1 UNITED STATES PATENT AND TRADEMARK OFFICE

2 BEFORE THE PATENT TRIAL AND APPEAL BOARD

3 _____

4 MICRON TECHNOLOGY, INC.,
Petitioner

5 v.

6 YANGTZE MEMORY TECHNOLOGIES COMPANY, LTD.,
Patent owner

7 _____

8 IPR2025-00189

9 Patent No. 11,145,666

10 _____

11

12

13

14 REMOTE EXAMINATION

15 OF JACK C. LEE, PH.D.

16 _____

17 TAKEN ON WEDNESDAY, AUGUST 13, 2025

18

19 CERTIFIED STENOGRAPHER:

20 JESSIE WAACK, RDR, CRR, CCRR, NYRCR, NYACR,
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REALTIME SYSTEMS ADMINISTRATOR

22 JOB NO.: 592770

YMTC
Exhibit 2031
Micron v. YMTC
PGR2025-00021
Ex. 2031-001

1

2 REMOTE EXAMINATION of JACK C. LEE,
3 PH.D., taken before JESSICA R. WAACK, Registered
4 Professional Reporter, Registered Merit
5 Reporter, Certified Realtime Reporter,
6 Registered Diplomate Reporter, California
7 Certified Realtime Reporter, New Jersey
8 Certified Court Reporter (License No.
9 30XI008238700); Texas Certified Shorthand
10 Reporter (License No. 11958); Washington State
11 Certified Court Reporter (License No.
12 21007264); California Certified Shorthand
13 Reporter (License No. 14420); New York
14 Association Certified Reporter, New York
15 Realtime Court Reporter and Notary Public of
16 Washington, D.C. and the States of New York,
17 Pennsylvania, Delaware, Maryland and Virginia,
18 held remotely via a videoconference platform,
19 on Wednesday, August 13, 2025, commencing at
20 9:01 a.m. and concluding at 5:04 p.m.
21
22

1 A P P E A R A N C E S
2 (all appearing remotely)
3
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20 A L S O P R E S E N T
21 LUCIEN NEWELL, document technician
22 --o0o--

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13 INFORMATION REQUESTED
14 None
15
16 WITNESS INSTRUCTED NOT TO ANSWER
17 None
18
19
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21
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8 original transcript **
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1 STIPULATIONS
2
3 IT IS HEREBY STIPULATED AND
4 AGREED by and between counsel no party to
5 the litigation will object to the remote
6 deposition on the grounds that the
7 certified stenographer may not have the
8 legal authority to swear in the witness.
9 FURTHER STIPULATED AND AGREED
10 that all parties are aware the certified
11 stenographer is not physically present in
12 the deposition room with the witness and
13 will be administering the oath and
14 reporting this deposition remotely.
15
16
17
18
19
20
21
22

1 STIPULATIONS
2
3 FURTHER STIPULATED AND AGREED
4 this transcript and all testimony will have
5 the same force and effect as if everyone
6 was present in person in the deposition
7 room.
8 FURTHER STIPULATED AND AGREED all
9 parties and their counsel consent to this
10 arrangement and waive any objections to
11 this manner of reporting.
12
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14
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17
18
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20
21
22

1 ******
2 REMOTE PROCEEDINGS
3 August 13, 2025, 9:01 a.m.
4 ******
5 DOCUMENT TECHNICIAN: Thank you
6 to everyone for attending this
7 proceeding remotely, which we
8 anticipate will run smoothly.
9 Please remember to speak slowly
10 and do your best not to talk over one
11 another. Please be aware that we are
12 recording this proceeding for backup
13 purposes.
14 Any off-the-record discussions
15 should be had away from the computer.
16 Please remember to mute your mic for
17 those conversations. Please have your
18 video enabled to help the reporter
19 identify who is speaking. If you are
20 unable to connect with video and are
21 connecting via phone, please identify
22 yourself each time before speaking.

1 We will provide a complementary
2 unedited recording of this deposition
3 with the purchase of a transcript. I
4 apologize in advance for any
5 technical-related interruptions.
6 Thank you.
7 *****
8 JACK C. LEE, PH.D., sworn
9 on oath and/or affirmed, called as a
10 witness herein, was examined and testified
11 as follows:
12 *****
13 EXAMINATION
14 BY ATTORNEY WATSON:
15 Q. Good morning, Dr. Lee.
16 A. Good morning.
17 Q. My name is Tom Watson. Nice to
18 meet you today.
19 A. Nice meeting you.
20 Q. Can you state your full name for
21 the record.
22 A. My name -- my full name is Jack

1 C. Lee.
2 Q. Okay. And can you spell that for
3 the record?
4 A. Jack is J-a-c-k. C., initial C.
5 as in Charlie. And Lee, L-e-e.
6 Q. Can you please state your home
7 address for the record.
8 A. It is 5803 Westslope, it's one
9 word, W-e-s-t-s-l-o-p-e, Cove, C-o-v-e.
10 It's in Austin, Texas, 78731.
11 Q. Dr. Lee, where are you located
12 right now?
13 A. I am located at the address that
14 I just provided.
15 Q. So you are at your home address?
16 A. That is correct.
17 Q. Dr. Lee, do you understand that
18 your testimony today is under oath and
19 under penalty of perjury?
20 A. Yes.
21 Q. And do you understand that you
22 are under the same obligation to tell the

1 truth as if you were testifying before a
2 judge and a jury?
3 A. Yes.
4 Q. Dr. Lee, have you been deposed
5 before?
6 A. Yes.
7 Q. I want to go over a couple of
8 ground rules for the deposition, if that's
9 okay.
10 A. Yes.
11 ATTORNEY WATSON: Can we go off
12 the record one second? I'm having a
13 technical difficulty with the realtime.
14 THE STENOGRAPHER: We're off the
15 record.
16 (Whereupon, a recess was taken at
17 9:05 a.m.)
18 THE STENOGRAPHER: We're back on
19 the record.
20 BY ATTORNEY WATSON:
21 Q. Dr. Lee, we have a court reporter
22 here, and it's important that she's able to

1 transcribe your record -- the record.
2 Do you understand that?
3 A. Yes.
4 Q. So when you answer my questions,
5 can you please do so verbally?
6 A. Yes.
7 Q. And if you don't understand my
8 question, can you please let me know so I
9 can rephrase it?
10 A. Yes.
11 Q. And do you understand that if you
12 answer my question, I will assume that you
13 have answered my -- you have understood my
14 question?
15 A. Yes.
16 Q. Dr. Lee, do you understand that
17 during the deposition, you are not to
18 communicate with your counsel while we are
19 on the record?
20 A. Yes.
21 Q. And is there any reason that you
22 cannot provide full and truthful testimony

1 today?
2 A. No.
3 Q. Dr. Lee, I want to set up some
4 shorthand for our deposition, if that's
5 okay.
6 A. Yes.
7 Q. Today, do you understand that we
8 are here today to discuss your testimony
9 regarding IPR proceeding 2025-00189?
10 A. I don't recall that specific
11 number.
12 Q. Okay. Let's pull up
13 Exhibit 1003.
14 DOCUMENT TECHNICIAN: And should
15 I mark this as Exhibit 1003?
16 ATTORNEY WATSON: Yes.
17 (Whereupon, Previously Marked
18 Exhibit 1003 is identified for
19 the record.)
20 BY ATTORNEY WATSON:
21 Q. Dr. Lee, do you recognize
22 Exhibit 1003 as the declaration you

1 submitted in support of inter partes review
2 of U.S. Patent 11,145,666?
3 A. Yes.
4 Q. So when I refer to this case,
5 will you understand that I'm referring to
6 IPR proceeding 2025-00189?
7 A. Yes.
8 Q. And when I refer to the '666
9 patent, I'm referring to U.S. Patent Number
10 11,145,666, understood?
11 A. Yes.
12 Q. Dr. Lee, do you have any
13 materials with you today?
14 A. No.
15 Q. And you don't have any notes in
16 front of you?
17 A. No.
18 Q. Do you have any applications open
19 on your computer other than this Zoom
20 deposition?
21 A. No.
22 Q. Are there any other screens in

1 your room?
2 A. Yes.
3 Q. Are any of those on?
4 A. Yes.
5 Q. What's on those screens at the
6 moment?
7 A. Nothing.
8 Q. During our deposition, will you
9 ensure that those screens remain clear of
10 any additional material?
11 A. Yes. Those screens are on in
12 case we have documents uploaded to the chat
13 and I can open it and displays in those
14 screens on the -- on my desk.
15 Q. Okay. So other than putting up
16 exhibits that we're talking about in this
17 deposition, you agree that you won't put
18 any other material up on the screens; is
19 that fair?
20 A. Yes.
21 Q. Is there anyone else in the room
22 with you right now?

