

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HANWHA SOLUTIONS CORPORATION,
Petitioner

v.

MAXEON SOLAR PTE. LTD.,
Patent Owner

Case No. IPR2024-01203
U.S. Patent No. 8,222,516

PATENT OWNER SUR-REPLY

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PATENT OWNER’S EXHIBIT LIST

Exhibit No.	Description
2001	<i>Intentionally Left Blank</i>
2002	<i>Intentionally Left Blank</i>
2003	Gan, Jon-Yiew, Polysilicon emitters for silicon concentrator solar cells, Stanford University (July 1990) (“Gan Thesis”)
2004	<i>Intentionally Left Blank</i>
2005	<i>Intentionally Left Blank</i>
2006	Federal Court Management Statistics (June 30, 2024)
2007	<i>Intentionally Left Blank</i>
2008	<i>Intentionally Left Blank</i>
2009	Invalidity Contentions, <i>Maxeon Solar Pte. Ltd. v. Canadian Solar, Inc.</i> , Case No. 2:24-cv-00210-JRG (E.D. Tex. Sept. 6, 2024).
2010	Feldman, et al., “A Passivated Rear Contact for High-Efficiency n-Type Silicon Solar Cells Enabling High VocS and FF > 82%” (28th European PV Solar Energy Conference & Exhibition, Paris, Sept. 30 – Oct. 4, 2013) (“Feldman”)
2011	Chieh-Wa Tsai, et. al, <i>Patent Analysis of High Efficiency Tunneling Oxide Passivated Contact Solar Cells</i> , 13 <i>Energies</i> 3060 (2020)
2012	File History of U.S. Patent No. 8,222,516
2013	<i>Intentionally Left Blank</i>
2014	<i>Intentionally Left Blank</i>
2015	<i>Intentionally Left Blank</i>
2016	<i>Intentionally Left Blank</i>
2017	<i>Intentionally Left Blank</i>

Exhibit No.	Description
2018	<i>Intentionally Left Blank</i>
2019	U.S. Patent no. 8,222,516 to Cousins
2020	<i>Intentionally Left Blank</i>
2021	Docket Sheet, <i>Maxeon Solar Pte. Ltd. v. Canadian Solar, Inc.</i> , Case No. 2:24-cv-00210-JRG (E.D. Tex.)
2022	Docket Sheet, <i>Maxeon Solar Pte. Ltd. v. Hanwha Solutions Corp.</i> , Case No. 2:24-cv-00262-JRG (E.D. Tex.)
2023	Docket Sheet, <i>Maxeon Solar Pte. Ltd. v. REC Solar Holdings AS</i> , Case No. 2:24-cv-00260-JRG (E.D. Tex.)
2024	Counterclaims, <i>Maxeon Solar Pte. Ltd. v. Hanwha Solutions Corp.</i> , Case No. 2:24-cv-00262-JRG (E.D. Tex. Nov. 15, 2024)
2025	IPR2024-01040 Petition
2026	Declaration of Mary K. Bolin
2027	Declaration of Douglas Ruby, Ph.D.
2028	Curriculum Vitae of Douglas Ruby, Ph.D.
2029	Transcript of Deposition of Petitioner's Expert Zachary Holman, Ph.D. (May 8, 2025)

I. INTRODUCTION

Patent Owner submits its Sur-Reply to Petitioner's Reply (Paper 37, "Reply") to Patent Owner's Response (Paper 29, "POR").

II. PETITIONER'S REPLY IS REplete WITH MISCHARACTERIZATIONS AND DISTRACTIONS

Petitioner opens with a red herring—that Patent Owner's expert, Dr. Ruby, applied the wrong legal standard because he allegedly "believed the probability of success must be 'close to 100 percent.'" Reply, 3. This is not Dr. Ruby's testimony. Ex. 1075, 165:22-166:8. Rather, Dr. Ruby emphasized at least three times that he was not familiar with legal terminology and only provided his understanding of "the plain English meaning" of the term "reasonable expectation of success." Ex. 1075, 165:22-166:1 (emphasis added).

Nor is Dr. Ruby's testimony at odds with the legal standard. *See, e.g.*, Ex. 2027, ¶¶18-20 (describing the legal standard of obviousness applied in Patent Owner's expert's declaration). "[C]lose to 100 percent" does not require "conclusive proof" or "absolute predictability," as Petitioner would have the Board believe. Reply, 3.

III. PETITIONER'S OBVIOUSNESS THEORIES ARE UNSOUND

Petitioner's obviousness theories rest on selective readings of the prior art and mischaracterizations of the record. As explained below, Petitioner's references disclose inconsistent, unreliable, or narrowly applicable teachings that undercut

Petitioner's theories, while Petitioner repeatedly overlooks these shortcomings in favor of speculation and hindsight.

A. Petitioner's Theory Based on Froitzheim and Gan Is Unsound

The Gan Thesis documents repeated failures and reliability concerns that would have discouraged a POSITA from modifying Froitzheim with Gan.

Petitioner's attempt to explain those failures and concerns away is futile.

