UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,
v.
ACORN SEMI, LLC,
Patent Owner.

Case Nos. IPR 2020-01183
IPR 2020-1204
IPR 2020-1205
IPR 2020-1206
IPR 2020-1207
IPR 2020-1279
IPR 2020-1282

VIDEO-RECORDED ZOOM DEPOSITION
UPON ORAL EXAMINATION OF
KELIN J. KUHN, Ph.D.
VOLUME II

9:04 A.M. PDT

WEDNESDAY; JULY 7, 2021

THIS DEPOSITION IS BEING TAKEN VIA VERITEXT VIRTUAL/TELEPHONICALLY, AND ALL PARTIES, THE WITNESS, AND COURT REPORTER ARE APPEARING REMOTELY

REPORTED BY: JUDY BONICELLI, RPR, CCR 2322, CSR 9091

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I N D E X

WITNESS: KELIN J. KUHN, Ph.D.

WEDNESDAY; JULY 7, 2021

9:04 A.M.

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THE VIDEOGRAPHER: We are on the record. The time is 9:04 a.m. on July 7th, 2021. This deposition is being conducted using virtual technology, and all participants are attending remotely. Audio and video recording will continue to take place unless all parties agree to go off the record.

This is Media Unit 1 in the video-recorded deposition of Dr. Kelin Kuhn taken by counsel for petitioner in the matter of Samsung Electronics Company Limited versus Acorn Semi LLC, filed before The Patent Trial and Appeal Board, Case No. IPR 20200-1183.

My name is Lori Talbott with the firm Veritext. I'm the videographer. The court reporter is Judy Bonicelli from the firm Veritext. I am not related to any party in this action, nor am I financially interested in this outcome.

If there are any objections to proceeding, please state them at the time of your appearance, and we'll begin with the noticing attorney, please.

MR. MAIER: Cosmin Maier of Desmarais LLP on behalf of petitioner.

MR. PHILLIPS: Matthew Phillips from Laurence & Phillips IP Law on behalf of the patent owner Acorn.

THE VIDEOGRAPHER: Thank you. Would the court reporter please swear in the witness?

KELIN J. KUHN, Ph.D.,

sworn as a witness by the Certified Court Reporter, testified as follows:

DIRECT EXAMINATION

BY MR. MAIER:

Q. Good morning, Dr. Kuhn.

A. Good morning.

Q. Just a couple preliminary things first. Am I correct that you did not discuss the substance of your testimony between the end of last night's -- yesterday's deposition and today?

A. I've had no discussion with Matt Phillips on any topic between yesterday and today.

Q. And have you discussed the substance of your testimony with anyone in between the end of yesterday's deposition and today's?

A. No.

Q. And have you performed any additional research to help with your testimony in these depositions since the deposition yesterday ended?

A. I reread my declaration.
Q. Anything else?
A. No. I just reread my declaration.
Q. Now, I want to pick up on something you said yesterday. Yesterday you described the alleged invention of the challenged patents using an analogy to Lego blocks. Do you recall that?
A. Yes.
Q. Can you explain what you meant by that analogy?
A. Yes, I can. I'm viewing this patent as a patent that introduced an idea which is the idea of putting this passivating and mid-separation layer between a metal and a semiconductor for the purpose of reducing contact resistance. And that idea used things already in the industry.
As we've had some discussions, the idea of the metal-semiconductor junction is certainly not new, people had built metal insulator semiconductor structures and semiconductor junction in the source-drain region is well discussed in research at the time of the patent. And the way I have always perceived this patent, and it's almost in context with Figure 8, is the inventors put the idea described by Figure 8 on the table with all of the building blocks

to make Figure 8 existent in the industry already.
Q. And you used the term "patent" in the singular, but were you referring to all of the challenge patents that are at issue here?
A. Yes, that's correct. On the Acorn patents, I often say patent singular because I tend to gloss over the fact that there is a multiplicity of these patents. So when I say Acorn patent, I do mean the set of Acorn patents.
Q. So I want to break down a little bit about which Lego blocks were known and what was actually novel.
Metal interface layer semiconductor structures were known before the alleged invention of the challenge patents, correct?
A. Let me pause for a moment and ask a procedural question. As with yesterday, I would like to take short notes, and you can certainly have copies of them whenever you want, to make sure that when I answer these questions I'm answering the stack that you asked. Are you okay with that?
Q. Yeah, that's fine. And we can mark them all at the end.
A. Okay. So could you please reask the question?
Q. Yes, so metal interface layer semiconductor

structures were known before the alleged invention of the challenge patents, correct?

A. Yes, metal interface layer semiconductor structures were known before the invention of the challenge patents.

Q. Metal insulating layer semiconductor structures were known before the alleged invention of the challenge patents, correct?

A. Metal insulating layer semiconductor structures were known before the invention of the challenge patents; that's correct.

Q. Structures comprising a metal layer, metal oxide layer, semiconductor oxide layer, and semiconductor substrate were known before the alleged invention of the challenge patents, correct?

MR. PHILLIPS: Objection to scope.

THE WITNESS: Yes. Structures formed of metal, metal oxide, semiconductor oxide, and semiconductor were known. An example of this is a HiK, gate dielectric.

(Reporter clarification.)

THE WITNESS: H-i-K, often with the K capitalized.

BY MR. MAIER:

Q. It was known before the alleged invention of the challenge patents that an interface layer between a metal layer and a semiconductor could passivate the semiconductor by satisfying dangling bonds, correct?

A. It was known prior to the patents that an interface layer between a metal and semiconductor could passivate dangling bonds on the semiconductor; that's correct.

Q. It was known before the alleged invention of the challenge patents that moving a metal layer farther from a semiconductor would reduce the effects of MIGS or metal-induced gap states, correct?

A. So the work of Tersoff showed that moving a metal layer away from a semiconductor could reduce the metal-induced gap states; that's correct.

Q. The novel aspect of the challenged patents was to provide an interface layer between a metal and a semiconductor that resulted in a reduction of specific contact resistivity, correct?

MR. PHILLIPS: Objection. Form. Objection. Scope.

THE WITNESS: One of the novel aspects of the patent was to introduce an interface layer or a combination of an interface layer and a separation layer between the metal and the semiconductor to reduce the contact resistance of a metal-semiconductor junction.

BY MR. MAIER:

Q. So I think we've got our terminology a little bit mixed up because you mentioned combination of interface layer and separation layer. I believe that the interface layer includes a separation layer and a passivation layer. Is that your understanding?

A. Yeah, I accept that correction. To be clear, there is a passivation layer and a separation layer, and I believe the patent does call those two together, an interface layer. In the literature, it is not uncommon for the passivation layer alone to be called the interface layer. So I will try to use the terminology of the patent in a clear way and say passivation layer and separation layer to keep that clear.

Q. Okay, thank you. I appreciate that.

You mentioned that one of the novel aspects of the patent was to provide an interface layer between a metal and semiconductor that results in a reduction of specific contact resistivity, correct?

A. Yes, I used the words "one of," that's correct.

Q. What are the other novel aspects of the challenge patents?

MR. PHILLIPS: Objection. Form. Scope.
THE WITNESS: I'd like to turn -- okay.
In addition to the Figure 8 discussion we've had, the patent also discussed other applications of the structure, and I point out, in particular, the patent has a section -- and let me find this. Okay, so I'm in the '423 patent, and I'm at the bottom of 15, and I'm going through one of several embodiments.

