

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

JINKOSOLAR CO., LTD.,
Petitioner,

v.

FIRST SOLAR, INC.,
Patent Owner

Case IPR2025-01130
Patent No. 9,130,074

PATENT OWNER PRELIMINARY RESPONSE

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2001	Keith R. Hummel Biography
2002	Declaration of Keith R. Hummel in Support of PHV Motion
2003	JinkoSolar, “About TOPCon Technology” (accessed Sept. 29, 2025)
2004	Chunduri, S.K., et al., “PERC Solar Cell Technology 2016: Background, Status and Outlook”, <i>TaiyangNews</i> (2016)
2005	JinkoSolar Press Release, “JinkoSolar Announces Fourth Quarter and Full Year 2018 Financial Results” (Mar. 22, 2019)
2006	Fuhs, M., “TOPCon: The next big thing after PERC”, <i>PV Magazine</i> (Oct. 8, 2018)
2007	Bellini, E., “Jinko claims 24.79% efficiency for n-type monocrystalline cell”, <i>PV Magazine</i> (Jul. 20, 2020)
2008	Shaw, V., “The weekend read: Life after PERC”, <i>PV Magazine</i> (May 8, 2021)
2009	JinkoSolar Press Release, “JinkoSolar’s 182 mm TOPCon Module Reaches Highest Conversion Efficiency of 25.42%” (June 11, 2024)
2010	Post-Conference Brief of China Chamber of Commerce for Import and Export of Machinery and Electronic Products, Volume I of II, ITC Inv. Nos. 701-TA-511 & 731-TA-1246-47 (Jan. 29, 2014)
2011	Zacks Equity Research, “FirstSolar to Buy TetraSun, Gives View”, <i>Yahoo! Finance</i> (Apr. 10, 2013)
2012	“First Solar to Acquire TetraSun to Expand Addressable Market Opportunity”, <i>Business Wire</i> (Apr. 9, 2013)
2013	Shepard, J., “First Solar to Acquire TetraSun to Expand Addressable Market Opportunity”, <i>EEPower</i> (Apr. 11, 2013)
2014	Glunz, S.W., et al., “Silicon-based passivating contacts: The TOPCon route”, <i>Progress in Photovoltaics</i> (Dec. 20, 2021)
2015	Espacenet cited documents list for CN110634996A
2016	Espacenet family members list for U.S. Pat. No. 9,130,074
2017	USPTO Global Dossier for CN110634996A, First Search (Oct. 26, 2020)
2018	Office of the United States Trade Representative, 2025 Special 301 Report (Apr. 2025)
2019	Gupta, K., et al., “Protecting Intellectual Property for National Security”, <i>Center for Strategic and International Studies</i> (Mar. 2025)
2020	Stipulation and Order to Amend Scheduling Order, <i>First Solar, Inc. v. JinkoSolar Holding Co., Ltd.</i> , No. 25-223 JLH (D. Del. Aug. 14, 2025), ECF No. 33

Exhibit	Description
2021	Defendants' Answer, Affirmative Defenses, and Counterclaims to Plaintiff's Complaint for Patent Infringement, <i>First Solar, Inc. v. JinkoSolar Holding Co., Ltd.</i> , No. 25-223 JLH (D. Del. Jun. 27, 2025), ECF No. 18
2022	U.S. Provisional Application No. 61/098,713

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1. INTRODUCTION

JinkoSolar's grounds do not support institution for a simple reason: No prior art reference or combination of references contains all of the elements of the challenged claims. And while JinkoSolar tries to use its expert declaration and attorney argument to fill in the gaps of the missing elements, these efforts are both improper and ineffective. *See, e.g.*, Pet. 27-29, 31-33, 54, 56, 57, 93-96.

First, JinkoSolar contends under Ground 1 that all challenged claims are anticipated or obvious over the Tamura reference. But JinkoSolar *admits* that Tamura does not disclose a process that results in a *shortened* charge flow path, which is a required claim element. Instead, JinkoSolar argues for an implicit claim construction in which a “shortened charge flow path” means a charge flow path of the *same* length (rather than a shorter length) but with a lower resistance. This construction is not supported by the claim language or the specification and should be rejected.

Second, JinkoSolar contends under Ground 2 that all challenged claims are anticipated or obvious over Borden. Here, too, JinkoSolar's grounds fall short: JinkoSolar's obviousness argument depends on modifying Borden to make it *inoperable* for its intended purpose, turning Borden's “alternates to diffused junctions” into a diffused junction. Specifically, while the challenged claims are directed to a method of manufacturing a high-efficiency solar cell involving

diffusing a dopant through various layers, Borden teaches away from such a diffusion-based approach and instead describes an *alternative* approach. Ground 3 has the same problem because it relies entirely on Borden for its invalidity arguments for claim 1, and the other challenged claims depend on claim 1.

Third, JinkoSolar contends under Ground 4 that all challenged claims are anticipated or obvious over Rana. As a threshold issue, JinkoSolar failed to meet its burden to show that Rana is, in fact, prior art to the '074 Patent (it is not). Further, Rana does not disclose the challenged claim limitations: specifically, in the process taught by Rana, the dopant does not diffuse *through* the requisite layers of the solar cell as in the challenged claims; it only diffuses *into one* of the layers.

Thus, the Board should deny institution because JinkoSolar has not shown a reasonable likelihood of success as to *any* challenged claim.

2. THE CHALLENGED PATENT

A. The Invention

Solar technologies convert sunlight into electrical energy. An emerging solar technology is known as TOPCon, which stands for “tunnel oxide passivated contact”. TOPCon solar cells have reduced recombination (*i.e.*, when excited electrons combine with atoms in the solar cell rather than generating electricity) and higher bifaciality (*i.e.*, the ability to generate electricity from both sides of a

