,¹

v.

TRINA SOLAR CO., LTD.

Patent Owner.

Inter Partes Review No. 2025-00006

Patent No. 10,230,009

PETITIONERS' REPLY TO PATENT OWNER RESPONSE

¹ Mundra Solar PV Ltd. and Adani Solar USA Inc. were joined as petitioners in this proceeding based on a petition and motion for joinder filed in IPR2025-00187, which was granted.

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I. INTRODUCTION

Patent Owner's (PO's) response provides no reason for the Board to depart from its Institution Decision (ID) concluding that Petitioner's prior art combinations render all claims obvious. PO repeats many of the same arguments from its preliminary response that the ID already rejected, focusing almost exclusively on the "*isolation portion*" limitation. For Petitioner's Chang/Jin combination, the ID correctly found that Chang discloses an "*isolation portion*" at the periphery of the substrate's back side. Without acknowledging or addressing the ID's dismissal of PO's misreading of Chang's paragraph 76, PO repeats the same rejected arguments. For Petitioner's Jin/Feldmann combination, rather than confronting the actual combination asserted in the Petition, PO sets up strawmen arguments, attacking "alternative" combinations that PO conjures, or else attacking the references individually without considering the combination as a whole. The Board should reject these arguments and find all claims of the 009 Patent unpatentable.

II. THE CHANG/JIN COMBINATIONS RENDER OBVIOUS ALL CLAIMS

PO's arguments focus on Chang's alleged non-disclosure of an "*isolation portion*" "*in an edge portion*" of the substrate "*for preventing a contact between the polysilicon layer and the emitter region.*" POR, 40. But in the ID, the Board rejected the same arguments that PO now repeats. ID, 26-28 ("We are also

persuaded that Petitioner adequately shows that Chang describes an isolation region” “synonymous with the claimed ‘*isolation portion*’”). PO presents no reason why the Board should reach a different conclusion here.

Contrary to PO's assertion that none of the prior art teaches a TOPCon cell with the claimed “*isolation portion*,” Chang discloses both. First, PO's expert admits that Chang discloses “a TOPCon solar cell,” i.e., a cell with a tunnel oxide layer and overlying polysilicon conductive layer. EX2001, ¶¶288, 44-47. Second, Chang discloses the claimed “*isolation portion*,” albeit in the specification, even if not depicted in the figures. Indeed, PO admits that “Chang does reference that its front and backside layers could potentially be omitted from an ‘inevitably’ formed ‘isolation region or the like.’” POR, 3. PO's dispute is that Chang's isolation region—described as being in a backside “periphery region”—is not shown in Chang's figures. *Id.* But there is no requirement that a prior art feature be depicted in a figure—disclosure in the patent's specification is sufficient. *See, e.g., Krippelz v. Ford Motor Co.*, 667 F.3d 1261, 1268-69 (Fed. Cir. 2012) (error for court to rely on the absence of a “conical beam of light” in a prior art drawing when it was described by the written description). And, as Jin Fig. 2 demonstrates, illustrations of solar cells like Chang's often depict only an interior portion showing the cross-sectional layers, not necessarily including the edge portion. EX1037-SupplDecl., ¶¶29-33; EX1009-Jin, ¶25, Figs. 1-3.

A. Chang Discloses the Claimed “Isolation Portion.”

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 region:

[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. [EX1013-Chang, ¶56.²]

See also EX1003, ¶210. Likewise, Chang 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 region. EX1013-Chang, ¶62; EX1003, ¶210.³

² Emphases added throughout except where noted.

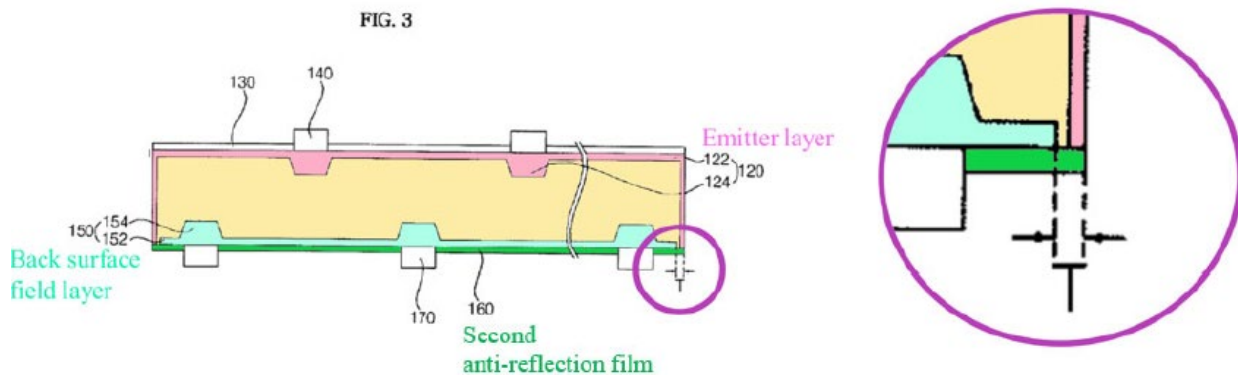
³ In a related proceeding, PO's expert testified that he was interpreting “entirely formed” in Chang “according to its ordinary definition” rather than using Chang's specific definition. EX1045, 161:13-162:3. This is legally improper, and renders PO's expert's opinions concerning Chang's teachings unreliable. See *Phillips v. AWH Corp.*, 415 F.3d 1303, 1329 (Fed. Cir. 2005) (“[T]he inventor's lexicography governs.”) (*en banc*).

In contrast, when describing the passivation film 31 over the back surface field area (BSF) 30, Chang does not use the defined term “entirely formed.” Instead, Chang describes the passivation film 31 as “***formed in a substantially entire region*** over the front surface of the back surface field area 30” excluding the electrode. *Id.*, ¶63. Thus, Chang uses the defined term “entirely formed” when intending to exclude a periphery isolation region, and “formed in a substantially entire region” when not intending to do so.

In its ID, the Board credited these statements and supporting testimony from Dr. Banerjee, stating: “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, 27. The Board also dismissed PO’s argument that Chang’s figures do not show the isolation region, noting that “[i]t is well settled that a prior art reference is relevant for all that it teaches to those of ordinary skill in the art.” ID, 28 quoting *In re Fritch*, 972 F.2d 1260, 1264 (Fed. Cir. 1992).