And the first embodiment is the interface layer incorporated into a device operable to pass current through the semiconductor surface and the interface layer during operation, and what I'm looking for -- ah, is in paragraph -- column 16 where the patent emphasizes barrier height can be adjusted. And then later on, the patent describes making the barrier height larger in order to create a Schottky barrier as opposed to an Ohmic barrier.

And so my point here is, and I'm not trying to limit this, but the patent describes more embodiments than just the one that we've been talking about to a large extent in this deposition.

BY MR. MAIER:
Q. But all of those embodiments that the patent describes rely on the concept of using an interface layer between a metal and semiconductor to reduce the

specific contact resistivity, correct?

MR. PHILLIPS: Objection. Form. Scope.

THE WITNESS: And I disagree with that, because of the discussion of making this do a Schottky diode, a diode that is conducting in one direction and not conducting in another direction. So I believe the core of the patent is the passivation and the use of the MIGS separation layer, the passivation, and the MIGS separation layer. The piece of the invention that I consider the most novel is the piece reflected by Figure 8 for a minimum in the curve of the specific contact resistivity.

But the patent discusses other embodiments, and I've not spent a lot of time studying those other embodiments, so I'm reluctant to limit the patent to embodiments I've not studied in any great length.

(Exhibit 2070 marked for identification.)

BY MR. MAIER:

Q. So let's try to limit this to what you've actually testified about via your declaration. Okay. Turn to paragraph 52 of your declaration, and the one I'm referencing is Exhibit 2070 in the 1204 proceeding.

A. I'm at paragraph 52.

Q. In paragraph 52, you say, "The core concept underlying the Acorn patents is deeply counterintuitive. The idea that one would place an insulator which has higher resistivity than either a metal or a semiconductor at the metal-semiconductor interface to improve the contact resistance of the junction is not something that would occur to even very skilled practitioners," and so forth.

Do you see that?

A. Yes.

Q. So in your declaration, the novel aspect of the Acorn patents that you identified was the idea of placing an insulator at the interface between a metal-semiconductor structure to improve the contact resistivity of the structure, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: So as I stated in this paragraph, I consider the core concept to be the idea of the insulator which has the high resistivity to be placed at the metal-semiconductor interface to improve the resistance. That, in my mind, is a counterintuitive concept and it's core to the patent. It's not the only concept in the patent and it's not, you know, the only embodiment in the patent, but it's the one that struck me as being central and counterintuitive at the same time.

BY MR. MAIER:
Q. And is that core concept a novel concept attributable to the Acorn patents?
MR. PHILLIPS: Objection. Form. Objection. Scope.
THE WITNESS: So I've not studied at any length the novelty of this concept. I've not gone back and done a significant review of the literature. When we've had questions of this type before, I've been relying either on the patent or on my own memory, but if I would be asked, I would not be able to answer that question effectively without having done a detailed study of the past literature. In my belief, this is novel to this patent, but I've not done the extensive background study to justify that comment other than my own personal belief.
BY MR. MAIER:
Q. So let me try to get this right, then. You cannot say one way or another, sitting here today at your deposition, that the core concept of the Acorn patents which involves placing an insulating interface layer at the metal-semiconductor junction -- strike that. Let me try to say this a different way. I'll start over.
You cannot say one way or another in this

deposition that the core concept of the Acorn patents which involves placing an interface layer between a metal and semiconductor to reduce the specific contact resistivity of the structure was novel to Acorn, correct?

MR. PHILLIPS: Objection. Scope.

THE WITNESS: I have not studied the question of novelty of the metal-insulator-semiconductor structure as described in the Acorn patents. So any information I give today in response to questions is not the result of an extensive study. I cannot say one way or the other, because I've not studied that in-depth.

BY MR. MAIER:

Q. So when you say the core concept of the Acorn patents is deeply counterintuitive, you're not certain whether someone else had come up with that counterintuitive concept before Acorn, correct?

A. When I say the core concept underlying the Acorn patents is deeply counterintuitive, I'm describing my response to seeing the concept for the first time, which was in roughly 2009, and I have not done a study of whether the concept is unique or novel to the Acorn patents. I've not done that study. I've not, you know, made any opining on that study in this declaration, and I do not recall opining on that in any other material for this case.

If I have, it would be great for you to point it out and we can talk about it and I can refresh my memory, but I do not believe I have opined on that question.

Q. Specific contact resistivity is a quantity expressed in ohms micron squared, correct?

A. Specific contact resistivity is a quantity expressed in ohm per unit squared. It could be ohm per micron squared, ohm per centimeter squared, ohm per meter squared. Different references use different numbers.

Q. The interface layer the challenge claims must be a thin film that permits tunneling, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: Can we go through the claims? This is one of these questions is a particular claim may not say that, and so it would be helpful to review the claims.

BY MR. MAIER:

Q. Yeah, I mean you have all of the patents. I'm happy for you to look at every single claim in the patents if you want, but my understanding was for this structure to work, you have to tunnel through the

interface layer; is that right?
A. That version of the question I like better. This structure requires tunneling through the interface layer; that's correct.
Q. I believe it's also your opinion that the interface layer of the challenge patents would be considered a dielectric or electrical insulator, correct?
A. Here, I need to refine that statement because of the comment you made earlier about the interface layer. The passivation layer is more broad than that. The patent itself describes arsenic as a possible passivation material. My comment was with regards to the separation layer, and my statement was the patent is clear, and we can reference the points in my declaration, that the separation layer needs to be a dielectric or insulator.
BY MR. MAIER:
Q. The interface layer can include an oxide, correct?
A. I'm going to answer that again breaking it up. I'm worried about the interface layer terminology now, simply because of the patents' use of it is -- or perhaps more specific than the broader culture. The passivation layer may be an oxide, does not have to be

an oxide. The separation layer is expressly described as an oxide.

Q. And I was actually quoting from a patent so let me just give you the patent.

A. Okay. And also I want to check my notes because I want to make sure I have the citation for that. Yes, okay.

(Exhibit 1001 marked for identification.)

BY MR. MAIER:

Q. So what I've uploaded is Exhibit 1001 from the 1183 proceeding which is U.S. patent 9,209,261. Let me know when you have it.

A. I'm opening '261 from a local copy. Where would you like me to go?

Q. Column 9, line 48.

A. Okay. I'm here.

Q. So let me just ask you a couple questions.

MR. PHILLIPS: Can you give me a second to catch up? Sorry.

MR. MAIER: Yes, no problem.

MR. PHILLIPS: Okay, '261 patent.

MR. MAIER: In column 9, line 48 for that whole paragraph.

MR. PHILLIPS: Okay. I'm there, thank you.

BY MR. MAIER:

Q. So the reason I was using the word interface layer, Dr. Kuhn, was because the patent here is talking about an interface layer. So let me ask the questions again.

The interface layer of the Acorn patents may be an oxide, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: The interface layer -- okay, so the interface layer, and we're talking here about the interface layer 520, may be an oxide. That's correct.

BY MR. MAIER:

Q. The interface layer of the Acorn patents may be an inorganic oxide, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: The patent does not restrict the oxide to any particular oxide. It simply says an oxide. So I would consider an inorganic oxide to be a subset of oxide and does include it.

