IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

MAXEON SOLAR PTE. LTD., Plaintiff and Counterclaim Defendant, v. **REC SOLAR HOLDINGS AS,** Defendant and Counterclaim Plaintiff.	**Case No. 2:24-cv-00260-JRG** **JURY TRIAL DEMANDED**

DEFENDANT'S INVALIDITY CONTENTIONS

TABLE OF CONTENTS

I. Overview 1

II. P.R. 3-3(a): Identification of Prior Art 9

A. State of the Art 12

1. State of the Art for the ’516 and ’053 Patents 12

2. State of the Art for the ‘315 Patent 13

B. Prior Art Patents, Patent Applications, and Publications 14

C. Prior Art Disclosures – Known/Used/Sold/Offered for Sale 40

D. Prior art under Pre-AIA 35 U.S.C. §§ 101, 102(f), 111, and 116 or AIA 35 U.S.C. §§ 101, 111, and 116 43

E. Prior art under Pre-AIA 35 U.S.C. § 102(g) 44

III. P.R. 3-3(b) & (c): Invalidity by Anticipation or Obviousness and Exemplary Invalidity Claim Charts 44

A. ’516 Patent 47

B. ’053 Patent 50

C. ’315 Patent 52

D. Rationales for Combining Disclosures 55

1. The ’516 and ’053 Patents 58

2. The ’315 Patent 72

IV. P.R. 3-3(d): Invalidity Under 35 U.S.C. § 112 86

A. Indefiniteness 87

1. The ’053 Patent 87

2. The ’315 Patent 88

B. Written Description 91

1. The ’516 Patent 91

2. The ’053 Patent 95

3. The ’315 Patent 100

C. Enablement 105

1. The ’516 Patent 106

2. The ’053 Patent 107

3. The ’315 Patent 108

V. P.R. 3-4: Document Production Accompanying Invalidity Contentions 109

Pursuant to Local Patent Rules 3-3 and 3-4 and the Court's Docket Control Order (Dkt. 31), Defendant REC Solar Holdings AS ("REC Solar"), hereby provide these Invalidity Contentions and accompanying document production to Plaintiff, Maxeon Solar Pte. Ltd. ("Maxeon").

I. Overview

In this action, Maxeon asserted in its P.R. 3-1 and 3-2 Disclosures of January 7, 2025, ("Infringement Contentions") that REC Solar allegedly infringes claims 9 and 10 of U.S. Patent No. 8,222,516 (the "'516 patent"), claims 9, 12, and 14-20 of U.S. Patent No. 8,878,053 (the "'053 patent"), and claims 10, 13-16, and 19 of U.S. Patent No. 11,251,315 (the "'315 patent")[1] (collectively, the "Patents-in-Suit" and the "Asserted Claims"). REC Solar hereby provides its disclosures pertaining only to the Asserted Claims identified by Maxeon in its Infringement Contentions. REC Solar's disclosures should not be construed to suggest that any non-asserted claims of the Patents-in-Suit are valid or enforceable.

REC Solar's investigation is ongoing. REC Solar serves these disclosures based on information currently available to REC Solar at this early stage of this action. REC Solar reserves the right to modify and supplement these disclosures in response to any amendment by Maxeon to its Infringement Contentions or as REC Solar discovers additional information in the course of discovery.

This Court has not yet construed any of the terms in the Patents-in-Suit. REC Solar's Invalidity Contentions are based on REC Solar's present understanding of Maxeon's apparent constructions or interpretations of the Asserted Claims, as advanced by Maxeon in its Complaint and Infringement Contentions, and REC Solar's own understanding of the scope of the Asserted

[1] While Maxeon added allegations of infringement with respect to claims 16 and 19, it withdrew its allegation of infringement of claim 11.

Claims, recognizing that REC Solar's investigation is ongoing. REC Solar takes no position on any matter of claim construction/interpretation in these contentions. REC Solar's contentions herein are not, and should in no way be seen as, admissions about or adoptions of any particular claim scope or construction, or any admission that any particular element is met in any particular way. REC Solar objects to any attempt to imply claim constructions from any identification or application of potential prior art. Any statement herein describing or tending to describe any claim element is provided solely for the purpose of understanding the relevant prior art. By including prior art that anticipates or renders obvious claims based on Maxeon's apparent claim constructions/interpretations, REC Solar does not thereby adopt Maxeon's apparent claim constructions/interpretations.

Moreover, nothing herein should be construed as an admission that REC Solar agrees with Maxeon's claim constructions/interpretations or that Maxeon has a plausible basis to allege infringement. Similarly, nothing herein shall be construed as an admission regarding the application of the Asserted Claims to any of REC Solar's accused products. REC Solar does not agree with Maxeon's application of the claims to the accused products, and REC Solar denies infringement. Furthermore, these contentions do not represent an agreement with Maxeon's views as to the meaning, definiteness, written description support for, or enablement of any of the Asserted Claims. In fact, REC Solar provides grounds for invalidity under § 112 below. Pursuant to the Court's Docket Control Order (Dkt. 31), REC Solar reserves the right to include arguments directed to indefiniteness in their Markman briefing. Nothing stated herein shall be construed as a waiver of any invalidity argument available under Title 35 of the U.S. Code. REC Solar expressly reserves the right to propose alternative constructions/interpretations to those advocated by Maxeon and to rebut Maxeon's actual claim construction and infringement positions. REC Solar

reserves the right to modify or supplement these contentions in response to Maxeon's claim construction positions (whether from the Preliminary Claim Constructions, the Joint Claim Construction Statement, or its Claim Construction briefing) and/or the Court's construction of the claim terms at issue.

Prior art not included in this disclosure may also become relevant. REC Solar is currently unaware of the extent, if any, to which Maxeon may contend that certain limitations of the Asserted Claims are not disclosed in the prior art identified by REC Solar. REC Solar reserves the right to identify other relevant prior art with respect to such allegedly missing limitation(s).

REC Solar's invalidity claim charts attached hereto cite to exemplary portions, teachings, and disclosures of the prior art as applied to limitations of the Asserted Claims. Persons of ordinary skill in the art, however, would recognize these as exemplary and may view an item of prior art in the context of other publications, literature, products, and understanding. Again, this is because the cited portions of prior art identified herein are exemplary only. The citations and discussion in the charts are organized by claim (and claim limitation) for convenience, but each limitation or claim section applies to the larger context of each claim, to any related dependent or independent claims, as well as all claims containing similar limitations or elements in the particularly asserted patent or other related patents also being asserted by Maxeon. For example, citations as to any recited limitation, step, or component in the claims apply wherever each such limitation, step, or component is repeated elsewhere in the claim of that patent or other related patent also being asserted by Maxeon. Any and all citations to particular figures in the attached charts or elsewhere in these contentions shall be deemed to wholly incorporate the figure by reference, and include the figure as if it had been inserted into the chart itself, as well as any text discussing the figure. Similarly, where REC Solar cites to particular text in a prior art reference concerning a drawing or

figure, the citation encompasses that drawing or figure as well as any other associated information in the prior art reference. REC Solar may therefore rely on the entirety of the prior art references listed herein, including uncited portions of those prior art references, as well as additional information including products, documents, materials, and expert testimony.

The references cited herein disclose the limitations of the Asserted Claims explicitly or inherently, and/or they may be relied upon to demonstrate how the state of the art in the relevant time frame invalidates each asserted patent claim. In the context of the knowledge of a person of ordinary skill in the art, each reference's disclosure applies in the context of both anticipation and obviousness. Therefore, any suggested single reference obviousness positions and obviousness combinations are provided in the alternative to REC Solar's anticipation contentions and are not to be construed to suggest that any reference included in the combinations is somehow deficient or is not by itself anticipatory. Further, the combinations listed herein are exemplary and not exhaustive. There are many possible invalidating combinations of the references listed herein, and it is not practical, at this early stage, to identify and list all potentially relevant combinations without the benefit of further factual investigation and the Court's claim construction.

In addition to the positions and prior art identified below, and the accompanying invalidity claim charts, REC Solar also incorporates by reference all invalidity contentions, prior art, invalidity claim charts, and expert declarations (including, without limitation, all anticipation positions, obviousness positions (including all prior art combinations and motivations to combine), indefiniteness positions, written description positions, and enablement positions) that have been or will be disclosed in any other action involving any of the Patents-in-Suit (including but not limited to *Maxeon Solar Pte. Ltd. v. Hanwha Solutions Corporation et al.*, No. 2:24-cv-00262 and *Maxeon Solar Pte. Ltd. v. Canadian Solar Inc.*, No. 2:24-cv-00210, in the Eastern District of

Texas, collectively "Related Litigations"), as well as any U.S. Patent and Trademark Office (USPTO) proceeding involving any of the Patents-in-Suit (including but not limited to IPR2024-01038, IPR2024-01039, IPR2024-01040, IPR2024-01194, IPR2024-01198, IPR2024-01199, IPR2024-01203, IPR2025-00592, IPR2025-00593, IPR2025-00594, and IPR2025-00595, collectively "Related IPRs") and that have or will be disclosed in any USPTO proceeding involving related patents (including but not limited to Appeal Nos. 2018-005662 and 2021-002647, and the *ex parte* prosecution of U.S. Patent Application Nos. 17/870,268 and 18/802,814). Such art and positions would have been obvious to combine with the prior art and combinations identified in these Invalidity Contentions. To the extent Maxeon (or the Board) puts forth an argument in any district court or USPTO proceeding contrary to the positions in the litigation, REC Solar reserves the right to raise and/or address such argument or position in this litigation.

REC Solar expects to rely on testimony of one or more expert witnesses and materials referenced by those expert witnesses in support of these contentions and incorporate those forthcoming expert reports as if fully set forth herein. Subsequent expert statements—including deposition and trial testimony, declarations, and reports—related to invalidity, interrogatory responses, and other discovery or pleadings may expand and elaborate upon the positions contained in these Invalidity Contentions as originally prepared or subsequently amended, and REC Solar reserves the right to incorporate such by reference. REC Solar may further rely on any inventor admissions concerning the scope of the prior art relevant to the Patents-in-Suit found in, *inter alia*: the patent prosecution histories for the Patents-in-Suit and related patents, patent applications, and/or re-examinations; deposition testimony of the named inventors listed on the Patents-in-Suit; and the papers and any evidence submitted by Maxeon in these actions.

Discovery has only just begun, and REC Solar's investigation into prior art—including third-party prior art, and related evidence, documents, and knowledgeable witnesses—remains ongoing. Moreover, prior art may become relevant depending on the claim interpretations and/or validity positions Maxeon or its expert witness(es) may assert, REC Solar's further understanding of Maxeon's Infringement Contentions, and any supplementation or modification of those Infringement Contentions. Accordingly, REC Solar reserves the right to supplement or modify these Invalidity Contentions based on further discovery and in a manner consistent with the Federal Rules of Civil Procedure and the Court's rules and schedule. To the extent Maxeon contends that any prior art presented in these contentions does not qualify as prior art to one or more Patents-in-Suit, the prior art remains relevant as evidence of simultaneous development as an indicia of obviousness. *See George M. Martin Co. v. Alliance Mach. Sys. Int'l LLC*, 618 F.3d 1294, 1305 (Fed. Cir. 2010) ("Independently made, simultaneous inventions … are persuasive evidence that the claimed apparatus was the product only of ordinary mechanical or engineering skill.").

As set forth in detail below, and in the invalidity claim charts which accompany these Invalidity Contentions as Exhibits A-1 to A-5, B-1 to B-2, and C-1 to C-6, the Asserted Claims of the Patents-in-Suit are invalid over the cited prior art listed below under either pre-AIA 35 U.S.C. §§ 102 and/or 103 or AIA 35 U.S.C. §§ 102 and/or 103. Regarding the obviousness of certain claims under pre-AIA 35 U.S.C. § 103 or AIA 35 U.S.C. § 103, one or more of the principles enumerated by the United States Supreme Court in *KSR International Co. v. Teleflex Inc*., 550 U.S. 398 (2007) apply to the Asserted Claims of the Patents-in-Suit, including, for example:

(a) combining various claimed elements known in the prior art according to known methods to yield a predictable result;

(b) making a simple substitution of one or more known elements for another to obtain a predictable result;

(c) using a known technique to improve a similar device or method in the same way;

(d) applying a known technique, known device or method ready for improvement to yield a predictable result;

(e) choosing from a finite number of identified, predictable solutions with a reasonable expectation of success or, in other words, the solution was one which was "obvious to try;"

(f) a known work in one field of endeavor prompting variations of it for use either in the same field or a different based on given design incentives or other market forces in which the variations were predictable to one of ordinary skill in the art; and/or

(g) a teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill in the art to modify the prior art reference or to combine the teachings of various prior art references to arrive at the claimed invention.

The above criteria may be collectively referred to herein as the "*KSR* Criteria."

Based on these considerations, as further detailed below and/or in the invalidity claim charts, one of ordinary skill in the art could and would have readily combined the teachings of the prior art references discussed and charted. The combinations of these references would have rendered obvious to one of ordinary skill in the art the subject matter of the Asserted Claims. The references identified in the claim charts for the respective Asserted Claims are analogous prior art to the subject matter of the Asserted Claims and, for at least the reasons set forth below and/or in the charts, are properly combinable. Because many, if not all, of these prior art references exist within a single field of art, particularly one in which individuals in the field often shared and/or

collaborated on their work, it would have been obvious for one of ordinary skill in the art to look from one piece of prior art to another in order to find any missing functionality they desired to implement. The art is replete with instances of skilled artisans looking to the same field or related fields for purposes of implementing techniques for identifying reflective objects, measuring their reflective characteristics, and determining their location. Therefore, these references provide interrelated teachings and one of ordinary skill would have looked to the concepts in any of these references when seeking to solve the problems purportedly addressed by the Patents-in-Suit.

Numerous prior art references and/or products, including in the invalidity claim charts, reflect common knowledge and the state of the prior art before the earliest effective priority date of the Patents-in-Suit. As it would be unduly burdensome to create detailed charts for all of the invalidating combinations, for at least the reasons described in these Invalidity Contentions, it would have been obvious to one of ordinary skill in the art to combine any of a number of prior art references, including any admitted prior art or any combination of those identified in the charts, to meet the limitations of the Asserted Claims. REC Solar's inclusion of exemplary combinations, in view of the factors and motivations identified here, does not preclude REC Solar from identifying other invalidating combinations and/or motivations as appropriate.

No showing of a specific motivation to combine prior art is required to combine the references disclosed above and in the attached invalidity claim charts, because each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR*, 550 U.S. at 415-16 (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach). That said, the Supreme Court's rationale, that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases

a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle," applies equally here. *Id.* at 1742.

Additional evidence that there would have been a motivation or reason to combine the prior art references identified herein includes but is not limited to the interrelated teachings of multiple prior art references; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution; the existence of a known need or problem in the field of endeavor at the time of the alleged inventions; and the background knowledge that would have been possessed by one of ordinary skill in the art. For example, the prior art references are generally directed to the same problems. Thus, a person of ordinary skill in the art seeking to solve these problems would look to these cited references in combination.

REC Solar contends there are no secondary considerations of non-obviousness evidencing the validity of any of the Asserted Claims. If Maxeon presents any alleged evidence of secondary considerations of non-obviousness, REC Solar reserves its right to respond to any such alleged evidence. Further, to the extent Maxeon identifies any product as allegedly practicing the claims and having been successful, there is no nexus between the claimed invention and the products' success and REC Solar reserves its right to respond to any such alleged evidence.

Nothing in these Invalidity Contentions constitutes an admission concerning the priority date, conception date, or reduction to practice of the Asserted Claims of the Patents-in-Suit.

II. P.R. 3-3(a): Identification of Prior Art

Pursuant to Patent Rule 3-3 and subject to REC Solar's reservations of rights in these Invalidity Contentions, REC Solar identifies the following prior art that anticipates and/or renders obvious one or more Asserted Claims of the Patents-in-Suit as detailed in the invalidity claim charts and elsewhere in these Invalidity Contentions. Below are tables identifying individual items

of prior art. The prior art references and products listed below and in the accompanying claim chart exhibits may be relied upon for certain limitations, state of the art, and background of the art; indicia of obviousness; as evidence of the level of skill in the art at the time of the filing of the Patents-in-Suit; and/or in support of assertions that it is proper to combine certain prior art prior art references and products in certain ways.

REC Solar also incorporates by reference each and every prior art reference of record in the prosecution of the Patents-in-Suit and patents or patent applications related to the Patents-in-Suit, the prior art referred to in the specifications of the Patents-in-Suit, as well as the prior art identified in past or present district court and USPTO proceeding involving any of the Patents-in-Suit or related patents or patent applications, including the Related Litigations and the Related IPRs. In these Invalidity Contentions, REC Solar has identified each item of prior art, based on currently available information, including:

(a) each patent or published patent application, constituting prior art under pre-AIA 35 U.S.C. §§ 102(a), (b), and/or (e) or under AIA 35 U.S.C. §§ 102(a)(1) and/or (a)(2), by its patent/application number, country of origin, and date of issue;

(b) each non-patent publication, constituting prior art under pre-AIA 35 U.S.C. §§ 102(a) and/or (b) or under AIA 35 U.S.C. §§ 102(a)(1) and/or (a)(2), by its title, date of publication, and, where feasible, author and publisher;

(c) sales or public disclosures, constituting prior art under pre-AIA 35 U.S.C. § 102(a) and/or (b) or under AIA 35 U.S.C. § 102(a)(1), by the item offered for sale or publicly used or known, the date the offer or use took place or the information became known, and the identity of the person or entity which made the use or which made and received

the offer, or the person or entity which made the information known or to whom it was made known;

(d) prior art under pre-AIA 35 U.S.C. § 102(f), by the name of the person(s) from whom and the circumstances under which the invention or any part of it was derived;

(e) prior art under pre-AIA 35 U.S.C. § 102(g), by the identities of the person(s) or entities involved in and the circumstances surrounding the making of the invention before the patent applicant(s); and

(f) prior art references under AIA 35 U.S.C. §102(a)(1) showing that the claimed invention was otherwise available to the public by specifying the form and nature of the reference, the manner in which the reference was made public, and the date on which the reference was made public.

REC Solar's identification of patents, patent applications, and publications as prior art herein and in the invalidity claim charts includes the publications themselves as well as the use of the products described therein. REC Solar's investigation continues, but information available to date indicates that such products were (1) known or used in the country before the alleged invention(s) of the claimed subject matter of the Asserted Claims, (2) were in public use and/or on sale in this country more than one year before the filing date of the Patents-in-Suit, and/or (3) were invented by another who did not abandon, suppress, or conceal, before the alleged invention(s) of the claimed subject matter of the Asserted Claims. Upon information and belief, these prior art products and their associated references anticipate and/or render obvious one or more of the Asserted Claims of the Patents-in-Suit.

REC Solar further intends to rely on any inventor admissions concerning the scope of the prior art relevant to the Patents-in-Suit found in, *inter alia*: the patent prosecution histories for the

Patents-in-Suit, related patents, and/or patent applications; any deposition testimony of the named inventors on the Patents-in-Suit; and the papers and any evidence submitted by Maxeon in this action, the Related Litigations, and/or the Related IPRs.

A. <u>State of the Art</u>

REC Solar sets forth a summary of its current understanding of the state of the art for general subject matter of the Patents-in-Suit. REC Solar expressly reserves the right to rely on each of the prior art references discussed in the below Sections, including exhibits cited therein, with respect to each Asserted Claim. REC Solar also reserves the right to rely on the discussions of the state of the art and prior art for the Patents-in-Suit and their file histories in explaining the state of the art and the references' correspondence with the claims of the Patents-in-Suit. REC Solar further expressly reserves the right to supplement its summary of the state of the art, including for example, by information from any of the authors or named inventors on any of the prior art references, by personnel familiar with products based on any of the prior art, or by technical experts retained on behalf of any party.

1. State of the Art for the '516 and '053 Patents

The '516 and '053 patents relate to solar cells and method of fabricating solar cells. The '516 and '053 patents assert a priority date of February 20, 2008.

By early 2008, the concepts embodied in the asserted claims were well known and commonplace in the solar cell/solar module marketplace. For example, the claims of the '516 patent purport to cover a solar cell with, *inter alia*, an oxide layer formed between the back surface of a substrate and an emitter layer (such as polysilicon), where the emitter layer forms a backside junction. The claims also cover solar cells with substrates having textured front surfaces with an optional antireflective layer, and metal contacts that make electrical connection with the substrate

and emitter and configured to allow an external circuit to be powered by the solar cell. Each of the features recited in claims 9 and 10 were well known by early 2008, as evidenced by the prior art described in the Exhibit A claim charts.

The claims of the ’053 patent are similar, purporting to cover a method of fabricating a solar cell by, *inter alia*, forming an optional oxide layer over the back surface of a substrate, forming a polysilicon layer over the back surface of the substrate (and option oxide layer), and diffusing dopants into the polysilicon layer and the front surface of the substrate from separate dopant source layers, whereby the diffusing yields a backside junction formed by the doped polysilicon layer and the substrate. The claims also cover forming metal contacts on the front surface of the substrate, texturizing the substrate surface and forming an antireflective layer, and an in-situ diffusion of dopants. Each of the features recited in claims 9, 12, and 14-20 were well known by early 2008, as evidenced by the prior art described in the Exhibit B claim charts.

Therefore, as explained below, to the extent that Maxeon argues that any of the primary references do not disclose the above features or operations, it would have been obvious to modify each reference to include them at least because they were well-known, routine, and conventional operations and features that could be readily combined without undue experimentation.

2. State of the Art for the ‘315 Patent

The ’315 patent relates to solar cells. The ’315 patent assert a priority date of December 22, 2014.

By late 2014, the concepts embodied in the asserted claims were well known and commonplace in the solar cell/solar module marketplace. For example, the claims of the ’315 patent purport to cover a solar cell with, *inter alia*, a silicon substrate with a portion, formed at the front side of the solar cell, having a dopant (such as p-type dopants, like boron) concentration of approximately $2x10^{18}$ cm^{-3}, a dielectric region formed over the substrate over the backside of the

solar cell, an emitter region (such as polysilicon) with metal impurities formed over the dielectric region, and metal contacts. The claims also cover solar cells with a second emitter region with metal contacts. Each of the features recited in claims 10, 13-16, and 19 were well known by late 2014, as evidenced by the prior art described in the Exhibit C claim charts.

Therefore, as explained below, to the extent that Maxeon argues that any of the primary references do not disclose the above features or operations, it would have been obvious to modify each reference to include them at least because they were well-known, routine, and conventional operations and features that could be readily combined without undue experimentation.

B. Prior Art Patents, Patent Applications, and Publications

The following prior art references would have anticipated and/or rendered obvious (as primary references, secondary references, and/or general background) the asserted claims of the corresponding patent. These invalidity contentions include a series of exemplary invalidity claim charts, providing disclosures that render each claim element anticipated and/or obvious. Based on REC Solar's understanding of Maxeon's Infringement Contentions, each chart identifies specific examples of where each limitation of the asserted claims is found in that reference.

To the extent Maxeon asserts that any of the primary references does not anticipate the asserted claims, it would have been obvious to combine or modify them with concepts apparent from the state of the art, from other prior art, or in view of the knowledge of one of ordinary skill in the art. REC Solar identifies the following prior art patents, patent applications, and publications as anticipating or rendering obvious, either alone or in combination with one or more other prior art references, one or more asserted claims of the Patents-in-Suit.