1 A. No.
2 Q. Can you agree with me to not take
3 out your cell phone during the deposition
4 today?
5 A. Yes.
6 Q. And can you agree with me not to
7 access the Internet during our deposition?
8 A. Yes.
9 Q. Dr. Lee, you mentioned you had
10 been deposed previously; is that correct?
11 A. Yes.
12 Q. How many times have you been
13 deposed?
14 A. I don't recall exactly how many
15 times.
16 Q. More than 10 times?
17 A. Yes.
18 Q. Dr. Lee, what did you do to
19 prepare for your deposition today?
20 A. I reviewed all the materials that
21 I cited in my declarations. I reviewed my
22 declarations and -- oh, I see the

1 declaration has been uploaded. Can I
2 download it?
3 Q. Yes.
4 (Pause in testimony.)
5 THE WITNESS: In paragraph 17, I
6 stated that, in forming my opinions in
7 this declaration, I consider and relied
8 on my education, my knowledge of the
9 relevant field and knowledge of science
10 and engineering principle and my
11 experience.
12 I also reviewed the patent,
13 obviously, '666 patent, the prosecution
14 history and the additional material
15 that's listed in the table of -- in the
16 table in paragraph 17.
17 BY ATTORNEY WATSON:
18 Q. To be clear, you reviewed the
19 materials cited in paragraph 17, you
20 reviewed your declaration, correct?
21 A. I also review the patent, the
22 '666 patent, Exhibit 1001 and the

1 prosecution history, Exhibit 1002.
2 Q. Other than the patent, the '666
3 patent, the prosecution history,
4 Exhibit 1002, the exhibits listed in
5 paragraph 17 of your declaration and your
6 declaration, did you review any other
7 materials in preparing for your deposition
8 today?
9 A. I see that Exhibit 1001 is the
10 '666 patent. 1002 is the prosecution
11 history. 1003 is my declaration. And then
12 the table started with Exhibit 1005
13 consecutively to 1018. I don't recall what
14 is Exhibit 1004.
15 Do you have that information?
16 Q. Exhibit 1004 is your CV.
17 A. Okay. All right. Thank you.
18 Q. Okay. So in preparing for your
19 deposition, you reviewed Exhibits 1001
20 through Exhibits 1018; is that fair?
21 A. Yes. Those are the materials
22 that I reviewed. And as I mentioned, I

1 also relied on my education, the knowledge
2 of the relevant field, the knowledge of
3 scientific and engineering principles and
4 my experience in preparing of my
5 declaration -- in preparing and forming my
6 opinion in this declaration.
7 Q. In preparing for your deposition,
8 did you review any materials other than
9 Exhibits 1001 through Exhibits 1018?
10 A. I don't recall any additional
11 material that I reviewed.
12 Q. Did you meet with anybody in
13 preparing for your deposition?
14 A. Yes.
15 Q. Who did you meet with?
16 A. I have met with counsel, Patrick
17 Herman.
18 Q. Did you meet with anyone other
19 than Mr. Herman in preparing for your
20 deposition?
21 A. No, I have not.
22 Q. How many times did you meet with

1 Mr. Herman in preparing for your
2 deposition?
3 A. I think twice, I believe.
4 Q. When were those meetings?
5 A. One was last week and one in this
6 week.
7 Q. And how long was each meeting?
8 A. Approximately hour and a half to
9 two hours.
10 Q. And were your meetings with
11 Mr. Herman in person or by video?
12 A. By video, Zoom call.
13 Q. Besides Mr. Herman, have you
14 discussed this case with anyone else?
15 A. No.
16 Q. In reviewing the documents you
17 reviewed, did your review refresh your
18 recollection of anything?
19 ATTORNEY HERMAN: Objection.
20 Form.
21 THE WITNESS: Can you repeat the
22 question, please?

1 BY ATTORNEY WATSON:
2 Q. Yeah, let me rephrase it.
3 When preparing to testify today,
4 did you review any documents?
5 A. Can you repeat the question,
6 please?
7 Q. Yeah.
8 While preparing to testify today,
9 did you review any documents?
10 A. As I mentioned previously, I have
11 reviewed Exhibit 1001 to Exhibit 1018
12 describe --
13 Q. Did your --
14 A. -- described in paragraph 17.
15 Q. Did your review of those
16 documents refresh your recollection?
17 ATTORNEY HERMAN: Objection.
18 Form.
19 THE WITNESS: I reviewed those
20 documents and discussed with counsel.
21 I'm not sure I understand what you mean
22 by "recollection."

1 BY ATTORNEY WATSON:
2 Q. Okay. I'll move on.
3 Dr. Lee, since you signed your
4 declaration that you submitted in this IPR,
5 have you changed any of your opinions?
6 A. No, I have not.
7 Q. Other than Mr. Herman, have you
8 discussed the substance of your declaration
9 with anyone else?
10 A. No.
11 Q. Have you formed any new opinions
12 in this case since submitting your
13 declaration?
14 A. No, I have not. However, there's
15 some figures in my declaration I could have
16 drawn it more clearly. And I can explain
17 it during the deposition.
18 Q. Okay. How much time have you put
19 into this IPR so far?
20 A. I don't recall.
21 Q. Would you say you spent a hundred
22 hours working on this declaration?

1 A. When you say "preparing the
2 declaration," you mean prior to preparation
3 for this deposition? Prior to November 22,
4 2024, the day that I signed the declaration
5 Exhibit 1003?
6 Q. Let me clarify. Have you spent
7 around a hundred hours working on this
8 particular IPR matter?
9 A. Is your question including both
10 drafting -- forming my opinion and drafting
11 the declarations plus the preparation time
12 for today's deposition?
13 Q. Yes. It includes both drafting,
14 forming your opinion and drafting the
15 declaration plus the preparation time for
16 today's deposition, how much time?
17 A. I don't recall, but I would say
18 at least 50 -- at least 50 to 75 hours or
19 even closer to a hundred hours. I don't
20 recall the exact number.
21 Q. Who initially drafted the text of
22 your declaration?

1 ATTORNEY HERMAN: Objection.
2 Form.
3 THE WITNESS: Both counsel and I
4 worked collaboratively in drafting the
5 initial draft of my declaration. At
6 the end of the day, this is my opinion.
7 BY ATTORNEY WATSON:
8 Q. And the entirety of the opinions
9 you are offering in this case are listed in
10 this declaration, correct?
11 A. Yes. The declaration includes
12 my -- all my opinion regarding the IPR of
13 '666 patent.
14 Q. Let's turn to paragraph 17 of
15 your declaration real quick.
16 Are you there, Dr. Lee?
17 A. I can see that on the screen and
18 on there, yes.
19 Q. In paragraph 17, you say that you
20 reviewed certain exhibits, correct?
21 A. Yes.
22 Q. And in your review of these

1 exhibits, you opine that some of the
2 exhibits are prior art; is that fair?
3 A. That's fair.
4 Q. Who provided the prior art for
5 your analysis?
6 A. I don't recall who provide the
7 prior art. I have access to the library at
8 University of Texas at Austin. And
9 periodically I was asked to search for
10 certain document, certain references.
11 And there -- as you know, there
12 are multiple IPR in this lawsuit. And at
13 times, I worked on multiple IPRs. And so I
14 don't recall in this particular IPR which
15 one I provided and which one provided by
16 counsel.
17 Q. Did you perform any independent
18 search of literature, patents or other
19 publications for your report?
20 A. As I mentioned before, I have
21 provided various publications to various
22 IPR declarations, IPR proceedings in this

1 case. I don't recall which one -- which of
2 the IPR I provided the publications.
3 And so I -- I could have provided
4 some of the prior art references for this
5 particular IPR. I just don't recall.
6 Q. You can't recall whether you
7 found prior art references in this IPR or
8 whether someone else did?
9 A. As I mentioned just now, I have
10 provided prior art references for various
11 IPR in this case. And I just don't recall
12 whether I have provided the prior art
13 references for this particular IPR.
14 Q. You don't recall, sitting here
15 today, whether you provided the prior art
16 references for this particular IPR?
17 A. No, I don't recall.
18 Q. Sitting here today, is there
19 anything in your declaration that you'd
20 like to correct?
21 A. I wouldn't say correct. I would
22 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

1 blue region is the claimed adjacent
2 insulating layer, okay?
3 The green region is the
4 conductive layer. And at the right-hand
5 most of the conductive layer is the
6 conductive pad or sometimes called the
7 contact pad which has a green portion at
8 the bottom and kind of brownish orangey
9 near the top, or at the top.
10 What would have been more clear
11 is that the top blue region should have
12 drawn to extend and covered the contact
13 pad.
14 In other words, it should have
15 extended all the way to the -- to cover the
16 brown orangey portion all the way to where
17 the vertical dash -- red dash line on the
18 left of the box that says laterally
19 display.
20 So, in summary, what I'd like to
21 provide a clarification is that the top
22 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

1 paragraph 343, Figure 7. Okay. The blue
2 region for the top insulating layer and the
3 adjacent insulating layer, I should have
4 been more clearer and drawn the same way as
5 the Figure 34 -- in figure -- in
6 paragraph 345.
7 In other words, both top and
8 bottom blue insulating layer 248 and 247
9 should extend to fully covered the contact
10 pad 237 and 236.
11 Put another way, that the
12 Figure 7 in 340 -- in paragraph 343 should
13 have drawn the same as Figure 7 in 245.
14 Does that make sense to you?
15 Q. Let me see if I can clarify that,
16 if that's okay.
17 Do you see the layer marked as
18 271 in the figures in paragraph 343 and
19 345?
20 A. Yes.
21 Q. Is it your opinion that the
22 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

1 layer extended from 236.
2 So that particular region of 271
3 is called a second portion of adjacent
4 insulating layer, so, yes, is the portion
5 of 271 on top of the contact pad as shown
6 in Figure 7 in paragraph 245. The only
7 clarification is that the top blue region
8 labeled as 248 should extend to fully
9 covered the green and brown contact pad.
10 Does that make sense to you?
11 The wording, in my opinion, the
12 wording in those paragraph are accurate.
13 And the figures are accurate except I
14 think, to be more clear, I like to make the
15 clarification that I just mentioned.
16 Q. So you would make the same change
17 to figure -- strike that. Let me try this
18 question again.
19 You would make the same change to
20 the figure found in paragraph 343 that you
21 would make in figure -- paragraph 345 in
22 your declaration, correct?