BY MR. MAIER:

Q. The interface layer may be a nitride, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: The interface layer expressly is described -- sorry, the exact words are the interface layer 520 may include a nitride; that's correct.

BY MR. MAIER:

Q. For the next questions, you may want to look at the paragraph beginning at line 60 of column 9.

A. Okay.

Q. The typical thickness of the claimed interface layers is less than about 50 angstroms, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: Well, the patent reads, "For example, depending on the particular implementation, the thickness may be less than about 1 nanometer," which would be 10 angstroms, "less than about 0.5 nanometers," which would be 5 angstroms, and "less than about 0.2 nanometers," which would be 2 angstroms.

Am I missing the place that you wish to discuss?

BY MR. MAIER:

Q. The very previous sentence. "Often, the 520-interface layer includes or is made up of a passivation layer with a thickness of between approximately .1 nanometers and about 5 nanometers."

Do you see that?

A. Yes.

Q. So that the claimed interface layers can be less than 50 angstroms, for example, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: Yes, the patent says with a thickness between approximately 0.1 nanometer, which would be 1 angstrom, and about 5 nanometers, which would be 50 angstroms.

BY MR. MAIER:

Q. The claimed interface layers can passivate the semiconductor by satisfying dangling bonds, correct?

A. Passivation is the process of satisfying dangling bonds of reducing surface states by completing dangling bonds; that is correct.

Q. And that is one of the functions provided by the claimed interface layers, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: That's actually the function of the passivation part of the interface layer if it's a bilayer, and it's a function of the entire layer if it's a single layer.

BY MR. MAIER:

Q. And the challenge patents explain that the interface layer can be a single layer, or they can be two layers, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: Yes, the patent describes the possibility of a bilayer where the first layer is a passivation layer, and the second layer is a separation layer; that's correct.

BY MR. MAIER:

Q. And the patent also describes the interface layer as a single layer, correct?

A. Yes, the patent, in places, describes the interface layer as a single layer that has all the functions in one layer; that's correct.

Q. And the claimed interface layers can reduce the effects of MIGS, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: If the interface layer is in the form of a single layer, then it has the two functions, the passivation function, and the MIGS separation function. If the interface layer is in the form of the two-layer version, the separation layer does the MIGS separation function.

BY MR. MAIER:

Q. Well, the passivation layer would actually perform some reduction in MIGS as well by virtue of it separating the metal from the semiconductor, right?

A. The patent allows the possibility of a monolayer passivation layer. And I would need to locate that -- ah, it's at the bottom of the page in column 9, and it does say, "may be the thickness corresponding to a single layer or monolayer of passivation material that is bonded to the semiconductor surface."

So while I agree the passivation layer could serve a MIGS separation function, the fact the patent expressly describes a monolayer says it does not have to serve that function.

Q. So let me make sure I understand this. The passivation layer of the challenge patents -- and I'm going to try to use challenge patents because we keep saying "patent" in the singular.

A. Uh-huh.

Q. I'll try to refer to the plural, the challenge patents allow for the passivation layer to reduce the effects of MIGS, correct?

A. I don't believe the challenge patents either limit -- let me say this another way. I don't believe the challenge patents discuss the MIGS separation function of the passivation material. The fact the passivation material can be a monolayer and the separation material is expressly described as performing the MIGS function, would suggest to me that while the passivation material may have a MIGS separation function, it is not required to have a MIGS separation function, nor is it prohibited from having a MIGS separation function.

Q. And you also said that the challenge patents allow for the passivation layer to be a monolayer. Do you recall that?

A. Yes. A few minutes ago I cited the bottom of column 9, line 67 and the top of column 10 where it says, "may be the thickness corresponding to a single layer or monolayer of passivation material that is bonded to the semiconductor surface or may even be the number of atoms of passivation material required to passivate substantially all the dangling bonds associated with the semiconductor surface."

So the patent describes a situation of even perhaps a partial monolayer of passivation material. It simply tagging all the bonds and it's done.

Q. Wait. So now you introduced another term there. I want to understand what you mean there. What do you mean that the challenge patents describe the passivation layer as perhaps even a partial monolayer?

A. So in column 10, line 3 -- column 10, lines 2 through 5, "or may even be the number of atoms of passivation material required to passivate substantially all the dangling bonds associated with the semiconductor surface." That phrase follows a stack of thickness phrases. From the previous column, "the thickness may be less than about 1 nanometer, less than about .5 nanometers, less than about .2 nanometers." Then it goes into, "may be the thickness corresponding to a single layer or monolayer of passivation material that is bonded with semiconductor surface or may even be the number of atoms of passivation material required to passivate substantially all the dangling bonds associated with the semiconductor surface."

The structure of that paragraph appears to be just walking down a layer of thickness options. It can be less than 1, less than .5, less than .2, a layer, a monolayer, or even the number of atoms of passivation material required to passivate substantially all the dangling bonds associated with the semiconductor surface.

A POSITA would read that last phrase as being "a layer of atoms that may not be complete, but that is passivating all the dangling bonds."

Q. Okay, so maybe I need just a little bit of technical definition here. What is a monolayer?

A. In the context that I've run into the term, a monolayer is a single, complete layer of a material that covers whatever your substrate is. If you're doing epitaxy-like MBE growth, it is extremely well-defined. Because a monolayer means you've bonded at least one atom to every location on the surface.

If you're doing an amorphous deposition, it's a little fuzzier, but the idea is that the surface is covered to the extent of one atom or one cluster everywhere that is appropriate for coverage.

Q. And when you say "cluster," are you talk about how, you know, like, Si02 isn't one atom, it's three atoms? So is that what you're talking about as a cluster?

A. Yes, and Si02 is even messier than that because it forms little tetrahedrons, so it has kind of a quasi-crystal structure. So the definition of a monolayer when you are talking about Si02 is intrinsically a little fuzzier. If I have a crystal and I grow -- and let's say I have a silicon crystal and I'm growing layers of silicon on it very slowly, well, a monolayer is very well defined. I have added one atom everywhere that the crystal permits an atom, and that's a monolayer.

If I'm putting Si02 down and I'm depositing it, for the other extreme, it's a little harder to describe exactly what a monolayer is because they'll tend to come down and bind tetrahedrally and may or may not give as complete and smooth a layer as a monolayer --

(Reporter clarification.)

-- as complete a surface coverage.

Q. So let me try to break that down since we had kind of a mix-up in the transcript. So let me ask just more definitional terms.

What is a partial monolayer?

A. Again, I'm going to jump back to the simplest definition which is when you're putting a crystal on top of a crystal, a partial monolayer is when all of the available atomic sites, one layer up are not filled. So if I have a perfectly flat semiconductor surface with all the bonds sticking up and I'm growing a new semiconductor layer on that perfectly flat surface, and I don't have the semiconductor on all the possible locations, I have islands that are 1 atom thick. People usually call that a partial monolayer. They sometimes call it island growth.

Q. Thank you. I think I'm visualizing what you're talking about now. The challenge claims allow for the passivation layer to be a monolayer thickness, correct?

MR. PHILLIPS: Objection. Form.

THE WITNESS: The patent certainly describes the possibility of the thickness being of the passivation layer corresponding to a single layer or monolayer of passivation material. That's what the specification says. And if the claim is referring to a passivation layer, I would assume that that monolayer would apply as well.