Equally futile is Petitioner's contention that Gan's oxide layer was a "known" element in related industries. The core dispute is whether a POSITA would have been able to implement such an oxide layer specifically in solar cells—something no prior art reference has documented with enough reliability to lead to a reasonable expectation of success.

Petitioner also relies on false expert statements. For example, the introductory paragraph under Section III of the Reply cites paragraph 20 of the declaration, which states "Dr. Ruby also does not dispute that a POSITA would have been motivated to combine the teachings of Froitzheim and Gan." Ex. 1077, ¶20 (citing Ex. 2027, ¶¶ 164-80). Paragraphs 164 and 175 of Dr. Ruby's

declaration in fact states “[i]n my opinion, a POSITA would not have combined Froitzheim and Gan,” and paragraphs 165 to 174 explain why.¹

1. The Gan Thesis Would Have Discouraged a POSITA from Attempting Gan

Petitioner provides no context to overcome the Gan Thesis’s record of repeated failure to reliably implement Gan’s polysilicon emitter and oxide layer structure. Reply, 8.

First, the Gan Thesis’s background on polysilicon emitters and interfacial oxides focuses on “silicon bipolar [transistor] technology” (i.e., integrated circuits), *see, e.g.*, Ex. 2003, 24, not solar cells as Petitioner mischaracterizes, Reply, 8 (citing Ex. 2003, 10, 24-48). This discussion may have sparked curiosity, but it alone would not have motivated a POSITA. *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Pat. Litig.*, 676 F.3d 1063, 1070 (Fed. Cir. 2012) (“While it may have been obvious to experiment with the use of the same PK profile when contemplating an extended-release formulation, there is nothing to indicate that a skilled artisan would have had a reasonable expectation that such an experiment would succeed in being therapeutically effective.”); *In re Kubin*, 561

¹ The fact that Dr. Ruby did not read the entire Gan Thesis is another red herring. Reply, 7, n. 3. The Gan Thesis is 120 pages long and much of it is not relevant to Dr. Ruby’s analysis.

F.3d 1351, 1359 (Fed. Cir. 2009) (citations omitted) (outlining “two classes of situations where ‘obvious to try’ is erroneously equated with obviousness under §103,” one of which occurs “where what was ‘obvious to try’ was to explore a new technology or general approach that seemed to be a promising field of experimentation, where the prior art gave only general guidance as to the particular form of the claimed invention or how to achieve it.”).

In fact, the pages of the Gan Thesis that Petitioner cites would have discouraged a POSITA from implementation. Ex. 2003, 24, 34, 46, 48 (repeatedly stating that the J_o of a polysilicon SIS emitter is too high for concentrator solar cells). Petitioner also has not shown that Gan’s J_o value would have been better than Froitzheim’s J_o value, and thus, has not shown why a POSITA would have looked to Gan for improvement.

Second, the Gan Thesis may have achieved low J_o and ρ_c sporadically, but not consistently or even predictably. POR, 30-34. This inconsistency would have deterred a POSITA. Ex. 2027, ¶¶165, 175. A POSITA would not have been motivated to implement a structure if he or she could not determine, from one cell to the next, the specific J_o values that would be achieved. Ex. 2027, ¶175. The Gan Thesis summarizes this in its “Conclusions” chapter, where it states on one hand that “polysilicon emitters with both low J_o and ρ_c can be obtained,” which is achieved by breaking the interfacial oxide “by only a very small fraction,” Ex.

2003, 118, but on the other hand that the oxide breakup “depends critically on the interfacial oxide thickness,” for which the “thin-oxide growth recipe used in this work was not reliable” and “a more reliable way of growing the thin oxide is needed,” *id.*, 119. Thus, a POSITA would have known that, based on the Gan Thesis, Gan’s fabrication of the oxide layer would not have been reliable. Ex. 1075, 60:21-61:4 (Patent Owner’s expert testifying that quality control was an important aspect of designing solar cells due to reproducibility—“you need to start with the same conditions in order to achieve the same results”).

Third, Petitioner mischaracterizes the Gan Thesis as “offer[ing] a solution,” Reply, 9-10 (citing Ex. 2003, 112), when the Gan Thesis merely considered an unproven assumption: “[I]t appears that the variation of the oxide thickness results mainly from the oxide-growth step. If this is the case, it is possible that the thin oxide growth can be improved by . . .” Ex. 2003, 112. This is at best speculation; the record makes clear that a reliable solution eluded Gan.