PO’s response does not rebut the ID’s recognition that Chang’s periphery isolation region electrically isolates Chang’s BSF 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. ID, 28; Pet., 63-66;

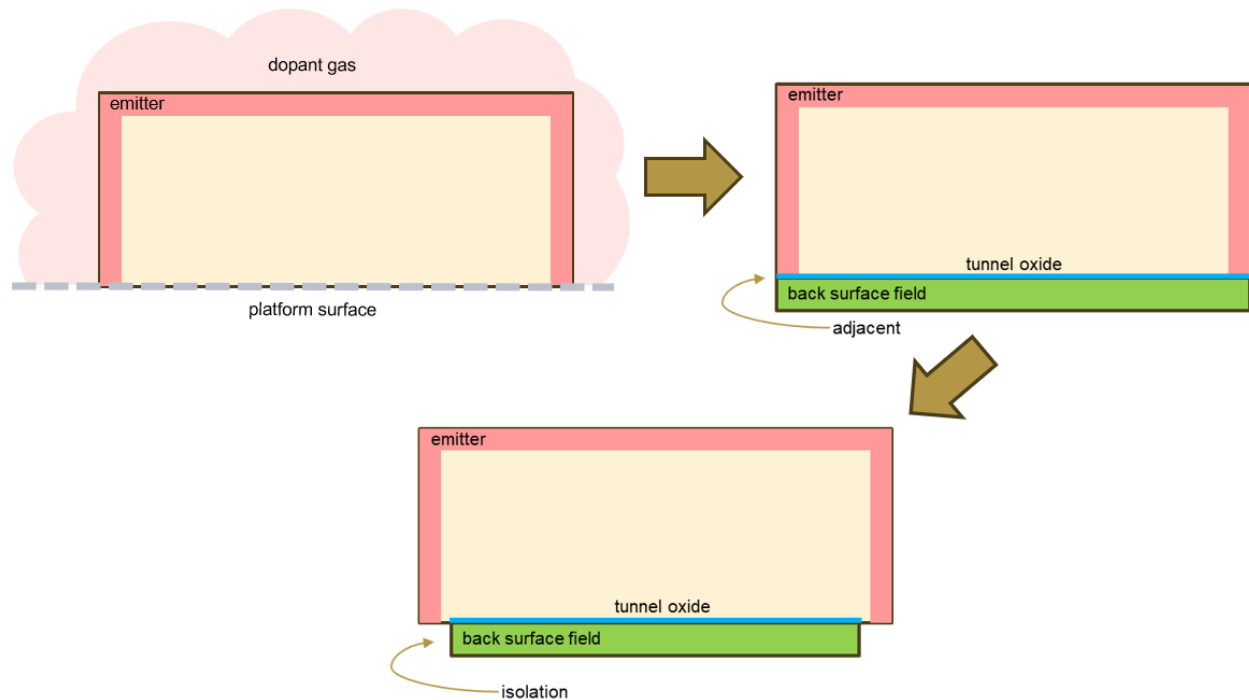
EX1003, ¶¶247-248; EX1013-Chang ¶98; EX1009-Jin ¶78; EX1001, 9:54-56. *See also*, Pet. 11-12; EX1003, ¶71 (describing thermal diffusion). Jin's Figure 3, which is a cross-section cut along line B-B' of Figure 1, explicitly shows the effects of the thermal diffusion—emitter 122 on the front as well as dopants diffusing down the lateral sides of the substrate. EX1009-Jin ¶¶13, 78, Fig. 3; EX1003, ¶71. It is this diffusion down the lateral sides of the substrate that would cause shorting with Chang's BSF 30 in the absence of Chang's periphery isolation (or Jin's gap-T). PO's response fails to rebut this.



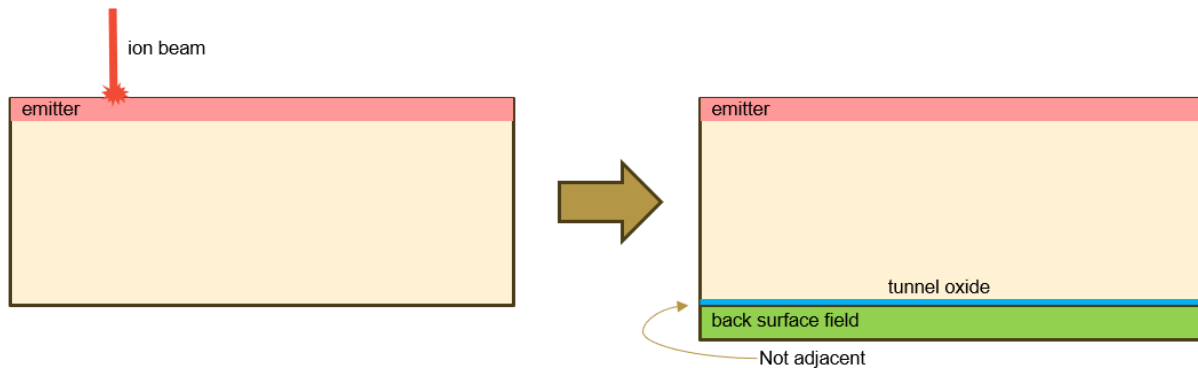
B. Chang Does Not “Eliminate” An Isolation Region Or The Need Thereof.

Unable to directly confront Chang's express teaching of a peripheral isolation region, PO simply asks the Board to ignore it. PO repeats its preliminary response argument, pointing to a single paragraph in Chang (¶76) it interprets as “eliminating” the need for any isolation at all. POR, 42-45. PO's argument fails to address the fact that paragraph 76 of Chang addresses a specific embodiment different than the one relied on by the Petition.

In particular, Chang discloses that the front emitter area 20 may be formed by thermal diffusion *or* ion implantation. EX1013-Chang, ¶98. As discussed above in §II.A, thermal diffusion results in dopants diffused down the lateral sides of the substrate. As shown below, when the tunnel oxide layer and BSF are subsequently deposited on the back side of the substrate using thermal diffusion, the BSF is “adjacent to”—and is subject to shorting to—the doped lateral sides of the emitter (second figure). EX1037-SuppDecl., ¶¶8, 25; *See also*, Pet., 11-12; EX1003, ¶71; EX1045, 150:10-20 (PO’s expert testifying that using a diffusion process “would contaminate the sidewall” of Chang). Thus, the peripheral isolation portion (third figure) of Chang and Jin’s gap-T are needed to avoid shorting, i.e., “*preventing a contact between the polysilicon layer and the emitter region.*” EX1013-Chang, ¶¶56, 61; EX1009-Jin, ¶¶58-59.