BY MR. MAIER:

Q. And similarly, the challenge patents allow for the passivation layer to be a partial monolayer, correct?

A. I don't want to use "that" words because I use those somewhat casually and I would prefer to use the words that the patent itself says because the patent was much more precise about saying it than I was, and I think the correct words are "may even be the number of atoms of passivation material required to passivate substantially all the dangling bonds associated with the semiconductor surface."

Q. So do you interpret that phrase to refer to a partial monolayer?

A. That would depend on the semiconductor.

Q. The semiconductor --

A. Would also did not on the surface reconstruction and some other things that are going on.

Keep in mind that the surface of the semiconductor does some oddball things that the bulk does not do, and so the number of atoms required to passivate all the dangling bonds on the surface may or may not be equal to the number of atoms required to make a monolayer, which is undoubtedly why the patent is written this way is they describe first a monolayer, then they describe the circumstance where the number of dangling bonds is less than the number of atoms required to make a monolayer, and then they basically say, "or even the number of atoms of passivation material required to passivate substantially all the dangling bonds."

Q. So I guess another way of asking it is do the challenge patents exclude a passivation -- let me ask it the other way. Strike that.

Do the challenge patents permit the passivation layer to be a partial monolayer?

MR. PHILLIPS: Objection. Form. Objection. Scope.

THE WITNESS: Following my definition of a monolayer and allowing that we do need to passivate substantially all the dangling bonds as discussed in column 10, yes, the patent specifications -- the patents specifications, in the plural, permit that configuration.

BY MR. MAIER:

Q. I'm going to add another exhibit here and this may actually go pretty quick because I think you said that you haven't reviewed certain materials, but I just want to be sure. So give me one minute and I'll upload another document.

(Exhibit 1016 marked for identification.)

BY MR. MAIER:

Q. So I've uploaded 1016 from IPR 2020-1183 which is U.S. patent No. 6,724,088 to Jammy et al. Let me know when you have that.

A. Okay. Okay. I have this patent open, U.S. Patent 6,724,088.

Q. Will you understand if I refer to this exhibit as Jammy, the name of the first-named inventor?

A. That's fine.

Q. You did not consider Jammy in forming your opinions stated in your declaration, correct?

A. I did not consider Jammy, and as a more global comment, I don't recognize this patent. I've not reviewed it or studied it.

Q. Okay, all right. Well, I think we can take a quick break because you haven't looked at this, so I think we can move onto the next section. So why don't we take ten minutes and then I'll move onto the next section and then I think I only have about another two sessions left for this morning.

THE WITNESS: Okay. So let's take a ten-minute break. We'll be back at 10 o'clock.

THE VIDEOGRAPHER: We are going off the record at 9:48.

(Recess taken 9:48 a.m. to 10:05 a.m.)

THE VIDEOGRAPHER: We are back on the record the time is 10:05. Please proceed.

(Exhibit 1132 marked for identification.)

(Exhibit 1133 marked for identification.)

BY MR. MAIER:

Q. Dr. Kuhn, very brief questions on two other exhibits that I've uploaded to the Exhibit Share. They are both from IPR 2020-1282. They are Exhibit 1132, which is a Japanese patent, and Exhibit 1133, which is a translation of that patent. Can you just take a glance at those and let me know when you're ready?

A. Okay, working on it. Okay. I have Exhibit 1133, which is the translated version, open.

Q. And do you see that the inventor's last name is Iwaguro?

A. Curiously, no. Where should I look?

Q. First page --

A. Oh, there I see, Iwaguro, yes, I see that.

Q. I'm going to refer to this Japanese patent and the translation as Iwaguro; is that okay?
A. Yes.
Q. You did not consider the Iwaguro reference in forming your opinions stated in your declaration, correct?
A. I have not seen this patent or studied this patent, and I have not discussed it in my declaration, that's correct.
Q. So we can put those away, then.
A. Okay.
Q. All right. A couple more questions on the interface layer. I believe you agree that the claimed interface layers can passivate the semiconductor by satisfying dangling bonds, correct?
A. Yes. Passivation by satisfying dangling bonds -- sorry, satisfying dangling bonds is the definition of passivation; that's correct.
Q. And I believe you also agree that the claimed interface layers can reduce the effects of MIGS, correct?
MR. PHILLIPS: Objection. Form.
THE WITNESS: So again, keeping in mind that the interface layer may consist of a passivation layer and a separation layer, the purpose of the

combined structure is to both passivate and reduce the impact of MIGS; that's right.

BY MR. MAIER:

Q. Can the claimed interface layers have any additional beneficial properties?

MR. PHILLIPS: Objection. Form.

THE WITNESS: I'm unaware of the patent either excluding or pointing out additional beneficial properties. If you have a place I should look at, we can talk about it.

BY MR. MAIER:

Q. I think we're on the same page, so let me just confirm. Can the claimed interface layer serve as a diffusion barrier so that dopant atoms in the semiconductor substrate do not diffuse into the metal contact?

MR. PHILLIPS: Objection. Scope.

THE WITNESS: I've not reviewed diffusion barriers in my declaration, and I'm unaware of the patent either discussing or -- what's the right word? Refuting, discussing, or not permitting diffusion barriers. So we've got a couple of layers "I've not thought about it, I've not talked about it," and I'm unaware of the patent either require or not requiring such layers. And again, if there is a place in the patent you can show me that we can talk about, we can continue the discussion.

BY MR. MAIER:

Q. So to me, I think it's silent on those. I just want to be sure you're not taking a position that the interface layer excludes certain properties.

MR. PHILLIPS: Objection. Form.

BY MR. MAIER:

Q. So let me ask a question.

A. Why don't you ask the question again, because I may be answering a slightly different question.

Q. And the word I'm going to begin with is "can." So can the claimed interface layers serve as a barrier so that metal atoms in the metal contact do not spike through into the semiconductor substrate?

MR. PHILLIPS: Objection. Scope, form.

THE WITNESS: So I've not taken a position on that question, so I have no opinion on that question either way.

BY MR. MAIER:

Q. Let's do the other one again just so I can get the clear answer. Can the claimed interface layers serve as a diffusion barrier so that dopant atoms in the semiconductor substrate do not diffuse into the metal contacts?

MR. PHILLIPS: Same objections.

THE WITNESS: And somewhat the same answer. I've not taken a position on diffusion barriers. I've not studied them. I have no opinion either way on that.

BY MR. MAIER:

Q. Let's turn back to your declaration, and specifically at paragraph 112. Let me know when you're there.

A. Yes, I'm at paragraph 112.

Q. Here you're summarizing, among other things, a set of criteria that would allegedly lead a person of ordinary skill in the art to a set of materials for the claimed separation layer, correct?

A. In general, yes.

Q. So what I want to do now is test these criteria, and you may want your notepad for this.

A. Okay.

Q. Okay. So I want you to consider a prior art structure that has the following configuration: Metal, silicide separation layer, silicon dioxide layer, and silicon substrate. Do you have that in mind?

A. So, let me repeat the layer back at you. It's a metal, it's a silicide, it's Si02, and it's a silicon substrate?

Q. Right.

MR. PHILLIPS: And I want to state a form objection.