2. *A POSITA Would Not Have Known How to Implement Gan’s Structure in Froitzheim’s Solar Cell*

Petitioner’s focus on the use of tunnel oxides in the transistor and semiconductor industries highlights the weakness of its arguments on the feasibility of combining tunnel oxides with a polysilicon emitter in a solar cell. To that end, Petitioner’s mere suggestion that “a POSITA would have readily reconciled the teachings of Gan and Froitzheim regarding processing

temperatures,” Reply, 3-4, or other missing components or variables for that matter, is not sufficient to show an expectation of success. *Grunenthal GMBH v. Alkem Lab'ys Ltd.*, 919 F.3d 1333, 1342 (Fed. Cir 2019) (Upholding ruling that prior art “provides insufficient guidance” and does not show an expectation of success where it instructs a POSITA to “vary temperature, concentration, agitation, pH.”); *Pfizer, Inc. v. Apotex Inc.*, 480 F.3d 1348, 1365 (Fed. Cir. 2007) (“To be sure, ‘to have a reasonable expectation of success, one must be motivated to do more than merely vary all parameters or try each of numerous possible choices ...’). Moreover, what works in one field of technology does not always work in another. *Nichia Corp. v. Everlight Americas, Inc.*, 855 F.3d 1328, 1337 (Fed. Cir. 2017) (affirming finding of no motivation to combine where claims were directed to making integrated circuit chips and the prior art references was directed to making LED electronics involving “substantial differences in the manufacturing processes and materials used in the different technologies.”). The Gan Thesis’ documentation of Gan’s failures and the Borden-575’s documentation of the solar cell industry’s general struggle with tunnel oxides undermine the motivation to make the specific combination of known elements Petitioner proposes. *Univ. of Strathclyde v. Clear-Vu Lighting LLC*, 17 F.4th 155, 164 (Fed. Cir. 2021) (“[T]here is also evidence showing that others had failed to inactivate MRSA. . . We have found that such failures undermine a finding of a reasonable expectation of

success.”) (emphasis added). Examination of the *Wands* factors also undermines assertion of reasonable expectation of success by showing that others have failed. *Id.* at 164.

Petitioner’s misdirects should not divert the Board’s attention from Petitioner’s consistent failure to provide evidence showing that Gan’s interfacial oxide could be reliably grown on the polysilicon emitter of the proposed Froitzheim-Gan solar cell. Petitioner again misrepresents Dr. Ruby’s testimony as affirming that “POSITAs would have known how to implement oxide layers.” Reply, 12 (citing Ex. 1075, 107:12-108:5). To the contrary, when asked simply whether “by 2008 a person of ordinary skill in the art would have known how to add a tunnel oxide to a solar cell,” Dr. Ruby testified that “it was a novel concept that was not generally known, discussed, or published. In fact, it was this Feldmann’s publication in 2013 where it became more generally known.” Ex. 1075, 200:10-201:1.

Petitioner also misrepresents that Swanson’s method of forming a tunnel oxide was instructive. Swanson’s tunnel oxide is formed using an “ozone oxidation process, which involves dipping wafer 102 in a bath comprising ozone suspended in deionized wafer” and where no heating is mentioned. Ex. 1015, 3:35-57 (cited in Reply, 12). In contrast, Gan’s interfacial oxide is thermally grown at 800°C during a 10-minute oxygen flow, Ex. 1005, 246 (step 3), and

requires further annealing to achieve breakups, *id.* at 249. Petitioner offers no support that a POSITA would have been able to form Gan's interfacial oxide layer using Swanson's method. Nor is there support that any generic knowledge of forming oxide layers in other fields would have been sufficient to satisfy Gan's desired amount of breakup to control J_o and ρ_c .

Another misdirection is Petitioner's argument that the '516 patent assumes a POSITA would have understood how to manufacture oxide layers. Obviousness involves a comparison between the challenged claims and the prior art. Paper 17 (Institution Decision), 7 (citing *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007)).

Petitioner points to no relevant case law stating otherwise. Reply, 13. Petitioner's case, *Uber Technologies*, is distinguishable because the court found that a POSITA "was more than capable of selecting between the known methods" that were not related to the "alleged novelty of the [asserted patent]." *Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1339 (Fed. Cir. 2020). There were no known methods for forming interfacial/tunnel oxide layers in solar cells and the author of Gan admits that he could not consistently form such a functional oxide layer. Petitioner's other case, *Hesai Technologies*, cites *Uber* and is distinguishable for the same reason. *Hesai Tech. Co., v. Ouster, Inc.*, IPR2023-01421, Paper 45, 34-35 n.6 (P.T.A.B. Mar. 13, 2025).

Nor is it the case (or of any relevance) that prior art disclosures are held to a higher standard than the challenged patent's disclosure. Petitioner seeks to distract the Board from the actual dispute between the parties—whether a POSITA would have been motivated to implement Gan's unreliable polysilicon emitter and oxide layer in Froitzheim's solar cell. With knowledge of the Gan Thesis, the answer is no.

B. Froitzheim Does Not Satisfy the Limitations of Claim 12

Petitioner's arguments regarding claim 12 fail legally and factually. Consequently, the proposed Froitzheim-Gan and Froitzheim-Borden-575 combinations fail to satisfy the limitations recited in claim 12 of the '516 patent.

1. Froitzheim Does Not Satisfy the Structural Limitations

Petitioner's argument that Froitzheim's screen-printing process involves “placing metal over a solar cell layer” before firing, Reply, 15, does not satisfy the claim limitation of “formed over.” Claim 12 is a product (apparatus) claim reciting structural limitations, but Petitioner's argument addresses a process limitation.