In contrast, ion implantation can advantageously “eliminate the need for edge isolation.” EX1038-Rohatgi, 5:18-21. This is because ion implantation accelerates a beam of dopants at the surface of the substrate, where they penetrate and settle an average distance into the substrate. EX1030-Streetman, 159; EX1037-SuppDecl., ¶27. Thus, doping occurs only where the beam is directed, such as the front of the substrate, *without* doping the lateral sides, and no edge isolation is needed. EX1037-SuppDecl., ¶¶27-28.



Notably, 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. EX1013-Chang, ¶76; EX1037-SuppDecl., ¶¶23-28.

Paragraph 76 deals only with certain instances, such as when ion implantation is used, and does not blanketly eliminate the need for edge isolation as the Board correctly recognized. ID, 27; *see also* EX1045, 146:20-149:12 (PO’s expert testifying that Chang ¶76 describes the ion implantation process). PO does not acknowledge or respond to this Board finding.

C. PO Is Incorrect That Chang’s Isolation Portion Is Not In the Edge Portion of the Substrate.

The Board should reject PO’s argument that Chang’s “‘isolation region or the like’ is not even *necessarily* located at the substrate edge.” POR, 43-44. PO’s argument has no merit both legally and factually.

First, it appears that PO is attempting to apply the “necessarily present” standard for inherent anticipation. *See Continental Can Co. USA v. Monsanto Co.*, 945 F.2d, 1264, 1268 (Fed. Cir. 1991). But Petitioner’s challenge is not based on inherency, it is based on express disclosure in Chang and obviousness in the combination of Chang and Jin. For the former, the Petition and Dr. Banerjee explained that the Skilled Artisan would understand Chang’s express disclosure to refer to a backside peripheral isolation portion. Pet., 64; EX1003-Decl., ¶¶244-245. For the latter, all that is required is that it would be obvious for the isolation region in Chang to be at the backside edge portion of the substrate in view of Jin, whose gap-T region is at the very edge.

Second, PO’s argument is that Chang does not “preclude” isolation that is not at the very edge of the substrate. POR, 44. Neither PO nor its expert argue that Chang in combination with Jin does not disclose an isolation portion at the periphery of the substrate. As the ID noted, Petitioner’s 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., 62-66; EX1003-Decl., ¶¶240-246.

PO further argues that a POSITA would have no reason to apply Jin’s gap-T to Chang because Jin’s gap-T only applies to solar cells in which the backside is formed by doping rather than deposition. POR, 44. As discussed above in §§II.A

and II.B, 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. PO's arguments are simply a rehash of Chang's paragraph 76, which, as explained in §II.B above, does not obviate an isolation portion in embodiments where the emitter is formed by thermal diffusion.

D. PO's Argument About Front and Back Periphery Regions Attacks an Embodiment Not Relied On By the Petition.

PO's argument (that the peripheral isolation region does not "*prevent a contact*" between the emitter and BSF because there is peripheral isolation of *both* the emitter on the front side and the BSF on the back side) fails for the obvious reason that Chang discloses that the isolation region on the front surface is optional. EX1013-Chang, ¶51 ("the first portion 20a of the emitter area 20 may be entirely formed..."). The Petition does not rely on embodiments in Chang that have a front isolation region. *See* Pet. 54 (depicting combination with an isolation region on the backside only). In the proposed combination, without the peripheral isolation region on the back side, the BSF would electrically contact and short with the emitter diffusion down the lateral sides of the substrate. Pet., 63-64, EX1003, ¶¶241-243, 247-248.

E. Chang Excludes the Tunnel Oxide From the Isolation Portion.

Chang's express teaching to exclude the tunnel oxide at the periphery/edge portion flatly dispels PO's argument that there would be no reason to exclude the tunnel oxide in the edge portion in Chang. POR, 45; EX1013, ¶56 ("entirely formed" definition applies to the tunneling layer 44). When a prior art reference discloses the claimed limitation, there is no requirement for finding a reason or motivation to include that limitation. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1372-73 (Fed. Cir. 2019); *see also* ID, 26 ("Petitioner reaches to Jin, not to supply a missing limitation, but rather to further detail what is already described in Chang.").

If, as PO contends, excluding the tunnel oxide from the periphery is "unnecessary," "non-sensical," and gives rise to "manufacturing difficulties and device performance issues" (POR, 45), PO and its expert do not and cannot explain why **both** Chang and the 009 Patent similarly disclose not having the tunnel oxide present in the substrate's edge portion. Indeed, if PO's arguments are accepted, the 009 Patent would suffer from the same "unnecessary," "non-sensical" "manufacturing difficulties and device performance issues" that PO argues would occur in Chang. For example, the 009 Patent discloses that its passivation film 190A is made from a nearly identical list of materials (including a "silicon oxide film") that PO claims would render Chang's disclosure non-sensical. *Compare*

EX1001, 11:34-40 *with* EX1013-Chang, ¶65. Jin also discloses nearly the same list. EX1009-Jin, ¶50. The lack of unexpected results evinces that the 009 Patent is simply following what was already known in the art in Chang or Jin, rather than coming up with something novel and inventive.

Moreover, PO and its expert are wrong to claim that it is unnecessary to exclude the tunnel oxide because the “tunnel oxide ... is an insulator.” POR, 25; EX2001, ¶296. By definition, 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. EX1037-SuppDecl., ¶5; EX1045, 182:8-17 (PO's expert testifying that “clearly current has to flow through the [tunnel] oxide in order to be collected to create power”). Chang expressly discloses that the “second tunneling layer 44 ... facilitates transfer of carriers through a tunneling effect” and thus is not insulating. EX1013-Chang, ¶57.