BY MR. MAIER:

Q. In this structure, the silicon dioxide layer can passivate the silicon semiconductor, correct?

MR. PHILLIPS: I'm going to have a running form objection to all the questions pertaining to this structure.

BY MR. MAIER:

Q. Okay.

A. So I've not opined on a structure with silicide, and so I'm going to answer some of these questions based on broad knowledge but sometimes I'm going to say I've not studied it and I've not thought about it.

So in the form of the question, the metal, the silicide, the Si02, and the silicon, the Si02 could passivate the silicon layer, but is not -- you need to know more details of the structure to know if it does.

Q. And in our hypothetical prior art structure, the silicide layer is sandwiched between the metal and the silicon dioxide layer. Are you with me so far?

A. I understand the structure to be a metal, an arbitrary metal, an arbitrary silicide at this point, so it's an arbitrary metal, an arbitrary silicide, an Si02 layer, and a silicon layer. That's how I understand the structure.

Q. And let's say that the silicide is a silicide of the metal in the metal layer, okay?

MR. PHILLIPS: Objection, scope.

THE WITNESS: Okay.

MR. PHILLIPS: I want to make a running scope objection as well to all questions pertaining to this structure.

BY MR. MAIER:

Q. And so if you can, Dr. Kuhn, keep paragraph 112 of your declaration open because I want to test these criteria, but I'm also going to give you some other documents. So if you can have 112 of your declaration open, what I'm going to do next is I'm going to upload Exhibit 1001 from the 1204 proceeding which is U.S. patent 8,766,336. I'll let you know once I've uploaded that.

(Exhibit 1001 marked for identification.)

BY MR. MAIER:

Q. So it should be accessible let me know when have it?

A. I'm doing the usual syncing of the share, which is very slow.

Q. Yes.
A. Can you remind me of the exhibit number? I'm not sure I have it yet.
Q. It's Exhibit 1001, and it's U.S. Patent 8,766,336.
A. Sorry, there are two, 101s [sic].
Q. Yeah, usually the patent in each IPR proceeding is 1001, so there are multiple versions. This is from the 1204 IPR.
A. Ah, I'm with you here. Okay. So I have patent 8,766,336 up, and I'm content with us calling it the '336 patent.
Q. Can you turn with me to column 14 at lines 56 to 60? Let me know when you're there.
A. 56 to 60, it's a paragraph starting "Another advantage."
Q. And I'm going to start with the second sentence of that paragraph where the '336 patent states, "Typically, metals chosen for application in classic Schottky diodes are those that conform a silicide with a silicon semiconductor. The formation of the silicide helps to reduce surface states (resulting from dangling bonds), but not the effect of MIGS. Thus, the Fermi level at the semiconductor surface is still pinned."

Did I read that correctly?

A. Yes, you did.

Q. Now, I want to go back to our hypothetical metal, metal silicide, silicon dioxide, silicon structure. Do you have that there?

A. Yes, I do.

Q. In the context of the '336 patent, the silicide layer cannot itself be a passivation layer, correct?

A. I don't know. I have not thought about the application of silicides to the question of the passivation layer.

Q. Well, the reason I'm asking that question is that in paragraph 112 of your declaration you say that the separation layer is not itself a passivation layer. Do you see that?

A. That's correct.

Q. Yet the challenge patents have this statement that "silicide helps to reduce surface states resulting from dangling bonds." Do you see that?

A. That's -- the formation of silicide helps to reduce surface states, that's quoted from the patent, that's correct.

Q. So I'm trying to reconcile those two statements. Can the silicide layer in our hypothetical structure itself be a passivation layer in the context of the challenge patent?

MR. PHILLIPS: Objection. Form. And scope.

THE WITNESS: So, first, I have not studied that question in detail, but I do want to add an additional observation which complicates the question. Many silicides are metals, so a structure that has a metal and a silicide may, in fact, have two metals one on top of the other. And so in your hypothetical of a metal, a silicide, Si02, and Si, depending on what silicide it is, what you may actually have is simply a metal, Si02, silicon structure, which is certainly within the claims of the patent.

BY MR. MAIER:

Q. Okay. So I see the confusion. So let's get a little more specific. Do you remember what the patent example is?

A. You mean its column --

MR. PHILLIPS: Object to the form.

BY MR. MAIER:

Q. That's a bad question, so let me ask this. The patent talks about using titanium as the metal layer.

A. For silicides? I'm sorry, you're going to have to tell me where to go in the patent. I just got enormously lost. I am at column 14 the discussion on metal silicides at the bottom of column 14.

Q. So remember when we talked about the '423 patent and we went through about over a dozen different metals that could be the metal layer during yesterday's deposition?

A. Yes, I recall that.

Q. And one of those options for the metal layer was titanium, do you recall that?

A. Yes, I recall that.

Q. Okay. So I want to put this structure together and ask about this passage in the '336 patent. So let's revise our structure to titanium, titanium silicide, silicon dioxide, silicon. Do you have that in mind?

A. Yes.

MR. PHILLIPS: Objection. Scope.

BY MR. MAIER:

Q. The '336 patent at column 14, lines 56 through 61, includes the statement, "The formation of the silicide helps to reduce surface states (resulting from dangling bonds), but not the effects of MIGS. Thus, the Fermi level at the semiconductor surface is still pinned."

Do you see that?

A. I see that.

Q. In the context of the challenge patents, a titanium silicide layer could have the proper thickness and band structure to reduce the effects of MIGS to prevent Fermi level pinning, correct?

A. I disagree with that. In my knowledge, titanium silicide is a metal. So if I have, for example, a metal contact of tungsten, a metal layer of Ti silicide, an Si02 layer, and a silicone layer, I have a metal insulator metal structure. And so the question of passivation in a metal layer is something that I've not discussed, and I don't actually understand.

If we're talking about a metal structure, a metal is a metal, it has pre-carrier density, it acts like a metal. So in my mind, the example of tungsten, Ti silicide, Si02, and silicon is simply another example of a metal Si02 semiconductor structure.

Q. Okay, give me one second. Let me ask you this, though, wouldn't you expect there to be some small amounts of oxygen in any titanium silicide layer that is formed?

MR. PHILLIPS: Objection. Scope, form.

THE WITNESS: That's actually an

interesting question because Ti silicide is formed by an exothermic reaction, and I think you'd have to know exactly how it was formed to know if it was contaminated by oxygen.

BY MR. MAIER:

Q. Well, let's assume that it was contaminated by some amount of oxygen, let's say 10 percent. Would such a titanium silicide layer satisfy the separation layer of the challenge claims?

MR. PHILLIPS: Objection. Form. Objection. Scope.

THE WITNESS: Okay. So I think the more interesting question here is if I have a layer, whatever percentage of titanium and silicon and oxygen -- or what exactly was your -- it was Ti silicide and oxygen? Do I have that correct?

BY MR. MAIER:

Q. Some oxygen got in there.

A. Yes, so if you have a Ti silicide and oxygen layer, that layer could easily be a metal oxide. Ti silicide is a metal and there is oxygen, so it's a metal oxide layer. And so, you know, depending on the circumstances and the formation of the layer and a whole bunch of other details of your hypothetical I don't have, it could certainly fulfill the definition of a metal oxide.

Q. How high would the concentration of oxygen have to be in order for that titanium silicide layer to be a metal oxide in your mind?

MR. PHILLIPS: Objection. Scope. Objection. Form.

