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UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD
RUNERGY USA INC. AND §
RUNERGY ALABAMA INC. §
§
Petitioners, §
§
VS § Case IPR2025-00006
§ Patent No. 10,230,009
§
TRINA SOLAR CO. LTD., §
§
Patent Owner. §

ORAL VIDEOCONFERENCE DEPOSITION OF
SANJAY BANERJEE, PhD
FRIDAY, JUNE 20, 2025
VOLUME 1 OF 1

ORAL VIDEOCONFERENCE DEPOSITION OF SANJAY
BANERJEE, PhD, located in Dallas, Texas, produced as
a witness, duly sworn by me at the instance of the
PATENT OWNER, was taken in the above-styled and
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10:02 A.M. to 11:55 P.M., Central Time, and reported
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PENNY L. PABITZKY, a Certified Shorthand
Stenographer, pursuant to 37 C.F.R. 42.53 and the
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immediately with this CERTIFIED FINAL TRANSCRIPT.

Job Number 989065

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STENOGRAPHER'S NOTE: Quotation marks are used for clarity and do not necessarily reflect a direct quote.

REQUESTED INFORMATION

PAGE/LINE NUMBER	DESCRIPTION
	(None.)

QUESTIONS INSTRUCTED NOT TO BE ANSWERED

PAGE/LINE NUMBER	QUESTION BY
	(None.)

NONRESPONSIVE/MOTION TO STRIKE OBJECTION INDEX

PAGE/LINE NUMBER	OBJECTION BY
	(None.)

EXHIBIT INDEX
ORAL VIDEOCONFERENCE DEPOSITION OF
SANJAY BANERJEE, PhD
FRIDAY, JUNE 20, 2025
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NO.	DESCRIPTION	PAGE
Exhibit IPR2025-00006, Ex 1003 (Expert Dec)	Declaration of Sanjay Banerjee Regarding, U.S. Patent No. 10,230,009, Patent No. 10,230,009; Issued: March 12, 2019; Filed: June 1, 2018; Inventor: Jungmin Ha, et al.; Title: Solar Cell and Method for Manufacturing the Same; Inter Partes Review No. IPR2025-00006, 186 pages	11
Exhibit IPR2025-00007, Ex 1003 (Expert Dec)	Declaration of Sanjay Banerjee Regarding U.S. Patent No. 9,722,104, Patent No. 9,722,104, Issued: August 1, 2017; Filed: November 27, 2015; Inventor: Jungmin Ha, et al.; Title: Solar Cell and Method for Manufacturing the Same; Inter Partes Review No. IPR2025-00007, 186 pages	11
Exhibit 1009	United States Patent Application Publication JIN et al., Pub. No.: US 2013/0056051A1 Pub. Date: 03/07/13	21
Exhibit 1012	"Passivated rear contacts for high-efficiency n-type Si solar cells providing high interface passivation quality and excellent transport characteristics," Solar Energy Materials & Solar Cells, F. Feldmann, 5 pages	30
Exhibit 1026	"Study on the edge isolation of industrial silicon solar cells with waterjet-guided laser," Science Direct, D. Kray, 7 pages	53

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NO.	DESCRIPTION	PAGE
Exhibit 1031	"Novel method for preparation of Interdigitated back contacted a-Si:H/c-Si heterojunction solar cells," Research Gate, 01/11, 6 pages	49
Exhibit 1032	"Novel low pressure sputtering source and improved vacuum deposition of small patterned features using precision shadow masks," W. Decker, ResearchGate, 05/16, 7 pages	57

1 PROCEEDINGS

2 THE CERTIFIED STENOGRAPHER: Good
3 morning. We are on the record. Today is
4 June 20th, 2025. The time is 10:02 a.m.,
5 Central Time. This is the remote
6 videoconference oral deposition of Sanjay
7 Banerjee in the Runergy USA versus Trina
8 Solar Company matter. It is being
9 conducted remotely.

10 I am your certified stenographer,
11 Penny Pabitzky, RPR 800526. I will be
12 administering the oath and reporting the
13 deposition remotely by stenographic means
14 from my office located in Nederland,
15 Texas.

16 The witness is located in Dallas,
17 Texas.

18 Are all parties waiving the
19 requirements of Federal Rule 30(b)(5), and
20 are you taking this pursuant to the Rules?

21 MR. HERMAN: This is Patrick,
22 Herman, counsel for patent owner; and yes.

23 MR. ROBERTS: And this is Michael
24 Roberts of Sidley Austin for Petitioners;
25 and also yes.

1 MR. TENNANT: David Tennant for
2 Petitioner Mundra and Adani, and yes.

3 THE CERTIFIED STENOGRAPHER: Before
4 I swear in the witness, I will ask counsel
5 to stipulate on the record that there is
6 no objection at this time, nor will there
7 be an objection at a future date, to my
8 swearing in the deponent remotely.

9 MR. HERMAN: No objection from
10 patent owner.

11 MR. ROBERTS: No objection for
12 Runergy petitioners.

13 MR. TENNANT: No objection for
14 Mundra and Adani. Thanks.

15 (Witness sworn.)

16 SANJAY BANERJEE, PhD,
17 having been first duly sworn to tell the truth, the
18 whole truth, and nothing but the truth, so help him
19 God, testified as follows:

20 EXAMINATION

21 BY MR. HERMAN:

22 Q. Hi. Good morning, Dr. Banerjee.

23 Did I get that right --

24 A. Yes.

25 Q. -- your name?

1 A. Good morning.

2 Q. You've been deposed many times before,
3 correct?

4 A. Yes.

5 Q. So despite that extensive experience, I'm
6 going to go through a few basic ground rules just
7 to make sure that things go smoothly today.

8 The first is, as you've seen, there's
9 a court reporter here; so it's important that you
10 respond verbally. Is that okay?

11 A. Yes.

12 Q. It's also important that we not talk over
13 each other. So I'll do my best to wait until you
14 to can finish answering before asking another
15 question, and I'll also ask that you wait until
16 I'm done with my question before answering.

17 Is that okay?

18 A. Yes.

19 Q. You're also entitled to a question you
20 understand. So if anything I ask today is
21 unclear, please ask me to clarify. Otherwise,
22 I'll assume we're on the same page. Is that okay?

23 A. Yes.

24 Q. Next I ask that you not look at anything
25 during the deposition besides the documents that I

1 give you. And if you do look at anything, I ask
2 that you tell me. Is that okay?

3 A. Yes. I have unmarked copies of the
4 patent, my two declarations, and the cited prior
5 art with me.

6 Q. Is that it? Any other materials --
7 (Overlapping speakers.)

8 A. That's it. No.

9 BY MR. HERMAN:

10 Q. All of those are clean copies; is that
11 correct?

12 A. Yes. Yes. Unmarked copies.

13 Q. I just ask if you're referring to one of
14 those documents in one of your answers to a
15 question that you please let me know which
16 document you're referring to. Okay?

17 A. Okay.

18 Q. Now, is there anything that would prevent
19 or interfere with your testimony today?

20 A. No.

21 Q. Now, my -- I understand that you may have
22 copies of these two documents already; but just to
23 make sure that we're talking about the same thing,
24 I'm going to put two copies of exhibits into the
25 Zoom chat, if you'll just give me a moment.

1 One of those has been marked
2 Exhibit 1003 and IPR2025 and then four zeroes and
3 a 6. And the other one has been marked
4 Exhibit 1003 and IPR2025 four zeros and then a 7.

5 Can you please let me know when you
6 have those two documents?

7 (Marked Exhibit Numbers 1003
8 IPR202500006 and 1003 IPR202500007.)