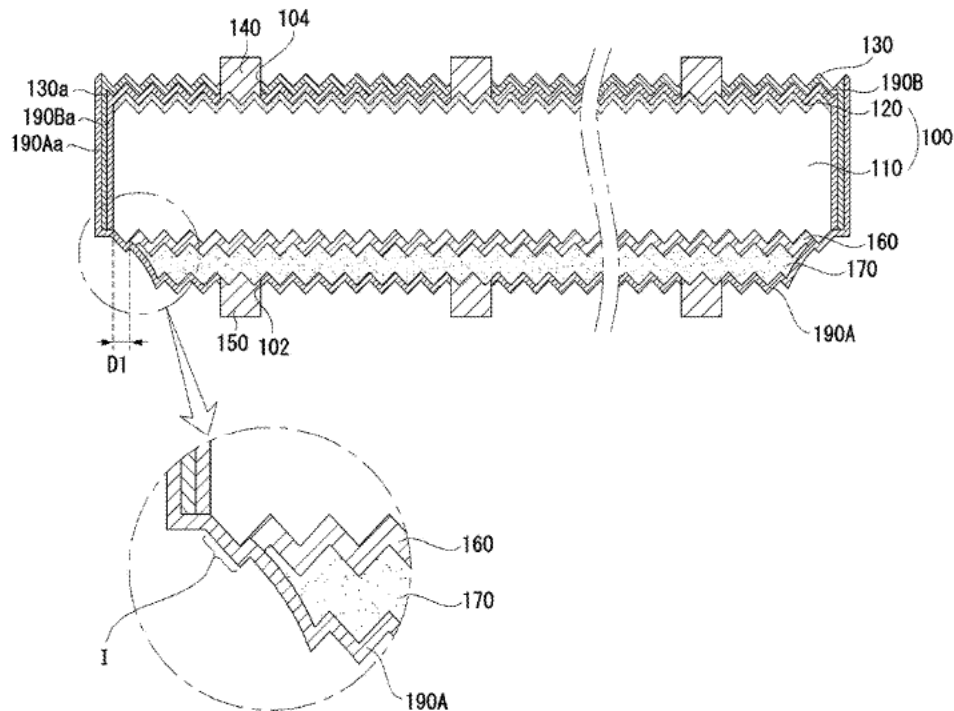
Finally, PO and its expert do not explain why the tunnel oxide “act[ing] as a diffusion barrier” would render it “unnecessary” to exclude the tunnel oxide from the edge portion. POR, 45; EX2001, ¶¶295-296. The tunnel oxide's alleged ability to block dopant diffusion does not stop shorting, which is the purpose of the isolation portion, because electrons/holes can readily transport across the tunnel oxide due to the tunneling effect, as discussed above. EX1037-SuppDecl., ¶5. Moreover, PO's expert is wrong. A tunnel oxide, which is ultrathin, is not

sufficient to block diffusion of dopants. EX1013-Chang, ¶149; EX1039-Yablonovitch, 1212 (2.5-4 nm oxide allows phosphorus diffusion); EX1024-Kwark, 742 (phosphorus outdiffusion from polysilicon through oxide layer); EX1037-SuppDecl., ¶¶9-15; EX1045, 182:8-17 (PO's expert testifying that "[t]o be an effective diffusion barrier, [the oxide layer] would have to be considerably thicker than a tunnel layer").

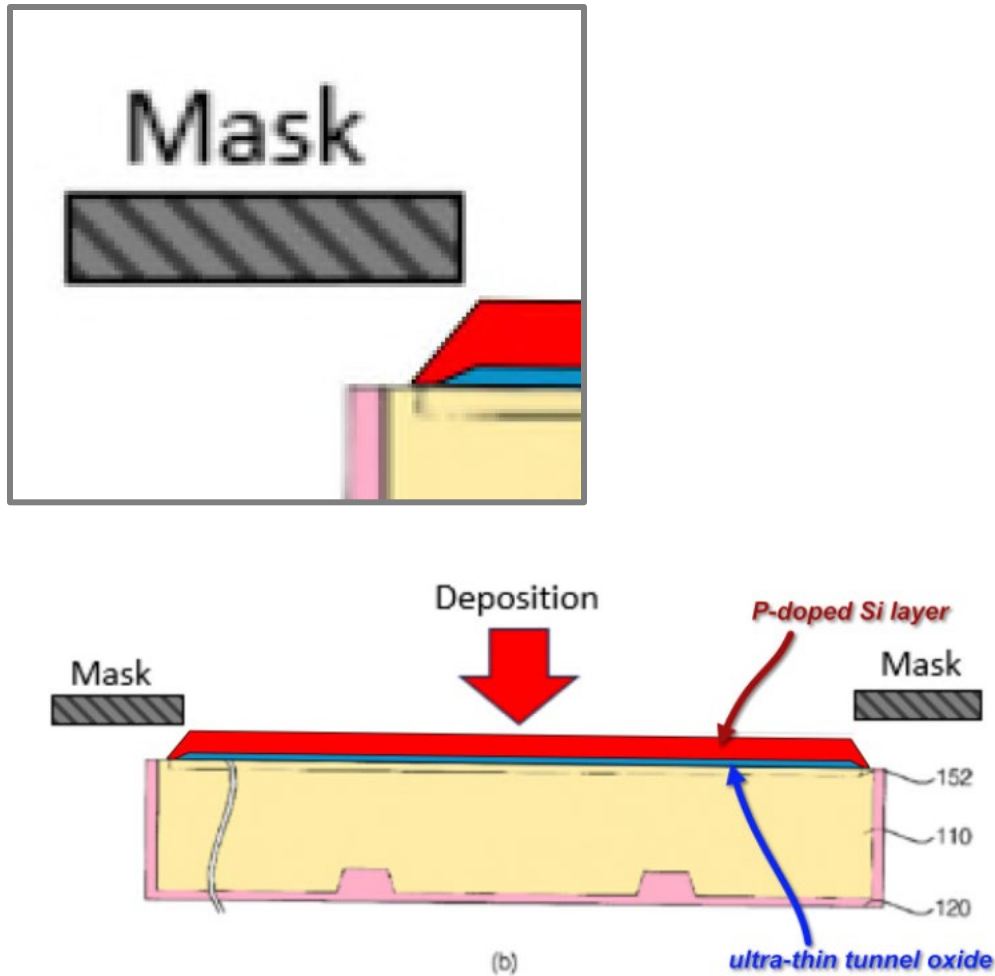
F. Chang and Jin Render Obvious Claim 8.

The Board should reject PO's argument that in the Chang/Jin combination, "the tapered polysilicon is within the gap T" and thus is not excluded from nor progressively decreases toward the "*isolation portion*." POR, 39-40, 46. This argument is meritless and is based on PO redefining or misapplying the claimed "*isolation portion*." *Id.*

The 009 Patent plainly defines the "isolation portion" as the region where ***both*** the polysilicon and underlying tunnel layer ***are absent***. EX1001, FIG 2, 7:55 (defining "I" as "isolation portion I" in 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"). *See also id.*, claim 1(j).