THE WITNESS: There is no way I can answer that here. We have a hypothetical that is becoming a very complex hypothetical. We have a hypothetical Ti silicide layer with a hypothetical oxygen content, and I am going back to the very fundamental point I make in paragraph 112 that -- and let me find the sentence which is important. "And has the function of providing the proper thickness and band structure."

In questions of this type, the band structure of your material becomes important because the band structure determines whether you have a metal, whether you have an insulator, and it determines other properties that are discussed in the patent around that particular layer. So you know, your hypothetical is rapidly moving into an "I would need to know the structure, its chemical properties, its dimensions, and so on and so forth" to give you an adequate answer to that question.

BY MR. MAIER:

Q. So what would the band structure have to be in our hypothetical Ti silicide oxygen layer for it to be considered a metal?

MR. PHILLIPS: Objection. Scope.

THE WITNESS: The definition of a metal from the band structure is well established in basic semiconductor physics. It's often Chapter 1 or 2 of the semiconductor physics textbook. And the definition of a metal is either the bands are overlapping or -- hold one second. Sorry. My thunderstorm just showed up -- either the bands are overlapping, or the Fermi level is lined through the band, and the patent itself describes this in very similar language. So you can determine whether a material is a metal based upon the band structure.

BY MR. MAIER:

Q. I want to talk a little bit about a different patent that I'm going to upload. And this will be the '395 patent, and I apologize but it is yet another Exhibit 1001, and it's in the 1282 proceeding.

(Exhibit 1101 marked for identification.)

BY MR. MAIER:

Q. I've just uploaded it. Let me know when you have access -- and I'm sorry, it's actually

Exhibit 1101 in this case.

A. So I used my local copy. Just to confirm this is U.S. Patent 10,090,395; is that correct?

Q. That's right.

A. Okay. Where would you like me to go?

Q. Okay, if you could go to column 8, lines 24 to 37, let me know when you're there.

A. So it's a paragraph starting, "A common processing operation"?

Q. That's right. The '395 patent states, "A common processing operation performed during semiconductor device fabrication is silicon surface passivation. Surface passivation, whether by an oxide or another material, chemically neutralizes and physically protects the underlying silicon.

For example, exposing a silicon surface to oxygen under the appropriate conditions to grow a protective film of silicon dioxide will allow the oxygen to react with the dangling bonds of the silicon surface to form covalent bonds that satisfactory the surface silicon atom's valency and render the surface fully coordinated. These covalent bonds provide chemical stability to the silicon surface. The covalent bonds also tie up unbound charges that exist on the silicone surface as a result of the discontinuation of the semiconductor crystal at the surface."

Did I read that correctly?

A. Yes, you did.

Q. What is your understanding of that paragraph and what it's describing?

A. So the paragraph is somewhat of an introductory or tutorial paragraph, in my mind. It's describing a common passivation process, and the particular example is probably the most common and well-understood passivation process, which is exposing a clean silicon surface to oxygen, the oxygen reacts with the dangling bonds, it satisfies the silicon surface atom's valency, or in a more relaxed parlance, it completes the surface dangling bonds, and it ties up unbound charges that exist on the silicon surface. So it's somewhat a textbook or standard description of passivation with a silicon dioxide example.

Q. Yesterday we used the term "native silicon dioxide." Do you recall that?

A. Yes.

Q. What is a "native silicon dioxide"?

A. The term native oxide in the general form is a common term applied to an oxide that grows on a material in the presence of oxygen. It's usually referred to as, for example, silicon dioxide is the native oxide of silicon. Iron oxide is the native oxide of iron, and so on. There is usually a level of detail involving which particular crystal structure or coordination of the oxide, but in sort of broad terms, a native oxide is the oxide that grows on a material surface in the presence of oxygen or water or steam or something of this nature.

Q. When you say, "in the presence of oxygen," are you referring to oxygen in the air?

A. There are -- let me describe this in a broad sense. First, the term "native oxide" is a generic term to describe the growth of an oxide in the presence of oxygen. There is also a use in the field of the word native oxide to describe surface contamination. This is -- I would call it a more casual use.

For example, when I was in the MBE world, we would talk about native oxides as a shorthand for surface contamination that we needed to be removed. And if one wants to be precise, one would say native oxide contamination is kind of a phrase to distinguish the contamination that forms on a wafer in an uncontrolled environment with the other definition of native oxide, which is simply the oxide that forms in the presence of the material in oxygen.

Q. Okay, thank you.

Let's keep reading in column 8 of the '395 patent, and specifically at lines 38 to 52.

A. I'm there.

Q. This passage states, "However, passivation with silicon dioxide has several significant disadvantages. For example, silicon dioxide is a dielectric insulator that poses a significant barrier to the flow of current. Accordingly, a layer of silicon dioxide deposited or grown on a silicon surface may significantly reduce the ability for electrical current to flow through that surface. As a result, the use of silicon dioxide has been limited in practicality to surfaces external to the active region of semiconductor devices through which current passes during device operation (e.g. as a gate oxide layer). This disadvantage is compounded by the fact that the silicon dioxide grows very rapidly and readily on the silicon surface so that it is difficult to limit the growth to a thin layer. Silicon dioxide is also a poor diffusion barrier to semiconductor dopants such as boron."

Did I read that correctly?

A. Yes, you did.

Q. And can you explain what you understand that paragraph to be describing?

A. The paragraph prior to this is, as I mentioned earlier, is a somewhat textbook or tutorial paragraph that describes silicon and silicon dioxide, where silicon dioxide is a passivation layer on silicon. Silicon dioxide is universally understood to be an excellent passivation layer for silicon. The culture is extraordinarily familiar with the material since the first MOS device was ever made in whatever year it was, the use of silicon dioxide on silicon has been known for the quality and excellence of its passivation.

So a POSITA understands that paragraph 1 is sort of saying at a very high level "we all understand silicon dioxide, and it's really, really good as a passivation layer," and then paragraph 2 is "but it's not perfect." And then paragraph 2 goes on to say that passivation with silicon dioxide has some issues. And then the paragraph lists the issues.

It's a dielectric insulator that poses a barrier to current flow, which is true of all dielectric insulators. And then it also talks about, I think, some more significant, more manufacturing concerns, which is silicon dioxide grows rapidly, and so it is not as easy to, perhaps, make a thin layer of the material as of certain other materials, and is a poor diffusion barrier to boron.

So I see these two paragraphs taken together to be kind of tutorial. The first paragraph in the general form saying, "We all know silicon dioxide. It's a wonderful passivation layer. We're all very familiar with it."

And then the second paragraph saying, "but it has some issues that we need to talk about, and maybe" -- and I presume the third paragraph after this is going to be, "and maybe we can use something else."

Q. Okay. So let's go to that next paragraph, and this will be the last one, but I want to get your take on it as well. At column 8, lines 53 to 63 of the '395 patent, it states, "Instead of making use of silicon dioxide then, in one embodiment, the present inventors utilize a nitride semiconductor surface to provide chemical passivation; that is, a nitride layer is introduced to passivate the semiconductor surface by eliminating or at least reducing the effects of surface states and possibly inhomogeneities. The nitride layer also displaces the metal from the semiconductor and eliminates or at least reduces the effects of MIGS. The result of introducing the nitride layer as an interface between the semiconductor and the metal is a depinning of the Fermi level of the semiconductor."

