UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICRON TECHNOLOGY, INC.,
Petitioner

v.

YANGTZE MEMORY TECHNOLOGIES COMPANY, LTD.,
Patent owner

IPR2025-00189

Patent No. 11,145,666

REMOTE EXAMINATION

OF JACK C. LEE, PH.D.

TAKEN ON WEDNESDAY, AUGUST 13, 2025

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JOB NO.: 592770

YMTC
Exhibit 2010
Micron v. YMTC
IPR2025-00189

Ex. 2010-001

REMOTE EXAMINATION of JACK C. LEE, PH.D., taken before JESSICA R. WAACK, Registered Professional Reporter, Registered Merit Reporter, Certified Realtime Reporter, Registered Diplomate Reporter, California Certified Realtime Reporter, New Jersey Certified Court Reporter (License No. 30XI008238700); Texas Certified Shorthand Reporter (License No. 11958); Washington State Certified Court Reporter (License No. 21007264); California Certified Shorthand Reporter (License No. 14420); New York Association Certified Reporter, New York Realtime Court Reporter and Notary Public of Washington, D.C. and the States of New York, Pennsylvania, Delaware, Maryland and Virginia, held remotely via a videoconference platform, on Wednesday, August 13, 2025, commencing at 9:01 a.m. and concluding at 5:04 p.m.

A P P E A R A N C E S

(all appearing remotely)

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A L S O P R E S E N T

LUCIEN NEWELL, document technician

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INFORMATION REQUESTED

None

WITNESS INSTRUCTED NOT TO ANSWER

None

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WITNESS: JACK C. LEE, PH.D.

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** All exhibits were attached to the original transcript **

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WITNESS: JACK C. LEE, PH.D.

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STIPULATIONS

IT IS HEREBY STIPULATED AND AGREED by and between counsel no party to the litigation will object to the remote deposition on the grounds that the certified stenographer may not have the legal authority to swear in the witness.

FURTHER STIPULATED AND AGREED that all parties are aware the certified stenographer is not physically present in the deposition room with the witness and will be administering the oath and reporting this deposition remotely.

STIPULATIONS

FURTHER STIPULATED AND AGREED this transcript and all testimony will have the same force and effect as if everyone was present in person in the deposition room.

FURTHER STIPULATED AND AGREED all parties and their counsel consent to this arrangement and waive any objections to this manner of reporting.

******

REMOTE PROCEEDINGS

August 13, 2025, 9:01 a.m.

******

DOCUMENT TECHNICIAN: Thank you to everyone for attending this proceeding remotely, which we anticipate will run smoothly.

Please remember to speak slowly and do your best not to talk over one another. Please be aware that we are recording this proceeding for backup purposes.

Any off-the-record discussions should be had away from the computer. Please remember to mute your mic for those conversations. Please have your video enabled to help the reporter identify who is speaking. If you are unable to connect with video and are connecting via phone, please identify yourself each time before speaking.

We will provide a complementary unedited recording of this deposition with the purchase of a transcript. I apologize in advance for any technical-related interruptions.

Thank you.

*****

JACK C. LEE, PH.D., sworn on oath and/or affirmed, called as a witness herein, was examined and testified as follows:

*****

EXAMINATION

BY ATTORNEY WATSON:

Q. Good morning, Dr. Lee.

A. Good morning.

Q. My name is Tom Watson. Nice to meet you today.

A. Nice meeting you.

Q. Can you state your full name for the record.

A. My name -- my full name is Jack

C. Lee.

Q. Okay. And can you spell that for the record?

A. Jack is J-a-c-k. C., initial C. as in Charlie. And Lee, L-e-e.

Q. Can you please state your home address for the record.

A. It is 5803 Westslope, it's one word, W-e-s-t-s-l-o-p-e, Cove, C-o-v-e. It's in Austin, Texas, 78731.

Q. Dr. Lee, where are you located right now?

A. I am located at the address that I just provided.

Q. So you are at your home address?

A. That is correct.

Q. Dr. Lee, do you understand that your testimony today is under oath and under penalty of perjury?

A. Yes.

Q. And do you understand that you are under the same obligation to tell the

truth as if you were testifying before a judge and a jury?

A. Yes.

Q. Dr. Lee, have you been deposed before?

A. Yes.

Q. I want to go over a couple of ground rules for the deposition, if that's okay.

A. Yes.

ATTORNEY WATSON: Can we go off the record one second? I'm having a technical difficulty with the realtime.

THE STENOGRAPHER: We're off the record.

(Whereupon, a recess was taken at 9:05 a.m.)

THE STENOGRAPHER: We're back on the record.

BY ATTORNEY WATSON:

Q. Dr. Lee, we have a court reporter here, and it's important that she's able to

transcribe your record -- the record.

Do you understand that?

A. Yes.

Q. So when you answer my questions, can you please do so verbally?

A. Yes.

Q. And if you don't understand my question, can you please let me know so I can rephrase it?

A. Yes.

Q. And do you understand that if you answer my question, I will assume that you have answered my -- you have understood my question?

A. Yes.

Q. Dr. Lee, do you understand that during the deposition, you are not to communicate with your counsel while we are on the record?

A. Yes.

Q. And is there any reason that you cannot provide full and truthful testimony

today?

A. No.

Q. Dr. Lee, I want to set up some shorthand for our deposition, if that's okay.

A. Yes.

Q. Today, do you understand that we are here today to discuss your testimony regarding IPR proceeding 2025-00189?

A. I don't recall that specific number.

Q. Okay. Let's pull up Exhibit 1003.

DOCUMENT TECHNICIAN: And should I mark this as Exhibit 1003?

ATTORNEY WATSON: Yes.

(Whereupon, Previously Marked Exhibit 1003 is identified for the record.)

BY ATTORNEY WATSON:

Q. Dr. Lee, do you recognize Exhibit 1003 as the declaration you

submitted in support of inter partes review of U.S. Patent 11,145,666?

A. Yes.

Q. So when I refer to this case, will you understand that I'm referring to IPR proceeding 2025-00189?

A. Yes.

Q. And when I refer to the '666 patent, I'm referring to U.S. Patent Number 11,145,666, understood?

A. Yes.

Q. Dr. Lee, do you have any materials with you today?

A. No.

Q. And you don't have any notes in front of you?

A. No.

Q. Do you have any applications open on your computer other than this Zoom deposition?

A. No.

Q. Are there any other screens in

your room?
A. Yes.
Q. Are any of those on?
A. Yes.
Q. What's on those screens at the moment?
A. Nothing.
Q. During our deposition, will you ensure that those screens remain clear of any additional material?
A. Yes. Those screens are on in case we have documents uploaded to the chat and I can open it and displays in those screens on the -- on my desk.
Q. Okay. So other than putting up exhibits that we're talking about in this deposition, you agree that you won't put any other material up on the screens; is that fair?
A. Yes.
Q. Is there anyone else in the room with you right now?

A. No.
Q. Can you agree with me to not take out your cell phone during the deposition today?
A. Yes.
Q. And can you agree with me not to access the Internet during our deposition?
A. Yes.
Q. Dr. Lee, you mentioned you had been deposed previously; is that correct?
A. Yes.
Q. How many times have you been deposed?
A. I don't recall exactly how many times.
Q. More than 10 times?
A. Yes.
Q. Dr. Lee, what did you do to prepare for your deposition today?
A. I reviewed all the materials that I cited in my declarations. I reviewed my declarations and -- oh, I see the

declaration has been uploaded. Can I download it?

Q. Yes.

(Pause in testimony.)

THE WITNESS: In paragraph 17, I stated that, in forming my opinions in this declaration, I consider and relied on my education, my knowledge of the relevant field and knowledge of science and engineering principle and my experience.

I also reviewed the patent, obviously, '666 patent, the prosecution history and the additional material that's listed in the table of -- in the table in paragraph 17.

BY ATTORNEY WATSON:

Q. To be clear, you reviewed the materials cited in paragraph 17, you reviewed your declaration, correct?

A. I also review the patent, the '666 patent, Exhibit 1001 and the

prosecution history, Exhibit 1002.

Q. Other than the patent, the '666 patent, the prosecution history, Exhibit 1002, the exhibits listed in paragraph 17 of your declaration and your declaration, did you review any other materials in preparing for your deposition today?

A. I see that Exhibit 1001 is the '666 patent. 1002 is the prosecution history. 1003 is my declaration. And then the table started with Exhibit 1005 consecutively to 1018. I don't recall what is Exhibit 1004.

Do you have that information?

Q. Exhibit 1004 is your CV.

A. Okay. All right. Thank you.

Q. Okay. So in preparing for your deposition, you reviewed Exhibits 1001 through Exhibits 1018; is that fair?

A. Yes. Those are the materials that I reviewed. And as I mentioned, I

also relied on my education, the knowledge of the relevant field, the knowledge of scientific and engineering principles and my experience in preparing of my declaration -- in preparing and forming my opinion in this declaration.

Q. In preparing for your deposition, did you review any materials other than Exhibits 1001 through Exhibits 1018?

A. I don't recall any additional material that I reviewed.

Q. Did you meet with anybody in preparing for your deposition?

A. Yes.

Q. Who did you meet with?

A. I have met with counsel, Patrick Herman.

Q. Did you meet with anyone other than Mr. Herman in preparing for your deposition?

A. No, I have not.

Q. How many times did you meet with

Mr. Herman in preparing for your deposition?

A. I think twice, I believe.

Q. When were those meetings?

A. One was last week and one in this week.

Q. And how long was each meeting?

A. Approximately hour and a half to two hours.

Q. And were your meetings with Mr. Herman in person or by video?

A. By video, Zoom call.

Q. Besides Mr. Herman, have you discussed this case with anyone else?

A. No.

Q. In reviewing the documents you reviewed, did your review refresh your recollection of anything?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Can you repeat the question, please?

BY ATTORNEY WATSON:

Q. Yeah, let me rephrase it.

When preparing to testify today, did you review any documents?

A. Can you repeat the question, please?

Q. Yeah.

While preparing to testify today, did you review any documents?

A. As I mentioned previously, I have reviewed Exhibit 1001 to Exhibit 1018 describe --

Q. Did your --

A. -- described in paragraph 17.

Q. Did your review of those documents refresh your recollection?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I reviewed those documents and discussed with counsel. I'm not sure I understand what you mean by "recollection."

BY ATTORNEY WATSON:

Q. Okay. I'll move on.

Dr. Lee, since you signed your declaration that you submitted in this IPR, have you changed any of your opinions?

A. No, I have not.

Q. Other than Mr. Herman, have you discussed the substance of your declaration with anyone else?

A. No.

Q. Have you formed any new opinions in this case since submitting your declaration?

A. No, I have not. However, there's some figures in my declaration I could have drawn it more clearly. And I can explain it during the deposition.

Q. Okay. How much time have you put into this IPR so far?

A. I don't recall.

Q. Would you say you spent a hundred hours working on this declaration?

A. When you say "preparing the declaration," you mean prior to preparation for this deposition? Prior to November 22, 2024, the day that I signed the declaration Exhibit 1003?

Q. Let me clarify. Have you spent around a hundred hours working on this particular IPR matter?

A. Is your question including both drafting -- forming my opinion and drafting the declarations plus the preparation time for today's deposition?

Q. Yes. It includes both drafting, forming your opinion and drafting the declaration plus the preparation time for today's deposition, how much time?

A. I don't recall, but I would say at least 50 -- at least 50 to 75 hours or even closer to a hundred hours. I don't recall the exact number.

Q. Who initially drafted the text of your declaration?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Both counsel and I worked collaboratively in drafting the initial draft of my declaration. At the end of the day, this is my opinion.

BY ATTORNEY WATSON:

Q. And the entirety of the opinions you are offering in this case are listed in this declaration, correct?

A. Yes. The declaration includes my -- all my opinion regarding the IPR of '666 patent.

Q. Let's turn to paragraph 17 of your declaration real quick.

Are you there, Dr. Lee?

A. I can see that on the screen and on there, yes.

Q. In paragraph 17, you say that you reviewed certain exhibits, correct?

A. Yes.

Q. And in your review of these

exhibits, you opine that some of the exhibits are prior art; is that fair?

A. That's fair.

Q. Who provided the prior art for your analysis?

A. I don't recall who provide the prior art. I have access to the library at University of Texas at Austin. And periodically I was asked to search for certain document, certain references.

And there -- as you know, there are multiple IPR in this lawsuit. And at times, I worked on multiple IPRs. And so I don't recall in this particular IPR which one I provided and which one provided by counsel.

Q. Did you perform any independent search of literature, patents or other publications for your report?

A. As I mentioned before, I have provided various publications to various IPR declarations, IPR proceedings in this

case. I don't recall which one -- which of the IPR I provided the publications.

And so I -- I could have provided some of the prior art references for this particular IPR. I just don't recall.

Q. You can't recall whether you found prior art references in this IPR or whether someone else did?

A. As I mentioned just now, I have provided prior art references for various IPR in this case. And I just don't recall whether I have provided the prior art references for this particular IPR.

Q. You don't recall, sitting here today, whether you provided the prior art references for this particular IPR?

A. No, I don't recall.

Q. Sitting here today, is there anything in your declaration that you'd like to correct?

A. I wouldn't say correct. I would say that there's still figures that I'd

like to provide a more clearly -- more clear demonstration.

Q. Can you tell me which figures you want to provide a more clear picture --

A. There are three pictures -- sorry, Patrick.

ATTORNEY HERMAN: I didn't say anything.

THE WITNESS: Oh.

There are three figures that I would like to provide more clarifications. The first one -- let me go there -- is in paragraph 345.

Are you there?

BY ATTORNEY WATSON:

Q. Yes. I'll turn to it right here on the screen.

Okay.

A. 345 shows two blue regions. And in between the two blue regions, there's a green region, okay? And the top blue region is the insulating layer. The lower

blue region is the claimed adjacent insulating layer, okay?

The green region is the conductive layer. And at the right-hand most of the conductive layer is the conductive pad or sometimes called the contact pad which has a green portion at the bottom and kind of brownish orangey near the top, or at the top.

What would have been more clear is that the top blue region should have drawn to extend and covered the contact pad.

In other words, it should have extended all the way to the -- to cover the brown orangey portion all the way to where the vertical dash -- red dash line on the left of the box that says laterally display.

So, in summary, what I'd like to provide a clarification is that the top blue region name insulating layer to be

more clear so to extend further to the right to cover the contact pad.

Does that make sense to you?

Q. Let me -- let me see if I can clarify that, if that's okay.

A. Sure.

Q. In the figure found in paragraph 345 of your declaration, you would extend what is marked as insulating layer all the way to the end of the contact pad?

A. That is correct. The top blue insulating layer -- let's see. I believe it's labeled 248 -- should extend to fully cover the green and brown colored contact pad --

Q. Okay.

A. -- labeled 237.

Q. What are the other figures you want to clarify?

A. Okay. So that's one figure. The other figure is a similar one in

paragraph 343, Figure 7. Okay. The blue region for the top insulating layer and the adjacent insulating layer, I should have been more clearer and drawn the same way as the Figure 34 -- in figure -- in paragraph 345.

In other words, both top and bottom blue insulating layer 248 and 247 should extend to fully covered the contact pad 237 and 236.

Put another way, that the Figure 7 in 340 -- in paragraph 343 should have drawn the same as Figure 7 in 245.

Does that make sense to you?

Q. Let me see if I can clarify that, if that's okay.

Do you see the layer marked as 271 in the figures in paragraph 343 and 345?

A. Yes.

Q. Is it your opinion that the insulating layer should cover both 248 and

271 such that it covers the entire contact pad?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: That's not exactly correct, what you just said. I'm saying that the blue regions covered region 248 plus the portion of 271, the portion that covered -- the portion of 271 that covered the contact pad.

BY ATTORNEY WATSON:

Q. When you say "the portion of 271 that covers the contact pad," is that the portion that covers the top of the contact pad?

A. If you look at Figure 7 on page -- on paragraph 245, you have two blue regions. If you look at the bottom blue region that is shown there labeled as "adjacent insulating layer," that the blue region covered the region 247 and a portion of 271 that covers the contact pad in the

layer extended from 236.

So that particular region of 271 is called a second portion of adjacent insulating layer, so, yes, is the portion of 271 on top of the contact pad as shown in Figure 7 in paragraph 245. The only clarification is that the top blue region labeled as 248 should extend to fully covered the green and brown contact pad.

Does that make sense to you?

The wording, in my opinion, the wording in those paragraph are accurate. And the figures are accurate except I think, to be more clear, I like to make the clarification that I just mentioned.

Q. So you would make the same change to figure -- strike that. Let me try this question again.

You would make the same change to the figure found in paragraph 343 that you would make in figure -- paragraph 345 in your declaration, correct?

A. That is correct.

Q. And that change would then extend the insulating layer to cover the contact pad; is that correct?

A. The insulating layers, to be more clearer, should have drawn to extend and fully covered the contact pads, both the top insulating layer, which is the claimed insulating layer and the bottom blue region, which is the claimed adjacent insulating layers -- insulating layer.

Q. Does the insulating layer in paragraphs 343 and 345 of your report extend to cover both the top and side surface of the contact pad?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: You see the way -- the Figure 40 -- Figure 7 in paragraph 345, the way the bottom blue region, which is the claimed adjacent insulating layer, the way it is drawn

is the clear way that covers the top -- fully covers the top of the contact pad.

BY ATTORNEY WATSON:

Q. So what is the claimed insulating layer in these figures should extend to cover the top surface of the contact pad?

A. Can you say that again?

Q. The claimed insulating layer, not the adjacent insulating layer, should extend to cover the top of the contact pad?

A. Yes --

Q. Okay.

A. -- the -- let me -- let me make sure that the...

The claim insulating layer, meaning the top blue region, should cover the top of the contact pad, which -- which is covered both green and brown colored, cover the curved part on the left and the curved part on the right.

You see the vertical dash line,

blue dash line, there's two -- sorry, red. You see the two vertical dash line, and between those two vertical dash line, there's an arrow and label laterally displayed?

Q. I see that.

A. The blue region on top of the green region should extend to fully cover the contact pad, in other words, so to extend all the way to the left vertical red dash line.

Does that make sense to you? Is that clear?

Q. The insulating layer should extend all the way to the furthest left red dash line in Figure 345, the figure found in 345 of your declaration?

A. That is correct.

Q. Okay. All right.

A. And the same applied to Figure 7 in paragraph 343.

Again, the wordings in all

these -- on those paragraphs are the same as what's written in the declaration, and my opinion has not changed. I just want to provide a clarification. It's not an error, but certain figure I should have perhaps drawn a bit more clearly.

Q. Okay. You said there's a third figure that you wanted to correct.

Which figure is that?

A. In paragraph 3 -- 4, sorry, 413, Figure 5B of the Lee reference.

Are you there?

Q. Yes.

A. In this annotated figure, Figure 5B of Lee in paragraph 413, I did not intend to imply that the corner would be eaten away by the oxidation process as someone might misinterpret the figure that I was -- that is drawn in paragraph 413.

I was trying to show the shape of the corners, that the shape of the corner would be curved and that, again, the

wordings surrounding that figure, figure 5B of paragraph -- in paragraph 413, particularly paragraph 412, paragraph 413 and -- I think those are the two paragraph, perhaps it may be other paragraph that I was trying -- the wordings are accurate.

And the figure, perhaps I should have drawn it a bit more clearly, to illustrate the curved shape of the colors when exposed to oxidant during the oxidation process.

Q. So the content in the paragraph 413 is correct?

A. The content in paragraph 412 and 413 -- let me see.

The content in that section which includes paragraph 411, 412 and 413, in fact, the entire sections regarding ground 3, the wordings are accurate. And my opinion has not changed.

The only point that I wanted to

make was that the figures, and this particular figure in paragraph 413, that I'd like to draw it a bit more clearly.

Q. How would you draw the figure in paragraph 413 more clearly?

A. The curve, shape would look more like an S-shape that you would have a rounded corner at the top corner and a rounded corner at the bottom corner.

And it's not drawn in such a way that it appears to be eaten up -- eaten away by the oxidation process.

The oxidation process is an additive process. So the -- it's almost like an S-shape like this, and it's extended to the left of that step.

Does that make sense to you?

Q. I think so. So let me just wrap -- wrap up this section, if that's okay.

A. Sure.

Q. Other than the changes to the

figures in paragraphs 343, 345 and 413 of your declaration, you have no other changes you'd like to make to your declaration at this time?

A. That is correct. There might be some typo that you might have found. But in terms of the figures, those are the three figures that I think that I'd like to draw a bit more clearly as I describe just now.