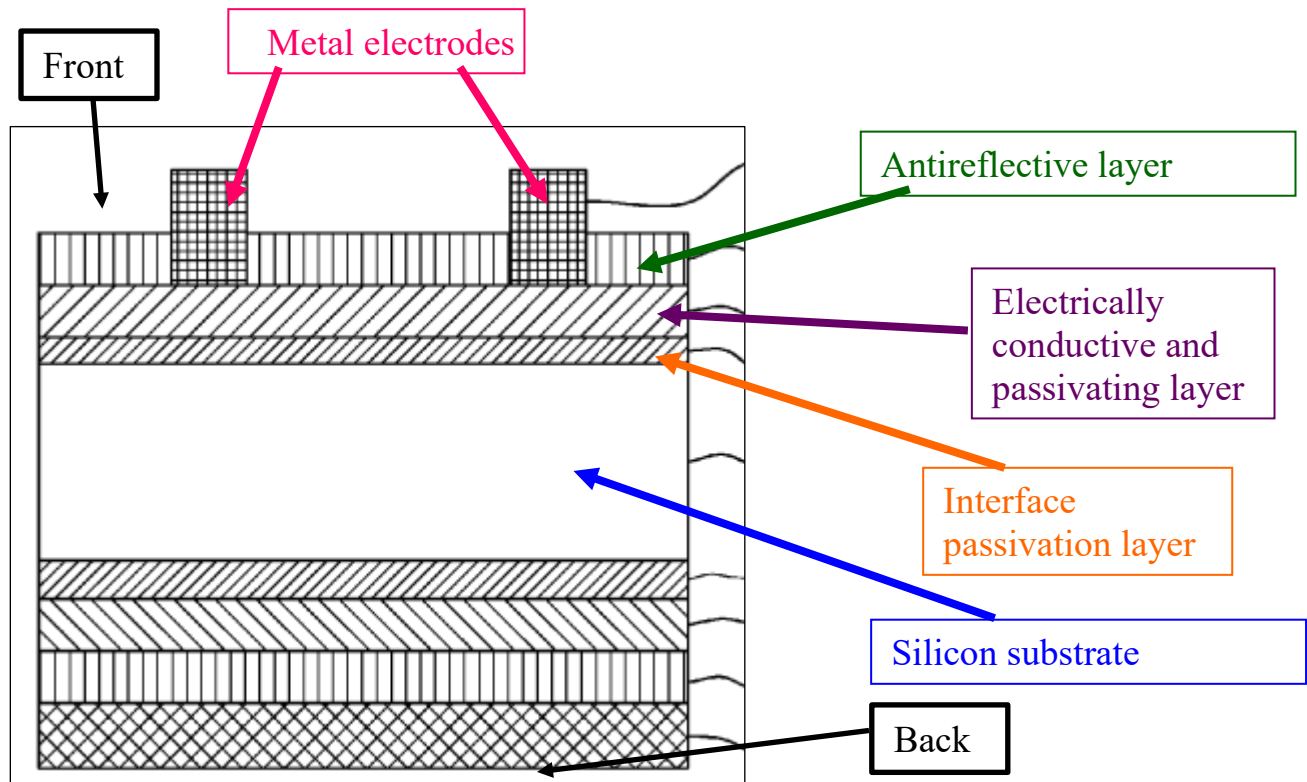
solar panel), which results in higher operational efficiency as compared to other solar cell technologies. Here, the claimed methods of the '074 Patent improve upon the manufacturing efficiency and performance of solar cells, particularly TOPCon solar cells.¹ The claimed methods of the '074 Patent were developed by the named inventors, Oliver Schultz-Wittmann and Denis DeCeuster, who co-founded TetraSun, now a fully owned subsidiary of First Solar.

As recited in claim 1, the inventive method of manufacturing solar cells involves using a silicon wafer as a central substrate, depositing or growing an interface passivation layer onto the substrate, and depositing a doped conductive and passivating layer on the interface passivation layer. Ex. 1001, 19:13-35. According to the claimed invention, this assembly of layers is heat-treated at a temperature of about 500 °C or higher, which facilitates diffusion of the dopant material (a “dopant” is a material, such as phosphorus or boron, that is added to

¹ JinkoSolar falsely states that “the *only* element of Claim 1 the Examiner found to be missing from the prior art was the limitation ‘providing metallization as electrodes which directly contact the at least one conductive and passivating layer following the thermal treatment thereof’”. Pet. 2 (emphasis in original). However, the portion of the prosecution history that JinkoSolar cites does not state that the given reason is the “only” reason for allowance. Ex. 1002, 485. Reasons for Allowance recorded by examiner are expressly non-exhaustive, according to the Manual of Patent Examining Procedure. See, MPEP 1302.14 (“The statement is not intended to necessarily state all the reasons for allowance or all the details why claims are allowed and should not be written to specifically or impliedly state that all the reasons for allowance are set forth”). See also *Salazar v. Procter & Gamble Co.*, 414 F.3d 1342, 1345 (Fed. Cir. 2005).

silicon, thus increasing the conductivity) from the conductive and passivating layer through the interface passivation layer. *Id.*

A non-limiting illustration of the structure resulting from the inventive method of claim 1 is reproduced in the diagram below.

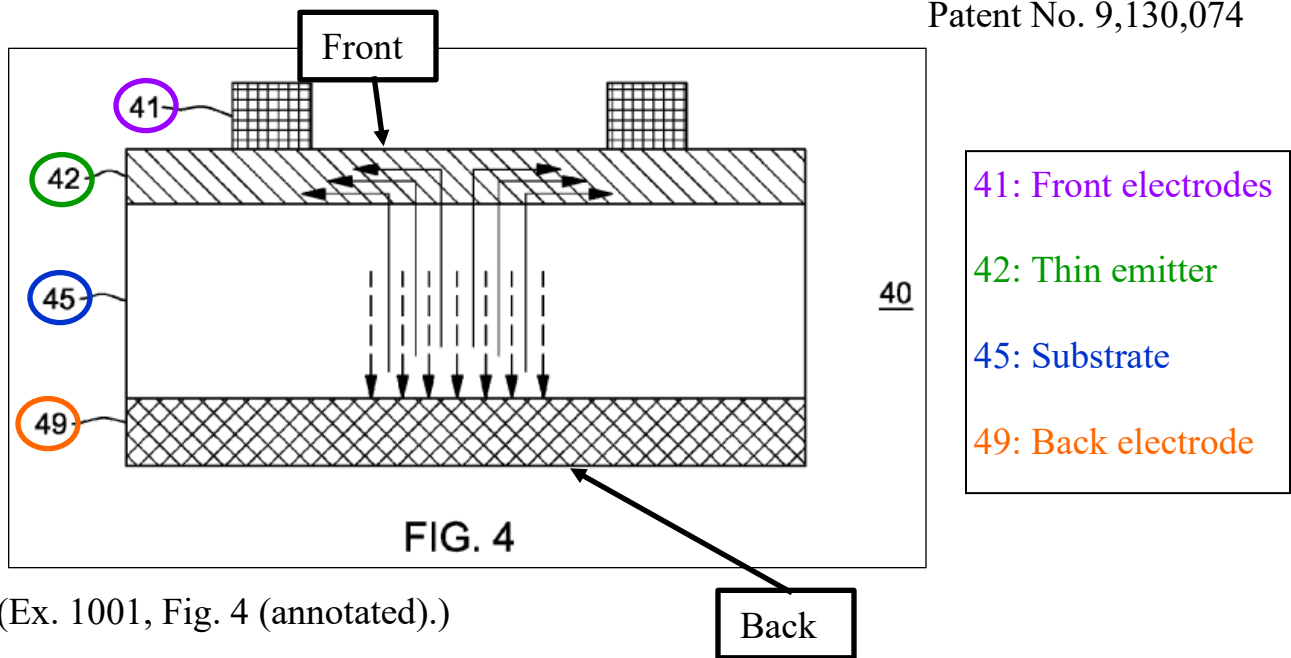


(Ex. 1001 ('074 Patent), Fig. 8 (annotated).)

In this assembly, when electrons are “excited” by sunlight, they move between the silicon substrate and the metal electrodes through both the interface passivation layer and the conductive and passivating layer. One step of the claimed process involves applying a thermal treatment to the assembly comprising the silicon substrate, the conductive and passivating layer, and the interface passivation layer. This thermal treatment facilitates diffusion of the dopant

through the interface passivation layer and, in some embodiments, into the silicon substrate. That diffusion of dopant creates charge carrier flow paths from the central silicon substrate to the front electrodes, thereby shortening the flow path the charge carriers (*e.g.*, electrons) must take through the substrate.