Hazani v. U.S. Int'l Trade Comm'n, 126 F.3d 1473, 1479 (Fed. Cir. 1997)

(Characterizing claims as “pure product claims” where the claim limitation, “read in context, describes the product more by its structure than by the process used to obtain it”).

Specifically, claim 12 recites a structural relationship that must be present:

“silver formed over a layer of silicon dioxide.” That structural relationship is not present in the proposed Froitzheim-Gan/Borden-575 combinations. *Vanguard Prods. Co. v. Parker Hannifin Corp.*, 234 F.3d 1370, 1372 (Fed.Cir.2000) (holding that the claim term “integral” “was used to describe the product, and not as a designation of a specific manufacturing process” and “[t]he method of manufacture, even when cited as advantageous, does not of itself convert product claims into claims limited to a particular process.”); *Cosms. v. Del Lab’ys Inc.*, 2008 WL 11334111, at *11 (C.D. Cal. Aug. 20, 2008) (citations omitted) (“[A] pure product claim recites the invention by its structural characteristics, i.e., the presence of specified components in the final product, not by how the product is made.”).

Petitioner’s argument—that claim 12 could be met if the metal contact is initially formed over the passivation layer but then burns through that layer—improperly imports process limitations into a product claim. *Cont’l Cirs. LLC v. Intel Corp.*, 915 F.3d 788, 799 (Fed. Cir. 2019) (citation omitted) (“Because the patentee has not ‘made clear’ that the repeated desmear process is ‘an essential part of the claimed invention,’ it was improper for the district court to read this process limitation into the product claims for this additional reason.”) (emphasis added); *3M Innovative Props. Co. v. Avery Dennison Corp.*, 350 F.3d 1365, 1371 (Fed. Cir.

2003) (“[E]ven words of limitation that can connote with equal force a structural characteristic of the product or a process of manufacture are commonly and by default interpreted in their structural sense, unless the patentee has demonstrated otherwise.”) (emphasis added).

2. *Froitzheim Contradicts Petitioner’s Argument that Metal Paste Remains Over the Passivation Layer After Screen Printing*

The parties disagree over whether metal paste remains “over” the passivation layer after Froitzheim’s screen printing. Petitioner’s expert contends that most of the metal paste remains over the passivation layer, while only “filaments” fired through to touch the wafer. Ex. 2029, 84:13-85:16. But Patent Owner’s expert testified that the screen printing causes the paste to “completely etch through” the passivation layer. Ex. 1075, 116:19-118:12. The Board should credit Patent Owner’s expert because his testimony aligns with Froitzheim’s disclosure and figures.² POR, 37-42.

² Petitioner’s argument that Froitzheim’s figure is “a basic patent publication graphic” is unpersuasive. Reply, 16. The ’516 patent’s figures, also a “basic patent publication graphic,” can nevertheless illustrate an overlap between the metal contact and the silicon dioxide as recited in claim 12. Petitioner also relies on Froitzheim’s figures throughout the Petition to illustrate various components.

Froitzheim's broader context discredits Petitioner's argument. Froitzheim discloses that its front side contacts are screen printed as well. Ex. 1004, ¶¶[0028, 49]. If, as Petitioner argues, screen printing leaves "most of the" metal paste on the front surface of the cell, then light absorption would be compromised, and the efficiency of the solar cell would be reduced. *See, e.g.*, Ex. 2027, ¶62 ("A tradeoff is made by having sufficient metal coverage to reduce the series resistance without shading too much of the cell, which reduces the capture of sunlight and, therefore, reduces current.").

The Board should disregard Petitioner's efforts to divert attention by citing references unrelated to Froitzheim. Reply, 16-17 (citing Ex. 1081, Fig. 14; Ex. 1083, 105-06 [*sic*]; Ex. 1084, 110 [*sic*]). For example, Psych, Liang, and Cabrera discuss contact formation on a SiN_x layer, not silicon dioxide as recited in claim 12. Ex. 1081, Fig. 14 (illustrating screen printing on a SiN_x layer); Ex. 1083, 066102-2 (discussing "[r]esidual SiN_x:H"); Ex. 1084, 114511-1 ("[D]uring firing, [the glass frit] etches the SiN_x layer."). Petitioner does not explain why the etching of silicon dioxide and SiN_x are similar in the screen printing process. Thus, Petitioner's cited references lack relevance. Further, Liang reports "[r]esidual SiN_x:H" in "optimally fired cells," which do not constitute "a layer of silicon dioxide" as claim 12 recites. Ex. 1083, 066102-2. Cabrera, published in 2011 is not even prior art.

