

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CANADIAN SOLAR, INC.

Petitioner

v.

MAXEON SOLAR PTE. LTD.,

Patent Owner.

IPR2024-01038

Patent 11,251,315 B2

Record of Oral hearing

Held: October 15, 2025

Before JO-ANNE M. KOKOSKI, KRISTINA M. KALAN, and
AVELYN M. ROSS, Administrative Patent Judges.

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The above-entitled matter came on for hearing Wednesday,
October 15, 2025, commencing at 10:00 a.m. MDT, via Videoconference.

P-R-O-C-E-E-D-I-N-G-S

(10:00 a.m.)

JUDGE KOKOSKI: Today we will hear arguments in IPR2024-01038 concerning U.S. Patent Number 11,251,315. I am Judge Kokoski and I am joined today by Judges Kalan and Ross.

Let's start with appearances, beginning with Petitioner.

MR. TIU: Good morning, Your Honor, or good afternoon if you're on the East Coast. Samuel Tiu, representing Canadian Solar, the Petitioner. Also on the line is Brooke Boll, who is my colleague, who is going to be presenting on the second session.

JUDGE KOKOSKI: Okay, thank you. Patent Owner?

MR. SNODGRASS: This is Jacob Snodgrass with PV Law, for Patent Owner. I have with me my colleague Jing Zhao. I'm expecting a further colleague, Jeremy Peterson to join as well who will be presenting on the next session.

JUDGE KOKOSKI: Okay, great, thank you. Before we begin, I just want to remind you that we each have a copy of the demonstratives that you provided, and during your argument, please identify clearly and specifically the demonstrative you're referencing by slide or screen number so that everyone can follow along, and that should ensure clarity and accuracy of the court reporter's transcript. We also request that you keep your line muted when you are not speaking. Also, please keep in mind that the remote nature of this hearing may result in audio lag, so please pause prior to speaking so as to avoid speaking over others.

As set forth in the hearing order, each party has 60 minutes to present their arguments. Petitioner will proceed first and may reserve time for

1 rebuttal. Petitioner, would you like to reserve, and how much time would
2 you like to reserve?

3 MR. TIU: Yes, Your Honor, about 10 to 15 minutes, depending on
4 how far I get to.

5 JUDGE KOKOSKI: Should I put you down for 15? If you go into
6 your rebuttal time, that's fine, I just need it for --

7 MR. TIU: Sure, let's say 10.

8 JUDGE KOKOSKI: Okay. Patent Owner will then have 60 minutes
9 to present their case, and they also reserve time for a sur-rebuttal. Patent
10 Owner, would you like to reserve time, and if so, how much?

11 MR. SNODGRASS: Yes, Your Honor. The same amount.

12 JUDGE KOKOSKI: Okay, great. Thank you. All right, Petitioner,
13 you may proceed when you're ready.

14 MR. TIU: Thank you, Your Honor. May I share screen as well, Your
15 Honor, for the demonstrative?

16 JUDGE KOKOSKI: Yes, that's fine.

17 MR. TIU: So, just to orient ourselves, we're here on two proceedings
18 that have been consolidated into one, and in particular, the first proceeding
19 was on the Independent Claim 10, 12, 15, but also a second proceeding that
20 has the dependent claims, Claims 16 and 19, that has been consolidated into
21 this proceeding. But the grounds for our challenge is fairly similar, so that's
22 why we're just going to talk about them together.

23 The claims at issue that I'm going to focus on today is Claims 10 and
24 16. Claim 10 is the independent claim, and Claim 16 is the dependent claim.
25 And the reason for that is, these two limitations that are highlighted on the
26 screen, which is Slide 3, that has Claims 10 and 16 are the two limitations at

1 issue that are disputed. The first limitation is the dopant concentration on
2 the front portion of the silicon substrate that is approximately less than or
3 equal to two times 10^{18} , or we call that the front dopant
4 concentration limitation. And the second limitation that is at issue is the first
5 emitter having metal impurities, and in particular the metal impurities,
6 whether they're present or not, that is the issue. And the difference between
7 Claim 10 and 16 is just that Claim 10 requires only one emitter, and Claim
8 16 requires an additional emitter, both on the back side of the solar cell.

9 So, I want to start first with the first limitation, although my
10 demonstratives start off with the impurities. But I want to make sure that I
11 cover enough time for the first limitation, so I want to start with the first
12 limitation. There is no dispute that the front dopant concentration of the
13 claim is disclosed in the prior art references that have been provided by
14 Petitioner. The only dispute is the motivation to combine. And the front
15 dopant concentration is disclosed, for example, in the King reference, that
16 Dr. Banerjee, Canadian Solar's expert, has discussed. And in particular, I'm
17 showing on the screen a portion of Dr. Banerjee's declaration on paragraph
18 75, where he discussed the King and Swanson reference published in 1990,
19 where he brought a quote where King said that in that contact solar cell, the
20 optimum emitter is one that provides the lowest J_0 . J_0 is a measure of
21 surface recombination. Surface recombination means that if there's
22 recombination it's bad for the solar cell, and it reduces efficiency, so you
23 want that lower. And for untextured surface, the front surface concentration,
24 for the optimal front surface concentration, it is said to be 10^{18} . And
25 for textured surface, that the near optimal concentration is also the same
26 amount. And this was done after King has done experiments to determine

1 and make this suggestion. And this was well known and provided back even
2 in the 1990s.

3 Now, the Board, in its institution decision, and I'm showing on my
4 screen the institution decision of the Board on page 21, had found that
5 Petitioner had provided sufficient evidence already that the skilled artisan
6 would have reasons to combine Li, which is our base reference for the back
7 contact solar cells, with King, Swanson, and Marvin, that discloses the front
8 dopant concentration, in particular the optimum front dopant concentration.
9 And the Board has already said that there's a reasonable likelihood of
10 showing that these claims are obvious, and that they would be combined.
11 And nothing has changed here. Nothing that Patent Owner has submitted in
12 its Response or in its Sur-reply will have changed that.

13 Now, we'll go back to my demonstrative on Slide 4. So, when Li
14 came along in 2011, Li disclosed a back contact solar cell. The back contact
15 solar cell that Li described was really focused on the back side, where you
16 would put a dielectric layer, which is the purple, and the emitter polysilicon
17 regions that are the green and the yellow. But it also describes that on the
18 front side, which was well known, that you would dope that with a dopant,
19 but he didn't disclose what that concentration would be because that was
20 well known. And so our combination is fairly simple, which is to take what
21 was well known and described as optimum or near optimum front dopant
22 concentration, taught for decades long, and combine that with Li, that has a
23 back contact solar cell. They're both for back contact solar cells, so the
24 combination is fairly simple.

25 Now, Patent Owner's going to try to misdirect with arguments and
26 raise some smoke screens and diversions, but those arguments don't stand

1 up to scrutiny. For example, Patent Owner's going to say, well, Canadian
2 Solar Petitioner is relying on old art, in the 1990s, and the newer trend
3 around 2014 was to use higher dopant concentration. And then he provided
4 an expert declaration on that end, but that argument doesn't hold water. So,
5 when we took the deposition of their expert, we asked him, and we found
6 out that he actually, as a skilled artisan was working on back contact solar
7 cells back in 2014, which was our effective filing date for the challenged
8 patent. And we asked him, do you recall what the concentration was that
9 you were using on that back contact solar cell? And he said 10 to the 18.
10 And we were kind of like, okay. So, during this deposition, we asked him
11 again, well, what is the concentration, do you recall? And he started
12 explaining what the front dopant concentration as he understood it to mean,
13 and that would mean the surface that then progressively decreases down to a
14 gradient. And he said, everybody knows that that's 10 to the 18.

15 So, even despite this new trend that Patent Owner suggests that there's
16 a new trend for higher dopant concentration, their expert who was skilled in
17 the art, working in the field, working with back contact solar cells, was
18 actually using 10 to the 18, and he said everybody knows. Now, this was
19 provided in my slides, 35 and 36, and the deposition transcript is Exhibit
20 1087, and this whole discussion starts from page 40 of the deposition to 49.
21 And I'm just pulling some excerpts, specifically page 45, lines 5 to 9, page
22 48, lines 16 and on, and page 44, 3 to 21.

23 JUDGE KOKOSKI: Counsel, we have the expert testimony that
24 everyone knows that's about 10 to the 18 or so. Is there any other
25 corroborating evidence, or is this all that we have in the record?

1 MR. TIU: Well, we have the publication themselves, which is 10 to
2 the 18, King, Swanson, and Marvin. We also have the other combination,
3 Your Honor, that we have, which is Li and Muller. Muller also used the
4 same claimed concentration, which is two times 10 to the 18.

5 May I proceed, Your Honor? So, one other smoke screen that Patent
6 Owner then raises is, well, in Li, they said that Li does not disclose an oxide
7 layer, and in King, Marvin, or Swanson, they were using that dopant
8 concentration because there was an oxide layer. Well, Li -- and now I'm
9 going to go to Slide 37 -- Li does not preclude a front oxide layer. And
10 there's nothing in the claim that says well, you have to use an oxide layer or
11 you can't use an oxide layer. So, Li says that in describing the -- I'm not
12 describing every single detail, and this is in paragraph 21 of Li, I'm not
13 describing every single detail of my invention here, I'm going to focus on
14 what my invention, which is more the back side. And so, other well known
15 fabrication techniques are not described in detail in my specification.

16 And what are those well-known techniques? We asked Patent
17 Owner's expert, again, Slide 18 of my demonstrative, we asked him well,
18 would you say that in 2014 it was common to have a silicon oxide layer on
19 the front surface of a back contact solar cell? He said yes. For all the
20 manufacturers that he knew, everybody was using silicon oxide on the front
21 surface. So, it's a well-known fact that Li does not have to disclose.

22 Now, the other smoke screen diversion is that well, Li -- I'm sorry,
23 King and Swanson -- that Patent Owner raises was, King and Swanson was
24 using a thick oxide layer. And the new trend was going for a thinner oxide
25 layer. So, if you have a thick oxide layer, maybe you can get away with a
26 lower concentration, if you have a thin one, you have to have a higher

1 concentration. Now, does it really matter? That is not part of the claim.
2 The claim doesn't say that you have to use a thin or a thick oxide layer. And
3 Li doesn't preclude the use of either of those, as I said. If it's well known, it
4 was already, Li said, I'm not describing it.