The general concept of shortened charge carrier flow paths is illustrated by comparing Figures 4 and 5 of the '074 Patent. When an electron is “excited”, the additional energy can cause it to move away from its current atom and take the path of least resistance to the electrodes. Figure 4, reproduced below with annotations, shows a solar cell structure with an electrode on each side (the front and back electrodes, 41 and 49) and two layers, the silicon substrate (45) and the conductive emitter layer (42) (*i.e.*, a layer with the opposite dopant as the substrate that acts as a source of electrons or holes), where the emitter layer is next to the front electrodes.

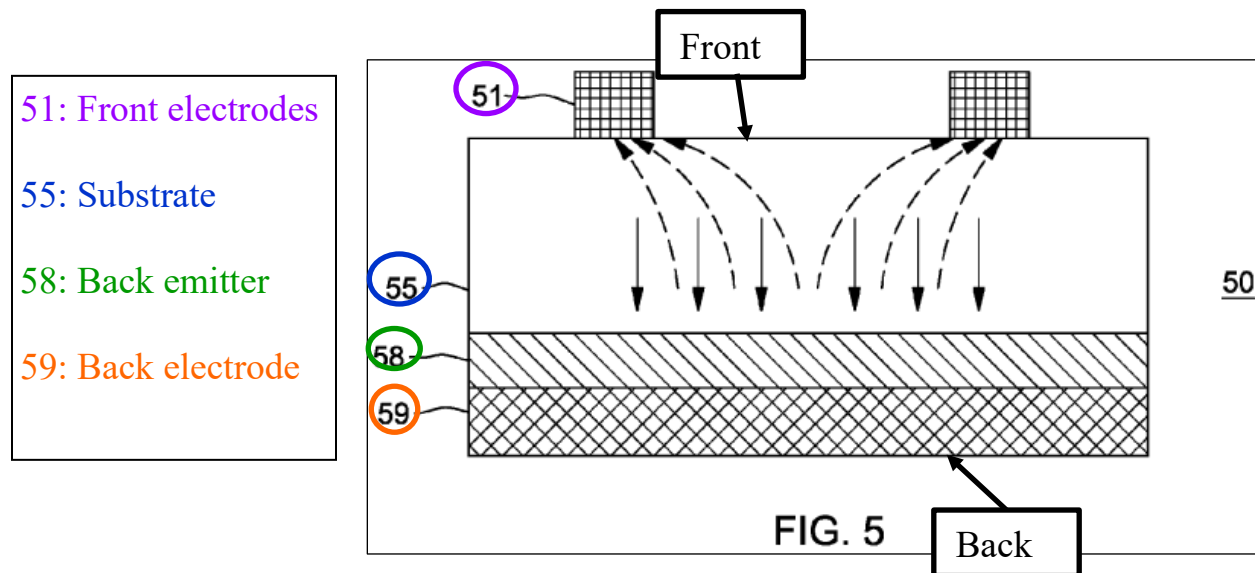


(Ex. 1001, Fig. 4 (annotated).)

Because the silicon substrate (45) is poorly conductive (and thus highly resistive) as compared to the emitter layer (42), the path of least resistance to the electrodes is vertically through the silicon substrate and laterally through the emitter layer, as illustrated by the solid lines in the annotated Figure 4 above. As the diagram illustrates, the overall distance the charge carriers travel to the front electrodes is longer than if the charge carriers had traveled along a path through the silicon substrate directly toward those electrodes.

Figure 5, reproduced below with annotations, shows another solar cell structure that does not have a highly conductive, heavily doped emitter layer between the silicon substrate (55) and the front electrodes (51); instead, the emitter layer is adjacent to the back surface electrodes. As a result, the charge flow path in Figure 5 does not travel through a region where the conductivity varies as significantly as the region illustrated in Figure 4. Because of this, the path of least

resistance in Figure 5 is also the shortest path to the front electrodes. The charge carriers take a shortened, curved path between the substrate and the electrodes, as represented by the dashed lines.



(Ex. 1001, Fig. 5 (annotated).)

The thermal treatment step claimed in the '074 Patent facilitates the creation of these shortened charge carrier flow paths. As noted above, thermal treatment results in the dopant being diffused through the interface passivation layer and, in some embodiments, into the silicon substrate. The areas where the dopant, *e.g.*, phosphorus, is incorporated into the interface passivation layer and, in some embodiments, the substrate, makes those areas more conductive. The diffusion of dopant thus increases the conductivity of the solar cell near the back surface of the silicon substrate, *i.e.*, through the interface passivation layer, such that its conductivity is more similar to the conductivity of the conductive and passivating layer. Because of the more uniform conductivity in the interface passivation layer

and the conductive and passivation layer, the charge carriers take a more direct route from the substrate toward the front electrodes, similar in concept to the flow path that is shown in Figure 5.

The diffusion of the dopant through the interface passivation layer further forms a p-n or high-low junction (*i.e.*, an area in a semiconductor (such as a solar cell) where two differently doped sections meet, which restricts the flow of electricity in one direction). Junctions between a highly doped section and lower-doped section (a “high-low junction”) create an electrical field, which decreases instances of electron recombination. A junction between two oppositely doped sections (a p-doped section and an n-doped section) forms a “p-n junction”.

B. The Claims

The '074 Patent has eight claims. The sole independent claim, Claim 1, recites:

1. (1[pre]) A method of fabricating a solar cell, comprising;
 - (1[a]) providing a wafer as a central substrate;
 - (1[b]) depositing or growing at least one amorphous interface passivation layer over the substrate;
 - (1[c]) depositing at least one conductive and passivating layer on the at least one interface passivation layer, the at

least one conductive and passivating layer comprising a dopant;

(1[d]) providing thermal treatment at a temperature of about 500° C. or higher, the thermal treatment crystallizing, at least in part, the at least one conductive and passivating layer and facilitating diffusion of the dopant from the at least one conductive and passivating layer through the at least one interface passivation layer; and

(1[e]) providing metallization as electrodes which directly contact the at least one conductive and passivating layer following the thermal treatment thereof, (1[f]) wherein the dopant diffused through the at least one interface passivation layer provides shortened charge carrier flow paths between the substrate and the electrodes through the at least one conductive and passivating layer and the at least one interface passivation layer.

Ex. 1001, 19:13-35.

3. LEVEL OF ORDINARY SKILL IN THE ART

For the purposes of this Response, First Solar accepts JinkoSolar's definition of a POSA: A POSA "would have had a bachelor's degree in in [sic] material science, material engineering, physics, electrical engineering, or a related or equivalent field, and two or more years of experience researching, developing,

designing, and/or evaluating solar cells or solar module systems. Ex-1003, ¶¶47-

49. A person with less formal education but additional relevant practical experience, or vice versa, would also qualify as a person of ordinary skill in the art. Ex-1003, ¶¶47-49.” Pet. 7-8. First Solar reserves the right to present issues relating to the level of ordinary skill should the Board institute this IPR and in other proceedings involving the ’074 Patent.

4. PETITIONER’S BURDEN

An IPR may be instituted only when “the *information presented in the petition* . . . shows that there is a *reasonable likelihood* that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition”. 35 U.S.C. § 314(a) (emphases added). Any IPR petition must “identif[y] . . . with particularity . . . the grounds on which the challenge to each claim is based . . .”. 35 U.S.C. § 312(a)(3). As such, it is JinkoSolar’s burden to “specify where each element of the claim is found in the prior art Patents or printed publications relied upon”. 37 C.F.R. § 42.104(b)(4).