Table 1: Prior Art Patents and Patent Applications

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	12/070742	February 20, 2008	July 17, 2012	Cousins	REC_000008571-REC_000008795
US	13/495577	February 20, 2008	November 4, 2014	Cousins	REC_000008796-REC_000009123
US	14/504,771	October 2, 2014	March 26, 2015	Cousins	REC_000009124-REC_000009655
US	16/460,035	July 2, 2019	December 26, 2019	Cousins	REC_000009656-REC_000009950
US	17/870,268	July 21, 2022	January 19, 2023	Cousins	REC_000009951-REC_000010348
US	18/802814	August 13, 2024	January 2, 2025	Cousins	REC_000010349-REC_000010424
US	2002/0142500 (“Foglietti”)	March 27, 2001	October 3, 2002	Foglietti et al.	REC_000010425-REC_000010439
US	2002/084503	December 31, 2001	July 4, 2002	Lee et al.	REC_000010440-REC_000010447
US	2002/0117199	February 6, 2002	August 29, 2002	Oswald	REC_000010448-REC_000010462
US	2003/0134469	January 27, 2003	July 17, 2003	Horzel et al.	REC_000010463-REC_000010475
US	2004/0106227	July 14, 2003	June 3, 2004	Naseem et al.	REC_000010476-REC_000010493
US	2005/0268963 (“Jordan”)	February 23, 2005	December 8, 2005	Jordan et al.	REC_000010494-REC_000010503
US	2005/0109388	October 25, 2004	May 26, 2005	Murakami et al.	REC_000010504-REC_000010528
US	2006/0118868	December 3, 2004	June 8, 2006	Yoshimura et al.	REC_000010529-REC_000010544

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	2006/0157103	August 16, 2005	July 20, 2006	Sheats et al.	REC_000010545-REC_000010561
US	2007/0151598	December 20, 2006	July 5, 2007	De Ceuster et al.	REC_000010562-REC_000010579
US	2007/0256728	May 4, 2006	November 8, 2007	Cousins et al.	REC_000010580-REC_000010588
US	2007/151599	December 30, 2005	July 5, 2007	Cousins	REC_000010589-REC_000010599
US	2008/0314443	June 20, 2008	December 25, 2008	Bonner et al.	REC_000010600-REC_000010609
US	2008/0035198	October 13, 2005	February 14, 2008	Teppe et al.	REC_000010610-REC_000010619
US	2008/0072953	September 25, 2007	March 27, 2008	Stephens et al.	REC_000010620-REC_000010658
US	2009/0092745	October 5, 2007	April 9, 2009	Pavani et al.	REC_000010659-REC_000010669
US	2009/0205712	February 20, 2008	August 20, 2009	Cousins	REC_000010670-REC_000010681
US	2010/0105190 (“Tomas”)	October 23, 2008	April 29, 2010	Tomas	REC_000010682-REC_000010691
US	2011/0056550	September 7, 2010	March 10, 2011	Choi et al.	REC_000010692-REC_000010709
US	2011/0132423	October 11, 2007	June 9, 2011	Joge et al.	REC_000010710-REC_000010719
US	2011/0214719 (“Li ’719”)	December 17, 2010	September 8, 2011	Li et al.	REC_000010720-REC_000010731
US	2011/0308585	June 16, 2010	December 22, 2011	Joshi et al.	REC_000010732-REC_000010741
US	2012/0006392	July 1, 2011	January 12, 2012	Gupta	REC_000010742-REC_000010755

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	2012/0048370	August 23, 2011	March 1, 2012	Kim et al.	REC_000010756-REC_000010764
US	2012/0318340 (“Heng”)	August 31, 2012	December 20, 2012	Heng et al.	REC_000010765-REC_000010776
US	2013/0164879	December 21, 2011	June 27, 2013	Cousins et al.	REC_000010777-REC_000010790
US	2013/0240029	May 13, 2013	September 19, 2013	Smith	REC_000010791-REC_000010802
US	2014/0038338	June 13, 2012	February 6, 2014	Cousins	REC_000010803-REC_000010814
US	2014/0311567 (“Choi ’567”)	April 22, 2014	October 23, 2014	Choi et al.	REC_000010815-REC_000010833
US	2015/0020877	August 9, 2012	January 22, 2015	Moslehi et al.	REC_000010834-REC_000010994
US	2015/008/3215	October 2, 2014	March 26, 2015	Cousins	REC_000010955-REC_000011006
US	2015/0090326	September 27, 2013	April 2, 2015	Sewell	REC_000011007-REC_000011027
US	2016/0126400 (“Ji ’400”)	November 3, 2015	May 5, 2016	Ji et al.	REC_000011028-REC_000011048
US	2019/0393368	July 2, 2019	December 26, 2019	Cousins	REC_000011049-REC_000011060
US	2023/0021009	July 21, 2022	January 19, 2023	Cousins	REC_000011061-REC_000011072
US	2025/0006851	August 13, 2024	January 2, 2025	Cousins	REC_000011073-REC_000011084
US	3,961,997	May 12, 1975	June 8, 1976	Chu et al.	REC_000011085-REC_000011094
US	4,053,335 (“Hu”)	April 2, 1977	Oct. 11, 1977	Hu	REC_000011095-REC_000011105

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	4,158,591	April 24, 1978	June 19, 1979	Avery et al.	REC_000011106-REC_000011114
US	4,165,558	November 21, 1977	Aug 28, 1979	Armitage et al.	REC_000011115-REC_000011118
US	4,234,352 (“Swanson ’352”)	January 26, 1978	November 18, 1980	Swanson	REC_000011119-REC_000011125
US	4,427,839	November 9, 1981	January 24, 1984	Hall	REC_000011126-REC_000011134
US	4,525,593 (“Yablonovitch ’593”)	April 16, 1984	June 25, 1985	Yablonovitch	REC_000011135-REC_000011140
US	4,665,277	March 11, 1986	May 12, 1987	Sah et al.	REC_000011141-REC_000011151
US	4,748,130	March 16, 1987	May 31, 1998	Wenham et al.	REC_000011152-REC_000011159
US	4,927,770	November 14, 1988	May 22, 1990	Swanson	REC_000011160-REC_000011165
US	5,030,295 (“Swanson ’295”)	February 12, 1990	July 9, 1991	Swanson et al.	REC_000011166-REC_000011169
US	5,053,083	May 8, 1989	October 1, 1991	Sinton	REC_000011170-REC_000011182
US	5,057,439	February 12, 1990	October 15, 1991	Swanson et al.	REC_000011183-REC_000011189
US	5,164,019	July 31, 1991	November 17, 1992	Sinton	REC_000011190-REC_000011195
US	5,217,539	September 5, 1991	June 8, 1993	Fraas et al.	REC_000011196-REC_000011211
US	5,266,125	May 12, 1992	November 30, 1993	Rand et al.	REC_000011212-REC_000011220
US	5,360,990	March 29, 1993	November 1, 1994	Swanson	REC_000011221-REC_000011225

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	5,369,291	May 28, 1993	November 29, 1994	Swanson	REC_000011226-REC_000011231
US	5,389,158	July 26, 1993	February 14, 1995	Fraas et al.	REC_000011232-REC_000011242
US	5,444,001	December 23, 1993	August 22, 1995	Tokuyama	REC_000011243-REC_000011259
US	5,449,626	July 6, 1994	September 12, 1995	Hezel	REC_000011260-REC_000011290
US	5,479,018	May 8, 1989	December 26, 1995	McKee et al.	REC_000011291-REC_000011301
US	5,510,271	September 9, 1994	April 23, 1996	Rohatgi et al.	REC_000011302-REC_000011327
US	5,627,081	November 29, 1994	May 6, 1997	Tsuo et al.	REC_000011328-REC_000011339
US	5,641,362	November 22, 1995	June 24, 1997	Meier	REC_000011340-REC_000011352
US	5,661,079	June 14, 1995	August 26, 1997	Harmel et al.	REC_000011353-REC_000011357
US	5,792,280	December 27, 1996	August 11, 1998	Ruby et al.	REC_000011358-REC_000011368
US	5,899,704	March 7, 1996	May 4, 1999	Schlosser et al.	REC_000011369-REC_000011375
US	60/936,954	June 23, 2007	January 30, 2008	De Ceuster	REC_000011376-REC_000011392
US	61/023,342 (“Borden ’578 Provisional”)	January 24, 2008	April 8, 2008	Borden et al.	REC_000011393-REC_000011420
US	61/023,354 (“Borden ’575 Provisional”)	January 24, 2008	February 26, 2008	Borden et al.	REC_000011421-REC_000011446
US	6,180,869	May 4, 1998	January 30, 2001	Meier et al.	REC_000011447-REC_000011467

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	6,262,359 (“Meier”)	October 7, 1999	July 17, 2001	Meier et al.	REC_000011468-REC_000011478
US	6,274,402	December 30, 1999	August 14, 2001	Verlinden et al.	REC_000011479-REC_000011498
US	6,313,395	April 24, 2000	November 6, 2001	Crane et al.	REC_000011499-REC_000011503
US	6,333,457	August 29, 2000	December 25, 2001	Mulligan et al.	REC_000011504-REC_000011508
US	6,337,283	December 30, 1999	January 8, 2002	Verlinden et al.	REC_000011509-REC_000011529
US	6,352,876	July 27, 2000	March 5, 2002	Bordogna et al.	REC_000011530-REC_000011535
US	6,387,726	December 30, 1999	May 14, 2002	Verlinden et al.	REC_000011536-REC_000011556
US	6,423,568	December 30, 1999	July 23, 2002	Verlinden et al.	REC_000011557-REC_000011576
US	6,441,297	March 14, 1999	August 27, 2002	Keller et al.	REC_000011577-REC_000011616
US	6,524,880	July 25, 2001	February 25, 2003	Moon et al.	REC_000011617-REC_000011626
US	6,632,730	March 29, 2000	October 14, 2003	Meier et al.	REC_000011627-REC_000011642
US	6,686,259	November 27, 2001	February 3, 2004	Park et al.	REC_000011643-REC_000011649
US	6,692,985	June 7, 2002	Feb 17, 2004	Huang	REC_000011650-REC_000011658
US	6,998,288 (“Smith”)	September 21, 2004	February 14, 2006	Smith et al.	REC_000011659-REC_000011668
US	7,071,018	June 17, 2002	July 4, 2006	Mason et al.	REC_000011669-REC_000011675

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
US	7,135,350	January 9, 2006	November 14, 2006	Smith et al.	REC_000011676-REC_000011682
US	7,144,751	February 3, 2005	December 5, 2006	Gee et al.	REC_000011683-REC_000011708
US	7,375,378	May 12, 2005	May 20, 2008	Manivannan et al.	REC_000011709-REC_000011722
US	7, 390,962	May 22, 2003	Jun 24, 2008	Greiff et al.	REC_000011723-REC_000011754
US	7,468,485 (“Swanson ’485”)	August 11, 2005	December 23, 2008	Swanson	REC_000011755-REC_000011768
US	7,701,011	August 3, 2007	April 20, 2010	Kamath et al.	REC_000011769-REC_000011784
US	7,718,888	December 30, 2005	May 18, 2010	Cousins	REC_000011785-REC_000011795
US	7,737,357	May 4, 2006	June 15, 2010	Cousins	REC_000011796-REC_000011805
US	8,124,502	October 23, 2008	February 28, 2012	Ferre et al.	REC_000011806-REC_000011816
US	8,207,444 (“Cousins ’444”)	July 1, 2008	June 26, 2012	Cousins	REC_000011817-REC_000011832
US	8,222,516	February 20, 2008	July 17, 2012	Cousins	REC_000011833-REC_000011844
US	8,878,053	June 13, 2012	November 4, 2014	Cousins	REC_000011845-REC_000011857
US	9,496,437	March 28, 2014	November 15, 2016	Harley et al.	REC_000011858-REC_000011876
US	2013/0247981 (“Yelundur”)	March 21, 2012	September 26, 2013	Yelundur	[2]

[2] At the time of service, REC Solar had technical difficulties that precluded inclusion of this document in the production. REC Solar will follow-up with a production of this document soon.

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
CA	2,605,600 (“Abdallah”)	April 11, 2006	October 26, 2006	Abdallah et al.	REC_000007545-REC_000007565
CN	100334744C	April 21, 2005	August 29, 2007	Zhao	REC_000007566-REC_000007592
CN	101017858A	January 10, 2007	August 15, 2007	Li	REC_000007593-REC_000007618
CN	101079452A	June 11, 2007	November 28, 2007	Kun	REC_000007619-REC_000007640
CN	101621084B	August 3, 2009	January 6, 2010	Wu et al.	REC_000007641-REC_000007666
CN	102694077A	June 11, 2012	September 26, 2012	Lin et al.	REC_000007667-REC_000007685
CN	102800738A (“Wu”)	May 24, 2011	November 28, 2012	Wu et al.	REC_000007686-REC_000007703
CN	1028819C	October 3, 1991	June 7, 1995	Rosenblum et al.	REC_000007704-REC_000007739
CN	103325861A	April 29, 2009	September 25, 2013	Smith	REC_000007740-REC_000007768
CN	103650165A	May 31, 2012	March 19, 2014	Fu	REC_000007769-REC_000007801
CN	104124302A (“Park”)	April 23, 2014	October 29, 2014	Park et al.	REC_000007802-REC_000007844
CN	1155107C	October 1, 1996	June 23, 2004	Srinivasan et al.	REC_000007845-REC_000007873
CN	1201408C	March 15, 2002	May 11, 2005	Shunichi	REC_000007874-REC_000007948
CN	1230920C	May 5, 1998	December 7, 2005	Davis	REC_000007949-REC_000008023
CN	1421908 A	April 16, 2002	June 4, 2003	Chae et al.	REC_000008024-REC_000008072

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
CN	1812136A	December 1, 2005	August 2, 2006	Zhou	REC_000008073-REC_000008085
CN	1949545A (“Li ’545”)	September 21, 2006	April 18, 2007	Li et al.	REC_000008086-REC_000008095
DE	696,19,149 T2	February 13, 2002	November 14, 2002	Hisamatsu	REC_000008096-REC_000008125
EP	0,735,597 B1	March 29, 1996	February 13, 2002	Hisamatsu	REC_000008126-REC_000008142
EP	1,732,142 A1 (“Froitzheim”)	September 6, 2005	December 13, 2006	Froitzheim	REC_000008143-REC_000008162
EP	2,180,531 A1	October 23, 2008	April 28, 2010	Ferre	REC_000008163-REC_000008175
EP	2,200,082	September 28, 2009	June 23, 2010	Camalleri et al.	REC_000008176-REC_000008194
JP	07-106611 (“Okayasu”)	September 29, 1993	April 21, 1995	Okayasu	REC_000008195-REC_000008230
JP	2004-179371A	November 27, 2002	June 24, 2004	Kengo et al.	REC_000008231-REC_000008248
JP	2006-287027	April 1, 2005	October 19, 2006	Namikata	REC_000008249-REC_000008267
JP	2011-166021	February 12, 2010	August 25, 2011	Tsukigata et al.	REC_000008268-REC_000008297
JP	3158027	November 27, 1995	Apr 23, 2001	Nishida	REC_000008298-REC_000008311
JP	5-75149	September 11, 1991	March 26, 1993	Yasuhiro et al.	REC_000008312-REC_000008327
KR	10-0204916	March 31, 1999	June 15, 1999	Nam et al.	REC_000008328-REC_000008336
KR	10-0645831	September 26, 2005	November 14, 2006	Kim et al.	REC_000008337-REC_000008354

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
KR	10-2013-0044982	April 23, 2013	April 20, 2016	Choi et al.	REC_000008355-REC_000008372
KR	10-2219804	November 4, 2014	February 24, 2021	Gwang-Seon et al.	REC_000008373-REC_000008408
KR	10-2007-0092953	October 13, 2005	September 14, 2007	Andreas et al.	REC_000008409-REC_000008433
KR	10-2013-0047320	October 31, 2011	May 8, 2013	Kim et al.	REC_000008434-REC_000008475
KR	93-5273	August 20, 1991	March 23, 1993	Nam et al.	REC_000008476-REC_000008478
KR	1995-0003952	May 25, 1994	February 17, 1995	Gyu-Jeong et al.	REC_000012874-REC_000012882
KR	1995-0003953	July 13, 1993	February 17, 1995	Gyu-Jeong et al.	REC_000012883-REC_000012897
PCT/US	09/32345	January 29, 2009	August 27, 2009	Cousins	REC_000008479-REC_000008520
TW	501286B	June 7, 2001	Sept 1, 2002	Huang	REC_000008521-REC_000008542
TW	I416598B	July 1, 2010	November 21, 2013	Yang	REC_000008543-REC_000008570
WO	00/55923	February 1, 2000	September 21, 2000	Meier et al.	REC_000011877-REC_000011915
WO	02/103810 A1	June 17, 2002	December 27, 2002	Mason et al.	REC_000011916-REC_000011932
WO	2004/086516	March 24, 2004	October 7, 2004	Ishihara	REC_000011933-REC_000011991
WO	2005/076960	February 4, 2005	August 25, 2005	Gee	REC_000011992-REC_000012037
WO	2006/097303 A1	March 16, 2006	September 21, 2006	Agostinelli et al.	REC_000012038-REC_000012080

Country	Patent/ Application/ Publication No.	Date of Filing	Date of Issue/ Publication	Inventor(s)	Bates Range
WO	2007/022955	August 22, 2006	March 1, 2007	Marz	REC_000012081-REC_000012108
WO	2007/059578 A1	November 24, 2006	May 31, 2007	Wenham et al.	REC_000012109-REC_000012205
WO	2007/130188 A2	February 9, 2007	November 15, 207	Cousins	REC_000012206-REC_000012222
WO	2008/004791	July 3, 2007	January 10, 2008	Ahn et al.	REC_000012223-REC_000012245
WO	2009/094575 (“Borden ’575”)	January 23, 2009	July 30, 2009	Borden et al.	REC_000012246-REC_000012260
WO	2009/094578 (“Borden ’578”)	January 23, 2009	July 30, 2009	Borden et al.	REC_000012261-REC_000012274
WO	2009/105314 A1	January 29, 2009	August 27, 2009	Cousins	REC_000012275-REC_000012299
WO	2010/033744 A2	September 18, 2009	March 25, 2010	Rana	REC_000012300-REC_000012336
WO	2010/092051 A2	February 9, 2010	August 19, 2010	Stoffregen et al.	REC_000012337-REC_000012707
WO	2011/0671276 A1	December 1, 2010	June 9, 2011	Bethoux et al.	REC_000012708-REC_000012742
WO	2011/152986 (“Rohatgi”)	May 17, 2011	December 8, 2011	Rohatgi	REC_000012743-REC_000012779
WO	2013/149093 A1	March 28, 2013	October 3, 3013	Seutter et al.	REC_000012780-REC_000012873

Table 2: Non-Patent Publications

Title	Publication Date	Author(s)	Publisher	Bates Range
Comparison of Experimental and Theoretical Results on Polysilicon Emitter Bipolar Transistors	July 1984	Ashburn et al.	IEEE	REC_000002094-REC_000002101
BP Solar Global Marketing, BP-MSX-120, 120-Watt Multicrystalline Photovolataic Module	February 2002	BP Solar	BP Solar Global Marking	REC_000002102-REC_000002105
Gettering of transition metal impurities during phosphorus emitter diffusion in multicrystalline silicon solar cell processing	May 15, 2006	Bentzen et al.	American Institue of Physics	REC_000002106-REC_000002112
Overview of phosphorus diffusion and gettering in multicrystalline silicon	March 15, 2009	Bentzen et al.	ScienceDirect	REC_000002113-REC_000002120
PECVD PSG as a Dopant Source for Industrial Solar Cells, Presented at the 21st European Photovoltaic Solar Energy Conference (“Benick”)	September 4, 2006	Benick et al.	21st European Photovoltaic Solar Energy Conference	REC_000002121-REC_000002124
Harnessing the Sun with Thin-Film Photovoltaics	April 1999	Birkmire et al.	NREL	REC_000002125-REC_000002135
Methods of emitter formation for crystalline silicon solar cells	2012	Bultman et al.	Photovoltaics International 6	REC_000002136-REC_000002147
Transition metals in photovoltaic-grade ingot-cast multicrystalline silicon: Assessing the role of impurities in silicon nitride crucible lining material, (“Buonassisi”)	January 25, 2006	Buonassisi, et al.	Elsevier	REC_000002148-REC_000002165
Project seeks to improve methods of harnessing solar energy	August 4, 2013	Capshaw-Mack et al.	Winston-Salem Journal	REC_000002166-REC_000002168

Title	Publication Date	Author(s)	Publisher	Bates Range
Silicon Heterojunction Solar Cell: A New Buffer Layer Concept With Low-Temperature Epitaxial Silicon	November 2004	Centurioni et al.	IEEE	REC_000002169-REC_000002175
Low Cost, high volume production of >22% efficiency silicon solar cells	September 3-7, 2007	De Ceuster et al.	22nd European Photovoltaic Solar Energy Conference	REC_000002176-REC_000002179
A New Silicon p-n Junction Photocell for Converting Solar Radiation into Electrical Power,	May 1954	Chapin et al.	American Institue of Physics	REC_000002180-REC_000002187
Impact of Metal Contamination in Silicon Solar Cells	February 2, 2011	Coletti et al.	Wiley	REC_000002188-REC_000002188
Impact of metal contamination in multicrystalline silicon solar cells: Case study of iron	June 20-25, 2010	Coletti et al.	IEEE	REC_000002189-REC_000002193
P-Type Versus n-Type Silicon Wafers: Prospects for High-Efficiency Commercial Silicon Solar Cells	August 2006	Cotter et al.	IEEE	REC_000002194-REC_000002202
Optimization of p-Type Screen Printed Interdigitated Back Contact Silicon Solar Cell with Aluminum Back Surface Field	April 2014	Desa et al.	IJENS	REC_000002203-REC_000002214
18% Efficient Silicon Photovoltaic Devices by Rapid Thermal Diffusion and Oxidation	August 1998	Doshi et al.	IEEE	REC_000002215-REC_000002227
Modeling and Characterization of High-Efficiency Silicon Solar Cells Fabricated by Rapid Thermal Processing, Screen Printing, and Plasma-Enhanced Chemical Vapor Deposition	September 1997	Doshi et al.	IEEE	REC_000002228-REC_000002241

Title	Publication Date	Author(s)	Publisher	Bates Range
Defect passivation of industrial multicrystalline solar cells based on PECVD silicon nitride	2002	Duerinckx et al.	Elsevier	REC_000002242-REC_000002257
Nanotechnology improves solar cell efficiency	August 28, 2007	EarthSky	EarthSky	REC_000002258-REC_000002261
Electrician high-tech series Fascicle II	March 2000	China Electrotechnical Society	Mechanical Industry Publishing House	REC_000002262-REC_000002297
OPTICAL, ELECTRICAL AND STRUCTURAL PROPERTIES OF PECVD QUASI EPITAXIAL PHOSPHOROUS DOPED SILICON FILMS ON CRYSTALLINE SILICON SUBSTRATE (“Farrokh-Baroughi”)	August 20-24, 2004	Farrokh-Baroughi et al.	Canadian Solar Buildings Conference	REC_000002298-REC_000002303
A PASSIVATED REAR CONTACT FOR HIGH-EFFICIENCY n-TYPE SILICON SOLAR CELLS ENABLING HIGH VocS AND FF>82%	September 30-October 4, 2013	Feldman et al.	28th European PV Solar Energy Conference & Exhibition	REC_000002304-REC_000002308
Improved iron gettering of contaminated multicrystalline silicon by high-temperature phosphorus diffusion	June 4, 2013	Fenning et al.	AIP Publishing LLC	REC_000002309-REC_000002318
Simultaneous gettering and emitter formation in multicrystalline-Si wafers by annealing phosphorus doped amorphous silicon compounds (“Ferre”)	January 10, 2011	Ferré et al.	Semantic Scholar	REC_000002319-REC_000002334
Material Properties and Device Physics Basic to Photovoltaics	2010	Fonash	Solar Cell Device Physics	REC_000002335-REC_000002399
Polysilicon: a versatile material for microsystems	April 2002	French	Elsevier	REC_000002400-REC_000002410