Q. Okay. Let's turn to paragraph 4 of your declaration. We have that on the screen.

A. Hold on. Let me get there.

I'm there.

Q. In paragraph 4, you state that you're being compensated at a rate of $680 per hour; is that correct?

A. That is correct.

Q. Okay. Do you have any stock in Micron?

A. No.

Q. Do you receive any bonuses --
A. No.
Q. -- tied to how well Micron does as a company?
A. No.
Q. Have you ever worked for Micron outside of the litigation expert role?
A. No, I don't think so.
Q. Okay. Let's turn to -- let's pull up Exhibit 1001.
(Whereupon, Previously Marked Exhibit 1001 is identified for the record.)
THE WITNESS: Would you mind upload this?
ATTORNEY WATSON: Can we upload that for Dr. Lee?
BY ATTORNEY WATSON:
Q. Dr. Lee, Exhibit 1001 is the '666 patent, correct?
A. Let me download it. I'm sorry. Yes.

Q. Now, the '666 patent is about a staircase structure for a 3D memory; is that right?

ATTORNEY HERMAN: Objection to form.

THE WITNESS: So as I discuss in my declaration in paragraph 65, the '666 patent relates generally to a staircase structure for memory device, for example, 3D memory device.

BY ATTORNEY WATSON:

Q. Okay. Let's turn to columns -- columns 5, lines 6 through 11.

A. One sec.

ATTORNEY WATSON: Can we zoom a little bit on this figure on this one on the screen? Thank you. That's a little bit easier to see.

BY ATTORNEY WATSON:

Q. Are you there on column 5, lines 6 through 11?

A. Yes.

Q. So the '666 patent here refers to a semiconductor device with vertically oriented screens of memory cells transistors, correct?

A. Yes. That's what it says there.

Q. Okay. Let's go to paragraph -- column 5, lines 44 through 47. Let me know when you're there.

A. Yes.

Q. In the '666 patent, "A staircase structure refers to a set of surfaces that include at least two horizontal surfaces, (e.g., a long and x-y plane) and at least two vertical surfaces, (e.g., along a z-axis)," correct?

A. Yes. That's what it says there.

Q. And so the horizontal surfaces run along the x-y plane; is that correct?

A. That's what it says there, that horizontal surface run along -- for example, along an x-y plane.

Q. And the vertical surfaces run

along the z plane?

A. That's what written in column 5 of the '666 patent.

Q. Let's go to Figure 1 of the '666 patent.

ATTORNEY WATSON: Could we rotate? Maybe I can do it.

THE WITNESS: So hold on one second.

Figure 1?

BY ATTORNEY WATSON:

Q. Uh-huh. Are you there, Dr. Lee?

A. I'm there.

Q. Okay. Would you agree with me that Figure 1, "Illustrates a cross-sectional view of a hard mask layer and a plurality of dielectric layer pairs over a substrate"?

A. Can you tell me where are you reading that?

Q. Sure. Column 3, lines 3 through 5.

A. Column 3.
Q. I have it on the screen here too.
A. No. I see that.
Q. So Figure 1, "Illustrates a cross-sectional view of a hard mask layer in a plurality of dielectric layer pairs over a substrate," correct?
A. That is correct. That is what it says there in column 3.
Q. Okay. Let's turn back to Figure 1.
Are you there, Dr. Lee?
A. Yes.
Q. Okay. So Figure 1 is shown in the x-z plane, correct?
A. That is right. It is a cross-section of the structure.
Q. And in Figure 1, there's an alternating layer stack formed on top of the substrate -- well, let me go back. Let me step back a little bit.
In Figure 1, what's marked 101 is

the substrate, correct?

A. That is correct.

Q. And the substrate is the material which subsequent layers are added on?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Hold on one second. Are you reading that from somewhere?

BY ATTORNEY WATSON:

Q. Column 4, lines 21 through 22.

A. Right. That's what it says there, the term "substrate" refers to a material on which -- onto which subsequent material layers are added.

Q. Now, the substrate in Figure 1 has a top surface, correct?

A. That is right, yes. In the same column, column 4, immediately after the sentence you just read, it says, "The substrate include a top surface and a bottom surface."

Q. So the top surface of the substrate is a horizontal surface; is that fair to say?

A. The top surface of the substrate is a horizontal surface parallel to the x-axis.

Q. So the top surface of the substrate runs along the x-y plane?

A. Yes. It is -- runs along the x-y plane perpendicular to the z-axis.

Q. The substrate also has a bottom surface, correct?

A. That's what I just read in column 4, that the substrate includes a top surface and a bottom surface.

Q. And the bottom surface of the substrate is also a horizontal surface, correct?

A. That is correct.

Q. So the bottom surface of the substrate also runs along the x-y plane?

A. Yes. The column 4 says the

bottom surface is opposite to the top surface, and, therefore, the bottom side of the substrate is opposite to the topside of this substrate.

And the bottom surface here is showing that a cross-sectioned two-dimensional view, a cross-section of the -- of the structure, the actual device, of course, is a three-dimensional -- three-dimensional structure.

It does not -- the drawing doesn't show the figures in the specification; only shows a two-dimensional figures, which is incomplete description of the entire -- entire structure.

Those figures do not show a three-dimensional schematic. So if we say that the top surface and the bottom surface are horizontal and parallel to the x-axis, we're assuming a person of ordinary skill in the art drawing their conclusion is assuming that the layers are, in fact,

horizontal planes.

Q. Okay. Let's pull up paragraph -- let's go to column 5, line 52 of the '666 patent.

A. Line 52.

Q. Are you there?

A. Yes.

Q. I'll pull it up on the screen too.

In the '666 patent, "A horizontal direction can refer to the direction, (e.g., the x-axis or the y-axis) parallel with a top surface of the substrate," correct?

A. Which line are you reading? I'm sorry.

Q. Let me go back.

A. Okay.

Q. Column 5, line 52 through 56, you see there.

A. Oh, yeah, I see it now. Okay.

Q. Yeah. In the '666 patent, "A

horizontal direction can refer to a direction, (e.g., the x-axis or the y-axis) parallel with a top surface of the substrate," correct?

A. That is -- that is correct. That's what it says there.

Q. Now let's go to the next sentence.

Are you with me?

A. Yes.

Q. In the '666 patent, "A vertical direction can refer to a direction, (e.g., the z-axis) perpendicular to the top surface of the substrate"?

A. That's what it read there.

ATTORNEY HERMAN: Objection to the form.

THE WITNESS: That's what it says.

BY ATTORNEY WATSON:

Q. Okay.

ATTORNEY WATSON: We've been

going about an hour and 10 minutes --

THE WITNESS: May I -- may I?

ATTORNEY WATSON: -- do you want to take a break -- oh, sorry.

THE WITNESS: May I -- what I was saying was from the figure itself, a person of ordinary skill in the art would not be able to draw a conclusion from the figure itself, because it's an incomplete two-dimensional figure while the structure is a three-dimensional structure, and a figure did not show a three-dimensional schematics.

So one cannot draw a conclusion what's it look like into the -- into the figures. And so, of course, one can learn about that reading the specification. And what you just read there that -- saying that -- actually, the sentence is above what you just read.

"Each of the horizontal surfaces

refer to a step and stairs of the staircase structure."

So from the written words in the specification, one can -- you can draw some clues about what the structure look like in the three-dimensional schematics.

BY ATTORNEY WATSON:

Q. Okay. So in the '666 patent, "A vertical direction can refer to a direction, (e.g., the z-axis) perpendicular to the top surface of the substrate," correct?

A. Yes. That's what it says --

Q. Okay.

A. -- in column 5.

ATTORNEY WATSON: Let's take a break. We've been going about an hour and 12 minutes. Take a quick break.

THE STENOGRAPHER: We're off the record.

///

(Whereupon, a recess was taken at 10:12 a.m.)

THE STENOGRAPHER: We are on the record.

BY ATTORNEY WATSON:

Q. Welcome back, Dr. Lee.

A. Thank you.

Q. Did you talk to anybody about the substance of your testimony during the break?

A. No.

Q. Okay. Let's turn to column 3, lines 10 through 12 of the '666 patent.

Are you with me?

A. Yes.

Q. So Figure 3 of the '666 patent, "Illustrates a cross-sectional view of a staircase structure with a material layer disposed therein," correct?

A. That is what it says there in column 3.

Q. Okay. Let's go to Figure 3.

ATTORNEY WATSON: Can we put the rotate screen up here? Thank you.

BY ATTORNEY WATSON:

Q. Do you have Figure 3 in front of you, Dr. Lee?

A. I see it, yes.

Q. Okay. So I just want to ask you a couple questions about Figure 3, if that's okay.

A. Sure.

Q. So Figure 3 is also shown in the x-z plane, correct?

A. Yes.

Q. And in Figure 3, what's marked as 206 is the hard mask layer?

A. Hold on one second.

In column 7, line 63, it says that, "Figure 3 illustrates a cross-sectional view of a staircase structure 300."

It went on to say that, "material layer 310 is formally disposed on staircase

structure 200B, including the top surface of hard mask layer 206."

So based on that, the layer 206 is a hard mask layer.

Q. So now that you have that section in front of you, I'm going to ask you questions about Figure 3. And feel free to refer back to the -- that column and line as we -- as we do this.

Is that okay?

A. Yes.

Q. So on Figure 3, what's marked as 206 is the hard mask layer, correct?

A. That's what it -- I just read.

Q. And in Figure 3, what's marked as 310 is the material layer, correct?

A. In column 8, it said that the formations of "material layer 310 can be similar to that of hard mask layer 106."

Q. Okay. But I don't think that answered my question.

What's marked as 310 in Figure 3

is the material layer, correct?

A. Well, the sentence that I read, the layer that mark 310 is what '666 patent refer to as material layer.

Q. Okay. And the '666 patent in column 7, lines 63 to line -- the column 8, line 4 refers to a "top surface of the hard mask layer 206."

Do you see that?

A. The bottom of column 7, it says the, "top surface of hard mask layer 206."

Q. And do you see the next sentence says, "a side of hard mask layer 206."

Do you see that?

A. Yes. That's what it says there between -- in column 7 and column 8.

ATTORNEY WATSON: Can we put up what I'll mark as Lee Exhibit 1, which will be the thing I think marked Figure 3 of the '666 patent.

(Whereupon, Exhibit 1 is marked for identification.)

BY ATTORNEY WATSON:

Q. Dr. Lee, do you recognize this as Figure 3 of the '666 patent?

A. Yes.

Q. Now, Dr. Lee, we discussed that the '666 patent refers to a "top surface of hard mask layer 206," correct?

A. Sorry. Is Exhibit Lee 1 the same as Exhibit 1001?

Q. Exhibit Lee 1 is just Figure 3 of --

A. Oh, I got it. Okay. Thank you.

Can you repeat the question, please.

Q. Sure.

You remember we just discussed that the '666 patent refers to top surface of hard mask layer 206, correct?

A. That is correct.

Q. Okay. Dr. Lee, would you be able to label for me, and I'll give you control of this -- the marker, where the top

surface of hard mask layer 206 is? Give me a second. Let me... [speaking sotto voce].

A. You know -- hello?

Q. Yeah. Can you --

A. Why don't you -- it might be easier that you label it, and ask me if I can -- if I can confirm or deny that.

Q. Okay. I can try to do that.

A. Yeah, controlling these things remotely is --

Q. Let me try to do it. And if not -- if that doesn't work, you let me know, okay? Does that make sense for you?

A. Yeah, that makes sense.

Q. Okay. So let's reorient ourselves.

So we're talking about hard mask layer 206, correct?

(Pause in testimony.)

BY ATTORNEY WATSON:

Q. Are you there, Dr. Lee?

A. I'm looking at what you are

trying to do.

(Pause in testimony.)

BY ATTORNEY WATSON:

Q. So, Dr. Lee, layer 206 is the hard mask layer, correct?

A. That is what has been written in '666 patent.

Q. Okay. And we just read that the Figure 3 includes a top surface of hard mask layer 206, correct?

A. That is correct. That's what we read in column -- bottom of column 7.

Q. Dr. Lee, is what I've marked in green the top surface of hard mask layer 206?

A. On the specification that what you just drawn is -- would glean, a person of ordinary skill in the art would understand that that is the top surface of hard mask layer 206, because later on in Figure 6, it says that the direct layer 620 covers a top surface of hard mask layer,

which is -- from that, one -- a person of ordinary skill in the art would concluded that what you just drawn in green is a top surface of hard mask layer 206.

Q. So what I just drew in green is a top surface of hard mask layer 206?

A. I think from what I read in the specification, what you just drew in green is the top surface of the hard mask layer 206.

Q. Okay. Now, the -- in column 7, the last line, line 67, it refers to a side of hard mask layer 206, correct?

A. Yes.

Q. Is what I've marked in red in Lee Exhibit 1 a side surface of hard mask layer 206?

(Pause in testimony.)

THE WITNESS: Yes, what you've just shown in red is a side surface of hard mask layer 206.

///

BY ATTORNEY WATSON:

Q. The top surface of the hard mask layer in Figure 3 runs along the x-y plane, correct?

A. Can you repeat that again?

Q. The top surface of the hard mask layer in Figure 3 runs along the x-y plane, correct?

A. That is correct.

Q. And the side surface of the hard mask layer in Figure 3 runs along the z-axis, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: The side surface of the hard mask layer 206 is parallel to the y-z-axis -- y-z plane, sorry.

BY ATTORNEY WATSON:

Q. Is the side surface of the hard mask layer in Figure 3 perpendicular to the x-plane?

A. Well, x is an axis.

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: X is an axis, so perhaps the more correct way of saying it is that the side surface of the 206 -- hard mask layer 206 is perpendicular to the x-y plane.

BY ATTORNEY WATSON:

Q. The hard mask layer 206 -- strike that. Let me try that again.

The side surface of the hard mask layer 206 is perpendicular to the x-y plane, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: The side surface of the hard mask layer 206 where you illustrate it in red, which of course doesn't show the plane, because this is a two-dimensional figure, but the side surface of the hard mask layer 206 is indeed perpendicular to the x-y plane.

And that's what I just said earlier.

ATTORNEY WATSON: We can take down Lee Exhibit 1. Let's go to -- well, I'll mark that with its red and green lines as Lee Exhibit 1.

And let's pull back up Exhibit 1001.

BY ATTORNEY WATSON:

Q. Let's go to column 8 of the '666 patent, line 29 through 31.

ATTORNEY WATSON: Lucien, can I get that -- yes, thank you.

BY ATTORNEY WATSON:

Q. Are you there, Dr. Lee?

A. Yes.

Q. "Figure 5 illustrates a cross-sectional view of a staircase structure after removal of an insulating layer," correct?

A. Yes. That's what it says in column 8, line 31 -- line 29 to 31.

Q. And in Figure 5 of the '666

patent, what's labeled as 410 is a spacer?

A. In column 8, line 38, it says, "Spacer 410 of each SC layer."

So, yes, 410 is a spacer.

Q. In Figure 5, 204 is a sacrificial layer, correct?

A. In column 8, line 38, it says, "sacrificial layer 204." So the answer is, yes, 204 is a sacrificial layer.

Q. And in Figure 5, there is a portion of the top surface of the sacrificial layer 204 and spacer 410, correct?

A. In column 8, line 36, this says, "As illustrated in Figure 5, each SC layer of the staircase structure 500 exposes a portion of the top surface of sacrificial layer 204 and spacer 410 of each SC layer."

Q. Okay. You can keep that up, but I'm going to put up what we'll mark as Lee Exhibit 2, which is Figure 5 of the '666 patent.

(Whereupon, Exhibit 2 is marked for identification.)

BY ATTORNEY WATSON:

Q. Dr. Lee, do you recognize what we marked as Lee Exhibit 2 as Figure 5 of the '666 patent?

A. Yes.

Q. Now, we just read that there is a top surface of sacrificial layer 204 in spacer 410 that is exposed, correct?

A. That's correct. I just read that --

Q. Okay.

A. -- each SC layer of staircase structure 500 exposes a portion of a top surface of sacrificial layer 204 and spacer to 410 of each SC layer.

Q. Is what I've marked in green the top surface of the sacrificial layer 204 and spacer 410?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: What you mark is a -- this is a cross-sectioned view, which is a two-dimensional schematic of the structure.

But a person of ordinary skill in the art would understand that a 3D layer is a three-dimensional structure. So, therefore, that -- what you've drawn in green is showing the top line of sacrificial layer 204 and spacer 410.

In other words, it is impossible for you to draw the top surface of a sacrificial layer 204 and spacer 410, because this is a two-dimensional cross-section.

So you can't really draw a -- and illustrate a three-dimensional structure in a two-dimensional cross-section.

So what you draw in green is not the top surface of the sacrificial

layer 204 and spacer 410.

Do you understand what I'm saying?

BY ATTORNEY WATSON:

Q. So are you saying that the top surface of the sacrificial layer 204 and spacer 410 run along the x-y plane?

A. Yes. And what you see is only a cross-section in the x-z plane. So a person of ordinary skill in the art would understand that the structure actually go into the -- into the figure -- right? -- into the paper, into the screen of Figure 5.

So when you draw the green line, it just illustrating a cross-section. And one cross-section of the top surface of the sacrificial layer 204 and spacer 410.

You see what I'm saying? The top surface is a two-dimensional -- two-dimensional structure -- surface into the plane of Figure 5. And so the line is

just illustrating one cross-section of the top surface.

Q. Got it. So when the '666 patent refers to a top surface, it's referring to a horizontal surface; is that fair?

A. Yes. The top surface is a horizontal surface parallel to the top surface and the bottom surface of the substrate parallel to the x-y plane.

Q. Okay. Now, go back to column 8, lines 39 through 40.

A. Okay.

Q. It says there, "In some embodiments, a side of insulating layer 502 of each SC layer of staircase structure 500 is exposed."

Do you see that?

A. Yes.

Q. Dr. Lee, in figure -- strike that.

Dr. Lee, in Exhibit Lee 2 --

A. Yeah.

Q. -- is what I've marked in red the side of insulating layer 502 referred to?

ATTORNEY HERMAN: Objection. Form.

BY ATTORNEY WATSON:

Q. Let me -- let me redo that. Sorry. I did not draw that correctly. Let me try that again. You are correct. Can I delete that? All right.

Well, Dr. Lee, I just read you that there is a side insulating 4 -- 502 of each layer of staircase structure 500 that is exposed, correct?

A. Yes.

Q. Is that side of insulating layer 502 along the z-axis?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: A side surface of the insulating layer 502 is a two-dimensional plane.

Are you saying that is it

parallel to the y-z plane?

BY ATTORNEY WATSON:

Q. Yes. Is the side of insulating layer 502 parallel to the y-z plane?

ATTORNEY HERMAN: Objection to form.

THE WITNESS: When you say the side surface of the layer 502, the insulating layer 502, insulating layer is a three-dimensional structure, there are many sides, right? There's at least six sides.

So what you just said, yeah, some of the sides of the insulating layer structure 502 is parallel to the y-z plane, but there's also other sides that is parallel to the x-z plane. There's also sides that are parallel to the x-y plane.

So I don't know --

BY ATTORNEY WATSON:

Q. Does --

A. -- what you are referring to.

Q. Does Figure 5 depict the side of insulating layer structure 502 as being parallel to the x-y plane?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Again, the insulating layer 502 is a three-dimensional structure. It has many side -- sides. There's many side surfaces. I don't know which side surface that you are referring to. Can you tell -- can you clarify your question, please?

BY ATTORNEY WATSON:

Q. I'm just referring to the -- in column 8, lines 39 and 40.

Do you see that?

A. Yes.

Q. It says, "a side of insulating layer 502 is exposed."

Do you see that?

A. Yes.

Q. Well, let's move on. We'll mark this as Lee Exhibit 2, and we'll move on.

A. Okay.

Q. We'll move on. Probably -- we'll go now to another -- another figure. Okay.

Let's go to column 8, lines 41 through 43.

Dr. Lee, Figure 6 illustrates a cross-sectional view of a staircase structure 600 with a dielectric layer 620 disposed thereon, correct?

A. That is what is written in column 8, line 41 to 42.

Q. And in Figure 6, what's marked as 620 is a dielectric layer, correct?

A. That is what is written in the subsequent sentence that you just read. In fact, the sentence also include a dielectric layer 620.

Q. And in Figure 6, the dielectric layer 620 covers a top surface of staircase

structure 500 and a portion of the staircase structure 500, correct?

A. That is what is written in --

ATTORNEY HERMAN: Objection.

THE WITNESS: -- in column --

ATTORNEY HERMAN: Objection.

Form.

THE WITNESS: What you just read is this second sentence in that paragraph.