C. Petitioner's Theory Based on Froitzheim and Borden-575 Is Unsound

Petitioner fails to overcome the procedural and substantive deficiencies in the Borden-575-related arguments. Mainly, the Petition proposes a Froitzheim-Borden-575 component that is impermissibly vague, and the Reply deepens the confusion. First, the Petition asserts a POSITA's motivation to combine only Borden-575's polysilicon emitter and tunnel oxide layer (and no other components of Borden-575) with Froitzheim. Petition, 65. Then, the Petition asserts that Borden-575's buried oxide in the proposed Froitzheim-Borden-575 combination would satisfy certain claim limitations, with no mention of Borden-575's tunnel oxide. Petition, 69-70; *id.* at 74-75. Lastly, the Reply argues that Borden-575's tunnel oxide now also satisfies those same claim limitations. This not only fails to overcome the procedural deficiency of improperly incorporating Borden-575's buried oxide, but now impermissibly adds a new argument relating to Borden-575's tunnel oxide.

1. Petitioner's New Argument Is Improper

In the Petition, Petitioner solely relies on Borden-575's buried oxide to satisfy claim limitations 9[c] and 1[e]. Petition, 69-70 (on limitation 9[c], only referencing Borden-575's buried oxide); *id.* at 74-75 (on limitation 1[e], incorporating arguments from limitation 9[c] and not mentioning Borden-575's tunnel oxide). Now, in its Reply, Petitioner alleges "[a]s the Petition explains (Pet.,

69-70), Borden-575’s ‘buried oxide’ and ‘tunnel oxide’ each meet the challenged claims’ oxide limitation.” Reply, 20. Petitioner’s argument that Borden-575’s tunnel oxide satisfies the challenged claims’ oxide limitation is not present in the Petition, and is therefore waived and should not be considered. *Corephotonics, Ltd. v. Apple Inc.*, 84 F.4th 990, 1002 (Fed. Cir. 2023) (quotations omitted) (“[T]he Board is not permitted to entertain ‘[s]hifting arguments’ but must, instead, reject any ‘entirely new theory of prima facie obviousness absent from the petition,’ if the petitioner attempts to inject such a theory into the proceeding post-petition.”); *Masimo Corp. v. Apple Inc.*, IPR2023-00745, Paper 44, 40 (PTAB Oct. 15, 2024) (Determining the petitioner’s argument as “waived because it presents an entirely new theory that does not clarify an earlier position, is not responsive to arguments presented in the Patent Owner’s Response, and it raises entirely new issues and evidence.”).

2. *Petitioner Fails to Overcome Patent Owner’s Procedural Arguments*

Patent Owner’s procedural argument stands that the proposed combination is impermissibly vague. POR, 51-53. Petitioner admits that the Petition’s motivation to combine analysis focuses on the tunnel oxide layer, but now argues that the Petition relies on both Borden-575’s buried oxide and tunnel oxide to satisfy the challenged claims’ oxide limitations (the Petition does not, as discussed in section III.C.1). Reply, 20. Petitioner’s excuse that Borden-575’s tunnel oxide layer “is

required ‘in order to make a functioning solar cell [in the proposed combination],’” *id.* (quotation omitted), fails to cure the Petition’s deficiency as to Borden-575’s buried oxide. Thus, the Board should not consider Petitioner’s arguments related to Borden-575’s buried oxide because Petitioner failed to establish that a POSITA would have been motivated to combine it with Froitzheim. POR, 54-55.

3. *Borden-575 Confirms that a POSITA Would Have Understood the Tunnel Oxide to Be Too Difficult to Implement*

As discussed in section III.A.2, Petitioner has not established a POSITA’s knowledge of how to implement tunnel oxides reliably in solar cells. Borden-575’s criticisms of attempts to use tunnel oxides adds to this conclusion.

Petitioner relies on Borden-575’s statement that solar cells using thin tunnel oxides “have not been commercially introduced,” Reply, 22, but ignores the reason: “because of the difficulty of reliably forming a thin tunnel oxide.” Ex. 1006, ¶[0005]. Because Petitioner does not address Borden-575’s skepticism that thin tunnel oxides can be reliably formed, Patent Owner’s argument stands that for reasons including unreliability, Borden-575 would not have motivated a POSITA to adopt tunnel oxides in solar cells. Consequently, a POSITA would not have been motivated to combine Froitzheim with Borden-575.

To support its commercial availability argument, Petitioner points to the testimonies of the experts of Patent Owner and Petitioner. Reply, 23 (citing Ex. 1075; Ex. 1077). But neither supports Petitioner’s proposition. Patent Owner’s

expert never testified to the commercial viability of tunnel oxides, and Petitioner's expert's statement misconstrues Borden-575's disclosure. Reply, 23 (citing Ex. 1077, ¶57). According to Petitioner's expert, "Borden-575's background section acknowledges that tunnel oxides were "well known, and have been used commercially by Schott solar to manufacture MIS solar cells." Ex. 1077, ¶57. Borden-575's background section states the opposite. Ex. 1006, ¶[0005].