Title	Publication Date	Author(s)	Publisher	Bates Range
POLYSILICON EMITTERS FOR SILICON CONCENTRATOR SOLAR CELLS (“Gan”)	May 21-25, 1990	Gan et al.	IEEE	REC_000002411-REC_000002580
SILICON DIOXIDE MASKING OF PHOSPHORUS DIFFUSION IN SILICON	1975	Ghoshtagore	Pergamon Press	REC_000002581-REC_000002588
Crystalline Silicon Solar Cells: State-of-the-Art and Future Developments	2012	Glunz et al.	Elsevier	REC_000002589-REC_000002635
Metal Precipitates in Silicon *p-n* Junctions	October 1960	Goetzberger et al.	AP Publishing	REC_000002636-REC_000002639
SOLAR ENERGY THE STATE OF THE ART	2001	Gordon	ISES	REC_000002640-REC_000002758
FRONT SURFACT PASSIVATION OF N-TYPE HIGH-EFFICIENTY BACK-JUNCTION SILICON SOLAR CELLS USING FRONT SURFACE FIELD	September 3-7, 2007	Granek et al.	22nd European Photovoltaic Solar Energy Conference and Exhibition	REC_000002759-REC_000002762
HIGH-EFFICIENCY BACK-CONTACT BACK-JUNCTION SILICON SOLAR CELLS (“Granek”)	July 31, 2009	Granek	ISE	REC_000002763-REC_000002971
HIGH EFFICIENCY N-SILICON SOLAR CELLS USING REAR JUNCTION STRUCTURES	1993	Green et al.	IEEE	REC_000002972-REC_000002975
Intrinsic concentration, effective densities of states, and effective mass in silicon	1990	Green	American Institute of Physics	REC_000002976-REC_000002987
SILICON SOLAR CELLS Advanced Principles & Practice (“Green-1995”)	March 1995	Green et al.	Centre for Photovoltaic Devices and Systems	REC_000002988-REC_000003063

Title	Publication Date	Author(s)	Publisher	Bates Range
Silicon solar cells: evolution, high-efficiency design and efficiency enhancements	July 20, 1992	Green et al.	IOP Publishing Ltd	REC_000003064-REC_000003075
SOLAR CELLS Operating Principles, Technology and System Applications	December 1986	Green	The University of New South Wales	REC_000003076-REC_000003105
Investigation of a-Si_H_c-Si heterojunction solar cells interface properties	2004	Gudovskikh et al.	Elsevier	REC_000003106-REC_000003110
As-grown iron precipitates and gettering in multicrystalline silicon	December 3, 2008	Haarahiltunen et al.	ScienceDirect	REC_000003111-REC_000003115
Low temperature formation of emitter and BSF by rapid thermal co-diffusion of P, AI or B	1994	Hartiti et al.	IEEE	REC_000003116 - REC_000003147
Low temperature formation of emitter and BSF by rapid thermal co-diffusion of P, Al or B (“Hartiti”)	December 5-9, 1994	Hartiti et al.	IEEE	REC_000003116-REC_000003147
Comparison of Different Techniques for Edge Isolation	October 22, 2001	Hauser et al.	17th European Photovoltaic Solar Energy Conference	REC_000003148-REC_000003151
Limiting efficiencies of ideal single and multiple energy gap terrestrial solar cells,	August 1, 1980	Henry	AIP Publishing	REC_000003152-REC_000003159
Analyzing the effects of front-surface fields of back-junction silicon solar cells using the charge-collection probability and the reciprocity theorem (“Hermle”)	March 10, 2008	Hermle et al.	American Institute of Physics	REC_000003160-REC_000003166

Title	Publication Date	Author(s)	Publisher	Bates Range
Electron Transport in Amorphous Silicon	May 2005	Holman	The Division of Mathematics and Natural Science, Reed College	REC_000003167-REC_000003265
Solar Cells From Basics to Advanced Systems	1983	Hu et al.	McGraw-Hill	REC_000003266-REC_000003307
Dynamics of a solar-powered fractional horse power motor	September 9, 2005	Bello et al.	IEEE	REC_000003308-REC_000003312
Comparison of POCI3 diffusion with phosphorus ion implantation for Czochralski and Quasi-mono silicon solar cells	June 8-13, 2014	Cho et al.	IEEE	REC_000003313-REC_000003317
Effect of annealing of multi crystalline edge wafers and Cz mono crystalline wafers based on metallurgical silicon	May 11-16, 2008	Holt et al.	IEEE	REC_000003318-REC_000003327
Investigation of barrier layers on ceramics for silicon thin film solar cells	May 19-24, 2002	Slaoui et al.	IEEE	REC_000003328-REC_000003332
Chalcogen incorporation in Cu(InGa)(SeS)/sub 2/ coevaporated thin films	January 3-7, 2005	Stavrides et al.	IEEE	REC_000003333-REC_000003337
Ion-Implanted Laser-Annealed p+ and n+ Regions: A Potential Solution for Industrially Feasible High-Efficiency N-Type Interdigitated Back-Contact Solar Cells	October 15, 2014	Yang et al.	IEEE	REC_000003338-REC_000003343
Gettering of Metallic Impurities from Planar Silicon Diodes	1963	Ing, Jr. et al.	ECS	REC_000003344-REC_000003348
Gettering Properties of Silicon Wafer Covered by Polysilicon	October 1993	Ishisaka et al.	Nippon Steel Technical Report No. 59	REC_000003349-REC_000003354

Title	Publication Date	Author(s)	Publisher	Bates Range
Gettering in silicon-on-insulator wafers: experimental studies and modelling ("Istratov")	April 15, 2005	Istratov et al.	Institute of Physics Publishing	REC_000003355-REC_000003362
Iron contamination in silicon technology	April 5, 2000	Istratov et al.	Institute of Physics Publishing	REC_000003363-REC_000003408
Experimental evidence for the presence of segregation and relaxation gettering of iron in polycrystalline silicon layers on silicon	November 8, 2004	Istratov et al.	American Institute of Physics	REC_000003409-REC_000003411
Study on polysilicon deposited on silicon wafer for impurity gettering	December 2001	Jing et al.	Journal of Functional Materials and Devices Vol 7, No. 4	REC_000003412-REC_000003419
Novel light trapping scheme for thin crystalline cells utilizing deep structures on both wafer sides	September 29-October 3, 1997	Jorgensen et al.	IEEE	REC_000003420-REC_000003427
A simple two-step phosphorus doping process for shallow junctions by applying a controlled adsorption and a diffusion in an oxidising ambient	December 15, 2004	Kalkofen et al.	ScienceDirect	REC_000003428-REC_000003433
Surface, Emitter and Bulk Recombination in Silicon and Development of Silicon Nitride Passivated Solar Cells ("Kerr")	June 2002	Kerr	The Australian National University	REC_000003434-REC_000003676
Studies of Diffused Phosphorous Emitters: Saturation Current, Surface Recombination Velocity, and Quantum Efficiency ("King")	February 1990	King et al.	IEEE	REC_000003677-REC_000003681
Phosphorus Direct Doping from Vapor Phase into Silicon for Shallow Junctions	August 1994	Kiyota et al.	JESOAN 141 (8)	REC_000003689-REC_000003696
Practical Photovoltaics Electricity ("Komp")	2002	Komp et al.	aatec	REC_000003697-REC_000003818

Title	Publication Date	Author(s)	Publisher	Bates Range
SIMULTANEOUS P AND B DIFFUSION, IN-SITU SURFACE PASSIVATION, IMPURITY FILTERING AND GETTERING FOR HIGH-EFFICIENCY SILICON SOLAR CELLS	September 29 – October 3, 1997	Krygowski et al.	IEEE	REC_000003819-REC_000003837
SIPOS HETEROJUNCTION CONTACTS TO SILICON (“Kwark”)	December 9-12, 1984	Kwark et al.	IEEE	REC_000003838-REC_000003841 REC_000003845-REC_000003859
SIPOS heterojunction contacts to silicon	February 1, 1986	Kwark et al.	OSTI.GOV	REC_000003842-REC_000003844
N-TYPE SIPOS AND POLY-SILICON EMITTERS (“Kwark (1987)”)	1987	Kwark et al.	Pergamon Journals Ltd	REC_000003860-REC_000003864
Towards 21% Efficient N-CZ IBC Based on Screen Printing	September 5-9, 2011	Lamers et al.	3th European Photovoltaic Solar Conference and Exhibition	REC_000003865-REC_000003868
The Interdigitated Back Contract Solar Cell: A Silicon Solar Cell for Use in Concentrated Sunlight	April 1977	Lammert et al.	IEEE	REC_000003869-REC_000003874
PHYSICAL PROPERTIES OF RT-LPCVD AND LPCVD POLYSILICON THIN FILMS: APPLICATION TO EMITTER SOLAR CELL	December 5-9, 1994	Lemiti et al.	IEEE	REC_000003875-REC_000003883
Heavily Doped Polysilicon-Contact Solar Cells	July 1985	Lindholm et al.	IEEE	REC_000003884-REC_000003886
Comparison and optimization of the performance of Si and GaAs solar cells	October 1992	Liou et al.	ScienceDirect	REC_000003887-REC_000003891

Title	Publication Date	Author(s)	Publisher	Bates Range
Direct Observation of the Impurity Gettering Layers in Polysilicon-Based Passivating Contacts for Silicon Solar Cells	2018	Liu et al.	ACS Publications	REC_000003892-REC_000003899
Effective impurity gettering by phosphorus- and boron-diffused polysilicon passivating contacts for silicon solar cells	2018	Liu et al.	Elsevier	REC_000003900-REC_000003905
Optical properties of phosphorus-doped polycrystalline silicon layers ("Lubberts")	November 1981	Lubberts et al.	American Institute of Physics	REC_000003906-REC_000003914
Handbook of Photovoltaic Science and Engineering ("Luque")[3]	2003	Luque et al.	Wiley	REC_000003915-REC_000003990
Structure and gettering properties of polycrystalline silicon layers,	2006	Lysáček et al.	Czech and Slovak Crystallographic Association	REC_000003991-REC_000003992
ANALYSIS OF INTERDIGITATED BACK CONTACT SILICON SOLAR CELLS FOR SPACE USE ("Marvin")	August 6-11, 1989	Marvin et al.	IEEE	REC_000003993-REC_000004015
Interdigitated Back Contact Silicon Solar Cell Analysis and Design Recommendations for Space Use ("Marvin-DTIC")	September 30, 1989	Marvin et al.	DTIC	REC_000004016-REC_000004045
Poisoning and Gettering Effects in Silicon Junctions	April 1965	Mets et al.	ECS	REC_000004046-REC_000004051

[3] At the time of service, REC Solar had technical difficulties that precluded inclusion of an updated version of this document in the production. REC Solar will follow-up with a production of this document soon.

Title	Publication Date	Author(s)	Publisher	Bates Range
18.5% Efficient First-Generation MIS Inversion-Layer Silicon Solar Cells	September 30, 1997	Metz et al.	IEEE	REC_000004052-REC_000004055
Atmospheric Pressure Chemical Vapor Deposition of CdTe for High Efficiency Thin Film PV Devices	September 1999	Meyers et al.	NREL	REC_000004056-REC_000004080
Ion Implantation for All-Alumina IBC Solar Cells with Floating Emitter ("Muller")	September 30, 1989	Müller et al.	ScienceDirect	REC_000004081-REC_000004087
MANUFACTURE OF SOLAR CELLS WITH 21% EFFICIENCY	June 7-11, 2004	Mulligan et al.	WIP-Munich and ETA-Florence	REC_000004088-REC_000004093
Electronic Materials Science and Technology	1989	Murarka	Academic Press	REC_000004094-REC_000004097
A controlling method for charging photovoltaic generation power obtained by a MPPT control method to series connected ultraelectric double layer capacitors	October 3-7, 2004	Mutoh et al.	IEEE	REC_000004098-REC_000004102
THE PHYSICS OF SOLAR CELLS ("Nelson")	2003	Nelson	Imperial College Press	REC_000004103-REC_000004321
Industrial Silicon Wafer Solar Cells ("Neuhaus")	2007	Neuhaus et al.	Hindawi	REC_000004322-REC_000004336
Spectroscopic Investigations of Borosilicate Glass and Its Application as a Dopant Source for Shallow Junctions	August 2000	Nolan et al.	The Electrochemical Society	REC_000004337-REC_000004343
DEVELOPMENT AND CHARACTERIZATION OF POLYSILICON EMITTER SOLAR CELLS	December 31, 1989	Papadopoulos	Ottawa-Carleton Institue for Electrical Engineering	REC_000004344-REC_000004566

Title	Publication Date	Author(s)	Publisher	Bates Range
A Simple Method to Control Bipolar Polysilicon Emitter Interfacial Oxide (“Parekh”)	November 1994	Parekh et al.	The Electrochemical Society	REC_000004567-REC_000004572
Identification of metal impurities in crystalline silicon wafers	June 3, 2012	Paudyal et al.	IEEE	REC_000004573-REC_000004594
Investigation of charges carrier density inphosphorus and boron doped SiNx:H layers for crystalline silicon solar cells	May 15, 2013	Paviet-Salomon et al.	ScienceDirect	REC_000004595-REC_000004602
Gettering of impurities in solar silicon	2002	Périchaud	Elsevier	REC_000004603-REC_000004614
Dopant-grading proposal for polysilicon passivating contact in crystalline silicon solar cells	January 18, 2022	Pham et al.	Elsevier	REC_000004615-REC_000004624
Semiconductor Device Fundamentals	1996	Pierret et al.	Addison-Wesley Longman	REC_000004625-REC_000004838
From electronic grade to solar grade silicon: chances and challenges in photovoltaics	November 11, 2005	Pizzini et al.	Wiley-VCH	REC_000004839-REC_000004853
Analysis of the impact of doping levels on performance of back contact – back junction solar cells (“Procel”)	2014	Procel et al.	ScienceDirect	REC_000004854-REC_000004858
Impact of *Ex-Situ* and *In-Situ* Cleans on the Performance of Bipolar Transistors With Low Thermal Budget *In-Situ* Phosphorus-Doped Polysilicon Emitter Contacts (“Rahim”)	November 2001	Rahim et al.	IEEE	REC_000004859-REC_000004866
Diffusion of Iron in Silicon Dioxide (“Ramappa”)	October 1999	Ramappa et al.	JESOAN 146 (10)	REC_000004867-REC_000004876

Title	Publication Date	Author(s)	Publisher	Bates Range
About the formation and avoidance of C and N related precipitates during directional solidification of multi-crystalline silicon from contaminated feedstock	April 15, 2010	Reimann et al.	ScienceDirect	REC_000004877-REC_000004883
Renewable Energy Data Book ("REDB-2013")	2013	Esterly et al.	U.S. Department of Energy	REC_000004884-REC_000005018
Comprehensive study of rapid, low-cost silicon surface passivation technologies	May 2000	Rohatgi et al.	IEEE	REC_000005019-REC_000005041
High-Throughput Ion-Implantation for Low-Cost High-Efficiency Silicon Solar Cells	2012	Rohatgi et al.	SciVerse ScienceDirect	REC_000005026-REC_000005035
THE FRONT SURFACE FIELD SOLAR CELL, A NEW CONCEPT	June 5-8, 1978	von Roos et al.	IEEE	REC_000005042-REC_000005045
New Plastic Solar Cell Breaks Efficiency Record	April 20, 2007	Wake Forest University	ScienceDaily	REC_000005046-REC_000005050
Gettering in silicon photovoltaics: current state and future perspectives ("Seibt")	March 2006	Seibt et al.	Wiley-VCH	REC_000005051-REC_000005082
Detailed Balance Limit of Efficiency of *p-n* Junction Solar Cells*	March 1961	Shockley et al.	Routledge	REC_000005083-REC_000005092
SERIES RESISTANCE IN DOUBLE-POLYSILICON-CONTACTED SILICON SOLAR CELLS.	May 13-17, 1996	Silvestre et al.	IEEE	REC_000005093-REC_000005096
Design Criteria for Si Point-Contact Concentrator Solar Cells ("Sinton")	October 1987	Sinton et al.	IEEE	REC_000005097-REC_000005104
Simplified Backside-Contact Solar Cells	1990	Sinton et al.	IEEE	REC_000005105-REC_000005109

Title	Publication Date	Author(s)	Publisher	Bates Range
RAPID THERMAL PROCESSING OF CONVENTIONALLY AND ELECTROMAGNETICALLY CAST 100 cm² MULTICRYSTALLINE SILICON ("Sivoththaman")	May 13-17, 1996	Sivoththaman et al.	IEEE	REC_000005110-REC_000005132
Passivated Tunneling Contacts to N-Type Wafer Silicon and Their Implementation into High Performance Solar Cells	December 2014	Stradins et al.	NREL	REC_000005133-REC_000005138
SunPower Launches X-Series Family of Solar Panels with World-Record Efficiencies of 21.5 Percent	April 3, 2013	SunPower Corporation	SunPower Corporation	REC_000005139-REC_000005139
Cypress Announces Investment In Designer and Manufacturer Of Ultra-High-Efficiency Silicon Solar Cells	May 31, 2002	SunPower Corporation	SunPower Corporation	REC_000005140-REC_000005141
SunPower Announces World's Most Efficient, Low-Cost Silicon Solar Cell	May 12, 2003	SunPower Corporation	SunPower Corporation	REC_000005142-REC_000005143
POINT-CONTACT SOLAR CELLS: MODELING AND EXPERIMENT	1986	Swanson et al.	Elsevier Sequoia	REC_000005144-REC_000005177
High-Efficiency Silicon Solar Cells	1990	Swanson et al.	American Solar Energy Society and Plenum Press	REC_000005178-REC_000005233
A polysilicon emitter solar cell	December 1985	Tarr	IEEE	REC_000005234-REC_000005237
Back-contact Solar Cells: A Review,	December 20, 2005	Van Kerschaver et al.	Wiley	REC_000005238-REC_000005254
Gettering of Iron in Silicon Solar Cells With Implanted Emitters	January 2014	Vähänissi et al.	IEEE	REC_000005255-REC_000005266

Title	Publication Date	Author(s)	Publisher	Bates Range
BACKSIDE-CONTACT SILICON SOLAR CELLS WITH IMPROVED EFFICIENCY FOR THE '96 WORLD SOLAR CHALLENGE	June 30 – July 4, 1997	Verlinden et al.	14th European Photovoltaic Solar Energy Conference, Barcelona, Spain	REC_000005267-REC_000005272
7000 High-efficiency Cells for a Dream	1994	Verlinden et al.	Wiley	REC_000005273-REC_000005282
An investigation of the thermal stability of the interfacial oxide in polycrystalline silicon emitter bipolar transistors by comparing device results with high-resolution electron microscopy observations ("Wolstenholme")	1987	Wolstenholme et al.	American Institute of Physics	REC_000005283-REC_000005291
A Study of n+ -SIPOS:p-Si Heterojunction Emitters ("Yablonovitch")	November 1985	Yablonovitch et al.	IEEE	REC_000005292-REC_000005294
A 720 mV open circuit voltage SiOx:c-Si:SiO x double heterostructure solar cell ("Yablonovitch-1985")	September 10, 1985	Yablonovitch et al.	American Institute of Physics	REC_000005295-REC_000005297
SEMICONDUCTOR MATERIAL AND DEVICE CHARACTERIZATION	2006	Schroder	IEEE	REC_000012898-REC_000013687

REC Solar further incorporates by reference all "U.S. Patent Documents" and "Other Publications" cited on the face of the Patents-in-Suit, and any references identified in the Related Litigations and the Related IPRs. Any citation to one or more of the above prior art references, or other prior art references regarding any product, should be construed to constitute not only a citation to the prior art reference itself, but also a reference to the product itself. Discovery has only just begun in this case, and REC Solar will supplement if and when more information becomes available from Maxeon or third parties.

C. Prior Art Disclosures – Known/Used/Sold/Offered for Sale

REC Solar believes that there were prior art disclosures in the form of sales, offers for sale, and/or uses by others of products that qualify as prior art under pre-AIA 35 U.S.C. § 102(a), (b), and/or (g) or under AIA 35 U.S.C. § 102(a)(1) against one or more of the Asserted Claims of the Patents-in-Suit.

REC Solar understands that Hanwha Solutions Corporation and Hanwha Energy Corporation contend that the following also constitute prior art under pre-AIA 35 U.S.C. § 102(a), (b), and/or (g) against the '516 and '053 patents:

Item Offered for Sale or Publicly Used or Known	Date Offered for Sale or First Public Use	Identity of the Entity
Q.Cells Monocrystalline and Multicrystalline Solar Cells, including but not limited to Q6, Q6M, Q6L, Q6LM, Q6LTT, Q6LTT3, Q6LPS, and/or Q8TT3	At least as early as Feb. 2006	Q.Cells
PhosTop Cell Process Technology ("PhosTop")	At least as early as June 22, 2003	Ebara Solar
Mitsubishi PV- Cell	At least as early as 2007	Mitsubishi
Schott Crystalline MAIN Cell	At least as early as 2005	Schott

Item Offered for Sale or Publicly Used or Known	Date Offered for Sale or First Public Use	Identity of the Entity
Schott Crystalline EFG Cell	At least as early as 2005	Schott
Sharp ND-, NE- and NT- Models	At least as early as 2007	Sharp Electronics
Suntech STP Models	At least as early as Apr. 2007	Suntech
BP Solar BP- and SX- Models	At least as early as 2005	BP Solar
SunPower Gen III and A-300 Solar Cells	At least as early as Aug. 2005	SunPower
Panasonic/Sanyo HIP- and HIT- Solar Cells, including but not limited to HIT Power and HIT Double Modules	At least as early as June 2006	Panasonic/Sanyo

REC Solar also understands that Canadian Solar Inc., Hanwha Solutions Corporation, and Hanwha Energy Corporation contend that the Maxeon/SunPower third generation solar cells or otherwise referred to as Generation 3 Solar Cells in some of SunPower's publications, which have been incorporated into SunPower's X-Series solar panels, constitute prior art under AIA 35 U.S.C. §102(a)(1) against the Asserted Claims of the '315 patent. The X-Series solar panel incorporating the Generation 3 Solar Cells was commercially launched by SunPower no later than April 3, 2013. https://newsroom.sunpower.com/press-releases?item=122903. REC Solar understands that Canadian Solar Inc., Hanwha Solutions Corporation, and Hanwha Energy Corporation contend SunPower offered for sale and sold the X-Series solar panels with the Generation 3 Solar Cells more than one year before December 22, 2014, and thus would be prior art under AIA 35 U.S.C. §102(a)(1).

REC Solar further understands that Hanwha Solutions Corporation, and Hanwha Energy Corporation contend that Silevo, Inc's Triex U-Series solar cells constitute prior art under AIA 35 U.S.C. §102(a)(1) against the Asserted Claims of the '315 patent.

Details regarding such offers for sale and public uses would be within the possession of Canadian Solar Inc., Hanwha Solutions Corporation, Hanwha Energy Corporation, Maxeon (including its predecessor SunPower), and third parties. REC Solar incorporates by references the Invalidity Disclosures of Canadian Solar Inc., Hanwha Solutions Corporation, Hanwha Energy Corporation and the documents and information that REC has sought from Maxeon through discovery regarding the disclosures about these products. As discovery progresses, REC Solar intends and reserves the right to promptly supplement and/or amend the lists below to include additional prior art products that anticipate and/or render the asserted claims obvious. To the extent Maxeon contends that any such product does not qualify as prior art to one or more Patents-in-Suit, REC Solar reserves the right to rely on any such product as evidence of simultaneous development as an indicia of obviousness.

For the public uses identified herein, REC Solar is investigating the identities of the individuals who knew about and/or were involved in the making, first public use, offer for sale and/or sale of these products. REC Solar is also investigating the exact date that these products were first made, first publicly used, offered for sale and/or sold. In addition, REC Solar is currently investigating the dates of conception and reduction to practice of these products and when these products were first known or used by others.

In the course of its investigation, REC Solar may identify additional prior art documents describing these products and/or disclosures that may also anticipate and/or render obvious as invalidating printed publications. Any citation to one or more prior art references regarding these products and/or disclosures should be construed to constitute not only a citation to the prior art reference itself, but also a reference to the associated products and/or disclosures.

D. **Prior art under Pre-AIA 35 U.S.C. §§ 101, 102(f), 111, and 116 or AIA 35 U.S.C. §§ 101, 111, and 116**

REC Solar contends that the Asserted Claims are invalid under pre-AIA 35 U.S.C. §§ 101, 102(f), 111, and 116 or AIA 35 U.S.C. §§ 101, 111, and 116 on the grounds that the named inventor(s) of the Patents-in-Suit did not invent the subject matter claimed therein and/or improperly omitted an inventor. *See, e.g., Trovan, Ltd. v. Sokymat SA*, 299 F.3d 1292, 1303 (Fed. Cir. 2002) ("A patent is invalid if more or less than the true inventors are named."). "All that is required of a joint inventor is that he or she (1) contribute in some significant manner to the conception or reduction to practice of the invention, (2) make a contribution to the claimed invention that is not insignificant in quality, when that contribution is measured against the dimension of the full invention, and (3) do more than merely explain to the real inventors well-known concepts and/or the current state of the art." *Pannu v. Iolab Corp.*, 155 F.3d 1344, 1351 (Fed. Cir. 1998). Moreover, "for the conception of a joint invention, each of the joint inventors need not 'make the same type or amount of contribution' to the invention. 35 U.S.C. § 116. Rather, each needs to perform only a part of the task which produces the invention." *Ethicon, Inc. v. United States Surgical Corp.*, 135 F.3d 1456, 1460 (Fed. Cir. 1998). For example, Defendant believes that one or more other people may have invented or contributed to the subject matter claimed in the Patents-in-Suit, whose subject matter qualifies as prior art under pre-AIA 35 U.S.C. § 102(f) or AIA 35 U.S.C. § 101 against one or more of the Patent-in-Suits.