The Board “will not take on the role of advocate for a party, trying to make out a case the party has not adequately stated”. Standing Order ¶ 121.5.2 (B.P.A.I. Mar. 8, 2011). Rather, it is Petitioner’s duty to provide sufficient grounds for the institution of a review “focus[ing] on concise, well organized, easy-to-follow arguments supported by readily identifiable evidence of record”. *Cisco Sys., Inc. v.*

C-Cation Tech, LLC, IPR2014-00454, Paper No. 12, at 11 (P.T.A.B. Aug. 29, 2014).

As explained below, the Petition fails to make even any showing (let alone demonstrate a reasonable likelihood) that *any* claim of the '074 Patent is unpatentable. The Petition should therefore be denied. The Petition should additionally be denied for the reasons described in First Solar's Request for Discretionary Denial. Dkt. 7.

5. THE PETITION FAILS TO ESTABLISH A REASONABLE LIKELIHOOD OF SUCCESS IN SHOWING THAT ANY CHALLENGED CLAIM IS UNPATENTABLE.

JinkoSolar has failed to establish a reasonable likelihood of success in showing that any of its asserted references or combinations renders obvious any of the claims of the '074 Patent.

A. Ground 1: JinkoSolar has not demonstrated a reasonable likelihood of success in showing that Tamura anticipates or renders obvious any challenged claim.

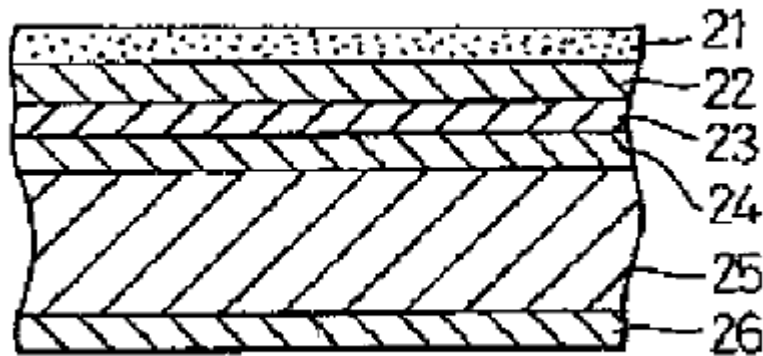
JinkoSolar fails to show that Tamura alone renders any of the challenged claims invalid. Specifically, as discussed below, Tamura does not disclose at least limitation 1[f] that the heat treatment of the silicon wafer assembly achieves shortened charge carrier flow paths.

Tamura (Japan Patent App. No. 1992245683, Ex. 1004) discloses “a method for manufacturing a solar cell” that involves depositing undoped amorphous silicon

and then depositing a conductive amorphous silicon layer (labeled as “n⁺”, which indicates a heavily doped n-type dopant) on the undoped amorphous silicon layer.

Ex. 1004, [Claim 1]. Tamura discloses heat-treating the undoped and conductive amorphous silicon layers to crystallize them and form a p-n junction. *Id.* at [0011].

Tamura teaches that the thermal treatment is at a low temperature to “prevent[] a dopant from diffusing deeply into the substrate”. *Id.* The top surface of the conductive type silicon layer 23 is completely covered by a transparent electrode 21 and electrode 22, as shown in Figure 3 (reproduced below). *Id.* [0018].



(Ex. 1004, Fig. 3.)

As discussed below, Tamura does not teach or disclose the claimed method. In particular, the process of the '074 Patent includes a high-temperature thermal treatment step that “facilitate[es] diffusion of the dopant” (element 1[d]), resulting in “shortened charge carrier flow paths between the substrate and the electrodes” (element 1[f]). *See, e.g., supra* sections 2.A, 2.B, Figs. 4, 5, and 8. In Tamura,

however, *the entire upper surface of the assembly* is covered by a transparent electrode. Thus, before thermal treatment is applied, the path between the substrate and the electrode is already a straight vertical line (the “‘shortest geometrical’ charge carrier flow path” possible). Pet. 26, 28. Thermal treatment cannot shorten it further.

i. JinkoSolar’s implicit construction of claim 1 should be rejected.

Rather than argue that Tamura discloses limitation 1[f], JinkoSolar instead opts to rewrite claim 1 to remove it. Specifically, JinkoSolar attempts to rewrite “shortened” to cover a flow path that remains the same length. Pet. 27.

As an initial matter, for IPRs filed on or after November 13, 2018, the Board applies the *Phillips* claim-construction standard. A claim subject to an IPR must be given its ordinary and customary meaning in light of the specification, *i.e.*, “the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention”. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc); 37 C.F.R. § 42.100(b). JinkoSolar’s stated position (which First Solar agrees with) is that none of the claim terms of the ’074 Patent require interpretation for purposes of deciding whether to institute a proceeding. Pet. 8. Accordingly, by JinkoSolar’s own admission, “shortened” should be construed in accordance with its ordinary and customary meaning.

But JinkoSolar then states (incorrectly) that “a POSITA would understand that the ‘shortened charge carrier flow paths’ can be achieved by *reducing the resistance* of the conductive and passivating layer” alone—that is, *without* shortening the geometrical path. Pet. 27 (emphasis added, citing JinkoSolar’s expert declaration). This is improper because it violates a critical element of the claim construction as set forth in *Philips*, that the claim term must be construed consistent with the specification. *Philips*, 415 F.3d at 1316 (“A fundamental rule of claim construction is that terms in a patent document are construed with the meaning with which they are presented in the patent document. Thus claims must be construed so as to be consistent with the specification, of which they are a part.”) (quoting *Merck & Co. v. Teva Pharms. USA, Inc.*, 347 F.3d 1367, 1371 (Fed. Cir. 2003); see also, *CUPP Computing AS v. Trend Micro Inc.*, 53 F.4th 1376, 1380 (Fed. Cir. 2022)).

As JinkoSolar admits, whenever the ’074 Patent refers to charge carrier flow path lengths, it expressly refers to it as a “*geometrical*” term. Pet. 26 (quoting Ex. 1001, 4:47-50); see, also, Ex. 1001, 4:41-43, 57-59, and 63-65. The cited portion of JinkoSolar’s expert declaration again acknowledges that the ’074 Patent expressly teaches that the length of a charge carrier flow path is a “*geometrical*” measurement. Ex. 1003, ¶ 126. Despite the ordinary and customary meaning of “shortened”, however, and the ’074 Patent’s repeated and consistent teaching that

the length of a charge carrier flow path is a “geometrical” measurement, JinkoSolar contends that “a POSITA would understand that the ‘shortened charge carrier flow paths’ would be understood to mean ‘reducing the resistance of the conductive and passivating layer’ (without shortening the geometrical path). Pet. 27 (citing JinkoSolar’s expert declaration). JinkoSolar cites no caselaw, no intrinsic evidence, and no extrinsic evidence to support this construction. Pet. 27. It is purely the conjecture of JinkoSolar’s expert. Because the specification makes it clear that the length of a charge carrier flow path is a “geometrical” measurement, a “shortened charge carrier flow path” must have less length.