5 But here's also the point, is that in Patent Owner's Response -- and
6 this is on page 49 that I'm going to put on the screen. Patent Owner says,
7 well, a thicker oxide layer coupled with a fewer dopants, meaning lower
8 concentration, provide the same effect as a thinner oxidation layer coupled
9 with more dopants. Right? So, both are equally available options to those
10 skilled in the art. So we have option one, option two. But that doesn't mean
11 that the thicker oxide with the lower concentration is not obvious. Under
12 Federal Circuit precedent, you don't -- motivation to combine does not
13 require the combination of the best option, it just has to be a suitable option.
14 And this is Par Pharmaceuticals versus TWI Pharmaceuticals, 773 F. 3rd,
15 1168, 1186, and page, specifically page 1197 to 1198.

16 So you have two options. Both are suitable, both are obvious. And
17 that's just KSR as well. If a technique has been used to improve one device
18 and a person of ordinary skill in the art would recognize that it would
19 improve a similar device, in this case the back contact solar cells, then using
20 that technique of a lower dopant concentration, 10 to the 18, is obvious,
21 unless its actual application is beyond his or her own skill. This is KSR at
22 550 U.S., at page 417.

23 Now, is it beyond a person of ordinary skill in the art? We asked
24 Patent Owner's expert, again, with -- and this is now going to Slide 41 of our
25 demonstrative. We asked Patent Owner's expert, do you agree that a skilled
26 artisan would have known that you could either use a low dopant

1 concentration with a thick oxide, or a higher dopant concentration and a thin
2 oxide? He answered yeah, yes, most likely they would have known that.
3 And the skilled artisan would have been able to implement either of those
4 options, yes. So now, again, it's not beyond the skill of ordinary skill to be
5 implementing both options, but that just means that either one of those is
6 obvious.

7 It's like this. You said, these references were back in the 1990s, and
8 so it's no longer obvious, but it was obvious back then. So it's like, if we
9 take, if you're in 1990 and you're using a telephone landline for your
10 communication, and now in 2014, the iPhone came along and now we're
11 doing wireless, can now I patent and say oh, it's non-obvious for me to use a
12 landline to order pizza, right? So, it was well known and supported by their
13 own expert testimony, and it's just a suitable option that a person of ordinary
14 skill in the art would use.

15 Now, I'm going to move to the next combination, Li and Muller, for
16 this front dopant concentration. But Judge Kokoski, you had a question?

17 JUDGE KOKOSKI: Yes. Before you move on, I just want to follow
18 up on something you said earlier. I think it was, you were referring to King,
19 that it reported on the optimum concentration. Is that optimum for all
20 environments, all applications? Or is it specific to what King was testing?

21 MR. TIU: So, it's optimum for back contact solar cells, right? And
22 he did experiments on this, various experiments where he measured the J_0
23 and see how they would go, and for textured and untextured. And the reason
24 for this -- Dr. Banerjee actually explained in his declaration on the next
25 paragraph, on paragraph 76 of his declaration. In the back contact solar
26 cells, you don't have metal on front. And so, you don't need that high

1 dopant concentration in order to conduct electricity or reduce the contact
2 resistance. And when you only have the metal on the back, the front portion
3 is really just to reduce surface recombination, and the lower you have for the
4 dopant concentration, the lower is the recombination, which is bad for the
5 solar cells.

6 So, in King, King was not distinguishing between concentrator or
7 non-concentrator, or space versus terrestrial, which Patent Owner is trying to
8 argue, but King is just back contact solar cells. And in particular, one other
9 thing I want to point out, too, is that the claim does not limit it to any
10 particular use, right? It's not as if the claim is only going to be used for non-
11 concentrator cells or terrestrial cells. And the same thing, Li does not say
12 that oh, my solar cell's only for terrestrial or for non-concentration. Li's just
13 quiet on that. It's just a broad disclosure that says I'm disclosing a back
14 contact solar cell, and people skilled in the art knows that you can use it for
15 concentrator, non-concentrator, space, or terrestrial.

16 JUDGE KOKOSKI: Okay, thank you.

17 MR. TIU: Thank you, Your Honor. And now, I'm going on to Li and
18 Muller. Muller is the other reference that we have back in 2014 that
19 discloses this front dopant concentration using two times 10 to the 18. And
20 in particular, we use Li because of the left side of the figure that is using
21 boron as the dopant for the front surface, and because one of the claims
22 requires that boron or a key-type dopant be used on one of the dependent
23 claims. So, in Li, he discloses that with this concentration of the boron, you
24 can actually get very good, again, reduction of surface recombination, and in
25 addition, you actually can reduce the UV degradation, or in a sense, provide
26 better UV stability. And so those are benefits that Muller had disclosed in

1 his publication, and Muller is Exhibit 1008, and I'm just discussing Slide 43
2 right now.

3 So, there is no dispute that Muller discloses the claim concentration.
4 And even if we look at Slide 44, even Maxeon's expert testified in his
5 deposition, yeah, I'm not disputing that Muller discloses that. Now, the
6 Board in its institution decision -- I'm now on Slide 45, already found that,
7 yeah, you know, there's sufficient motivation to combine here, because the
8 combination would result in an increased solar cell efficiency and better
9 stability for under UV illumination. So there's two reasons there for
10 providing that motivation to combine.

11 Now, Patent Owner's going to say well, there's no evidence in the
12 record, or it's not supported that the ion implantation technique that Muller
13 is using will actually increase solar cell efficiency, but that's not true. If we
14 look at Slide 49, which is exhibit -- I'm referring to Exhibit 1036, the
15 Rhotagi reference that we disclose, or that we provided. It clearly says right
16 there in the abstract, ion implantation can raise the efficiency of the solar
17 cell by .08 percent absolute, while reducing the process sequence by one
18 step relative to the traditional doping process with a phosphorus. Now, this
19 is comparing phosphorus ion implantation and phosphorus gaseous doping.
20 And with that, you saw you can increase the efficiency.

21 Now, Muller then comes along and provides the additional data that
22 says, what if we compare them with ion implantation with boron and ion
23 implantation with phosphorus, right? We know that ion implantation with
24 phosphorus can increase the efficiency, and Muller with the boron says well,
25 efficiency wise they're similar, but then I get better prevention of
26 recombination and better UV resistance. And that's in Slide 50, where

1 Muller changed the dopant in the front from phosphorus to boron and show
2 that the floating emitter boron can reduce the J_0 even further, five to seven,
3 compared to 12 to 10.

4 And then, with the UV resistance, you can actually see that if you use
5 the phosphorus, then the UV efficiency will -- under UV light, the efficiency
6 will drop from 20 to 9.6, and in using the boron, the UV illumination
7 efficiency will only drop from 20 to 19.6. So, that's a big difference. That's
8 a reason for a motivation to combine.

9 Now, Maxeon is going to raise, well, ion implantation, there's a lot of
10 drawbacks, blah, blah, blah, because you have to have more steps in there,
11 but Li does not say that you cannot have more steps. Li actually says that
12 improving solar cell efficiency was what's desirable. It's desirable to
13 increase solar cell efficiency, and that's on Slide 46, in paragraph 5 of Li,
14 Exhibit 1005. And if we look at Slide 47, Li says that in some of his
15 embodiments, you can reduce the process step. In others, you can increase
16 the process steps. So that means Li is agnostic as to whether you have more
17 steps or less steps. What Li cares about is increasing the efficiency, and
18 that's what Muller provides.

19 So, the criticism about well, you know, you need more steps in ion
20 implantation and all that kind of stuff and more complicated, Li doesn't care.
21 So, those skilled in the art can combine them and will be motivated to
22 combine them because it will increase the efficiency and have better UV
23 quality. Now, we asked the expert as well, this is Slide 48, Patent Owner's
24 expert whether Li requires reduction of steps, and he says no. He agrees that
25 Li doesn't actually require reduction of step.

1 Now, before I move to the impurities, which is the second limitation, I
2 want to touch on one quick point, which is, one criticism that Patent Owner
3 had said was, like, well, if you use the boron ion implantation in Muller then
4 you're going to reduce the metal impurities that goes in and stuff. Again,
5 this is another misunderstanding and misdirection. And Dr. Banerjee -- and
6 I'm on Slide 52. Dr. Banerjee actually anticipated this, right? So, yes, ion
7 implantation has a less gettering effect. And what Li has provided is that
8 well, you do the ion -- what Muller has provided, you do the ion
9 implantation on the front side. But what you do is then you then insert the
10 Muller ion implantation before you do the process on the back side of Li,
11 where you're putting on the polysilicon and doing the diffusion where the
12 gettering is occurring. What does that mean? So, by the time, before, when
13 you do the ion implantation, the polysilicon is not on the back side yet,
14 right? Because you're doing the ion implantation first.

15 And so, yeah, it doesn't matter if there's no gettering, because the
16 gettering occurs when you do the polysilicon formation at the back side, and
17 then you diffuse the dopant at the high temperature into the polysilicon.
18 And you do that afterwards. You do that after the ion implantation. And
19 that's on paragraph 99, explained by Dr. Banerjee. So, this idea that ion
20 implantation will reduce the gettering, I mean, it's just again a misdirection,
21 because the gettering is not occurring at the ion implantation stage, it's
22 occurring during the dopant diffusion process in Li, which is at 950 degrees.

23 Now, I want to move to the second limitation, but before that, I would
24 just want to ask if Your Honors have any questions on the first limitation so
25 far? Thank you.

1 So, now on the second limitation, this is the metal impurities in the
2 emitter region. Petitioner, we provided extensive evidence that the silicon
3 wafer disclosed in Li has high impurities, and that you would getter those
4 during this high-temperature step. And even the Board in its institution
5 decision already found that Petitioner had provided sufficient evidence to
6 establish that the natural result of the structures and processes of Li is to
7 getter the metal impurities from the substrate and into the P-type and N-type
8 regions.