Discovery has only just recently begun, and inventor discovery is forthcoming. Maxeon may have in its possession, custody, or control information related to or pertaining to prior art under pre-AIA 35 U.S.C. §§ 101, 102(f), 111, and 116 or 35 U.S.C. §§ 101, 111, and 116, but has yet to produce that information in discovery. REC Solar will supplement these Invalidity

Contentions if and when Maxeon produces such information and REC Solar has had the opportunity to obtain and analyze that information.

E. Prior art under Pre-AIA 35 U.S.C. § 102(g)

Maxeon has not provided evidence of conception dates earlier than the filing dates of the Patents-in-Suit or the priority dates listed on the faces of the Patents-in-Suit. Should the Court permit Maxeon to provide evidence of an earlier conception date, REC Solar reserves the right to assert that any of the prior art references identified in the sections above as pre-AIA 35 U.S.C. § 102(a) prior art is also pre-AIA 35 U.S.C. § 102(g) prior art. On information and belief, the prior art references identified in the sections above may provide evidence that prior to the effective filing dates the claimed invention was made in this country by another inventor who did not abandon, suppress, or conceal it.

III. P.R. 3-3(b) & (c): Invalidity by Anticipation or Obviousness and Exemplary Invalidity Claim Charts

Subject to the REC Solar's reservation of rights stated in these Invalidity Contentions and based on REC Solar's present understanding of the Asserted Claims and the apparent construction(s)/interpretation(s) that Maxeon is/are asserting based on Maxeon's Complaint and its Infringement Contentions, REC Solar provides below exemplary references and combinations of references that anticipate and/or render obvious the Asserted Claims of the '516 patent in Table 3 (based on Charts A-1 to A-5), exemplary references and combinations of references that anticipate and/or render obvious the Asserted Claims of the '053 patent in Table 4 (based on Charts B-1 to B-2), and exemplary references and combinations of references that anticipate and/or render obvious the Asserted Claims of the '315 patent in Table 5 (based on Charts C-1 to C-6).

Aspects of these Invalidity Contentions are based, in whole or in part, on REC Solar's present understanding of Maxeon's apparent construction(s)/interpretation(s) of the Asserted

Claims based on Maxeon's Complaint and its Infringement Contentions. Given Maxeon's apparent construction(s)/interpretation(s) of the Asserted Claims, REC Solar has attempted to consider those interpretations, but this consideration of Maxeon's construction(s)/interpretation(s) is not an agreement or admission that any of Maxeon's construction(s)/interpretation(s) are correct. To be clear, REC Solar does not agree with Maxeon's Infringement Contentions but are merely offering Invalidity Contentions considering those construction(s)/interpretation(s).

A reference is anticipatory if it describes, either expressly or inherently, each and every claim limitation and enables a person of ordinary skill in the art to practice an embodiment of the claimed subject matter without undue experimentation. A reference may anticipate inherently if a claim limitation that is not expressly disclosed is "necessarily present, or inherent, in the single anticipating reference." *In re Aoyama*, 656 F.3d 1293, 1337 (Fed. Cir. 2011) (*quoting Schering Corp. v. Geneva Pharm.*, Inc., 339 F.3d 1373, 1377 (Fed. Cir. 2003)); *Akami Techs., Inc. v. Cable & Wireless Internet Servs., Inc.*, 344 F.3d 1186, 1195 (Fed. Cir. 2003). Extrinsic evidence may be used to demonstrate the presence of a feature inherent in the reference. *See Telemac Cellular Corp. v. Topp Telecom, Inc.*, 247 F.3d 1316, 1328 (Fed. Cir. 2011). Later evidence may also elucidate the prior art. *Schering*, 339 at 1377.

A claim is obvious when, for example, a person of ordinary skill in the art would have a reason to modify a prior art reference, or combine the teaching of the prior art reference, to achieve the claimed subject matter and would have had a reasonable expectation of success in doing so. *See, e.g., Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). While an analysis of any teaching, suggestion, or motivation to combine elements from different prior art references is useful in an obviousness analysis, the overall inquiry is expansive and flexible, and

includes the common sense and ordinary creativity of a person having ordinary skill in the art. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 419-21 (2007).

The references identified in the exhibits attached to these Invalidity Contentions may disclose the elements of the Asserted Claims explicitly and/or inherently, and/or they may be relied upon to show how the state of the art in the relevant time frame invalidates the asserted patent claims. In some instances, multiple prior art publications discuss the same underlying product. For example, some patents and published patent applications reflect commercial products offered in the market. It would have been obvious to consider and combine the teachings of a patent or patent application that relate to a certain product with the features of that product as provided commercially. Similarly, where multiple publications discuss the same underlying product, it would have been obvious to combine the discussions and disclosures of the publications as they would have been understood to describe features or potential features of the underlying subject matter. Likewise, where one publication discusses another publication, it would have been obvious to consider and combine the teachings of each publication in combination with each other.

REC Solar's contentions that the references in this section, in various combinations, render the Asserted Claims of the Patents-in-Suit obvious under pre-AIA 35 U.S.C. § 103 or AIA 35 U.S.C. § 103 are in no way an admission or suggestion that each reference does not independently anticipate the Asserted Claims under pre-AIA 35 U.S.C. § 102 or AIA 35 U.S.C. § 102. Any of these references may be combined with other disclosed references, the disclosed products, and/or with the knowledge of one of ordinary skill in the art during the relevant time period to render obvious, and, therefore, invalidate, the Asserted Claims of the Patents-in-Suit.

Although REC Solar has identified at least one disclosure of a limitation for each prior art reference, each and every disclosure of the same limitation in the same reference is not necessarily

identified. To focus on the issues, REC Solar cites exemplary and representative portions of an identified reference, even where a reference may contain additional support for a particular claim limitation. Persons of ordinary skill in the art read an item of prior art as a whole and in the context of other publications and literature. Thus, to understand and interpret any specific statement or disclosure within a prior art reference that REC Solar identifies as exemplary and representative, such persons of ordinary skill in the art would rely on other information within the reference, along with other publications and their general scientific or engineering knowledge. As such, REC Solar may rely upon uncited portions of the prior art references and on other publications and expert testimony to provide context, and as aids to understanding and interpreting the exemplary portions that are cited.

A. ’516 Patent

Table 3: Exemplary Anticipatory and Combinations for the Asserted Claims of the ’516 Patent

Chart	Prior Art References
A-1	Abdallah Abdallah with knowledge of a Person of Ordinary Skill in the Art Abdallah and Swanson ’295 Abdallah and Borden ’578 Abdallah, Swanson ’295, and Borden ’578
A-2	Borden ’575 Borden ‘’575 with knowledge of a Person of Ordinary Skill in the Art
A-3	Froitzheim Froitzheim with knowledge of a Person of Ordinary Skill in the Art Froitzheim and Gan Froitzheim and Kwark Froitzheim and Borden ’575 Froitzheim and Borden ’578

Chart	Prior Art References
A-4	Li ’545 Li ’545 with knowledge of a Person of Ordinary Skill in the Art Li ’545 and Gan Li ’545 and Swanson ’295 Li ’545, Gan, and Swanson ’295
A-5	Meier Meier with knowledge of a Person of Ordinary Skill in the Art Meier, Okayasu, and Borden ’578 Meier, Okayasu, and Jordan Meier, Okayasu, Borden ’578, and Jordan Meier, Okayasu, Gan, Foglietti, and Jordan

The prior art identified above, and in the attached ’516 charts, individually anticipate and/or can properly be combined in multiple ways to demonstrate the obviousness of the Asserted Claims of the ’516 patent. Various combinations of the references would have naturally been considered as part of the exercise of ordinary skill by one skilled in the art. The references disclosed in the attached charts and herein are also directed to the same or similar features as the purported invention claimed in the Asserted Claims of the ’516 patent. To the extent Maxeon contends that any of these features solved a problem in the art, the references cited herein show that that problem was known to those of ordinary skill and had already been solved using obvious solutions.

To that end, the Asserted Claims of the ’516 patent simply combine elements already disclosed and well known in the art and yield no more than what one skilled in the art would have expected from such a combination. For example, with respect to the ’516 patent, when confronted with the alleged problems described in the ’516 patent, one of ordinary skill in the art at the time of the alleged invention would have been motivated to consider the techniques taught by the prior art cited in these Invalidity Contentions. Consideration of the teachings of this prior art, both individually and in combination, would necessarily lead to the alleged invention claimed in the

’516 patent. This is demonstrated by the cited prior art, which disclose all of the elements of the Asserted Claims of the ’516 patent, as well as motivations to modify or combine their individual teachings. One of ordinary skill in the art would have been motivated to either modify the prior art identified in the claim charts or to combine that prior art in the manner indicated by, for example, their background knowledge, design incentives, effects of demands known to the design community, or other market forces. Moreover, the cited prior art share commonalities. To the extent it is argued that any cited prior art does not expressly disclose a particular claim or element, it would have been inherent in the disclosure and/or obvious to a person of ordinary skill in the art to include the claimed element to perform the invention as claimed in the ’516 patent.

As described in the attached charts, all the elements of the Asserted Claims of the ’516 patent were commonplace before the alleged date of inventions. For each element, there exists evidence from the cited prior art that it was well known in the art prior to the date of invention. To the extent it is argued that any of the cited prior art references and/or products do not anticipate the Asserted Claims, it would have been obvious to a person of ordinary skill in the art that the Asserted Claims are merely combinations of well-known products resulting in expected results.

Additionally, REC Solar hereby incorporates by reference the motivations to combine references set forth during the prosecution of the ’516 patent, including the statements and reasoning set forth by the examiner, as to why it would have been obvious to modify or combine references to arrive at the limitations of the Asserted Claims of the ’516 patent. REC Solar also incorporates by reference the admissions made in the ’516 patent and/or during prosecution regarding what was already known in the art.

B. ’053 Patent

Table 4: Exemplary Anticipatory and Combinations for the Asserted Claims of the ’053 Patent

Chart	Prior Art References
B-1	Froitzheim Froitzheim with knowledge of a Person of Ordinary Skill in the Art Froitzheim and Gan Froitzheim, Gan, and Haratiti Froitzheim, Gan, and Siviththaman Froitzheim, Gan, and Smith Froitzheim and Kwark Froitzheim, Kwark, and Haratiti Froitzheim, Kwark, and Siviththaman Froitzheim and Smith
B-2	Li ’545 Li ’545 with knowledge of a Person of Ordinary Skill in the Art Li ’545 and Gan Li ’545, Gan, and Haratiti Li ’545, Gan, and Siviththaman Li ’545, Gan, and Smith Li ’545 and Kwark Li ’545, Kwark, and Haratiti Li ’545, Kwark, and Siviththaman

The prior art identified above, and in the attached ’053 charts, individually anticipate and/or can properly be combined in multiple ways to demonstrate the obviousness of the Asserted Claims of the ’053 patent. Various combinations of the references would have naturally been considered as part of the exercise of ordinary skill by one skilled in the art. The references disclosed in the attached charts and herein are also directed to the same or similar features as the purported invention claimed in the Asserted Claims of the ’053 patent. To the extent Maxeon contends that any of these features solved a problem in the art, the references cited herein show that that problem was known to those of ordinary skill and had already been solved using obvious solutions.

To that end, the Asserted Claims of the ’053 patent simply combine elements already disclosed and well known in the art and yield no more than what one skilled in the art would have expected from such a combination. For example, with respect to the ’053 patent, when confronted with the alleged problems described in the ’053 patent, one of ordinary skill in the art at the time of the alleged invention would have been motivated to consider the techniques taught by the prior art cited in these Invalidity Contentions. Consideration of the teachings of this prior art, both individually and in combination, would necessarily lead to the alleged invention claimed in the ’053 patent. This is demonstrated by the cited prior art, which disclose all of the elements of the Asserted Claims of the ’053 patent, as well as motivations to modify or combine their individual teachings. One of ordinary skill in the art would have been motivated to either modify the prior art identified in the claim charts or to combine that prior art in the manner indicated by, for example, their background knowledge, design incentives, effects of demands known to the design community, or other market forces. Moreover, the cited prior art share commonalities. To the extent it is argued that any cited prior art does not expressly disclose a particular claim or element, it would have been inherent in the disclosure and/or obvious to a person of ordinary skill in the art to include the claimed element to perform the invention as claimed in the ’053 patent.

As described in the attached charts, all the elements of the Asserted Claims of the ’053 patent were commonplace before the alleged date of inventions. For each element, there exists evidence from the cited prior art that it was well known in the art prior to the date of invention. To the extent it is argued that any of the cited prior art references and/or products do not anticipate the Asserted Claims, it would have been obvious to a person of ordinary skill in the art that the Asserted Claims are merely combinations of well-known products resulting in expected results.

Additionally, REC Solar hereby incorporates by reference the motivations to combine references set forth during the prosecution of the ’053 patent, including the statements and reasoning set forth by the examiner, as to why it would have been obvious to modify or combine references to arrive at the limitations of the Asserted Claims of the ’053 patent. REC Solar also incorporates by reference the admissions made in the ’053 patent and/or during prosecution regarding what was already known in the art.

C. ’315 Patent

Table 5: Exemplary Anticipatory and Combinations for the Asserted Claims of the ’315 Patent

Chart	Prior Art References
C-1	Choi ’567 Choi ’567 with knowledge of a Person of Ordinary Skill in the Art Choi ’567, Grancek, and Istratov Choi ’567, Marvin 1989, and Istratov Choi ’567, Muller, and Istratov Choi ’567, Grancek, Hu, and Ramappa Choi ’567, Marvin 1989, Hu, and Ramappa Choi ’567, Muller, Hu, and Ramappa
C-2	Cousins ’444 Cousins ’444 with knowledge of a Person of Ordinary Skill in the Art Cousins ’444, Grancek, and Istratov Cousins ’444, Marvin 1989, and Istratov Cousins ’444, Grancek, Hu, and Ramappa Cousins ’444, Marvin 1989, Hu, and Ramappa
C-3	Heng Heng with knowledge of a Person of Ordinary Skill in the Art Heng and Istratov Heng and Rohatgi Heng, Istratov, and Rohatgi
C-4	Ji ’400 Ji ’400 with knowledge of a Person of Ordinary Skill in the Art Ji ’400 and King Ji ’400, King, and Istratov Ji ’400, King, and Rohatgi

C-5	Li ’719 Li ’719 with knowledge of a Person of Ordinary Skill in the Art Li ’719 and King Li ’719, King, Hu, and Ramappa Li ’719 and Swanson ’352 Li ’719, Swanson ’352, Hu, and Ramappa Li ’719 and Marvin 1989 Li ’719, Marvin 1989, Hu, and Ramappa Li ’719 and Muller Li ’719, Muller, Hu, and Ramappa
C-6	Park Park with knowledge of a Person of Ordinary Skill in the Art Park and Wu Park, Wu, and Istratov Park, Wu, and Rohatgi

The prior art identified above, and in the attached ’315 charts, individually anticipate and/or can properly be combined in multiple ways to demonstrate the obviousness of the Asserted Claims of the ’315 patent. Various combinations of the references would have naturally been considered as part of the exercise of ordinary skill by one skilled in the art. The references disclosed in the attached charts and herein are also directed to the same or similar features as the purported invention claimed in the Asserted Claims of the ’315 patent. To the extent Maxeon contends that any of these features solved a problem in the art, the references cited herein show that that problem was known to those of ordinary skill and had already been solved using obvious solutions.

To that end, the Asserted Claims of the ’315 patent simply combine elements already disclosed and well known in the art and yield no more than what one skilled in the art would have expected from such a combination. For example, with respect to the ’315 patent, when confronted with the alleged problems described in the ’315 patent, one of ordinary skill in the art at the time of the alleged invention would have been motivated to consider the techniques taught by the prior art cited in these Invalidity Contentions. Consideration of the teachings of this prior art, both

individually and in combination, would necessarily lead to the alleged invention claimed in the ’315 patent. This is demonstrated by the cited prior art, which disclose all of the elements of the Asserted Claims of the ’315 patent, as well as motivations to modify or combine their individual teachings. One of ordinary skill in the art would have been motivated to either modify the prior art identified in the claim charts or to combine that prior art in the manner indicated by, for example, their background knowledge, design incentives, effects of demands known to the design community, or other market forces. Moreover, the cited prior art share commonalities. To the extent it is argued that any cited prior art does not expressly disclose a particular claim or element, it would have been inherent in the disclosure and/or obvious to a person of ordinary skill in the art to include the claimed element to perform the invention as claimed in the ’315 patent.

As described in the attached charts, all the elements of the Asserted Claims of the ’315 patent were commonplace before the alleged date of inventions. For each element, there exists evidence from the cited prior art that it was well known in the art prior to the date of invention. To the extent it is argued that any of the cited prior art references and/or products do not anticipate the Asserted Claims, it would have been obvious to a person of ordinary skill in the art that the Asserted Claims are merely combinations of well-known products resulting in expected results.

Additionally, REC Solar hereby incorporates by reference the motivations to combine references set forth during the prosecution of the ’315 patent, including the statements and reasoning set forth by the examiner, as to why it would have been obvious to modify or combine references to arrive at the limitations of the Asserted Claims of the ’315 patent. REC Solar also incorporates by reference the admissions made in the ’315 patent and/or during prosecution regarding what was already known in the art.

D. **Rationales for Combining Disclosures**

To the extent a finder of fact determines that a limitation of any Asserted Claim was not disclosed by one of the prior art references, systems, and products identified herein, REC Solar contends that the claim is nonetheless unpatentable as obvious for failing to constitute a patentable invention. For example, the Asserted Claims do not go beyond combining familiar elements according to known methods to achieve predictable results and do no more than choose between alternatives known to those of ordinary skill in the art and/or inherent in the prior art. To the extent one or more of the Asserted Claims recites a particular range or amount of a given variable, they are presumptively obvious at least because the claimed range or amount overlaps, lies inside ranges or amounts disclosed in the prior art, or is sufficiently close to ranges or amounts disclosed in the prior art that a person of ordinary skill in the art would have expected them to have the same properties. *See, e.g.*, *In re Wertheim*, 541 F.2d 257 (C.C.P.A. 1976); *In re Woodruff*, 919 F.2d 1575 (Fed. Cir. 1990); *Titanium Metals Corp. of Am. v. Banner*, 778 F.2d 775 (Fed. Cir. 1985). Moreover, each value or amount claimed in the Asserted Claims is of a known result effective variable and "discovery of an optimum value of a variable in a known process is usually obvious." *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1368 (Fed. Cir. 2007); *see also In re Aller*, 220 F.2d 454, 456 (C.C.P.A. 1955) ("[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."); *In re Boesch*, 617 F.2d 272, 276 (C.C.P.A. 1980) ("[D]iscovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."); *In re Geisler*, 116 F.3d 1465, 1470 (Fed. Cir. 1997) ("[I]t is not inventive to discover the optimum or workable ranges by routine experimentation." (*quoting Aller*, 220 F.2d at 456)).

One or more combinations of the prior art references, systems, and products identified herein would have been obvious because these prior art references, systems, and products would

have been combined using: known methods to yield predictable results; known techniques in the same way; a simple substitution of one known, equivalent element for another to obtain predictable results; and/or a teaching, suggestion, or motivation in the prior art generally. In addition, it would have been obvious to try combining the prior art references, systems, and products identified above, e.g., because there were only a finite number of predictable solutions and/or because known work in one field of endeavor prompts variations based on predictable design incentives and/or market forces either in the same field or a different one. In addition, the combinations of the prior art references, systems, and products identified above would have been obvious because the combinations represent the known potential options with a reasonable expectation of success. Further, the claimed subject matter would have been obvious based on the obvious optimization of one or more variables disclosed in the prior art references, systems, and products to, for example, determine optimum or workable ranges because the prior art recognizes the one or more variables as result-effective (e.g., as achieving a recognized result). *See, e.g.*, *In re Antonie*, 559 F.2d 618 (C.C.P.A. 1977); *see also KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007).

Motivation to combine any two or more of the identified prior art references, systems, and/or products comes from the fact that one skilled in the art would have been motivated by considerations of efficiency, effectiveness, convenience, cost-savings, power savings, and accessibility, to combine the various teachings. Additional evidence that there would have been a motivation or reason to combine the prior art references and/or products identified above includes the interrelated teachings of multiple prior art disclosures; the effects of demands known to the design community or present in the marketplace; the existence of a known problem for which there was an obvious solution; the existence of a known need or problem in the field of endeavor at the time of the invention; and the background knowledge that would have been possessed by a person

having ordinary skill in the art. For example, the prior art references and/or products are generally directed to the same or similar problems. Some prior art references and/or products expressly incorporate others by reference or are authored by the same inventor. Thus, a skilled artisan seeking to solve these known problems in and/or make improvement to the art would have looked to these cited disclosures in combination.

The motivation or reason, and reasonable expectation of success, to combine the teachings of the prior art references and/or products disclosed herein is found in the references and products themselves and in: (1) the nature of the problem being solved; (2) the express, implied, and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the fact that the prior art is generally directed towards the same problem; (5) the predictable results obtained in combining the different elements of the prior art; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions having a reasonable expectation of success; and/or (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces. Additionally, one of ordinary skill in the art would have been motivated, with a reasonable expectation of success, to address at least these alleged problems or achieve the purported objectives identified in the description of the Patents-in-Suit.

The Supreme Court has explained: "[A]s progress beginning from higher levels of achievement is expected in the normal course, the results of ordinary innovation are not the subject of exclusive rights under the patent laws. Were it otherwise patents might stifle, rather than promote, the progress of useful arts." *KSR*, 550 U.S. at 427.

No showing of an express motivation to combine prior art is required to combine the prior art references and products disclosed above and in the attached charts, as each combination of art would have no unexpected results, and at most would simply represent a known alternative to one of ordinary skill in the art. *See KSR*, 550 U.S. at 415-16 (rejecting the Federal Circuit's "rigid" application of the teaching, suggestion, or motivation to combine test, instead espousing an "expansive and flexible" approach). That said, the Supreme Court's rationale, that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle," applies equally here. *Id*. at 420-21.

While no express showing of motivation to combine the prior art references and products is required, in addition to the information contained in the section(s) above and elsewhere in these contentions, REC Solar hereby identifies additional, non-limiting exemplary motivations to combine the prior art references, systems, and products are provided herein with respect to one or more of the Patents-in-Suit:

1. The '516 and '053 Patents

Prior to the alleged invention of the '516 and '053 patents, the concept and structure of "back side emitter solar cells" had been well-known in the art. *See, e.g.*, Froitzheim at ¶ 8; Meier at 2:33-44. A person of ordinary skill in the art would have understood an emitter to be the portion of the solar cell that is oppositely doped from the substrate. *See, e.g.*, '516 and '053 patent prosecution histories; Luque at 258, 264, 266. A skilled artisan would have also recognized that there are well-known methods to create an emitter on a solar cell. For example, these include diffusing dopants into an oppositely doped substrate or depositing an oppositely doped semiconductor layer onto one side of the substrate. Before the invention of the '516 and '053 patents the art was moving away from forming an emitter through a diffusion process of opposite

doping into the substrate directly and towards using deposition of oppositely doped semiconductors. For example, Gan teaches a method of a solar cell fabrication that includes the steps of "[p]olysilicon deposition" followed by "[d]oped glass deposition" and a drive-in step. Gan at 246.