JinkoSolar’s claim construction should be rejected. As stated above, and as acknowledged by both JinkoSolar and JinkoSolar’s expert, the ’074 Patent repeatedly and expressly states that the shortness of a charge carrier flow path is a “geometric[]” measurement. Thus, a claim construction that “shortened charge carrier flow path” is not a geometric term would be inconsistent with the specification and thus improper. *In re Suitco Surface, Inc.*, 603 F.3d 1255, 1259 (Fed. Cir. 2010). Because Ground 1 is entirely dependent on an improper construction, JinkoSolar does not have a reasonable likelihood of success.

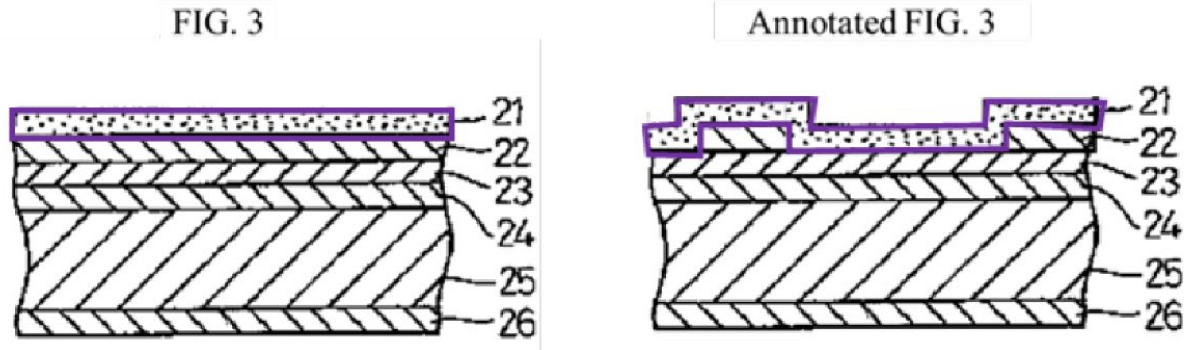
- ii. Under the ordinary and customary meaning of claim 1, Tamura does not anticipate or render obvious claim element 1[f] “wherein the dopant diffused through the at least one interface passivation layer provides shortened charge carrier flow paths between the substrate and the electrodes through the at least one conductive and passivating layer and the at least one interface passivation layer”.

Tamura neither anticipates nor renders obvious claim 1[f]. Pet. 26-30.

Specifically, Tamura does not disclose the diffusion of dopant providing a “shortened charge carrier flow path between the substrate and the electrodes”.

Reproduced below are Figure 3 of Tamura and the Jinko-created “Annotated FIG. 3” from the Petition. Pet. 30.² In FIG. 3, the electrodes 21/22 cover the entire upper surface of the n^+ type crystalline silicon layer 23. As JinkoSolar states (Pet. 28), this structure is a “full area contact” because the entire area of the upper surface of the n^+ type crystalline silicon layer 23 is in contact with the electrodes. According to JinkoSolar, a full area contact structure has the “‘shortest geometrical’ charge carrier flow path”—that is, one that is a straight vertical line from the substrate to the electrode. Pet. 26.

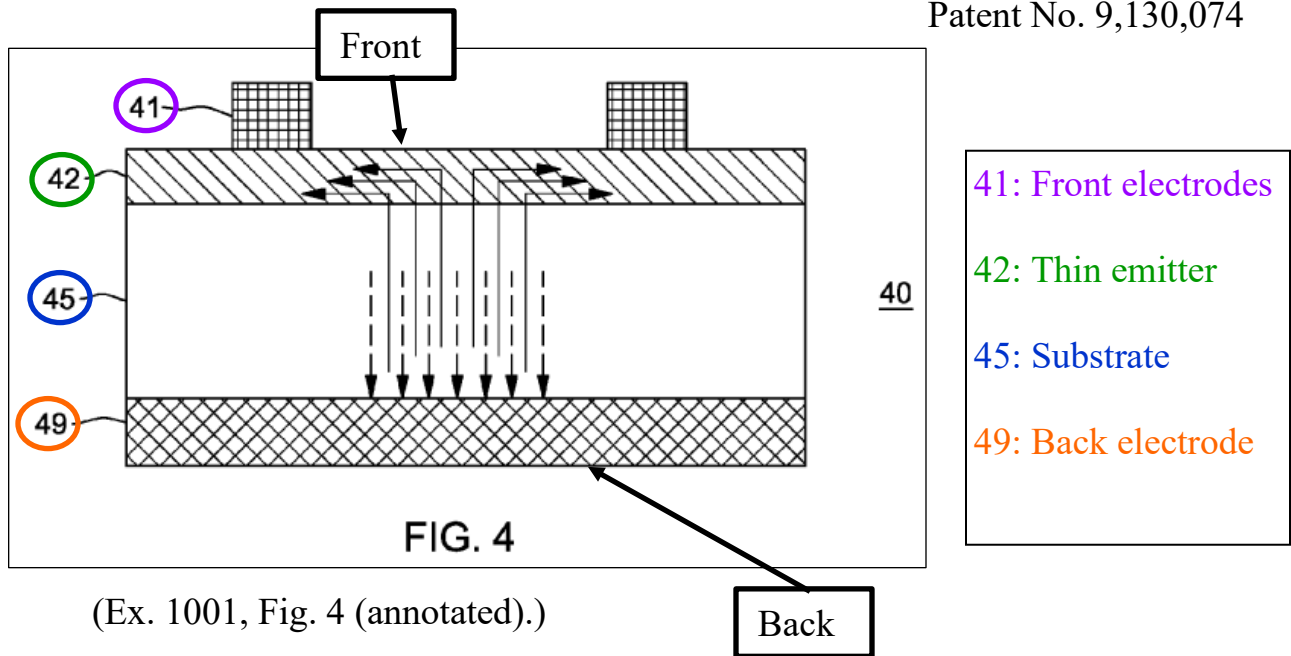
² Despite referring to the image as “Annotated FIG. 3”, JinkoSolar does not add annotations but rather redraws the FIG. 3. However, for the purposes of this Response, First Solar will accept JinkoSolar’s “Annotated” FIG. 3.



(Pet. 30 and 32; Ex. 1003 at 77, 78, and 80.)