FIG. 2

PO misconstrues the claimed “*isolation portion*” to argue that the polysilicon “overspray” under Jin’s mask would be within the “*isolation portion*.” POR, 39-40, 46. But the “*isolation portion*” does not include the region where the polysilicon thickness decreases. EX1001, FIG. 2. Nor is the “*isolation portion*” defined by the width of the mask used to create the isolation gap. PO’s own illustration of the “more likely result” of the polysilicon overspray using Jin’s mask admittedly shows that even when the polysilicon tapers, there is still a gap/isolation region where ***both the polysilicon and the tunnel oxide are absent***. POR, 34.



This 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*." See §II.A. And the polysilicon thickness is shown to progressively decrease toward this gap or isolation portion where both polysilicon and tunnel oxide are absent. Notably, PO does not dispute that a metal mask used in depositing the polysilicon would allow small amounts of polysilicon under the mask, thereby resulting in a decreasing amount of polysilicon toward a

region where there is no tunnel oxide and polysilicon to short to the emitter. POR, 33-34.

III. THE JIN/FELDMANN COMBINATIONS RENDER OBVIOUS ALL CLAIMS

PO's arguments regarding Jin/Feldmann should be rejected as strawmen arguments. Rather than addressing the combination Petitioner proposed, PO presents its own, "alternative" combination that it posits the Skilled Artisan *would have* made from Jin and Feldmann, and then argues why PO's alternative combination fails to teach the claimed "*isolation portion*" and other limitations. Critically, the POR does not contest that the *Petition's* combination of Jin and Feldmann fails to teach any claim limitations, and admits that the Skilled Artisan would combine the references.

A. The Jin/Feldmann Combination Teaches All of Claim 1's Limitations.

Petitioner's proposed combination is straightforward. First, Jin teaches a bifacial solar cell with a traditional, in-substrate diffused BSF that is separated from the edge of the substrate's back surface by a gap-T to prevent short-circuiting between the BSF and the frontside emitter extending down the lateral sides of the substrate (because it is formed by a heat diffusion process). Pet., 17-18. Second, Feldmann taught to use a TOPCon structure—a tunnel oxide layer and doped polysilicon layer—in place of traditional diffused BSFs, because such TOPCon

BSFs “have shown excellent performance” and increased efficiency. *Id.*, 20-22; EX1012-Feldmann, 274 §3. Feldmann’s front emitter, like Jin’s, is formed by diffusion. EX1012-Feldmann, 270 §1 (disclosing “a diffused boron-doped emitter on the front side”). Thus, the emitter is subject to shorting and would benefit from Jin’s gap-T isolation. EX1003, ¶116. It would have been obvious for the Skilled Artisan to simply connect these two dots, “substituting the diffused BSF layer 150 (green) of Jin” that is separated from the substrate’s edge by a gap “with the phosphorous-doped polysilicon layer (red) of Feldmann along with the beneficial tunnel oxide layer (blue),” the result of which has all of the limitations of claim 1 and the pertinent features of Fig. 2 of the 009 Patent. Pet., 24. The Board agreed in the ID at 19-21.

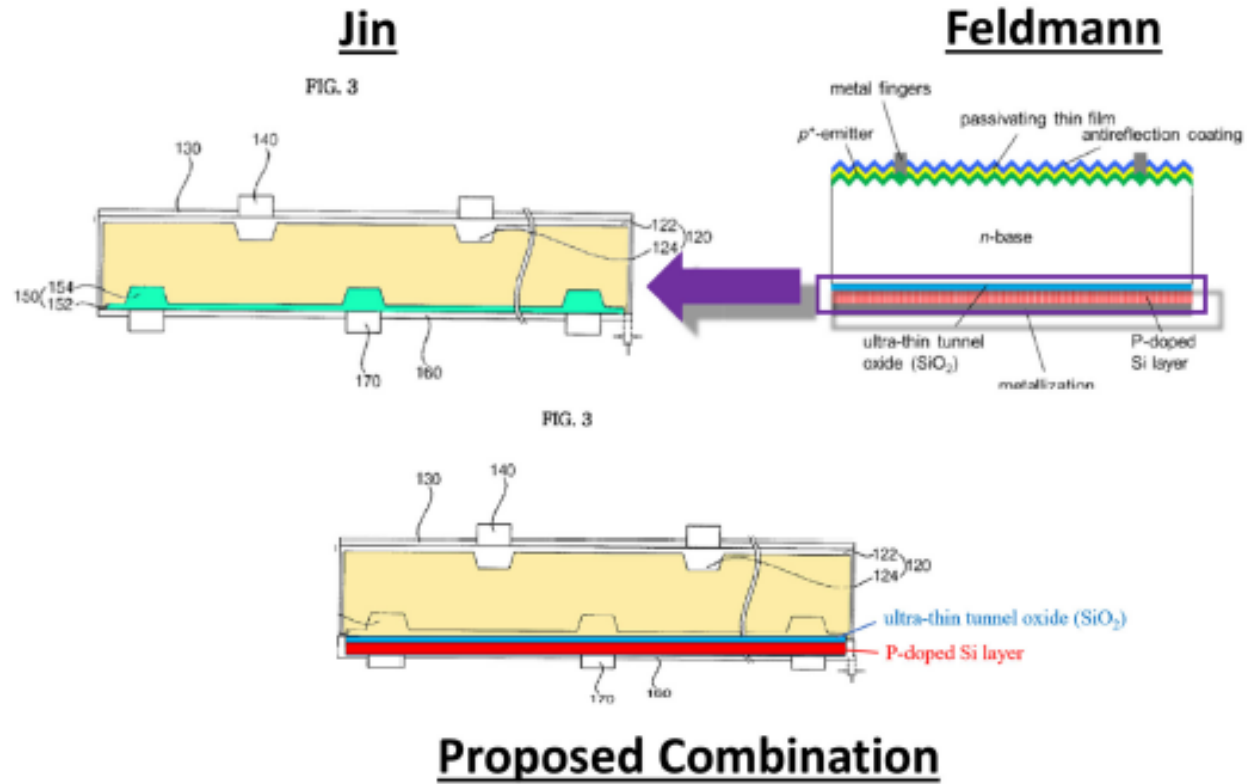
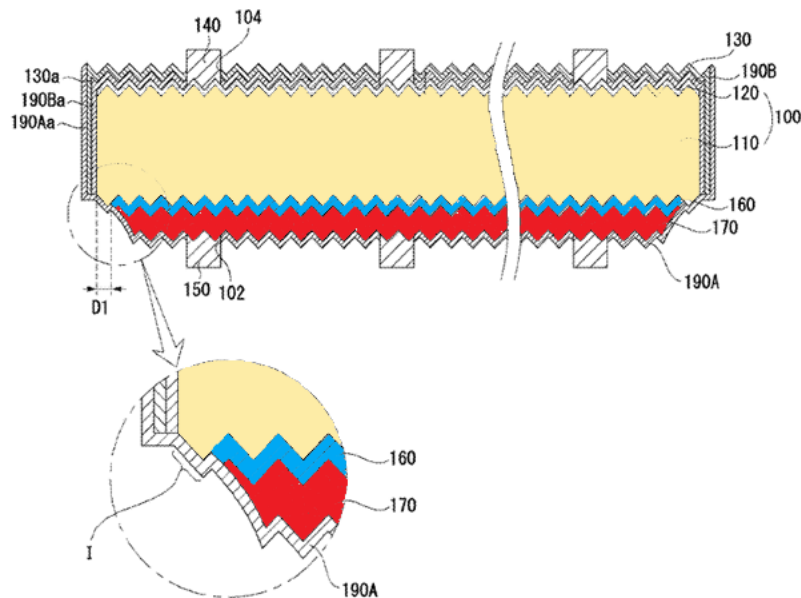