Indeed, as early as 1984, it would have been recognized in the art that replacing diffused emitters with deposited polysilicon emitters would improve semiconductor devices. Ashburn at 853. For example, the use of a polysilicon emitter with an interfacial oxide layer was first used to improve the performance of bipolar transistors. *See, e.g.*, Rahim at 2506; Parekh at 3167; Wolstenholme at 232; Green-1995 at 218. Soon after, this polysilicon emitter-oxide structure was being used to improve other semiconductor devices, such as solar cells. Yablonovitch at 597 ("There have been a considerable number of reports recently on improved bipolar transistor emitters made of polycrystalline silicon. . . . Such heterojunctions are valuable not only for emitter efficiency in bipolar transistors, but also for solar cells"); Kwark at 742 ("Incorporation of these films into the emitter structure of an NPN bipolar transistor . . . translates into potential improvements of energy conversion efficiency for solar cells . . . ."); Sinton at 2122, Fig. 9 ("It is interesting to project what should be possible if the best available emitter technology were applied to point contact cells rather than the diffused emitters from the current process."); Farrokh-Baroughi, 5-6; Lubberts, 6877, Gan at 245, 249 ("cell performance can be improved if the diffused-emitter is replaced with the polysilicon emitter" even in "backside contact solar cells"); Sinton at 2122, Fig. 9 (reproduced below).

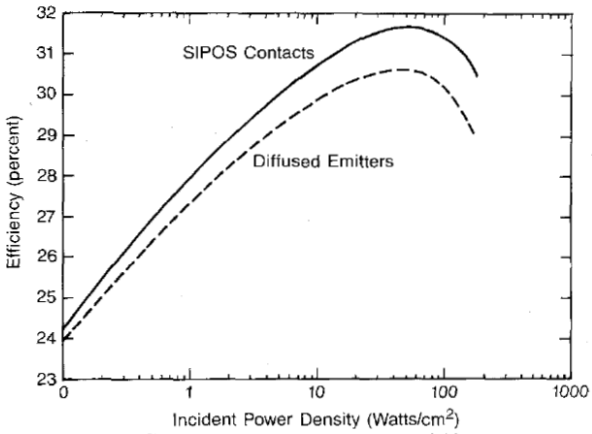


Fig. 9. A comparison of the projected efficiencies possible for a cell incorporating SIPOS emitters (solid curve), compared to projections for diffused emitters as used to date (dashed curve).

At this time, skilled artisans were also developing polysilicon emitter solar cells with interfacial oxide layers. *See* Gan at 245; Kwark at 742-43. Indeed, several years before the alleged invention of the ’516 and ’053 patents, SunPower had already filed several applications related to polysilicon emitters. Smith at Abstract, 4:18-6:33; Swanson ’485 at Abstract, 7:4-8:54; Swanson ’295 at Abstract, 3:34-4:36. Moreover, this structure was also being applied by skilled artisans to solar cells having heterojunction with intrinsic layers. *See* Borden ’578, Provisional at Abstract; Borden ’578 at Abstract; Borden ’575, Provisional at Abstract; Borden ’575 at Abstract. Skilled artisans were well versed in the techniques to form polysilicon emitters before the invention of the ’516 and ’053 patents. Yablonovitch at 597; Kwark at 742; Sinton at 2122; Gan at 245, 249; Borden ’578 at Abstract; Borden ’575 at Abstract. Indeed, the ’053 patent tacitly admits that a skilled artisan would have understood how to manufacture these layers, as it describes them without specific implementation details. *Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1339 (Fed. Cir. 2020) (specification’s silence “suggest[s] that a [POSA] was more than capable of selecting between the known methods”).

Moreover, prior to the alleged invention of the ’516 and ’053 patents, the concepts and structures of textured surfaces and antireflective layers had been well known in the art. *See* Luque

at 268-269; *see also*, Froitzheim at ¶ 39 ("[E]tching can be used to texture the surface in order to improve the geometry of incidence of light in order to prevent reflection."); Li '545 at 4 ("At least one surface of the front surface or the back surface of the structure can be subjected to texturing treatment to reduce light reflection and improve a light trapping effect, which is conducive to improving the photoelectric conversion efficiency of the cell."); Jordan at 22 ("Texturing generally increases the efficiency of the resulting photovoltaic cell by increasing light absorption.").

Additionally, prior to the alleged invention of the '516 and '053 patents, the concepts of diffusing n-type and p-type dopants into solar cell structures was well known in the art. *See, e.g.*, Benick at Abstract ("Emitter formation by in-line deposition of a PECVD PSG and subsequent diffusion in an in-line belt furnace."); Froitzheim at ¶¶ 11 ("diffusion from a p-type dopant from a liquid that is applied to the rear side"), 22, 24-26, 32-33, 41-44; Smith at 3:40-68 (depositing boron-doped silicon dioxide ("BSG") and phosphorus-doped silicon dioxide and diffusing dopants into a wafer); Gan at 245-46; Sivohthaman at 621-22; Hartiti at 1519-20; Komp at 11, Nelson at 181-82, 187. For example, dopant diffusion can be accomplished through the use of, for example, applying a gas dopant or applying a dopant source and then heating the structure to drive dopants into the layer below the dopant source. *See, e.g.*, Gan, 245-46; Froitzheim, ¶ 40.

As discussed in greater detail below, a person of ordinary skill in the art would have been motivated to combine with a reasonable expectation of success the teachings of the prior art, including that charted in Exhibits A and B, to reach the purported inventions of the asserted claims of the '516 and '053 patents. Among other reasons, a skilled artisan would have been motivated to make such combinations because doing so would have improved the problems of efficiency and cost-effectiveness of solar cell designs. *See, e.g.*, Li '545 at 3-4 ("[I]mprovement of the cell efficiency and simplification of processes can make up for adverse influence caused by increase

of material costs.”). Such combinations would have involved applying known solar cell designs such as a polysilicon emitter, oxide layer, textured front surface, antireflective layer, dopant sources, and diffusion to a back junction solar cell. Such combinations would have required only routine skill and techniques to implement. Such designs and their usage were widely known long before the purported invention of the ’516 and ’053 patents.

In view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art, one of ordinary skill in the art would know have been motivated to replace a diffused emitter structure of a solar cell with a polysilicon emitter. As described above, it was well known before the alleged invention of at least the ’516 patent to use a doped polysilicon layer in a solar cell rather than diffuse dopant into the substrate to form an emitter. *See e.g.*, Gan at 245 (“Consequently, the cell performance can be improved if the diffused-emitter is replaced with the polysilicon emitter, of which the J_0 is less than 4.5 x 10^{-13} A/cm^2 and the ρ_c = is low enough.”); Okayasu at ¶ 44; Kwark at 743; Borden ’578 at ¶ 16 (explaining “that tunnel oxides can be used between a heavily doped or insulating layer of polysilicon and a crystal silicon substrate, forming a polysilicon emitter solar cell”), and Borden ’575 at ¶ 7 (“[T]he invention places a buried oxide under the emitter of a polysilicon emitter solar cell.”). The prior art taught, for example, that a polysilicon emitter can replace a diffused emitter by “CVD method[s]” or “ion plating method[s]”. Okayasu at ¶¶ 42-43, 47-48; Kwark at 742. A skilled artisan would have appreciated that the deposition of the polysilicon emitter could be performed at lower temperatures and allow for more accurate control of emitter thickness. *See, e.g.*, Okayasu at ¶¶ 5-8, 44. Additionally, the art taught that such a modification improved solar cell efficiency. Gan at 245, 248-49, Fig. 6. Therefore, replacing a diffused emitter with a polysilicon emitter would have been

nothing more than a simple substitution of one known element for another to obtain predictable results with a reasonable expectation of success.

Furthermore, there would have been a reasonable expectation of success in swapping a diffused emitter for a polysilicon emitter in a solar cell. The swap would have merely required the use of well-known and well-understood solar cell components, the function and operation of which would have been readily understood, and which could have been implemented with no more than the exercise of ordinary skill. Fabrication methods and the components for solar cells had also been well-known, and a skilled artisan would have understood how to implement these common-place methods.

In view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art, it would also have been obvious to a person of ordinary skill in the art to add an oxide layer between the substrate of a solar cell and the polysilicon emitter. As described above, it was well known before the alleged invention of at least the ’516 patent to incorporate an oxide layer between a substrate and a polysilicon layer emitter. Indeed, some even recognized that “[i]t was found that, between the polysilicon and the substrate, always exists a very thin oxide (interfacial oxide).” Gan at 245; Foglietti, ¶ 46 (“the wafer has the single crystal substrate 250 and an interfacial oxide 260 formed thereon in accordance with the present invention and a polysilicon layer 262 lies thereover”). Thus, the incorporation of an oxide layer between a polysilicon emitter and a substrate would have been no more than a combination of prior art elements according to known methods to yield predictable results.

A skilled artisan would have also recognized that an oxide layer between a polysilicon emitter and a substrate provides beneficial properties to a solar cell. For example, an oxide layer can passivate the surface of another layer. Borden ’575 at ¶ 7. Passivation is important to minimize

recombination losses, among other purposes. Froitzheim at ¶¶ 10-11, 17-21, 33. Additionally, an oxide layer can further provide tunneling properties, where certain carriers are allowed to pass through what would ordinarily be considered an insulating layer. *See, e.g.*, Komp at 23 ("Current carriers pass through this insulator by a quantum mechanical process called tunneling. . . . If the insulating layer is one of the proper thickness, around 20 Å, the open-circuit voltage of a cell can be increased without any significant loss in short-circuit current."); Borden '575 at ¶ 22; Gan at 245; Kwark (1987) at 1125; Yablonovitch '593 at 3:61-64; Yablonovitch-1985 at 1212-13. When combined with a polysilicon layer, the oxide layer improves emitter saturation current density (J_o) and solar cell efficiency. Gan at 245 (explaining that "the cell performance can be improved if the diffused-emitter is replaced with the polysilicon emitter, of which the J_0 is less than 4.5 x 10^{-13} A/cm^2 and the ρ_c = is low enough."), 249, Fig. 6 (reproduced, annotated below).

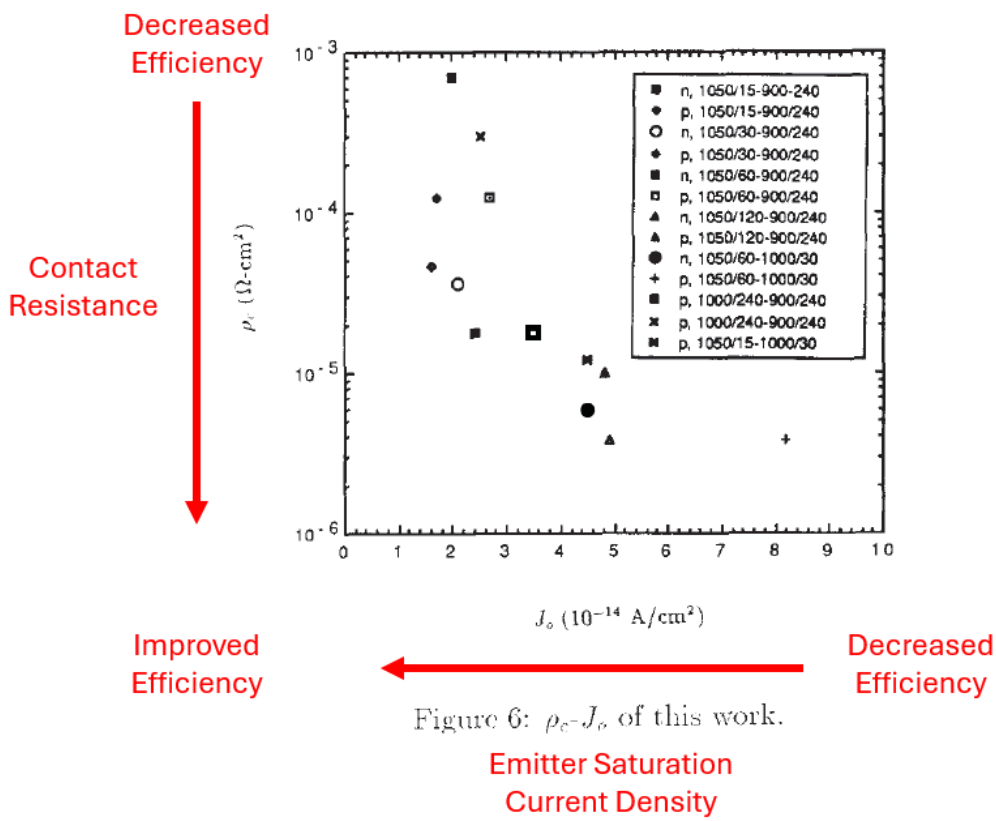


Figure 6: ρ_c-J_o of this work.

The addition of an interfacial oxide between polysilicon and the substrate "greatly decreases the J_{oe}," which "translates into potential improvements of energy conversion efficiency for solar cells." Kwark at 742, 745, Fig. 4 (reproduced and annotated below, noting "the large difference when the interfacial oxide is missing").

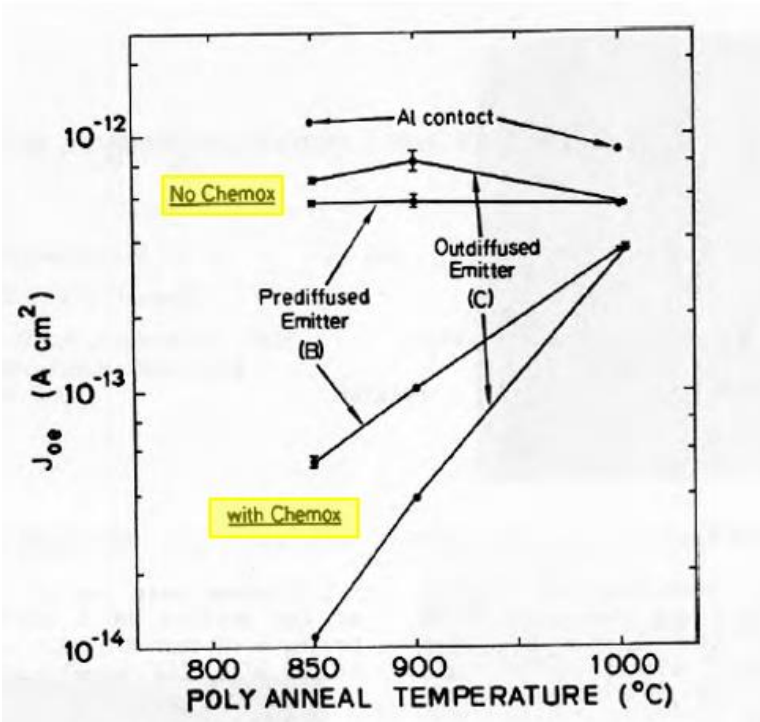


Fig. 4: emitter saturation current for POLY contacts with and without a chemically grown interfacial layer vs. anneal temperature. Thicknesses range from 3000-3600 angstroms. Note the large difference when the interfacial oxide is missing.

Further, a skilled artisan would have further been motivated to include a polysilicon emitter because fabricating this structure could be performed at lower temperatures. Okayasu at ¶¶ 5-8, 44.

Moreover, a skilled artisan would have been motivated to include an oxide layer because adding one would further prevent growth of amorphous silicon and protect the substrate from damage during deposition of the emitter. Borden '578 at ¶¶ 8, 15, 22. Indeed, the techniques to

modify the steps of forming the emitter through diffusion with forming an oxide layer and then forming a layer of polysilicon over the oxide layer were known. For example, Gan teaches a method a solar cell fabrication that includes the steps of "[t]hin thermal oxide growth" followed by "[p]olysilicon deposition." Gan at 246.

Therefore, adding an oxide layer between a substrate and a polysilicon layer would have been nothing more than a combination of prior art elements according to known methods to yield predictable results, and applying a known technique to a known device (method, or product) ready for improvement to yield predictable results. Moreover, a skilled artisan would have understood that it would be a simple design choice to modify or replace the structure of or steps of forming the emitter through diffusion with forming an oxide layer and then forming a layer of polysilicon over the oxide layer. The methods of forming emitters comprise compatible manufacturing processes. Indeed, little to no new equipment would be needed to accomplish this modification. Froitzheim at ¶¶ 42, 87; Li '545 at 4; Gan at 246; Kwark at 242-43. However, even if a skilled artisan would have thought that additional steps were required to implement a polysilicon emitter and oxide layer structure, motivation existed due the known increase in efficiency.

Furthermore, there would have been a reasonable expectation of success when including an oxide layer between the polysilicon emitter and substrate. The addition of the oxide layer would have merely required the use of well-known and well-understood solar cell components, the function and operation of which would be readily understood, and which could have been implemented with no more than the exercise of ordinary skill. Fabrication methods and the components for solar cells had also been well-known, and a skilled artisan would have understood how to implement these common-place methods.

Additionally, in view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art, it would have been obvious to a person of ordinary skill in the art to modify the structure of a solar cell having a heterojunction with an intrinsic thin layer (HIT) to include an oxide layer and a polysilicon emitter. Moreover, the skilled artisan would have been motivated to incorporate an oxide layer into a HIT structure even without a polysilicon emitter layer because the art recognized that "thin tunnel oxide layers can be used in solar cells." Borden '578 at ¶ 16. Indeed, Borden '578 incorporated an oxide layer between its substrate and an intrinsic layer/amorphous silicon emitter layer. *Id.* Thus, the incorporation of an oxide layer into HIT solar cells would have been no more than a combination of prior art elements according to known methods to yield predictable results.

Furthermore, there would have been a reasonable expectation of success to incorporate an oxide layer and/or a polysilicon emitter in a HIT solar cell for the same reasons described above. Indeed, doing so would have merely required the use of well-known and well-understood solar cell components, the function and operation of which would be readily understood, and which could have been implemented with no more than the exercise of ordinary skill. Fabrication methods and the components for solar cells had also been well-known, and a skilled artisan would have understood how to implement these common-place methods.

It would also have been obvious to a person of ordinary skill in the art to texturize the front surface of the substrate of a solar cell in view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art. As described above, it was well known before the alleged invention of at least the '516 patent to texturize the front surface of the substrate of a solar cell. A skilled artisan would have been motivated to do so at least because texturizing increases light absorption, which in turn increases the efficiency of the solar cell.

Jordan at 22. Texturing a substrate's front surface would have been no more than applying a known technique to a known device ready for improvement to yield predictable results; and/or the use of a known technique to improve similar devices in the same way.

Furthermore, there would have been a reasonable expectation of success in texturizing the front surface of substrate of a solar cell. Indeed, doing so would have merely required the use of well-known and well-understood solar cell components, the function and operation of which would have been readily understood, and which could have been implemented with no more than the exercise of ordinary skill. Fabrication methods and the components for solar cells were well-known, and a skilled artisan would have understood how to implement these common-place methods.

In view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art, when fabricating a solar cell having a backside diffused emitter, it would have been obvious to a person of ordinary skill in the art to include the steps of forming a dopant source layer and diffusing dopants from the dopant source to form a polysilicon emitter. As described above, it was well known before the alleged invention of at least the '053 patent to deposit a polysilicon emitter layer in a solar cell rather than diffuse dopants directly into the substrate to form an emitter. For example, it had been well known that dopant source layers could be applied over polysilicon layers and dopants diffused into the polysilicon to transform the polysilicon into an emitter and form a junction with the substrate. *See, e.g.*, Gan at 246 (describing solar cell fabrication that includes the steps of "[d]oped glass deposition on both sides of the wafer" followed by driving in the dopants). A skilled artisan would have been motivated to implement this method. For example, doing so would have improved the overall efficiency of the solar cell compared to emitters that are diffused directly into the substrate. Gan at 245-49. A person of

ordinary skill in the art would have also found this method obvious to try as it does not involve varying all parameters, the art provides specific guidance on which parameters to vary, and doing so would not involve exploring new technologies. Gan, 245-49; Froitzheim at ¶¶ 11, 22, 24-26, 32-33, 41-44; Smith at 1:44-57, 3:40-68; Sivoththaman at 621-22; Hartiti at 1519-20. Therefore, this modification is no more than a use of a known technique to improve similar methods in the same way and applying a known technique to a known method ready for improvement to yield predictable results.

In view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art, when fabricating a solar cell having a backside diffused emitter, it would also have been obvious to a person of ordinary skill in the art to include the step of diffusing dopants into the front surface of a substrate to form a front surface field. As described above, diffusion of dopants into solar cells was well known within the art. *See, e.g.*, Benick at Abstract; Froitzheim at ¶¶ 11, 22, 24-26, 32-33, 41-44; Smith, 3:40-68; Gan at 245-46; Sivoththaman at 621-22; Hartiti at 1519-20. Diffusion can be accomplished through the use of, for example, applying a gas dopant or utilizing a dopant source layer. *See, e.g.*, Gan, 245-46; Froitzheim, ¶ 40. A skilled artisan would have been motivated to diffuse dopants into the front surface of a substrate at least to create a front surface field that would be involved in the collection of a minority carriers.

For example, a person of ordinary skill in the art would have known how to use p-type dopants so as to form a polysilicon emitter for a n-type doped substrate or to form front surface field for the front surface of a p-type doped substrate. One well-known technique for diffusing p-type dopants includes borosilicate glass ("BSG") diffusion. This technique involved forming a layer of BSG on the surface of the substrate (or a polysilicon layer) and then applying heat to drive

boron from this dopant source layer into the surface below. Smith at 2:44-4:2; Froitzheim at ¶¶ 40-41; Kerr at 153-155; Sivoththaman at 622; (using "either APCVD borosilicate glass (BSG), or evaporated aluminum . . . as RT-diffusion sources"); Hartiti at 1519 (disclosing "boron doped AP-CVD oxides"). A person of ordinary skill in the art therefore would have known this technique to be nothing more than the combination of prior art elements according to known methods to yield predictable results, the use of a known technique to improve similar methods in the same way; or applying a known technique to a known method ready for improvement to yield predictable results.

Furthermore, there would have been a reasonable expectation of success when either forming a dopant source layer and diffusing dopants from the dopant source into the polysilicon layer to form a polysilicon emitter or diffusing dopants into the front surface of a substrate. These similar techniques would have merely required the use of well-known and well-understood solar cell fabrication techniques, the function and operation of which would have been readily understood, and which could have been implemented with no more than the exercise of ordinary skill.

It would have been obvious to a person of ordinary skill in the art to diffuse dopants into the front and back sides of a solar cell at the same time in view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art. Simultaneous, or "in-situ," diffusion of dopants was well known in the art. *See, e.g.*, Gan at 245-46 (teaching "[d]oped glass deposition on both sides of the wafer" followed by driving in the dopants); Smith at 3:66-4:2 (fabricating a solar cell with *in situ* diffusion of different types of dopants to the frontside and the backside of the solar cell); Sivoththaman at 621 ("A commercial RTP furnace was used."); Hartiti at 1519 (using a "model FAV4 of Jipelec (Grenoble, France)."). A skilled artisan would have been motivated to combine either technique into other solar cell fabrication

methods because doing so would have "simplifie[d] the fabrication process." Smith at 4:1-2. Indeed, by simultaneously driving dopants on both sides of cell, a method of fabrication would have one less annealing step. A person of ordinary skill in the art therefore would have known this step to be nothing more than the use of a known technique to improve similar methods in the same way or applying a known technique to a known method ready for improvement to yield predictable results.

Furthermore, there would have been a reasonable expectation of success in conducting in-situ doping because doing so would require only the use of well-known and well-understood solar cell fabrication techniques, the function and operation of which would have been readily understood, and which could have been implemented with no more than the exercise of ordinary skill.