BY ATTORNEY WATSON:

Q. Well, let's put on the screen what we'll mark as Lee Exhibit 3, which is Figure 6 of the '666 patent.

(Whereupon, Exhibit 3 is marked for identification.)

BY ATTORNEY WATSON:

Q. Dr. Lee, do you recognize what we've marked as Lee Exhibit 3 as being Figure 6 of the '666 patent?

A. Yes.

Q. Okay. Now, in the portion of the

'666 patent we just read, it says, "Dielectric layer 620 covers a top surface of staircase structure 500," correct?

A. Yes.

Q. Okay. Dr. Lee, have I marked in green the top surface of staircase structure 500 that is covered by dielectric layer 620 to the extent it shows it in this cross-sectional view?

A. Again, this is just showing a cross-sectioned view of a three-dimensional structure. So as such, it is impossible for you to illustrate the top surface in a cross-sectional view of the 3D NAND structure such as one shown in Figure 6.

What you just shown is simply a line which is not -- which is a one-dimensional -- one-dimensional figure while the top surface or any surface is a two-dimensional entity.

Q. So you can't determine whether something is a surface based on a

two-dimensional cross-sectional? Is that your testimony?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I'm saying what you've just drawn is a line. It's not a surface. Anybody who took geometry in high school or middle school would understand that that is not a surface. It's a line.

BY ATTORNEY WATSON:

Q. So you'd agree with me that Figure 6 does not show the top surface of staircase structure 500?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Figure 6 simply illustrate a cross-sectional view of a staircase structure 600. It doesn't show.

BY ATTORNEY WATSON:

Q. Well --

A. It does not show the top surfaces or bottom surfaces of any layers.

Q. And that's because the top and bottom surfaces are horizontal surfaces in the x-y plane, correct?

A. That is correct. The top surface of the staircase structure is a two-dimensional plane parallel to the x-y plane which you cannot see in the cross-sectional view as illustrated in Figure 6.

Q. Now, if you go to column 8, lines 43 through 45, it also describes the dielectric layer 620 covering a portion of side -- of a side of staircase structure 500, correct?

A. Yes. That is what is written in column 8, line 43 to 45.

Q. Is what I've marked in red in Lee Exhibit 3 a portion of a side of staircase structure 500 covered by the dielectric layer 620?

A. Again, a staircase structure 500 is a three-dimensional structure. A side or a side surface is a two-dimensional entity. What you just draw is a line, which is a 1D entity, which doesn't illustrate a side surface or side of a staircase structure 500.

Q. Would you agree with me then that there is a plane in the vertical direction that is a side surface of staircase structure 500 covered by the dielectric layer in Figure 6?

A. Which dielectric layer are you referring to?

Q. Dielectric layer 620.

A. So you are saying that is there a surface perpendicular to the x-y plane, in other words, a surface going into the board -- going into the screen from what you -- what you draw the red line, is that a side surface of the staircase structure?

Is that what you mean?

Q. Yes.

A. Yes. Even though this is an incomplete two-dimensional illustration, that a person of ordinary skill in the art, in fact, someone who has taken geometry will understand that when you draw, it's just a line.

However, that from the illustration and from the specification of the '666 patent, one can say that the side surface of the staircase structure 500 is parallel to the y-z axis and perpendicular to the x-y plane.

Q. So to be clear, the side surface of the staircase structure 500 is parallel to the x-z axis, correct?

A. Parallel to the x-z plane.

Q. And the side surface of staircase structure 500 is perpendicular to the x-y plane, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: The side surface of the staircase structure 500, again, there are -- the structure is a three-dimensional structure, but each layer have many sides, okay?

And in your sentence, in your question, I don't know which side you are referring to.

BY ATTORNEY WATSON:

Q. Fair, fair.

A. A person listening to your question, which side are you referring to? Are you referring to a particular side of the staircase structure?

What I'm saying is that your question is incomplete.

Q. Okay. Let's move on then. Let's go to column 8, lines 51 through 52 of the '666 patent.

A. Okay.

Q. We can take Exhibit 3 off.

A. 51 to 52?

Q. Yeah.

ATTORNEY WATSON: Can you put back on Exhibit 1001.

BY ATTORNEY WATSON:

Q. In column 8, lines 51 through 52 of the '666 patent, it says "In some embodiments, dielectric layer 620 has poor step-coverage on staircase structure 500," correct?

A. That's what it says in that -- in column 8, line 51 to 52.

Q. What is "poor step-coverage"?

A. Well, a step-coverage -- right? --

Q. Uh-huh.

A. -- and I -- let me go to my declaration. Sorry.

(Pause in testimony.)

THE WITNESS: We don't talk about that. I'm trying to see.

BY ATTORNEY WATSON:

Q. Do you know what poor

step-coverage is?

A. I want to make sure that...

So a step-coverage -- I thought I say something about that in my declaration. I'm trying to search for the word "step-coverage," but it doesn't appear to -- to be there.

A person of ordinary skill in the art -- in fact, I teach this in my undergraduate class and my graduate class, that a step-coverage refers to how uniform a deposited film coat the surfaces of a structure, right? That has a topography.

And how well it coat the surfaces such as the steps, the side relative to the coating on the planar surface.

So it's -- a good step-coverage means that if you have a step in a semiconductor structure, a good step-coverage is that the film thickness measure on the side wall is the same as the film thickness on the top surface.

So a step-coverage of 100 percent, a step-coverage, in general, defined as the ratio of the thickness, the film thickness on the side wall or on the bottom of the step over this film thickness on top surface, okay?

So if the -- if the two thicknesses are the same, then the step-coverage is 100 percent and is good.

And, in general, when you do a chemical vapor deposition or an atomic layer deposition, that is very -- the coverage -- the deposition is very conformal, meaning that it follows the contour of the step and that the step-coverage is 100 percent.

Meaning that the thickness measure on the side wall, the thickness of the film on the side wall is equal to the thickness of the film on the top surface.

So when the patent said that it is a poor step-coverage, it means that

there is -- the thickness on the side wall is smaller than the thickness on the top surface. And that is illustrated in figure -- I try to see -- you probably can find it. [Speaking sotto voce].

So it is illustrated in Figure 6. If you show the screen on Figure 6, Mr. Watson.

Q. Yep. I'm pulling it up.

A. You see that as it's illustrated in Figure 6, the thickness of the layer 1, 620 on top surfaces are thicker than the thickness of the deposit film 620 on the side wall of the staircase structure 500.

So that is what it means by poor step-coverage.

Q. So Figure 6 depicts poor step-coverage; is that fair?

A. It illustrate a poor step-coverage of the deposit layer, dielectric layer 620 of the staircase structure. And it is likely formed by

physical vapor deposition that is well known to give you a poor step-coverage.

Q. And the reason you know this is poor step-coverage is because the top surfaces of layer 620 are thicker than the thickness of layer 620 on the side wall?

A. That is correct. That the Figure 6 illustrating that -- illustrates that layer 620 is not conformally deposited over the staircase structure.

So, therefore, as a consequence of that deposition, you have the thickness of layer 620 on top surfaces to be thicker than the film thickness on the side walls of the staircase structure 500 -- or 600 in Figure 6.

Q. When you say "side walls," are you referring to the side surfaces?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: In general, as you can see in Figure 6, that each

staircase has a -- as illustrated in Figure 6, has a side as a side of staircase structure 500.

And so, yes, I'm saying that the thickness of the film 620 is thicker on the top surface than on the side surface of the staircase structure.

BY ATTORNEY WATSON:

Q. Now, in Figure 6, dielectric layer 620 has a curved surface at the bottom of each step.

Do you see that?

A. So can you -- I'm not sure what you're referring to.

Q. So, for example, if you look at layer 620 here, layer 620 --

A. Would you mind rotating the figure?

ATTORNEY WATSON: Yeah, yeah. Can we get the rotation feature up on the screen? I don't have it on the screen, Lucien.

Yeah, perfect.

BY ATTORNEY WATSON:

Q. So in Figure 6, there's layer 620.

You see that here?

A. Yes.

Q. Okay. And if you go to the far left, there's a curve of sorts that curves down.

Do you see that?

A. Can you use a color and show me where --

Q. Let me see if I can use a color. I don't need to mark -- I don't necessarily want to mark another exhibit, but let's see if we can.

You know what, we'll just move on, if that's okay.

So you mentioned before that poor step coverage is typically forwarded by physical vapor deposition, correct?

A. Yes. There's one way to -- one

such process that would result in poor step-coverage, because the process is more line of sight, shadowing effect, which can be a thinner spot on the side of the structure.

Q. And so when you use physical vapor deposition, you deposit species to the staircase structure using both directional and isotropic fluxes, correct?

A. Can you repeat that again?

Q. Sure.

When you use physical vapor deposition, you deposit species to the staircase structure using both directional and isotropic fluxes, correct?

ATTORNEY HERMAN: Objection to form.

THE WITNESS: You said directional isotropic?

BY ATTORNEY WATSON:

Q. And isotropic, yes.

A. Okay. Directional and isotropic?

Q. Correct.

A. Okay. So because directional, isotropic are conflicting with each other. So you're saying that physical vapor deposition is such a -- such deposition that result in more a line of sight directional deposition, which would result in poor step-coverage.

Q. I'm saying -- oh, go ahead.

A. So one such process is, for example, sputtering. Sputtering process is that ions are striking -- creating a plasma that strike a target and not the atoms free, which then deposit onto the wafer. So, therefore, it's almost, like, vertical shower onto the substrate.

As a result, this is a line of sight deposition and, therefore, that you would have a thick -- thin thickness on top surfaces of the step and thin thickness on the side -- vertical side of the structures in the substrate.

Q. Now, do you see in Figure 6 there's an overhang of the dielectric layer over the end of each stair.

Do you see that?

A. Can you color what you mean --

Q. I'm not sure if it's easy -- that easy to color, but let me see. So there's a -- I don't know what you want to call it, a curved overhang over that -- that overhangs over the end of each step.

Do you see that?

(Pause in testimony.)

BY ATTORNEY WATSON:

Q. Let me try it this way. Can you go to the '666 patent, column 12, lines 30 -- go to 36.

A. Yes.

Q. Okay. Let me know when you're there.

A. I'm there.

Q. Yeah. So in the '666 patent, it says, "The dielectric layer is

substantially thinner at a side of a staircase structure than at a top surface of the staircase structure."

Do you see that?

A. Yes. That's what happened --

Q. That -- that's referring to the poor step-coverage, correct?

A. Yes. That is the result of the non-conformal deposition.

Q. And because the top surface of the staircase structure is so much thicker than the side surface of the -- strike that. I had that all wrong.

Because the top surface of the dielectric layer is thicker than the side surface, you cannot deliver additional species to that bottom corner on the side surface, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I don't think your question make any sense.

BY ATTORNEY WATSON:

Q. Let me -- let me move on. I'll move on --

A. Okay. Thank you.

Q. -- and we'll go over the next thing.

A. Okay.

Q. So Figure 6 is a step of the process used to form the staircase structure described in the '666 patent, correct?

A. Figure 6 shows one step of the fabrication process.

Q. Okay. So after Figure 6, the '666 patent describes removing the spacers 410 in a portion of the dielectric 620 to form the landing pads, correct?

A. Are you reading from the -- from '666 patent?

Q. I'm not reading directly from it. I'm trying to summarize it to save us time.

A. So --

Q. But you can go to column 9, lines 8 through 23 if you want to see where I'm getting that from.

A. Column 9. Line what?

Q. 8 through 23.

A. Oh, Figure 7?

Q. Yeah. So in the fabrication process described in the '666 patent, after Figure 6, the patent describes removing spacers 410 and a portion of dielectric 620 to form landing pad 720, correct?

A. So, yes, in column 9, line 12, it says, "After removing spacer 410 and the portion of dielectric layer 620, a landing pad is formed over each SC layer of the staircase structure 700."

Q. Now let's go down to -- let's go to Figure 8 --

A. Okay.

Q. -- of the '666 patent.

A. Okay.

Q. The description of Figure 8 is

found in columns 9/35 to column 10/43.

Do you see that?

A. Yes.

Q. Okay. So, "Figure 8 illustrates a cross-sectional view of a staircase structure 800 with a dielectric layer 825 disposed thereon," correct?

A. That's what it is written in column 9, line 35 to 36.

Q. Okay. And if you look at Figure 8, like the other figures in the '666 patent, Figure 8 is oriented in the x-z plane, correct?

A. Figure 8 is a cross-sectional view of a staircase structure labeled as 800 in Figure 8, the cross-sectional view in the x-z plane.

Q. And in Figure 8, what's labeled as 820 is the landing pad, correct?

A. That is what is written in column -- sorry. Column 9, line 47, landing pad 820.

Q. And in Figure 8, there is a conductive layer labeled 840, correct?

A. In column 9, line 47 to 48 says "conductive layer 840."

Q. Okay. And the landing pad 820 can be the same material as the conductive layer 840, correct?

A. Yes.

Q. Okay. And in Figure 8, there's an insulating layer 502, correct?

A. Yes.

Q. Okay.

A. In column 9, for example, line 49, 52, 54 all indicating that 502 is what is called insulating layer.

Q. Now, we talked before about horizontal surfaces being referred to as a step of the staircase structure.

Do you remember that?

A. Can you repeat your question, please?

Q. Yeah.

Do you remember that the '666 patent refers to horizontal surfaces as a step or stair of the staircase structure?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Which...

BY ATTORNEY WATSON:

Q. We can go to column 5, lines 47 through 52 if you want. Let's go there.

ATTORNEY WATSON: Can we rotate this back.

THE WITNESS: Line 47?

BY ATTORNEY WATSON:

Q. Yeah.

A. "Each horizontal surface is adjoined to a vertical -- first vertical surface that extend upward from the first -- from a first etch of the horizontal surface."

Is that what you're referring to?

Q. Yes.

A. Okay. That's what it says there.

Q. Okay. It then says, "Each of the horizontal surfaces is referred to as a step or stair of the staircase structure."

Do you see that?

A. In line 51, it says each of the horizontal surfaces is referred as step or stair of the staircase structure, yes, that's what it says there.

Q. Okay. Let's go back to Figure 8 of the '666 patent.

Are you able to see the steps of the staircase structure in Figure 8?

A. Each of the horizontal surfaces is referred to a step or stair of the staircase structure. So horizontal surface means that it is parallel to the top surface of the substrate, which means it's in the x-y plane.

Q. But you're not able to see or identify the steps in Figure 8, because you can't see into the x-y plane, correct?

A. That is correct. This is just a

cross-section. It doesn't demonstrate a three-dimensional structure. So you cannot see the step of the staircase structure, because it is in the x-y plane, which it's not illustrated in Figure 8.

Q. Now, Figure 8, each insulating layer 502 has a top surface, correct?

A. Do you read it from the specification?

Q. No. I'm just looking at the figure.

Would you agree with me that each insulating layer 502 has a top surface?

A. Again, this is a cross-section, so one cannot see the x-y plane. So it would be best if we can illustrate it from the specification.

Q. Okay. So how would you illustrate the top surface of insulating layer 502?

A. What I'm saying is that if you can find me where in the specification talk

about the top surfaces of 502 in Figure 8 and that it is a parallel layer parallel to the top surface of the substrate, in other words, parallel to the x-y plane.

So even though it cannot be illustrated in the figure, perhaps it have discussed that in the specification.

Q. So in the specification, it refers to each step having two horizontal surfaces and two vertical surfaces.

Do you remember that?

A. Can you point to where --

Q. Yeah. We talked about it in column 5, lines 44 through 47.

A. Column 5?

Q. Uh-huh.

A. Line?

Q. 44 through 47.

A. The staircase structure refer to a set of services that include at least two horizontal surfaces alone -- that is, for example, along an x-y plane and at least

two vertical surfaces, for example, along the z-axis.

See, that's -- that's not really accurate. Along a y-z plane, I think that's what the patent trying to say.

Q. Are you saying that the patent is inaccurate in column 5, lines 44 through 47?

A. I'm saying that it could be more clearer and more accurate to say along an X -- along the y-z plane rather than along an X -- along the z-axis.

Q. So the vertical surfaces must be along the y-z axis; is that fair to say?

A. Parallel to -- parallel to the y-z plane.

Q. So the vertical surfaces described in the '666 patent are parallel to the y-z plane?

A. Exactly.

Q. Why are they not parallel to the x-z plane?

A. Well, it could be, because the way it is written, it says along the z-axis. So it's not -- it could be the surface -- the side surface, the vertical surface, the spacing us -- on -- in Figure 8, in other words, parallel to the x-z plane.

That's why I said that that sentence is not written so clearly. Because when they say that along the z-axis, meaning parallel to the z-axis or, you know, it could be parallel to the x-z -- X -- parallel to the y-z plane, it could be parallel to the x-z plane, and there -- you know, four different surfaces that is vertical surfaces.

Q. And those four different surfaces that are vertical surfaces, those would be side surfaces, correct?

A. So you have a three-dimensional object -- right? -- that has at least six sides. So the vertical surfaces can be

parallel to y-z plane or can be parallel to the x-z plane assuming that this is a cube, not a sphere.

Q. Okay.

A. So to answer your question, yes, those perhaps a person of ordinary skill in the art or even a middle school student taking geometry would say that those are -- those can be referred to as a side surface -- side surfaces.

Q. Now let's go to your declaration real quick.

A. Okay.

Q. Let's go to -- so let's pull up Exhibit 1003. We'll go to paragraphs 56 through -- I'm sorry -- go to paragraph -- go to paragraph 65 through 74.

A. Okay.

Q. Let me know when you're there.

A. 65 to 74?

Q. Yeah.

A. Is under section B, "Overview."

Q. Uh-huh. Now, your section found in paragraphs 65 through 74 discuss the '666 patent, correct?

A. Well, as I mention, that this is a brief overview of the '666 patent.

Q. Okay.

A. Obviously, that -- there's a lot more detail, but this is simply a brief overview.

And is there a question?

Q. I just wanted to know, can you point to someplace in your declaration were you identify a curved side surface in the '666 patent?

A. Well, the specifications of the '666 patent does not use the word "curve." Nowhere in the specification talk about curved side surface. It's never -- the word "curve" or "curvature" or "curved side surface" is not in the specification of the '666 patent.

Q. Is there a curved side surface

shown in any of the figures of the '666 patent?

A. Again, the patent never describe a curved surface. In the specification, it never illustrate as far as a person of ordinary skill in the art would see that has not illustrate and back up with a specifications that the structure discussed in the specifications of the '666 patent has a curve or has a curved side surface or has a curved surface, for that matter.

Q. So it's your opinion that none of the figures in the '666 patent show a curved side surface?

ATTORNEY HERMAN: Objection to form.

THE WITNESS: You see, the claims that we're dealing with talks about this Claim 17 and Claim 19, right?

BY ATTORNEY WATSON:

Q. Uh-huh.

A. Which is a structural claim, not

a method claim. So we're talking about a final structure of the process.

So you agree that that is Figure 8 of the '666 patent. And the specification never use the word "curved" never construe the word "curved" and never say that certain figure, particular Figure 8 illustrate a curved side surface.

And the drawing is not particularly clear, black and white with poor resolution, a person of ordinary skill in the art looking at those figure along with specification would not conclude that any of those surfaces is curved.

Q. Do you offer -- you don't offer the opinion in your declaration that the '666 patent does not enable a curved side surface, correct?

A. If you read my overview, of the '666 patent -- right? -- in section B, there is no word where it says "curve" or "curved side surface."

Q. But that's not my question.

My question is: Do you offer an opinion in your declaration that the '666 patent does not enable a curved side surface?

A. I'm saying that based on the specifications of the '666 patent, the inventor does not use the word "curve" and does not describe any surfaces as curve and does not discuss a curve side surface.

Q. Yeah, but that's not my question.

My question is: Did you offer an opinion in your declaration that the '666 patent does not enable a curve side surface?

ATTORNEY HERMAN: Objection. Asked and answered.

THE WITNESS: I believe that the specification does not use the word "curve" or does not describe a curved side surface and does not describe how to form a side surface.

So, therefore, a person of ordinary skill in the art reading the '666 patent would not understand what the inventor tried to say in terms of how to form a side surface.

BY ATTORNEY WATSON:

Q. So can you direct me to where in your declaration you say a person of ordinary skill in the art would not understand how to form a side surface in view of the '666 patent?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I'm saying that in the summary, in the overview of the '666 patent and my declaration and a person of ordinary skill in the art reading the specifications of the '666 patent which does not use the word "curve," does not describe a curved side surface, does not describe how to form a curved side surface.

And a person of ordinary skill in the art reading the '666 patent specification and the file history would not understand that the way to -- would understand that there's no description of '666 patent in terms of how to enable the curved surface.