9 A. I do.

10 BY MR. HERMAN:

11 Q. Now, starting with Exhibit 1003 from
12 IPR2025, the four zeros and then the 6 -- do you
13 have that document in front of you?

14 A. Yes.

15 Q. That's your declaration relating to U.S.
16 Patent Number 10,230,009, correct?

17 A. Yes.

18 Q. Is it okay if I refer to that patent
19 today as the '009 patent?

20 A. Yes.

21 Q. And can I also refer to this particular
22 declaration as your '009 patent declaration?

23 A. Yes.

24 Q. Is there anything in that declaration
25 that, sitting here today, you believe is

1 inaccurate?

2 A. No.

3 Q. Now, if you could take a look at the
4 other exhibit I gave you, that's Exhibit 1003 and
5 the IPR2025, the four zeros, and then the 7
6 preceding.

7 A. Yes.

8 Q. That relates to U.S. Patent Number
9 9,722,104, correct?

10 A. Yes.

11 Q. Is it okay if I refer to that as the '104
12 patent?

13 A. Yes.

14 Q. And can I refer to this declaration today
15 as your '104 patent declaration?

16 A. Yes.

17 Q. Now, is there anything, sitting here
18 today, that you believe is inaccurate in the '104
19 patent declaration?

20 A. No.

21 Q. Now, what is a TOPCon solar cell?

22 MR. ROBERTS: Object to form.

23 And also, Mr. Herman -- well,
24 before we get too far along, I just want
25 to note for the record that the objections

1 I'm making are on behalf of all
2 petitioners; but Adani may make
3 Adani-specific objections during the
4 deposition.

5 MR. HERMAN: Okay.

6 A. Are you asking me in general, or are you
7 asking me to look at a specific part of my
8 declaration?

9 BY MR. HERMAN:

10 Q. In general.

11 A. In general, it stands for tunnel oxide
12 passivated contact solar cell.

13 Q. So the phrase that I use, TOPCon, is an
14 acronym, correct?

15 A. Yes.

16 Q. And the acronym stands for tunnel oxide
17 passivated contact, correct?

18 A. Yes.

19 Q. What does it mean to have a tunnel oxide
20 passivated contact?

21 A. A tunnel oxide is a very thin insulator
22 so that charge carriers, such as electrons or
23 holes, can penetrate that even if there is an
24 energy less than the potential energy barrier, and
25 that is a quantum mechanical phenomena.

1 The term "passivation" refers to the
2 fact that at the surface of a semiconductor, such
3 as silicon, can have defects at the surface which
4 can facilitate the recombination of electrons and
5 poles. By using a passivation layer it can
6 eliminate some of these recombination sites, and
7 that's what passivation means.

8 Q. So what other types of solar cells were
9 generally known in the art when the '009 patent
10 was filed besides TOPCon solar cells?

11 A. Solar cells date back to the '60s. And
12 over the years there have been many variants of
13 the original design. I have not reviewed the
14 exact timeline; but, you know, we have things like
15 IBC cells, interdigitated back contact solar
16 cells. But I do not recall offhand the exact
17 timeline when those cells were invented.

18 Q. Have you personally ever been involved in
19 the manufacturing of a TOPCon solar cell?

20 A. I work at the university; so we do basic
21 research. And I have worked on solar cells for
22 many years. And I've taught solar cell physics
23 even longer, since 1987. And I have researched
24 the fabrication techniques that they use in solar
25 cell manufacturing as well as other semiconducting

1 devices since the 1980s. I believe the list of my
2 publications relating to solar cells is shown in
3 my CV.

4 Now, the term "TOPCon" is the moniker
5 that, I think, was introduced by Fraunhofer; but
6 the basic technology was known a long time before
7 that, and I have worked on those aspects also,
8 myself.

9 Q. Have you ever been involved in the
10 manufacturing of a TOPCon solar cell personally?

11 MR. ROBERTS: Object to form.

12 A. I've made solar cells which used TOPCon
13 technology but in a research environment at the
14 university.

15 BY MR. HERMAN:

16 Q. Have you ever written a paper that
17 specifically relates to a TOPCon solar cell?

18 MR. ROBERTS: Object to form.

19 A. I don't recall if my papers specifically
20 used the term "TOPCon." I did review -- I think I
21 have a couple of dozen papers related to solar
22 cells but I have looked at various aspects of
23 solar cell design. Off the top of my head, I
24 can't remember exactly.

25 BY MR. HERMAN:

1 Q. Do you know if you've ever designed a
2 TOPCon solar cell?

3 MR. ROBERTS: Object to form.

4 A. In the course of my research, I've
5 designed many types of solar cells. It's been a
6 while. So I don't recall what went into each of
7 my couple of dozen or so papers.

8 BY MR. HERMAN:

9 Q. So sitting here today, you don't remember
10 any of your papers specifically relating to the
11 conducting of the TOPCon solar cells. Is that
12 true?

13 A. I've been teaching solar cell physics, as
14 I told you, since the late '80s to my undergrad
15 students. And as new solar cells are introduced,
16 I discuss those in my lectures. But I certainly
17 have talked about TOPCon solar cells when I teach
18 solar cell physics to my undergraduate students.
19 I've also worked on, as I told you, solar cells as
20 well as the manufacturing techniques involved in
21 such solar cells for a long time.

22 So, for example, I've worked on Foley
23 inter junctions which lie at the heart of solar
24 cell physics. I don't remember exactly, I'd have
25 to look at my CV, but I've done Foley image of p-n

1 junctions, I think, since the early '90s, if I
2 remember right. Because that structure has been
3 used not only for solar cells but for Foley image
4 of bipolar junction transistors.

5 Q. Now, switching gears a little bit.
6 Throughout your '009 patent declaration, in
7 several places you refer to a deposition method
8 known as CVD; is that right?

9 A. Yes.

10 Q. And CVD refers to chemical vapor
11 deposition, correct?

12 A. Yes.

13 Q. How do you control the thickness of a
14 layer deposited via CVD?

15 A. I've been working on CVD research, by the
16 way, in my lab since the 1980s. I've designed CVD
17 reactors, and I also used to direct the team room
18 where we had multiple CVD reactors but it didn't
19 terminally, nonetheless, enhance CVD.

20 So to answer your question, we can
21 control the thickness by the deposition time, for
22 example. In general, the longer you do the
23 deposition, the thicker the film will be. Or you
24 can change the temperature. You can increase the
25 temperature to speed up the reaction. You can

1 change the mole fraction of the precursors that is
2 flowing. So there's multiple knobs that it can
3 create a little --

4 THE CERTIFIED STENOGRAPHER: I'm
5 sorry. Multiple knobs that it?

6 THE WITNESS: Adjust.

7 BY MR. HERMAN:

8 Q. So assuming that your deposition
9 temperature is the same and the mole ratio of
10 components in your precursor gas is the same,
11 there will be a direct relationship between
12 deposition time and layer thickness. True?

13 MR. ROBERTS: Object to form.

14 A. It depends on what you mean by "direct
15 relationship." In general, the longer you do the
16 deposition some will be taken; but in some
17 processes, you can have what we call "an
18 incubation time." So it takes a while for that
19 deposition to start.

20 So you have to show me a specific
21 piece of art to give you a definitive answer. It
22 all depends on the context.

23 BY MR. HERMAN:

24 Q. So how about with polysilicon, for
25 instance? When depositing a layer of polysilicon

1 would a longer deposition time result in a thicker
2 layer and a shorter deposition time result in a
3 thinner layer if the temperature is the same?