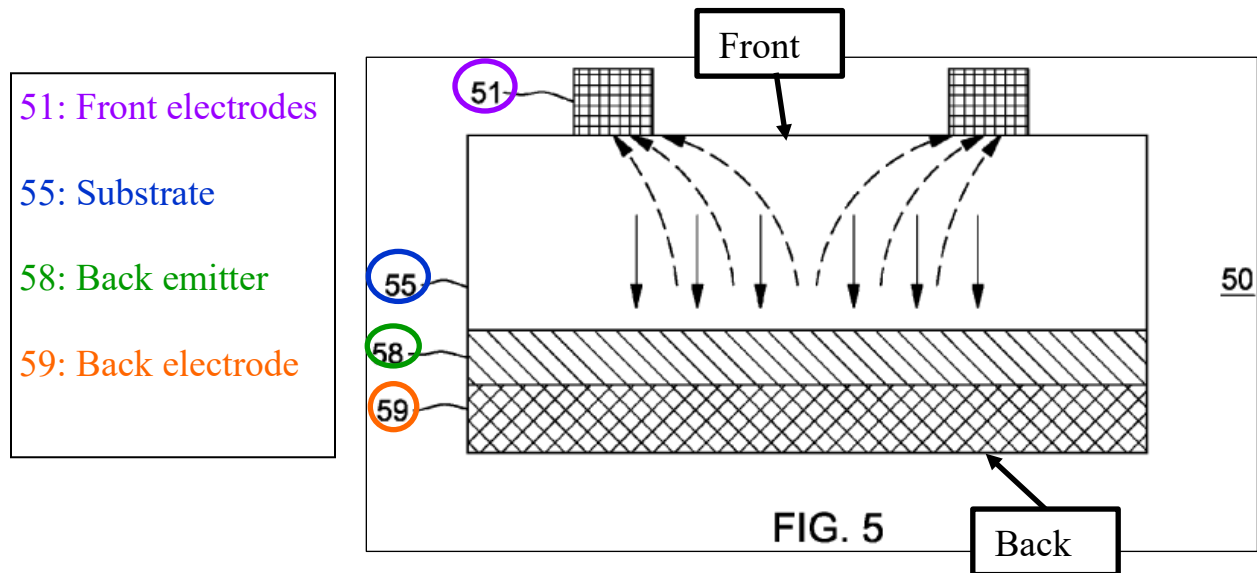
Tamura does not disclose, nor does JinkoSolar contend it discloses, any geometric shortening of the charge carrier path. Indeed, it cannot because the flow path is already the shortest possible geometric path, regardless of the diffusion of dopant. Pet. 28; Ex. 1003 ¶ 130. Instead, the charge carrier flow paths in Tamura (and in the petition) remain the same length both before and after any thermal treatment is performed. *Id.*

According to the '074 Patent, in the absence of the claimed thermal treatment, the charge carrier flow paths extend vertically through the less-conductive layer and then horizontally to the electrodes through the more-conductive layer along a lengthy flow path, such as those shown by the solid arrows in Figure 4 of the '074 Patent, replicated below.



(Ex. 1001, Fig. 4 (annotated).)

The thermal treatment of the claimed process facilitates diffusion of the dopant from the conductive and passivating layer through the interface passivation layer. Ex. 1001, 16:17-20, 18:46-51. The changed amount of dopant changes the conductivity of the conductive and passivating layer and interface passivation layer of the solar cell assembly (Ex. 1003 ¶¶ 113-14), which causes the charge carrier flow paths to have the claimed shorter, curved shape. As recited in the claim, “*the dopant diffused through the at least one interface passivation layer provides shortened charge carrier flow paths between the substrate and the electrodes through the at least one conductive and passivating layer and the at least one interface passivation layer*”. Ex. 1001, 19:30-34.



(Ex. 1001, Fig. 5 (annotated).)

Tamura neither anticipates nor renders obvious 1[f], “*facilitating diffusion of dopant*” “*wherein the dopant diffused through the at least one interface passivation layer provides shortened charge carrier flow paths between the substrate and the electrodes through the at least one conductive and passivating layer and the at least one interface passivation layer*”, as recited in claim 1.

Claims 2-8 of the '074 Patent depend from claim 1. Accordingly, claims 2-8 are patentable over Tamura for at least the reasons given above with respect to claim 1.

B. Ground 2: JinkoSolar has not demonstrated a reasonable likelihood of success in showing that Borden anticipates or renders obvious claims 1-2 and 4-8.

JinkoSolar fails to show that Borden renders any of the challenged claims invalid. JinkoSolar mischaracterizes Borden’s disclosure and thus overstates the relevance of Borden to the '074 Patent. Specifically, JinkoSolar proposes

modifying Borden in a way that would render Borden inoperable for its intended purpose.

Claim 1 of the '074 Patent recites “*providing thermal treatment . . . the thermal treatment crystallizing, at least in part, the at least one conductive and passivating layer and **facilitating diffusion of the dopant** from the at least one conductive and passivating layer through the at least one interface passivation layer*” (emphasis added). In the claimed inventive methods, the diffusion of dopant from the conductive and passivating layer through the interface passivation layer creates a diffused junction between the now doped interface passivation layer and the substrate (which is differently doped).

Borden is directed to precisely the opposite type of system. The title of Borden is “Polysilicon Tunnel Junctions as *Alternates to Diffused Junctions*”. Ex. 1006, 1149 (emphasis added). As described in the first sentence of the abstract, the authors “report use of heavily doped polysilicon combined with a tunnel dielectric to provide an *alternate to diffused junctions* for solar cells”. *Id.* (emphasis added). The introduction similarly begins “[t]he deep *diffusions* required for a two-step junction [1] to provide the emitter and contact passivation required for high efficiency cells *is a complex and expensive process*. An *attractive alternate approach* is to . . .”. *Id.* (emphases added). In other words, the stated purpose of Borden is to provide an alternative to the process of diffusing dopant to form

junctions. The Petition does not acknowledge, let alone address, this clear incompatibility of Borden and the '074 Patent.

Instead, JinkoSolar asserts that “Borden discloses growing thin **tunnel dielectrics** (also referred to as **tunnel layers** or **tunnel insulators**) over the front and/or back of the n-type substrate. Pet. 46 (emphases in original). JinkoSolar alleges that these tunnel dielectrics are an “*interface passivation layer*” of claim 1, through which dopant is diffused. *Id.* However, JinkoSolar ignores a critical teaching about the tunnel dielectrics in Borden: “[t]hin tunnel dielectrics (6-12A) are fabricated using methods adapted from IC [*i.e.*, integrated circuit] processing. ***These serve as diffusion barriers***”—that is, they block the type of layer-to-layer diffusion recited in the claim. Ex. 1016, Abstract (emphasis added). Similarly, JinkoSolar ignores that Borden discloses that the tunnel dielectrics act as a “tunnel barrier” and “blocking tunnel dielectric”, which Borden teaches “serve as diffusion barriers” and thus “enable[e] low dark currents not possible with diffused emitters”. *Id.* at Abstract, 1150. Borden further includes test results showing that, rather than diffusion, the dopant profile shows a “sharp” drop-off. *Id.* at 1150 (“a sharp junction profile is obtained, in large part due to the blocking tunnel dielectric”). Accordingly, Borden both teaches that the tunnel dielectric is intended to serve as a barrier, preventing diffusion of dopant, and discloses test results showing that, in practice, the barrier successfully blocks said diffusion.

Despite the fact that Borden only teaches an *alternative* to diffusion emitters, JinkoSolar is not deterred: the Petition asserts that Borden discloses diffusion emitters. Specifically, the Petition asserts that “[a] POSITA would understand that the thermal treatment facilitates diffusion of the dopant from the crystallized poly layer (*a conductive and passivating layer*) through the tunnel dielectric (*an interface passivation layer*).” Pet. 52; *see, also*, Pet. 55 (referring to this resulting structure as an emitter). JinkoSolar’s only support for this assertion is a single paragraph of a declaration from its expert, Dr. Hatalis, which states:

Borden discloses that the doped polysilicon layer is initially amorphous silicon (a-Si) and is crystallized through thermal treatment, specifically through rapid thermal annealing (RTA) at 1000°C. Borden, 1150 (“Amorphous silicon was then deposited and **crystallized** with a 30 second **RTA at 1000°C**”). *See also* Borden, FIGs. 3-4.