1 A. That is correct.
2 Q. And that change would then extend
3 the insulating layer to cover the contact
4 pad; is that correct?
5 A. The insulating layers, to be more
6 clearer, should have drawn to extend and
7 fully covered the contact pads, both the
8 top insulating layer, which is the claimed
9 insulating layer and the bottom blue
10 region, which is the claimed adjacent
11 insulating layers -- insulating layer.
12 Q. Does the insulating layer in
13 paragraphs 343 and 345 of your report
14 extend to cover both the top and side
15 surface of the contact pad?
16 ATTORNEY HERMAN: Objection.
17 Form.
18 THE WITNESS: You see the way --
19 the Figure 40 -- Figure 7 in
20 paragraph 345, the way the bottom blue
21 region, which is the claimed adjacent
22 insulating layer, the way it is drawn

1 is the clear way that covers the top --
2 fully covers the top of the contact
3 pad.
4 BY ATTORNEY WATSON:
5 Q. So what is the claimed insulating
6 layer in these figures should extend to
7 cover the top surface of the contact pad?
8 A. Can you say that again?
9 Q. The claimed insulating layer, not
10 the adjacent insulating layer, should
11 extend to cover the top of the contact pad?
12 A. Yes --
13 Q. Okay.
14 A. -- the -- let me -- let me make
15 sure that the...
16 The claim insulating layer,
17 meaning the top blue region, should cover
18 the top of the contact pad, which -- which
19 is covered both green and brown colored,
20 cover the curved part on the left and the
21 curved part on the right.
22 You see the vertical dash line,

1 blue dash line, there's two -- sorry, red.
2 You see the two vertical dash line, and
3 between those two vertical dash line,
4 there's an arrow and label laterally
5 displayed?
6 Q. I see that.
7 A. The blue region on top of the
8 green region should extend to fully cover
9 the contact pad, in other words, so to
10 extend all the way to the left vertical red
11 dash line.
12 Does that make sense to you? Is
13 that clear?
14 Q. The insulating layer should
15 extend all the way to the furthest left red
16 dash line in Figure 345, the figure found
17 in 345 of your declaration?
18 A. That is correct.
19 Q. Okay. All right.
20 A. And the same applied to Figure 7
21 in paragraph 343.
22 Again, the wordings in all

1 these -- on those paragraphs are the same
2 as what's written in the declaration, and
3 my opinion has not changed. I just want to
4 provide a clarification. It's not an
5 error, but certain figure I should have
6 perhaps drawn a bit more clearly.
7 Q. Okay. You said there's a third
8 figure that you wanted to correct.
9 Which figure is that?
10 A. In paragraph 3 -- 4, sorry, 413,
11 Figure 5B of the Lee reference.
12 Are you there?
13 Q. Yes.
14 A. In this annotated figure,
15 Figure 5B of Lee in paragraph 413, I did
16 not intend to imply that the corner would
17 be eaten away by the oxidation process as
18 someone might misinterpret the figure that
19 I was -- that is drawn in paragraph 413.
20 I was trying to show the shape of
21 the corners, that the shape of the corner
22 would be curved and that, again, the

1 wordings surrounding that figure, figure 5B
2 of paragraph -- in paragraph 413,
3 particularly paragraph 412,
4 paragraph 413 and -- I think those are the
5 two paragraph, perhaps it may be other
6 paragraph that I was trying -- the wordings
7 are accurate.
8 And the figure, perhaps I should
9 have drawn it a bit more clearly, to
10 illustrate the curved shape of the colors
11 when exposed to oxidant during the
12 oxidation process.
13 Q. So the content in the
14 paragraph 413 is correct?
15 A. The content in paragraph 412 and
16 413 -- let me see.
17 The content in that section which
18 includes paragraph 411, 412 and 413, in
19 fact, the entire sections regarding
20 ground 3, the wordings are accurate. And
21 my opinion has not changed.
22 The only point that I wanted to

1 make was that the figures, and this
2 particular figure in paragraph 413, that
3 I'd like to draw it a bit more clearly.
4 Q. How would you draw the figure in
5 paragraph 413 more clearly?
6 A. The curve, shape would look more
7 like an S-shape that you would have a
8 rounded corner at the top corner and a
9 rounded corner at the bottom corner.
10 And it's not drawn in such a way
11 that it appears to be eaten up -- eaten
12 away by the oxidation process.
13 The oxidation process is an
14 additive process. So the -- it's almost
15 like an S-shape like this, and it's
16 extended to the left of that step.
17 Does that make sense to you?
18 Q. I think so. So let me just
19 wrap -- wrap up this section, if that's
20 okay.
21 A. Sure.
22 Q. Other than the changes to the

1 figures in paragraphs 343, 345 and 413 of
2 your declaration, you have no other changes
3 you'd like to make to your declaration at
4 this time?
5 A. That is correct. There might be
6 some typo that you might have found. But
7 in terms of the figures, those are the
8 three figures that I think that I'd like to
9 draw a bit more clearly as I describe just
10 now.
11 Q. Okay. Let's turn to paragraph 4
12 of your declaration. We have that on the
13 screen.
14 A. Hold on. Let me get there.
15 I'm there.
16 Q. In paragraph 4, you state that
17 you're being compensated at a rate of $680
18 per hour; is that correct?
19 A. That is correct.
20 Q. Okay. Do you have any stock in
21 Micron?
22 A. No.

1 Q. Do you receive any bonuses --
2 A. No.
3 Q. -- tied to how well Micron does
4 as a company?
5 A. No.
6 Q. Have you ever worked for Micron
7 outside of the litigation expert role?
8 A. No, I don't think so.
9 Q. Okay. Let's turn to -- let's
10 pull up Exhibit 1001.
11 (Whereupon, Previously Marked
12 Exhibit 1001 is identified for
13 the record.)
14 THE WITNESS: Would you mind
15 upload this?
16 ATTORNEY WATSON: Can we upload
17 that for Dr. Lee?
18 BY ATTORNEY WATSON:
19 Q. Dr. Lee, Exhibit 1001 is the '666
20 patent, correct?
21 A. Let me download it. I'm sorry.
22 Yes.

1 Q. Now, the '666 patent is about a
2 staircase structure for a 3D memory; is
3 that right?
4 ATTORNEY HERMAN: Objection to
5 form.
6 THE WITNESS: So as I discuss in
7 my declaration in paragraph 65, the
8 '666 patent relates generally to a
9 staircase structure for memory device,
10 for example, 3D memory device.
11 BY ATTORNEY WATSON:
12 Q. Okay. Let's turn to columns --
13 columns 5, lines 6 through 11.
14 A. One sec.
15 ATTORNEY WATSON: Can we zoom a
16 little bit on this figure on this one
17 on the screen? Thank you. That's a
18 little bit easier to see.
19 BY ATTORNEY WATSON:
20 Q. Are you there on column 5, lines
21 6 through 11?
22 A. Yes.

1 Q. So the '666 patent here refers to
2 a semiconductor device with vertically
3 oriented screens of memory cells
4 transistors, correct?
5 A. Yes. That's what it says there.
6 Q. Okay. Let's go to paragraph --
7 column 5, lines 44 through 47. Let me know
8 when you're there.
9 A. Yes.
10 Q. In the '666 patent, "A staircase
11 structure refers to a set of surfaces that
12 include at least two horizontal surfaces,
13 (e.g., a long and x-y plane) and at least
14 two vertical surfaces, (e.g., along a
15 z-axis)," correct?
16 A. Yes. That's what it says there.
17 Q. And so the horizontal surfaces
18 run along the x-y plane; is that correct?
19 A. That's what it says there, that
20 horizontal surface run along -- for
21 example, along an x-y plane.
22 Q. And the vertical surfaces run

1 along the z plane?
2 A. That's what written in column 5
3 of the '666 patent.
4 Q. Let's go to Figure 1 of the '666
5 patent.
6 ATTORNEY WATSON: Could we
7 rotate? Maybe I can do it.
8 THE WITNESS: So hold on one
9 second.
10 Figure 1?
11 BY ATTORNEY WATSON:
12 Q. Uh-huh. Are you there, Dr. Lee?
13 A. I'm there.
14 Q. Okay. Would you agree with me
15 that Figure 1, "Illustrates a
16 cross-sectional view of a hard mask layer
17 and a plurality of dielectric layer pairs
18 over a substrate"?
19 A. Can you tell me where are you
20 reading that?
21 Q. Sure. Column 3, lines 3 through
22 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

1 the substrate, correct?
2 A. That is correct.
3 Q. And the substrate is the material
4 which subsequent layers are added on?
5 ATTORNEY HERMAN: Objection.
6 Form.
7 THE WITNESS: Hold on one second.
8 Are you reading that from
9 somewhere?
10 BY ATTORNEY WATSON:
11 Q. Column 4, lines 21 through 22.
12 A. Right. That's what it says
13 there, the term "substrate" refers to a
14 material on which -- onto which subsequent
15 material layers are added.
16 Q. Now, the substrate in Figure 1
17 has a top surface, correct?
18 A. That is right, yes. In the same
19 column, column 4, immediately after the
20 sentence you just read, it says, "The
21 substrate include a top surface and a
22 bottom surface."