4 MR. ROBERTS: Object to form.

5 A. So, once again, it depends on the
6 context. You can do polysilicon deposition with
7 different gases, such as silane or dichlorosilane
8 or disilane. They all have different
9 decomposition temperatures. And even if you kept
10 all those parameters the same in terms of
11 temperature, precursor chemistry, depending on the
12 context, in general, a longer deposition will lead
13 to a thicker film.

14 BY MR. HERMAN:

15 Q. Now, if you could get your '009 patent
16 declaration in front of you.

17 A. Yes.

18 Q. And I'd like to direct your attention to
19 paragraph 108 of that declaration, which you can
20 find on label page 52.

21 A. Yes, I have it.

22 Q. Now, at the end of paragraph 108 you have
23 a figure that you've labeled with the caption
24 "Proposed Combination"; is that right?

25 A. On my copy at the end of paragraph 52 I

1 have the sentence "The resulting solar cell would
2 meet all the limitations of example, Claim 1, as
3 illustrated below using a modified Jin Figure 3."

4 Q. So I think those figures are also part of
5 paragraph 108, if you turn to the next page.

6 A. Okay. Yes.

7 Q. So looking at the figures that appear
8 after, I suppose, paragraph 108, there's a figure
9 there that's labeled "Proposed Combination,"
10 correct?

11 A. Yes.

12 Q. And that figure is meant to reflect how
13 you believe a person having ordinary skill of the
14 art would apply a prior art reference to Feldmann
15 to a prior art reference to Jin; is that correct?

16 MR. ROBERTS: Object to form.

17 A. We have three figures. On the top left
18 we have the Jin figure, top right we have the
19 Feldmann figure, and below that we have the figure
20 showing my proposed combination.

21 BY MR. HERMAN:

22 Q. And in that proposed combination figure,
23 you have eliminated Jin's back surface field Layer
24 150, which you annotated in what looks like cyan
25 in the Jin figure that's above; is that correct?

1 MR. ROBERTS: Object to form.

2 A. In Jin figure, the back surface field is
3 shown at one -- Layer 150, which is composed of
4 Layers 152 and 154.

5 BY MR. HERMAN:

6 Q. And that Layer 150 is formed in Jin by
7 applying ion implantations on the backside of
8 Jin's substrate, correct?

9 A. I'm looking at the Jin prior art, just so
10 that you know, on my copy.

11 Q. And for the record, the Jin prior art
12 reference is Exhibit 1009.

13 That's what you're looking at,
14 correct?

15 A. Yes. I don't see a reference to ion
16 implantation being used for this process. If
17 you'll direct me to a particular location in Jin.

18 Q. Sure. So I'm going to put a copy of the
19 Jin reference in the chat just so everybody has it
20 and we can be sure we're talking about the same
21 thing.

22 (Marked Exhibit Number 1009.)

23 BY MR. HERMAN:

24 Q. And if you look at paragraph 0009 of Jin,
25 that paragraph starts "Also, to achieve the

1 objective, a manufacturing method for a solar cell
2 according to one embodiment of the invention
3 includes," and the remainder of that paragraph
4 references a first ion implantation of a first
5 impurity and then a second ion implantation of a
6 second impurity.

7 Do you see that?

8 A. Yes.

9 Q. So Jin forms it's Layer 150 via ion
10 implantation --

11 THE CERTIFIED STENOGRAPHER: I'm
12 sorry. There's sound interference.

13 BY MR. HERMAN:

14 Q. So Jin employs ion implantation of the
15 impurities to form its Layer 150, correct?

16 MR. ROBERTS: Object to form.

17 A. One could use ion implantation to
18 introduce the impurities shown on the backside of
19 Figure 3 of Jin all forming this Layer 150, but
20 there are other ways also of introducing such
21 dopants.

22 BY MR. HERMAN:

23 Q. The way that Jin introduces such dopants
24 is via ion implantation. True?

25 MR. ROBERTS: Object to form.

1 A. (Perusing documents.)

2 BY MR. HERMAN:

3 Q. If it helps, you may be looking for a
4 passage that can be found in paragraph 78 of Jin,
5 which is on page 18; and, in particular, the final
6 sentence.

7 A. Thank you. So if you look at the end of
8 paragraph 78, it's clear that certainly ion
9 implantation could be used as a method of
10 introducing the dopant; but Jin also talks about
11 other techniques such as thermal diffusion, laser
12 doping. So ion implantation can be one way of
13 introducing the doping.

14 Q. So in all cases, though, Jin is
15 introducing dopant into its Substrate 110,
16 correct?

17 MR. ROBERTS: Object to form.

18 A. If you look at the very end of paragraph
19 78, Jin says that "Other methods for doping the
20 substrate may be used." So I believe that opens
21 up the possibility of implanting into the
22 substrate but also introducing the dopant by other
23 techniques such as depositing a dope polysilicon
24 layer as one example.

25 BY MR. HERMAN:

1 Q. But Jin does not include an example of
2 depositing a doped polysilicon layer, correct?

3 A. Using doped polysilicon layers for such
4 purposes was very well known in the art,
5 especially in the TOPCon literature, and even
6 predating that TOPCon literature in the days of
7 Lindholm and Kwark.

8 Q. So which paragraph of your declaration
9 includes the opinion that Layer 150 would be a
10 doped polysilicon layer in your declaration? Can
11 you point me to that paragraph?

12 MR. ROBERTS: Object to form.

13 A. No. I did not state in my declaration
14 that 150 is a doped polysilicon layer. That is
15 why we are proposing the one of three arguments of
16 using the TOPCon structure of Feldmann and
17 replacing that with 150 Jin, which is a simple
18 substitution.

19 BY MR. HERMAN:

20 Q. So Layer 150 in Jin is not, in fact, a
21 doped polysilicon layer, but it is located within
22 Jin substrate, correct?

23 A. In one embodiment of Jin 158 is located
24 in the substrate. But, as I told you, it would be
25 very straightforward to replace that with the

1 doped polysilicon on the left side of structure
2 drawn by Feldmann as I show in my proposed
3 combination.

4 BY MR. HERMAN:

5 Q. So what you've done in your proposed
6 combination is you have eliminated Jin's Layer 150
7 that's located within its substrate and you've
8 replaced that Layer 150 with Feldmann's ultrathin
9 tunnel oxide and P-doped Si layer; is that
10 correct?

11 MR. ROBERTS: Object to form.

12 A. As I discuss in my declaration in
13 paragraphs 109, 110, and so on, what we're
14 proposing is replace 150 in Jin with the TOPCon
15 structure of Feldmann; and I foresee they would be
16 motivated to do that because such a simple
17 modification will improve the efficiency of the
18 solar cell.

19 BY MR. HERMAN:

20 Q. Now, that tunnel oxide layer and the
21 P-doped Si layer are deposited on top of the
22 backside of the substrate, not within the
23 substrate, correct?

24 A. The tunnel oxide can be formed in
25 different ways. It can deposit the tunnel oxide

1 through the CVD techniques, but it could also grow
2 a thermal -- tunnel oxide thermally by reacting
3 silicon with either oxygen or H₂O. And if you
4 grew a tunnel oxide thermally, it actually
5 penetrates into the substrate a little bit. For
6 every nanometer of tunnel oxide that you grow, .44
7 nanometers of the silicon is consumed. So in that
8 context, the tunnel oxide does penetrate partially
9 to the substrate.

10 Q. So, in other words, part of the substrate
11 is being consumed to form the tunnel oxide in that
12 process that you just discussed; is that right?