9 Now, actually, there is no dispute, because again, they've raised a lot
10 of smoke screens. But if we ask the expert, there's no dispute that there are
11 metal impurities in the polysilicon regions. And I just want to stop right
12 here in the claims. The reason is, as you look at the claims, there is no
13 requirement on what a certain quantity or what a certain level of metal
14 impurities. It just had to have metal impurities. So, Patent Owner claims,
15 well, I had my expert do a calculation, and it's very small. It's a small
16 amount that is in this. So, when we asked the expert, and this is now on
17 Slide 16 of my demonstratives, we asked the expert, under the assumptions
18 that you articulated and that you calculated, that there would be a small
19 number of iron impurity atoms would getter -- sorry for the typo. It says
20 gather, but it should be getter. Would getter through the silicon oxide and
21 into the polysilicon, correct? And he said yes, that's correct, albeit a small
22 amount, but it will be there. So there is no dispute that there will be metal
23 impurities. The dispute is how much, but there's no dispute that there will
24 be, and the claims does not require a particular number for the metal
25 impurities to be there.

1 And again, on Slide 17, just to provide context for the calculation that
2 Patent Owner's expert has done, is that he testified, he's not saying that
3 there's absolutely no impurities in the polysilicon region. He's just saying
4 that's not his opinion. He's just saying it's a very small amount. Now, the
5 question is, and we submitted this in our brief, is that, even a trace amount is
6 sufficient for inherency. And that's the SmithKline Beecham case versus
7 Apotex, 403 F.3rd 1331, *pin cite* 1344.

8 The inherency will be met even if they have a trace amount, and even
9 if it was not detectable at the time of the prior art. So, Patent Owner's raised
10 this issue, oh, oh, you can't detect this small amount, blah, blah, blah, but
11 they put a qualifier in there. Their expert put a qualifier and said you can't
12 detect this by a reasonable detection means. So, we asked him in his
13 deposition, what do you mean by -- and this is now Slide 29 of my
14 demonstrative. What do you mean by a reasonable detection means? Then
15 he started explaining, well, you have non-destructive means and you have
16 destructive means. But then he admitted that today we are able to detect and
17 see these levels this small that he's calculated. And so we said okay, well,
18 what about in 2014 when the effective priority date is? And he said, yeah, in
19 2014, there may not be a commercially available technique, but laboratories
20 were doing it, including one here at Wake Forest. The Patent Owner's
21 expert is located in Wake Forest.

22 So, he's testifying that these small amounts that he's saying is very
23 small, actually you can detect them. And as I've said, there is no
24 requirement that you could detect them at the time of the prior art. And
25 here, we've been admitting, Patent Owner's own expert admits that you
26 could detect these small quantities of metal impurities that he admits is also

1 present in the polysilicon. Now, I'm not going to agree that the amount is
2 small, but again, as I said, it doesn't matter for purpose of the claim, because
3 there's no amount that is set by the claim. But I want to point out certain
4 things about the calculation and the assumptions that Patent Owner's expert
5 has used.

6 There's four faulty assumptions that he used. First, he assumed that
7 the substrate had low metal impurities, right? And second, he assumed a
8 temperature that we know, based on the record, is not sufficient. And third,
9 he ignored the thinness of the silicon oxide, and fourth, he ignored doping of
10 the polysilicon layer. So, let's first start with number one, which is the
11 substrate. I'm going to Slide 7 of my demonstrative.

12 Li discloses that the substrate, you could use a single crystalline
13 silicon or you can have a multi-crystalline silicon substrate. And this is on
14 paragraph 37 of Li. Now going to Slide 8, Petitioner had provided extensive
15 evidence, reference after reference, reference after reference, that Dr.
16 Banerjee has discussed, that for multi-crystalline silicon, you have a very
17 high concentration of iron and metal impurities, even 10 to the 14 to 10 to
18 the 16. I don't know how to put that in words, but there's a ton, a lot, a lot.
19 More than a quadrillion. And so, the substrate itself has a lot of impurities,
20 and the Patent Owner's expert is assuming that there's not a lot.

21 Now, Patent Owner's going to say, well, that's only for the low cost
22 stuff, right? And not for the high-quality silicon. That's not true, as well.
23 When we asked Patent Owner's expert, as you may remember, he was
24 working on solar cells, but he was also working on semiconductor. In Slide
25 9, in the time frame of 2010 to 2015 time frame, what was the level of the
26 metal impurities that you see? And he said over 10 to the 15. Is that for an

1 average silicon semiconductor that you're expecting this 10 to the 15? He
2 said, well, yes, we actually bought the pretty good stuff. Right? So, even
3 the good stuff that he's using both for the semiconductor application and for
4 solar cell, he had very high metal impurities for the silicon. And it's
5 understandable, because the experts agreed that it's practically impossible to
6 make silicon without the metal impurities.

7 I'm on Slide 10. Dr. Banerjee, Petitioner's, Canadian Solar's expert
8 says, was asked, can you make a silicon without impurities? He said, he's
9 practically impossible. Right, it's a manufacturing process of silicon, you
10 know, six leaks in these iron and metal impurities. Same thing we asked the
11 expert, Patent Owner's expert, Slide 11. Well, what would it take to prepare
12 a completely pure silicon substrate without the impurities in 2014? Would
13 be extraordinarily expensive, is the answer. Well, we provided a case called
14 Atlas Powder versus IRECO, which says that you don't avoid inherency if
15 you have to take extraordinary measures to actually, to not see the inherent
16 result. And that's Atlas Powder versus 190 -- cite is 190 F.3rd, 1342, pin
17 cite 1439. And here, you would have to extraordinarily do something so that
18 you don't have the metal impurities.

19 So, talk about the substrate. Let's talk about the temperature. Now,
20 what, in the calculation that Patent Owner's expert did, what temperature did
21 he use? He used with a particular reference to the concentrations at 900
22 degrees. Okay. Why is that important? Because we know from both the
23 '315 Patent and also from Ramappa, that that is the key transition
24 temperature from which you switch from being insufficient gettering to
25 having gettering, right?

1 So, if we look at Slide 14, which is the '315 Patent, the '315 Patent
2 discloses that yeah, you have this tunnel oxide that is between the substrate
3 and the polysilicon regions. And so, for you to be able to diffuse or getter
4 the metal impurities through that, you would need to go beyond 900 degrees
5 because 900 degrees or below, no, at 900 degrees or below, it is insufficient.
6 You have to go above 900 degrees in order to getter that. So when Patent
7 Owner's expert calculated his small number, he was basing it on a
8 temperature that, 900 degrees, that we know is insufficient according to the
9 patent.

10 The same thing, if we look at Ramappa, and the Board already
11 actually pointed this out during, in its initial decision, that there is a
12 temperature -- Ramappa is the reference that Petitioner is relying on both for
13 its teaching on supporting inherency, but also for obviousness. And Patent
14 Owner's expert is using that and said well, Ramappa teaches that, well,
15 you're going to have this blocking effect of the silicon oxide. But Ramappa
16 actually teaches that if you increase the temperature, right, you get more
17 diffusion across that. And what is the temperature that Ramappa is using, on
18 Slide 19? It's actually, again, 900 degrees centigrade. And so this is --
19 Ramappa is Exhibit 1025, on page 3775, it says that at the lower
20 temperatures, less than 900, the diffusing across is relatively small. At
21 above 900 degrees, there's a significant increase of the amount of iron that is
22 diffusing across. So, and that gives the conclusion that the Board cited that
23 Ramappa teaches that a silicon dioxide layer placed between the substrate
24 and the polycrystalline layer does not impede the gettering of metal
25 impurities at the increased diffusion temperature. So, that's the second
26 faulty assumption.

1 Third is that when we look at the thickness of the silicon oxide, Li
2 discloses the thickness is only one to two nanometers, and Dr. Banerjee
3 actually, tells us, like at that thickness, and if you have the high temperature,
4 it's like a hot knife slicing through butter. The metal impurities are just
5 going to diffuse through. And this is supported by, again, evidence that
6 Petitioner provided, specifically the Liu reference. Now, there's two Liu
7 reference, Liu-1 and Liu-2. In particular, Liu-2 discussed the thickness and
8 said that the presence of the oxide interlayer, like the tunnel oxide, that
9 normally will hinder gettering, but at the optimum polysilicon fabrication
10 conditions, the blocking effect is very small, enabling the removal of more
11 than 99.9 percent of the bulk iron. And what were those two parameters that
12 Liu pointed to? I'm on Slide 20. Liu-2 is Exhibit 1029. Those two
13 parameters are very thin oxides combined with sufficiently high diffusion
14 temperature dose. Those are key parameter that allows for this diffusion to
15 go through.

16 And so, if we look at Slide 21, Li provides the data. And what is the
17 thickness of the tunnel oxide in Liu-2? It's 1.3 nanometers. That's the exact
18 same range as Li. So, in the thickness that Li has, even at the temperature
19 that Liu was doing right here, is at the phosphorus on the left-hand side, is
20 that 780, 820, and 890, you get the gettering effect increasing with
21 increasing temperature, and it's just going through. And the same with
22 boron. As the higher temperature you go through, you get the gettering
23 effect increasing. At four nanometers, yeah, you may potentially inhibit the
24 gettering, but still, half of them, it's going through.

25 So, I just wanted to point out that the faulty assumption is, he did not
26 take that into consideration. And then what's the last one he didn't take into

1 consideration? Would be, doping. Now, when you dope, remember, in the
2 solar cell art, the gettering is not a specific step that they take. In the solar
3 cell fabrication, the gettering just happens. They take advantage of that
4 gettering effect during the diffusion of the dopants, because you're doing it
5 at the very high temperature at that time. So, Ramappa was the basis of the
6 ex-Patent Owner's expert's calculation, was doing it in un-doped silicon.
7 And we know that when you dope the silicon, when you dope the
8 polysilicon, you actually get a much higher diffusion effect. And so, this
9 again is Liu-2 on Slide 24, Exhibit 1029, and page 139.

10 And it's, in Figure 3, it talks about intrinsic polysilicon, that means
11 un-doped polysilicon, do not have significant gettering effect. But does it
12 mean that it has nothing? No. It removes only half of the initial bulk
13 concentration. Now, if you have a quadrillion, and then you have half of it,
14 that's still a lot, but they call it not significant gettering action because
15 you're not removing the outer big mass of it. But if you then use doping, as
16 you can see, that you have doping with dopants in the polysilicon, the
17 gettering effect substantially increases, you remove most of the metal
18 impurities. So again, Patent Owner's expert also did not rely on that.