1 Q. So the top surface of the
2 substrate is a horizontal surface; is that
3 fair to say?
4 A. The top surface of the substrate
5 is a horizontal surface parallel to the
6 x-axis.
7 Q. So the top surface of the
8 substrate runs along the x-y plane?
9 A. Yes. It is -- runs along the x-y
10 plane perpendicular to the z-axis.
11 Q. The substrate also has a bottom
12 surface, correct?
13 A. That's what I just read in
14 column 4, that the substrate includes a top
15 surface and a bottom surface.
16 Q. And the bottom surface of the
17 substrate is also a horizontal surface,
18 correct?
19 A. That is correct.
20 Q. So the bottom surface of the
21 substrate also runs along the x-y plane?
22 A. Yes. The column 4 says the

1 bottom surface is opposite to the top
2 surface, and, therefore, the bottom side of
3 the substrate is opposite to the topside of
4 this substrate.
5 And the bottom surface here is
6 showing that a cross-sectioned
7 two-dimensional view, a cross-section of
8 the -- of the structure, the actual device,
9 of course, is a three-dimensional --
10 three-dimensional structure.
11 It does not -- the drawing
12 doesn't show the figures in the
13 specification; only shows a two-dimensional
14 figures, which is incomplete description of
15 the entire -- entire structure.
16 Those figures do not show a
17 three-dimensional schematic. So if we say
18 that the top surface and the bottom surface
19 are horizontal and parallel to the x-axis,
20 we're assuming a person of ordinary skill
21 in the art drawing their conclusion is
22 assuming that the layers are, in fact,

1 horizontal planes.
2 Q. Okay. Let's pull up paragraph --
3 let's go to column 5, line 52 of the '666
4 patent.
5 A. Line 52.
6 Q. Are you there?
7 A. Yes.
8 Q. I'll pull it up on the screen
9 too.
10 In the '666 patent, "A horizontal
11 direction can refer to the direction,
12 (e.g., the x-axis or the y-axis) parallel
13 with a top surface of the substrate,"
14 correct?
15 A. Which line are you reading? I'm
16 sorry.
17 Q. Let me go back.
18 A. Okay.
19 Q. Column 5, line 52 through 56, you
20 see there.
21 A. Oh, yeah, I see it now. Okay.
22 Q. Yeah. In the '666 patent, "A

1 horizontal direction can refer to a
2 direction, (e.g., the x-axis or the y-axis)
3 parallel with a top surface of the
4 substrate," correct?
5 A. That is -- that is correct.
6 That's what it says there.
7 Q. Now let's go to the next
8 sentence.
9 Are you with me?
10 A. Yes.
11 Q. In the '666 patent, "A vertical
12 direction can refer to a direction, (e.g.,
13 the z-axis) perpendicular to the top
14 surface of the substrate"?
15 A. That's what it read there.
16 ATTORNEY HERMAN: Objection to
17 the form.
18 THE WITNESS: That's what it
19 says.
20 BY ATTORNEY WATSON:
21 Q. Okay.
22 ATTORNEY WATSON: We've been

1 going about an hour and 10 minutes --
2 THE WITNESS: May I -- may I?
3 ATTORNEY WATSON: -- do you want
4 to take a break -- oh, sorry.
5 THE WITNESS: May I -- what I was
6 saying was from the figure itself, a
7 person of ordinary skill in the art
8 would not be able to draw a conclusion
9 from the figure itself, because it's an
10 incomplete two-dimensional figure while
11 the structure is a three-dimensional
12 structure, and a figure did not show a
13 three-dimensional schematics.
14 So one cannot draw a conclusion
15 what's it look like into the -- into
16 the figures. And so, of course, one
17 can learn about that reading the
18 specification. And what you just read
19 there that -- saying that -- actually,
20 the sentence is above what you just
21 read.
22 "Each of the horizontal surfaces

1 refer to a step and stairs of the
2 staircase structure."
3 So from the written words in the
4 specification, one can -- you can draw
5 some clues about what the structure
6 look like in the three-dimensional
7 schematics.
8 BY ATTORNEY WATSON:
9 Q. Okay. So in the '666 patent, "A
10 vertical direction can refer to a
11 direction, (e.g., the z-axis) perpendicular
12 to the top surface of the substrate,"
13 correct?
14 A. Yes. That's what it says --
15 Q. Okay.
16 A. -- in column 5.
17 ATTORNEY WATSON: Let's take a
18 break. We've been going about an hour
19 and 12 minutes. Take a quick break.
20 THE STENOGRAPHER: We're off the
21 record.
22 ///

(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.

1 ATTORNEY WATSON: Can we put the
2 rotate screen up here? Thank you.
3 BY ATTORNEY WATSON:
4 Q. Do you have Figure 3 in front of
5 you, Dr. Lee?
6 A. I see it, yes.
7 Q. Okay. So I just want to ask you
8 a couple questions about Figure 3, if
9 that's okay.
10 A. Sure.
11 Q. So Figure 3 is also shown in the
12 x-z plane, correct?
13 A. Yes.
14 Q. And in Figure 3, what's marked as
15 206 is the hard mask layer?
16 A. Hold on one second.
17 In column 7, line 63, it says
18 that, "Figure 3 illustrates a
19 cross-sectional view of a staircase
20 structure 300."
21 It went on to say that, "material
22 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

1 is the material layer, correct?
2 A. Well, the sentence that I read,
3 the layer that mark 310 is what '666 patent
4 refer to as material layer.
5 Q. Okay. And the '666 patent in
6 column 7, lines 63 to line -- the column 8,
7 line 4 refers to a "top surface of the hard
8 mask layer 206."
9 Do you see that?
10 A. The bottom of column 7, it says
11 the, "top surface of hard mask layer 206."
12 Q. And do you see the next sentence
13 says, "a side of hard mask layer 206."
14 Do you see that?
15 A. Yes. That's what it says there
16 between -- in column 7 and column 8.
17 ATTORNEY WATSON: Can we put up
18 what I'll mark as Lee Exhibit 1, which
19 will be the thing I think marked
20 Figure 3 of the '666 patent.
21 (Whereupon, Exhibit 1 is marked
22 for identification.)

1 BY ATTORNEY WATSON:
2 Q. Dr. Lee, do you recognize this as
3 Figure 3 of the '666 patent?
4 A. Yes.
5 Q. Now, Dr. Lee, we discussed that
6 the '666 patent refers to a "top surface of
7 hard mask layer 206," correct?
8 A. Sorry. Is Exhibit Lee 1 the same
9 as Exhibit 1001?
10 Q. Exhibit Lee 1 is just Figure 3
11 of --
12 A. Oh, I got it. Okay. Thank you.
13 Can you repeat the question,
14 please.
15 Q. Sure.
16 You remember we just discussed
17 that the '666 patent refers to top surface
18 of hard mask layer 206, correct?
19 A. That is correct.
20 Q. Okay. Dr. Lee, would you be able
21 to label for me, and I'll give you control
22 of this -- the marker, where the top

1 surface of hard mask layer 206 is? Give me
2 a second. Let me... [speaking sotto voce].
3 A. You know -- hello?
4 Q. Yeah. Can you --
5 A. Why don't you -- it might be
6 easier that you label it, and ask me if I
7 can -- if I can confirm or deny that.
8 Q. Okay. I can try to do that.
9 A. Yeah, controlling these things
10 remotely is --
11 Q. Let me try to do it. And if
12 not -- if that doesn't work, you let me
13 know, okay? Does that make sense for you?
14 A. Yeah, that makes sense.
15 Q. Okay. So let's reorient
16 ourselves.
17 So we're talking about hard mask
18 layer 206, correct?
19 (Pause in testimony.)
20 BY ATTORNEY WATSON:
21 Q. Are you there, Dr. Lee?
22 A. I'm looking at what you are

1 trying to do.
2 (Pause in testimony.)
3 BY ATTORNEY WATSON:
4 Q. So, Dr. Lee, layer 206 is the
5 hard mask layer, correct?
6 A. That is what has been written in
7 '666 patent.
8 Q. Okay. And we just read that the
9 Figure 3 includes a top surface of hard
10 mask layer 206, correct?
11 A. That is correct. That's what we
12 read in column -- bottom of column 7.
13 Q. Dr. Lee, is what I've marked in
14 green the top surface of hard mask layer
15 206?
16 A. On the specification that what
17 you just drawn is -- would glean, a person
18 of ordinary skill in the art would
19 understand that that is the top surface of
20 hard mask layer 206, because later on in
21 Figure 6, it says that the direct layer 620
22 covers a top surface of hard mask layer,

1 which is -- from that, one -- a person of
2 ordinary skill in the art would concluded
3 that what you just drawn in green is a top
4 surface of hard mask layer 206.
5 Q. So what I just drew in green is a
6 top surface of hard mask layer 206?
7 A. I think from what I read in the
8 specification, what you just drew in green
9 is the top surface of the hard mask layer
10 206.
11 Q. Okay. Now, the -- in column 7,
12 the last line, line 67, it refers to a side
13 of hard mask layer 206, correct?
14 A. Yes.
15 Q. Is what I've marked in red in Lee
16 Exhibit 1 a side surface of hard mask layer
17 206?
18 (Pause in testimony.)
19 THE WITNESS: Yes, what you've
20 just shown in red is a side surface of
21 hard mask layer 206.
22 ///

1 BY ATTORNEY WATSON:
2 Q. The top surface of the hard mask
3 layer in Figure 3 runs along the x-y plane,
4 correct?
5 A. Can you repeat that again?
6 Q. The top surface of the hard mask
7 layer in Figure 3 runs along the x-y plane,
8 correct?
9 A. That is correct.
10 Q. And the side surface of the hard
11 mask layer in Figure 3 runs along the
12 z-axis, correct?
13 ATTORNEY HERMAN: Objection.
14 Form.
15 THE WITNESS: The side surface of
16 the hard mask layer 206 is parallel to
17 the y-z-axis -- y-z plane, sorry.
18 BY ATTORNEY WATSON:
19 Q. Is the side surface of the hard
20 mask layer in Figure 3 perpendicular to the
21 x-plane?
22 A. Well, x is an axis.