13 MR. ROBERTS: Object to form.

14 A. If you grow a tunnel oxide thermally by
15 reacting with an oxidant, you consume part of that
16 silicon substrate in the process.

17 BY MR. HERMAN:

18 Q. Now, in your proposed combination figure,
19 that tunnel oxide layer that you've depicted is
20 shown in blue; is that right?

21 A. Yes.

22 Q. And that is located physically between
23 Jin's existing Layer 120 and the added P-doped Si
24 layer that you've shown in red; is that right?

25 A. Can you repeat that question, please?

1 Q. The blue tunnel oxide layer that you've
2 drawn in your proposed combination is located
3 physically between Jin's existing Layer 120 and
4 the red P-doped Si layer that you've also added to
5 your proposed combination figure, correct?

6 A. Yes. It's in between the 120 and the
7 phosphorus-doped polysilicon Layer 160.

8 Q. So the figure that you've drawn there,
9 there's no direct contact between Jin's existing
10 Layer 120 and the P-doped Si layer, correct?

11 MR. ROBERTS: Object to form.

12 A. It depends what you mean by "direct
13 contact." One is to keep in mind that such
14 figures are highly stylized versions and don't
15 necessarily show all aspects of the structure.
16 Whether you have a direct contact or not will
17 depend on the details of the fabrication process.
18 For example, if you use thermal diffusion to
19 deposit Layer 120 on the top, if you also form a
20 dope layer on the sides of the silicon wafer, and
21 then it will be a direct contact with -- in Jin
22 what's called Layer 150. And that's why Jin
23 introduces this isolation layer to prevent
24 contact.

25 BY MR. HERMAN:

1 Q. In your proposed combination, though, 120
2 would be contacting the ultrathin tunnel oxide
3 layer, not the P-doped Si layer. True?

4 MR. ROBERTS: Object to form.

5 A. Are you referring to our proposed
6 modification shown in the lower part of the
7 figure?

8 BY MR. HERMAN:

9 Q. Yes.

10 A. In that proposed combination we have this
11 isolation gap-T, which then prevents the contact
12 between the doping 120 that would be on the sides
13 of the wafer and with the tunnel oxide as well as
14 the phosphorus-doped polysilicon layer.

15 Q. So even if that isolation gap-T were not
16 there, 120 would be touching the tunnel oxide, not
17 the P-doped Si layer. True?

18 MR. ROBERTS: Object to form.

19 A. Whether it touches or not depends on the
20 fabrication process. So for argument's sake, if
21 you use a CVD technique to deposit the phosphorus-
22 doped polysilicon layer, that deposition could
23 extend to the sides of the silicon wafer and could
24 touch diffused Layer 120 on the sides. But even
25 for argument's sake, if you didn't have that --

1 and I am not granting you that assumption.
2 Suppose you had the doped polysilicon layer, the
3 tunnel oxide, and then the diffused Layer 120 on
4 the side of the silicon substrate. The tunnel
5 oxide is a leaky oxide. Okay. It allows
6 technical communication. So you still get
7 tunnelling contact in that case between the
8 phosphorus-doped polysilicon and the 120 extending
9 on the sides of the wafer.

10 BY MR. HERMAN:

11 Q. Now, what is that tunnel oxide layer made
12 from in your proposed combination?

13 A. You can have tunnel oxide made up of
14 different insulators. Silicon dioxide is a very
15 commonly used tunnel oxide. What's key is for
16 tunnelling to happen. The tunnelling value is the
17 thickness of the oxide, which will be very thin so
18 that the electrons can quantum mechanically
19 penetrate through the barrier rather than have to
20 go over the barrier.

21 Q. Do you have an understanding of how thick
22 Feldmann intends its tunnel oxide layer to be?

23 A. Let me look at Feldmann.

24 Q. And for the record, Feldmann is Exhibit
25 1012; is that right?

1 MR. HERMAN: And just so you have
2 it and everybody else has it, I'll put a
3 copy of that exhibit into the chat.

4 (Marked Exhibit Number 1012.)

5 A. Yes, it is 1012. I'm looking at Feldmann
6 on page 171 -- sorry -- 271, left-hand column. It
7 says that he grew an ultrathin chemical oxide of
8 about 14 angstroms. And they further stated that
9 oxide thicker than 20 angstroms or so make the
10 tunneling process very inefficient. That gives
11 you an idea of the range.

12 BY MR. HERMAN:

13 Q. So he's giving you the range in
14 angstroms. If I wanted to do that in nanometers,
15 that would be somewhere about 1.4 nanometers; and
16 if you get up to 2 nanometers, problems arise. Is
17 that right?

18 A. That is correct. You go from angstroms
19 to nanometers by dividing by 10.

20 Q. Now, looking back at the proposed
21 combination in Exhibit 1003, as you noted, you
22 emitted both the tunnel oxide and the P-doped Si
23 layer from the portion of the substrate backside
24 that Jin labels as a gap or distance T; is that
25 right?

1 A. In the proposed combination the
2 phosphorus-doped polysilicon and the tunnel oxide
3 were removed in the gap-T.

4 Q. But as you've drawn your proposed
5 combination, that gap-T is covered by what Jin
6 labels as Layer 160; is that correct?

7 A. Please read the question again.

8 Q. So the portion of the substrate standing
9 gap-T in your proposed combination is covered by
10 what Jin labels as 160, correct?

11 A. Yes. That's what it looks like.

12 Q. So Layer 160 is touching the substrate,
13 at least to some degree, in that particular area?

14 A. Yes.

15 Q. And that Layer 160 is -- do you know what
16 materials it can be made from?

17 A. Well, Jin says it's going to be an
18 antireflection coating, and one can use different
19 types of materials for that process. You choose
20 appropriate thickness, depending on the material,
21 to do the cancellation of the then rate.

22 Q. And one of the materials you could use
23 would be a silicon oxide, correct?

24 A. That's certainly possible. Let me look
25 at Jin to see what he might have proposed. One

1 can use silicon oxide, silicon nitride. There's
2 many choices.

3 Q. So if you look at paragraph 50 of Jin,
4 which is on page 16, that paragraph discusses what
5 Jin calls a second antireflection film 160.

6 Do you see that?

7 A. Yes.

8 Q. And in the middle of the paragraph Jin
9 lists a number of materials that can be used to
10 form that second reflection film 160, correct?

11 A. Yes.

12 Q. And among other things, Jin identifies
13 silicon oxide, correct?

14 A. That's one of the possibilities, yes.

15 Q. Now, if you could turn to paragraph 116
16 of your declaration.

17 A. Okay.

18 Q. In about the middle of this paragraph on
19 page 58 there's a sentence that reads "If the
20 tunnel oxide layer were to extend to the edge, the
21 exposed portions of the oxide could trap
22 impurities and create negative fixed oxide
23 charges, which could then create a p-type
24 inversion in the n-type base substrate, leading to
25 a leakage path to the p-type emitter on the front

1 of the solar cell."

2 Do you see that?

3 A. Yes.

4 Q. There's no citation after that sentence.
5 True?

6 A. True.

7 Q. So you don't cite to any patents,
8 articles, or texts after that sentence, correct?

9 A. This -- basically that sentence that's
10 been known since, I think, the 1960s or '70s.

11 Q. So what you're discussing here is not
12 something that's unique to tunnel oxides, correct?

13 MR. ROBERTS: Object to form.

14 A. Yeah. My comment over here applies to
15 tunnel oxides, but it will also apply to other
16 types of thicker oxides.