19 Now, I want to just touch one last point on the metal impurities that
20 Patent Owner had raised for the first time in this Sur-reply, which is this
21 issue of boron not being as effective as phosphorus and stuff in the
22 polysilicon. The Board should not even consider that, but if you do consider
23 it, I just want to point out something, is that we've provided evidence for
24 both phosphorus and boron polysilicon, that shows diffusion across the 1.3
25 nanometer tunnel oxide into the polysilicon. And that's in the Liu-1 paper
26 that Dr. Banerjee discussed. And this is, I'm starting on page 25.

1 Now, one thing to -- if we look back at Claim 10, Claim 10 only
2 requires one of the emitter regions to have a metal impurity, because it only
3 requires one emitter region. There's no dispute that the phosphorus works
4 very, very well, in terms of that Patent Owner is not disputing that. So,
5 that's not even an issue for Claim 10. So, the only issue of the boron is for
6 Claim 16, which requires the second emitter region to also have metal
7 impurities. So, if we looked at the data for the boron, and now I'm on Slide
8 26. Now, Dr. Banerjee also testified, taking the data from Liu-1, that in the
9 boron diffused polysilicon, Liu-1 shows that you have metal impurities
10 gettering also, also into the polysilicon region, which is this region right
11 here. Right? So, yeah, it is not as big as you would see in phosphorus, but
12 as you could see in this region, you still see metal impurities. Now, as I
13 reminded the Board, there is no requirement in the claim of how much metal
14 impurities needs to be in the polysilicon. It just has to be there. So, Liu-1
15 shows the data that actually you have metal impurities gettering into the
16 polysilicon. And what temperature was that experiment done? That was
17 done at 900. Imagine if they had done it even more, right? So you would
18 get more of that metal impurities going through, because as we talked about,
19 900 is a key transition temperature.

20 Now, when we asked Patent Owner's expert about this, we asked
21 them, well, about the same figure, and he agreed that this is what the
22 inventor -- or not -- the authors were intending to show, that you would
23 getter the metal impurities from the substrate and into the polysilicon
24 through the silicon dioxide substrate. Yes, he agreed that that is what the
25 data is intended to show. And so there is no dispute that there is boron, there
26 is metal impurities present even in the boron-diffused emitter, which is the

1 second emitter region of Claim 16. And I think with that, I'm going to
2 reserve my time for rebuttal, unless Your Honors have any questions. I'll
3 stop sharing.

4 JUDGE KOKOSKI: I think we're all set. Thank you very much.
5 You've got the full 15 minutes for rebuttal.

6 MR. TIU: Thank you, Your Honor.

7 JUDGE KOKOSKI: Patent Owner, you can begin when you're ready.

8 MR. SNODGRASS: Thank you, Your Honor. I'm going to bring up
9 our demonstratives. Your Honor, are you able to see our demonstratives?

10 JUDGE KOKOSKI: Yes, I can see them.

11 MR. SNODGRASS: All right, thank you. And these demonstratives
12 that I'll be referring to have been filed as Exhibit 2040 in the lead
13 proceeding, IPR2024-01038. I want to begin with, on Slide 2, Li's failure to
14 inherently disclose the metal impurities limitation.

15 Before we get into the parties' various factual disputes, of which there
16 are many, I think it's important to discuss the governing legal framework.
17 We have cited here, on Slides 3 and 4, some of the doctrines of inherency.
18 We've cited more in our papers as well. The Federal Circuit says that
19 inherency is a high bar. The Federal Circuit says that inherency requires that
20 the proponent show that the limitation at issue necessarily must be present
21 for the natural result of what else is disclosed. Turning to Slide 4, the
22 Federal Circuit tells us that the mere fact that something may result from a
23 set of circumstances is not sufficient.

24 Canadian Solar does not embrace those doctrines, nor does it directly
25 refute them. It would be hard to refute them, these are controlling
26 precedents, but it makes arguments that would apply only under an

1 alternative regime. It makes arguments, for example, as to what might be in
2 Li, what the impurity concentration may be in the substrate to start. That's
3 not a proper inherency analysis. Petitioner chose to rely on inherency, it
4 chose to embrace the high standard, and it should have, at every juncture,
5 made assumptions that are sound and that are supported by the evidence and
6 not that have relied on optimism and beneficial options when multiple
7 options were available.

8 Turning to Slide 5, we can see many of the errors that Petitioner
9 committed by following the supposed path of iron that it's theory demands.
10 Here we have reproduced on Slide 5, Figure 5A of Li. And according to
11 Petitioner, iron in substrate 508, during a heating step, will migrate across
12 the substrate, across the interface between the substrate 508 and the
13 dielectric layer 510. It will also traverse the thickness of the dielectric layer
14 510, cross over the interface between 510 and the material layer 506, and
15 then reside in material layer 506. According to Petitioner, through
16 subsequent processing, that layer 506 later becomes what are equivalent to
17 the first emitter region and second emitter region in the claims of the '315
18 Patent.

19 And Petitioner's theory gets off to the wrong start, because they
20 assume an improperly high level of iron concentration in the substrate. Here
21 on Slide 6, we have an example of Petitioner perhaps misunderstanding Dr.
22 Carroll's testimony. Canadian Solar states that Maxeon's expert, Dr.
23 Carroll, agrees that in around 2014, low quality silicon would have been
24 used for solar cells. What he in fact testified to, is that one can use low
25 quality silicon for solar cells, but in the last two sentences of what's
26 reproduced on the right-hand side of Slide 6, you don't have to do that. You

1 can use the higher quality stuff, but it will cost you more. So, this inherency
2 theory is getting off to the wrong start because it's premised on this idea that
3 low quality silicon will be used. Many of the references that we saw during
4 Petitioner's presentation assume a low-quality silicon, and that's simply not
5 proper under an inherency analysis. Petitioner should have proceeded with
6 what would have been the lowest amount of iron that one would reasonably
7 expect in a silicon substrate.

8 We put forward the number 10 to the 11 per cubic centimeter. Ten to
9 the 11. Ten to the 11 atoms per cubic centimeter. We've seen various
10 numbers from Petitioner, but we don't actually know what their theory is.
11 They hesitate to give us a definitive answer there. We've seen numbers like
12 10 to the 14, 10 to the 16. Petitioner stated that that was tons, an enormous
13 number. It certainly sounds like a large number, but in context, it's not. The
14 concentration of silicon is five times 10 to the 22 per cubic centimeter. So,
15 one in a million would be five times 10 to the 16, and Petitioner's not even
16 advocating for a concentration that high. So we are talking about one part in
17 far less than a million, just to provide some context.

18 So we don't know, Li doesn't describe whether it's high-quality
19 silicon, low quality silicon, so we don't know if it's going to have a high
20 level of iron impurities or a low level of impurities. To the extent that the
21 surrounding evidence gives us any indication, however, it's likely that Li is
22 of a higher quality silicon. And we know this because Li matured as a
23 patent that was assigned to SunPower, which is the predecessor to Patent
24 Owner Maxeon. And we know from an exhibit that Petitioner has put into
25 the record, the Neuhaus reference, Exhibit 1011, that SunPower was
26 commercializing IBC solar cells. IBC, interdigitated back contact solar

1 cells. And this Neuhaus reference states, here on the lower right-hand side
2 of Slide 7, that IBC solar cell design requires extraordinarily high lifetime
3 silicon starting material.

4 We also know from this reference that those IBC solar cells were
5 around since 1977. That's the purpose of the citation in the upper right-hand
6 part of Slide 7. So, by the time Neuhaus is published, which is in 2007, 30
7 years after IBC solar cells have been discussed in the literature, SunPower is
8 commercializing those. And Newhouse makes clear that that design that
9 SunPower is using requires high-lifetime silicon starting material.

10 Canadian Solar has seized on a case that coincidentally uses the word
11 extraordinary, as well, but it's conflating two separate issues. The case law
12 states that you cannot avoid inherency by taking extraordinary measures, but
13 that's not what's happening here. SunPower is achieving extraordinary
14 results, but it's doing so in a commercial context. It's not creating one-off
15 cells in labs, it is commercializing these products. That cannot be
16 considered extraordinary measures.

17 JUDGE KOKOSKI: Counsel, excuse me, before you move on, can
18 you just explain what extraordinarily high lifetime silicon means in terms of
19 the concentration of metal impurities? Or what we would take away from
20 that?

21 MR. SNODGRASS: Yeah, Your Honor, I think you should interpret
22 that to place Li at the lower end of the spectrum of concentrations that have
23 been proffered by the parties. So we put in references, 10 to the 11, 10 to
24 the 12. They put in references, I believe 10 to the 13, 10 to the 15, maybe
25 one 10 to the 16. I believe that this evidence suggests we're at the lower end
26 of that. It may not matter, at the end of the day, because we lose so much

1 silicon as we proceed from the Li substrate across the interfaces into the
2 material layer. We lose orders of magnitude of iron, that we get well below
3 the detection limits of iron. So, it may not matter where we start, but to the
4 extent that there is a factual dispute as to what the detection limits were, that
5 would be when this Board may have to wrestle with where on that spectrum
6 are we? Again, we've put forward a concentration, 10 to the 11. I don't
7 think we've seen one from Petitioners. And considering this is an issue in
8 which they carry the burden, I think that is odd. I think they should have
9 performed calculations and provided us with their idea as to how much iron
10 was in Li's silicon substrate.

11 JUDGE KOKOSKI: Okay, thank you.

12 JUDGE KALAN: I have a quick question.

13 MR. SNODGRASS: Yes, Your Honor.

14 JUDGE KALAN: So you are saying, though, that there is some iron
15 or impurities present even at these lifetime silicon starting materials, is that
16 correct?

17 MR. SNODGRASS: Yes, Your Honor. We're not saying it goes to
18 zero, however we will get to Dr. Carroll's calculations. And it's important
19 to understand, Dr. Carroll was not calculating what he believes would be the
20 concentration of iron in the material layer. He was performing some
21 calculations under certain assumptions, many of which were very favorable
22 to Petitioner. And he said, if you start with 10 to the 11, just the losses at the
23 interfaces alone, gets you 2.7 atoms of iron per 100,000 cubic centimeters of
24 silicon. Okay, so we can't say it goes to zero definitively, but we are talking
25 about far less than a single atom of iron in what would be a solar cell. What
26 would be in one solar cell would be a handful of cubic centimeters of silicon.