1 ATTORNEY HERMAN: Objection.
2 Form.
3 THE WITNESS: X is an axis, so
4 perhaps the more correct way of saying
5 it is that the side surface of the
6 206 -- hard mask layer 206 is
7 perpendicular to the x-y plane.
8 BY ATTORNEY WATSON:
9 Q. The hard mask layer 206 -- strike
10 that. Let me try that again.
11 The side surface of the hard mask
12 layer 206 is perpendicular to the x-y
13 plane, correct?
14 ATTORNEY HERMAN: Objection.
15 Form.
16 THE WITNESS: The side surface of
17 the hard mask layer 206 where you
18 illustrate it in red, which of course
19 doesn't show the plane, because this is
20 a two-dimensional figure, but the side
21 surface of the hard mask layer 206 is
22 indeed perpendicular to the x-y plane.

1 And that's what I just said earlier.
2 ATTORNEY WATSON: We can take
3 down Lee Exhibit 1. Let's go to --
4 well, I'll mark that with its red and
5 green lines as Lee Exhibit 1.
6 And let's pull back up
7 Exhibit 1001.
8 BY ATTORNEY WATSON:
9 Q. Let's go to column 8 of the '666
10 patent, line 29 through 31.
11 ATTORNEY WATSON: Lucien, can I
12 get that -- yes, thank you.
13 BY ATTORNEY WATSON:
14 Q. Are you there, Dr. Lee?
15 A. Yes.
16 Q. "Figure 5 illustrates a
17 cross-sectional view of a staircase
18 structure after removal of an insulating
19 layer," correct?
20 A. Yes. That's what it says in
21 column 8, line 31 -- line 29 to 31.
22 Q. And in Figure 5 of the '666

1 patent, what's labeled as 410 is a spacer?
2 A. In column 8, line 38, it says,
3 "Spacer 410 of each SC layer."
4 So, yes, 410 is a spacer.
5 Q. In Figure 5, 204 is a sacrificial
6 layer, correct?
7 A. In column 8, line 38, it says,
8 "sacrificial layer 204." So the answer is,
9 yes, 204 is a sacrificial layer.
10 Q. And in Figure 5, there is a
11 portion of the top surface of the
12 sacrificial layer 204 and spacer 410,
13 correct?
14 A. In column 8, line 36, this says,
15 "As illustrated in Figure 5, each SC layer
16 of the staircase structure 500 exposes a
17 portion of the top surface of sacrificial
18 layer 204 and spacer 410 of each SC layer."
19 Q. Okay. You can keep that up, but
20 I'm going to put up what we'll mark as Lee
21 Exhibit 2, which is Figure 5 of the '666
22 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.

1 THE WITNESS: What you mark is
2 a -- this is a cross-sectioned view,
3 which is a two-dimensional schematic of
4 the structure.
5 But a person of ordinary skill in
6 the art would understand that a 3D
7 layer is a three-dimensional structure.
8 So, therefore, that -- what you've
9 drawn in green is showing the top line
10 of sacrificial layer 204 and spacer
11 410.
12 In other words, it is impossible
13 for you to draw the top surface of a
14 sacrificial layer 204 and spacer 410,
15 because this is a two-dimensional
16 cross-section.
17 So you can't really draw a -- and
18 illustrate a three-dimensional
19 structure in a two-dimensional
20 cross-section.
21 So what you draw in green is not
22 the top surface of the sacrificial

1 layer 204 and spacer 410.
2 Do you understand what I'm
3 saying?
4 BY ATTORNEY WATSON:
5 Q. So are you saying that the top
6 surface of the sacrificial layer 204 and
7 spacer 410 run along the x-y plane?
8 A. Yes. And what you see is only a
9 cross-section in the x-z plane. So a
10 person of ordinary skill in the art would
11 understand that the structure actually go
12 into the -- into the figure -- right? --
13 into the paper, into the screen of
14 Figure 5.
15 So when you draw the green line,
16 it just illustrating a cross-section. And
17 one cross-section of the top surface of the
18 sacrificial layer 204 and spacer 410.
19 You see what I'm saying? The top
20 surface is a two-dimensional --
21 two-dimensional structure -- surface into
22 the plane of Figure 5. And so the line is

1 just illustrating one cross-section of the
2 top surface.
3 Q. Got it. So when the '666 patent
4 refers to a top surface, it's referring to
5 a horizontal surface; is that fair?
6 A. Yes. The top surface is a
7 horizontal surface parallel to the top
8 surface and the bottom surface of the
9 substrate parallel to the x-y plane.
10 Q. Okay. Now, go back to column 8,
11 lines 39 through 40.
12 A. Okay.
13 Q. It says there, "In some
14 embodiments, a side of insulating layer 502
15 of each SC layer of staircase structure 500
16 is exposed."
17 Do you see that?
18 A. Yes.
19 Q. Dr. Lee, in figure -- strike
20 that.
21 Dr. Lee, in Exhibit Lee 2 --
22 A. Yeah.

1 Q. -- is what I've marked in red the
2 side of insulating layer 502 referred to?
3 ATTORNEY HERMAN: Objection.
4 Form.
5 BY ATTORNEY WATSON:
6 Q. Let me -- let me redo that.
7 Sorry. I did not draw that correctly. Let
8 me try that again. You are correct. Can I
9 delete that? All right.
10 Well, Dr. Lee, I just read you
11 that there is a side insulating 4 -- 502 of
12 each layer of staircase structure 500 that
13 is exposed, correct?
14 A. Yes.
15 Q. Is that side of insulating layer
16 502 along the z-axis?
17 ATTORNEY HERMAN: Objection.
18 Form.
19 THE WITNESS: A side surface of
20 the insulating layer 502 is a
21 two-dimensional plane.
22 Are you saying that is it

1 parallel to the y-z plane?
2 BY ATTORNEY WATSON:
3 Q. Yes. Is the side of insulating
4 layer 502 parallel to the y-z plane?
5 ATTORNEY HERMAN: Objection to
6 form.
7 THE WITNESS: When you say the
8 side surface of the layer 502, the
9 insulating layer 502, insulating layer
10 is a three-dimensional structure, there
11 are many sides, right? There's at
12 least six sides.
13 So what you just said, yeah, some
14 of the sides of the insulating layer
15 structure 502 is parallel to the y-z
16 plane, but there's also other sides
17 that is parallel to the x-z plane.
18 There's also sides that are parallel to
19 the x-y plane.
20 So I don't know --
21 BY ATTORNEY WATSON:
22 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

1 structure 500 and a portion of the
2 staircase structure 500, correct?
3 A. That is what is written in --
4 ATTORNEY HERMAN: Objection.
5 THE WITNESS: -- in column --
6 ATTORNEY HERMAN: Objection.
7 Form.
8 THE WITNESS: What you just read
9 is this second sentence in that
10 paragraph.
11 BY ATTORNEY WATSON:
12 Q. Well, let's put on the screen
13 what we'll mark as Lee Exhibit 3, which is
14 Figure 6 of the '666 patent.
15 (Whereupon, Exhibit 3 is marked
16 for identification.)
17 BY ATTORNEY WATSON:
18 Q. Dr. Lee, do you recognize what
19 we've marked as Lee Exhibit 3 as being
20 Figure 6 of the '666 patent?
21 A. Yes.
22 Q. Okay. Now, in the portion of the

1 '666 patent we just read, it says,
2 "Dielectric layer 620 covers a top surface
3 of staircase structure 500," correct?
4 A. Yes.
5 Q. Okay. Dr. Lee, have I marked in
6 green the top surface of staircase
7 structure 500 that is covered by dielectric
8 layer 620 to the extent it shows it in this
9 cross-sectional view?
10 A. Again, this is just showing a
11 cross-sectioned view of a three-dimensional
12 structure. So as such, it is impossible
13 for you to illustrate the top surface in a
14 cross-sectional view of the 3D NAND
15 structure such as one shown in Figure 6.
16 What you just shown is simply a
17 line which is not -- which is a
18 one-dimensional -- one-dimensional figure
19 while the top surface or any surface is a
20 two-dimensional entity.
21 Q. So you can't determine whether
22 something is a surface based on a

1 two-dimensional cross-sectional? Is that
2 your testimony?
3 ATTORNEY HERMAN: Objection.
4 Form.
5 THE WITNESS: I'm saying what
6 you've just drawn is a line. It's not
7 a surface. Anybody who took geometry
8 in high school or middle school would
9 understand that that is not a surface.
10 It's a line.
11 BY ATTORNEY WATSON:
12 Q. So you'd agree with me that
13 Figure 6 does not show the top surface of
14 staircase structure 500?
15 ATTORNEY HERMAN: Objection.
16 Form.
17 THE WITNESS: Figure 6 simply
18 illustrate a cross-sectional view of a
19 staircase structure 600. It doesn't
20 show.
21 BY ATTORNEY WATSON:
22 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?

1 Q. Yes.
2 A. Yes. Even though this is an
3 incomplete two-dimensional illustration,
4 that a person of ordinary skill in the art,
5 in fact, someone who has taken geometry
6 will understand that when you draw, it's
7 just a line.
8 However, that from the
9 illustration and from the specification of
10 the '666 patent, one can say that the side
11 surface of the staircase structure 500 is
12 parallel to the y-z axis and perpendicular
13 to the x-y plane.
14 Q. So to be clear, the side surface
15 of the staircase structure 500 is parallel
16 to the x-z axis, correct?
17 A. Parallel to the x-z plane.
18 Q. And the side surface of staircase
19 structure 500 is perpendicular to the x-y
20 plane, correct?
21 ATTORNEY HERMAN: Objection.
22 Form.