17 BY MR. HERMAN:

18 Q. So other types of thicker oxides can also
19 trap impurities and create negative fixed oxide
20 charges, correct?

21 A. Depends on the context; but, yes, it
22 could.

23 Q. Now, the sentence we've been reading also
24 references "the exposed portions of the oxide."

25 Do you see those words?

1 A. Yes.

2 Q. What are you referring to when you say
3 "the exposed portion of the oxide"?

4 A. I meant exposed to the ambient, not
5 covered by another layer.

6 Q. So looking at your proposed combination,
7 I'm not seeing any oxide that is exposed to the
8 ambient; is that right?

9 MR. ROBERTS: Object to form.

10 A. In the proposed combination, we have to
11 move the tunnel oxide in this isolation layer T --
12 labeled T. And then we have covered it up with
13 Layer 160, which wraps around it. In this case,
14 the tunnel oxide is not exposed to the ambient.
15 It's being encapsulated.

16 BY MR. HERMAN:

17 Q. So you're saying that if the tunnel oxide
18 covered the entire back surface, the edge of it
19 would be exposed to the ambient; is that right?

20 MR. ROBERTS: Object to the form.

21 A. Yes. That's one possibility.

22 BY MR. HERMAN:

23 Q. And that edge, as we discussed, would be
24 approximately 1.4 nanometers of exposure to the
25 ambient, correct?

1 MR. ROBERTS: Object to form.

2 A. The exposure rate -- range, which would
3 be on the order of, say, 1.4 nanometers as
4 discussed by Feldmann. But, remember, it wraps
5 around the entire circumference of the wafer. And
6 that's generally worth about five times the
7 diameter of the solar cell of the total volume.

8 MR. HERMAN: I think we've been
9 going been going for almost an hour. Now
10 I'm going to switch gears; so maybe now is
11 a good time for a brief five-minute break.

12 Does that work for you?

13 THE WITNESS: Wonderful. Thank
14 you.

15 THE CERTIFIED STENOGRAPHER: We are
16 off the record at 10:54 a.m.

17 (Recess taken from 10:54 a.m. to
18 11:02 a.m.)

19 THE CERTIFIED STENOGRAPHER: We are
20 back on the record at 11:02 a.m.

21 BY MR. HERMAN:

22 Q. Now, Doctor, if you could take a look at
23 Exhibit 1009, that's the Jin prior art reference.
24 Let me know when you have that in front of you.

25 A. I do.

1 Q. So Jin does not, itself, stand alone and
2 teach a TOPCon solar cell; is that correct?

3 MR. ROBERTS: Object to form.

4 A. Jin does not have a TOPCon solar cell
5 structure, but he doesn't preclude using a TOPCon.

6 BY MR. HERMAN:

7 Q. Now, if you look at paragraph 6 of Jin,
8 the last sentence reads "For the solar cell
9 discussed above, it is very important to improve
10 the efficiency thereof."

11 Do you see that?

12 A. Yes.

13 Q. How does Jin go about improving the
14 efficiency of a solar cell?

15 MR. ROBERTS: Object to the form.

16 A. I think this is a pretty generic
17 statement about wanting to improve efficiency of a
18 cell. This might relate to the sentence before
19 that that they're talking about solar cells made
20 up of silicon, which can very often be made up of
21 single-crystal silicon, which gives you a high
22 efficiency, versus silicon solar cells which would
23 often be made up of amorphous polycrystalline cells
24 with a lot of defects, which can then lower the
25 efficiency. There are other ways of improving

1 efficiency also.

2 BY MR. HERMAN:

3 Q. So let's turn to paragraph 32 of Jin.

4 It's on the next page.

5 Let me know when you're there?

6 A. Yes. I see it.

7 Q. There Jin explains that "to reduce
8 surface resistance against the front finger lines
9 140 and prevent or reduce degradation of
10 efficiency of a solar cell 100 due to service
11 recombination, the solar cell 100 according to the
12 invention may be formed such that the first area
13 124 adjoining the front finger lines 140 has a
14 relatively high doping density than that of the
15 second area 122."

16 Do you see that?

17 A. Yes.

18 Q. Now, areas 124 and 122 are both part of
19 Jin's front emitter Layer 120, correct?

20 MR. ROBERTS: Object to form.

21 A. There 122 is the shallow part of the
22 diffuse front emitter and 124 has the deeper more
23 highly doped regions where the contact is made.

24 BY MR. HERMAN:

25 Q. So in this paragraph, one of the ways

1 that Jin is noting that it improves efficiency of
2 a solar cell is by both increasing the doping
3 density of its emitter Layer 120 and making the
4 doping thicker in the area of its finger lines,
5 correct?

6 MR. ROBERTS: Object to the form.

7 A. As I told you, there are many knobs that
8 can be adjusted to increase efficiency of a solar
9 cell; and this is one of them.

10 BY MR. HERMAN:

11 Q. And by "one of them," you're referring to
12 this paragraph discussion of making or changing
13 doping density and doping thickness in the area of
14 the front finger lines 140, correct?

15 MR. ROBERTS: Object to form.

16 A. I'm referring to the first few sentences
17 in paragraph 32 of Jin.

18 BY MR. HERMAN:

19 Q. Now, if we turn to paragraph 42 of Jin,
20 paragraph 42 states that "the back surface field
21 Layer 150 may have the same structure as the
22 aforementioned emitter Layer 120."

23 Do you see that?

24 A. Yes.

25 Q. So in Figure 3 of Jin you can see that

1 that back surface field Layer 150 has certain
2 areas of increased doping density that are labeled
3 154. True?

4 MR. ROBERTS: Object to form.

5 A. Jin has many embodiments. In Figure 3
6 they do show this doping -- higher doping
7 properties 154 and 124 on the front surface. But
8 if you look at Figures 15, 16, 17 in Jin, he shows
9 other possibilities. They have these enhanced
10 doping regions on the front only, at the back
11 only, or in either surface. So there's different
12 embodiments that Jin is talking about.

13 BY MR. HERMAN:

14 Q. Now, in your combined version of Jin and
15 Feldmann, you did not include thicker areas of
16 increased doping density on the backside of the
17 combined structure substrate, correct?

18 MR. ROBERTS: Object to the form.

19 A. In the proposed combination of the
20 backside TOPCon structure, Feldmann, it's inserted
21 on the backside of Jin to replace the diffused
22 back surface field. I do not show the enhanced
23 doping properties 154. But, as I told you a few
24 minutes back, Jin does show us various
25 embodiments, some of which don't have these

1 enhanced doping properties. Some of them do.

2 BY MR. HERMAN:

3 Q. Now, if you could get out Exhibit 1012
4 again. That's a prior art reference to Feldmann.

5 A. Okay.

6 Q. So Feldmann does relate to a TOPCon solar
7 cell, correct?

8 A. Yes.

9 Q. Now, if you look at the right-hand column
10 of page 270 of Feldmann, that's the front page.
11 The paragraph that ends the page starts by stating
12 "To obtain highly efficient passivated contacts
13 for solar cells," and then it goes on.

14 Do you see that?

15 A. Yes.

16 Q. You agree that one of Feldman's goals is
17 to achieve a more efficient solar cell?

18 MR. ROBERTS: Object to form.

19 A. In general, it's always the goal to
20 increase efficiency of a solar cell, other things
21 being equal. And Feldmann does talk about highly
22 efficient passivated contacts for solar cells.

23 BY MR. HERMAN:

24 Q. Now, at the end of page 270, Feldmann
25 notes that "We examine the cell's light trapping

1 scheme with a focus on an appropriate rear
2 metallization."

3 Do you see that?

4 A. Yes.

5 Q. Now, if we turn on to page 273, in the
6 left-hand column of text, Feldmann explains that
7 "the requirement for a rear contact in terms of
8 internal reflection is quite high."