Did I read that correctly?
A. Yes, you did.
Q. I guess my question here is -- let me take it in two parts because you mentioned there are two understandings of native oxides. One understanding of a native silicon oxide is a native silicon dioxide that forms from contamination, right?
A. So, as I mentioned, there are two common uses of the word "native oxide." The first is native oxide simply being the oxide that forms on a material in the presence of oxygen. And then the second form that you see is people using it as a shorthand for native oxide contamination; and by that, what is meant is the myriad of things that form on the surface in ambient air, which could include oxygen. It could also include oil. It could include other background chemicals that adsorb to the surface. The culture does generically use the term "native oxide," and sometimes forgets to use the term "contamination" when they're referring to the contaminated layer that forms on a wafer in an uncontrolled environment.
BY MR. MAIER:
Q. So I'll try to be specific when I'm referring to those two different options. It was -- actually, let me ask it this way: Does -- can a native silicon

dioxide from contamination satisfy the passivation layer of the challenge claims?

MR. PHILLIPS: Objection. Scope. Form.

THE WITNESS: Keep in mind that a native oxide from contamination is contaminated. And in the usual way that word is used, it is contaminated in an uncontrolled way in an uncontrolled environment. So back in my university days, we used the term when we wafer were sitting on the table and it could have been contaminated by somebody's lunch. So in order to answer that question, you would need to know the contamination.

Certainly, if the native oxide happened to not be contaminated but was a pure and well-behaved silicon dioxide layer that simply formed, then it would be as good as any other silicon dioxide layer. But if it was contaminated in some way, then, of course, your properties would be influenced by the contamination.

BY MR. MAIER:

Q. Okay. So I think I'm confused by the word "contamination." When you say contamination in the context of a silicon dioxide, are you saying that the layer is not solely silicon dioxide but has some other things in it?

MR. PHILLIPS: Object to form.

THE WITNESS: When people use the word "native oxide contamination" or more commonly -- and I'll give an example -- the graduate student walks in with the wafer, gloved, true, in his gloved hands with the box open and says, "I have native oxide on this wafer," what the graduate student means is that the wafer has been left out in the open and has formed a native oxide that is contaminated by the ambient environment. And the term is used very commonly that way.

And back when I was doing MBE, the first thing we did is we shove those wafers in the load lock and blew off the native oxide contamination, which included oxygen oxides, and since this was 35, it was arsenic and germanium oxides and things of that nature.

And so whenever someone uses the word "native oxide," you need to drill down as to whether someone simply means an oxide that was formed under controlled conditions, but possibly not in a high-temperature chamber. So for example, you could take a wafer and put it in a room temperature chamber that was purged with oxygen, and you'd get a native oxide growth that is quite thin, and that's a perfectly respectable oxide.

You could also leave it out in your laboratory overnight and put it in your tool, and then that native oxide will be contaminated. And one of the issues that exists in the culture is people use the two terms interchangeably, so when -- you have to look at the layer itself and how it was formed. There is nothing wrong with taking a clean wafer, sticking it at room temperature in a purged box and purging the box with oxygen. It will then form a perfectly respectable film that is a native oxide film; however, if you take that same wafer and leave it out in the laboratory all night, it will become contaminated with native oxide and that native oxide will be contaminated with all the other things that are going on in the laboratory.

BY MR. MAIER:

Q. I think what threw me off is you mentioned it could be contaminated by someone's lunch and I was picturing someone spilling ketchup on the wafer, but maybe that's a different level of contamination than you were talking about.

A. Well, if you're talking about graduate students, that's actually realistic. Keep in mind that the most common appearance of native oxide issues tends to be in an academic setting because there are not load locks. There are not vacuum chambers to store things in between operations. So wafers are carried around the university to various tools at the university, and they pick up native oxide contamination because they're not being stored in a high vacuum between steps.

And so issues of native oxide contamination in an academic environment can indeed include the student's lunch. I'm being a little facetious there. More often, there is every attempt by the students to keep things clean, but you're still taking a wafer out of a tool, putting it in a box, running across campus with it, putting it back into another tool, and that is going to create issues. There is going to be adsorb CO2. There is going to be other materials.

In an industrial environment or a highly-constrained academic environment, the wafer never leaves the vacuum system, and so you can do something like take the wafer, put it in a side chamber, close off the side chamber, purge the wafer with oxygen, get a controlled native oxide growth that is not contaminated and pop it back in the tool if you want.

BY MR. MAIER:

Q. I think I have one more question on this topic. Would a silicon dioxide layer, 1 monolayer thick, still satisfactory the passivation layer of the challenge claims?

A. Well, one would need to know a few more characteristics of the layer but given what we have discussed earlier about the passivation layer needing only to terminate the dangling bonds, I see no reason why a single monolayer of Si02 that terminated dangling bonds correctly would not serve as a perfectly fine passivation.

Q. Can you turn to page 22 of your declaration, it's not paragraph, but page 22 of your declaration?

A. Sure. I'm on page 22.

Q. On the previous page, you mention that the figure shown on page 22 is taken from a book, a textbook, right?

A. Ah, yes and no. The figure is a textbook figure but the picture itself was taken from my IEDM 2008 short course.

Q. So my question was going to be what textbook was that figure taken from, and your answer would be?

A. My answer would be I was using "textbook" in a different sense. I was using textbook in the sense of a tutorial image. I was not using textbook in the sense of a literal textbook. The image at the top of page 22 is an image from my IEDM short course. It's an image I drew personally for the short course, and so it is not in itself from any particular textbook. It is simply intended to be of a tutorial nature in the sense of textbook with quotes around it.

Q. I have a number of questions that relate to your past work. You have previously been adverse to Samsung, correct?

A. Yes.

Q. How many times have you been an expert witness adverse to Samsung?

A. Two different patents. The first one was what I'm going to call the Kaist patent which was an extensive litigation. The plaintiff changed names once during the litigation, and it's referenced in my CV, and why don't I go to my CV, if I may, and give you some more details on that.

Q. Yeah, and you've provided a case list that was separate from your CV, so if it would be helpful I will upload that in the Exhibit Share as well.

A. That would be good. I'm going to actually open that too.

(Exhibit 2072 marked for identification.)

BY MR. MAIER:

Q. So it's Exhibit 2072 from the 1204 IPR proceeding. And let me know when you're ready.

A. Yeah, I have that open. The two bottom cases, Kaist IP versus Samsung and KIPB versus Samsung, are the same patent in the same group. The broad history here is the -- and it's a single FinFET patent, and we can look up the number if we want, but let me give you the broad history and then I can go back and dig up the number. The litigation began with Kaist versus Samsung, and that was the Glaser Weil project. It moved through IPRs which we've talked about. It then litigated and ended in trial here in 2018. The verdict was in favor of Kaist, and then this particular first proceeding only litigated up to 14 nanometers.

And so Kaist, which by then had changed names and turned to KIPB, started its second litigation against Samsung on the same patent for 14 nanometers and beyond. And that litigation got up to the point of a report in a deposition in 2020, and then Kaist, which by then was KIPB, and Samsung sat down and settled. And so this was a case that, you know, basically went over about four years when you count day 1 to day end that involved four different law firms during this time, but was a single patent moving through the system. So that was my first option to Samsung.