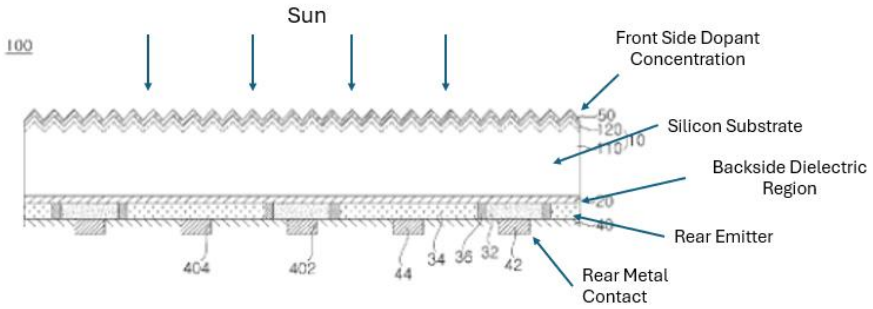
Accordingly, one of ordinary skill would have been motivated to develop a back side emitter solar cell that uses the combination of these features in the same way allegedly disclosed in the '516 and '053 patents, and to do so with a reasonable expectation of success using methodologies that were commonly understood in the art. The prior art references identified herein, individually and in combination, demonstrate that each of the purported features of the '516 and '053 patents were known to those of ordinary skill in the art. A skilled artisan would have readily understood that to design an efficient back emitter solar cell, it would have to identify and be aware of a (1) the type of back emitter, (2) the need for passivation or tunneling features (e.g., oxide layers), (3) the benefits of using a textured surface, and (4) the use of different doping methods and different dopants. Thus, a person of ordinary skill in the art would have readily recognized and appreciated that including these capabilities in a back emitter solar cell would have provided functionalities that are desirable, if not necessary.

Further, each of the references cited in Exhibits A and B are directed to the same, or similar, fields of endeavor. In particular, the cited prior art references relate to design of solar cells and fabrication techniques to increase solar cell efficiency. In addition, each reference is directed to solving the same, or similar, problems: generating an efficient, high integrity, reliable, and robust solar cell. With these shared goals in mind, and a limited number of options available to assist in achieving that objective, a person of ordinary skill in the art would have been motivated to consider the disclosed techniques and systems and combine their teachings to develop the alleged inventive systems claimed in the ’516 and ’053 patents.

2. The ’315 Patent

Prior to the alleged invention of the ’315 patent, the concept and structure of “back contact solar cells” had been known by persons of ordinary skill in the art for decades. Notably, a person of ordinary skill in the art would have understood that a back contact solar cell has a front side that faces the sun, and the backside of the solar cell consists of a silicon substrate, backside dielectric region, a rear emitter, and a rear metal contact. *See, e.g.*, Li ’719. Exemplary disclosures are legion. Li ’719 at ¶ 39 (disclosing a “back-contact solar cell 300 [which] further includes a dielectric film 320 disposed directly between material layer 302 and substrate 304”); Choi ’567 at ¶ 23 (disclosing a “solar cell” with a “tunneling layer 20 formed on one surface (for example, back surface) of the

FIG. 1



semiconductor substrate 10, and a first conductive type area 32, a second conductive type area 34 and a barrier area 36 formed on the tunneling layer 20" that "further includes first and second electrodes 42 and 44 which are connected to first and second conductive type areas 32 and 34"), Figure 1 (annotated, below);

Ji '400 at ¶ 17 (disclosing a solar cell where "[t]he tunnel layer, the emitter region, and the dopant layer may be positioned on a back surface of the semiconductor substrate"); Cousins '444 at Claim 1 (claiming a "solar cell comprising: a silicon substrate; a first layer of doped polysilicon formed over a back surface of the substrate, the first layer of doped polysilicon forming a backside junction with the substrate; a second layer of doped polysilicon formed over a front surface of the substrate, the second layer of doped polysilicon making an electrical connection to the substrate"); Heng at ¶ 29 ("The back junction solar cell further includes a thin dielectric layer functioning as an interface passivation layer"); Park at ¶ 35 (disclosing a solar cell where the "tunneling layer 20 may be entirely formed on the rear surface of the semiconductor substrate 10" so the "tunneling layer 20 completely passivates the rear surface of the semiconductor substrate 10."); *see also* Marvin, Muller, and Wu.

Luque's Handbook of Photovoltaic Science and Engineering published in 2003 disclosed a basic "[s]chematic of a back-contact solar cell," showing that the front side facing the sun has no metal contacts and the opposite/back side contains P-type and N-type doped regions, with both the positive and negative metal contacts formed at the backside and contacting the doped regions, respectively:

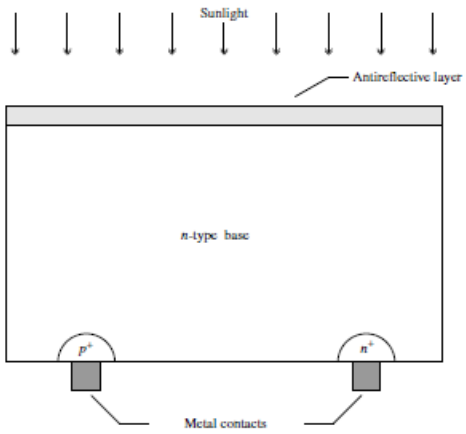


Figure 3.26 Schematic of a back-contact solar cell

Luque at Figure 3.26, 108. Similarly, Neuhaus in 2007 recognized "[k]ey design features that contribute to high efficiency" back-contact solar cells include "localized back contacts" and "a gridless front surface which permits optimization of light trapping and passivation," as shown in the "IBC solar cell structure" of Neuhaus Figure 8. Neuhaus at 11. As shown below, the front side of Neuhaus Figure 8 included a "n^+ front surface field," having the same dopant type as the "n-type substrate," and silicon oxide and silicon nitride passivation layers on top.

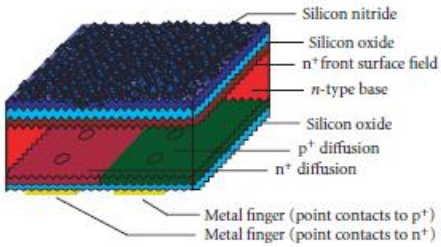
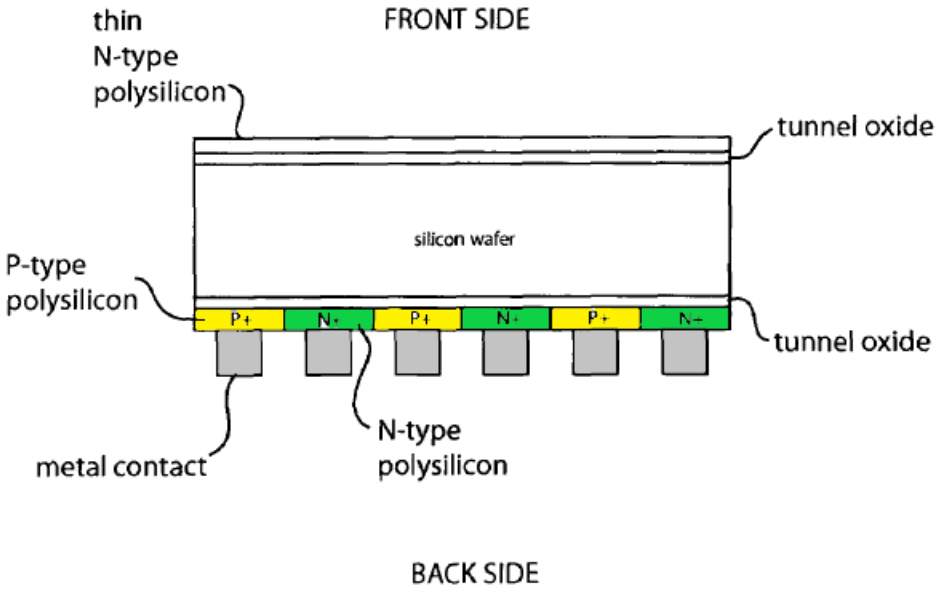


FIGURE 8: Schematic drawing of an IBC solar cell of SunPower.

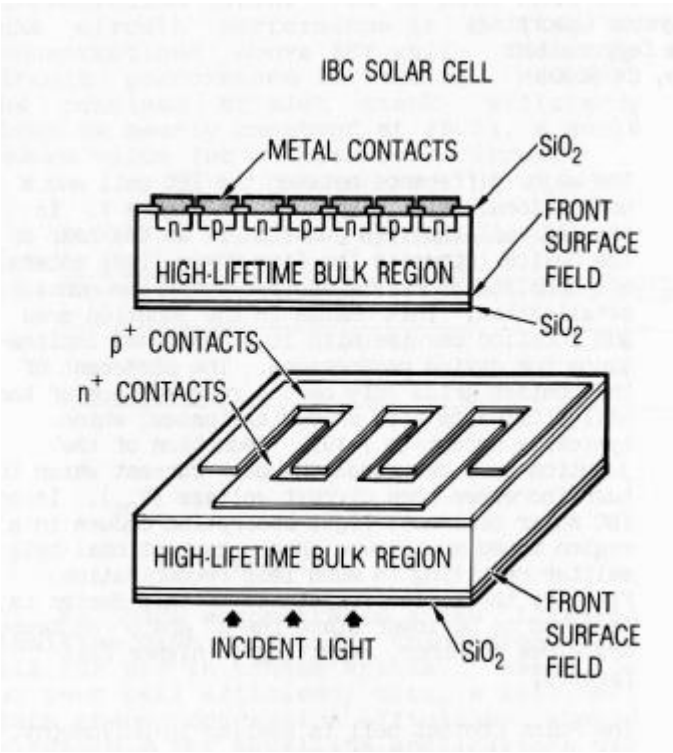
Id.

In 2008, U.S. Patent 7,468,485 ("Swanson '485") issued, showing a back-contact solar cell having metal contacts (shown in gray) over doped polysilicon regions (shown in yellow and green) formed over a tunnel oxide layer on the back side:



Swanson ’485 at Figure 1. Swanson ’485’s “Description of the Background Art” recognized that “[i]n a back side contact solar cell, the p-type and n-type regions are coupled to metal contacts on the back side of the solar cell to allow an external electrical circuit or device to be coupled to and be powered by the solar cell.” *Id.* at 1:20-23. Forming metal contacts over doped polysilicon was well known and within the level of ordinary skill in the art. Indeed, according to Swanson ’485, forming them can use “[c]onventional solar cell back-end processes.” *Id*. at 6:38-46.

Studies as far back as Marvin, published in 1989, disclose the benefits of such an "interdigitated back contact solar cell":



Marvin at Figure 1, 822. With regards to the concept and structure of a silicon substrate, one of ordinary skill in the art was familiar prior to the alleged invention of the '315 patent with silicon substrates comprising N-type dopants (e.g., phosphorous) and/or P-type dopants (e.g., boron). Indeed, many of the same primary references discussed above also disclose back junction solar cells embodiments with N-type dopants and/or P-type dopants. *See, e.g.*, Li '719 at ¶ 37 (disclosing an embodiment where the "substrate 304 is a single-crystalline silicon substrate, P-type region 310 includes boron dopant impurity atoms, and N-type region includes phosphorous dopant impurity atoms"); Choi '567 at ¶ 25 (disclosing a "crystalline semiconductor" where "the first conductive-type dopant may be, for example, an n-type or p-type dopant" and the "p-type impurity such as a Group III element including boron."); Ji '400 at ¶¶ 48, 58; Cousins '444 claim 4 (claiming "wherein the substrate comprises an N-type silicon substrate, the first layer of doped polysilicon

comprises a P-type doped polysilicon, and the second layer of doped polysilicon comprises an N-type doped polysilicon."); Heng at ¶ 36 ("Either n- or p-type doped high-quality solar-grade silicon (SG-Si) wafers can be used to build the back junction solar cell."); Park at ¶ 27 ("The crystalline semiconductor may be single crystal silicon, and the first conductivity type dopant may be, for example, an n-type or p-type dopant. . . . Alternatively, the first conductive type dopant may be a p-type impurity such as a Group III element including boron (B)").

Choi '567 also discloses a back contact solar cell with a "front surface field layer" that is "formed on the front surface of the semiconductor substrate 10 . . . where the first conductive-type dopant is doped at a concentration higher than the semiconductor substrate 10." Choi '567 at ¶ 29. Indeed, a front dopant concentration of approximately *less than or equal to* 2×10^{18} cm^{-3} was well documented and well known by those of ordinary skill in the art. For example, King, a 1990 publication, reported that "[i]n the case of a back-contacted cell in which the sunside diffusion is used mainly to reduce surface recombination, not to collect current, the ***optimum*** emitter is the one with the ***lowest*** J_0," and that for both textured and untextured surfaces this corresponds to a surface dopant concentration of approximately "***1 x 10^18 cm^-3 that is as thin as possible***." King at 369 (emphasis added), 370. This lower front dopant concentration is preferred for back contact cells because it reduces surface recombination leading to higher cell efficiency. *See* Swanson '352 at 4:42–51 ("The maximum surface dopant concentration of the diffused regions 60 and 62 is 10^{18} atoms per cubic centimeter.").

Other studies have confirmed these findings. For example, a 1989 study by Marvin concluded that optimal performance and efficiency of back-contact solar cells for space use should include a silicon substrate with a front portion having "***peak doping concentration of 1E18 [1 x 10^18] cm^-3***." Marvin at 826-827 (emphasis added); *see also* Marvin-DTIC at 5, 21, 25. In 2014,

Muller published the results of a comparative study of back-contact solar cells with either a boron or phosphorus ion-implanted front region, in both cases at dopant concentration less than or equal to approximately 2×10^{18} cm^{-3}. Muller at 267; *see also, id*. at 267 (disclosing "peak doping concentrations in the range of 1e17 to 2e18 cm^{-3}"); Rohatgi at 12:12-22 ("The dopant concentration may be in a range from 10^{15} to 10^{17} atoms per cubic centimeter (atoms/cm^3)"); Procel, 1; Hermle, 5-6.

One of ordinary skill in the art was familiar prior to the alleged invention of the '315 patent with the concept of gettering metal impurities in silicon substrate. The presence of metallic impurities in the substrate, such as iron, nickel, or gold, have long been known to lead to undesired recombination that reduce a solar cell's ability to generate electricity. Before the alleged invention, one skilled in the art knew that metal impurities were found in silicon wafers for substrates. *See* Ferre at 1; REDB-2013 at 66; Bounassisi at 402; Luque at 283; Tomas at ¶ 6; Seibt at 696 (iron impurities as high as 10^{14}-10^{16} cm^{-3}). A person of ordinary skill in the art also knew how to remove these metal impurities from the substrate by "gettering" them into a benign location of the solar cell to reduce the effect on performance. It was well known that "[g]ettering techniques eliminate or reduce contaminant impurities in a [silicon] wafer." Luque at 262. Indeed, it was long recognized that "the incorporation of gettering steps into the processing scheme is a ***prerequisite*** for the production of efficient solar cells." Sebit at 696 (emphasis added).

Known gettering techniques included moving the metal impurities from the substrate and into a back side polysilicon layer. For example, a 1977 patent to Hu (U.S. Patent No. 4,053,335) taught a skilled artisan that during heating in the range of 1000°C or less, "getterable impurities such as copper, lithium, sodium, potassium, iron, cobalt, nickel, chromium, and gold will diffuse to, and become trapped in, the polycrystalline silicon film impurity sink" formed on the back

surface of the silicon substrate. Hu at 5:61-6:6. Notably, it had been standard industry practice to use a dopant diffusion step to getter metal impurities. *See, e.g.*, Ferre at 1; Luque at 262; Seibt at 707.

As discussed in greater detail below, a person of ordinary skill in the art would have been motivated to combine with a reasonable expectation of success the teachings of the prior art, including that charted in Exhibit C, to reach the purported inventions of the asserted claims of the ’315 patent because doing so would have improved the problems of efficiency in solar cell designs. Among other reasons, a skilled artisan would have been motivated to make such combinations because they would have involved applying known back contact solar cell designs, with rear metal contacts and a doped polysilicon layer, with a known dopant concentration and established gettering techniques to increase solar cell efficiency. Such combinations would have required only routine skill and well-known techniques to implement. Such designs and their usage were widely known long before the purported invention of the ’315 patent.

In view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art, one of ordinary skill in the art would have been motivated to modify a back contact solar cell to have a front surface dopant concentration that is less than or equal to 2×10^{18} cm^{-3} with a reasonable expectation of success. As discussed above, the prior art disclosed that such a dopant concentration had been known, including King teaching that this concentration was the “optimum” for back-contact solar cells, and Swanson ’352 teaching to use it as the maximum concentration for this portion of a back contact solar cell. Accordingly, a skilled artisan would have looked to any number of references to determine an appropriate, if not an ideal, front surface dopant concentration.

For example, the prior art taught that for space applications, a "peak doping concentration of 1E18 [1 x 10^{18}] cm^{-3}" or lower with a "Gaussian doping profile with a characteristic width of 15 [micrometers]" resulted in better efficiency metrics than higher doping concentrations. Marvin at 826-827; *see also* Granek at 120-122. The government report version of Marvin's study (Marvin-DTIC) also confirmed this, thus bolstering the motivation for a skilled artisan to rely on Marvin's FSF doping concentration. For cells of the same thickness, Marvin-DTIC reported that end-of-life efficiency as a function of cell thickness was consistently worse at higher FSF doping concentrations, including when comparing cells with thickness of 65 and 80 microns at concentrations of 1 x 10^{18} cm^{-3} and 5 x 10^{18} cm^{-3} (see Table 8 of Marvin-DTIC, annotated below):

Table 8. EOL Efficiency as a Function of cell Thickness and FSF at 100 Suns

Cell Thickness (μm)	Graded FSF (μm)	Step FSF (μm)	FSF Doping cm^{-3}	*Spacing a/b/c	Cell Efficiency (%)
50	15	—	1E18	10/20/10	14.64
50	15	—	1E18	5/10/5	15.44
65	15	—	1E18	5/10/5	11.57
80	15	—	1E18	5/10/5	8.97
200	15	—	5E18	5/10/5	1.18
65	—	0.5	5E18	5/10/5	8.17
80	—	0.5	5E18	5/10/5	6.83

*a,c = spaces between right and left edges of collectors and unit cell boundaries, resp.; b = space between collectors. All dimensions are in micrometers.

Based on this data, the report concluded that "to maximize the EOL performance," the "FSF is graded over 15 [micrometers] with a peak doping concentration of 1E17 to 1E18 cm^{-3}." Marvin-DTIC at 25.

Alternatively, it had also known to persons of ordinary skill in the art that, for a back-contact solar cell utilizing an N-type substrate, "[i]on implantation is suitable to form lowly doped

regions acting as front surface field (FSF) or front floating emitter (FFE) in *n*-type IBC solar cells." Muller at 271. Muller discloses that "[a]s the IBC solar cell relies on a perfect passivation on the front side, the formation of a very lowly doped FSF or FFE which allows for a low recombination would be quite beneficial for this type of cell." *Id.* at 266.

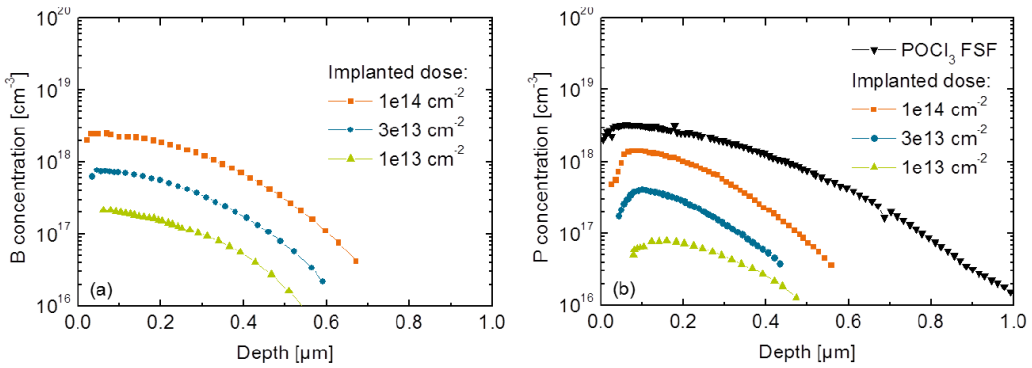


Fig. 1. ECV profiles measured on planar samples after ion implantation and annealing for 80 min at 1050 °C. (a) Low dose boron implantations for a floating emitter; (b) low dose phosphorus implantations for a front surface field. A conventional $POCl_3$-diffused FSF used in Ref [8] is shown for comparison.

Muller at Figure 1.

For example, a boron-doped ion-implanted front floating emitter ("FFE") at a front dopant concentration of $2x10^{18}$ cm^{-3} or less and then passivating the front side with a Al_2O_3/SiNx stack for better resistance to surface recombination (Jo) and UV degradation and overall efficiency of the solar cell was known. Muller at Tables 1 and 2.

Table 1. Characteristics of the investigated profiles (best values achieved so far). Sheet resistance was measured by 4 point probe on planar reference samples. J_0 was extracted from QSSPC measurements (textured samples for FSF & FFE and planar samples for emitter and BSF) using the high injection method [11].

Sample type	Species	Implanted dose [cm^{-2}]	R_{Sheet} [Ω/sq]	J_0 [fA/cm^2]	Passivation
Floating emitter (FFE)	Boron	1e13	3900	5	Al_2O_3
		3e13	1500	6	
		1e14	650	7	
Front surface field (FSF)	Phosphorus	1e13	2200	12	SiO_2/SiN_x
		3e13	880	15	
		1e14	440	10	
Emitter	Boron	7e14	147	9	Al_2O_3
		1e15	108	22	
		1.5e15	73	24	
Back surface field (BSF)	Phosphorus	3e15	39	370	Al_2O_3

Muller at Table 1 (showing a solar cell with the ion-implanted boron-doped FFE and Al_2O_3 passivation had a lower J_0 (leakage current, where a lower value indicates better passivation).

Table 2. Degradation of IBC solar cells under UV-illumination in a sun tester for 36 h at 500 W/m^2.

Front side	State	V_{OC} [mV]	J_{SC} [mA/cm^2]	FF [%]	η [%]
Front surface field (FSF)	before UV exposure	672	39.2	79.6	20.9
	after UV exposure	612	19.8	79.3	9.6
Floating emitter (FE)	before UV exposure	673	39.9	77.3	20.7
	after UV exposure	668	38.2	76.7	19.6

Muller at Table 2 (showing ion-implanted FFE and FSF were tested with 1.5X UV-illumination to assess degradation, the FSF solar cell conversion efficiency (η) dropped 2 fold from 20.9% to 9.6% after UV exposure).

Given the state of the art premise that "[e]fficiency is an important characteristic of a solar cell as it is directly related to the solar cell's capability to generate power" and that "[a]ccordingly, techniques for increasing the efficiency of solar cells are generally desirable" (Li '719 at ¶ 5), one of ordinary skill in the art would further have been motivated to select an efficient front doping concentration reported in the art, such as by King, Swanson '352, Rohatgi, Marvin, and Muller.

Furthermore, there would have been a reasonable expectation of success for a person of ordinary skill in the art to modify a back contact solar cell to have a front surface dopant concentration that is less than or equal to 2 x 10^{18} cm^{-3}. As evidenced by these references, doing so would have required merely applying a well-established, known dopant concentration, to a solar cell that discloses the need for a "first conductive-type dopant [that] is doped at a concentration higher than the semiconductor substrate 10." *See, e.g.*, Choi '567 at ¶ 29. The modification would have merely required the use of well-known and well-understood solar cell fabrication techniques, the function and operation of which would have been readily understood, and which could have been implemented with no more than the exercise of ordinary skill.

In view of any of the references disclosed herein and in the attached invalidity claim charts, including for the state of the art, one of ordinary skill in the art would know have been motivated to move metal impurities out of the bulk substrate region and into the dielectric region in order to improve cell efficiency. Going back to 1977, Hu explained that "[a]n economical determinant of integrated circuit process technology is the yield," and one major factor that affects this yield is "contaminants of elements different from the semiconductor substrates" such as metal impurities. Hu at 1:11-25. In fact, 65% of the silicon solar cells in 2013 utilized multicrystalline silicon substrates, which were known to have substantial metal impurity concentrations (such as iron) in the substrate. REDB-2013 at 66; *see also* Seibt at 696. Concerned with solar cell efficiency, one of ordinary skill would have looked to a known process to move the metal impurities out of the bulk substrate region and into the dielectric region, such as disclosed by Hu, at high temperatures that were generally used in the art, such as in Li. Li '719 at ¶ 45.

One of ordinary skill would have known that gettering through heating the solar cell was indeed the preferred method for semiconductors, including solar cells, to remove metal impurities.

See, e.g., Istratov at 570; Hu at 3:15-16 ("Polycrystalline silicon gettering is based on the preferred segregation of impurities at the polycrystalline boundaries, and hence remains effective during high temperature processing."); Ramappa at 3773 (disclosing that iron contamination could be segregated from silicon dioxide through thermal annealing for a "duration of 90 min at several temperatures over the range of 700-1100°C.").