9 A. Yes.

10 Q. In the right-hand column, Feldmann notes
11 that it employed an ITO/Ag stack and an Ag single
12 layer respectively to significantly increase the
13 rear side reflection; is that correct?

14 MR. ROBERTS: Object to form.

15 A. You're looking at the right-hand column
16 of page 273?

17 BY MR. HERMAN:

18 Q. Yes.

19 A. Which line, approximately?

20 Q. There's a paragraph that starts "The
21 corresponding solar cell results are given in ..."

22 Do you see that paragraph?

23 A. Yes.

24 Q. And that same paragraph references an
25 "ITO/Ag stack and Ag single layer respectively."

1 Do you see that?

2 A. Yeah. Yeah.

3 Q. Then it goes on to say "significantly
4 increased."

5 That phrase appears, correct?

6 A. Yeah.

7 Q. And then "rear side reflection," correct?

8 A. Yes.

9 Q. So Figure 3 of Feldmann shows a
10 metallization layer that extends over the entire
11 backside of its solar cell, correct?

12 A. Yes.

13 MR. ROBERTS: Object to form.

14 BY MR. HERMAN:

15 Q. Now, in your proposed combination of Jin
16 and Feldmann, you did not include a similar
17 metallization layer extending over the entire
18 backside of the combined solar cell. True?

19 MR. ROBERTS: Object to form.

20 A. In our proposed combination, we are
21 inserting the TOPCon structure of Feldmann with
22 the polysilicon on top of the tunnel oxide and
23 inserting that in the Jin. Because both Jin as
24 well as the patents at issue are bifacial solar
25 cells. It does not make sense to cover up the

1 entire backside of the metal for the structure
2 TOPCon back also.

3 BY MR. HERMAN:

4 Q. So your proposed combination would not
5 accomplish the same significant increase in rear
6 side reflection that's discussed in the right-hand
7 column on page 273 of Feldmann, correct?

8 MR. ROBERTS: Object to the form.

9 A. In my opinion, that procedure would find
10 it very straightforward and logical to improve
11 efficiency of the Jin solar cell by taking the
12 TOPCon structure of Feldmann. There's no need to
13 incorporate all parts of the structure Feldmann if
14 it doesn't make sense.

15 BY MR. HERMAN:

16 Q. But my question was this particular
17 benefit that's discussed in page 273 in the
18 right-hand column, the significant increase in
19 rear side reflection, that would not be present in
20 your proposed combination, correct?

21 MR. ROBERTS: Object to the form.

22 A. If you had a complete coverage of the
23 backside with silver, it might reflect photons
24 into them from the front back into the base of the
25 solar cell. However, you also block protons from

1 the back from impinging on the solar cell, which
2 is what you use in the bifacial solar cell. We
3 are cutting off a big chunk of the proton from
4 being absorbed; so that would be counterproductive.

5 BY MR. HERMAN:

6 Q. Now, Feldmann does not use the word
7 "mask." Is that true?

8 A. Does not use the word "mask"?

9 Q. Yes.

10 A. I couldn't tell you offhand. I don't
11 remember. But in looking at the Figure 3 of
12 Feldmann, it must be using some sort of a mask to
13 encapsulate the metal fingers on the front
14 surface.

15 BY MR. HERMAN:

16 Q. Now turning to page 271, there's a
17 section entitled, "Experimental Details and
18 Results."

19 Do you see that?

20 A. Yes.

21 Q. And there's a formula that's labeled 1.

22 Do you see that?

23 A. Yes.

24 Q. And below that there's text, and there's
25 a sentence that reads "Then an ultrathin wet

1 chemical oxide layer was grown."

2 Do you see that?

3 A. Yes.

4 Q. That's discussing the formation of
5 Feldmann's tunnel oxide layer, correct?

6 A. Yes.

7 Q. And it does not refer to the use of a
8 mask there, correct?

9 A. It's not using a mask for forming the
10 tunnel oxide.

11 Q. And then there's another sentence that
12 reads "Subsequently, a 20 nanometer thick
13 phosphorus-doped Si layer was deposited on both
14 sides."

15 Do you see that?

16 A. Yes.

17 Q. That's talking about forming the
18 phosphorus-doped Si layer that will eventually
19 become a polysilicon layer. True?

20 A. Yes.

21 Q. And that's also not referring to the use
22 of a mask, correct?

23 A. In this part of the discussion, Feldmann
24 is actually making a etched structure and gleaning
25 parameters, such as these inside Voc, which would

1 be then relevant for the solar cell. So if you
2 deposited this dope polysilicon on both front and
3 back, that's not what we have in the final solar
4 cell. Here he's simply trying to study the
5 interface properties.

6 Q. And if you're depositing the polysilicon
7 on both the front and the back, you're certainly
8 not using a mask, correct?

9 MR. ROBERTS: Object to form.

10 A. In this tech structure they're not using
11 a mask but that's not a functioning solar cell.
12 They're estimating parameters such as this high Voc
13 implied open-circuit voltage, where if you did
14 make a solar cell, which would require a mask, as
15 shown in Figure 3, the inside view of Voc would be
16 parameter that'd be extrapolatable the solar cell.

17 BY MR. HERMAN:

18 Q. Now, there's nowhere else in Feldmann
19 that discusses the use of a mask when depositing
20 its P-doped Si layer. True?

21 A. If I look at Figure 3 of Feldmann as a
22 guide, I see the use of a mask on the front
23 surface. But, sitting here, I don't see masks
24 being used on the back because they're not
25 patterning the P-doped polysilicon.

1 Q. Now, if you could go back to your
2 declaration, Exhibit 1003, and in particular, your
3 '009 declaration, just to be clear.

4 A. Okay.

5 Q. And if you could turn to paragraph 119.

6 A. Okay.

7 Q. And in paragraph 119 you say, "As a first
8 example, Jin discloses a mask in Figure 9 that
9 would be used to cover the periphery or edge
10 portion of the back surface of the substrate."

11 Do you see that?

12 A. Yes.

13 Q. That mask is being used during the
14 formation of Jin's Layer 150, correct?

15 A. Yes.

16 Q. And as we discussed before, that Layer
17 150 can be formed using ion implantation and the
18 other methods that are discussed in, I believe,
19 paragraph 58 of Jin, correct?

20 I think I got the paragraph number
21 wrong. Paragraph 78.

22 A. Yes. I see that.

23 Q. So that mask is intended to be used
24 during a heat diffusion method, a laser doping
25 method, or an ion implantation method as discussed

1 in paragraph 78, correct?

2 MR. ROBERTS: Object to form.

3 A. Depending on how one is doing the
4 masking, some of these doping techniques may or
5 may not be possible. If you use a metal mask in
6 the shape of a ring, you could use that to mask
7 ion implantation. But you could not use that for
8 thermal diffusion of the doping. But there are
9 other ways of masking thermal diffusion.

10 BY MR. HERMAN:

11 Q. So you're saying you need different types
12 of masks for different types of processes; is that
13 correct?

14 MR. ROBERTS: Object to form.

15 A. Yeah. You couldn't require different
16 types of masking for different doping techniques.
17 But I believe Jin is proposing actually exactly
18 that the masking is done. I'm looking at Figure 9
19 description. Give me a second.

20 If you look at paragraph 83 on Jin.
21 This talks about using a mask. I don't think it
22 restricts masking to any particular type of mask.

23 BY MR. HERMAN:

24 Q. Now, in your --

25 A. I don't --

1 (Overlapping speakers.)