1 And Dr. Carroll has performed calculations, which they've been maybe
2 disparaged by Petitioner, and Petitioner may not like them, but Petitioner
3 fails to identify exactly what is wrong with them, and fails to proffer any
4 alternative calculations of its own. So we're in a regime where we're likely
5 presented with a solar cell of a handful of cubic centimeters of silicon. We
6 can't say definitively there's not a single atom of iron in there, but there
7 likely isn't one, let alone two.

8 JUDGE KALAN: Okay. And maybe you're going to get to this in a
9 minute, but Petitioner brought up the fact that even if it's not detectable by
10 commercial means, that as long as there is some iron there, it meets the
11 claim limitation. And if you touch on it later, that's fine, I just want you to
12 comment on that at some point, please.

13 MR. SNODGRASS: Thank you, Your Honor. That is not consistent
14 with the law. In re Seaborg, which is the case we've cited in our papers,
15 makes very clear that if it's undetectable, it's not inherent. In that case, there
16 was a claim directed at an element, americium, and there was a prior art
17 process that was, I believe, the Fermi process, I believe it is the famous
18 Enrico Fermi. And there was evidence deduced that that prior art process
19 could have produced, I believe, a billionth of a gram of americium, which
20 was the claimed element. And the Court of Customs and Patent Appeals
21 stated, even if that's the case, that's not sufficient, because that is not
22 detectable. So whether it exists is not sufficient. Even if it does exist, it's
23 not sufficient to meet the inherency bar.

24 JUDGE KALAN: Okay, what about the argument that Petitioner
25 made that it is detectable, it was detectable by things at Wake Forest, but just
26 not detectable by commercial means?

1 MR. SNODGRASS: That also is incorrect. Petitioners seize on a
2 discussion in the transcript regarding paragraph 60 of Dr. Carroll's
3 declaration in support of Patent Owner's Response. So this will be Exhibit
4 2021, paragraph 60 of Exhibit 2021, and this is where Dr. Carroll has
5 performed certain calculations with certain assumptions that I wish to
6 address in a minute.

7 And there are many concentrations recited in that paragraph, and
8 there's no indication as to what the questions are directed at. There's a
9 general discussion about concentrations that you discuss in this paragraph.
10 No suggestion that the lower concentrations that Dr. Carroll provides, such
11 as 2.7 atoms per 100,000 cubic centimeters would be detectable. In fact, we
12 know the Liu-1 reference, this is Exhibit 1028, one of the references upon
13 which Petitioner heavily relies, it states that the detection limit for iron is
14 five times 10^{15} . So again, there's five times 10^{22} atoms of
15 silicon in the cubic centimeter, five times 10^{15} , sounds like a big
16 number, that's one in 10 million.

17 Liu-1 has a line in many of its figures, we saw many of those today in
18 Petitioner's demonstratives. It has a grey horizontal line in many of those
19 figures, and it says Fe detection limit, and that's the detection limit for iron.
20 And it's at five times 10^{15} . So, we are talking about many, many,
21 many orders of magnitude between what the detection limit was and what
22 we're likely to experience or expect from Li.

23 Now, it's also important to note, Petitioner didn't give Dr. Carroll's
24 full testimony in this regard. When he was asked about detecting these
25 minor levels of impurities, he talked about how far off one would be from
26 detecting these levels of impurities. Even if one were to melt the silicon and

1 observe the gases, which was the most refined means available, and he
2 talked about even under those circumstances you would have a one or two
3 sigma confidence, rather than the five that's standard in the industry. In
4 other words, you would never be able to tell yes, there is iron there. You
5 could only perhaps tell that there was a possibility of iron.

6 And we've cited this in our paper. I want to get the cite. So this will
7 be at Exhibit 1087, which is Dr. Carroll's deposition transcript, at page 87,
8 lines 16 through 17. This is where he states "how far away you would still
9 be, even using the best detectability at your disposal in 2014." And that's
10 not surprising. So, we have Liu-1, their reference, that says five times 10 to
11 the 15 is the detection limit, and we have Dr. Carroll, who is calculating
12 numbers way less than one. In fact, 2.7 times 10 to the -5. So we're talking
13 about 20 orders of magnitude different between Liu-1 and what Dr. Carroll
14 is suggesting is possible. It's not surprising that Petitioner is not able to
15 bridge that gap. So we don't see anything from Dr. Banerjee about what the
16 detection limits were, we don't see much from Petitioner in this regard.
17 There is a suggestion, I do believe they put out the number seven times 10 to
18 the 10. They found a reference, the Ramappa reference, that makes some
19 reference to the technique of surface photovoltage, and suggests that that
20 might get them detections at the level of seven times 10 to the 10. They
21 have no expert testimony in support of what that is and how that could be
22 used here, and whether that would be used to detect iron in Li's material
23 layer. But even crediting a number like seven times 10 to the 10, we are
24 way, way below the levels of detection.

25 And a large reason that we get below that level is because of the
26 impurity sinks that exist between Li's substrate 508 and the material layer

1 506. And those two impurity sinks, where iron will quote/unquote pile up,
2 and this is a term that I believe Ramappa itself uses, is at the interface
3 between 508 and 510, and 510 and 506. Petitioners and Patent Owner both
4 like Figure 5 of Ramappa. Petitioners contend that Ramappa confirmed that
5 iron readily passes through the interface. Here I am on Slide 9. Ramappa
6 confirmed that iron readily passes through the interface between the silicon
7 oxide and silicon substrate, even with undoped surfaces and extremely thick
8 oxides. They cite Ramappa, Exhibit 1025, at Figure 5.

9 We've reproduced, also on this slide, Ramappa Figure 5. We interpret
10 that figure differently. The interface between the silicon, which is on the
11 right-hand side, and the silicon oxide, which is on the left-hand side, is the
12 vertical line down the middle. We don't see iron readily passing through
13 that interface. We see a sharp, what Ramappa calls discontinuity. And that
14 discontinuity is so great that Ramappa had to chop off part of the Y axis, as
15 indicated here with the red circle, just so it could -- this is logarithmic. Even
16 though it's logarithmic, it still had to chop off part of the Y axis in order to
17 get these concentrations onto the same graph. We see, in general, we see
18 concentrations on one side of that interface in the neighborhood of 10 to the
19 12, 10 to the 13, and on the other, way over 10 to the 19.

20 Now, Dr. Carroll used 900 degrees in his calculations. We have no
21 calculations from Dr. Banerjee. Dr. Carroll used 900 degrees, because that's
22 what's provided in Ramappa. That, along with 1,000, and 1,100. Now,
23 returning to what we discussed at the very beginning, we're under an
24 inherency argument. So between the two, you can pick 900 or you could
25 pick 1,000. And we know that generally speaking, higher temperature leads
26 to more diffusion.

1 If one's going to make an inherency argument, they should choose the
2 900. That's why Dr. Carroll chose 900. If one were to choose 1,000, the
3 result's going to be that much different, though. We can look at this graph,
4 and applying the same methodology that Dr. Carroll used, Dr. Carroll didn't
5 use sophisticated math, it was very simple. He just divided whatever the
6 initial concentration was by the discontinuity shown in Ramappa, then you
7 get what the iron could be in the oxide layer. And you do that again,
8 because there's another interface, Dr. Carroll's un rebutted testimony, that
9 second interface is going to have a similar discontinuity as the first. One
10 could take these numbers at 1,000 or even 1,100, and one's going to quickly
11 drop from 10 to the 16, we can give Petitioners the benefit of the doubt, and
12 quickly find themselves way below the detection limit.

13 Another way in which these calculations are very beneficial to
14 Petitioner, Ramappa used a time far greater than what would be expected in
15 Li. So, Ramappa used a 90-minute heat treatment duration. Li doesn't tell
16 us how long its heat treatment is, but it's likely five minutes, is likely what it
17 is. That's what both parties' experts agreed to. I believe Dr. Banerjee may
18 have said five to 15, but here again, we are in an inherency regime, so we
19 should go to the lower end of that. Even 15 minutes is still a fraction of the
20 90 minutes that Ramappa has. So one would expect even a sharper
21 discontinuity than what Ramappa shows in Li, because Li is subjected to that
22 temperature for far less time.

23 While we're talking about detection, we should also talk about trace,
24 because there's this notion that, I believe, Petitioners believe that trace is
25 anything, and that's not our contention at all. We put forward a definition of
26 what we think trace means, and that is something that can be detectable. If

1 something left a trace, you can see it, and you know it was there. If
2 something left without a trace, it left no trace. You can't detect it. So we
3 believe trace and detection are synonymous.

4 They've not liked that definition, but have failed to proffer a
5 definition of their own, and they've also failed to harmonize their
6 understanding of trace with the In re Seaborg case that we discussed. In re
7 Seaborg makes very clear even a billionth of a gram isn't sufficient. And if
8 a billionth of a gram is not sufficient, 2.7 atoms in a 100,000 cubic
9 centimeters of silicon isn't sufficient either. And again, those calculations,
10 just applying Ramappa's discontinuity in a lot of junctures, making
11 assumptions beneficial to Petitioner, ignoring the fact that Ramappa is a
12 much longer duration. Assuming that there is no loss across the oxide layer.
13 Dr. Carroll is only looking at the losses at the interfaces, at the impurity
14 sinks. There was a criticism of Dr. Carroll that he failed to consider the
15 thickness of Li's oxide layer. He's not assuming anything is lost in that
16 layer, he's assuming perfect transmission across that layer.

17 There was a discussion about -- so there's not sufficient iron in any
18 part of material layer 506, which again, according to the Petitioner, has
19 become first emitter region and second emitter region. I believe there was a
20 statement that the one that's doped with phosphorus, there's no dispute
21 about that one. If that meant that we concede there's iron in either emitter
22 region, that's incorrect. We vehemently dispute that there's sufficient iron
23 in any part of 506, Li's 506. And this failure is even more pronounced when
24 one considers that one of those regions is going to be doped with boron.
25 Layer 506 is initially undoped, and Petitioner pointed this out in the
26 presentation today.