FIG. 2

**009 Patent, Fig. 2**

B. The Proposed Combination Applies a Known Technique (Feldmann's TOPCon Structure) to a Similar Device (Jin's Solar Cell) to Address a Known Problem (Recombination).

Although the POR has a ten page section (§II.C.1) purporting to explain why the Jin/Feldmann combination fails to teach the claimed “*isolation portion*,” that section is really an attack on the motivation to combine. *E.g.*, POR, 23 (“a POSITA would not have been motivated...”). But as the Petition explained, for decades before the 009 Patent, it had been known that replacing a diffused BSF with a polysilicon BSF would have improved efficiency. Pet., 14-15. It was also known that a thin oxide layer between the substrate and BSF increases efficiency by reducing electron-hole recombination in solar cells. Pet., 15. Feldmann applied both concepts together in the form of a TOPCon BSF, and the proposed combination applies that improvement to Jin's bifacial solar cell. Pet., 25-26. “There is a motivation to combine when a known technique ‘has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way[.]’” *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380-81 (Fed. Cir. 2023) (citing *KSR*).

In fact, PO admits that the Skilled Artisan *would have* combined the teachings of Jin and Feldmann, complaining only that the Petition's proposed combination is not the “most natural.” POR, 24. This argument fails on its face

because “[i]t’s not necessary to show that a combination is the best option, only that it be a suitable option.” *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 797 (Fed. Cir. 2021). In any event, PO’s assorted technical reasons why the Skilled Artisan would not have arrived at the proposed combination are wrong.

First, PO argues that the combination would not require an isolation gap-T because either (1) Feldmann’s tunnel oxide already physically separates the polysilicon BSF from the emitter, or (2) in the proposed combination, the BSF is no longer formed by doping the substrate, which obviates the need for an isolation gap-T. POR, 21-22. But as explained in the Chang discussion above, the tunnel oxide leaks current, allows dopant diffusion, and would not prevent shorting between the BSF and the emitter because electrical current can pass/tunnel through the tunnel oxide. §II.E. Feldmann expressly states that the tunnel oxide does not “hinder majority charge carrier transport across its barrier.” EX1012, §2.2, 272. Nor does the fact that the BSF is formed by depositing polysilicon on top of the substrate eliminate the problem of shorting discussed in Jin, which is caused by using thermal diffusion to form the emitter. §II.C. Like Jin and Chang, Feldmann used thermal diffusion to form the front side emitter, and thus would have the same shorting issue as Jin and Chang, as discussed in §II.A above. EX1012-Feldmann, 270 (TOPCon “offers a simple processing scheme, which is *compatible with high-temperature processes such as*

diffusion”), 271-272 (TOPCon “was implemented at the rear side of n-type silicon solar cells with a *diffused* boron-doped *emitter* (140 Ω /sq) *at the front side*”); 273 (TOPCon deposited “following emitter diffusion and drive-in anneal”); EX1037-SuppDecl., ¶40. Thus, separating the TOPCon structure from the substrate’s backside edge portion as Jin taught would improve the solar cell by preventing electrical contact between the BSF and emitter.

PO next argues that the Skilled Artisan would have “maximized the size of at least the tunnel oxide layer such that it covers the entire rear surface of Jin’s substrate.” POR, 23 (emphasis PO’s). But this argument relies on the same misunderstanding that the tunnel oxide prevents electrical contact and diffusion of dopants into the substrate (*id.*), which Petitioner has shown to be incorrect above. In any event, the fact that Chang (which came after Feldmann) expressly teaches to exclude the tunnel oxide from the isolation region belies PO’s contention. *See supra* §II.E. And PO’s argument that the tunnel oxide needs to passivate the gap-T region (POR, 23-24) also fails because, just like in claim 1, the passivation film 160 from Jin would have passivated that gap in the proposed combination, making the tunnel oxide unnecessary in that region. EX1003-Decl., ¶151. Moreover, Petitioner’s expert explained why the Skilled Artisan would *not* want to form the tunnel oxide in the isolation gap, because doing so could trap detrimental impurities. EX1003-Decl., ¶116; EX1037-SuppDecl.,

¶¶50-56.⁴ PO contends that the trapped-impurities problem would also exist in the proposed combination, but only if Jin's antireflection film 160 were made of silicon oxide (the same material as the tunnel oxide). POR, 27. However, the Petition relied only on Jin's disclosure that the antireflection film 160 functions as a passivation layer, and which Jin discloses can be of several different materials selected from nearly the same exact list as the 009 Patent's antireflection film. *See*

⁴ In his declaration here, PO's expert disputes Dr. Banerjee's explanation that the tunnel oxide could trap negative impurities, but he does so by focusing only on characteristics of "thermally grown" oxides, rather than oxides deposited via CVD or chemical treatment as discussed in the Petition. EX2001, ¶160; Pet., 27; EX1003-Decl. ¶120; EX1037-SuppDecl., ¶55. Chang discloses that tunnel oxides can be formed using CVD, which, consistent with Dr. Banerjee's explanation, further explains why Chang teaches to exclude the tunnel oxide from the isolation region. EX1037-SuppDecl., ¶55; EX1013-Chang, ¶146. Feldmann discloses an oxide layer formed by chemical treatment. EX1012, 271; EX1037-SuppDecl., ¶55. In a deposition in another proceeding given after the submission of his declaration here, PO's expert testified that he actually does not *dispute* Dr. Banerjee's explanation regarding trapped negative impurities, he simply found it speculative. EX1045, 199:2-200:16.