2 BY MR. HERMAN:

3 Q. Sorry. Go ahead.

4 A. I think the mask in isolation being at T.
5 That's all that Jin is proposing.

6 Q. Now, looking back at your paragraph 119,
7 if you reference in Exhibit 1031.

8 Do you see that?

9 A. Yes.

10 Q. I'm going to put Exhibit 1031 in the chat
11 so that you have a copy of it.

12 (Marked Exhibit Number 1031.)

13 BY MR. HERMAN:

14 Q. And Exhibit 1031 is an article by Scherff
15 and a number of other authors, correct?

16 A. Yes.

17 Q. Actually, maybe it's only Scherff.
18 That's one author, correct?

19 A. Yeah. I did not make a printout of
20 Scherff. I can look at the soft copy.

21 Q. Now, if you look at Scherff's abstract,
22 Scherff notes that it relates to an interdigitated
23 back contact silicon heterojunction solar cell.

24 Do you see that?

25 A. Yes. I see that.

1 Q. So Scherff is not related to the use of a
2 mask in forming a TOPCon solar cell specifically,
3 correct?

4 MR. ROBERTS: Object to form.

5 A. The teaching that we're gleaned from
6 Scherff is in view that the mask, in conjunction
7 with plasma-enhanced chemical deposition, and the
8 main teaching that's relevant is any deposits
9 through openings in the mask, the deposited layer
10 will go laterally underneath the mask to a certain
11 extent, such that it will form tapered edges.

12 BY MR. HERMAN:

13 Q. My question is whether or not Scherff
14 discusses forming a TOPCon solar cell.

15 Does it?

16 A. Scherff did not disclose a TOPCon solar
17 cell. That's irrelevant, in my opinion. Scherff
18 discloses the use of plasma-enhanced CVD deposited
19 layers in metal mask, I think. And the deposition
20 technique with a mask is what's relevant. What
21 is --

22 Q. Now, if we turn -- sorry, go ahead.
23 Sorry to interrupt.

24 A. I was going to say that the fact that
25 Scherff is not using the deposition and masking

1 technique to make solar cells -- TOPCon solar
2 cells is irrelevant, in my opinion.

3 Q. Now, if we turn to page 2126 of
4 Scherff --

5 A. Okay.

6 Q. -- Scherff depicts multiple photographs
7 of what are characterized as an approximately 10-
8 micron-thick structured amorphous silicon layer,
9 correct?

10 A. Yes.

11 Q. So 10 microns is about 10,000 nanometers.
12 True?

13 A. Yes.

14 Q. And that's about four orders of magnitude
15 thicker than Feldmann's tunnel oxide layer. True?

16 MR. ROBERTS: Object to the form.

17 A. I think we are comparing apples to
18 oranges. The tunnel oxide is an insulator. And
19 this is a amorphous silicon layer, which is a
20 semiconductor. But all of that is making the
21 point, Scherff teaches us how we can use a mask
22 and do deposition through PECVD through the
23 openings in the mask and subsequently simply
24 removing the mask --

25 (Overlapping speakers.)

1 BY MR. HERMAN:

2 Q. The term --

3 A. -- and that's --

4 BY MR. HERMAN:

5 Q. Oh, sorry. Go ahead.

6 A. All right. I was going to say that's
7 what's the relevant teaching.

8 Q. So if we turn to page 2127, there's a
9 Figure 4.

10 Do you see that?

11 A. Yes.

12 Q. And there's reference in the caption of
13 that figure to an 80-nanometer-thick structured
14 indium tin 10 oxide ITO layer.

15 Do you see that?

16 A. Yes.

17 Q. 80 nanometers is still an order of
18 magnitude thicker than Feldmann's tunnel oxide
19 layer, correct?

20 MR. ROBERTS: Object to form.

21 A. One thing, and I think you're comparing
22 apples to oranges, a tunnel oxide is a tunnelling
23 insulator where ITO is going to be a conductor.
24 But, once again, that's besides the point because
25 what's important is that Scherff teaches us the

1 ability to deposit various kinds of layers --
2 tunnel oxides; doped polysilicon, if need be;
3 RITO, amorphous layers -- to the simple masking
4 technique. That's what's the relevant part.

5 BY MR. HERMAN:

6 Q. Now, I'm going to give you another
7 exhibit that's been marked as 1026.

8 (Marked Exhibit Number 1026.)

9 BY MR. HERMAN:

10 Q. Let me know when you have that.

11 A. Yes, I have it.

12 Q. It's an article by Kray and a number of
13 other authors entitled, "Study on the edge
14 isolation of industrial silicon solar cells with
15 waterjet-guided laser," correct?

16 A. My apologies. Are you wanting me to --
17 let me see. Yeah. Okay.

18 What was the question again? Sorry.

19 Q. It's an article by Kray and a number of
20 others entitled, "Study on the edge isolation of
21 industrial silicon solar cells with
22 waterjet-guided laser." True?

23 A. Yes.

24 Q. If you turn to the second page of
25 Exhibit 1026, there's a Figure 1.

1 A. Yes.

2 Q. And in Figure 1, there's a label, "Edge
3 Isolation."

4 Do you see that?

5 A. Yes.

6 Q. And it's pointing to what looks like a
7 recess or an abscess, correct?

8 A. Yes.

9 Q. And that recess or access as depicted is
10 not actually at the outer boundary of the depicted
11 solar cell. True?

12 MR. ROBERTS: Object to the form.

13 A. One should remember that all these
14 figures tend to be highly stylized schematics.
15 Whether it's exactly out of boundary or not, I
16 think depends on the details of how the mask can
17 be positioned with respect to the solar cell. But
18 regardless, the important point is it achieves
19 edge isolation.

20 BY MR. HERMAN:

21 Q. But as depicted in Figure 1, the edge
22 isolation is not, in fact, located at the edge of
23 the solar cell. It is in from the edge. True?

24 MR. ROBERTS: Object to form.

25 A. Since Kray discusses the use of this

1 waterjet-guided laser, I mean, it's
2 straightforward to position the waterjet right at
3 the periphery, if need be, or slightly away from
4 the periphery, as shown, in the highly stylized
5 schematic Figure 1. So whether the edge isolation
6 is right at the edge or slightly away from the
7 edge would simply depend on where one directs the
8 waterjet.

9 BY MR. HERMAN:

10 Q. Now, let's go back to your declaration,
11 the '009 patent declaration.

12 A. Okay.

13 Q. And if you could turn to paragraph 161,
14 which is on page 88.

15 A. Okay.

16 Q. And this is the beginning of the section
17 discussing Claim 8, correct?

18 A. Yes.

19 Q. Now, if we look down to paragraph 162, in
20 the second sentence of that paragraph you state,
21 "During the deposition process, small amounts of
22 the polysilicon would collect in the 'shadow'
23 region underneath the mask."

24 Do you see that?

25 A. Yes.

1 Q. And if you look at page 91, you've got a
2 number of figures on page 91.

3 A. Yes.

4 Q. And those figures -- well, at least two
5 of the figures are providing examples of what you
6 just discussed in paragraph 162, small amounts of
7 polysilicon collecting in the shadow region
8 underneath the mask; is that right?

9 A. Yes.

10 Q. So, for instance, in Figure 4 on the top
11 of page 91, the figure to the left, there's a red
12 circle showing what could be polysilicon
13 collecting in the shadow region underneath of a
14 mask; is that right?