1 The Liu-2 reference shows -- this is Figure 3 on the far-left hand side,
2 shows that undoped silicon is not gettering at all. And that's how Li's
3 material layer 506 is initially. And it only becomes doped during the very
4 process that Petitioners contend will getter materials from the substrate in Li
5 through the oxide 510 into the material layer 506. But the parties' experts
6 agree that once doping has occurred into 506, into material layer 506 from
7 above -- this is a different direction than the iron. The iron is coming from
8 below 506, the dopants are coming in from above. Once the dopants come
9 in from above, there's no reason to be prolonging that process. So once that
10 material layer is doped, there's not going to be any more heat treatment with
11 substrate 506 in Li. To the extent that there is any residual heat treatment,
12 the region that is doped with boron is going to have even less iron than the
13 other.

14 I'm going to jump forward to, this is Slide 16. We've reproduced a
15 portion of Liu-1, Exhibit 1028, which says that the B doped, boron doped
16 polysilicon layer on its own exhibits a poor gettering effect. And I want to
17 discuss just for a minute Liu-1 and Liu-2, Exhibit 1028 and 1029. Neither of
18 these are prior art, okay? And that's important, because they are relevant to
19 this proceeding only insofar as they accurately describe some other
20 reference. If one were to have a link between, for example, Li and these Liu
21 references, then these references would be relevant. But these are not
22 themselves prior art, and they would only be relevant, again if they
23 accurately describe some other reference. There are so many variables,
24 though, and Petitioner does nothing to tie these Liu references, Exhibit 1028
25 and 1029, to for example, Li.

1 The Liu-2 figure, Figure 3, it's the bar graph. It's got the different
2 permutations about the different thicknesses and how the oxide layer was
3 grown, et cetera. Petitioner has failed to link any one of those bar graphs to
4 the process of Li. So, the Board should handle Liu-1 and Liu-2 with caution,
5 and understand that they are not prior art and they cannot fill in gaps that's
6 left by the other references.

7 So, there is an issue about which of the two regions, first emitter
8 region, second emitter region, is doped with boron. Again, neither one of
9 them have sufficient levels of iron that can be detectable, or anywhere close
10 to it. We're orders of magnitude away from that, but to the extent that
11 there's a finding that the boron doped region would not have iron and the
12 phosphorus doped region would, we think that's incorrect. Neither would,
13 but to the extent that's a conclusion, one should determine whether the boron
14 doped is the first emitter region or the second. Petitioners don't help us out,
15 because they've not identified in their Petition or any of their other papers
16 which one they believe to be the first emitter region and the second emitter
17 region. They group them both together, in every instance that we've found,
18 at least.

19 But the way they're presented -- here I am on Slide 18, the way that
20 Petitioners present these regions in order, they reference the P-type region
21 310 first, and the N-type region 308 second. P-type is going to be boron, N-
22 type will be phosphorus. And they talk about this aligning with the first and
23 second emitter region. Those correspond to the green and yellow regions.
24 The natural implication is that the boron is the quote/unquote first emitter
25 region and the phosphorus is the second emitter region. This matters only if
26 one were determine that the boron doped region does not have iron and the

1 phosphorus doped region does, but if that is the conclusion, Claim 10 fails,
2 because there is no first emitter region with metal impurities.

3 I want to be sure to touch on the other failure of -- so, this issue, really
4 it dispenses with the entire IPR. Ostensibly, it's only for Grounds 1 and 2,
5 do they rely on inherency, and they purport to have an alternative in
6 Grounds 3 and 4, that's based on obviousness. But I'm going to jump
7 forward to Slide 23. We see in their Petition that they've used obviousness
8 in a somewhat unique way, and they don't seem to mean a traditional 103
9 sense, but rather what is obvious, or what would be readily apparent to a
10 skilled artisan as inherent? So, here we've reproduced a couple of excerpts
11 from their Petition, and they're not suggesting any changes to Li, they're just
12 saying, for example, here on the left-hand side of Figure 23, "it would have
13 been obvious to the skilled artisan that such metal impurities would be
14 present." That sounds a lot like inherency. Same thing on the right-hand
15 side, another excerpt from the Petition. These allegedly 103 references, Hu
16 and Ramappa, confirm that Li's heating would result in metal impurities.
17 That, again, sounds like inherency.

18 And in fact, Dr. Banerjee, Petitioner's expert, confirmed that all of his
19 obviousness opinions are premised on the notion of inherency. We asked
20 him at two different junctures during his deposition, and he confirmed that in
21 fact all of them are. So, in sum, this issue of the failure of Li to inherently
22 disclose metal impurities dispenses with all grounds, because they are all
23 premised on that. This backup argument would fail even if it had made a
24 proper 103 argument. The Hu reference, Exhibit 7, does not show gettering
25 through an oxide layer.

1 In fact, it shows, here on Slide 25, where there is an oxide layer. This
2 is region 2 on the left part of Figure 5 of Hu. The table right below that
3 indicates that region 2 is ungettered. And on the right-hand side we have
4 Ramappa as well, which shows that interfaces act as a sink for impurities.
5 And Figure 5 from Ramappa shows the obstruction that those interfaces
6 serve. There was a comment that Ramappa suggests that there's a
7 temperature at which the oxide layer fails to mask gettering. If that's true,
8 it's not 900 degrees, it's not 1,000, it's not 1,100. We know that from
9 Figure 5 of Ramappa. All of those temperatures are shown to show severe
10 discontinuities.

11 I want to address another issue, the doping concentration on the front
12 side of the solar cell. So we've been talking so far about what's called the
13 back side, this is the side furthest from the sun, and that's where the emitters
14 are, that's where the claims require emitters with metal impurities, and
15 according to Petitioner, iron travels to that back side and into those regions.
16 Now we're going to talk about the front side, and the claims require that
17 there be a doping concentration of approximately less than or equal to two
18 times 10^{18} per cubic centimeter. Two times 10^{18} atoms per
19 cubic centimeter. The Petition proceeded with this argument that there was
20 an optimal level, and it was one times 10^{18} , and they had three
21 references that allegedly disclosed this magic number. And for that reason,
22 it would have been obvious to modify Li, or to implement that concentration
23 in Li.

24 That is not correct. We spent a lot of our Patent Owner Response and
25 Sur-reply defeating that argument. And in fact, it appeared at one juncture
26 that Petitioners had shifted away from that to a different argument that we

1 didn't hear much about today. We'll get to that in a second, about the
2 obvious to try and a finite number. There was, in response to the panel's
3 question today, there was a comment about the King reference, and to the
4 extent the comment meant to suggest that King establishes one times 10 to
5 the 18 as an optimal doping concentration for back contact solar cells, that is
6 incorrect. One need look no further than the Marvin reference, which is a
7 reference that Petitioners rely on. That is Exhibit 1035.

8 I'm going to jump to Slide 31 here. Marvin tells us one times 10 to
9 the 18 is a good doping concentration if you're in space. And it says if
10 you're in a terrestrial environment, if you stay on the ground, you should use
11 five times 10 to the 18. Both of those are in a back contact solar cell
12 application, and Marvin is very good evidence that the proper doping
13 concentration depends on a lot of different factors, and there is no magic
14 number. The three references that we have introduced into this proceeding
15 for the purpose of defeating this optimal doping concentration argument also
16 are in a back contact solar cell environment, and all disclose doping
17 concentrations greater than two times 10 to the 18. Those are Exhibits 2024,
18 2025, and 2026. We talk about those in our papers. They have found in
19 various applications doping concentrations ranging from over three times 10
20 to the 18 to up to one times 10 to the 19. So, this idea that there is an
21 optimal concentration is not correct.

22 And so, it matters. It matters whether you're in space, on the ground,
23 concentrated or not concentrated, other design parameters. One thing that
24 matters a lot is whether that surface, that front surface, is passivated with an
25 oxide layer. I'm going to jump back to Slide 28. King is, Li is not. King,
26 here on Slide 28, has a disclosure about both sides of the oxide being

1 passivated -- excuse me, both sides of the wafer being passivated with a
2 thermal oxide. Dr. Banerjee concedes that Li does not disclose a passivating
3 layer. Same thing with Swanson, it has a passivating layer. Swanson is also
4 a concentrator environment. In fact, it's experiencing concentrations 20,000
5 times the concentration of a one sun environment. It's doing that through a
6 series of, we see here on Slide 29, this curved reflector 14 and also this
7 funnel 22, it is funneling sunlight in so that the temperature inside this
8 chamber where the solar cell is is much elevated. And that demands unique
9 design considerations. Marvin also is passivated as well, and again, Marvin
10 in some ways is a great reference for us. It says five times 10 to the 18 is
11 what should be used in a terrestrial environment.

12 And here on Slide 32, we have Dr. Carroll discussing the exhibits that
13 I just mentioned. These are 2024, 2025, 2026. That's Lamers, Desa, and
14 Procel. There was a discussion about, a recognition that Li does not have an
15 oxide passivating layer, and a discussion about how it would be obvious to
16 implement one. That is a new argument. That is not in the Petition. That is
17 not in the Reply. We would love to have seen a 103 argument with a
18 reference that discloses that, and an argument as to why it would have been
19 obvious to combine those references, and then we can address that. But we
20 have an obviousness argument that we're hearing for the first time today,
21 and we don't even really know what it is.

22 What reference is it that you want to marry with Li? What is its
23 thickness? And then we can address whether it would have been obvious.
24 It's kind of too late to do that now. So, Li has no oxide layer on the front,
25 and they've not made an obviousness argument until today, and so, the
26 question is, would it have been obvious to one of skill in the art to simply

1 pluck one of these concentrations from one of these other references and just
2 plug it into Li? And the answer is no. And I believe there's agreement with
3 the parties that a thinner oxide layer demands a higher doping concentration,
4 a thicker oxide layer demands a lower doping concentration. I'll start over
5 in case I misspoke. A thinner oxide layer demands a higher doping
6 concentration, a thicker oxide layer demands a lower doping concentration.
7 No oxide layer at all would demand a very high doping concentration. Dr.
8 Carroll testifies to this fact, it's undisputed. That's where we are with Li.
9 So no, it would not have been obvious to a person of ordinary skill in the art
10 to pluck something from King or Swanson or Marvin, at least one half of
11 Marvin, the space-based part of Marvin, into Li as it is.

12 I want to discuss the Li-Muller combination. This is Grounds 2 and 4.
13 Again, Grounds 2 and 4 fail because of Li's failure to disclose metal
14 impurities in emitter regions. These also fail because there's been no
15 legitimate motivation to combine these references. We've heard a lot of
16 discussion about how Muller prefers one of its embodiments over another of
17 its embodiments. That's another of Muller's embodiments, not Li. Same
18 thing with the Rhotagi reference that Petitioner cites.