I don't need to explicitly say that in my declaration. A person of ordinary skill in the art reading the specifications would understand that. It didn't talk about it.

BY ATTORNEY WATSON:

Q. But you agree with me that you did not make that opinion in your declaration, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I don't need to. And I'm offering you this opinion now that the specification of the '666 patent does not use the words "curve,"

never describe what a curved side surface is, never discuss how to form a curved side surface.

A person of ordinary skill in the art reading that would understand that they didn't talk about it, period. I, you know, don't think I need to spell out everything that's absent from the specification.

BY ATTORNEY WATSON:

Q. I don't think that was my question.

I just asked you: You did not make that opinion in your declaration?

A. I don't think I need to, because it is clear --

Q. Whether or not you need to, my question is: Did you offer -- you didn't -- let me...

Did you offer that opinion in your declaration?

ATTORNEY HERMAN: Objection.

Form. Also asked and answered.

THE WITNESS: Again, I don't need to offer that opinion, because it is clear that the specification did not talk about curve, did not talk about curve side surface, did not talk about how to form curve side surface.

So I don't need to, and I didn't.

ATTORNEY WATSON: Let's take a break. We've been going about an hour, hour and a half or so.

THE WITNESS: Okay.

THE STENOGRAPHER: We're off the record.

(Whereupon, a recess was taken at 11:57 a.m.)

THE STENOGRAPHER: We're back on the record.

BY ATTORNEY WATSON:

Q. Welcome back, Dr. Lee.

A. Thank you.

Q. Did you discuss your testimony

with anyone during the break?
A. No.
Q. Now let's go to paragraph 64 of your declaration.
A. Let me get there.
Q. Are you there, Dr. Lee?
A. "For the purpose of this declaration," is that right?
Q. Yes, that's the right paragraph.
A. Okay.
Q. You applied the date of August 28, 2017, as the effective filing date of the '666 patent, correct?
A. Yes. I was -- I had been instructed to use August 28, 2017, as effective filing date of the '666 patent.
Q. Did you -- did you do any analysis to determine whether the '666 patent can claim priority back to August 28 of 2017?
A. I beg your pardon?
Q. Did you do any analysis to

determine whether the '666 patent with claim priority back to August 28, 2017?

A. Did I do any analysis? Is that what your question is?

Q. Yes.

A. I'm not a lawyer, but my understanding is that -- my understanding is that the -- the priority date is based on the earliest applications in the chain.

Again, I'm not a lawyer, so you tell me. But according to counsel, August 28, 2017, is the effective filing date of the '666 patent.

Q. Do you agree that August 28, 2017, is the effective filing date of the '666 patent?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Again, I'm not a lawyer. And all the fine details and intricacies of what determine the effective filing date of certain patent

is beyond -- you know, there's so much detail.

But I believe that -- I agree that based on what I read on the front page of the '666 patent, the earliest date in the chain is August 28, 2017.

BY ATTORNEY WATSON:

Q. Did you apply the August 28, 2017, effective filing date, because counsel gave you that date to apply?

A. Again, I'm not a lawyer. I have to gain advice from my counsel. And I have done many patents litigations. And it seems to agree with my understanding of what it means by "effective filing date" of this patent.

Q. So with counsel, you came up with the effective filing date of August 28, 2017?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: So my understanding

that -- is the effective filing date of a patent is the date that's used to determine what counts as prior art against it.

And that my understanding is that if there's an earlier filing or earlier application, then we should consider the earliest application or filing date of the chain of the application of the patent.

So, for example, if the patent was filed in January 1, 2020, but there's a provisional patent filed a year earlier, let's say February -- February the 2nd, 2019, then the effective date -- effective filing date will be February 2, 2019.

But, again, I relied on counsel to determine what is the effective -- effective filing date of the '666 patent. And since this is a legal matter and so I have been -- I rely on

the instruction for my counsel.

BY ATTORNEY WATSON:

Q. Sitting here today, do you have any reason to believe that the effective filing date of the '666 patent is later than August 28, 2017?

ATTORNEY HERMAN: Objection. Form. Also outside the scope of direct.

THE WITNESS: As I discuss in paragraph 64, that I have been instructed to use August 28, 2017, as the effective filing date of the '666 patent, so there's no reason for me that the effective date is later than that. You tell me. You're the lawyer.

BY ATTORNEY WATSON:

Q. Well, in your declaration you didn't do any analysis to determine when the effective filing date of the '666 patent was, correct?

A. What do you mean I didn't do any

analysis? What kind of analysis --

Q. You applied --

A. What kind -- what kind -- what kind of analysis are you talking about?

Q. You applied the effective filing date that was given to you by counsel, correct?

A. Yes, that is correct. But that aligns with my understanding looking at the front page of '666 patent that the earliest application shown to be August 28, 2017.

Q. Okay. All right. Let's go to paragraphs 36 and 37 of your declaration.

A. Hold on. 30... [speaking sotto voce].

36?

Q. And 37. And let me know when you're there.

A. So this is the section under level of skill in the art.

Q. Correct. Does paragraphs 36 and 37 lay out your opinion of the

qualification of a person of ordinary skill in the art that you used when analyzing obviousness for the '666 patent?

A. Well, I think the entire section, paragraph 34 to 38, is my understanding of what is considered to be a person of ordinary skill in the art.

Q. Did you apply any other qualifications of a person of ordinary skill in the art in your analysis other than those listed in paragraphs 34 through 38 of your declaration?

A. No. I mean, I have written what I considered to be a person of ordinary skill in the art in paragraph 34 to 38. So I did not use other criteria --

Q. Okay.

A. -- to advise.

Q. Let's go to paragraphs 75 through 92.

A. 75. Okay. To? Are you talking about --

Q. 92.
A. Okay.
Q. You reviewed the prosecution history of the '666 patent?
A. Yes.
Q. And your opinions about the relevance of the prosecution history of the '666 patent are contained in this section of your report?
ATTORNEY HERMAN: Objection. Form.
THE WITNESS: Can you clarify your question? I'm not sure if I understand what you mean by that.
BY ATTORNEY WATSON:
Q. This section in paragraphs 75 through 92 lays out your discussion about the prosecution history, correct?
A. Yes. That is my understanding of the prosecution history summarized in Section C in paragraph 75 to 92.
Q. Let's turn to paragraph 84 of

your declaration.

Do you see that?

A. Yes.

Q. In paragraph 84, you discuss a prior reference called Hyun, correct?

A. Hyun.

Q. Hyun?

A. Hyun. Yeah.

Q. Okay. And in paragraph 48, you show Figure 2H of Hyun, correct?

A. Which paragraph?

Q. Paragraph 84 of your declaration.

A. Yes.

Q. Now, Figure 2H of Hyun is shown to be a cross-sectional image in the x-z direction; is that fair?

A. Do you have a copy of the Hyun?

Q. I don't. But do you know based on this figure which -- which direction is being shown here?

A. That's why I'm asking for the prior art Hyun, whether it label the x-y

axis or z-y axis.

Q. But based on your discussion in your collation, you don't make any mention about whether it's an x-y or x-z direction, correct?

A. No. I did not discuss what plane -- or which plane is -- this cross-section or parallel to.

But if you can show me the Exhibit 1016, it would be very helpful to answer your question directly.

Q. Okay. I may come back to that.

But does this figure in Hyun show a curved side surface?

A. As far as I can tell -- again, it would be good if you -- let me check if I have discussed more in my declaration.

I'm looking at this now. Hyun in Figure 2H does not show a curved side surface.

Q. Now, in this section regarding the prosecution history, you don't identify

any discussion about the curvature of surfaces in the x-y direction, correct?

A. Yeah. As I mention, that the -- earlier that the specification does not use the word "curve." And I believe that none of the prior art, for example, Hyun has -- in the file history has discussed.

Q. So in your --

A. For example --

Q. Oh, sorry.

A. For example, as I discussed in paragraph 81, none of the lead prior art in the file history, 385, none of those pads appears to include a curved side surface.

Q. Is there any discussion that you're aware of in the prosecution history about curvature of surfaces in the x-y direction?

A. As I discuss in this section, for example, in paragraph 87, Hyun and Hashimoto do not appear to illustrate landing pad with -- with the type of curve

side surface that the Claim 17 of '666 require.

And so not only the specification of the '666 patent does not use the words "curve" or "curved side surface" or method of forming a curved side surface, none of the prior art discussed during the prosecution history including Lee, Hyun and Hashimoto discuss -- at least does not appear to discuss the landing pad of the staircase having any type of curved side surface.

So, therefore, the person -- a person of ordinary skill in the art reading the specification of '666 and the prior art in the file history, including Lee, Hyun and Hashimoto would understand what the inventor mean by "curve."

Because none of those prior arts, and including '666 patent, the specification of '666 patent use the word "curve" or "curved side surface" or the

method of creating curved side surface.

Q. Are you aware of any discussion in the prosecution history by the applicant or examiner about the curvature of side surfaces in the x-y direction?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Well, as I discuss and answer just a second ago, that none of the specification of the patent, '666 patent and the prior art discuss in the file history including Lee 385, Hyun 540 and Hashimoto, none of those discuss the word or use the word "curve" or "curved side surface."

BY ATTORNEY WATSON:

Q. What about the applicant and the examiner in the prosecution history? Are you --

A. As --

Q. Go ahead.

A. As far as I can recall, the file

history shows that the inventor did not use a specific term called "curved side surface." He might have used -- it had -- it had used specific terms like top side surface when they wanted to specify a particular side surface. And I don't recall any correspondence in the file history mention curved side surface and -- except in the claims of Claim 17.

Q. Other than the claims in Claim 17, you can't identify any discussion in the prosecution history about the curved side surface; is that fair to say?

A. Other than the claims -- other than the Claim 17, we're dealing with only Claim 17 and Claim 19 here. Other than in the Claim 17, a curved side surface is mentioned in Claim 17.

Other than that, I don't recall any prior art references in the course of the file history discuss or appear to show curved side surface.

And so that's my answer to your questions.

Q. So you don't recall any correspondence in the file history that mentioned a curved side surface?

A. I don't recall any correspondence. But if you can give me -- it's been a while that I review the document and the file history. And so if you can provide the file history and upload it in the link, I can answer your questions more clearly.

But at this point as I sit here today, I don't recall mentioning the word "curved side surface" in the correspondence perhaps except for the term in the claim language.

Q. Okay. Let's go to paragraph 90 -- paragraphs 94 through 97 --

A. Yes.

Q. -- of your declaration.

A. Yes.

Q. In performing your analysis, you use the plain and ordinary meanings of the terms in the '666 patent, correct?

A. That's what it says there.

Q. You didn't apply any special definitions to any claim term, correct?

A. I did not provide any claim construction or any explicit or give any explicit definition of any claim term.

Q. Okay.

A. And the words, as I --

Q. And you didn't identify any terms that require claim construction?

A. So in paragraph 97, I clearly -- so it's my opinion that the terms of '666 patent's claims do not require further construction and can be afforded their plain and ordinary meaning for the purpose of the analysis of prior art that I'm conducting in this declaration.

Q. All right. So, Dr. Lee, in your declaration you're arguing three different

grounds of obviousness; is that fair?
A. Yes. Ground 1, 2 and 3 as listed in the table of content.
Q. Let's turn to paragraph 135 of your declaration.
A. Let me get there.
Q. Are you there, Dr. Lee?
A. Yeah, is there a question?
Q. Yeah. So the first ground of obvious that you claim are that Claims 17, 19 and 20 are obvious over Kim, correct?
A. Yes.
Q. You have not offered an opinion that the claims of the '666 patent are anticipated by Kim, correct?
A. No, I did not.
Q. Okay. Let's go to paragraph 157.
Are you there?
A. Yes.
Q. Paragraph -- in paragraph 157 and 158, you offer the opinion that the limitation, "A plurality of layer stacks,

each layer stack comprising an insulating layer disposed over a first portion of a conductive layer is taught by Kim," correct?

A. That's what I wrote in paragraph 157 and 158 at Claim 17 -- well, "Requires plurality of layers stack. Each layer stack in this plurality must include insulating and conductive layer. The insulating layer must be disposed over the first portion -- a first portion of the conductive layer."

And in paragraph 158, I said, "In my opinion, this is taught by Kim."

Q. So let's go then to paragraph 186.

Are you there?

A. Yes.

Q. In paragraph 186, you opine that, "Kim, in view of the knowledge of a POSITA, renders the limitation wherein a second portion of the conductive layer comprises a

curved side surface in contact with a side surface of the insulating layer obvious," correct?

A. That's what is written there.

Q. Okay. So you do not opine that this limitation, limitation 17.C.2 is "taught by Kim," correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I don't know what you mean by "taught by Kim."

BY ATTORNEY WATSON:

Q. Well, with regards to the limitation 17.C.1, you say, Kim teaches this limitation, right?

A. Which paragraph?

Q. So previously for all the other limitations, you say this limitation is taught by Kim.

Do you see that in paragraph 158?

A. 158, I need to go there. Sorry.

Q. In paragraph 158, you say, the

limitation is "taught by Kim," fair?

A. Sorry. Let me go there. Sorry. 158?

Q. Uh-huh. Do you see that? Are you at paragraph 158?

A. Yes. I see that. And that means that...

Q. Where does it mean that the limitation is taught by Kim?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I'm sorry. I'm trying to search word -- I think that what I meant is that Kim expressly or inherently disclose that limitation 17.C.1. And because each layer stack comprises an insulating layer disposed over the first portion of the conductive layer.

So it is clearly shown in Figure 4B and clearly discuss in the specifications of Kim. And, at worse,

would make it obvious.

But 17.C.2, Kim does not expressedly or inherently disclose the curved side surface. But a person of ordinary skill in the art reading Kim in view of his knowledge would render this limitation obvious.

BY ATTORNEY WATSON:

Q. So it's your opinion that limitation 17.C.2 is obvious in view of Kim, correct?

A. Yes. 17.C.2 that a person of ordinary skill in the art reading Kim in view of his knowledge would render this limitation 17.C.2 obvious.

Q. It is also your opinion that Kim does not expressly or inherently disclose limitation 17.C.2, correct?

A. Let me think about that. Sorry.

Q. Well, for the other limitations, you rely for -- you rely on it being taught, correct?

(Pause in testimony.)
BY ATTORNEY WATSON:
Q. Let me -- let me --
A. That is correct that when I say that Kim in view of the knowledge of the POSITA render this obvious means that Kim alone does not expressedly or inherently disclose this claim limitation.
A person of ordinary skill in the art with the knowledge and would find it obvious to render this limitation invalid -- render this limitation obvious.
Meaning that it would be obvious to implement the missing features without extensive or undue experiments or experimentation.
Q. Kim alone does not expressly or inherently disclose limitation 17.C.2, correct?
A. I think I answered that, that Kim alone does not expressly or inherently disclose every element of that limitation

17.C.2 --

Q. Okay.

A. -- exactly as claimed.

Q. Now let's go to -- let's talk about Kim a little bit, if that's okay.

A. Sure.

Q. All right. Let's turn to paragraph 144 of your declaration.

A. Okay.

Q. In paragraph 144 of your declaration, you include an annotated version of Figure 4B of Kim, correct?

A. Yes.

Q. And you labeled the top surface in Figure 4B, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Yes.

BY ATTORNEY WATSON:

Q. Now, this is a cross-sectional view, correct?

A. That is -- that is correct. So

based on the description of Kim, that it is understood that this three-dimensional structure is extended into -- from this cross-section into the -- into the screen or into the board of the picture.

So, therefore, with that in mind, a person of ordinary skill in the art would understand that -- that it extend into the -- into the x-y plane.

In fact, Kim -- also if I -- if you can upload Kim, they -- Kim also disclose -- discloses three-dimensional drawing of the structure, which demonstrates that the cross-sectional view.

Even though it is a two-dimensional cross-sectional view, looking at those three-dimensional schematic, a person of ordinary skill in the art reading Kim would understand what it look like in the three-dimensional perspective even though some of the figures only show two-dimensional cross-section.

Q. Now, this top surface in Kim that you identify, is that a horizontal plane?

A. Yes. It is a horizontal plane parallel to the surface of the substrate.

Q. And the top surface of the substrate in Kim is not a vertical plane, correct?

A. When you say "vertical," it means that it's in the z direction?

Q. Correct.

A. No, it is not a vertical plane.

Q. Okay. Let's turn to paragraph 193 of your report.

Are you there, Dr. Lee?

A. Yes.

Q. In paragraph 193 of your report, you annotate a version of Figure 4B from Lee -- or from Kim, correct?

A. That's right.

Q. And in this Figure 4B, you identify the insulating layer in blue, correct?

A. Yes.

Q. The insulating layer you identify stops in the x direction at the contact pad, correct?

A. Yes. As shown in Figure 4B in paragraph 193, that I show that the insulating layer including element 110 and element 122 and it stop -- is shown to stop at the contact pad.

Q. So the insulating layer in Kim does not include element 122 that's on the far right of the contact pad, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: What I illustrate there is that -- see, the insulating film or insulating layer, a person of ordinary skill in the art reading the claims would understand that the insulating layer is part of the staircase layer that define the contact holes.

Based on Kim, a specific insulating layer that define the contact holes is the border line, which is 110 and a portion of 122.

Now, you could -- a person of ordinary skill in the art, understand that depending on the -- well, understanding that the contact pad is defined not only on the left side, the left -- the portion of 122 on the left side of the contact pad shown in Figure 4B in paragraph 193 but also a portion of 122 on the right side of the contact pad highlighted in brown.

But what I'm trying to illustrate in paragraph 193 and subsequent paragraph is that the second portion of the conductive layer comprises a curved side surface in contact with a side surface of the insulating Layer.

So I did that, because I simply want to illustrate that there's a

curved side surface between the blue layer, so called the insulating layer and the brown layer, which is the second portion of the conductive layer that I want to show that it is obvious that the contact point -- the point of contact is comprising a curved side surface.

BY ATTORNEY WATSON:

Q. Okay. So let me ask you a question about this figure, Figure 4B.

Do you see that there --

A. Yes.

Q. -- in your --

Okay. The first portion of the conductive layer expands the entirety of the x direction of the conductive layer; is that fair to say?

A. I don't know what you mean by "entirety."

Q. Well, you identify a conductive layer, a first portion of the conductive

layer in green, correct?

A. Entirety of a particular step in the staircase region? Because entirety could mean -- you know, various things. Entirety from across the entire chip? When you say "entirety," I'm not sure what you mean by that.

Q. Let me clarify, if that's okay. I'll clarify that, okay?

A. Yeah. Please, please.

Q. The first portion of the conductive layer you identify covers the entire x direction of the stair of the conductive layer, correct?

A. The first portion of the conductive...

Q. Would you like me to rephrase that? Can I rephrase that, Jack -- or Dr. Lee? Sorry.

A. Sure.

Q. Okay. The first portion of the conductive layer expands the entirety of

the x direction of the conductive layer in the stair?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: The first portion is the gate electrode 300. And the attached base pad being identified as pad_b. Again, in green, okay? So in paragraph 193, I clearly explain what I mean by first portion and second portion.

If you go to 193, I said that, "As shown by annotated Kim's device including both conductive layer, (one such layer is annotated in green) with both a first portion, [as read]" which is the "gate electrode 300 and attached base pad pad_b, again" highlighted in green.

BY ATTORNEY WATSON:

Q. Okay. So --

A. So --

Q. Go ahead.
A. So that's the first portion.
Q. Okay.
A. So I want to make sure --
Q. In -- so the first portion --
A. Excuse me. When you say "entirety," that could mean anything in the context. I just want to make sure I don't -- I don't want to use the word "entirety," because it could mean different things.
Q. Understood.
So the first portion of the conductive layer is the gate electrode 300 and the attached base pad, pad_b, correct?
A. Yep.
Q. Okay. And if you look at the figure in paragraph 193 that you annotated?
A. Yeah.
Q. The insulating layer is not disposed over the entire first portion of the conductive layer, correct?

A. Again, you use the word "entire." I'm not sure what you mean by that.
Q. The incidence --
A. The insulating.
Q. Let me clarify. Should I clarify for you?
A. Sure.
THE STENOGRAPHER: Excuse me, Dr. Lee. Can you move your hand so I can better understand?
THE WITNESS: I'm sorry. I'm sorry.
BY ATTORNEY WATSON:
Q. The insulating layer is not disposed over pad_b, correct?
ATTORNEY HERMAN: Objection. Form.
THE WITNESS: Again, I don't know what you mean by that the insulator -- the insulating layer, as I explain, is the -- is the layer 110 and layer 122 together correspond to the claimed term

insulating layer. And I don't think there's need to compare that to the conductive layer.