4. *Petitioner Fails to Reconcile Borden-575's High Anneal Temperature with Gan's Unsatisfactory Results*

Gan and the Gan Thesis would have discouraged a POSITA from adopting Borden-575's tunnel oxide in Froitzheim's solar cell because Borden-575's high anneal temperature would have resulted in the same unsatisfactory results that Gan and the Gan Thesis experienced and cautioned against. POR, 56-59. Petitioner does not contest that Gan's teaching is applicable to Borden-575's tunnel oxide. Petitioner also does not contest that at 1050°C, Gan experienced undesirable results. Instead, Petitioner suggests without basis that "[a] POSITA would have readily understood how to adjust Gan's ranges to successfully implement an oxide layer while maintaining the solar cell's integrity." Reply, 23 (citing Ex. 1075; Ex. 1077). But the Gan Thesis reports that the author, Gan, failed when trying to adjust anneal temperature and duration ranges to reliably implement its oxide layer in a solar cell. Thus, not only is Petitioner's argument without support, it is contrary to the record.

Equally without support is Petitioner's expert's argument in his declaration that Gan and the Gan Thesis teach the same anneal temperature as Borden-575. Ex. 1077, ¶58. In fact, Borden-575's anneal is used "after deposition [to activate] the dopants." Ex. 1006, ¶[0022]. The equivalent step in Gan is the dopant drive-in step at 900-1000°C. Ex. 1005, 246 (step 10). Gan's first-step anneal at 1050 °C occurs before dopant deposition and is therefore not relevant. *Id.* (step 4 being first-step anneal, and step 9 being dopant deposition).

Petitioner's expert also illogically argued that Borden-575's anneal temperature (1050°C) would yield better ρ_c and thus, a POSITA would have made a "tradeoff" between this and Gan's undesirable J_o . Ex. 1077, ¶58. This argument dismisses the higher J_o as irrelevant when Petitioner's motivation to combine Froitzheim and Gan is, in part, based on Gan's observation of a lower J_o . Petition, 30-31 (quoting Ex. 1005, 248).

Further, not all tradeoffs are justified, and Petitioner speculates baselessly that a POSITA would have traded a better ρ_c for an undesirable J_o . *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 (Fed. Cir. 2000) ("Trade-offs often concern what is feasible, not what is, on balance, desirable. Motivation to combine requires the latter."); Ex. 1075, 71:13-20 (testifying, in the context of cost reduction, that tradeoffs should only be considered "assuming you could maintain [cell] performance at the same time."); *id.* at 32:17-33:21 (testifying that he never

had to “face a trade-off where a feature added benefits to some aspects of a cell, but was disadvantageous for some other reason.”).

5. *Petitioner Fails to Reconcile the Proposed Combination with Borden-575’s Buried Oxide and Contact Holes*

Petitioner does not contest the functions of Borden-575’s buried oxide (to isolate the polysilicon emitter from the metal contacts) and contact holes (to facilitate current flow). Reply, 23. Instead, Petitioner argues Borden-575’s tunnel oxide would sufficiently replace both to form a functioning solar cell in Froitzheim’s structure. *Id.* But Petitioner provides no support—no showing of any functional similarities between the tunnel oxide and the components it would replace, nor any showing that Borden-575’s purported benefits would exist if the buried oxide and contact holes are removed. Thus, Patent Owner’s arguments stand that, without Borden-575’s buried oxide and contact holes, the proposed Froitzheim-Borden-575 combination would be inoperable.

6. *Petitioner Does Not Contest that the Borden-575 Provisional Fails to Disclose Tunnel Current Flow*

The portions of Borden-575 that Petitioner relies upon are not prior art unless supported by the Borden-575 Provisional. *In re Riggs*, 131 F.4th 1377, 1386 (Fed. Cir. 2025) (vacating and remand for the Board to determine whether the Lettich Provisional Application provides written description support for the

specific disclosures in Lettich that the Examiner identified and relied on in the prior art rejections.”); *see also* POR, 21-24.

The Borden-575 Provisional only discloses “passivation between the substrate and the polysilicon” as a function of its tunnel oxide, whereas Borden-575 discloses “tunnel current flow” as an additional function. POR, 65. Petitioner does not contend otherwise. Instead, Petitioner relies on newly presented expert testimony to augment the teachings of the provisional to include that tunnel oxides allow current to tunnel. Reply, 24. This testimony does not rehabilitate the absence of such disclosure in the provisional. Thus, the Board should not consider Petitioner’s argument relying on that testimony. *See, e.g.*, Petition, 66 (arguing motivation to combine based on Borden-575’s teaching, including tunnel flow, which is not disclosed in the provisional).

D. Petitioner’s Theory Based on Froitzheim, Gan/Borden-575, and Sheats Is Unsound

Petitioner fails to overcome Patent Owner’s arguments against Sheats. First, in response to Patent Owner’s argument that Sheats’ trench is superfluous to Froitzheim’s plasma etching, Petitioner asserts that Sheats “provides additional details on the trench that Froitzheim assumes a POSITA would know.” Reply, 27. This assertion fails because, Froitzheim discloses a different edge isolation mechanism (plasma etching) and has no use for Sheats’ “additional details” on trenching.

Second, Petitioner admits that Froitzheim discloses plasma etching as “one possible technique,” but argues a POSITA would have adopted Sheats’ trench because it was another successful technique. Reply, 27-28. Without explaining why a POSITA would have abandoned Froitzheim’s technique in the first place, Petitioner’s argument is irrelevant.