19 This will be in reference to their Slide 49. This is Exhibit 1036.
20 There's a discussion in the abstract about an increase in efficiency. Well,
21 natural question is, increased relative to what? If one looks at Rhotagi, it
22 appears as though they're comparing it to an embodiment of Figure 1, of
23 Rhotagi's Figure 1, in which there is no tunnelling oxide layer in between
24 the substrate and the emitter. And in their solution, in their great step
25 forward that Rhotagi talks about, they do have that tunneling oxide layer.
26 But Li already has that. This is layer 510 in Li. So Rhotagi provides no

1 motivation to modify Li in view of Muller. Muller doesn't provide that
2 motivation either. Muller talks about ion implantation with phosphorus or
3 with boron, and in both circumstances, the solar cell is passivated on that
4 front side. Li is not passivated, Li does not have phosphorus ion
5 implantation. So, Muller is not comparing the embodiment that Petitioners
6 cite for Muller relative to Li. Muller is comparing two different
7 embodiments of its own creation.

8 There was some discussion about Dr. Banerjee's opinions on Muller,
9 and the Board should not give those any weight. Dr. Banerjee said, he
10 hadn't really looked at Muller. Let me make sure I get that right. He said
11 that he, quote, hadn't really looked at Muller. This is Exhibit 2022, at page
12 170, line 8. There was no errata provided in that, there was no subsequent
13 declaration from Dr. Banerjee that he misspoke. We take Dr. Banerjee at his
14 word that he did not in fact review Muller, so none of his opinions regarding
15 Muller should be credited. And that leaves Petitioner with nothing but
16 attorney argument, which obviously is insufficient.

17 I want to, before I rest for the time being, I want to just correct one
18 point, because it affects Dr. Carroll's testimony, and I want to make sure the
19 expert's testimony is not misunderstood in any way. There was, I believe --
20 well, it's in the slide title, actually. This is their Slide 44. They state that,
21 I'm reading, Maxeon's expert agrees that Muller disclosed the claimed front
22 dopant concentration limitation. He did not agree to that. He did not
23 dispute it, he did not agree. He has no opinion on the matter. I do think
24 there is a difference. It may be a subtle difference, but I just want to be sure
25 that his testimony isn't misunderstood. We talk about how Muller, those
26 curves do exceed two times 10^{-18} , they approach three times 10^{-18} to the

1 18. But Dr. Carroll did not opine on that, and I just wanted to kind of defend
2 his testimony. With that, Your Honor, I believe, if my clock is right, I've
3 got maybe 14 minutes left?

4 JUDGE KOKOSKI: Yes, that's where I have you, at 14 minutes.

5 MR. SNODGRASS: Okay, and I'm happy to answer questions now
6 or hand it back over.

7 JUDGE KOKOSKI: I think we're all set. Thank you so much.

8 MR. TIU: May I proceed, Your Honor, on rebuttal?

9 JUDGE KOKOSKI: Just give me one minute, please.

10 MR. TIU: Sure.

11 JUDGE KOKOSKI: Okay, Petitioner, you can start when you're
12 ready.

13 MR. TIU: Okay. Just a few points. First, I want to just quickly touch
14 on, there was a reference to the Seaborg case. I think we are clearly
15 distinguishable from the Seaborg case, and that, I don't believe is the law as
16 well. We've submitted the SmithKline Beecham case, which is, I talked
17 about it in the opening, which says that this is the trace amount where you
18 could not detect it, even at the time of the prior art. So, we submit that as the
19 controlling case.

20 With respect to whether it's detectable or not, there was a discussion
21 about well, you know, paragraph 60, when Dr. Carroll was asked, he was not
22 clear as to whether it was, what concentration it was talking about. Well,
23 you know, we could quickly take a look at paragraph 60, and the question
24 that was asked is, what do you mean by reasonable detection means? And
25 that sentence followed immediately on this number that Patent Owner is
26 pointing to us, this small number with respect to the metal impurities that are

1 admittedly present in the polysilicon by their own expert. So it's not out of
2 context, it's exactly in context, because it's right next to the number that is
3 being asked for and the reasonable detection means. And that in particular
4 was the question on Slide 29, on my demonstrative, Exhibit 1104. When
5 you're referring to reasonable detection means, what do you mean? And
6 then he talks about well, you know, today we are at a point where we would
7 be able to see a level this small. Well, it's right next to the number that he
8 was referring to. How about in 2014? Well, it was not commercially
9 available, but we could do it here at Wake Forest.

10 Now, I wanted to point out one quick thing about the Ramappa Figure
11 5 that they mentioned there was no evidence in the record of how the
12 calculation would occur in the higher temperature, but one thing to point out
13 is that he said it's a logarithmic scale, right? So, that difference in temp is
14 going to jump in the logarithmic fashion. Patent Owner also raised this
15 issue, well, Ramappa's time is like very long, 90 minutes or something like
16 that. But remember, Ramappa's silicon dioxide that they were working with
17 in that experiment was what? 1,200 angstrom, meaning 120 nanometers.
18 So, Li's tunnel oxide, it has to be one to two nanometers. That's like 100-
19 fold difference in terms of the thickness, the difference in thickness. When
20 you have such a high temperature, we saw in Liu, it's just going to go
21 through very, very quickly.

22 Now, there's one point about this, like well, there's differences in
23 terms of the time. Even if it's not inherent, well, the person of ordinary skill
24 in the art knows how to adjust the time, knows how to modify the process.
25 And that's what the obviousness case is. Now, there was also mention that
26 in Liu --

1 JUDGE KOKOSKI: Can I interrupt just a minute?

2 MR. TIU: Sure.

3 JUDGE KOKOSKI: Is that in your pleadings? The alternative
4 obviousness case? And if so, could you point it out to us?

5 MR. TIU: Yes, it's in the Reply, page 21. It's at, this is in response
6 to their argument, right, and it's like well, you did not do all these
7 parameters or stuff like that, but in Reply, page 21, we said the skilled
8 artisan would have made modifications to Li's existing steps. For example,
9 modifying the heating process. Heating process, you have temperature and
10 time to ensure effective gettering of the metal impurities into the doped
11 polysilicon regions.

12 JUDGE KOKOSKI: Okay, is that in your Petition?

13 MR. TIU: I would have to double check. I was just remembering that
14 at this point, but let me double check, get back to you on that one.

15 JUDGE KOKOSKI: Okay.

16 JUDGE ROSS: Counsel, while you're in a transition, on Patent
17 Owner's demonstratives, Slides 23 and 24, they assert that you haven't made
18 out a prima facie case of obviousness, and also that your expert had agreed
19 that those were based on inherency. If you could address that, please?

20 MR. TIU: Yeah. Well, in terms of obviousness, we have made out an
21 obviousness case. Look, Ramappa provides for the conditions. Like as the
22 Board recognized, Ramappa says that if you increase the temperature to a
23 higher, greater than 900 degrees, then you will be able to so quickly getter
24 through the material. And with respect to that, Ramappa was using like, as I
25 mentioned, 120-nanometer thickness. So in terms of Li, they could modify
26 the process real well, such that you could have the thickness but also the

1 temperature at a higher temperature. Li was at 950, you could modify that
2 the temperature go even higher. Or the time, as I mentioned.

3 With respect to the expert, I guess the question is a little bit unfair for
4 the expert, right, in terms of experts are not legal experts, and so to them,
5 you know, is it inherency and stuff, these are legal terms that during
6 deposition, obviously, maybe the expert got tripped up with respect to
7 understanding the difference between inherency or obviousness. But that, I
8 think is the explanation I could give you at this point.

9 JUDGE ROSS: Thank you. So the excerpts on Slide 23, you are
10 saying that there is more in the Petition that supports your assertions of, for
11 example, motivation to combine and reasonable expectation of success of all
12 of those references to them --

13 MR. TIU: Correct, Your Honor.

14 JUDGE ROSS: Okay, thank you.

15 MR. TIU: And now I want to point out something about -- I
16 mentioned that in Li, the polysilicon region was undoped, and this was being
17 done at a time when the diffusion was occurring. Let me find that slide real
18 quick. Yeah, so this is the slide in Li. That gettering effect in Li is going on
19 at the time where the temperature is heated up and the phosphorus and the
20 boron are also diffusing from the source layer into the polysilicon. The
21 simultaneous diffusion, one with the dopant and one with the gettering,
22 that's well known in the art, right?

23 If we look at Liu -- Li, I'm sorry. If we look at Li, and this is Liu-1,
24 Exhibit 1028, that's exactly what they were doing. Initially, and this is on
25 page 2276 of 1028, they were depositing first an intrinsic amorphous silicon.
26 Intrinsic means undoped. And then, you would then do the diffusion after

1 you deposit it. So the diffusion of the phosphorus and the boron. And as we
2 pointed out in the references, the references that we have, the gettering step
3 is not a separate step, you know, those solar cell fabricator, that they have to
4 do. It's part of the diffusion process that they heat this up at the same time
5 that it's coming in, the dopants are coming in, the metal impurities are going
6 out. There's a gradient effect that's happening at that time, you know,
7 because you know, you're sucking each other out in terms of the
8 concentration. And so, that does not negate the fact that Liu initially was
9 undoped, but that you are doing the diffusion at the same time.

10 With respect to the whole issue -- I want to move real quick to the
11 front dopant concentration, there's talk about the well, Swanson was a
12 concentrator cell, Marvin was a space cell. I want to come back to the
13 fundamentals. The claim is not limited to say well, you have to have the
14 solar cell to only be a solar cell on earth or that it's a non-concentrator cell.
15 It doesn't say that. And Li, also the disclosures of Li is pretty broad. Li is
16 just talking about the internal structure of the solar cell. It doesn't care how
17 you apply it. And so that really is a red herring, in our view. And one thing
18 to note is that Marvin was 1989 and King was 1990. So yeah, maybe in
19 1989 there was some understanding based on Marvin, but that quickly
20 changed with King was an influential paper in 1990 that says look, this is the
21 optimal dopant concentration for back contact solar cell.