But as shown in Figure 4B in paragraph 193, that you're right, that the blue section seems to be shorter than the green section.

Now, once again, I could have include portions of 122 on the right side of the contact pad. Either way, it is -- I just want to illustrate the contact -- the point of contact of the insulating layer and the contact pad.

BY ATTORNEY WATSON:

Q. Would you agree with me that the first conductive portion -- strike that.

Would you agree with me that the first portion of the conductive layer is directly beneath the second portion of the conductive layer in certain places?

A. Yeah, because the second portion is the protrusion pad, p-a-d_P annotated in

orange and brown.

So, yeah, it is sitting on top of the first portion of the conductive layer.

Q. And where the second portion of the conductive layer is on top of the first portion of the conductive layer, the insulating layer is not above that second portion of the conductive layer, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: The insulating layer in Kim is the element 122 together with 110, because those two pieces cooperate to define the whole in which the contact -- the conductive pad resides.

In other words, those two pieces together cooperate to define the contact hole. So as you can see in illustrations of Figure 4B, region 110 and 122 is not what you say, covering the contact pad.

BY ATTORNEY WATSON:

Q. So regions 110 and 122 are not disposed over the contact pads?

A. I think I said that, that elements 12.

(Stenographer requests clarification and colloquy will not be captured on the written record.)

THE WITNESS: 122 and 110, those two pieces together cooperate to define the contact hole. And as illustrated in Figure 4B in Kim, the insulating layer do not dispose over the contact pad.

BY ATTORNEY WATSON:

Q. All right.

A. So --

Q. All right.

A. You're breaking up.

Q. Sorry. Let's move on to column 12 of Kim. Let's put Kim on the

screen. That's Exhibit 1005.

A. Column 12.

Q. So Figure 12 in Kim describes a photosensitive resin pattern M formed on the auxiliary insulating layer 122, correct?

A. Are you referring to -- hold on one second.

Q. Oh, sorry. Let me make sure you have that in front of you. Can you turn to column 12, lines 61 -- starting at line 61.

Are you there?

A. Yes.

Q. Referring to Figure 12, a photosensitive resin pattern M being formed -- is being formed on the auxiliary insulating layer 122, correct?

A. That's what it says there in column 12 line 61 to 62.

Q. And the photosensitive resin pattern M is formed so that the predetermined regions of auxiliary

insulating layer 122 are exposed?

A. Yes. That's what it says there.

Q. The regions of auxiliary region 122 exposed by the photosensitive resin in pattern M may include a region 122_I, correct?

A. That's what it says in column 12.

Q. And that exposed region 122_I is doped with predetermined ions?

A. That's what it says in column 12, lines 65.

Q. So let's pull up Figure 12 of Kim.

ATTORNEY WATSON: Can we rotate this, this one?

BY ATTORNEY WATSON:

Q. Dr. Lee, do you see Figure 12 in front of you?

A. Yes.

Q. So in Figure 12, there's a bunch of arrows pointing down.

Do you see those?

A. Yes.
Q. What are those arrows?
A. I believe that is illustrating the injection process that might be performed on the whole surface of the photosensitive resin pattern M.
Q. And in this figure, the injection process occurs by shining a light down in the z direction?
ATTORNEY HERMAN: Objection. Form.
THE WITNESS: Wait. Say that again.
BY ATTORNEY WATSON:
Q. The arrows are showing vertical deposition of ions onto the surface of the staircase structure, correct?
ATTORNEY HERMAN: Objection. Form.
THE WITNESS: I don't think your question makes sense. It doesn't deposit a layer. It's simply injecting

the ions into the opening by the -- the opening that is formed by the photoresist M and inject those ions into the exposed 122 region.

It doesn't deposit anything.

BY ATTORNEY WATSON:

Q. Fair. Fair. I'll use the word "inject" going forward.

So those arrows depict the vertical injection of ions, fair?

A. That is correct.

Q. And the exposed insulating layer 122 is exposed along the horizontal plane, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I'm not sure what you mean by that, because this is a three-dimensional structure. So are you saying that the bottom surface of the exposed 122 and the top surface of the exposed 122 is parallel to the top

surface of the substrate?

Is that what you mean by your question?

BY ATTORNEY WATSON:

Q. No. Let me -- let me try it again.

The shape of the x-y surface is determined by the shape of the openings in the photosensitive pattern M?

A. The shape of the x-y, can you repeat that again.

Q. The shape of the x-y surface is determined by the shape of the openings in the photosensitive pattern M?

A. X-y surface of what? Do you mean that the exposed region of 122 is determined by the pattern of the photosensitive region? And if that's your question, yes.

Q. So the shape of the exposed -- of the x-y surface in the exposed region of 122 is determined by the shape of the

openings in the photosensitive pattern M?

A. Yeah, let me explain how the photoresist work. You put on the photoresist and you expose the photoresist with UV light. And then you develop the photoresist such that the exposed photoresist region will dissolve and so you left behind an opening.

And that opening, of course, is determined by your mask that is used to define the photoresist pattern. And so, yeah, the exposed region is determined by the pattern of the mast defining the photoresist pattern.

Does that make sense?

Q. So the shape of the horizontal surface of the exposed surface -- let me strike that. I'm trying to make sure I understand your testimony here in a simple way.

The shape of the horizontal surface of the exposed region of insulating

layer 122 is determined by the openings in the photosensitive pattern M?

A. Yeah, I don't think you need to use the word "horizontal." Because the exposed region is the opening defined by the photoresist.

Q. The opening that's defined by the photoresist is a horizontal surface, correct?

A. No. The opening is a three-dimensional structure. The opening is a trench, is a whole.

So are you -- are you saying that from the top view -- from the top view -- point of view, the opening is -- let's say a rectangle or a square. And from the top view the opening is square, then that opening pattern will be transferred to the exposed regions of 122.

Subsequently when you do the ion injections, those ion injections, it only occur within that -- within that square

opening.

But the opening is not a two-dimensional structure. You can see that it's adept to it. So your question doesn't make sense.

Q. So the opening of the photosensitive mask, is that a square?

A. Well, we don't know, because we only see the cross-section.

Q. What else could the opening of the photosensitive mask be if it's not a square?

A. Well, it could be an oval shape. It could be a rectangular shape. It doesn't show the three-dimensional structure. Three-dimensional -- it doesn't show the mask that you -- that is used to define the opening in the photoresist region.

Q. But the top of the mask is some shape in the horizontal direction, correct?

A. The top of the mask is a shape

defined by the process engineer and is defined by the shape on the mask. It could be a rectangle. It could be a square. It could be an oval shape.

But all we see here is a cross-section in the -- in a particular -- all we see here is a cross-section in the z-x plane. We don't know what's the other perspective in the -- into the board.

In fact, it could be a circle. It could be an oval shape.

Q. But the shape that it is, is a shape along the horizontal direction, correct? It's not a vertical shape?

A. Yeah. From the top view you see the opening defined by the mask. And, yeah, you could say that this is a horizontal top view of the opening. But even the opening, like I said, is a three-dimensional structure.

The whole is not a two-dimensional structure. It's a

three-dimensional structure. All we see in Figure 12, it's just a cross-section.

Q. So in Figure 12 of Kim, that's what you refer to in your declaration as an ion implantation step?

A. Where you try to say that?

Q. Paragraph 234 of your declaration.

A. 234. Wait. In my declaration, 234?

Q. Yes.

A. Okay. Let me go there. Sorry. Right.

Q. So Figure 12 shows an ion implantation step, correct?

A. Yes. In paragraph 234, I said, in particular, the ion implantation step shown in Figure 12 of Kim, yes.

Q. Okay. So let's turn back to Figure 12 of Kim.

A. Okay.

Q. So Kim performs the ion

implantation step --

A. Yes.

Q. -- through photosensitive resin pattern M onto the auxiliary insulating layer 122 formed on the top of the sacrificial layer?

A. Yes.

Q. And the surfaces are doped along the x-y plane in Figure 12?

A. What do you mean by that, along the x-y plane? Because a dope region is also a three-dimensional structure. There's a -- a dope region when you implant certain ions onto -- onto the -- onto the substrate.

You can have a -- you can implant it in such a way that it is uniform throughout the depth of the structure of the implant regions.

Or you can tailor it to form the dope region with a curve rather than straight sides as I discuss in

paragraph 234.

And with that simple step, the rest of the process would proceed the same way and you would result in a contact pad with a curved side view from the cross-sectional x-z plane.

Q. Okay. So let's talk a little bit about -- about the -- this Figure 12 a little more, okay? Are you with me?

You got Figure 12 in front of you?

A. Yeah, yeah, I see it.

Q. Okay. So the ions injected only reach the exposed regions of 122_I of the auxiliary insulating layer, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Can you repeat that question again?

BY ATTORNEY WATSON:

Q. The ions injected only reach the exposed regions 122_I of the auxiliary

insulating layer?

ATTORNEY HERMAN: Same objection.

THE WITNESS: Well, the opening in the photoresist is defined by the mask. And as shown in Figure 12, when you inject or implant the ion, you inject it on the entire surface and the photoresist basically block the injected ions.

And the injected ion only go through the opening and inject it into the exposed 122. And Kim refer those region as 122_I, because those region is now dope with the implant ions.

BY ATTORNEY WATSON:

Q. So the regions 122_I become doped regions compared to the rest of the insulating layer 122?

A. Yes. And the purpose of that is so that when you -- when you etch a sacrificial layer in the subsequent steps, that the implanted region will be etched

out while the unimplanted region of 122 will be -- will remain.

And that's the reason why they implant.

And by adjusting the -- by tailoring the implant profile, one can easily achieve a curve structure in the cross-sectional view. And by defining the mask in a certain geometry, a circle or oval shape, one can then achieve a curved side contact from the top view, meaning from the x-y plane.

Q. Okay. So once the ions are injected into regions 122_I, those regions 122_I have a different etching ridge -- ratio compared to the rest of the auxiliary insulating layer, correct?

A. Yes. That's what I explain just now.

Q. Okay. I thought so. I just wanted to make it clear, make sure that was right.

After the ion injection step, the auxiliary insulating layer is then composed of two different materials, correct?

A. Say that again. I'm sorry.

ATTORNEY HERMAN: Objection.

Form.

BY ATTORNEY WATSON:

Q. After the ion injection occurs, the auxiliary insulating layer is composed of two different materials, correct?

A. No. It's the same material. You mean -- you're talking about 122, right?

Q. 122, yes. 122 and -- let me strike that question.

After the injection step, auxiliary insulating layer 122 has portions that have been doped and portions that have not been doped, correct?

A. Right. Yes. It's the same material. You didn't change the material. You just add the exposed region is doped, the unexposed region is not dope with the

ion. You don't change the material.

Q. After the ion injection step in Kim, Kim teaches removing the mask pattern and placing insulating layer 215 over the step y structure, correct?

A. As shown in Figure 13.

Q. Okay. And once Step 13 of -- strike that.

Once Figure 13 of Kim occurs, the sacrificial layers 120 can be removed, correct?

Strike that question. Let me ask --

A. You -- I think you skip a few steps. You jump to Figure 16, which is fine. Yeah.

Q. Let me ask --

A. Go ahead.

Q. The sacrificial layers are then removed from the etching process?

The sacrificial layers 120 are removed during an etching process, correct?

A. Yes. As shown in Figure 16.
Q. Okay. Let's go to Figure 16.
A. That originally you have 120, which is a sacrificial layer. Okay. And now with an isotropic etch, meaning in all direction, you left all the region -- all the sacrificial region completely etch out and you left with trench -- trenches.
And then because of the dope region has a different etch rate compared to the undoped region, the dope region of the 122 is also removed by the isotropic etch.
Q. Will the doped region at 122_I have the same etch rate?
A. As what?
Q. Well, will they have the same etch rate as other areas of the doped region I22_I [as spoken]?
A. Wait. Wait a minute.
ATTORNEY HERMAN: Objection. Form.

BY ATTORNEY WATSON:

Q. So --

A. Wait. 122_I is the dope region.

Q. So there's multiple doped regions -- correct? -- where each hole is formed in the photomask region?

A. There's multiple dope region, because these are steps. Each step has one dope region.

Is that what you mean?

Q. Yes.

A. Yeah. So...

Q. And because those regions 122_I are made of the same material, they'll have the same etch rate, correct?

A. Yeah. Most likely that the etch rate would be the same, because this is done by iso -- isotropic etch.

However, of course, the detail is slightly different, because those etch has to go all the way down from the top to the bottom of the stack and go into the etching

the sacrificial layer and then go up to etch the dope 122 region.

So one of the difficult part about forming 3D NAND is that the stack are very tall. So it takes time for the etching to go all the way down and go sideway through the sacrificial layer and then go on top to the dope 122 regions.

So but in theory, all the 122 -- dope 122 region, so-called 122_I has the same etch rate with each other. It doesn't have to be the same etch rate of the sacrificial layer.

Q. But the exposed areas 122_I will all have the same etch rate compared to each other?

A. Yes. Ideally.

Q. Okay. So after the exposed area 122_I is etched, the sacrificial layers 120 -- and opening 122_O are filled with conductive materials to form gate electrodes 300, correct?

A. Well, it is not just a gate electrode material filled with a gate electrode, but also formed a contact pad.

Q. The portion of the openings 122_O and filled by the conductive material are called by Kim the protrusion pad, pad_p; is that right?

A. Yes. Where are you reading?

Q. I believe it's 14 -- Kim 14/12 through 15.

A. Yes. The protrusion pad PE -- pad_p.

Q. And the longer portion protrusion pad_p, which is not covered by insulating layer 120 is referred to as base pad, pad_b, correct?

A. Yes. So base pad, pad_b is basically the region underneath the contact -- contact pad. And so I discuss that in my declaration very thoroughly.

Q. Okay. So the entire protrusion pad_p will be made of the same conductive

material, correct?

A. As what?

Q. Well, the entire pad_p will all be the same conductive material, correct?

A. You mean all the conductive pad are of the same material?

Q. The entire pad_p will be the same conductive material, correct?

A. What do you mean the entire P -- you mean the -- every -- there's so -- multiple contact pad.

Are you saying that all these multiple contact pad in many steps of the staircase region are made of the same material -- same conductive material?

Q. Yes.

A. Is that -- yes, the answer is yes. In fact, it very likely to be the same as --

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(Stenographer requests clarification and colloquy will not be captured on the written record.)

THE STENOGRAPHER: The what gate electrode?

THE WITNESS: Word line gate electrode.

BY ATTORNEY WATSON:

Q. Now by combining pad_b with protrusion pad_p, you increase the thickness of the pad in the vertical z direction, correct?

A. Can you repeat that again.

Q. By combining pad_b with protrusion pad_p, you increase the thickness of the pad in the vertical direction, correct?

A. You increase the thickness of the pad with respect to what?

Q. With respect to each pad individually?

A. What do you mean "each pad individually"?

You're saying that by having a protrusion pad, p-a-d_p, by having that, the total thickness will be greater than just a base pad, p-a-d_b?

Is that your question?

Q. Yes.

A. Yeah, obviously, yes.

Q. And that increases -- that increases the thickness in the vertical direction, correct?

A. Yeah, that -- yeah, because you're adding something on top. Obviously that increases the thickness of the overall layer.

Q. Does increasing the thickness of the pad help prevent damage to the pad during the manufacturing process?

A. Yes. Of course.

Q. Okay.

A. Because those pads are eventually

used to form the conductive veer, meaning the vertical conduit. And if the pad is thin, that it can -- you know, first you do an oxide etch of the field oxide, and then you deposit the -- the content material, conductive material.

Those process, if the contact pad is thin, can easily damage the contact region and such that the -- you would have a potential shorting issues.

Q. Okay.

A. And the reliability of the memory cell would not be -- will be degraded.

ATTORNEY WATSON: Okay. Let's take a break. We've been going for, what? About an hour and a half. Let's take a break.

THE WITNESS: Sure.

THE STENOGRAPHER: Off the record.

(Whereupon, a recess was taken at 1:59 p.m.)

THE STENOGRAPHER: We're back on the record.

BY ATTORNEY WATSON:

Q. Welcome back, Dr. Lee.

A. Thank you.

Q. Let's turn to Kim column 7. And let's put Kim on the screen. And let's turn to line 63 through 67.

Do you see that?

A. 63 to 67?

Q. Yep.

A. Hold on. Let me get there. Okay. They are referring to -- is that Figure 5?

Q. Figures 4B and 5, I think.

A. Yeah.

Q. Okay. So my question for you is: Kim teaches that the pad unit pad and the adjacent pad unit -- strike that.

Kim teaches that, "The pad unit pad and the adjacent pad unit pad may not overlap with each other," correct?

A. Wait. Where are you reading?
Q. Line 66 and 67.
A. "The pad unit PAD and the adjacent pad may not overlap with each other."
Q. Do you see that?
A. Yes.
Q. So there's no overlap in the adjacent pad and the pad unit pad in Kim, right?
ATTORNEY HERMAN: Objection. Form.
THE WITNESS: One second, please.
(Pause in testimony.)
THE WITNESS: Can you ask the question again? I'm sorry.
BY ATTORNEY WATSON:
Q. So there's no overlap in the adjacent pad and the pad unit in Kim?
ATTORNEY HERMAN: Objection. Form.
THE WITNESS: What it says is

that the pad unit PAD and the adjacent pad unit PAD may not overlap with each other.

What that means is that the pads at different vertical levels are not only separated -- right? -- so that -- as shown in Figure 4B so that the footprint in the top view -- right? -- the plane view do not overlap.

Because if it overlap, eventually -- if it overlap, you can form the conduction near to the -- from the bit line to the -- to the contact pad.

So this little offset basically reduces the risk of electrical short.

Do you understand?

BY ATTORNEY WATSON:

Q. Yes, understood.

So let's turn to paragraph 199 of your declaration. Let's pull that up again.

A. 199, okay.
Q. Do you have paragraph 199 in front of you?
A. Yes.
Q. In paragraph 199 of your declaration, you include an annotated image from Figure 4B of Kim?
A. Yep.
Q. Okay. Now, would you agree with me that Figure 4B of Kim is showing the staircase structure in the x-z cross-sectional?
A. Yes.
Q. And as shown in Figure 4B, the portion where the insulating layer and the second portion of the conductive layer meet is not curved, correct?
A. You mean in Kim's Figure 4B?
Q. Correct.
A. So as I explained in my declaration, that even though the figure doesn't appear to show a curve structure, a

curve contact pad, but Kim explained that in column 8 that the protrusion pad, PAD_p has a rectangular parallel shape and that the protrusion pad PAD_p is not limit to -- is not limited thereto and may have a shape including a curve surface based on virtual -- based on a virtual rectangular parallel shape, cylindrical shape or any shape.

This is in column 8, line 29 to 34.

Q. That didn't quite answer my question.

My question was: Figure B does not show a curved side surface as claimed in the '666 patent, correct?

A. I think I answered your question in my answer just given previously. It's not Figure B. In Figure 4B, Figure 4B does not show a curved -- curved region; however, the specification of Kim clearly express -- expressly stated that the side

surface is curve.

So a person of ordinary skill in the art would understand Kim actually wanted and embraces the curve side surface when viewed either from the top or from the side.

Q. Let's -- let's talk a little bit about the rectangular parallel shape that you mentioned, okay?

A. Sure.

Q. Okay.

A. Go ahead.

Q. Let's go to column 8, lines 29 through 34.

A. Yeah.

Q. Are you there?

A. Line what?

Q. Lines 29 through 34.

A. Yes.

Q. Okay. So this is the rectangular parallel shape you were referring to in your previous answer; is that right?

A. Rec -- a virtual rectangular parallel shape, yes.

Q. Okay.

A. I'm sorry.

Q. None of the figures in Kim show that particular shape, correct?

A. Again, as I explain in my declarations, yes. Although, none of the figures, maybe it's in Figure 4B, that it doesn't appear to show a curved sidewall side surface.

But in the specifications that a -- and particularly in column 8, shows that Kim embraces curve sidewall surface -- curved side surface when they -- when one views from the top or from the side, from the top view or from the side view.

Q. Well, let's go to paragraph 234 of your declaration. Let's put it up on the screen.

A. Say it again, 234?

Q. 234.

A. Thank you.
Q. Do you have paragraph 234 in front of you?
A. Yes, I do.
Q. So you opine that the ion implantation step shown in Figure 12 of Kim would be simpler -- simply be tailored to form a doped region I -- or 122_I with curved rather than straight sides, correct?
A. Right. See --
Q. So it's your --
A. Let --
Q. Maybe my next question will get -- get where you're going.
So a person of ordinary skill in the art would be able to form the curved side preference using the same process described in Kim except for changing the ion implantation step shown in Figure 12 of Kim; is that fair?
A. I wouldn't say changes. I would say that the person of ordinary skill in

the art understanding the -- Kim's disclosed fabrication process, particularly the ion implantation steps in Figure 12 can easily tailor so that the implanted damage in the region 122_I has a curve boundary instead of a straight -- instead of a straight one.