1 THE WITNESS: The side surface of
2 the staircase structure 500, again,
3 there are -- the structure is a
4 three-dimensional structure, but each
5 layer have many sides, okay?
6 And in your sentence, in your
7 question, I don't know which side you
8 are referring to.
9 BY ATTORNEY WATSON:
10 Q. Fair, fair.
11 A. A person listening to your
12 question, which side are you referring to?
13 Are you referring to a particular side of
14 the staircase structure?
15 What I'm saying is that your
16 question is incomplete.
17 Q. Okay. Let's move on then. Let's
18 go to column 8, lines 51 through 52 of the
19 '666 patent.
20 A. Okay.
21 Q. We can take Exhibit 3 off.
22 A. 51 to 52?

1 Q. Yeah.
2 ATTORNEY WATSON: Can you put
3 back on Exhibit 1001.
4 BY ATTORNEY WATSON:
5 Q. In column 8, lines 51 through 52
6 of the '666 patent, it says "In some
7 embodiments, dielectric layer 620 has poor
8 step-coverage on staircase structure 500,"
9 correct?
10 A. That's what it says in that -- in
11 column 8, line 51 to 52.
12 Q. What is "poor step-coverage"?
13 A. Well, a step-coverage --
14 right? --
15 Q. Uh-huh.
16 A. -- and I -- let me go to my
17 declaration. Sorry.
18 (Pause in testimony.)
19 THE WITNESS: We don't talk about
20 that. I'm trying to see.
21 BY ATTORNEY WATSON:
22 Q. Do you know what poor

1 step-coverage is?
2 A. I want to make sure that...
3 So a step-coverage -- I thought I
4 say something about that in my declaration.
5 I'm trying to search for the word
6 "step-coverage," but it doesn't appear
7 to -- to be there.
8 A person of ordinary skill in the
9 art -- in fact, I teach this in my
10 undergraduate class and my graduate class,
11 that a step-coverage refers to how uniform
12 a deposited film coat the surfaces of a
13 structure, right? That has a topography.
14 And how well it coat the surfaces
15 such as the steps, the side relative to the
16 coating on the planar surface.
17 So it's -- a good step-coverage
18 means that if you have a step in a
19 semiconductor structure, a good
20 step-coverage is that the film thickness
21 measure on the side wall is the same as the
22 film thickness on the top surface.

1 So a step-coverage of
2 100 percent, a step-coverage, in general,
3 defined as the ratio of the thickness, the
4 film thickness on the side wall or on the
5 bottom of the step over this film thickness
6 on top surface, okay?
7 So if the -- if the two
8 thicknesses are the same, then the
9 step-coverage is 100 percent and is good.
10 And, in general, when you do a
11 chemical vapor deposition or an atomic
12 layer deposition, that is very -- the
13 coverage -- the deposition is very
14 conformal, meaning that it follows the
15 contour of the step and that the
16 step-coverage is 100 percent.
17 Meaning that the thickness
18 measure on the side wall, the thickness of
19 the film on the side wall is equal to the
20 thickness of the film on the top surface.
21 So when the patent said that it
22 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

1 physical vapor deposition that is well
2 known to give you a poor step-coverage.
3 Q. And the reason you know this is
4 poor step-coverage is because the top
5 surfaces of layer 620 are thicker than the
6 thickness of layer 620 on the side wall?
7 A. That is correct. That the
8 Figure 6 illustrating that -- illustrates
9 that layer 620 is not conformally deposited
10 over the staircase structure.
11 So, therefore, as a consequence
12 of that deposition, you have the thickness
13 of layer 620 on top surfaces to be thicker
14 than the film thickness on the side walls
15 of the staircase structure 500 -- or 600 in
16 Figure 6.
17 Q. When you say "side walls," are
18 you referring to the side surfaces?
19 ATTORNEY HERMAN: Objection.
20 Form.
21 THE WITNESS: In general, as you
22 can see in Figure 6, that each

1 staircase has a -- as illustrated in
2 Figure 6, has a side as a side of
3 staircase structure 500.
4 And so, yes, I'm saying that the
5 thickness of the film 620 is thicker on
6 the top surface than on the side
7 surface of the staircase structure.
8 BY ATTORNEY WATSON:
9 Q. Now, in Figure 6, dielectric
10 layer 620 has a curved surface at the
11 bottom of each step.
12 Do you see that?
13 A. So can you -- I'm not sure what
14 you're referring to.
15 Q. So, for example, if you look at
16 layer 620 here, layer 620 --
17 A. Would you mind rotating the
18 figure?
19 ATTORNEY WATSON: Yeah, yeah.
20 Can we get the rotation feature up on
21 the screen? I don't have it on the
22 screen, Lucien.

1 Yeah, perfect.
2 BY ATTORNEY WATSON:
3 Q. So in Figure 6, there's layer
4 620.
5 You see that here?
6 A. Yes.
7 Q. Okay. And if you go to the far
8 left, there's a curve of sorts that curves
9 down.
10 Do you see that?
11 A. Can you use a color and show me
12 where --
13 Q. Let me see if I can use a color.
14 I don't need to mark -- I don't necessarily
15 want to mark another exhibit, but let's see
16 if we can.
17 You know what, we'll just move
18 on, if that's okay.
19 So you mentioned before that poor
20 step coverage is typically forwarded by
21 physical vapor deposition, correct?
22 A. Yes. There's one way to -- one

1 such process that would result in poor
2 step-coverage, because the process is more
3 line of sight, shadowing effect, which can
4 be a thinner spot on the side of the
5 structure.
6 Q. And so when you use physical
7 vapor deposition, you deposit species to
8 the staircase structure using both
9 directional and isotropic fluxes, correct?
10 A. Can you repeat that again?
11 Q. Sure.
12 When you use physical vapor
13 deposition, you deposit species to the
14 staircase structure using both directional
15 and isotropic fluxes, correct?
16 ATTORNEY HERMAN: Objection to
17 form.
18 THE WITNESS: You said
19 directional isotropic?
20 BY ATTORNEY WATSON:
21 Q. And isotropic, yes.
22 A. Okay. Directional and isotropic?

1 Q. Correct.
2 A. Okay. So because directional,
3 isotropic are conflicting with each other.
4 So you're saying that physical vapor
5 deposition is such a -- such deposition
6 that result in more a line of sight
7 directional deposition, which would result
8 in poor step-coverage.
9 Q. I'm saying -- oh, go ahead.
10 A. So one such process is, for
11 example, sputtering. Sputtering process is
12 that ions are striking -- creating a plasma
13 that strike a target and not the atoms
14 free, which then deposit onto the wafer.
15 So, therefore, it's almost, like, vertical
16 shower onto the substrate.
17 As a result, this is a line of
18 sight deposition and, therefore, that you
19 would have a thick -- thin thickness on top
20 surfaces of the step and thin thickness on
21 the side -- vertical side of the structures
22 in the substrate.

1 Q. Now, do you see in Figure 6
2 there's an overhang of the dielectric layer
3 over the end of each stair.
4 Do you see that?
5 A. Can you color what you mean --
6 Q. I'm not sure if it's easy -- that
7 easy to color, but let me see. So there's
8 a -- I don't know what you want to call it,
9 a curved overhang over that -- that
10 overhangs over the end of each step.
11 Do you see that?
12 (Pause in testimony.)
13 BY ATTORNEY WATSON:
14 Q. Let me try it this way. Can you
15 go to the '666 patent, column 12,
16 lines 30 -- go to 36.
17 A. Yes.
18 Q. Okay. Let me know when you're
19 there.
20 A. I'm there.
21 Q. Yeah. So in the '666 patent, it
22 says, "The dielectric layer is

1 substantially thinner at a side of a
2 staircase structure than at a top surface
3 of the staircase structure."
4 Do you see that?
5 A. Yes. That's what happened --
6 Q. That -- that's referring to the
7 poor step-coverage, correct?
8 A. Yes. That is the result of the
9 non-conformal deposition.
10 Q. And because the top surface of
11 the staircase structure is so much thicker
12 than the side surface of the -- strike
13 that. I had that all wrong.
14 Because the top surface of the
15 dielectric layer is thicker than the side
16 surface, you cannot deliver additional
17 species to that bottom corner on the side
18 surface, correct?
19 ATTORNEY HERMAN: Objection.
20 Form.
21 THE WITNESS: I don't think your
22 question make any sense.