Furthermore, there would have been a reasonable expectation of success to move the metal impurities out of the bulk substrate region and into the dielectric region. As evidenced by these references, doing so would have merely required the use of well-known and well-understood solar cell fabrication techniques, the function and operation of which would be readily understood, and which could be implemented with no more than the exercise of ordinary skill. Indeed, it would have been appreciated that these known gettering processes would be successful even with an intervening oxide layer, such as SiO_2:

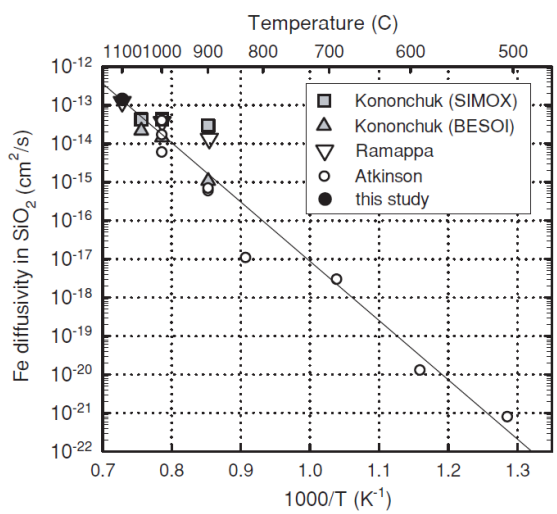


Figure 1. Diffusivity of iron in silicon dioxide, according to the data of Atkinson *et al* [2], Kononchuk *et al* [4] and Ramappa *et al* [3]. Black circle at 1100 °C denotes our data point obtained from the analysis of iron diffusion profile in figure 3.

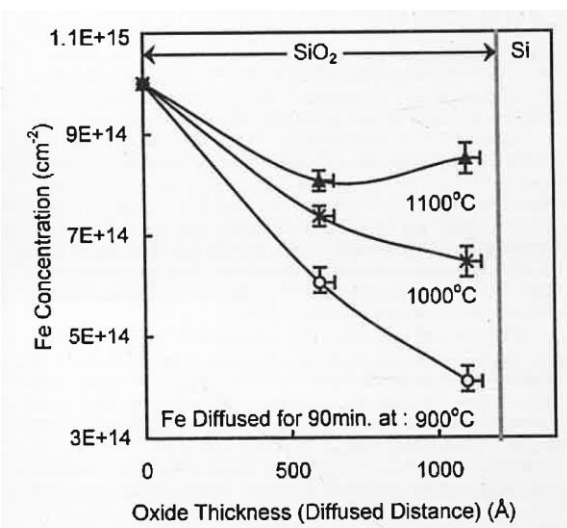


Figure 1. Iron concentration profile in SiO_2 following in-diffusion at temperatures of 900, 1000, and 1100°C for 90 min. Iron concentrations were measured by TXRF.

Istratov at Figure 1; Ramappa at Figure 1.

The person of ordinary skill in the art would have also recognized that the gettering process is merely an arrangement of old elements (i.e., known gettering steps and temperatures) with each

performing the same function it had been known to perform (the gettering of iron metal impurities into backside polysilicon layer) and yielding no more than what one would expect from such an arrangement (a solar cell with metal impurities being present in the backside polysilicon emitter region). Accordingly, a skilled artisan would have been motivated to develop a back contact solar cell that uses the combination of these features in the same way allegedly disclosed in the ’315 patent, and to do so with a reasonable expectation of success using methodologies that were commonly understood in the art. The prior art references identified herein, individually and in combination, demonstrate that each of the purported features of the ’315 patent was known to those of ordinary skill in the art. A skilled artisan would have readily understood that to design an efficient back contact solar cell, it would have to identify and be aware of a (1) specific front surface dopant concentration, and (2) a way to move metal impurities out of the substrate. Thus, a person of ordinary skill in the art would have readily recognized and appreciated that including this capability in a back contact solar cell would provide functionalities that are desirable, if not necessary.

Accordingly, one of ordinary skill would have been motivated to develop a back side emitter solar cell that uses the combination of these features in the same way allegedly disclosed in the ’315 patent, and to do so with a reasonable expectation of success using methodologies that were commonly understood in the art. The prior art references identified herein, individually and in combination, demonstrate that each of the purported features of the ’315 patent were known to those of ordinary skill in the art. A skilled artisan would have readily understood that to design an efficient back emitter solar cell, it would have to identify and be aware of a (1) the type of back emitter, (2) the use of front surface dopant concentration that is less than or equal to 2×10^{18} cm^{-3}. and (3) the moving of metal impurities out of the bulk substrate region and into the dielectric

region. Thus, a person of ordinary skill in the art would have readily recognized and appreciated that including these capabilities in a back emitter solar cell would have provided functionalities that are desirable, if not necessary.

Further, each of the references cited in Exhibits C are directed to the same, or similar, fields of endeavor. In particular, the cited prior art references relate to design of back contact solar cells, front surface dopant concentrations, and methods to move metal impurities out of the bulk substrate to increase cell efficiency. In addition, each reference is directed to solving the same, or similar, problems: generating an efficient, back-contact solar cell. With these shared goals in mind, and a limited number of options available to assist in achieving that objective, a person of ordinary skill in the art would have been motivated to consider the disclosed techniques and systems and combine their teachings to develop the alleged inventive systems claimed in the ’315 patent.

IV. P.R. 3-3(d): Invalidity Under 35 U.S.C. § 112

REC Solar contends that one or more of the Asserted Claims are invalid under pre-AIA 35 U.S.C. § 112 or AIA 35 U.S.C. § 112. As explained below, these claims are indefinite and/or fail to satisfy the written description and/or enablement requirements. Maxeon’s assertions in this forum[4] and/or before the PTAB may lead to additional Section 112 invalidity positions on indefiniteness, written description, and/or enablement.

[4] For each of the Patents-in-Suit, there exists a wealth of prior art that leads to conclusions of prior art invalidity under Sections 102 and 103. In terms of the teachings provided by this prior art and the motivations to combine different individual prior art references within this wealth of art, these Invalidity Contentions provide numerous examples. Should Maxeon try to later dispute (whether here, in the Related Litigations, or the Related IPRs) the teachings provided by this prior art and/or dispute any of the motivations to combine individual references within this wealth of prior art, Maxeon’s later arguments in dispute of what would have been known to persons of ordinary skill in the art may well raise additional Section 112 bases for the invalidity of the Asserted Claims, including additional examples of written description deficiencies as well as a lack of an enabling disclosure. Since Maxeon has not yet shared those positions, should it later choose to do so, REC Solar reserves its rights to amend these contentions based on this later provided information.

A. <u>Indefiniteness</u>

A patent is invalid under pre-AIA 35 U.S.C. § 112, ¶ 2 or AIA 35 U.S.C. § 112(b) as indefinite when its claims, "read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc.*, 134 S. Ct. 2120, 2124 (2014); *see also United Carbon Co. v. Binney & Smith Co.*, 317 U.S. 228, 236 (1942) (emphasizing without sufficient precision, there would be "[a] zone of uncertainty which enterprise and experimentation may enter only at the risk of infringement claims."); *IQASR LLC v. Wendt Corp.*, 825 F. App'x 900, 906 (Fed. Cir. 2020) ("*non-limiting* examples do not on their own expressly define the bounds—the *limits*—of the claim"). "It cannot be sufficient that a court can ascribe some meaning to a patent's claims . . . ." *Nautilus,* 134 S. Ct. at 2130. Documents that support this contention include the Patents-in-Suit and their respective prosecution histories, the state of the art as reflected in the materials cited herein, as well as documents already in the possession of and known to Maxeon.

1. The '053 Patent

The phrases and terms used in the claims of the '053 patent, including but not limited to at least the following, do not allow one of ordinary skill in the art to ascertain their meanings in light of his or her knowledge of the art and in light of the disclosures of the '053 patent.

For example, claim 15 is indefinite for reciting that "the diffusion of dopants from the first dopant source layer to the layer of polysilicon and the diffusion of dopants into the front surface of the silicon substrate are performed in situ." '053 patent at 7:14-17. The only embodiment describing the "in situ" step is as follows:

> The drive-in step to dope the polysilicon emitter **108** on the backside and to form the N-type doped regions **105** and **106** on the front side may be formed in-situ, which in the context of the present disclosure

> means a single manual (i.e., by fabrication personnel) loading of the substrate **101** in a furnace or other single chamber or multi-chamber processing tool.

Id. at 5:9-15. However, the phrase is not defined in a meaningful or precise manner such that a person of ordinary skill in the art would reasonably understand the scope of the claimed invention. While the specification exemplifies an "in situ" process may occur in a "furnace or other single chamber or multi-chamber processing tool" and by means of "a single manual (i.e., by fabrication personnel) loading of the substrate," the explanatory language was only applied in the context of a "drive-in" step, which is not recited by the claims. *Id.* While "in situ" may define a location for the recitations of claim 15, it does not define or otherwise characterize the order of process steps (e.g., simultaneous or consecutive), or the scope of a process being "in situ" when using a "multi-chamber tool," in a manner that informs, with reasonable certainty, those skilled in the art about the scope of what is claimed by claim 15. And to the extent that Maxeon argues that a "drive-in" step is subsumed with the claim language of "diffusing dopants," the temporal relationship of the timing of the "drive-in" steps with respect to the other aspects of the claims is undefined and, thus, also indefinite.

2. The '315 Patent

The phrases and terms used in the claims of the '315 patent, including but not limited to at least the following, do not allow one of ordinary skill in the art to ascertain their meanings in light of his or her knowledge of the art and in light of the disclosures of the '315 patent.

For example, independent claim 10 (and all claims that depend therefrom) is indefinite for reciting "a silicon substrate, wherein a portion of the silicon substrate has a dopant concentration of approximately less than or equal to 2×10^{18} cm^{-3} and wherein the portion of the silicon substrate is formed at the front side of the solar cell." '315 patent at 10:48-61. First, while claim 10 defines in-part where the "portion of the silicon substrate" may be found (i.e., "at the front of the solar

cell"), the phrase is not defined in a meaningful or precise manner such that a person of ordinary skill in the art would reasonably understand the scope of the claimed invention. *Id.* For example, neither the claim nor the specification of the '315 patent defines the metes and bounds of the "portion" (where it starts and ends) or how a person of ordinary skill in the art is to determine the dopant concentration of the "portion," , for example, the dopant concentration of a location within three dimensional space of the "portion" (e.g., surface of substrate, a depth within the substrate, a surface/depth at an edge of the substrate wafer, or a surface/depth at the center of the substrate wafer) or the dopant concentration across a "portion," particularly if the dopant concentration varies with depth from the surface of the silicon substrate or across the surface of the substrate. *See, e.g., id.* at 2:67-3:6 ("Terms such as 'front', 'back', 'rear', 'side', 'outboard', and 'inboard' describe the orientation and/or location of portions of the component within a consistent but arbitrary frame of reference which is made clear by reference to the text and the associated drawings describing the component under discussion."), 4:17-24, 5:26-33, 5:64-6:5, 6:40-49, 7:4-6, 7:40-42, 7:59-62, 8:30-32, 8:40-45, 8:51-53, Figures 2-7. Without that information, a person of ordinary skill in the art cannot determine whether a "portion" of the silicon substrate has a dopant concentration within or out of claims 10, 13, and 16-19. *See Teva Pharms. USA, Inc. v. Sandoz, Inc.*, 789 F.3d 1335, 1344-45 (Fed. Cir. 2015) (where "molecular weight" could mean M_p, M_n, or M_w, the claim was indefinite because the patent did not identify which measure to use).

Second, independent claim 10 (and all claims that depend therefrom) is indefinite for lack of specificity with respect to "approximately." While a term of degree is not necessarily indefinite, there must be objective boundaries from which the determination may be made. *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1370-71 (Fed. Cir. 2014). Such objective boundaries for the

term are lacking in the specification of the ’315 patent and its prosecution history. *See, e.g.*, ’315 patent at 4:21-24, 5:67-6:2, 6:47-49, 7:21-24, 7:59-62, 8:40-50, 8:51-65, 9:1-9, Figures 2-7.

Third, independent claim 10 (and all claims that depend therefrom) is indefinite for failing to define how a person of ordinary skill in the art is to determine the “dopant concentration,” as claimed. *Id.* at 10:48-61. Where a claim term requires a measured property, the specification and prosecution history must provide a person of ordinary skill in the art with the necessary guidance to make that measurement. *See, e.g., Pac. Coast Bldg. Prod., Inc. v. CertainTeed Gypsum, Inc*., 816 Fed.Appx. 454, 458(Fed. Cir. 2020) (“We have previously found claims indefinite where the claim requires a specific measurement or calculation, more than one measurement method may be used and no guidance has been provided.”); *Dow Chemical Co. v. Nova Chemicals Corp. (Canada)*, 803 F.3d 620, 631-35 (Fed. Cir. 2015) (holding claims indefinite where three methods of measurement were provided and no guidance was given to select a method of measurement). Here a variety of different techniques have been known to determine dopant concentration, such as x-ray photoelectron spectroscopy, secondary ion mass spectrometry, auger electron spectroscopy, and capacitance-voltage analysis. *See, e.g.*, Dieter Schroder, Semiconductor Material and Device Characterization, 61-77, 102-103, 627-674, (3rd Ed. 2006). The specification provides no guidance to one skilled in the art as to what technique would be appropriate.

Fourth, independent claim 10 (and all claims that depend therefrom) is indefinite for reciting “a first emitter region having metal impurities.” ’315 patent at 10:48-61. The specification provides only non-limiting examples of what may constitute “metal impurities” in the emitter region. *See, e.g.*, *id.* at 4:65-5:39, 6:57-62, 7:48-52, 8:16-22. For example, the specification states that the silicon substrate “can have contaminants and/or impurities[], for example metal contaminants and/or metal impurities, such as iron, nickel, and/or chromium among others” and that “[a] gettering process can be used to trap the metal impurities [] in the emitter regions.” ’315 patent at 4:65-5:15. The specification

does not describe what else may or may not constitute a "metal impurity" including known dopants for silicon, such as aluminum (p-type), antimony (n-type), and gallium (p-type) in the emitter region. *See, e.g.*, US 2012/0048370 A1 at ¶¶ 8, 36-38.

B. <u>Written Description</u>

The Asserted Claims are invalid under pre-AIA 35 U.S.C. § 112, ¶ 1 or AIA 35 U.S.C. § 112(a) for lack of written description. The Patents-in-Suit do not convey to a person of ordinary skill in the art that the alleged inventors had possession of the full scope of the claimed subject matter at the time of filing. *See, e.g., Ariad Pharm., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) ("[T]he test for sufficiency is whether the disclosure of the application relied upon reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date.") (citations omitted). Documents that support this contention include the Patents-in-Suit and their respective prosecution histories, the state of the art as reflected in the materials cited herein, as well as documents already in the possession of and known to Maxeon.

1. The '516 Patent

The '516 patent does not provide sufficient written description support—by itself or through any disclosure incorporated by reference—for at least the following claim terms in combination with the other recited limitations of the claims:

- "an emitter layer formed over a back surface of the substrate, the emitter layer forming a backside junction with the substrate;"
- "an oxide layer formed between the back surface of the substrate and the emitter layer;" and
- "a second metal contact making an electrical connection to the emitter layer on the backside of the solar cell."

’516 patent at 6:42-59.

For example, claims 9 and 10 require “an emitter layer formed over a back surface of the substrate” where “the emitter layer form[s] a backside junction with the substrate,” “an oxide layer formed between the back surface of the substrate and the emitter layer,” and “a second metal contact making an electrical connection to the *emitter layer* on the backside of the solar cell.” *Id.* To the extent that Maxeon contends that claims 9 and 10 of the ’516 patent are broad enough to encompass a solar cell with a back surface field formed by a polysilicon layer formed over a back surface of a substrate with the polysilicon layer and substrate having the same dopant type, the claims lack written description support. Rather, the disclosures of the specification of the ’516 patent are consistent with the state of the art and arguments presented in the prosecution history, including to obtain allowance of the claims, that a backside emitter layer is a layer doped with a dopant that is of the opposite type than the dopant of the bulk of the substrate while a layer forming a back surface field is doped with a dopant that is of the same type as the dopant of the bulk of the substrate. *See, e.g.*, ’516 patent at Abstract (“a backside junction formed by an N-type silicon substrate and a P-type polysilicon emitter formed on the backside of the solar cell”), 1:22-23, 1:46-48, 2:28-31 (“In the example of FIG. 1, the solar cell **100** includes a backside junction formed by a P-type doped polysilicon emitter 108 serving as a P-type diffusion region and an N-type silicon substrate **101** serving as an N-type diffusion region.”), 3:47-4:10 (“A layer of polysilicon is then formed on the tunnel oxides **402** and **107** to form the polysilicon layer **401** and the polysilicon emitter **108**, respectively.”), 4:52-5:10; ’516 prosecution history at March 28, 2012 Notice of Allowance, 2 (“The prior art of record lacks an oxide layer formed between an emitter and an oppositely doped substrate . . . .”); *id.* at March 19, 2010, Response, 5 (“In Meier, the p+ emitter 320 is formed within the n-type silicon substrate 318 (Meier, FIG. 6). In Jordan, just like in Meier,

the n layer is formed within the silicon substrate (Jordan, paragraph 10). That is **both Meier and Jordan disclose an emitter formed within the substrate**. In marked contrast, claim 17 recites an emitter layer formed over a back surface of the substrate.") (emphasis in original); *see also*, '053 prosecution history at April 16, 2014, Response, 2 ("Here, claim 9 recites that the layer of polysilicon forms a backside junction with the silicon substrate. Accordingly, the layer of polysilicon is P-type when the silicon substrate is N-type. In marked contrast, Silvestre discloses a solar cell with a polysilicon back surface field (BSF). As is well known, **a BSF has the same dopant type as the substrate**, but at a higher concentration to keep minority charge carriers away from the back surface.") (emphasis in original); *id.* at April 16, 2014, Response, 3 ("In the combination of Silvestre, Lindholm, and Smith the polysilicon forms a BSF with the substrate, as opposed to a backside junction with the substrate."); *id.* at May 27, 2014, Pre-Appeal Brief Request for Review, 2 ("the polysilicon forms a BSF with the substrate, as opposed to a backside junction with the substrate."); *id.* at July 7, 2014, Notice of Allowance, 2 ("The prior art of record lacks the instantly claimed backside junction formed at the interface of a first material of a silicon substrate comprising one dopant type and a second material of a polysilicon layer of an opposite dopant type. Furthermore, the backside junction is formed on the backside of the solar cell which is opposite to the light incident front side of the solar cell."); prosecution history of continuation application No. 14/504,771 at November 8, 2017, Appeal Brief, 4 ("Okayasu discloses a manufacturing method for a BSF type solar cell. As is well known, a BSF layer is a backside layer that has the same polarity as the substrate. That is, an n-type substrate would have an n-type BSF layer, and a p-type substrate would have a p-type BSF layer (Okayasu, paragraph [0008]). More particularly, a BSF layer cannot form a backside junction with the substrate because it has the same polarity as the substrate."), *id.* at May 8, 2018, Reply Brief, 3 ("Okayasu discloses an alternative

way of forming a back surface field (BSF) layer (Okayasu, paragraph 1). A BSF layer forms a high-low (HL) junction, i.e., the highly doped and lightly doped layers of the BSF have the ***same polarity*** on the ***backside*** of the solar cell (Okayasu, paragraph 14)[.] This is opposite to a backside junction, whose layers have ***opposite polarity*** on the ***backside*** of the solar cell. In other words, the proposed modification uses Okayasu' s teaching of forming a BSF layer on the backside of the solar cell for a totally different function (i.e., to form a backside junction) in Meier.") (emphasis in original).

Further, claims 9 and 10 require "an oxide layer formed between the back surface of the substrate and the emitter layer." '516 patent at 6:42-59. The specification of the '516 patent, however, fails to show that the alleged inventors had possession of the full scope of the claimed subject matter. *See, e.g., AbbVie Deutschland GmbH & Co., KG v. Janssen Biotech, Inc.*, 759 F.3d 1285, 1301-02 (Fed. Cir. 2014) (holding that substantial evidence supported the jury verdict of invalidity for lack of an adequate written description and affirming the district court's denial of JMOL where "[t]he asserted claims attempt to claim every fully human IL–12 antibody that would achieve a desired result, i.e., high binding affinity and neutralizing activity, and cover an antibody as different as Stelara, whereas the patents do not describe representative examples to support the full scope of the claims"); *see also*, '516 patent at 2:57-66 ("In one embodiment, … [t]the tunnel oxide layer **107** may comprise silicon dioxide thermally grown to a thickness of about 10 to 50 Angstroms on the backside surface of the substrate **101**), 3:62-4:2 ("In FIG. 4B, tunnel oxides **402** and **107** are formed on the front and back surfaces, respectively, of the substrate **101**. The tunnel oxides **402** and **107** may comprise silicon dioxide thermally grown to a thickness of about 10 to 50 Angstroms on the surfaces of the N-type silicon substrate **101**. A layer of polysilicon is then formed on the tunnel oxides **402** and **107** to form the polysilicon layer **401** and the polysilicon

emitter **108**, respectively."). Specifically, the specification does not show that the inventors had possession of a solar cell with a layer (i) formed of any oxide (ii) of any thickness, (iii) having any characterization (e.g., quality or uniformity), and (iv) with any other layers intervening between the substrate and the oxide layer or between oxide layer and the emitter layer.

2. The '053 Patent

The '053 patent does not provide sufficient written description support—by itself or through any disclosure incorporated by reference—for at least the following claim terms in combination with the other recited limitations of the claims:

- "diffusing dopants from the first dopant source layer to the layer of polysilicon to form a backside junction with the silicon substrate;"
- "diffusing dopants into a front surface of the silicon substrate, the front surface of the silicon substrate facing the sun during normal operation;"
- "diffusing dopants into the front surface of the silicon substrate comprises forming a second dopant source layer over the silicon substrate and diffusing dopants from the second dopant source layer into the silicon substrate;"
- "diffusion of dopants from the first dopant source layer to the layer of polysilicon and the diffusion of dopants into the front surface of the silicon substrate are performed in situ;"
- "the diffusion of dopants from the first dopant source layer to the layer of polysilicon and the diffusion of dopants into the front surface of the silicon substrate are performed in situ;"
- "forming an oxide layer over a back surface of a silicon substrate;"
- "forming a layer of polysilicon over the oxide layer;"

- "diffusing dopants into the layer of polysilicon to form a backside junction with the silicon substrate;"
- "diffusing dopants into a front surface of the silicon substrate;"
- "diffusing dopants into the layer of polysilicon to form the backside junction with the silicon substrate comprises: forming a first dopant source layer over the layer of polysilicon; and diffusing dopants from the first dopant source layer into the layer of polysilicon;" and
- "diffusing dopants into the front surface of the silicon substrate comprises forming a second dopant source layer over the silicon substrate and diffusing dopants from the second dopant source layer into the silicon substrate."

'053 patent at 6:52-8:23.