And when that happens, during the etching, the subsequent etching of the sacrificial layer and etching of 122_I will result in a curve side surface. The contact with the contact pad. In other words, the point of contact would be curved rather than a straight one.

Q. So the way you get a curved side surface in Kim is by tailoring the ion implantation step?

A. It's a very simple change as I explain in paragraph 134. And I explain in subsequent paragraphs, there are other ways that you can form a curve shape such as, as I mentioned earlier.

And in paragraph 241 of my declaration, you can also define the opening of the mask in Figure 12 such that you have a circular structure or elliptical structure and so on.

Q. Okay. So let's go to paragraph 241 of your declaration.

A. 241, okay.

Q. So in this paragraph you mention a cylindrical contact pad, correct?

A. I think there's more than that.

Q. Well, let me talk about this paragraph, in particular.

In paragraph 241, you state, "Kim does not include any figure showing cylindrical contact pads," correct?

A. That is -- that is what I wrote there, yes.

Q. Okay. And a cylindrical pad would look like one of the three shapes you include in the figure at the bottom of paragraph 241?

A. Right.

Q. Okay. In each of these figures, there's a curve along the x-y plane, correct?

A. Yes.

Q. None of these figures depict a curve along the z direction, correct?

A. None of the curve -- none of the figure shows the pad has a curve side in the x-z plane; however, as I describe in paragraph 234 that I just discuss, one can easily tailor the implant so that not only that you form a curve structure from the top view, but you also form a curve side from the side view.

Q. And so you'd agree with me that in paragraph 241, none of these cylindrical contact pads would be curved in the vertical direction, fair?

A. Example that I've drawn there, that I did not indicate that the cross-section view have a curve side in the

x-z direction. Because I want to delineate the discussions using tailor implant regions and also using the -- the shape of the opening.

And I could have a person of ordinary skill in the art would understood -- would have understood that you could combine both techniques so that you have curve side from the top view as shown in Figure 41 -- 241A of -- paragraph 241 as well as the curve side -- curve side from the cross-sectional view that's discussed in paragraph 234.

Q. So the way you would get these cylindrical pads shown in paragraph 241 is by changing the shape of the openings in the photosensitive mask; is that right?

A. Kim -- I don't think he has discussed the shape of the opening. And Kim does not show any figure so in the cylindrical contact pad.

Nevertheless, a person of

ordinary skill in the art would have understood that these pad can be shape with the side opening. And it's not changing the design. It's simply implementing these design.

Q. All right. Let's turn to Kim -- let's just do a quick couple of things with Kim. So let's go to Exhibit 1005.

A. Okay.

Q. Let's go to Kim, column 9, lines 46 through 49.

A. 46 to 49.

Q. Uh-huh.

"By using the mass pattern to form pad_p in precise locations, Kim ensures that the protrusion pad_p -- pad_p is inside from the edge of a surface of the base pad, pad_b to prevent the short circuit between the pad units pad positioned at different rows," correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: So you just read column 9 from row 46, right?

BY ATTORNEY WATSON:

Q. Uh-huh.

A. To 49, that's what you read?

Q. Yes. Do you want me to ask you the question again?

A. Yeah. I didn't think that you had. I thought -- sorry about that. I thought you just read the --

Q. Pretty close, but let me ask the question again.

"By using the mask pattern to form pad_p in precise locations, Kim ensures that the protrusion pad, pad_p is inside from the edge of a surface of the base pad, pad_b to prevent the short circuit between the pad units pad positioned at different rows."

A. Yeah. Essentially that what it read there.

Q. Okay. So Kim teaches that

offsetting the adjacent conducting layer in the step direction helps to avoid a short circuit; is that fair?

A. Yeah. You have to offset it. Otherwise if you don't offset it, you will have short circuit. So, yes, Kim does provide a technique -- one technique to prevent shorting?

Q. Okay. Let's go to paragraph 9 -- or column 9, lines 50 through 55.

You there?

A. Hold on. Column 9, line 50 to 55?

Q. Yep.

A. Okay.

Q. "Kim teaches that the short circuit between the pad units pad may be effectively prevented through auxiliary -- the auxiliary insulating layer 122 positioned between the adjacent protrusion pads, pad_p positioned at different rows," correct?

A. Okay. That's what it says there, yes.

Q. So Kim teaches that a short circuit may be prevented by placing auxiliary insulating layer 122 between adjacent protrusion pads pad_p positioned at different rows?

A. Okay.

Q. All right. You can put that away. We'll put away Kim for a second. Let's go back up --

A. So --

Q. -- to your declaration.

A. Okay.

Q. Let's turn to paragraph 260 of your declaration.

A. Hold on one sec.

260?

Q. Yep.

A. Yep, okay.

Q. Okay. The second ground of obviousness you identify is Claims 17, 19

and 20 are obvious over Nam, correct?

A. So, wait a minute. Let me go back to your last question. Okay. Let me go back to your last question there you ask about Kim.

Q. Okay.

A. I want to point out that what we just read is that Kim identified short circuit risk and proposed mitigations -- right? -- proposed solutions.

In other words, Kim is attune to short circuit risk when you design the staircase -- staircase region. So a person of ordinary skill in the art would understand that Kim is very aware of the short circuit risk.

And even though it proposed a certain solution, it might not get to 100 percent --

Q. Okay.

A. -- completely solved.

Q. Okay.

A. So motivated to make additional modification to further reduce shorting a risk.

Q. I don't think I asked a question about any of that. But thank you for that.

Let's go to paragraph 260. I'll move to strike that last answer.

A. 260 --

ATTORNEY HERMAN: Objection to form.

BY ATTORNEY WATSON:

Q. Let's go to paragraph 260.

A. Okay.

Q. The second ground of obviousness you identified is that Claims 17, 19 and 20 are obvious over Nam.

Do you see that?

A. Yes.

Q. Okay. You have not offered an opinion that the claims of the '666 patent are anticipated by Nam, correct?

A. No. It's based on obviousness.

Although, certain elements are taught by Nam, meaning that it is expressly disclosed by Nam including Claim 19.

Q. But not every element of the claims of the '666 patent are disclosed by Nam, correct?

A. Not every element in Claim 17 are disclosed by Nam --

Q. Let's go --

A. -- but there's a number -- there's a number of claim limitation are taught by Nam. And I disclose -- disclose that in my declarations. And I also state that Claim 19 is taught by Nam.

Q. Dr. Lee, let's go to paragraph 296.

Do you see that?

A. Yes.

Q. Your opinion is Nam renders limitation 17.C.2 obvious, correct?

A. Yes.

Q. So Nam does not teach wherein a

second portion of the conductive layer provides a curved side surface in contact with a side surface of insulating layer?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: It does not expressly disclose the claim element 17.C.2; however, it is my opinion that Nam render this claim limitation obvious.

BY ATTORNEY WATSON:

Q. Okay. Let's go to paragraph 326 of your expert report.

A. 326. Let me get there. Sorry. Yes.

Q. In paragraph 326, you bold the word "insulating layer," correct?

A. Yes.

Q. And then after that, you put in parentheses "the portion of insulating layer 271 adjacent to the contact pad annotated below."

A. Sorry. Let me...

A portion -- yeah, the portion of insulating layer 271 adjacent to the contact pad. And so what I shown here -- is there a question?

Q. So in this figure, figure -- the figure in paragraph 326 of your report, does that show the entirety of the insulating layer you were labeling?

A. Highlighted in blue?

Q. Yes.

A. No. What I show there, I just want to show that I just wanted to highlight the point of contact that is curve side surface.

And that a person of ordinary skill in the art would understand that in Nam, the two pieces of insulating layer are responsible to define the contact holes and, therefore, are together meet the claim term insulating layer.

And those two elements are 248

and 271 as shown in -- you know, in this figure on page -- on paragraph 326. And as I discuss earlier, that the blue should have extended all the way to cover the brown/yellow regions.

You understand?

And the reason why I didn't do that is because what I wanted to show is just highlight the point of contact between the insulating layer, which is 248, which is one of the element 240. 240 is basically all the word lines. And each step -- each level has labeled different numbers, 248, 249 and so on.

And so in this figure is 248 and 271. And as I describe at the beginning of my deposition, that in paragraph 240 -- 245, if you can turn to paragraph 235.

Q. 235?

A. Sorry. 345.

Q. All right. That makes more sense. Okay.

A. Yeah. Sorry.

That the top blue region, the insulating layer on top of the conductive layer, the blue should extend to covered the brown and gold region.

In other words, should extend all the way to the vertical, the left vertical red line, that vertical red dash line.

So, in other words, that the figure in -- what paragraph was that? -- 314 -- was not -- you know, to be more complete should have drawn the blue, should have drawn all the way to the end of the second portion of the conductive layer.

I didn't do that, because the purpose of that drawing is simply highlight the point of contact.

Q. Is there a single figure annotated in your declaration of Nam that highlights the entire insulating layer as you've described it?

A. The wording in my declarations is

accurate, okay? And in paragraph 345, okay, the insulator, which is the blue region underneath the green region, you can see that it is shown all the way to cover the entire contact pad.

The -- so that's -- that one is very clear. And as I explain at the beginning of the deposition, that I wanted to clarified in the drawing to make it more clear that the insulating layer should extend such that it would cover the contact pad, in other words, the 230 -- 237.

Q. Dr. Lee, I don't think that was an answer to my question.

My question was simply: Is there a single figure annotated in your declaration that highlights the entire insulating layer you're relying on?

ATTORNEY HERMAN: Objection --

THE WITNESS: Yes.

ATTORNEY HERMAN: -- asked and answered. And also mischaracterizes

the witness's testimony.

THE WITNESS: Yes.

BY ATTORNEY WATSON:

Q. Where --

A. In figure -- may I?

Q. Yeah.

A. Yeah. In paragraph 345, you see that the insulating layer underneath the green area, the conductive layer, show that the insulating layer extend all the way and covered the contact pad.

And so there is one graph, one schematic annotated figure that illustrate that. And then --

Q. Sorry.

A. Finish?

Q. Well, I was just gonna ask a follow-up question on that, if that's okay.

A. Sure. Go ahead.

Q. So what you're -- the figure in paragraph 345 -- let me start this question again.

What you identify as the insulating layer in paragraph -- the figure in paragraph 345 is not complete, but the adjacent insulating layer shows the entirety of the insulating layer?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Well, I wouldn't say it's not complete. I would say that -- that's why I want to clarify that. Again, the wording of the -- my declaration is 100 percent correct.

And that the figures should have been -- I could have drawn it more clearly to the top blue region should extend and include the insulating layer 248 and 271 to cover the contact pad, the gold blue region.

BY ATTORNEY WATSON:

Q. Okay. Let's go to paragraph 329, because you said that -- you mentioned the text explains this.

A. 329?
Q. Yep. Dr. Lee, is it your opinion that both layers 248 and layer 271 together form Nam's insulating layer?
A. Yes. It is my opinion that the layer at the element 248 and element 271 together form the Nam -- Nam's insulating layer. And the reason is that those two pieces together define the contact hole.
Q. Okay. Let's --
A. Ask --
Q. -- put up what I've marked as -- we'll mark it as Lee Exhibit 5. And that's Figure 8A of Nam annotated.
(Whereupon, Exhibit 4 is marked for identification.)
DOCUMENT TECHNICIAN: And figure 8A Nam annotated part 2 and one is that not --
ATTORNEY WATSON: Just part -- just part 1.
Let's put that all the way on the

screen so it's fully visible. Is this Lee Exhibit 4, sorry. We'll mark this as Lee Exhibit 4.

Can we make that full screen?

THE WITNESS: What you've done is incorrect.

ATTORNEY WATSON: We'll get there.

Can we make this full screen so we can see the whole figure?

DOCUMENT TECHNICIAN: One second. I think there's a bug.

ATTORNEY WATSON: Okay.

DOCUMENT TECHNICIAN: Can you see it now?

ATTORNEY WATSON: Yes.

BY ATTORNEY WATSON:

Q. So, Dr. Lee, do you recognize this as an annotated figure of Figure 8A of Nam?

A. Yes.

Q. Okay. And in this figure, 248

and 271 have both been colored in blue, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Yes. But that it's -- what you've shown there is incorrect.

BY ATTORNEY WATSON:

Q. Why is 248 and 271 not the entirety of the insulating there?

A. No. You have to understand, for the claim term insulating layer, it is discussed -- it is a person of ordinary skill in the art would understand that the claim term insulating layer are the portion of the insulating layer whether it's one insulating layer or multiple pieces of insulating layer that define the contact holes, okay?

So, therefore, a person of -- of ordinary skill in the art would understand -- would understand that the

part of the element 240 and 271 or 248 and 271 that define the contact hole is not at the bottom of the pad.

It's on the top, because a person of ordinary skill in the art understanding the technology would understand that the pattern that defined a hole is from the top. It's not from the bottom.

So, therefore, the correct way of shading the portion of the 248 and 271 is simply on top of the contact pad from the -- from the right side all the way to where the second portion of the end of the second portion of the conductive layer. Because that is what define the contact hole.

The insulating layer underneath the contact pad does not define that particular contact hole in that particular step, okay?

In that particular step in that particular level of the staircase

structure.

Q. So let me be clear.

The problem you have with this structure is the insulating layer should not include what's marked as 247; is that correct?

A. No. I didn't say that. I did not say that.

I said that it's only include the portion of 271 above the three -- 237 -- the curve -- the curve -- the top curve region, so-called -- what is called the second portion of conductive layer.

Q. So you're -- you are -- so the figure I have here is not a correct depiction of what you're defining as the insulating layer, correct?

A. Absolutely not. What I define as the insulating layer is the pieces of the insulating layer that together cooperate to define the contact hole, the hole in which the contact -- the conductive path resides

in.

Q. Okay.

A. So.

Q. So let me try --

A. Hold on one second. When you pattern a contact hole, you're patterning from the top, not from the bottom, you understand?

So, therefore, it's only the contact -- the contact is defined from the top, so, therefore, it's only the insulator that is above the second portion of the contact layer of 271.

That is considered to be -- together with 248 that meets the claim limitations of insulating layer.

Q. Okay. Well, let me -- let me put a different figure in front of you then, if that's okay.

A. Sure.

Q. I'm going to mark this what I'm putting in the chat as Lee Exhibit 5.

(Whereupon, Exhibit 5 is marked for identification.)

ATTORNEY WATSON: Let's put that on the screen, if you don't mind.

DOCUMENT TECHNICIAN: Stand by.

BY ATTORNEY WATSON:

Q. Dr. Lee, do you recognize Lee Exhibit 5 as an annotated version of Figure 8A of Nam?

A. Yes.

Q. Does this accurately reflect what you're considering the insulating layer?

A. No.

Q. Why does this not reflect it?

A. Because you still include part of the 271 underneath 237. So it would be correct only if you include the portions of the blue area above the 237.

Q. So would -- the areas above 237A and 237B -- strike that.

The portions of insulating layer 248 and 271 that are above 237A and 237B

are what you consider the insulating layer?

A. It's not what I consider. It is a person of ordinary skill in the art reading the '666 patent and the claims regarding the claim term insulating layer that -- so if you can modify that and you move the bottom part of the -- of the shaded blue region, can you try that?

Q. How about after the break. Let's take a break right here, and I'll see if I can get you an image like that.

A. Okay. Thank you.

ATTORNEY WATSON: Let's take a break.

THE STENOGRAPHER: We're off the record.

(Whereupon, a recess was taken at 3:00 p.m.)

THE STENOGRAPHER: All right. We're back on the record.

BY ATTORNEY WATSON:

Q. Dr. Lee, I'm going to put on the

screen what we'll mark as Lee Exhibit 6. Let's go put that up. I just added what we'll mark as Lee Exhibit 6 to the chat. Can you put that up?

Dr. Lee, do you see what's been marked as Lee Exhibit 6?

A. Yes.

(Whereupon, Exhibit 6 is marked for identification.)

BY ATTORNEY WATSON:

Q. Okay. And is Lee Exhibit 6 annotated version of Figure 8A from Nam?

A. Yes.

Q. Does Lee Exhibit 6 show your opinion of where the claimed insulating layer is in Nam?

A. Hold on one second. Sorry.

Not exactly. The -- you see that on the right side, that -- you seem to include the region curving upward.

Do you see that?

Q. Curving --

A. I'm sorry. On the left side.
Q. Okay. Yes, I see that.
A. Yeah, I think that, you know -- I don't want to misled that the blue region extend further upward. It's actually -- so stop in the top horizontal line of 217.
Do you see what I'm saying?
Q. Well, let's go to Figure 295 -- the figure in 295.
Do you see that? Let's go to 295 of your declaration. Let's pull that up.
A. 295, yeah.
Q. Or we can use this one. Figure -- this figure in paragraph 23 -- 326 of your declaration.
Do you see that?
A. Yeah.
Q. In Figure 326 of your declaration, you highlight portions of the insulating layer that are curved upwards, correct?
A. Yeah. But not all the way to the

top, yeah. It should -- it should be extended horizontally to the -- to cover the -- the brown and gold region.

The way you draw it in Exhibit 6, Lee 6 seems to suggest that they continue going up. Here -- here I want highlight in this particular figure in paragraph 230 -- 326, I just want to highlight the contact -- point of contact.

And I also don't want to give the impression that this 271 that define the contact hole for this particular level extend upward toward the next level to the top.

So to be more precise in your -- in your exhibit Lee 6, I wouldn't draw the blue -- blue region to go all the way to the top.

You understand what I'm saying?

Q. I'll try in a second.

You do not include any figures with that annotation in your declaration,

correct?

A. Like I -- if you go to paragraph 345.

Q. Okay. Let me change my question.

A. No, no.

Q. You --

A. Let me answer your question first.

Q. Okay. Go ahead.

A. If you go to 345.

Q. Okay.

A. Okay? 345. Not 343.

Q. 345. Okay.

A. Okay. And you enlarge it.

Q. Yes, I can enlarge it as much --

A. Okay.

Q. Can we make this bigger? I don't know why I keep losing my thing here that I can control.

Paragraph 345, okay.

A. 345.

Q. Okay. Okay. I'm at 345.

A. Yep. You see the adjacent insulating layer.
Q. Uh-huh.
A. Okay. That how each insulating layer should be drawn.
Q. Each insulating layer should be drawn like you drew the adjacent insulating layer in the figure.
(Simultaneous unreportable crosstalk occurs among parties.)
(Stenographer requests one speaker at a time.)
BY ATTORNEY WATSON:
Q. Yeah, let me finish the question, Dr. Lee.
Each insulating layer should be drawn like you drew the adjacent insulating layer in figure -- the figure in paragraph 345 of your declaration?
A. In the sense that -- that's correct. In the sense that the blue region should extend and cover the contact pad for

a specific -- a particular level of the staircase region.

And so, for example, in this particular figure, Figure 7 in paragraph 345, to be more clearer, the blue region above the contact layer, the green region, should be drawn to extend all the way toward the vertical dash red line on the left, okay?

But not have the blue region extended upward as is shown in Lee Exhibit 6.

You understand what I'm saying?

Q. I think so. You do not include anywhere in your declaration a drawing of the insulating layer that shows that, correct?

ATTORNEY HERMAN: Objection. Form. Also repeatedly asked and answered.

THE WITNESS: As I mentioned, that the wording in my declaration and

my opinion has not changed.

I just want to clarify that -- that some of the drawing to be more clearer, that all the insulating layer should be drawn similarly to the adjacent insulating layer as shown in Figure 7 in paragraph 345.

And, of course, they're not the same. The name are different. And that -- but it's similar in the sense that, for example, the blue region above the green region should extend horizontally to cover the contact pad shown at the brown and orangey color.

BY ATTORNEY WATSON:

Q. Why do you divide insulating layer 271 such that the entire 271 is not the insulating layer?

A. The reason is not the entire 271 -- do not -- does not define the contact hole. Only a portion of 271 define hole -- the contact hole, define the hole

in which conductive pad resides in.