And my second opposition for Samsung is the case we're talking about now, the Acorn case.

Q. Other than the Acorn case, can you describe your role in your cases adverse to Samsung in terms of infringement and validity, et cetera?

A. So in the two Kaist cases, I did both infringement and validity. In the first Kaist case, as I mentioned, I gave the direct infringement report and did that at trial, and then a day or so later did the validity, and as I mentioned I did the IPRs on that case.

On the second case, I'd have to look because it terminated with settlement. I certainly recall doing the direct report. I don't recall if I did the validity or not because it -- I believe I did, and then it terminated before trial. And there was no IPR on the second. There was an EPR on the second one but no IPR.

Q. When you say "EPR," you're referring to an ex parte re-exam?

A. Yes.

Q. And did you submit declaration testimony during that ex parte re-exam?

A. Yes.

Q. The next question may require an approximation, but approximately how much money have you made in your work adverse to Samsung over the years?

MR. PHILLIPS: Objection. Scope.

Objection. Relevance.

THE WITNESS: I don't know. If it's incredibly important, I can sit down and go through all the invoices, but I can't do that off the top of my head.

BY MR. MAIER:

Q. Do you know whether it was above or below a million dollars?

MR. PHILLIPS: Same objections.

THE WITNESS: I don't think I've made a million dollars consulting if I include all my consulting wages for the past five years. I don't know exactly but I don't think I'm anywhere close to that.

BY MR. MAIER:

Q. What's your best ballpark for how much money you made from your consulting work adverse to Samsung?

MR. PHILLIPS: Same objections.

THE WITNESS: I'm -- I can't do this, you know, if this is important, we can go offline and I can put the invoices together and I can answer that question accurately, but it's not something I even thought of in preparing for this deposition.

MR. MAIER: All right. Why don't we take another break, and then we'll do the last section.

THE WITNESS: Okay, sounds good. Ten

minutes, maybe 11:05?

MR. MAIER: Let's go off the record.

THE VIDEOGRAPHER: Thank you. We are going off the record at 10:54.

(Recess taken 10:54 a.m. to 11:15 a.m.)

THE VIDEOGRAPHER: We are back on the record the time is 11:15. Please proceed.

MR. MAIER: Dr. Kuhn, I have no further questions unless there is any redirect, so thank you for your time.

THE WITNESS: Well, thank you.

MR. PHILLIPS: Sorry to interrupt. I do not have any redirect. So I believe we are done.

THE VIDEOGRAPHER: This concludes today's testimony given by Dr. Kelin Kuhn. The total number of media units used is two. All media will be retained by Veritext on a local secured drive and redundantly stored in the Veritext-managed Amazon Cloud S-3 services for preservation purposes.

We're going off the record at 11:15.

(Signature was reserved.)

(Deposition concluded at 11:15 a.m.)

REPORTER'S CERTIFICATE

I, JUDY BONICELLI, the undersigned Certified Court Reporter, pursuant to RCW 5.28.010 authorized to administer oaths and affirmations in and for the State of Washington, do hereby certify:

That the sworn testimony and/or proceedings, a transcript of which is attached, was given before me at the time and place stated therein; that any and/or all witness(es) were duly sworn to testify to the truth; that the sworn testimony and/or proceedings were by me stenographically recorded and transcribed under my supervision, to the best of my ability; that the foregoing transcript contains a full, true, and accurate record of all the sworn testimony and/or proceedings given and occurring at the time and place stated in the transcript; that I am in no way related to any party to the matter, nor to any counsel, nor do I have any financial interest in the event of the cause; that a review was requested.

WITNESS MY HAND and DIGITAL SIGNATURE this 13th day of July 2021.

JUDY BONICELLI, RPR, CCR
Washington Certified Court Reporter, CCR 2322
California Certified Court Reporter, CSR 9091

Matthew Phillips, Esq.,
MPHILLIPS@LPIPLAW.COM

July 13, 2021

RE: Samsung Electronics Co. v. Acorn Semi, LLC
7/7/2021, Dr. Kelin Kuhn (#4683523)

The above-referenced transcript is available for review.

Within the applicable timeframe, the witness should read the testimony to verify its accuracy. If there are any changes, the witness should note those with the reason, on the attached Errata Sheet.

The witness should sign the Acknowledgment of Deponent and Errata and return to the deposing attorney. Copies should be sent to all counsel, and to Veritext at cs-ny@veritext.com

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Samsung Electronics Co. v. Acorn Semi, LLC

Dr. Kelin Kuhn (#4683523)

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Kelin J. Kuhn (signature) 7/22/21

Dr. Kelin Kuhn Date

Samsung Electronics Co. v. Acorn Semi, LLC

Dr. Kelin Kuhn (#4683523)

ACKNOWLEDGEMENT OF DEPONENT

I, Dr. Kelin Kuhn, do hereby declare that I have read the foregoing transcript, I have made any corrections, additions, or changes I deemed necessary as noted above to be appended hereto, and that the same is a true, correct and complete transcript of the testimony given by me.

Kelin J. Kuhn ______________________ 7/22/21 ______________

Dr. Kelin Kuhn Date

*If notary is required

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______ DAY OF ________________, 20___.

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NOTARY PUBLIC

ERRATA FOR DEPOSITION OF DR. KUHN – JULY 6-7, 2021

Page:Line	Correction
15:16	"patents" → "petitions"
30:1	"for" → "from"
45:9	"exclaiming" → "explaining"
54:15	"interphase" → "interface"
94:15	"oxide silicon" → "oxide, silicon"
95:616-17	"widely spread" → "widely read"
95:23	"must" → "much"
102:20	"EV" → "eV"
141:13	"reprise" → "rephase"
146:4	"R-fab" → "our fab"
151:3	"mass" → "mask"
153:6	"one more" → "one or more"
172:10	"silk" → "SiLK"
186:25	"this" → "this is a"
193:13	"intentioned" → "in tension"
204:4	"doesn't → "does"
228:12	"an idea which" → "an idea, which"
228:13	"mid-separation → "MIG-separation"
228:20	"structures and" → "structures. And"
228:25	"table with" → "table, with"
229:15	"challenge" → "challenged"
230:2	"challenge" → "challenged"
230:5	"challenge" → "challenged"
230:8	"challenge" → "challenged"
230:11	"challenge" → "challenged"
230:15	"challenge" → "challenged"
231:1	"challenge" → "challenged"
231:9	"challenge" → "challenged"

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232:25	"challenge" → "challenged"
243:22	"challenge" → "challenged"
245:11	"challenge" → "challenged"
245:12	"challenge" → "challenged"
245:15	"challenge" → "challenged"
245:18	"challenge" → "challenged"
245:20	"challenge" → "challenged"
246:4	"challenge" → "challenged"
249:22	"challenge" → "challenged"
250:24	"did not" → "determined"
251:6-7	"this way is" → "this way, in"
251:16	"challenge" → "challenged"
255:24	"require" → "requiring:
264:3	"challenge" → "challenged"
264:10	"silicone" → "silicon"
264:16	"pre-carrier" → "free-carrier"
276:14	"35" → "III-V"
278:11	"adsorb" → "adsorbed"
281:21	"option" → "opposition"

Kelin J. Kuhn
Dr. Kelin J. Kuhn

Date: 7/22/21