Pet., 32; EX1009-Jin, ¶50; EX1037-SuppDecl., ¶59-60; EX1001, 11:34-40. The POR does not contend that materials other than oxides would trap detrimental impurities, and provides no unexpected results by the 009 Patent's removal of the tunnel oxide at the edge portion and then coating with the same list of antireflection film materials as Jin. The lack of unexpected results supports the finding that the claimed invention was obvious. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) (“[W]hen a patent ‘simply arranges old elements with each performing the same function it had been known to perform’ and yields no more than one would expect from such an arrangement, the combination is obvious.”).

C. The Skilled Artisan Would Have Had Reasonable Success Making the Proposed Combination.

The Petition, supported by Petitioner's expert (who has “extensive experience in semiconductor development and fabrication including that of solar cells,” EX1003 ¶4) explains that the Skilled Artisan could implement Jin's gap-T in the combination using, *e.g.*, a shadow mask technique like the one used by Jin, though this is not the only way the process could be performed. Pet., 27; EX1003-Decl. ¶¶119-125 (explaining five different ways to create gap-T); EX1037-SuppDecl., ¶44 (explaining that thin oxide layers can be formed using a mask with low temperature CVD).

The ID already rejected many of the arguments PO repeats in its response, including that the “elements of Feldmann could not have or would not have been

incorporated into Jin successfully.” ID, 20-21. The Board should reject them again here, because obviousness does not require bodily incorporation. *Elbrus Int’l Ltd. v. Samsung Elecs. Co., Ltd.*, 738 Fed. Appx. 694, *698-99 (Fed. Cir. 2018) (rejecting argument that the proposed combination “would lead to an inoperable circuit absent significant additional design work”).

Responding to Jin’s use of a shadow mask technique to form the gap-T, PO argues that neither Feldmann nor the later TOPCon art in general taught to use masks to form the TOPCon layers. POR, 29. But PO’s criticism is myopic and irrelevant. The relevant field is not merely TOPCon art, but solar cell design generally. EX1003-Decl., ¶109; EX1001, title, 1:21-23 (identifying “Field of the Invention” broadly as “solar cell[s]”). And Petitioner adduced evidence to show that masks have been successfully used to pattern layers in solar cells. EX1031-Scherff; EX1003-Decl., ¶119.

PO counters that even in 2024 masks in TOPCon manufacture were only in the “‘idea’ phase.” POR, 30 (citing EX2007, 1). But PO’s cited article (Krieg) simply observes, similar to Dr. Banerjee’s observations, that others have had the “idea” to use mask techniques in the fabrication of TOPCon processes.

EX2007, 1.⁵ In reality, PO's criticism of the Jin/Feldmann combination pertains to *commercial* feasibility, not *technological* feasibility. *See, e.g.*, POR, 29 (masks were "not ***routinely*** used in the art"), 30 (contending mask would result in "worsening device uniformity and performance"). But the claims do not require a requisite level of uniformity or performance, they merely require a TOPCon solar cell with an isolation portion, which the proposed combination has. *See Sound View Innovations, LLC v. Hulu, LLC*, 818 Fed. Appx. 1009, 1012-13 & n.3 (Fed. Cir. 2020) (Board need not find a "certain level of practicability" when the claims do not so require). *See also*, ID, 21 ("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.").

D. The Proposed Combination Does Not Eliminate Efficiency.

PO's additional reasons why the Skilled Artisan would be purportedly unmotivated to combine Jin and Feldmann in the proposed manner fare no better. POR, 35-40. First, PO contends that the proposed combination eliminates the

⁵ The reference 7 that Krieg cites actually reports the "successful demonstration" of the patterning of deposited silicon layers. EX1040-Stöhr, 524; EX1037-SuppDecl., ¶45.

“primary” efficiency benefit taught by Jin—forming BSF 150 with areas of varying doping densities.

As Dr. Banerjee explained, Jin discloses that varying the doping density is just one of “many knobs that can be adjusted to increase efficiency of a solar cell.” EX2002, 38:7-14. And Jin is clear that the BSF 150 of the Fig. 3 embodiment identified by PO “*may*” be formed with different doping densities, not that it must be. Jin ¶¶32, 42. Jin teaches other embodiments, including Figs. 16-17, in which the BSF does not have varying doping densities and expressly discloses that the disclosed embodiments are not limited to those with the varying doping densities of Figs. 1-3. EX1009-Jin, ¶¶119-123; EX2002, 39:5-13. Although Jin’s Figs. 16-17 do not show the isolation gap-T, this does not mean that these embodiments exclude it, because Figs. 16-17 depict only the solar cell’s internal portion (that does not extend to the cell’s lateral sides and backside edge portion) in the same way as Fig. 2. EX1037-SuppDecl., ¶¶30-31 (explaining that Fig. 2 is a cross-section cut of line A-A’ from Fig. 1 showing only an internal portion, unlike Fig. 3 that is a cross-section cut along line B-B’ of Fig. 1 showing the entire width of the cell); EX1009-Jin, ¶¶12-13. Figures 2, 16, and 17 lack the wavy break line in Figure 3 that indicates its extension to the lateral sides of the solar cells. When this break line is present in the figures, the figures depict the lateral sides that show dopant diffusion down the lateral sides or presence of the isolation gap-T.

EX1009-Jin, Figs. 3, 4, 7(b), 8(b)-(c), 9(b), and 11. The Board was also unconvinced in the ID absent expert evidence that the varying doping feature of Jin was “of central importance,” and the POR failed to provide any. ID, 19; POR, 35. PO’s cited paragraphs 237-256 from Dr. Peckerar’s declaration fail to address the fact that Jin’s doping density is only an optional feature. He also did not explain why shorting would only apply to a BSF with areas of varying doping densities.