(Ex. 1003 ¶ 205 (citing Ex. 1006, 1150).) But this says nothing about Borden’s teachings concerning diffusion of dopant through the tunnel dielectrics, nor does anything else the Petition cites. *Id.* That is because no such teaching exists in Borden. Such teaching would be antithetical to Borden’s actual teaching, which is that the tunnel dielectrics prevent diffusion of dopant therein to create an attractive alternate to emitters formed by diffusion. Ex. 1006.

The Petition also states that “Dr. Hatalis further explains that Borden discloses that the thermal treatment causes boron (i.e., the dopant) to diffuse into the substrate”. Pet. 52. Again, this conclusion is based on a single paragraph of

Dr. Hatalis’s declaration that also ignores Borden’s teaching that the tunnel dielectrics “serve as diffusion barriers”. Ex. 1003 ¶ 206. Instead, Dr. Hatalis offers the unsupported conclusion that “a POSITA would understand that heating the poly layer at 1000°C increases the atomic motion of the dopant atoms (*i.e.*, boron), allowing the dopant atoms from the doped poly layer to ***diffuse through the tunnel dielectric*** into the n-type silicon substrate”. *Id.* (emphasis added). This is simply wrong, because a POSITA would understand that the “***diffusion barrier***” of Borden would not permit diffusion therethrough.

It is a well-established, fundamental principle of patent law that if a proposed modification would render the prior art invention being modified “inoperable for its intended purpose”, there can be no suggestion or motivation to make the proposed modification. *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984); *see also*, *Univ. of Md. Biotechnology Inst. v. Presens Precision Sensing GmbH*, 711 F. App’x 1007, 1010 (Fed. Cir. 2017) (“[W]e also exercise caution before holding a claimed invention obvious when combining references would violate the principle of operation of the modified reference. This is because a person of ordinary skill would not be motivated to modify a reference by contradicting its basic teachings, *see id.*, or by making it ‘inoperable for its intended purpose’”[.]); *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012). There can be no dispute that the intended purpose of Borden is, as its title recites, to

create “tunnel junctions as alternates to diffused junctions”. Ex. 1006, 1149.

Thus, the Petition’s assertion that a POSA would understand that one could diffuse dopant through tunnel barriers of Borden to form a diffused junction improperly “contradict[s] [Borden’s] basic teachings” and “mak[es] it ‘inoperable for its intended purpose’”. *See Univ. of Md. Biotechnology Inst.*, 711 F. App’x at 1010.

Claims 2 and 4-8 depend from claim 1. Accordingly, JinkoSolar has not demonstrated a reasonable likelihood of success on any challenged claim under Ground 2 for the reasons in this section.

- C. Ground 3: JinkoSolar has not demonstrated a reasonable likelihood of success in showing that claims 3-4 are rendered obvious by Borden and Gan, Kwark, or Swanson.

Ground 3 of the Petition relied on Ground 2 for all of the elements of claim 1. Pet. 72. As discussed above, Ground 2 fails to anticipate or render obvious claim 1 of the ’074 Patent. *See supra* section 5.B. Claims 3 and 4 depend from claim 1. Accordingly, JinkoSolar has not demonstrated a reasonable likelihood of success on Ground 3 for the reasons in section 5.B.

- D. Ground 4: JinkoSolar has not demonstrated a reasonable likelihood of success in showing that Rana renders obvious claims 1-8.

JinkoSolar fails to show that Rana renders any of the challenged claims invalid. JinkoSolar first fails to establish that Rana is prior art to the ’074 Patent and then mischaracterizes the extent of Rana’s disclosure and, as a result, overstates the relevance of Rana to the ’074 Patent. Even taking JinkoSolar’s

characterization of Rana, the Petition fails to address at least one element of independent claim 1.

- i. JinkoSolar fails to establish that Rana is prior art to the '074 Patent.

JinkoSolar bears the burden of establishing that asserted references are prior art to the challenged claims. *CQV Co., Ltd. v. Merck Pat. GmbH*, 130 F.4th 1344, 1349 (Fed. Cir. 2025). JinkoSolar fails to do so here. Rana was filed on September 18, 2009, and published on September 23, 2010. The '074 Patent declares priority to U.S. Pro. App. No. 61/171,194, which was filed on April 21, 2009, five months before the application that published as Rana. The Petition argues that “Rana is prior art under pre-AIA 35 U.S.C. § 102(e) because it claims priority to Provisional Application No. 61/098,713, filed on September 19, 2008, before the earliest claimed priority date of the '074 patent”. Pet. 11. However, the Petition does not attach the '713 provisional application, nor does it make any assertions that the relied-upon disclosure of Rana was initially disclosed in said provisional. JinkoSolar therefore fails to meet its burden to establish that Rana is entitled to the priority date of the provisional. *In re Riggs*, 131 F.4th 1377, 1384 (Fed. Cir. 2025) (holding that “any party challenging the validity of a patent” must demonstrate that the specific portions of the prior art identified and relied upon are supported in the provisional).

Not only did JinkoSolar fail to meet its burden, the relied-upon disclosure of Rana was, in fact, ***not*** disclosed in the '713 provisional. For example, both the Petition and declaration repeatedly cite to Figure 1 of Rana, which is ***absent*** from the '713 Application. *See, e.g.*, Pet. 12, 13, 82, 83, 84, 87, and 89; Ex. 1003 at pp. 40, 170, 171, 172, 173, 177, 179, and 180; Ex. 2022. Between the Petition and declaration, the Petition cites Figure 1 of Rana ***ten*** times. Similarly, the Petition and declaration repeatedly cite Figures 3, 4a, and 4c of Rana, none of which appear in the '713 Application. Because the specific relied-upon portions of the non-provisional application are not supported by the provisional application, Rana is not entitled to the provisional application's filing date for the purposes of its treatment as prior art. *In re Riggs*, 131 F.4th at 1385 (holding that prior art is not entitled to the priority date of its provisional unless the provisional provides support for the specific portions of the prior art being relied upon).

Because JinkoSolar failed to establish that Rana is prior art to the challenged claims of the '074 Patent, institution on Ground 4 should be denied.

ii. Even if Rana were prior art, it fails to render obvious claims 1-8.

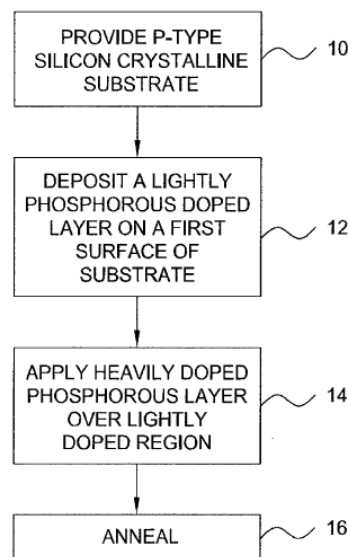
Rana discloses a method of making an emitter for a solar cell. Ex. 1007, Abstract. The method involves depositing a doped amorphous silicon layer over an upper surface of a crystalline silicon substrate, depositing a second doped amorphous silicon layer on the first amorphous silicon layer, and heating to cause

solid phase epitaxial crystallization of the first and second amorphous silicon

layers. *Id.* Rana discloses heating the first amorphous silicon layer “at a temperature sufficient to diffuse the phosphorous [sic] in the lightly doped amorphous silicon layer into the crystalline silicon substrate”. *Id.* [0011].