1 BY ATTORNEY WATSON:
2 Q. Let me -- let me move on. I'll
3 move on --
4 A. Okay. Thank you.
5 Q. -- and we'll go over the next
6 thing.
7 A. Okay.
8 Q. So Figure 6 is a step of the
9 process used to form the staircase
10 structure described in the '666 patent,
11 correct?
12 A. Figure 6 shows one step of the
13 fabrication process.
14 Q. Okay. So after Figure 6, the
15 '666 patent describes removing the spacers
16 410 in a portion of the dielectric 620 to
17 form the landing pads, correct?
18 A. Are you reading from the -- from
19 '666 patent?
20 Q. I'm not reading directly from it.
21 I'm trying to summarize it to save us time.
22 A. So --

1 Q. But you can go to column 9,
2 lines 8 through 23 if you want to see where
3 I'm getting that from.
4 A. Column 9. Line what?
5 Q. 8 through 23.
6 A. Oh, Figure 7?
7 Q. Yeah. So in the fabrication
8 process described in the '666 patent, after
9 Figure 6, the patent describes removing
10 spacers 410 and a portion of dielectric 620
11 to form landing pad 720, correct?
12 A. So, yes, in column 9, line 12, it
13 says, "After removing spacer 410 and the
14 portion of dielectric layer 620, a landing
15 pad is formed over each SC layer of the
16 staircase structure 700."
17 Q. Now let's go down to -- let's go
18 to Figure 8 --
19 A. Okay.
20 Q. -- of the '666 patent.
21 A. Okay.
22 Q. The description of Figure 8 is

1 found in columns 9/35 to column 10/43.
2 Do you see that?
3 A. Yes.
4 Q. Okay. So, "Figure 8 illustrates
5 a cross-sectional view of a staircase
6 structure 800 with a dielectric layer 825
7 disposed thereon," correct?
8 A. That's what it is written in
9 column 9, line 35 to 36.
10 Q. Okay. And if you look at
11 Figure 8, like the other figures in the
12 '666 patent, Figure 8 is oriented in the
13 x-z plane, correct?
14 A. Figure 8 is a cross-sectional
15 view of a staircase structure labeled as
16 800 in Figure 8, the cross-sectional view
17 in the x-z plane.
18 Q. And in Figure 8, what's labeled
19 as 820 is the landing pad, correct?
20 A. That is what is written in
21 column -- sorry. Column 9, line 47,
22 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.

1 Do you remember that the '666
2 patent refers to horizontal surfaces as a
3 step or stair of the staircase structure?
4 ATTORNEY HERMAN: Objection.
5 Form.
6 THE WITNESS: Which...
7 BY ATTORNEY WATSON:
8 Q. We can go to column 5, lines 47
9 through 52 if you want. Let's go there.
10 ATTORNEY WATSON: Can we rotate
11 this back.
12 THE WITNESS: Line 47?
13 BY ATTORNEY WATSON:
14 Q. Yeah.
15 A. "Each horizontal surface is
16 adjoined to a vertical -- first vertical
17 surface that extend upward from the
18 first -- from a first etch of the
19 horizontal surface."
20 Is that what you're referring to?
21 Q. Yes.
22 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

1 cross-section. It doesn't demonstrate a
2 three-dimensional structure. So you cannot
3 see the step of the staircase structure,
4 because it is in the x-y plane, which it's
5 not illustrated in Figure 8.
6 Q. Now, Figure 8, each insulating
7 layer 502 has a top surface, correct?
8 A. Do you read it from the
9 specification?
10 Q. No. I'm just looking at the
11 figure.
12 Would you agree with me that each
13 insulating layer 502 has a top surface?
14 A. Again, this is a cross-section,
15 so one cannot see the x-y plane. So it
16 would be best if we can illustrate it from
17 the specification.
18 Q. Okay. So how would you
19 illustrate the top surface of insulating
20 layer 502?
21 A. What I'm saying is that if you
22 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

1 two vertical surfaces, for example, along
2 the z-axis.
3 See, that's -- that's not really
4 accurate. Along a y-z plane, I think
5 that's what the patent trying to say.
6 Q. Are you saying that the patent is
7 inaccurate in column 5, lines 44 through
8 47?
9 A. I'm saying that it could be more
10 clearer and more accurate to say along an
11 X -- along the y-z plane rather than along
12 an X -- along the z-axis.
13 Q. So the vertical surfaces must be
14 along the y-z axis; is that fair to say?
15 A. Parallel to -- parallel to the
16 y-z plane.
17 Q. So the vertical surfaces
18 described in the '666 patent are parallel
19 to the y-z plane?
20 A. Exactly.
21 Q. Why are they not parallel to the
22 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

1 parallel to y-z plane or can be parallel to
2 the x-z plane assuming that this is a cube,
3 not a sphere.
4 Q. Okay.
5 A. So to answer your question, yes,
6 those perhaps a person of ordinary skill in
7 the art or even a middle school student
8 taking geometry would say that those are --
9 those can be referred to as a side
10 surface -- side surfaces.
11 Q. Now let's go to your declaration
12 real quick.
13 A. Okay.
14 Q. Let's go to -- so let's pull up
15 Exhibit 1003. We'll go to paragraphs 56
16 through -- I'm sorry -- go to paragraph --
17 go to paragraph 65 through 74.
18 A. Okay.
19 Q. Let me know when you're there.
20 A. 65 to 74?
21 Q. Yeah.
22 A. Is under section B, "Overview."

1 Q. Uh-huh. Now, your section found
2 in paragraphs 65 through 74 discuss the
3 '666 patent, correct?
4 A. Well, as I mention, that this is
5 a brief overview of the '666 patent.
6 Q. Okay.
7 A. Obviously, that -- there's a lot
8 more detail, but this is simply a brief
9 overview.
10 And is there a question?
11 Q. I just wanted to know, can you
12 point to someplace in your declaration were
13 you identify a curved side surface in the
14 '666 patent?
15 A. Well, the specifications of the
16 '666 patent does not use the word "curve."
17 Nowhere in the specification talk about
18 curved side surface. It's never -- the
19 word "curve" or "curvature" or "curved side
20 surface" is not in the specification of the
21 '666 patent.
22 Q. Is there a curved side surface

1 shown in any of the figures of the '666
2 patent?
3 A. Again, the patent never describe
4 a curved surface. In the specification, it
5 never illustrate as far as a person of
6 ordinary skill in the art would see that
7 has not illustrate and back up with a
8 specifications that the structure discussed
9 in the specifications of the '666 patent
10 has a curve or has a curved side surface or
11 has a curved surface, for that matter.
12 Q. So it's your opinion that none of
13 the figures in the '666 patent show a
14 curved side surface?
15 ATTORNEY HERMAN: Objection to
16 form.
17 THE WITNESS: You see, the claims
18 that we're dealing with talks about
19 this Claim 17 and Claim 19, right?
20 BY ATTORNEY WATSON:
21 Q. Uh-huh.
22 A. Which is a structural claim, not

1 a method claim. So we're talking about a
2 final structure of the process.
3 So you agree that that is
4 Figure 8 of the '666 patent. And the
5 specification never use the word "curved"
6 never construe the word "curved" and never
7 say that certain figure, particular
8 Figure 8 illustrate a curved side surface.
9 And the drawing is not
10 particularly clear, black and white with
11 poor resolution, a person of ordinary skill
12 in the art looking at those figure along
13 with specification would not conclude that
14 any of those surfaces is curved.
15 Q. Do you offer -- you don't offer
16 the opinion in your declaration that the
17 '666 patent does not enable a curved side
18 surface, correct?
19 A. If you read my overview, of the
20 '666 patent -- right? -- in section B,
21 there is no word where it says "curve" or
22 "curved side surface."

1 Q. But that's not my question.
2 My question is: Do you offer an
3 opinion in your declaration that the '666
4 patent does not enable a curved side
5 surface?
6 A. I'm saying that based on the
7 specifications of the '666 patent, the
8 inventor does not use the word "curve" and
9 does not describe any surfaces as curve and
10 does not discuss a curve side surface.
11 Q. Yeah, but that's not my question.
12 My question is: Did you offer an
13 opinion in your declaration that the '666
14 patent does not enable a curve side
15 surface?
16 ATTORNEY HERMAN: Objection.
17 Asked and answered.
18 THE WITNESS: I believe that the
19 specification does not use the word
20 "curve" or does not describe a curved
21 side surface and does not describe how
22 to form a side surface.

1 So, therefore, a person of
2 ordinary skill in the art reading the
3 '666 patent would not understand what
4 the inventor tried to say in terms of
5 how to form a side surface.
6 BY ATTORNEY WATSON:
7 Q. So can you direct me to where in
8 your declaration you say a person of
9 ordinary skill in the art would not
10 understand how to form a side surface in
11 view of the '666 patent?
12 ATTORNEY HERMAN: Objection.
13 Form.
14 THE WITNESS: I'm saying that in
15 the summary, in the overview of the
16 '666 patent and my declaration and a
17 person of ordinary skill in the art
18 reading the specifications of the '666
19 patent which does not use the word
20 "curve," does not describe a curved
21 side surface, does not describe how to
22 form a curved side surface.

1 And a person of ordinary skill in
2 the art reading the '666 patent
3 specification and the file history
4 would not understand that the way to --
5 would understand that there's no
6 description of '666 patent in terms of
7 how to enable the curved surface.
8 I don't need to explicitly say
9 that in my declaration. A person of
10 ordinary skill in the art reading the
11 specifications would understand that.
12 It didn't talk about it.
13 BY ATTORNEY WATSON:
14 Q. But you agree with me that you
15 did not make that opinion in your
16 declaration, correct?
17 ATTORNEY HERMAN: Objection.
18 Form.
19 THE WITNESS: I don't need to.
20 And I'm offering you this opinion now
21 that the specification of the '666
22 patent does not use the words "curve,"

1 never describe what a curved side
2 surface is, never discuss how to form a
3 curved side surface.
4 A person of ordinary skill in the
5 art reading that would understand that
6 they didn't talk about it, period. I,
7 you know, don't think I need to spell
8 out everything that's absent from the
9 specification.
10 BY ATTORNEY WATSON:
11 Q. I don't think that was my
12 question.
13 I just asked you: You did not
14 make that opinion in your declaration?
15 A. I don't think I need to, because
16 it is clear --
17 Q. Whether or not you need to, my
18 question is: Did you offer -- you
19 didn't -- let me...
20 Did you offer that opinion in
21 your declaration?
22 ATTORNEY HERMAN: Objection.