Second, PO argues that Feldmann discouraged the use of “point contacts,” instead advocating for full rear metallization. POR, 36. However, the salient question is whether the Skilled Artisan would understand that incorporating Feldmann’s TOPCon structure *into Jin* would improve *Jin’s* device. Jin (unlike Feldmann) teaches a bifacial solar cell, which receives light from both the front and back sides in order to generate even more power than a monofacial cell, and for which “[i]t does not make sense to cover up the entire backside” with reflective metal that would prevent light from entering the cell. EX2002, 42:20-43:2, 42:22-44:4; EX1003-Decl. ¶115; EX1022-Luque, 282 (“Bifacial cells are designed to collect light incident at both faces, which allows a boost in output power....”).

In addition, PO and its expert misunderstand Feldmann’s comments regarding “point contacts.” POR, 36. First, Feldmann actually says that the TOPCon approach is “[c]ontrary to point contact rear side passivation schemes *like PERL*,” (the POR omits the emphasized language). EX1012-Feldmann, 274.

“PERL” stands for “Passivated Emitter and Rear Locally diffused” cells, like the one below depicted in the Luque textbook. EX1012-Feldmann, 274; EX1022-Luque, Fig. 7.2. Point contacts are needed in PERL cells because, unlike the thin tunnel oxide in Feldmann’s TOPCon structure, the “SiO_x” oxide layer in PERL cells is too thick to allow current through. EX1003-SuppDecl. ¶¶64-66; EX1046-Benick, 3. Contact windows in the oxide layer are therefore needed to allow current through. EX1003-SuppDecl. ¶¶64-66. The asserted combinations, however, use a tunnel oxide layer like Feldmann’s that allows charge carriers to tunnel through, eliminating the need for point contacts like those in the PERL cells Feldmann criticizes. Second, point contacts are not the same as finger electrodes, like those used by Jin. *Id.*, ¶¶67-69; EX1022-Luque, Fig. 7.2 (showing long finger electrodes on top and contact windows through the SiO₂ for point contacts on the bottom). Thus, Feldmann’s criticism of point contacts in PERL cells is not a criticism of Jin’s finger electrodes, especially when combined with Feldmann’s tunnel oxide. *See* Pet., 39-40; EX1009-Jin, Fig. 3.

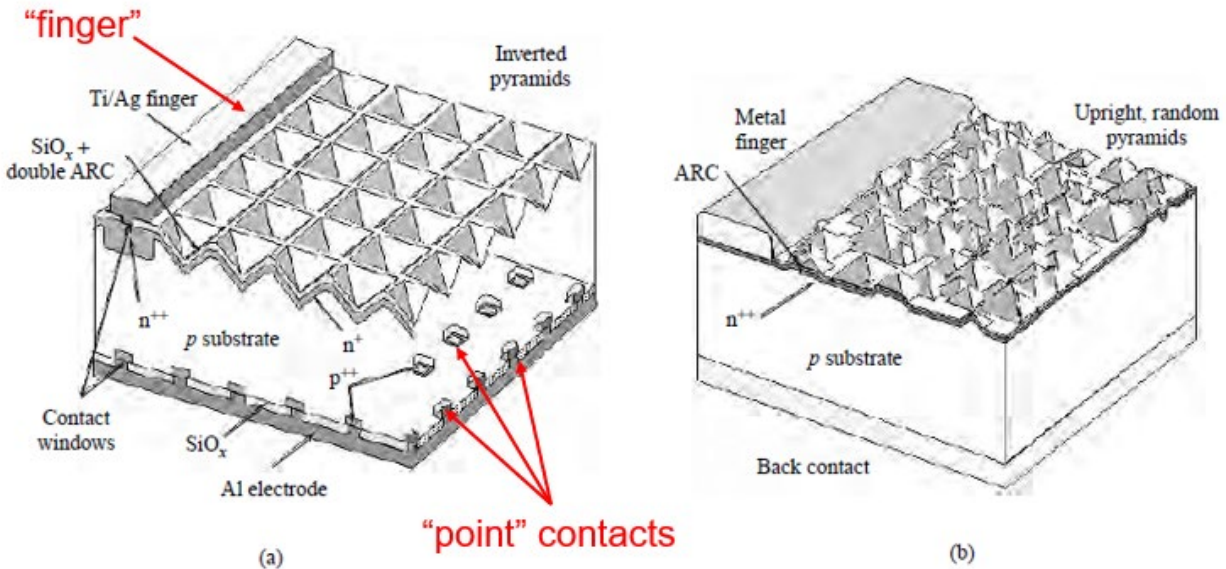


Figure 7.2 (a) Passivated emitter and rear locally diffused (PERL) cell; and (b) industrial cell with screen-printed contacts. (Not to scale)

The proposed combination therefore preserves various important features of Jin (e.g., a bifacial structure receiving sunlight from both sides, reducing shorting by employing gap-T) and further incorporates productive teachings from Feldmann (replacing conventional BSFs with a TOPCon structure) that aim to reduce recombination and increase efficiency. EX1003-SuppDecl. ¶¶71-73; EX2002, 25:12-18, 43:9-12.

Lastly, PO reprises related arguments that the Skilled Artisan would have been motivated to make other, different combinations of Jin and Feldmann than the combination proposed, POR at 37-39, which PO conclusorily asserts (without any quantitative analysis) would have been a “less efficient” design option. Again, that is not the relevant inquiry. “It’s enough for [Petitioner] to show that there was a known problem of [recombination] in the art, [and] that [Feldmann’s TOPcon

structure] helped address that issue,” whether or not the combination “was an ‘improvement’ in a categorical sense.” *PACT*, 61 F.4th at 1381. Petitioner need not show that the combination is the “best option, only that it be a suitable option.” *Intel*, 21 F.4th at 797.

E. Jin and Feldmann Render Obvious Claim 8.

PO's argument that the tapering polysilicon extends into the claimed “*isolation portion*” in the Jin/Feldmann combination fails for the same reasons discussed above in §II.F.

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CERTIFICATE OF SERVICE

I hereby certify that on this 20th day of October 2025, a copy of this Petitioner's Reply to Patent Owner's Response, including all attachments, appendices and exhibits, has been served in its entirety via electronic mail on the following counsel of record for the Patent Owner:

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CERTIFICATE OF COMPLIANCE

I hereby certify that this brief complies with the type-volume limitations of 37 C.F.R. § 42.24, because it contains 5,597 words (as determined by the Microsoft Word word-processing system used to prepare the brief), excluding the parts of the brief exempted by 37 C.F.R. § 42.24.

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