As asserted in the Petition, Figure 1 of Rana (reproduced below) discloses providing a p-type silicon crystalline substrate (a *central substrate*), depositing a phosphorus-doped layer on a first surface of the substrate (an *interface passivation layer*), applying a heavily doped phosphorus layer over the lightly doped region (a *conductive and passivating layer*), and annealing (*providing thermal treatment*).

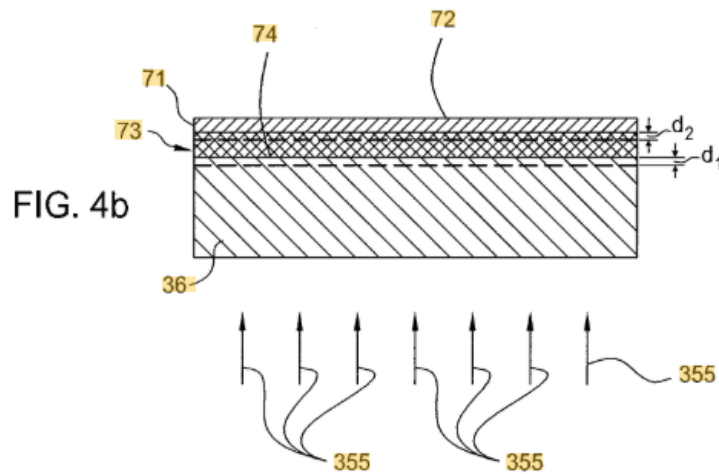
Pet. 82-89.



Ex. 1007, FIG. 1

The Petition further states that, as to claim element 1[d], the annealing step of Rana causes crystallization of both the lightly doped (*interface passivation layer*) and heavily doped layer (*conductive and passivating layer*). Pet. 88-91. According to the Petition, “Rana further discloses that during the annealing process, the heat energy facilitates diffusion of the dopants into the substrate”. Pet. 91 (citing Ex. 1007, [0042]). In support, the Petition (1) reproduces FIG. 4c of Rana, which shows the crystalline structure of Rana after the annealing step (Ex. 1007, [0043]), and (2) includes a partial quote that states that ““the substrate 36 with the deposited amorphous silicon layers 73, 71 is annealed . . . at a temperature sufficient to activate and cause the dopant atoms (e.g., phosphorous [sic]) in the lightly and heavily doped amorphous silicon layers 73,71 to diffuse into the substrate 36””. Pet. 91.

But JinkoSolar omits the actual teaching of Rana. FIG. 4b, which JinkoSolar does not cite, shows the structure of the solar cell assembly in Rana *after* the dopant has been diffused in the annealing step (Ex. 1007 [0042]). As Rana states: “The dotted lines in FIG. 4 b shows the status of the structure after the lightly doped layer 73 has been diffused into the first surface of the substrate a desired distance d1 and the heavily doped layer 71 [i.e., a *conductive and passivating layer*] has been diffused into the lightly doped layer 73 [i.e., an *interface passivating layer*] a desired distance d2”. Ex. 1007 [0042].



(Ex. 1007, FIG. 4b.)

As FIG. 4b (shown above) makes clear, the dopant from the highly doped layer 71 (*conductive and passivating layer*) does not diffuse **through** the lightly doped layer 73 (*interface passivation layer*), as in the challenged claims, but rather only diffuses a very short distance d_2 into the surface of the lightly doped layer 73 (*interface passivation layer*).

Thus, the dopant diffused into the substrate 36 (*central substrate*) originates from the lightly doped layer 73 (*interface passivation layer*), not the highly doped layer 71 (*conductive and passivating layer*). *Id.* This is recognized throughout Rana: “sufficient to diffuse the phosphorous [sic] in the lightly doped amorphous silicon layer into the crystalline silicon substrate” (*Id.* [0011]), “the doping atoms in the deposited lightly doped amorphous layer will also diffuse into the p-type substrate” (*Id.* [0030]), “a region to which the phosphorous [sic] atoms from the

lightly doped amorphous silicon layer is diffused will become a doped n-type region within the p-type single crystal silicon substrate” (*Id.* [0043]), “after the lightly doped layer 102 of amorphous silicon has been diffused into the substrate” (*Id.* [0048]), etc.

The fact that the dopant diffused into the substrate is from the lightly doped layer rather than the highly doped layer is an important and intentional aspect of the invention of Rana. As shown in FIG. 4b, the annealing step of Rana involves applying heat 355 from the bottom surface of the substrate 36 (*central substrate*). As described in Rana, the substrate is intentionally heated from the bottom (that is, the side away from the highly doped layer 73) because “the heating element 355A (FIG. 3) or 35 (FIG. 2) is generally used to create a temperature gradient between the first surface and the second surface of the substrate, such that a *temperature of an interface between the lightly doped amorphous silicon layer 73 and the crystalline silicon substrate 36 is higher than a temperature of a point in the heavily doped amorphous silicon layer 71* that is distance [sic] from the interface between the lightly doped amorphous silicon layer 73 and the crystalline silicon substrate 36”. *Id.* [0041] (emphasis added). This temperature gradient is used “to form a desired emitter dopant profile”, which, here, is a stepped dopant profile with distinct lightly doped and highly doped layers.

In contrast, the '074 Patent claims “facilitating diffusion of the dopant from the at least one conductive and passivating layer ***through the at least one interface passivation layer***”. Ex. 1001, 19:25-27 (emphasis added). As described above, Rana fails to render this claim element obvious because (1) Rana expressly teaches that dopant is not diffused ***through*** the interface passivation layer, (2) Rana expressly teaches heating the structure in a way to ***avoid*** diffusing dopant from a conductive and passivating layer (as defined by JinkoSolar) ***through*** an interface passivation layer so as to maintain the desired dopant profile, and, in any event, (3) Rana’s interface passivation layer (as defined by JinkoSolar) is already doped before the annealing step and thus does not need dopant diffused through it. Thus, Rana does not render obvious 1[d].

Claims 2-8 depend from claim 1 and thus are patentable over Rana for the same reason. JinkoSolar has not shown a reasonable likelihood of success of prevailing as to any challenged claim in Ground 4.

6. CONCLUSION

For the reasons set forth above, JinkoSolar has not met its burden of establishing a reasonable likelihood of success in arguing that any of the challenged claims of the '074 Patent are obvious under the asserted grounds. Therefore, First Solar respectfully requests that the Board deny institution of *inter partes* review.

Dated: October 31, 2025

Respectfully submitted,



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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that First Solar's Patent Owner Preliminary Response contains 6306 words as counted by the word processing program used to generate this document. The figures in this response contain approximately an additional 162 words. This brings the total number of words to 6468. This total does not include the table of contents, table of authorities, appendix of exhibits, certificate of service, signature or certificate of word count.

Dated: October 31, 2025

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CERTIFICATE OF SERVICE

The undersigned certifies that a copy of the attached Request and supporting materials were served on October 31, 2025, by electronic mail, as authorized by

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