Third, in response to Patent Owner’s argument that Sheats’ trench is used in solar arrays, POR 45-50, Petitioner contends that “trenches are physically and functionally similar” within the cell or between cells, Reply, 28. This contention is unsupported—Petitioner only cites to Patent Owner’s expert’s testimony that “short circuits are issues for solar arrays and cells” and Petitioner’s expert’s declaration rehashing that testimony. Reply, 28 (citing Ex. 1075; Ex. 1077). Petitioner has not shown that Sheats’ trench designed for arrays can and would also be used in a single cell. Thus, Patent Owner’s argument, once again, stands.

E. Petitioner’s Theory Based on Li and Gan Is Unsound

Petitioner’s obviousness theory based on Li, Gan, and Smith also fails. As argued in sections III.A.1-III.A.2, Petitioner has not shown that a POSITA would have been motivated to combine Froitzheim with Gan. For the same reasons, a POSITA would not have been motivated to combine Li with Gan.

Further, Petitioner’s effort to recast Li’s express criticism of high-temperature diffusion as a preference is inconsistent with both Li’s disclosure and

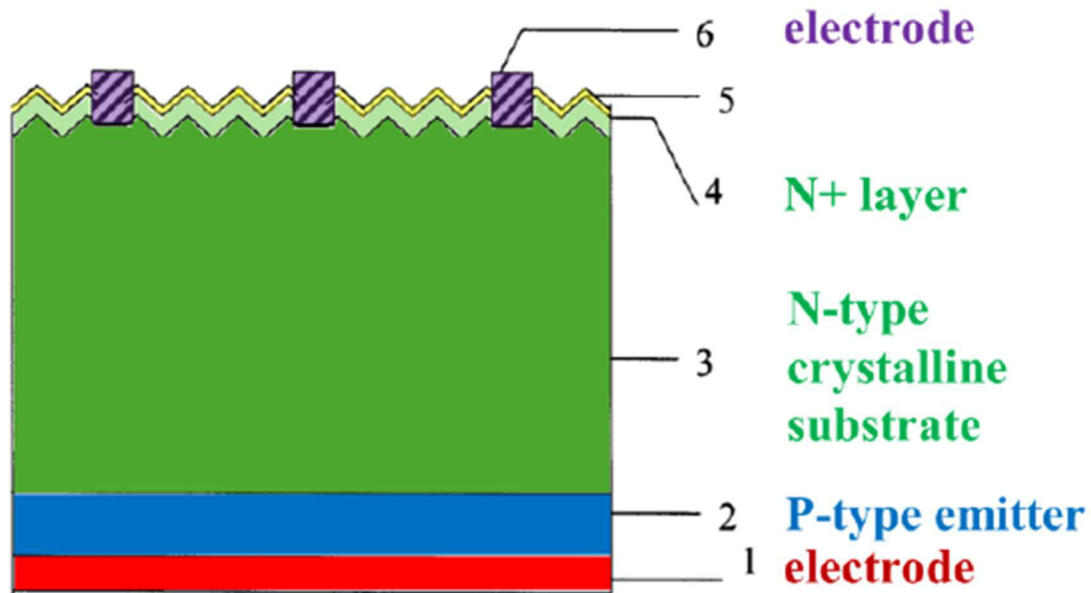
the legal principles of teaching away. Petitioner also relies on expert statements that contradict facts. For example, the Reply cites paragraph 63 of the declaration, Reply, 24, which states “Dr. Ruby’s declaration also does not contest . . . that a POSITA would have had a reasonable expectation of success at combining Li and Gan,” Ex. 1077, ¶63 (citing Ex. 2027, ¶¶ 268-80). Paragraph 268 of Dr. Ruby’s declaration in fact states “[i]n my opinion, a POSITA would not have been motivated to modify Li using Gan’s polysilicon emitter and oxide layer, Paper 3, 79, because Li and Gan’s teachings are in conflict,” and paragraphs 269 to 280 explain why.

1. Li’s Low Temperature Diffusion Is Not a Preferred Embodiment; It Is Li’s Only Embodiment

Li directly contradicts Petitioner’s argument that it merely prefers low-temperature diffusion but permits high-temperature diffusion. Reply, 24-26. Petitioner cites no support that Li permits or contemplates high-temperature diffusion at any point, other than Petitioner’s expert noting that Li permits “any deposition method.” Ex. 1077, ¶66 (citing Ex. 1008, 4). Deposition methods are not relevant to the parties’ dispute over deposition temperature.

Equally irrelevant are the additional references Petitioner’s expert cites to claim that Li’s “phosphorus diffusion step requires higher temperatures.” Ex. 1077, ¶66. The parties’ dispute is over boron diffusion, not phosphorus diffusion. According to Li, “a PN junction is prepared by a low-temperature method, which

avoids a conventional diffusion process at 800-1000°C.” Ex. 1008, 4 (emphasis added). As shown below, the proposed Li-Gan-Smith combination would include Li’s N-type substrate and a P-type polysilicon emitter.