Q. Are you labeling --

A. So that is the reason.

Q. Are you labeling the insulating layer 271 based on your understanding of the '666 patent?

A. Absolutely.

Q. Okay.

A. Each -- each level has the corresponding insulating layer, okay?

Q. Let's --

A. So --

Q. Oh, you're still going. Sorry. I'm just trying to get answers to my questions, Doctor.

A. You cannot say the entire 271 is the insulating layer, because for each level, a person of ordinary skill in the art would understand that only a portion of 271 is defining the contact hole and, therefore, only the portion -- a portion of 271 together with 248 meet the claim

limitations of insulating layer of Claim 17 and Claim 18.

Q. Only a portion of layer 271 together with 248 meet the claim limitation of an insulating layer from Claim 17 of the '666 patent, correct?

A. That is correct. That for each level, the pieces are different.

So you can modify the Lee Exhibit 6.

Q. Okay. We'll go back and do that at the next break. But let's go -- let's go to paragraph 315 of your declaration.

A. 315?

Q. 315.

A. 315, are you going --

Q. Paragraph 315 of your declaration.

Okay. In paragraphs 315 through 325 of your declaration, you describe how the structure in Nam is formed, correct?

A. Yes.

Q. Okay. So in paragraph 16, you state that, "To begin this process, Nam forms an alternating stack of sacrificial layers 220 and insulating layers 240," correct?

A. Yes.

Q. In paragraph 17, 317, you state, "Then the steps are formed in the sacrificial and insulating layers," correct?

A. You're reading it right, yeah.

Q. Yeah, okay.

And the steps of alternating stack and sacrificial layers 2020 and insulating layers 240 are shown in Figure 31 of Nam.

A. Actually.

Q. What's that? Go ahead.

A. I'm sorry. Which paragraph are you reading?

Q. Paragraph 317?

A. 317, okay.

Q. So next, the sacrificial and insulating layers are formed, correct?

A. Where are you? I'm sorry.

Q. In 317, "The steps are formed in these layers"?

A. Okay.

Q. After forming the steps of alternating -- strike that. Let me try that again.

After forming the sacrificial layers 220 and insulating layers 240, the steps are covered with a first interlayer insulating layer 271, correct?

A. Okay.

Q. Are insulating layers 240 and first insulating layer -- interlayer -- strike that.

Are insulating layers 240 and first interlayer -- insulating layer 271 formed separately in Nam?

A. Hold on. Let me go there.

If you look at Figure 30 and 31,

you see that the 248 is formed first and then 271 is formed second. Yes, it is separate steps.

Q. Okay. So figures -- so the insulating layer 240 and first interlayer insulating layer 271 are formed sequentially?

A. Well, I don't know about sequentially, but it's different steps. 271 is formed after 240.

Q. Okay. Let's pull up Nam real quick. That's Exhibit 1006.

(Whereupon, Previously Marked Exhibit 1006 is identified for the record.)

BY ATTORNEY WATSON:

Q. Dr. Lee, you recognize Exhibit 1006 as --

A. Yes.

Q. -- the Nam reference?

A. Yes.

Q. Okay. Let's go down to

paragraph 82.

DOCUMENT TECHNICIAN: I'll let you do that.

ATTORNEY WATSON: You want me to handle that? Okay. We'll go down to paragraph 82 of Nam.

BY ATTORNEY WATSON:

Q. So the first interlayer insulating layer -- actually, let's go to paragraph 98. Sorry.

A. Wait, 98?

Q. We're at paragraph 98 of Nam. Sorry.

A. Hold on. Let me go there.

Q. Yeah.

A. Okay.

Q. The "first interlayer insulating layer 271 is made of silicon oxide or the like," correct?

A. Wait. You said 98?

Q. Yes. Paragraph 98.

A. There's nothing about 271.

Q. Go to the bottom of paragraph 98.
A. Oh, I see, okay. Yeah, okay.
Q. So let me repeat my question.
The first interlayer insulating layer 271 includes silicon oxide or the like?
A. Okay.
Q. Agreed?
A. That's what it says there, yes.
Q. Okay. And would you agree with me that layer 271 is -- the entirety -- strike that.
Would you agree with me that the entirety of layer 271 is made of the same material?
A. Yes.
Q. Okay. How would a person of ordinary skill in the art deposit the first interlayer insulating layer 271?
A. Well, there's various different ways of doing that.
Q. Would a person of ordinary skill

in the art use high density plasma to deposit first insulating layer 271?

A. You could do that if you want. But you don't -- there's one method. There's another method, simply CBD process, chemical vapor deposition or plasma enhanced CBD.

Q. Could you use tetraethyl silicate oxide to deposit the first interlayer insulating layer 271?

A. Yes.

Q. By adding the insulating layer 271 by these processes, does that result in insulating layer 271 conforming around each step in the staircase structure?

A. You mean does it result in what is shown in Figure 31?

Q. Yes.

A. Yes.

Q. And in Figure 31, layer 271 is conformal around the staircase structure, correct?

A. Yes.
Q. Would you -- let's go to Figure 31 real quick. All right. And let's rotate this real quick.
ATTORNEY WATSON: Can we rotate that, Lucien.
BY ATTORNEY WATSON:
Q. Dr. Lee, if Figure 31, layer 271 is longer in the x direction than it is tall in the z direction on each stair, correct?
A. Well, first of all, it really -- this drawing is not drawn to scale. This is only showing how many level, nine level maybe -- right? -- or eight levels. But you know and I know that in a 3D NAND, there are many, many different levels. So this is just an illustration.
And the aspect ratio is not drawn to reflect the actual 3D NAND structure, so to -- just this drawing not supposedly drawn to scale and showing the correct

aspect ratio.

So I don't think one can conclude whether it is wider than height or taller than width.

Q. Let's go back to paragraph 318 of your declaration.

A. 318.

Q. Are you there?

A. I'm there.

Q. Okay. You say, "Next a multistep ion implantation process is performed to create a damaged region DA1 surrounding the ends of the sacrificial layers 220," correct?

A. That's right. That's what I wrote there.

Q. And Figures 32 and 33 of Nam show that implantation process, correct?

A. Yes.

Q. Let's go to paragraph 319 of your declaration.

A. Okay.

Q. "This damaged region is more susceptible to etching -- is more susceptible to etching," correct?

A. That's the first part of the first sentence -- well, the only sentence.

Q. Okay. You agree with that, the damaged region is more susceptible to etching?

A. Well, there -- that is what Nam describe --

Q. Okay.

A. -- in paragraph 66, 90 and 103.

Q. And this damaged region is located at the interface between the sacrificial layer and the interlayer insulating layers?

A. Yes.

Q. And this damage region has the shape of the intended contact pad, correct?

A. Yes. That's what I wrote here in paragraph 319.

Q. Let's go to Figure 330 -- or

Figure 34 of Nam.

A. Okay.

Q. What is Figure 34 of Nam showing?

A. Well, it's showing the general locations of ion implantation.

Q. What do the dotted lines represent in Figure 34?

A. It's showing different locations -- hold on one second.

(Pause for reading/reviewing.)

THE WITNESS: Hold on. [Speaking sotto voce].

So the dotted line is simply showing the damage region DA. And basically shows the extent of the degraded region in the sacrificial -- sacrificial layers.

BY ATTORNEY WATSON:

Q. The dotted lines represent where the ions are implanted during the ion implantation process; is that fair?

A. You can say that, but it's

really -- I believe it's DA, meaning that damage area, damage region. So it's really showing the damage region. Because the damage region have a different etch rate compared to the non-damage regions.

As a result, when you etch the sacrificial layer, you end up with the figure as shown in Figure 36 of Nam.

Q. Now, if you look at Figure 34, the damage region extends into parts of the sacrificial layers 220, correct?

A. That is correct.

Q. And the damage --

A. Wait, wait. Hold on one second.

Can you repeat the question again?

Q. Sure.

The damaged area extends into some of the sacrificial layers 220?

A. Well, it's mainly in the 220, and it's also part of it in 271.

Q. So some of the damaged area is

also found in insulating area 271?

A. As shown in Figure 34.

Q. Now, Figure 34, the ions are implanted using three different energy levels, correct?

A. Yes.

Q. And the ions penetrate the insulating and sacrificial layers to the various dotted lines, correct?

A. You can say that. But basically that the Nam discuss about damage with -- let me see. Let me -- sorry.

So you are say -- you are asking -- I want to look for the -- so you're asking whether Nam uses different ion implantation energy at different steps to control how deep and where the damage region is?

Q. Yes.

A. The answer is yes.

By adjusting the ion implantation energy, a low energy will concentrate the

damage near the top of the sacrificial layer, higher energy will push the damage deeper into the regions.

So by adjusting the tailor, the shape and the depth of the damage regions, then damage region they call it DA, D-A. So that when the damage material is later etch -- right? -- together with the sacrificial layer, it will produce the -- the desire -- what they call -- what Nam call the curve -- I think bullnose profile, right?

And at least -- going back to my dep -- declaration -- sorry.

Yeah. So to answer your question, yeah, they use a multi ion implantation step.

Q. Okay. Now, will the amount of dope be the -- relatively uniform across the x direction of the damaged area?

A. You have to understand how ion implantation work. Ion implantation is not

like a laser scanning across a wafer. It is implanted the entire wafer at the same time at different energy and at different dosage.

So, therefore, you know, of course the top surface might be patterned by a photoresist or a hard mask.

So, therefore, that -- the ion implantation dosage can be changed with respect to z axis, can be changed, like I said, the higher energy will be -- the ion implant would go deeper, the lower energy would go closer to the top. And it depends on the dosage, the dosage could also vary vertically. But it doesn't change horizontally.

Q. The damaged area doesn't have a different amount of dopant horizontally, correct?

A. Yes. In other words, in Figure 34 the damage in the top level -- right? -- 228 is the same as the damage in

227, 226 all the way to 221.

And so, in general, ideally, you know, all the process steps, depending on the tolerance of the equipment, it might change slightly. But ideally and, in general, it is very accurate that the damage in each level and the profile is exactly the same.

Q. Now, in Figure 34, the ions only get implanted to the bottommost dotted line in Figure 34, correct?

A. I don't understand your question.

Q. Well, let me try this. Let's pull up what we'll mark as Lee Exhibit 6.

(Whereupon, Exhibit 7 is marked for identification.)

THE WITNESS: You already have 6, I think.

BY ATTORNEY WATSON:

Q. Oh, Lee Exhibit 7. Let's pull up -- let's pull up what we'll mark as Lee Exhibit 7. That will be the Figure 34 of

Nam annotated.

ATTORNEY WATSON: So this is -- we're going to mark this as Lee Exhibit 6 [sic].

BY ATTORNEY WATSON:

Q. Dr. Lee, do you recognize Lee Exhibit 6 as an annotated version of Figure 34 of Nam?

DOCUMENT TECHNICIAN: Sorry, Counsel. I believe we're on 7. I'm looking at the last --

ATTORNEY WATSON: Oh, perfect. That's what I need to know. Perfect. Let's -- let's change that.

BY ATTORNEY WATSON:

Q. Dr. Lee, do you recognize Lee Exhibit 7 as an annotated version of Figure 34 of Nam?

A. Yes.

Q. Okay. And in Figure 34, you see there's a bunch of red boxes?

A. You annotated those red boxes.

Q. Okay. When the ion implantation process occurs in Nam Figure 34, no ions penetrate into these boxes, correct?

A. It is designed that it does not go through into the red boxes.

Q. And so these areas marked in red boxes will not be etched away during their replacement process, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: I don't understand what you mean. Because those sacrificial layer within -- for example, if you look at the second level from the top, 227, okay? Can you point to that 227?

BY ATTORNEY WATSON:

Q. Uh-huh.

A. When you etch 227, the region within the red box on the far left would still be etched in 227. Why wouldn't it be etched?

Q. Let me change my question. I understand what you're saying. Okay.

So when replacing the damaged areas in Figure 34, there will not be a replacement of anything in the red boxes?

A. I don't understand your question.

What do you mean by "replacement"?

Q. Well, after -- so let me -- let me continue.

So during the process described in Nam, Nam forms damaged areas, correct?

A. Yes.

Q. Okay. Let's turn to paragraph 320 of your declaration. We'll go to that.

A. 320?

Q. 320, yep.

A. Right.

Q. Okay. You say in paragraph 320 that, "Per Nam, the implanted impurities can be diffused into the surrounding

insulating layer 271 via the application of heat," correct?

A. That's what I wrote there.

Q. What does it mean that the impurities are diffused by heat?

A. Well, diffusion is a process in which the particle will diffuse from a high concentration area toward the low concentration area.

In other words, if I give you a bucket of water -- okay -- if I give you a bucket of water and you drop some ink, a blue ink in one corner of the bucket of water, eventually it will -- because you have higher concentration of blue ink in one corner and very low concentration of blue ink in other places due to random motions, that these blue ink will collide and eventually will diffuse from high concentration to low concentration region until the entire bucket of water has the same concentration.

In other words, it will diffuse toward the entire bucket of water until it is entirely blue, okay?

Now, of course, how fast it diffuse depends on the temperature. The higher the temperature, the faster these particle will diffuse.

Similarly, the -- in paragraph 320, the implanted impurity was implanted primarily in the -- in the sacrificial layer, okay? So, therefore, there's a high concentration of impurity in that region while 271 does not have a -- you know, when they deposit it, they didn't have any implant damage.

So as a result of the diffusion mechanism, that it diffuse -- the implant would diffuse into the surrounding insulating layer 271 via the application of heat.

In other words, if you don't apply heat, the impurity would not diffuse.

Q. Okay. Will the damaged region diffuse in both the x and z directions?

A. The damage region -- the impurity will diffuse from low concentration -- from high concentration to low concentration. So it depends on what the concentration is in the z direction and -- but, in general, it would diffuse into the surrounding insulating layer.

Q. And will the rate of diffusion in the left and right on the x direction, will that rate of diffusion be constant?

A. What do you mean by "constant"? Constant with time? Constant with precision?

Q. How about this: The damage region -- will the damage region -- strike that.

Let me start that again.

Will the damage region diffuse to the same rate to the left as to the right of the stair?

A. So the diffusion not only depends on the concentration gradient but also depends on the media that the diffusion occurs. And the sacrificial layer, in general, made by silicon nitride and the 271, I believe is -- let's see.

So 271 is -- yeah, we read that before, and you mentioned that before is -- can be formed by HET or TEOS. So it's SiO2. So it's different material. So the diffusion will be different to the left and to the right.

Q. Will it diffuse faster to the left or to the right?

A. Assuming that the sacrificial layer -- let's see. Hold on. 227, 228. We're looking for Nam. I believe that is like a polysilicon region. So 220 is polysilicon.

So your question is whether impurity diffuse faster in oxide versus polysilicon.

Well, it depends. In -- it depends on what is the polysilicon composed of, how big are the -- how big is the grain and how big -- you know, what is the -- polysilicon could be dope, what is the dope and -- and, but, in general -- and also oxide, you know, how dense is the oxide.

But, in general, is -- impurity usually diffuse much faster in polysilicon than oxide.

Q. Let's go to paragraph 322 of your declaration.

A. Yeah. That's -- but I don't think it matters in the way that Nam describe how to form a bullnose contact pad.

What paragraph you looking for?

Q. I'm -- right now I'm going paragraph 322 of your declaration.

A. 322. Okay.

Q. All right. So after this diffusion step, "Both the sacrificial

layers and the damage regions are etched to form opening regions OP in the shape of a gate electrodes and contact pads," correct?

A. That's what I wrote there.

Q. And if you'll turn to paragraph 90 of Nam.

Do you have paragraph 90 of Nam in front of you?

A. About Figure 17 to 20? Is that right? Is that what you mean?

Q. Yes. It starts with "then." But go towards the middle of the paragraph.

A. Okay.

Q. So --

A. Hold on. Let me read that.

Q. Yep.

(Pause for reading/reviewing.)

THE WITNESS: Okay. It uses two different damage -- two separate ion implantation steps, right?

BY ATTORNEY WATSON:

Q. But -- yeah, so I actually have a

question about I think the next sentence.

A. I'm sorry.

Q. The sacrificial and --

A. Wait. Hold on. Where are you? What line are you?

Q. I'm going to the paragraph that says -- or the sentence that says the "damage regions DA1 and DA2."

A. Yeah.

Q. Okay. "The damage regions DA1 and DA2 and surrounding areas have film characteristics with damage caused by the impurities, and thus, may be removed more rapidly when an etching solution such as phosphoric acid or the like is introduced thereto."

Do you see that?

A. Yes.

Q. So phosphoric acid is used to help etch these damage regions out?

A. Okay. This is a different figure now.

Q. Well, let me just ask this question: Would you use phosphoric acid to etch out damaged areas?

A. Well, it depends on what material you are. And phosphoric acid generally is used to etch out silicon nitride. And so I have to look back and see Figure 17 to 20, what is the material.

So even though, in general, phosphoric acid is a standard selective wet etch for silicon nitride, but it can also be used in etching particularly damage polysilicon in such a way that it will -- it will etch the damaged sacrificial region much faster than the undamage sacrificial layer.

So, therefore, because of that differential etch rate, you end up with the bullnose contact pad that Nam describes.

ATTORNEY WATSON: Okay. Well, let's take a -- let's take a break real quick for, I don't know, five minutes.

THE WITNESS: Sure.

In the meantime, can you -- would you mind changing the Nam -- I mean the Lee Exhibit 6 or 7. Remember we talked about that?

ATTORNEY WATSON: Sure, yeah, I plan on coming back with an updated version, so we'll talk about that after the break.

THE WITNESS: Okay. Thank you.

THE STENOGRAPHER: Off the record.

(Whereupon, a recess was taken at 3:59 p.m.)

(Whereupon, Exhibit 8 is marked for identification.)

THE STENOGRAPHER: Back on the record.

BY ATTORNEY WATSON:

Q. Dr. Lee, I'm putting on the screen what's been marked as Lee Exhibit 8.

Do you see that?

A. Yes.

Q. Okay. Lee Exhibit 8 is an annotated version of Exhibit -- of Figure 8A from Nam?

A. Yes.

Q. Does the blue in this figure Lee Exhibit 8 reflect your opinions of what the insulating layer is?

A. Yes. The blue area is -- including the element 248 in portion of 271, that portion together, these two pieces together cooperate and define the contact hole, which is what the claim term insulating layer means.

So, therefore, what you have drawn there is -- is correct that that is the region in which the blue region is the region in which the element 248 and portion of 271 together meet the claim term insulating layer.

As I discussed before, that is similar to the figure that I drawn in

paragraph 345.

Q. So can I ask one follow-up question, just a yes or no?

A. Sure.

Q. Lee Exhibit 8 depicts the insulating layer you identify for purposes of your obviousness analysis for the '666 patent, correct?

A. Nam --

Q. Let me -- let me change the question.

A. Sorry exhibit -- sorry -- I forgot what the number is. 1006.

Q. Lee Exhibit 6 -- or, sorry. Strike that.

Lee Exhibit 8 depicts in blue the insulating layer you rely on in your obviousness analysis for the '666 patent?

A. For the prior art Nam.

Q. Yes.

A. Yes.

Q. Okay. Let's take that off the

screen for now.

And let's pull up Dr. Lee's declaration.

Dr. Lee, you offer a third ground in paragraph 351, correct?

A. Let me go there.

Q. Sure. Let's go to paragraph 351.

A. Yes.

Q. Your third ground of obviousness is that Lee, when modified in view of Park and knowledge of a POSITA renders Claims 17, 19, and 20 of the '666 patent obvious.

A. Yes.

Q. You have not offered an opinion that the claims of the '666 patent are anticipated by Lee, correct?

A. Some of the claims are taught by Lee, in other words, are expressedly disclosed by Lee -- some of the claim element is disclosed by Lee.

For example, 17.3 -- claim

limitation 17.B -- sorry, 17.A, 17.B and 17.C as well as 17.C.1.

Q. Okay.

A. And I think those are the ones that are taught by Lee -- oh, and including Claim 19 is also taught by Lee.

Q. Okay. Limitation 17.C.2 is not taught by Lee, correct?

A. Let me go there.

Yeah. That's the only claim limitation that Lee does not teach, so I rely on obviousness to invalidate claim limitation 17.C.2.

Q. In your opinion, is Claim 17.C.2 -- is obviousness when Lee is modified in view of Park, correct?

A. In paragraph 401, I said that a POSITA would -- would have consider it obvious to make the side surface of Lee second portion of the conductive layer curved in view of Park's teaching.

Q. So you rely on the teachings of

Park to form a curved side surface in ground three, correct?

A. That's right.

Q. Okay. Let's pull up Park. Park's Exhibit 1008.

A. Okay.

(Whereupon, Previously Marked Exhibit 1008 is identified for the record.)

BY ATTORNEY WATSON:

Q. And let's turn to column 12, line 16.

A. Column 12, line what?

Q. 16.

A. 16 to...

Q. We will go 16 to 23.

A. Hold on one second. This is regarding Figure 9B, right?

Is there a question?