22 And then I want to quickly just touch on this comment, and I think it's
23 a choice of word that is -- I think it's important, about the thick and thin
24 oxide. It's not that the thin oxide demands a higher concentration or the
25 thick oxide demands a lower concentration. That's not the case. It's
26 actually that it allows for it, right? So, it's not that it's a requirement and

1 stuff. And if you notice that in Swanson, the oxide layer was thick because
2 they were using it for purpose of reflection, anti-reflection. So that was the
3 purpose in Swanson.

4 And finally, I think in terms of Dr. Banerjee's comment about Muller,
5 I just want to comment real quick about it. I think that's a
6 misunderstanding. I think the context was, in terms of the documents that he
7 had reviewed as he prepared for deposition. So clearly it was not something
8 that -- it was taken out of context. So with that, unless Your Honors have
9 additional questions, I think those are some of the rebuttals that I wanted to
10 point out.

11 JUDGE ROSS: I have a question about the low-quality silicon versus
12 the high-quality silicon. Is that going to make a difference to your position
13 on inherency, if those have different properties, but you're relying on an
14 inherency approach to nail down a specific set of required properties?

15 MR. TIU: No, Your Honor. And the reason that they're not going to
16 affect my result is that their expert admitted that even in the assumption that
17 he had made, right, and you've heard the assumption. He said well, in the
18 assumption he was using 10 to the 11 or something like that. He admitted
19 that there's a small amount of metal impurities in the polysilicon, and the
20 claim does not have any requirement as to what level. And he admitted that
21 they're detectable. Even back in 2014, they were detectable. And as I
22 mentioned, I don't want to repeat the faulty assumptions that he made, but
23 there was a false assumption. He admitted that even the good stuff, even the
24 high-quality stuff, the good stuff that he was working with back in 2014 had
25 10 to the 15, over 10 to the 15 metal impurities with a silicon substrate.

26 JUDGE KALAN: I have a follow up question to that.

1 MR. TIU: Sure.

2 JUDGE KALAN: Because I'm pretty sure I heard your colleague for
3 the Patent Owner argue that it's difficult to tell really if iron is present.
4 There's a possibility that iron is present, but you can't really determine that
5 iron is present with any certain level of confidence. Can you speak to that for
6 me please?

7 MR. TIU: Yeah. So, I think that, you know, all the circumstantial
8 evidence point to the fact that we can be confident that iron is present, and
9 the metal impurities, right? Because, look, we have the right temperature,
10 and that's all that the Patent Owner in his application had pointed to, which
11 is you go above 900, then you get this gettering effect from the tunnel oxide
12 layer. And Li is clearly above that. The expert admitted that yeah, you
13 know, maybe it's small, but we could detect it, right? We could detect it.
14 He calculated, as I showed you the record. It was not something that we
15 took out of context, we were asking him specifically, right next to the
16 number that he pointed to, what the reasonable detection means was that he
17 meant. And he said well yeah, there's these techniques and that technique,
18 but we could detect it. So, it's not an issue of it might, it actually will be,
19 and we presented evidence that because of the fact that Li's tunnel oxide is
20 very thin, one to two nanometers, that that's just going to go through. You
21 know, you've heard about -- and all that kind, but that didn't stop the Liu
22 reference or the '315, right? It's just, if you have the temperature above the
23 900 degrees, at that higher temperature, you're going to go through that.
24 That's also supported by the Ramappa reference, which says that at a higher
25 temperature, you would get that increased temperature, and that 900 degrees
26 was a key temperature as well, as cited by the Board.

1 JUDGE KALAN: Thank you.

2 JUDGE KOKOSKI: Okay, I think that's all that we have, so thank
3 you very much.

4 MR. SNODGRASS: Your Honor, I'd like to respond.

5 JUDGE KOKOSKI: Oh yes. Getting to you next, it's okay.

6 MR. SNODGRASS: All right, thank you. I'm going to go ahead and
7 bring up my demonstratives. Give me just a second, please. I believe Your
8 Honors can see them now, is that correct?

9 JUDGE KOKOSKI: Yes, we can.

10 MR. SNODGRASS: Okay, thank you. So, we touched on a wide
11 range of issues, so I'll just try to address them point by point. There was an
12 argument, I believe, that Seaborg is no longer good law. I'm not sure what
13 the basis for that is. We've not seen any subsequent decisions from the
14 Federal Circuit reversing that, and Petitioners have not explained why it
15 would no longer be good law in any of their papers. So, I believe this Board
16 is bound by that, and it remains good law.

17 There was a discussion about this inherency argument. It enjoys no
18 expert witness support. Dr. Banerjee was very clear that he believed that
19 inherency undergirded all of his obviousness opinions. When asked about
20 inherency and obviousness, he did not express any confusion as to what
21 those legal concepts were, and in fact he discusses those legal concepts at
22 the beginning of his declaration. This is Exhibit 1003, I'm looking at
23 paragraph 26. He expresses his understanding that anticipation can be
24 express or inherent, and then he has a separate section beginning on page 8
25 of 1003 discussing obviousness. So this contention that he perhaps was
26 confused does not seem to be the case. I guess I should note that was

1 referring to quotes on page 24 of our demonstratives in regard to Dr.
2 Banerjee's testimony regarding inherency.

3 I want to go back to Ramappa as well. There's a further criticism that
4 this 900 degrees is not the proper temperature. Right now, it will not take
5 long, look at 1,000 degrees. We see concentrations on one side well above
6 10 to the 19th at 1,000 degrees. Those are the ones indicated with a circle.
7 On the other side of that interface, we see concentrations below 10 to the 13.
8 No higher than 10 to the 13. So we have a difference of one in a million.
9 Six orders of magnitude across that one interface. And Dr. Carroll's
10 un rebutted testimony is that we get a similar decrease across the second
11 interface. So we have lost 12 orders of magnitude just across the interfaces
12 alone, even if we were at 90 minutes. There's some discussion about
13 Ramappa has a thicker oxide layer than Li. Again, Dr. Carroll gave
14 Petitioners the benefit of the doubt on that. Dr. Carroll is not subtracting any
15 metal impurities across the thickness of the oxide layer. He's only looking
16 at the two interfaces. So, only looking at those interfaces, you can start with
17 the number 10 to the 16, and we're now down to 10 to the 4. 10,000 atoms
18 in a cubic centimeter. There's no evidence in the record that any detection
19 means comes anywhere near that level. We have references from them that
20 say maybe seven times 10 to the 10, and we have one that says five times 10
21 to the 15. And it's important. That Liu reference, five times 10 to the 15, is
22 far later in time than the Ramappa reference. So it's curious indeed that that
23 Liu-1 can be so wrong. It says the detection limit is five times 10 to the 15.
24 It says that, I may get the year wrong, I believe it's a 2018 publication, and
25 the contention is years before, when you could actually get down less than
26 one. Not 10 to the 15, but less than one. That Liu-1 was wrong by like 15,

1 16 orders of magnitude. That's too large of a leap. If Liu-1 is that wrong,
2 there should be documentation supporting that.

3 I do want to address, we heard again Dr. Carroll's testimony, and I
4 just want to reiterate, page 87, this comes immediately after this discussion
5 that they cite. Page 87 of Exhibit 1087. This is Dr. Carroll, you have to
6 understand, when we talk about something that is difficult to detect, we give
7 you a sigma number so that we can tell you the confidence of detectability.
8 In these cases, you would be within one or two sigma of a certainty that you
9 had detected it. The standard for the field is six sigma. So that's how far
10 away you would be, even using the best detectability at your disposal in
11 2014. That best detectability is melting the silicon cell itself and looking at
12 the gases. And even then, you don't have confidence standard in the field to
13 determine that there is indeed iron in those layers.

14 There was a discussion about Marvin having a preferred concentration
15 in a terrestrial environment, and a preferred concentration in the space
16 environment, and how Li is not that restrictive. Well, the obviousness
17 theory should be restricted. And this is how it matters. Early on in our
18 papers, we talked about the doping concentration of Li's silicon substrate,
19 and they cite testimony regarding what that might be in a terrestrial
20 environment. What's the cheapest silicon you can find and how much iron
21 would be in it? Now, when it comes to the other doping concentration on
22 the front side, they all of a sudden want to take that terrestrial solar cell and
23 put it up into space and say okay, now we're in space, so we get to look at
24 references that talk about preferred parameters in a space environment. They
25 can't have it both ways. They need to construct one obviousness theory, and
26 that needs to satisfy all the claim limitations. They want to live with

1 Marvin's space applications, so be it, but they have to live with that for the
2 starting concentration in Li's substrate as well. You want to put that
3 substrate up in space, then you're going to make sure that's got space-quality
4 silicon. And that's going to have very low levels of impurities.

5 I believe there was a contention that King came after Marvin, and thus
6 Marvin's five times 10 to the 15 is no longer valid. Well, Desa, Lamers, the
7 other references that we cite, those came after King. And those are above
8 two times 10 to the 18. So, if Petitioner is correct, that the more we've
9 proceeded in time the more accurate the industry has gotten, then that's
10 reason enough to dispense with King. And if anything, it would be quite
11 odd that Lamers, Desa, all these other authors would not appreciate that
12 King had established this gold standard of one times 10 to the 18, this
13 universally applicable ideal dopant concentration in all circumstances. The
14 evidence just does not support that.

15 There was an argument that, and it was just argument, it was not
16 evidence, that Dr. Banerjee, when he said that he hadn't reviewed the Muller
17 reference, he perhaps was referring to what he had reviewed in preparation.
18 There is no evidence to that effect. There's no declaration from him after
19 the fact saying that's what I was referring to, there's no surrounding context
20 that suggests that that would be the case. That is pure attorney speculation.
21 That is not evidence. Dr. Banerjee did not review the Muller publication, we
22 know that because he testified to it, and he did not suggest that it was
23 erroneous when he gave it. With that, Your Honors, I'm happy to rest or
24 field any questions.

25 JUDGE KOKOSKI: I don't think we have any further questions.
26 Thank you very much.

1 MR. SNODGRASS: Thank you.

2 JUDGE KOKOSKI: The case is now submitted to the panel for
3 determination in preparation of the final written decision. We want to thank
4 both parties for their arguments here today and they've been very helpful as
5 we go forward to determine the final decision in this case. With that, we are
6 adjourned.

7 (Whereupon, the above-entitled matter went off the record at
8 11:58 a.m.)

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