Petition, 86. Thus, in the proposed combination, Gan’s polysilicon emitter would be diffused with boron, not phosphorus. Ex. 1003, ¶51 (“It was well known prior to 2008 that boron was commonly used as a dopant to create p-type regions or layers.”); *id.* at ¶49 (“It was well known prior to 2008 that phosphorus was commonly used as a dopant to create n-type regions or layers.”).

In contrast, Patent Owner’s argument that low-temperature diffusion is Li’s requirement (not preference) is rooted in Li’s specification and is relevant to the parties’ dispute. Li begins with a description of crystalline silicon solar cell structures and its shortcomings, the first one being “such cells have the

disadvantages that the high-temperature diffusion may cause more defects in silicon materials.” Ex. 1008, 3. This shortcoming leads to many problems (defects in silicon materials, pollution caused in high-temperature process, reduced cell efficiency) and forces complicated solutions (high requirements for materials and production environment). *Id.*

Li’s solution is the “[a]doption of amorphous silicon emitting region,” which not only has a “good surface passivation effect,” but also requires a low deposition temperature and simple deposition process “such that a high-temperature process is avoided, and the manufacturing cost of the cell is reduced.” Ex. 1008, 3. Thus, the amorphous silicon emitting region in Li’s cell structure is not a preferred embodiment, it is part of Li’s novelty.

Because the amorphous silicon emitting region is part of Li’s novel structure, high temperature diffusion would not be permitted. This is not only because Li expressly criticized higher temperature diffusion, but also because Li expressly stated that amorphous silicon uses low deposition temperature (200°C). Ex. 1008, 3. And although Li contemplates use of microcrystalline silicon or nano-silicon instead of amorphous silicon, Li reiterates again in its “Detailed Description of Embodiments” section that “a PN junction is prepared by a low-temperature deposition method, which avoids a conventional diffusion process at 800-1000°C.” Ex. 1008, 4. If Li’s strong criticism of high-temperature diffusion is reduced to a

mere preference to avoid, then specifications lose meaning and purpose. *In re Urbanski*, 809 F.3d 1237, 1244 (Fed. Cir. 2016) (“A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.”).

Lastly, even if Li merely expressed a preference (it does not), that preference would have, at a minimum, discouraged a POSITA from combining it with Gan and its high temperature drive-in (diffusion). *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1069 (Fed. Cir. 2018) (“[E]ven if a reference is not found to teach away, its statements regarding preferences are relevant to a finding regarding whether a skilled artisan would be motivated to combine that reference with another reference.”).

2. *Li Teaches Low Temperature Diffusion and Discourages High Temperature Diffusion*

On one hand, Petitioner does not dispute the applicability of Patent Owner’s case *In re Urbanski*, in which the Federal Circuit defined teaching away to be broader than what Petitioner asserts: “A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” 809 F.3d 1237, 1244 (Fed. Cir. 2016) (quotation omitted). On the other hand, Petitioner seeks to impose a

narrower standard for teaching away—that a reference may only teach away “when it suggests that the developments flowing from its disclosures are unlikely to produce the objective of the applicant’s invention.” Reply, 25 (quoting *Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1380 (Fed. Cir. 2005)).

While Patent Owner disputes Petitioner’s outdated definition of teaching away, the outcome under either case is the same. *Syntex* agrees that a statement constitutes teaching away if it conveys “clear discouragement of that combination.” Reply, 25 (quoting *Syntex*). As discussed in section III.E.1 above, that is precisely what Li provided—clear discouragement of using high temperature diffusion in its invention.

Thus, Li’s low temperature diffusion (200°C) and Li’s criticism of higher temperature diffusion (800-1000°C) would have discouraged a POSITA from replacing Li’s components with Gan’s structure that requires multiple rounds of high temperature processing, including diffusion at 900-1000°C. POR, 67-69. This is teaching away under *Urbanski* and “clear discouragement” under *Syntex*.

Lastly, because Li teaches away from Gan’s high temperature diffusion, Petitioner’s argument that Li’s lower temperature is a mere “trade off” in cell design is irrelevant. *See, e.g., Winner*, 202 F.3d at 1349-50 (after examining a “trade-off” argument, holding that “if [prior art reference] Johnson did in fact teach

away from [prior art reference] Moore, then that finding alone can defeat [defendant's] obviousness claim.").

IV. CONCLUSION

For the foregoing reasons and those in the Patent Owner Response, claims 1-12 of the '516 patent are patentable.

Respectfully submitted,

Date: September 25, 2025

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that this Patent Owner Sur-Reply, exclusive of the table of contents, table of authorities, certificate of service, certificate of word count, and list of exhibits, includes 5,565 words. Pursuant to 37 C.F.R. § 42.24(d), Patent Owner relied on the word count feature of the word-processing system used to prepare this paper.

Dated: September 25, 2025

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CERTIFICATE OF SERVICE

I certify that the Patent Owner Sur-Reply was served on Petitioner's counsel
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