Q. Give me one second. Let me just make sure I have the right question here.

A. 9 --

Q. Let's go to paragraph 405 of your declaration first, actually.

A. Okay. 405.

Q. Are you there?

A. Yes.

Q. "Park explains that it achieves its rounded contact pad by ion implanting impurities into an insulating layer and performing an oxidation step to create an additional sacrificial layer having a higher etching rate than the surrounding insulation"?

A. Right. That's what I read -- written there.

Q. So in Park, the oxidation is performed on the sacrificial layer patterns, correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: This is --

BY ATTORNEY WATSON:

Q. Let me direct your attention to

column 12, line 6. Actually, column 12, line 9, starting there, that sentence. I'll give you a second to read it.

A. Okay. In Figure 9B, right?

Q. Uh-huh.

A. Line what?

Q. Line -- let's go to line 16.

A. Okay. I thought you said that.

Q. Sorry. I must have misspoken. Yeah, line 16.

A. Yes.

Q. "In Park, the oxidation is performed on the sacrificial layer patterns," correct?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: So Figure 9D, it shows that Park formed additional insulating layer 66 -- right? -- by thermally oxidizing the exposed surface on the top as well as the side surface of the sacrificial layer pattern 62A,

B, C, D, E, F that are not covered by the interlayer insulating layer 52A, 52B, 52C all the way to 52F.

BY ATTORNEY WATSON:

Q. So Park --

A. Yeah, so Park used thermal oxidation to form the additional insulating layer 66.

Q. So Park thermally oxidizes the exposed surface of the sacrificial layer patterns to form the additional insulating layer 66, correct?

A. That is what I just said, yes. And the oxidation process can round off one end of the additional insulating layer 66.

Q. Okay. Now let's go to the bottom of column 11, the last sentence where it starts, "The sacrificial layer patterns."

Do you see that?

A. Sorry. Sorry. Let me go there. The last paragraph -- last --

Q. Sentence of column 11 in this --

first two sentences of column 12.

A. This is in line 62?

Q. Starting with the paragraph line 62, I'm particularly going to ask you about the last sentence, the sacrificial layer pattern 62A.

Do you see that?

A. Hold on one second. Sorry. Let me read it to myself. Sorry.

(Pause for reading/reviewing.)

THE WITNESS: It's been a long day. So are you referring to column 11 on the bottom and column 12 on top?

BY ATTORNEY WATSON:

Q. Yes. That's what I'm going to ask you a question about.

A. Okay.

Q. The sacrificial layers that are thermally oxidized are made of silicon nitride or polysilicon, correct?

A. The sacrificial layer 62A through 62F or maybe even higher are made of

material that can selectively etch relative to silicon dioxide, I think such as silicon nitride or polysilicon.

So you're right that the interlayer insulating layer pattern 52A through 52F are made of silicon dioxide whereas the sacrificial layer 62A to 62F are made of either silicon nitride or polysilicon.

Q. How is the silicon nitride or polysilicon oxidized in Park's process?

A. Well, let's see. There's a Figure 9B.

Well, when you expose polysilicon to oxygen, it will oxidize. And so that's how you can oxidize the sacrificial layer such as polysilicon.

Is that what you -- what you're asking?

Q. Sure. So let me try the question this way.

In Park, the sacrificial layers

are oxidized by applying an oxygen gas to the sacrificial layers?

A. One can do that, yes.

Q. And by applying the oxygen gas to the silicon nitrate in Park, that layer is then oxidized to form silicon dioxide, correct?

A. Yes.

Q. Now let's turn to Figure 9B real quick of Park.

Are you there?

A. Yes.

Q. In Figure 9B, none of the sacrificial layers are being removed by adding the oxidant, correct?

A. None of the what?

ATTORNEY HERMAN: Objection. Form.

BY ATTORNEY WATSON:

Q. None of the sacrificial layers -- let me repeat the question.

In Figure 9B, none of the

sacrificial layers are being removed by adding the oxidant, correct?

A. What do you mean by "removed"?

Q. Well, does adding an oxidant remove an insulating layer?

A. It's not an insulating layer. It's -- it's a polysilicon layer. The sacrificial layer is polysilicon.

Are you asking during the -- during the oxidation, whether the polysilicon such as 62A through 62F, would it be consumed? Is that what you're asking?

Q. Yes.

A. It will be consumed. So this picture, it's just showing a cartoon photo, cartoon illustration. But when you expose a silicon region -- right? -- to oxygen such as what you shown here, polysilicon is simply a silicon region just like a silicon substrate.

When you expose to oxygen,

silicon plus oxygen would form SiO2. But where does the silicon come from? The silicon is coming from the silicon substrate and in this case is coming from the polysilicon line and so, therefore, the oxygen is actually react with the silicon to form SiO2.

So, therefore, when you grow an oxide such as you -- let's say you form a hundred angstroms of oxide. 40 percent is -- around 40 percent is actually consume in the original silicon layer.

And then 60 percent is grow on top. So, therefore, to answer your question, yes, some of the polysilicon layer is consumed. Because in order to have the reaction of silicon plus O2 equal to SiO2, the silicon got to come from somewhere.

And that silicon is coming from the polysilicon layer.

Q. Let's go to paragraph 236 of your

declaration.

A. Okay. Let me find it. 236. Yep.

Q. So you claim in 236 that, "Park details how oxidation and ion implantation is used to form a raised pad portion with rounded sides [as read]." Correct?

A. Yes.

Q. Now, you also say, "In particular, an additional sacrificial layer 44 with a desired rounded shape is formed by both an oxidation process and ion implanting impurities 42 into an additional insulating layer 40," correct?

A. Okay. This -- this is regarding which -- which figure is this?

Q. Which figure are you referring to in paragraph 236?

A. I'm trying to see. Figure 6D.

Q. Okay. So based on what you said in paragraph 236, Park requires the use of both oxidation and ion implantation to form

the rounded surfaces, correct?

A. Right. The implantation is adjusting the -- so first Park oxidize the sacrificial layer to grow additional sacrificial layer 44 and, therefore, would have a rounded profile due to the oxidation mechanism, faster oxidation in the convex etches, okay?

And then Park implant impurity 42 in the -- in the additional insulating layer 40, which has a higher etch rate compared to the surrounding oxide.

And --

Q. Let me -- oh, sorry.

A. So the oxidation is achieved -- a rounded profile, and the implantation is to adjust the etch rate, subsequent etch rate.

Q. Let's -- let's go turn now -- I want to talk a little bit about Lee, okay? Are you with me? Do you know what I'm referring to --

A. Are you talking about ground 3?

Q. Ground 3, yes.
A. Okay. Go ahead.
Q. Okay. Lee is what's marked as Exhibit 1007. So let's pull that up real quick.
(Whereupon, Previously Marked Exhibit 1007 is identified for the record.)
THE WITNESS: Can you upload that, please? Unless you don't think it's necessary.
BY ATTORNEY WATSON:
Q. We're going to actually go more to your declaration, if that's okay. I just want to have this available for you.
Can you turn to your declaration in paragraph 390.
Are you there?
A. Not yet.
Okay.
Q. Okay. In paragraph 390, you describe -- or starting at 389, you

describe the process Lee uses to form the pad, correct?

A. Yes.

Q. Okay. In paragraph 391, you say, "The layers 21, which will eventually be replaced by Lee's conductive layers are formed of materials having a high etch selectivity with respect to the second material layers 22."

Do you see that?

A. Yes. That's what I -- yeah.

Q. So material layer 21 will eventually become a conductive layer, correct?

A. Hold on. Let me go there. Sorry.

390...

Okay.

Q. So the conductive layer 21 will eventually be -- strike that. Let me -- let me go -- try that again.

The material layer 21 will

eventually become the conductive layer, correct?

A. Yes. That's what I said in paragraph 90.

Q. And in paragraph 391 of your declaration, you say that the second material layers 22 are an insulating layer such as an oxide layer?

A. That's right.

Q. So the insulating layer simply include an oxide?

A. Yes.

Q. And then paragraph 392, you say, "Lee then employs an ion implantation process to implant impurity regions 23 into the insulating layers 22" --

A. Yes.

Q. -- correct?

A. Yes.

Q. Then let's go to paragraph 385 -- or 395.

A. 395, okay.

Q. Yeah. You say, "Then, Lee etches layers 21 using an isotropic etch step"?

A. Right.

Q. "Then Lee performs a second wet etch step to remove the impurity regions 23 to form recessed regions RC between the remaining portions of the insulating layers 22 [as read]," correct?

A. Okay.

Q. All right. Now let's go to paragraph 397 to your declaration.

Are you there?

A. Yep.

Q. Okay. Now, after you perform these steps, openings are formed as shown in Figure 5B of Lee, correct?

A. Okay.

Q. Is that right?

A. That's what I written there.

Q. Now let's turn to paragraph 411 of your declaration.

A. 411, yes.

Q. Okay. In paragraph 411, you state in the last sentence, "To achieve a rounded, rather than straight-sided contact pad, oxidant would be introduced into the openings."

A. Yes.

Q. Okay. So per your opinion, a person of ordinary skill in the art would be able to form a rounded side by introducing oxidant into the openings shown in Figure 5B of Lee, correct?

A. Yes.

Q. Okay. Let's go up to paragraph 397 of Lee -- of the declaration. Sorry.

Are you there?

A. Yep, I'm there.

Q. Paragraph 397 shows Figure 5B of Lee, correct?

A. Yes.

Q. Where are the openings in Figure 5B of Lee?

A. It's only by RC.
Q. What do you mean by "only by RC"?
A. So you see the arrow RC where it says regions --
Q. Uh-huh.
A. -- so those are the opening.
Q. Okay. So where it says "RC," those are the openings you would introduce oxidant into?
A. Yes.
Q. Okay. Now, can a person of ordinary skill oxidize a solid oxide material with oxygen gas?
A. Sure, you can do that.
Q. How do you do that?
A. Well, when you have a thin oxide, let's say, on top of a silicon substrate, if you want to add more oxide, one way to do that is by exposing it to oxygen so that oxygen will diffuse through the thin oxide and react with silicon underneath the thin oxide and form additional SiO2.

So just because you have a solid oxide doesn't mean that you cannot further increase the thickness by thermal oxidation.

Q. What are the conditions necessary to oxide a solid oxide?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: It just like anytime you have heat and introducing oxidants such as O2 or O3 ozone, you can also use plasma -- plasma enhance oxidations. You can use, you know, simple thermally -- thermal oxidations. Just expose the opening with oxygen.

Just because you have no oxide region doesn't mean that you cannot oxidize further.

BY ATTORNEY WATSON:

Q. So it's your testimony that you can oxidize a solid oxide using oxygen gas?

A. I do that all the time in my lab.

You have a thin oxide, you want to grow more, so you expose it to oxygen. And that it will grow oxide. Simple as that.

Q. What if you --

A. Sure.

Q. So in order to oxidize a solid oxide using oxygen gas, you need to start with a thin oxide to begin with?

ATTORNEY HERMAN: Objection to form.

THE WITNESS: Well, no, not necessary. Depending on the thin of the oxide, obviously you can oxidize much more easily. The thicker oxide you can still oxidize as long as you given enough time and temperature.

It's explained in any textbook in semiconductor fabrications in undergraduate classes or graduate classes. I taught it at UT, and I taught it in short courses in industry. It's a very simple process.

BY ATTORNEY WATSON:

Q. Did you cite any of those textbooks in your declaration?

A. It's a very well-known oxidation process. And it is -- it's a simple oxidation process as anyone, a person of ordinary skill in the art would understand it when you expose a region with oxygen, it will oxidize.

Q. Did you cite to any exhibits to support your position that when you expose a region to oxide, it will oxidize even if that region is already a solid oxide?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: You make it sound like an oxide cannot be further oxidized. And a person of ordinary skill in the art would -- so think about this. Think about it, Mr. Watson.

When you grow an oxide on

silicon, you didn't start out with any oxide, let's say. And you grow an oxide and you want it to be a hundred angstroms. When you grow the oxide, halfway is 50 angstroms -- you already have 50 angstroms, and you still continue to grow 200 angstroms.

Wow. How do you do that? So think about it. Let's say you grow an oxide on top of silicon substrate. You grow an oxide to 50 angstroms and you continue to grow to 100 angstroms or you grow an oxide to 50 angstroms bringing down to the -- bringing -- out the chamber, exposure to air, brought it back in, you continue to grow it just like what you have done earlier.

So you don't need any -- I don't need any exhibit or prior art or textbook to explain this. This is a simple thermal oxidation process.

Otherwise are you saying that

when you growing the oxide on the plain silicon substrate, it will be -- there will be a limit? You can't grow any thicker once you grow a certain thickness. That's ridiculous.

BY ATTORNEY WATSON:

Q. I didn't ask most of that.

I just wanted to know: Did you cite an exhibit in your declaration to support your position that you could thermally oxidize an oxide?

A. You don't need to. I don't need to, because this is as simple as one plus one.

Q. Okay.

A. A person of ordinary skill in the art would understand that when you grow a thermal oxide, when you expose the oxygen, it will grow an oxide depending on temperature and depending on the concentration of oxygen and depends on how long you -- you leave the wafer in the

chamber.

Q. What is formed when you oxidize silicon dioxide?

A. Silicon dioxide, that is what is form.

Q. So if you already are silicon dioxide, you're further oxidizing it into more silicon dioxide?

A. Yes. Again, think about it. When you have a plain substrate, you expose to oxygen halfway to 50 angstroms. It's not going to stop or it's not gonna be like, oh, you already have a solid oxide, how can you -- how can you grow even further?

You have oxide that's 100 angstrom, 3,000 angstrom, easily in the semiconductor integrated circuit.

So just because you have a solid -- you call it solid -- yeah, it's a solid oxide doesn't mean that you cannot further oxidize that layer.

Q. So what would the chemical equation be for that oxidation?

A. Same as before. You react a silicon with oxygen to form SiO2. And that silicon exist in silicon dioxide and also exist in the underlying substrate.

Q. So if I started with silicon dioxide and I added oxygen to it, what would the end product be? Silicon dioxide?

A. Silicon dioxide, yes.

Q. Okay. All right.

A. And -- and as I explained in the paragraph 412 and 413, I explain why that the oxidation not only depends on how fast -- how much -- what the temperature is and how long you leave it in, but also depends on the topography of the substrate.

If it is a corner, depends on whether it's exterior corner or interior corner. It will oxidize faster and slower compared to what? Compared to the planar surface on the substrate.

In other words, that differential in oxidation rate at the corner versus the planar surfaces causes both type of corners to round off.

And that's what I tried to explain in paragraph 413. And that as I explained early in the deposition, that drawing could have been drawn more accurately. And I didn't intend it to imply the corner would be --

(Stenographer requests clarification and colloquy will not be captured on the written record.)

THE WITNESS: Eaten away by the oxidation process. I just want to try -- I was trying to show that the shape of the corner would be curved.

BY ATTORNEY WATSON:

Q. Oxidation is an additive process, correct?

A. It is, yes.

ATTORNEY WATSON: Okay. All right. Let's take a break. I'm just about wrapped up. So if I have questions, it will be a few last questions. Let's take a break right now.

THE STENOGRAPHER: Okay. We're off the record.

(Whereupon, a recess was taken at 4:51 p.m.)

(Whereupon, Exhibit 9 is marked for identification.)

THE STENOGRAPHER: All right. We're on the record.

BY ATTORNEY WATSON:

Q. Dr. Lee, did you discuss the substance of your testimony with anyone during the break?

A. No.

Q. Okay. I'm putting on the screen what's been marked as Lee Exhibit 9.

Do you see that?

A. Yes. That's what you showed earlier.

Q. Uh-huh. The insulating layer is labeled in blue, correct?

A. Yes.

Q. Where is the top surface of insulating layer?

A. Well, it is 271, that what you drawn up there.

Q. Do you mind if I do some drawing real quick?

Is the top layer of the insulating layer what I've drawn in green here?

ATTORNEY HERMAN: Objection. Form.

THE WITNESS: Again, the insulating layer is a two-dimensional -- a three-dimensional structure, and you're drawing a one-dimensional line.

And the reason why 248 and 271

are together and meet the claim limitations of insulating layer, because those two pieces together cooperate to define the contact holes.

BY ATTORNEY WATSON:

Q. Now, this green line, if you extended it in the y-plane, would that be the top surface of the insulating layer?

A. So we don't have the -- Nam did not provide, if I -- Nam did not provide any three-dimensional picture, I don't think. I don't -- I don't recall.

Q. What -- what is the side surface of insulating layer in Nam?

A. Well, it depends on what the -- depends on what the design of the structure is. And so without talking about -- without having the three-dimensional picture, I'm not sure if -- if one can determine what the side is.

Because that really depends on whether the entire pad take over -- took

over the -- the entire conductive layer.

So to answer your question, a person of ordinary skill in the art, I don't think -- I don't think that Nam describe the three-dimensional illustrations of what this structure look like.

Q. Oh, okay.

So in Exhibit -- or strike that.

In Figure 8A, you cannot identify the side surface of insulating layer, correct?

ATTORNEY HERMAN: Objection. Form.

That's inconsistent with the witness's testimony.

THE WITNESS: Figure 8A shows a two-dimensional cross-section of a three-dimensional structure.

So unless information have been given on what the -- what the three-dimensional structure is, look

like, a person of ordinary skill in the art would not -- understood what the side -- when you say "side surface," are you talking about the side surface perpendicular to the x-y plane, or are you talking about the side surface perpendicular to the x-z plane.

I don't understand what you mean by "side surface."

BY ATTORNEY WATSON:

Q. Okay. Let me ask you --

ATTORNEY HERMAN: How are we on the time?

ATTORNEY WATSON: Last question. Last question, Patrick. Last question, and then I'll be done.

ATTORNEY HERMAN: Frankly, he has offered opinions in his declaration about what constitutes the claimed side surface that you're intentionally trying to mislead him in time --

ATTORNEY WATSON: I'm not trying

to do anything. I'm trying to get him to answer my question, and he's not been doing it.

ATTORNEY HERMAN: Yes, he has.

ATTORNEY WATSON: So let me ask this last question.

ATTORNEY HERMAN: You're not being clear.

BY ATTORNEY WATSON:

Q. Dr. Lee, let me ask you this question --

A. Mr. Watson, actually, your question does not make sense at all. I already discuss side surface, and now you twist it around and say the side surface in the certain -- certain plane.

The -- I already discuss how the side surface is curved in my declaration and especially Nam. So I don't understand the confusing question that you have.

Q. Well, this is my last question, so we'll end with this, okay? Are you

ready? That wasn't my last question, but...

A. Okay. Oh, you already asked a question, you ready.

Q. In this Lee Exhibit 9, can you identify the bottom surface of the insulating layer?

A. And what do you mean by the "bottom surface"? The blue regions shows the bottom follow the contour of the contact pad.

Is that what you mean?

Q. Sure.

A. Well, if that's what you mean, then the bottom of the layer is following the contour of the blue region. Your question is very confusing.

ATTORNEY WATSON: Okay. That's my last question, unless, Patrick, you have any --

ATTORNEY HERMAN: No, I don't have any further questions.

ATTORNEY WATSON: Okay. Thank you so much, Dr. Lee. I appreciate your time.

THE WITNESS: Thank you.

ATTORNEY WATSON: Patrick, thank you for your time as well.

THE STENOGRAPHER: We're off the record.

(Time noted: 5:04 p.m.)

REPORTER CERTIFICATE

I, the undersigned, do hereby certify:

That JACK C. LEE, PH.D., the witness whose Deposition is hereinbefore set forth, was duly sworn by me before the commencement of such deposition and that such deposition was taken virtually and is a true record of the testimony given by such witness.

I further certify that the adverse party, MICRON TECHNOLOGY, INC., was represented by counsel at the deposition.

I further certify that the deposition of JACK C. LEE, PH.D., occurred virtually, on Wednesday, August 13th, 2025, from 9:01 a.m. to 5:04 p.m..

I further certify that I am not related to any of the parties to this action by blood or marriage, I am not employed by or an attorney to any of the parties to this action, and that I am in no way interested,

financially or otherwise, in the outcome of this matter.

IN WITNESS WHEREOF, I have hereunto set my hand this 17th day of August, 2025.



JESSICA R. WAACK
Registered Diplomate Reporter
Certified Realtime Reporter
New York Realtime Court Reporter
New York Association Court Reporter
Notary Public, State of New York
CCR-NJ (No. 30XI008238700) CSR-TX (No. 11958)
CCR-WA (No. 21007264), CSR-CA (No. 14420)

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