15 A. Yes.

16 Q. What factors impact the amount of
17 polysilicon that collects in that particular area
18 underneath the mask?

19 MR. ROBERTS: Object to form.

20 A. Could I look at Decker, please? That's
21 1032.

22 BY MR. HERMAN:

23 Q. Exhibit 1032?

24 A. Yes.

25 Q. Just give me one moment. I put a copy of

1 Exhibit 1032 into the chat, and Exhibit 1032 is an
2 article by Decker and a number of others.

3 (Marked Exhibit Number 1032.)

4 BY MR. HERMAN:

5 Q. Let me know when you've got a copy of
6 that.

7 A. Yes, I have it. Okay.

8 Q. That's the reference you're looking for?

9 A. Yeah. So in this case he's using sputter
10 deposition, which I've used for 30 years. You
11 immerse a sputtering target, which is noted as the
12 material source in the plasma, typically an argon
13 plasma. It bombards the target with argon ions.
14 It basically ejects atoms from this material
15 source, and it goes through the opening of the
16 mask onto the substrate. And as shown in the
17 schematic Figure 4, because of the fact that the
18 material source has a finite extent, you can kind
19 of draw straight lines past and you can see then
20 that you get the uniform thickness in the middle
21 of the opening. But at the edges, you get this,
22 what he calls overspray, I guess. And, in fact,
23 it's kind of akin to if you have an extended light
24 source shining through an opening, you get the
25 lighted zone, but then you get a graded shadow of

1 area which is called a phenomena. It's kind of
2 akin to that.

3 Now, there's additional factors that
4 can affect this overspray; and that is the chamber
5 operating pressure, which in turn impacts the mean
6 free path of the species. In general, the higher
7 the pressure, you have more collisions of the gas,
8 a shorter mean free path. And that can cause
9 lateral extension of the deposited species
10 underneath the mask. The reason I bring that up
11 is I believe in some of the art that was cited,
12 they were talking about CVD techniques and the
13 deposition pressure and the mean free path is
14 relevant in that context in terms of determining
15 the shapes of the side walls.

16 Q. How about the precursor you're using,
17 does the precursor you're using have any impact on
18 the amount of overspray?

19 A. In the case of sputtering, it's not a
20 chemical vapor deposition process. It's a
21 physical vapor deposition process. But in
22 general, you don't have any chemistry involved.
23 You state a target and you bombard it with these
24 ions that are created in the plasma. In most
25 cases, it's going to be an argon plasma, even

1 though there's no chemistry involved. So one
2 doesn't use the term "precursor" in that context.

3 Now, there's always a caveat. It
4 could sometimes react to sputtering, but the
5 precursor really applies to the implied CVD or
6 plasma-enhanced CVD; and, in the lateral extent,
7 as I told you, would primarily depend on the
8 operating pressure. And I've been teaching this
9 for 40 years to my undergrads.

10 Q. And how about time? Does the amount of
11 deposition time play a role in the lateral extent
12 of overspray?

13 A. So what tends to happen is, usually you
14 have a gap between the mask and the soft shape.
15 And as I'm starting to cover the top of the
16 substrate with this deposited material, be that
17 through physical vapor deposition such as
18 sputtering or chemical vapor deposition, you get
19 some degree of lateral extension.

20 Now, as the deposition thickness
21 builds up, you continue to get lateral extension;
22 but at some point, the plasma completely covered
23 the aperture, in which case you will have kind of
24 block the lateral extension. So the important
25 point is you get these tapered structures and

1 things like this also.

2 Q. So I think what you said is that that
3 overspray will grow until you fill up the entire
4 aperture and then it stops growing; is that
5 correct?

6 MR. ROBERTS: Object to form.

7 A. The overspray will stop either when you
8 fill up the gap or when you stop the deposition
9 process.

10 BY MR. HERMAN:

11 Q. So it will continue growing until either,
12 whichever happens first, the gap gets filled or
13 you stop the deposition process, correct?

14 MR. ROBERTS: Object to the form.

15 A. It might depend on the context, but
16 sitting here, I think that's true.

17 MR. HERMAN: I don't have any
18 further questions.

19 MR. ROBERTS: Do you mind if we
20 take just a quick five-minute break?

21 MR. HERMAN: Yeah, take your time.

22 THE CERTIFIED STENOGRAPHER: We are
23 off the record at 11:49.

24 (Recess taken from 11:49 a.m. to
25 11:54 a.m.)

1 THE CERTIFIED STENOGRAPHER: We are
2 back on the record at 11:54.

3 MR. ROBERTS: The Runergy and Adani
4 petitioners don't have any redirect
5 questions for Dr. Banerjee.

6 THE CERTIFIED STENOGRAPHER: Does
7 this conclude the deposition?

8 MR. HERMAN: Yes, I believe so.

9 THE WITNESS: Thank you.

10 MR. HERMAN: Thank you for your
11 time, Doctor.

12 THE CERTIFIED STENOGRAPHER: We are
13 off the record at 11:55 a.m., June 20th,
14 2025. This concludes the deposition of
15 Dr. Sanjay Banerjee.

16 (The deposition concluded at
17 11:55 a.m., Friday, June 20, 2025.)
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REASON

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I, SANJAY BANERJEE, PhD, have read the foregoing deposition and hereby affix my signature that same is true and correct, except as noted above.

SANJAY BANERJEE, PhD

THE STATE OF _____)

COUNTY OF _____)

Before me, _____, on this day personally appeared SANJAY BANERJEE, PhD, known to me or proved to me on the oath or through _____) (description of identity card or other document) to be the person whose name is subscribed to the foregoing instrument and acknowledged to me that they executed the same for the purposes and consideration therein expressed.

Given under my hand and seal of office this _____ day of _____, 2025.

NOTARY PUBLIC IN AND FOR

THE STATE OF _____

My commission expires: _____

Job Number 989065

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UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD
RUNERGY USA INC. AND §
RUNERGY ALABAMA INC. §
§
Petitioners, §
§
VS § Case IPR2025-00006
§ Patent No. 10,230,009
§
TRINA SOLAR CO. LTD., §
§
Patent Owner. §

ORAL VIDEOCONFERENCE DEPOSITION OF
SANJAY BANERJEE, PhD
FRIDAY, JUNE 20, 2025
VOLUME 1 OF 1

CERTIFIED STENOGRAPHER'S CERTIFICATION

I, Penny L. Pabitzky, CSR, RPR, residing in
the state of Texas, do hereby certify that the
foregoing proceedings were reported by me a
certified machine shorthand reporter, and that the
foregoing transcript constitutes a full, true, and
correct transcription of my stenographic notes, to
the best of my ability, and I hereby certify to the
following:
That the witness, SANJAY BANERJEE, PhD,
located in Dallas, Texas, was duly sworn by me and

1 that the transcript of the oral deposition is a true
2 record of the testimony given by the witness;

3 That the original deposition was delivered to
4 PATRICK HERMAN, custodial attorney;

5 That a copy of this certificate was served on
6 all parties and/or the witness shown herein on

7 _____.

8 I further certify that the signature of the
9 deponent was requested by the deponent or a party
10 and the signature is to be returned within 30 days
11 from date of receipt of the transcript.

12 If returned, the attached Changes and
13 Signature Page contains any changes and the reasons
14 therefor.

15 That pursuant to information given to the
16 deposition officer at the time said testimony was
17 taken, the following includes counsel for all
18 parties of record:

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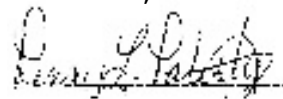
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15 I further certify that I am neither counsel
16 for, related to, nor employed by any of the parties
17 in the action in which this proceeding was taken,
18 and further that I am not financially or otherwise
19 interested in the outcome of the action.

20 Subscribed and sworn to on this the 10TH day
21 of JULY, 2025.

22 

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