For example, independent claims 9 and 16 (and the claims that depend therefrom) require "diffusing dopants from the first dopant source layer to the layer of polysilicon to form a backside junction with the silicon substrate" and "diffusing dopants into the layer of polysilicon to form a backside junction with the silicon substrate." *Id.* To the extent that Maxeon contends that claims 9, 12, and 14-20 of the '053 patent are broad enough to encompass a method of fabricating a solar cell including diffusing dopants to a layer of polysilicon to form a back surface field with a silicon substrate where the polysilicon layer and silicon substrate have the same dopant type, the claims lack written description support. Rather, the disclosures of the specification of the '053 patent are consistent with the state of the art and arguments presented in the prosecution history, including to obtain allowance of the claims, that a backside junction forms when a layer doped with a dopant that is of the opposite type than the dopant of the bulk of the silicon substrate while a back surface field forms when a layer is doped with a dopant that is of the same type as the dopant of the bulk

of the silicon substrate. *See, e.g.*, ’053 patent at Abstract (“a backside junction formed by an N-type silicon substrate and a P-type polysilicon emitter formed on the backside of the solar cell”), 1:28-29, 1:53-55, 2:35-38 (“In the example of FIG. 1, the solar cell **100** includes a backside junction formed by a P-type doped polysilicon emitter **108** serving as a P-type diffusion region and an N-type silicon substrate **101** serving as an N-type diffusion region.”), 3:56-4:18 (“A layer of polysilicon is then formed on the tunnel oxides **402** and **107** to form the polysilicon layer **401** and the polysilicon emitter **108**, respectively.”), 4:60-5:18; ’516 prosecution history at March 28, 2012, Notice of Allowance, 2 (“The prior art of record lacks an oxide layer formed between an emitter and an oppositely doped substrate . . . .”); *id.* at March 19, 2010, Response, 5 (“In Meier, the p+ emitter 320 is formed within the n-type silicon substrate 318 (Meier, FIG. 6). In Jordan, just like in Meier, the n layer is formed within the silicon substrate (Jordan, paragraph 10). That is **both Meier and Jordan disclose an emitter formed within the substrate**. In marked contrast, claim 17 recites an emitter layer formed over a back surface of the substrate.”) (emphasis in original); ’053 prosecution history at April 16, 2014, Response, 2 (“Here, claim 9 recites that the layer of polysilicon forms a backside junction with the silicon substrate. Accordingly, the layer of polysilicon is P-type when the silicon substrate is N-type. In marked contrast, Silvestre discloses a solar cell with a polysilicon back surface field (BSF). As is well known, **a BSF has the same dopant type as the substrate**, but at a higher concentration to keep minority charge carriers away from the back surface.”) (emphasis in original); *id.* at April 16, 2014, Response, 3 (“In the combination of Silvestre, Lindholm, and Smith the polysilicon forms a BSF with the substrate, as opposed to a backside junction with the substrate.”); *id.* at May 27, 2014, Pre-Appeal Brief Request for Review, 2 (“the polysilicon forms a BSF with the substrate, as opposed to a backside junction with the substrate.”); *id.* at July 7, 2014, Notice of Allowance, 2 (“The prior art of record lacks the

instantly claimed backside junction formed at the interface of a first material of a silicon substrate comprising one dopant type and a second material of a polysilicon layer of an opposite dopant type. Furthermore, the backside junction is formed on the backside of the solar cell which is opposite to the light incident front side of the solar cell."); *see also*, prosecution history of continuation application No. 14/504,771 at November 8, 2017, Appeal Brief, 4 ("Okayasu discloses a manufacturing method for a BSF type solar cell. As is well known, a BSF layer is a backside layer that has the same polarity as the substrate. That is, an n-type substrate would have an n-type BSF layer, and a p-type substrate would have a p-type BSF layer (Okayasu, paragraph [0008]). More particularly, a BSF layer cannot form a backside junction with the substrate because it has the same polarity as the substrate."); *id.* at May 8, 2018, Reply Brief, 3 ("Okayasu discloses an alternative way of forming a back surface field (BSF) layer (Okayasu, paragraph 1). A BSF layer forms a high-low (HL) junction, i.e., the highly doped and lightly doped layers of the BSF have the ***same polarity*** on the ***backside*** of the solar cell (Okayasu, paragraph 14) This is opposite to a backside junction, whose layers have ***opposite polarity*** on the ***backside*** of the solar cell. In other words, the proposed modification uses Okayasu' s teaching of forming a BSF layer on the backside of the solar cell for a totally different function (i.e., to form a backside junction) in Meier.") (emphasis in original).

Further, independent claim 16 (and the claims that depend therefrom) require "forming an oxide layer over a back surface of a silicon substrate" and "forming a layer of polysilicon over the oxide layer." '053 patent at 7:19-8:23. The specification of the '053 patent, however, fails to show that the alleged inventors had possession of the full scope of the claimed subject matter. *See, e.g.*, *AbbVie*, 759 F.3d at 1301-02 (holding that substantial evidence supported the jury verdict of invalidity for lack of an adequate written description and affirming the district court's denial of

JMOL where "[t]he asserted claims attempt to claim every fully human IL–12 antibody that would achieve a desired result, i.e., high binding affinity and neutralizing activity, and cover an antibody as different as Stelara, whereas the patents do not describe representative examples to support the full scope of the claims"); *see also*, '053 patent at 2:64-3:6 ("In one embodiment, . . . [t]the tunnel oxide layer **107** may comprise silicon dioxide thermally grown to a thickness of about 10 to 50 Angstroms on the backside surface of the substrate **101**."), 4:4-11 ("In FIG. 4B, tunnel oxides **402** and **107** are formed on the front and back surfaces, respectively, of the substrate **101**. The tunnel oxides **402** and **107** may comprise silicon dioxide thermally grown to a thickness of about 10 to 50 Angstroms on the surfaces of the N-type silicon substrate **101**. A layer of polysilicon is then formed on the tunnel oxides **402** and **107** to form the polysilicon layer **401** and the polysilicon emitter **108**, respectively."). Specifically, the specification does not show that the inventors had possession of a method of fabricating a solar cell by forming an oxide layer (i) of any oxide composition (ii) of any thickness, (iii) having any characterization (e.g., quality or uniformity), and (iv) with any other layers intervening between the silicon substrate and the oxide layer or between oxide layer and the polysilicon layer. For example, whereas the specification of the '053 patent only characterizes a "tunnel oxide layer," the scope of claim 16 is not that narrow. Nothing in the claim or the prosecution history requires the oxide layer function as a "tunnel oxide layer."

Additionally, claim 15 requires that "the diffusion of dopants from the first dopant source layer to the layer of polysilicon and the diffusion of dopants into the front surface of the silicon substrate [of claim 9] are performed in situ." '053 patent at 7:15-18. To the extent that Maxeon contends that claim 15 of the '053 patent is broad enough to encompass automated processes, the claim lacks written description support. Rather, the disclosure of the specification of the '053 patent reports that "in-situ, [ ] in the context of the present disclosure means a single ***manual (i.e.,***

by fabrication personnel) loading of the substrate **101** in a furnace or other single chamber or multi-chamber processing tool." *Id.*at 5:9-15.

Finally, independent claims 9 and 16 (and the claims that depend therefrom) require "diffusing dopants" to a layer of polysilicon. *Id.* at 6:52-8:23. To the extent that Maxeon contends that claims 9, 12, and 14-20 of the '053 patent are broad enough to encompass doping by a method other than the use of a "dopant source" layer (e.g., doping the surface with a gas) to form a backside junction, the claims lack written description support. Rather, the disclosures from the specification of the '053 patent are limited to methods using a "dopant source" layer to form a backside junction. *Compare id.* at 4:14-27 ("As its name implies, the P-type dopant source **461** provides a source of P-type dopants for diffusion into the polysilicon emitter **108** in a subsequent dopant drive-in step. A dielectric capping layer **462** is formed on the P-type dopant source **461** to prevent dopants from escaping from the backside of the solar cell during the drive-in step."), 4:60-5:8 ("In FIG. 4G, a dopant drive-in step is performed to diffuse N-type dopants from the N-type dopant source **412** into the substrate **101** to form the N-type dope region **106**, to diffuse P-type dopants from the P-type dopant source **461** to the polysilicon emitter **108**."), *and* 5:9-18 *with* 5:19-27 ("It is to be noted that the step of using an N-type dopant source **412** to diffuse dopants into the N-type doped region **106** may be omitted in some applications. That is, in an alternative process, the formation of the N-type dopant source **412** in FIG. 4F may be omitted. In that case, the N-type doped regions **105** and **106** will be both doped by introduction of an N-type dopant in the diffusion furnace during the drive-in step. All other process steps disclosed herein remain essentially the same.").

3. The '315 Patent

The '315 patent does not provide sufficient written description support—by itself or through any disclosure incorporated by reference—for at least the following claim terms in combination with the other recited limitations of the claims:

- "a silicon substrate, wherein a portion of the silicon substrate has a dopant concentration of approximately less than or equal to 2×10^{18} cm^{-3};"
- "a dielectric region formed over the silicon substrate, wherein the dielectric region is formed over the back side of solar;"
- "a first emitter region having metal impurities formed over the dielectric region;"
- a second emitter region having metal impurities formed over the dielectric region;"
- "a first metal contact formed over the first emitter region;" and
- "a second metal contact formed over the second emitter region."

'315 patent at 10:48-11:20.

For example, independent claim 10 (and the claims that depend therefrom) require "a silicon substrate, wherein a portion of the silicon substrate has a dopant concentration of approximately less than or equal to 2×10^{18} cm^{-3}." *Id.* To the extent "approximately" permits values greater than enumerated in the claims, claims 10, 13-16, and 19 of the '315 patent lack written description support for dopant concentrations in a silicon substrate formed at the front side of the solar cell greater than 2×10^{18} cm^{-3}. *See, e.g., id.* at 4:21-24 ("In an embodiment, the portion of the silicon substrate can have a dopant concentration of approximately less than or equal to 2×10^{18} cm^{-3} after the heating process as discussed in block **106**."), 5:67-6:2 ("In an example, the dopant concentration of the portion **206** of the silicon substrate **202** can be approximately less than or equal to 2×10^{18} cm^{-3} after the heating."), 6:45-49 ("In an embodiment, a portion **306** of the silicon substrate **302** can have a doping concentration **322** of approximately less than or equal to 2×10^{18} cm^{-3}."), 7:20-22 ("In an embodiment, a portion **406** of the silicon substrate **402** can have a doping concentration **422** of approximately less than or equal to 2×10^{18} cm^{-3}."), 7:59-51 ("In an embodiment, a portion **506** of the silicon substrate **502** can have a doping concentration **522** of

approximately equal to or less than 2×10^{18} cm^{-3}."), 8:40-44 ("The method of FIGS. 1-4 is exemplified in Example Process C of FIG. 11, where a surface, or a portion near the surface, of a silicon substrate was doped at approximately less than or equal to 2×10^{18} cm^{-3}."), 8:51-53 ("In contrast, referring to Example Process A, a surface, or a portion near the surface, of the silicon substrate was doped at approximately less than or equal to 2×10^{18} cm^{-3}."), 8:60-62 ("In another example, referring to Example Process B, a surface of the silicon substrate was doped at approximately 4×10^{18} cm^{-3}."), 9:1-3 ("In yet another example comparison, in Example Process D a surface of the silicon substrate was doped at approximately 4×10^{18} cm^{-3}."), Figures, 2-7.

Further, independent claim 10 (and the claims that depend therefrom) requires "a dielectric region formed over the silicon substrate, wherein the dielectric region is formed over the back side of the solar cell" and "a first emitter region having metal impurities formed over the dielectric region." '053 patent at 6:52-8:23. Claim 16 further requires "a second emitter region having metal impurities formed over the dielectric region." *Id.* To the extent that Maxeon contends that claims 10, 13-16, and 19 of the '315 patent are broad enough to encompass a solar cell with a back surface field formed by a polysilicon layer formed over a back surface of a substrate with the polysilicon layer and substrate having the same dopant type, the claims lack written description support. Rather, the disclosures of the specification of the '315 patent are consistent with the state of the art and arguments presented in the prosecution history that a emitter layer is a layer doped with a dopant that is of the opposite type than the dopant of the bulk of the substrate while a layer forming a back surface field is doped with a dopant that is of the same type as the dopant of the bulk of the substrate. *See, e.g.*, '315 patent at 2:40-46 ("In an embodiment, an emitter region can be a doped region of a solar cell for collecting positive and negative charge carriers."), 4:51-54 ("In an embodiment, the emitter region **212** can be a doped polysilicon. In an example, the doped

polysilicon can be N-type doped or P-type doped polysilicon."), 6:53-57 ("In an embodiment, the solar cell **300** can have first and second emitter regions **312**, **314**. In an example, the first and second emitter regions **312**, **314** can be P-type and N-type doped polysilicon regions, respectively."),7:28-35 ("In an embodiment, the solar cell **400** can have first and second emitter regions **412**, **414**. In some embodiments, the first emitter region **412** can be formed on the back side **403** of the solar cell **400** and the second emitter region **414** can be formed on the front side **401** of the solar cell **400**. In an example, the first and second emitter regions **412**, **414** can be P-type and/or N-type doped polysilicon regions."), 7:66-8:5 ("In an embodiment, the solar cell **500** can have first and second emitter regions **512**, **514**. In an example, the first and second emitter regions **512**, **514** can be P-type and/or N-type doped polysilicon regions, respectively. In one embodiment, the second emitter region **514** can be at least partially formed over the first emitter region **512**, as shown."). During prosecution of the application leading to the '315 patent (Application No. 14/579,935), the Examiner rejected claims reciting an "emitter region" over Yelundur (US 2013/0247981), highlighting emitter 15 and contacts 30. '315 prosecution history at Jan. 11, 2016, Pre-Interview Communication, 2. Of particular interest here, Yelundur explained that:

> The emitter layer **15** may be doped with impurities of a second conductivity type opposite that of the first conductivity type of the base layer **10**. For example, … in an instance in which the first conductivity type is n-type, the emitter layer **15** may comprise p-type dopant. A p-n junction **25** may be formed at the interface between the base layer **10** and the emitter layer **15**. Because of their opposite conductivities, the base layer **10** and the emitter layer **15** create an electric field across the p-n junction **25** that separates free electrons and holes resulting from absorption of light photons and forces them to move in opposite directions to respective front and back contacts **30**, **35**.

Yelundur at ¶ 42; *see also id*. at ¶¶ 28, 40 (the base layer 10 is defined as doped region of a substrate), 55, 61.

Moreover, the specification of the ’315 patent fails to show that the alleged inventors had possession of the full scope of the claimed subject matter of independent claim 10 (and the claims that depend therefrom) with respect to those recitations (“a dielectric region formed over the silicon substrate, wherein the dielectric region is formed over the back side of the solar cell;” “a first emitter region having metal impurities formed over the dielectric region;” and “a second emitter region having metal impurities formed over the dielectric region.”). ’315 patent at 6:52-8:23. *See, e.g., AbbVie*, 759 F.3d at 1301-02 (holding that substantial evidence supported the jury verdict of invalidity for lack of an adequate written description and affirming the district court's denial of JMOL where “[t]he asserted claims attempt to claim every fully human IL–12 antibody that would achieve a desired result, i.e., high binding affinity and neutralizing activity, and cover an antibody as different as Stelara, whereas the patents do not describe representative examples to support the full scope of the claims”). Specifically, the specification does not show that the inventors had possession of a solar cell with a dielectric region (i) formed of any dielectric (ii) of any thickness, (iii) having any characterization (e.g., quality or uniformity), and (iv) with any other layers intervening between the substrate and the dielectric region or between the dielectric region oxide layer and the emitter regions. *See, e.g*., ’315 patent at 3:31-32 (“At 100, a dielectric can be formed on a silicon substrate of a solar cell.), 3:38-41 (“In an embodiment, the dielectric can be a tunnel oxide. In one embodiment, the dielectric can be silicon dioxide. In an embodiment, the dielectric region can be grown and/or formed through a thermal process.”), 3:42-43 (“At 102, an emitter region can be formed over the dielectric region.”), 4:44-49 (“In an embodiment, a dielectric region **210** can be formed over a silicon substrate **202** of the solar cell **200**. In an embodiment, the dielectric region **210** can be a tunnel oxide. In one example, the dielectric region **210** can be silicon dioxide. In an embodiment, an emitter region **212** can be formed on the dielectric region **210**.”),

6:50-57 ("The solar cell **300** can have a dielectric region 310 formed over the silicon substrate **302**. In an embodiment, the dielectric **310** can be a tunnel oxide. In some embodiments, the dielectric region **310** can be silicon dioxide."), 7:25-35 (same for solar cell 400), 7:63-8:1 (same for solar cell 500).

Finally, claims 10 and 16 further recite "a first metal contact formed over the first emitter region" and "a second metal contact formed over the second emitter region," respectively. *Id.* at 6:52-8:23. To the extent that Maxeon contends that claims 10, 13-16, and 19 of the '315 patent are broad enough to encompass a solar cell with a continuous doped polysilicon layer with a first metal contact and a second metal contact of the same type, the claims lack written description support. Rather, the disclosures of the specification of the '315 patent consistently discloses solar cells with separate and discrete layers with dopants of opposite type over which the first and second metal contacts are respectively formed. *See, e,g.,* '315 patent at 6:33-37 ("As shown in FIG. 4 a single metal contact is illustrated for example, which can be on a front side or back side of the solar cell. In an example, multiple metal contacts, e.g. some positive and others negative, can exist."), 6:63-65 ("In an embodiment, the solar cell **300** can have first and second metal contacts **342**, **344** formed on the first and second emitter regions **312**, **314**, respectively."), 7:36-38 (same for solar cell 400), 8:23-25 (same for solar cell 500). A person of ordinary skill in the art would have understood that the first and second metal contacts of the '315 patent were of opposite, not the same, polarity.

C. <u>Enablement</u>

The Asserted Claims are invalid under pre-AIA 35 U.S.C. § 112, ¶ 1 or AIA 35 U.S.C. § 112(a) as not enabled. The Patents-in-Suit fail to "teach those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation." *In re Wright*, 999 F.2d 1557, 1561 (Fed. Cir. 1993). The patents also fail to satisfy the statutory bargain underlying § 112, which requires that the scope of the claims also must be "commensurate" with teachings in the

specification. *See, e.g.*, *Sitrick v. Dreamworks, LLC*, 516 F.3d 993, 999 (Fed. Cir. 2008) ("The scope of the claims must be less than or equal to the scope of the enablement to ensure that the public knowledge is enriched by the patent specification to a degree at least commensurate with the scope of the claims."); *Enzo Biochem, Inc. v. Calgene, Inc.*, 188 F.3d 1362, 1377 (Fed. Cir. 1999) ("the breadth of enablement in the patent specifications is not commensurate in scope with the claims");; *Nat'l Recovery Techs., Inc. v. Magnetic Separation Sys., Inc.*, 166 F.3d 1190, 1196 (Fed. Cir. 1999). Documents that support this contention include the Patents-in-Suit and their respective prosecution histories, the state of the art as reflected in the materials cited herein, as well as documents already in the possession of and known to Maxeon.

1. The '516 Patent

The '516 patent does not provide an enabling disclosure for the full breadth of at least the following claim terms:

- "an oxide layer formed between the back surface of the substrate and the emitter layer."

'516 patent at 6:43-59.

For example, undue experimentation would be required given the breadth of claims 9 and 10 with respect to "an oxide layer formed between the back surface of the substrate and the emitter layer." *Id.* Maxeon has alleged that "[t]he Asserted Patents are directed to improvements in solar cell technologies. Specifically, the Asserted Patents are directed to "TOPCon" solar cells—solar cells that incorporate a tunnel oxide passivated contact." Infringement Contentions at 2. However, the specification of the '516 patent fails to enable the full scope of the claim, particularly with respect to (i) the scope of oxide compositions, (ii) the scope of oxide thicknesses, (iii) having any characterization (e.g., quality or uniformity), and (iv) the scope of permitted layers intervening between the substrate and the oxide layer or between oxide layer and the "emitter layer." *See supra* § IV.B.1. "It is the specification, not the knowledge of one skilled in the art, that must supply the novel

aspects of an invention in order to constitute adequate enablement." *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed. Cir. 1997); *see also Crown Operations Intern., Ltd. v. Solutia Inc.*, 289 F.3d 1367, 1380 (Fed. Cir. 2002) ("the novel aspects of the invention must be disclosed and not left to inference, that is, a patentee may not rely on inference of a person of ordinary skill in the pertinent art to supply such novel aspects").

2. The '053 Patent

The '053 patent does not provide an enabling disclosure for the full breadth of at least the following claim terms:

- "forming an oxide layer over a back surface of a silicon substrate;" and
- "forming a layer of polysilicon over the oxide layer."

'053 patent at 6:52-8:23.

For example, undue experimentation would be required given the breadth of claims 9, 12, an 14-20 with respect to "forming an oxide layer over a back surface of a silicon substrate" and "forming a layer of polysilicon over the oxide layer." *Id.* Maxeon has alleged that "[t]he Asserted Patents are directed to improvements in solar cell technologies. Specifically, the Asserted Patents are directed to "TOPCon" solar cells—solar cells that incorporate a tunnel oxide passivated contact." Infringement Contentions at 2. However, the specification of the '053 patent fails to enable the full scope of the claim, particularly with respect to a method of fabricating a solar cell by forming an oxide layer (i) of any oxide composition (ii) of any thickness, (iii) having any characterization (e.g., quality or uniformity), and (iv) with any other layers intervening between the substrate and the oxide layer or between oxide layer and the polysilicon layer. *See supra* § IV.B.2. "It is the specification, not the knowledge of one skilled in the art, that must supply the novel aspects of an invention in order to constitute adequate enablement." *Genentech*, 108 F.3d at 1366; *see also Crown Operations*, 289 F.3d at 1380 ("the novel aspects of the invention must be disclosed and not left to inference, that is, a

patentee may not rely on inference of a person of ordinary skill in the pertinent art to supply such novel aspects").

3. The '315 Patent

The '315 patent does not provide an enabling disclosure for the full breadth of at least the following claim terms:

- "a dielectric region formed over the silicon substrate;" and
- "a first emitter region having metal impurities formed over the dielectric region."

'315 patent at 10:48-11:20.

For example, undue experimentation would be required given the breadth of claims 10, 13-16, and 19 with respect to "a dielectric region formed over the silicon substrate" and "a first emitter region having metal impurities formed over the dielectric region." *Id.* Maxeon has alleged that "[t]he Asserted Patents are directed to improvements in solar cell technologies. Specifically, the Asserted Patents are directed to "TOPCon" solar cells—solar cells that incorporate a tunnel oxide passivated contact." Infringement Contentions at 2. However, the specification fails to enable the full scope of the claim, particularly with respect to (i) the scope of dielectric region compositions, (ii) the scope of dielectric region thicknesses, (iii) having any characterization (e.g., quality or uniformity), and (iv) scope of permitted layers intervening between the silicon substrate and the dielectric region or between dielectric region and the emitter region. *See supra* § IV.B.3. "It is the specification, not the knowledge of one skilled in the art, that must supply the novel aspects of an invention in order to constitute adequate enablement." *Genentech*, 108 F.3d at 1366; *see also Crown Operations*, 289 F.3d at 1380, ("the novel aspects of the invention must be disclosed and not left to inference, that is, a patentee may not rely on inference of a person of ordinary skill in the pertinent art to supply such novel aspects").

V. P.R. 3-4: Document Production Accompanying Invalidity Contentions

REC Solar has produced documents, including REC_000000001 through REC_000002093 and REC_000002094 through REC_000013687, pursuant to P.R. 3-4(a) and P.R. 3-4(b).

REC Solar's search for prior art references, additional documentation, and/or corroborating evidence concerning prior art products is ongoing. Accordingly, REC Solar reserves the right to continue to supplement its production during the course of discovery.

Dated: March 4, 2025

Respectfully submitted,

/s/ James R. Barney

James R. Barney (LEAD) (DC Bar No. 473732)
Mareesa A. Frederick (*pro hac vice*)
Forrest A. Jones (*pro hac vice*)
Anthony A. Hartmann (*pro hac vice*)
Jordan M. Cowger (DC Bar No. 90004829)
FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, LLP
901 New York Avenue, NW
Washington, DC 20001-4413
Telephone: (202) 408-4000
Facsimile: (202) 408-4400
james.barney@finnegan.com
mareesa.frederick@finnegan.com
forrest.jones@finnegan.com
anthony.hartmann@finnegan.com
jordan.cowger@finnegan.com

Gary C. Ma (*pro hac vice*)
FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, L.L.P.
Stanford Research Park
3300 Hillview Avenue, 2nd Floor
Palo Alto, CA 94304-1203
Telephone: (650) 849-6600
Facsimile: (650) 849-6666
gary.ma@finnegan.com

Eric H. Findlay (TX Bar No. 00789886)
FINDLAY CRAFT, P.C.

7270 Crosswater Avenue, Suite B
Tyler, Texas 75703
Tel: (903) 534-1100
Fax: (903) 534-1137
Email: efindlay@findlaycraft.com
Counsel for Defendant REC Solar Holdings, AS

CERTIFICATE OF SERVICE

I hereby certify that on March 4, 2025, a complete copy of the foregoing document and its Exhibits were served via electronic mail to all counsel of record.

/s/Yanira K. Lopez
Yanira K. Lopez