1 Form. Also asked and answered.
2 THE WITNESS: Again, I don't need
3 to offer that opinion, because it is
4 clear that the specification did not
5 talk about curve, did not talk about
6 curve side surface, did not talk about
7 how to form curve side surface.
8 So I don't need to, and I didn't.
9 ATTORNEY WATSON: Let's take a
10 break. We've been going about an hour,
11 hour and a half or so.
12 THE WITNESS: Okay.
13 THE STENOGRAPHER: We're off the
14 record.
15 (Whereupon, a recess was taken at
16 11:57 a.m.)
17 THE STENOGRAPHER: We're back on
18 the record.
19 BY ATTORNEY WATSON:
20 Q. Welcome back, Dr. Lee.
21 A. Thank you.
22 Q. Did you discuss your testimony

1 with anyone during the break?
2 A. No.
3 Q. Now let's go to paragraph 64 of
4 your declaration.
5 A. Let me get there.
6 Q. Are you there, Dr. Lee?
7 A. "For the purpose of this
8 declaration," is that right?
9 Q. Yes, that's the right paragraph.
10 A. Okay.
11 Q. You applied the date of
12 August 28, 2017, as the effective filing
13 date of the '666 patent, correct?
14 A. Yes. I was -- I had been
15 instructed to use August 28, 2017, as
16 effective filing date of the '666 patent.
17 Q. Did you -- did you do any
18 analysis to determine whether the '666
19 patent can claim priority back to August 28
20 of 2017?
21 A. I beg your pardon?
22 Q. Did you do any analysis to

1 determine whether the '666 patent with
2 claim priority back to August 28, 2017?
3 A. Did I do any analysis? Is that
4 what your question is?
5 Q. Yes.
6 A. I'm not a lawyer, but my
7 understanding is that -- my understanding
8 is that the -- the priority date is based
9 on the earliest applications in the chain.
10 Again, I'm not a lawyer, so you
11 tell me. But according to counsel,
12 August 28, 2017, is the effective filing
13 date of the '666 patent.
14 Q. Do you agree that August 28,
15 2017, is the effective filing date of the
16 '666 patent?
17 ATTORNEY HERMAN: Objection.
18 Form.
19 THE WITNESS: Again, I'm not a
20 lawyer. And all the fine details and
21 intricacies of what determine the
22 effective filing date of certain patent

1 is beyond -- you know, there's so much
2 detail.
3 But I believe that -- I agree
4 that based on what I read on the front
5 page of the '666 patent, the earliest
6 date in the chain is August 28, 2017.
7 BY ATTORNEY WATSON:
8 Q. Did you apply the August 28,
9 2017, effective filing date, because
10 counsel gave you that date to apply?
11 A. Again, I'm not a lawyer. I have
12 to gain advice from my counsel. And I have
13 done many patents litigations. And it
14 seems to agree with my understanding of
15 what it means by "effective filing date" of
16 this patent.
17 Q. So with counsel, you came up with
18 the effective filing date of August 28,
19 2017?
20 ATTORNEY HERMAN: Objection.
21 Form.
22 THE WITNESS: So my understanding

1 that -- is the effective filing date of
2 a patent is the date that's used to
3 determine what counts as prior art
4 against it.
5 And that my understanding is that
6 if there's an earlier filing or earlier
7 application, then we should consider
8 the earliest application or filing date
9 of the chain of the application of the
10 patent.
11 So, for example, if the patent
12 was filed in January 1, 2020, but
13 there's a provisional patent filed a
14 year earlier, let's say February --
15 February the 2nd, 2019, then the
16 effective date -- effective filing date
17 will be February 2, 2019.
18 But, again, I relied on counsel
19 to determine what is the effective --
20 effective filing date of the '666
21 patent. And since this is a legal
22 matter and so I have been -- I rely on

1 the instruction for my counsel.
2 BY ATTORNEY WATSON:
3 Q. Sitting here today, do you have
4 any reason to believe that the effective
5 filing date of the '666 patent is later
6 than August 28, 2017?
7 ATTORNEY HERMAN: Objection.
8 Form. Also outside the scope of
9 direct.
10 THE WITNESS: As I discuss in
11 paragraph 64, that I have been
12 instructed to use August 28, 2017, as
13 the effective filing date of the '666
14 patent, so there's no reason for me
15 that the effective date is later than
16 that. You tell me. You're the lawyer.
17 BY ATTORNEY WATSON:
18 Q. Well, in your declaration you
19 didn't do any analysis to determine when
20 the effective filing date of the '666
21 patent was, correct?
22 A. What do you mean I didn't do any

1 analysis? What kind of analysis --
2 Q. You applied --
3 A. What kind -- what kind -- what
4 kind of analysis are you talking about?
5 Q. You applied the effective filing
6 date that was given to you by counsel,
7 correct?
8 A. Yes, that is correct. But that
9 aligns with my understanding looking at the
10 front page of '666 patent that the earliest
11 application shown to be August 28, 2017.
12 Q. Okay. All right. Let's go to
13 paragraphs 36 and 37 of your declaration.
14 A. Hold on. 30... [speaking sotto
15 voce].
16 36?
17 Q. And 37. And let me know when
18 you're there.
19 A. So this is the section under
20 level of skill in the art.
21 Q. Correct. Does paragraphs 36 and
22 37 lay out your opinion of the

1 qualification of a person of ordinary skill
2 in the art that you used when analyzing
3 obviousness for the '666 patent?
4 A. Well, I think the entire section,
5 paragraph 34 to 38, is my understanding of
6 what is considered to be a person of
7 ordinary skill in the art.
8 Q. Did you apply any other
9 qualifications of a person of ordinary
10 skill in the art in your analysis other
11 than those listed in paragraphs 34 through
12 38 of your declaration?
13 A. No. I mean, I have written what
14 I considered to be a person of ordinary
15 skill in the art in paragraph 34 to 38. So
16 I did not use other criteria --
17 Q. Okay.
18 A. -- to advise.
19 Q. Let's go to paragraphs 75 through
20 92.
21 A. 75. Okay. To? Are you talking
22 about --

1 Q. 92.
2 A. Okay.
3 Q. You reviewed the prosecution
4 history of the '666 patent?
5 A. Yes.
6 Q. And your opinions about the
7 relevance of the prosecution history of the
8 '666 patent are contained in this section
9 of your report?
10 ATTORNEY HERMAN: Objection.
11 Form.
12 THE WITNESS: Can you clarify
13 your question? I'm not sure if I
14 understand what you mean by that.
15 BY ATTORNEY WATSON:
16 Q. This section in paragraphs 75
17 through 92 lays out your discussion about
18 the prosecution history, correct?
19 A. Yes. That is my understanding of
20 the prosecution history summarized in
21 Section C in paragraph 75 to 92.
22 Q. Let's turn to paragraph 84 of

1 your declaration.
2 Do you see that?
3 A. Yes.
4 Q. In paragraph 84, you discuss a
5 prior reference called Hyun, correct?
6 A. Hyun.
7 Q. Hyun?
8 A. Hyun. Yeah.
9 Q. Okay. And in paragraph 48, you
10 show Figure 2H of Hyun, correct?
11 A. Which paragraph?
12 Q. Paragraph 84 of your declaration.
13 A. Yes.
14 Q. Now, Figure 2H of Hyun is shown
15 to be a cross-sectional image in the x-z
16 direction; is that fair?
17 A. Do you have a copy of the Hyun?
18 Q. I don't. But do you know based
19 on this figure which -- which direction is
20 being shown here?
21 A. That's why I'm asking for the
22 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

1 any discussion about the curvature of
2 surfaces in the x-y direction, correct?
3 A. Yeah. As I mention, that the --
4 earlier that the specification does not use
5 the word "curve." And I believe that none
6 of the prior art, for example, Hyun has --
7 in the file history has discussed.
8 Q. So in your --
9 A. For example --
10 Q. Oh, sorry.
11 A. For example, as I discussed in
12 paragraph 81, none of the lead prior art in
13 the file history, 385, none of those pads
14 appears to include a curved side surface.
15 Q. Is there any discussion that
16 you're aware of in the prosecution history
17 about curvature of surfaces in the x-y
18 direction?
19 A. As I discuss in this section, for
20 example, in paragraph 87, Hyun and
21 Hashimoto do not appear to illustrate
22 landing pad with -- with the type of curve

1 side surface that the Claim 17 of '666
2 require.
3 And so not only the specification
4 of the '666 patent does not use the words
5 "curve" or "curved side surface" or method
6 of forming a curved side surface, none of
7 the prior art discussed during the
8 prosecution history including Lee, Hyun and
9 Hashimoto discuss -- at least does not
10 appear to discuss the landing pad of the
11 staircase having any type of curved side
12 surface.
13 So, therefore, the person -- a
14 person of ordinary skill in the art reading
15 the specification of '666 and the prior art
16 in the file history, including Lee, Hyun
17 and Hashimoto would understand what the
18 inventor mean by "curve."
19 Because none of those prior arts,
20 and including '666 patent, the
21 specification of '666 patent use the word
22 "curve" or "curved side surface" or the

1 method of creating curved side surface.
2 Q. Are you aware of any discussion
3 in the prosecution history by the applicant
4 or examiner about the curvature of side
5 surfaces in the x-y direction?
6 ATTORNEY HERMAN: Objection.
7 Form.
8 THE WITNESS: Well, as I discuss
9 and answer just a second ago, that none
10 of the specification of the patent,
11 '666 patent and the prior art discuss
12 in the file history including Lee 385,
13 Hyun 540 and Hashimoto, none of those
14 discuss the word or use the word
15 "curve" or "curved side surface."
16 BY ATTORNEY WATSON:
17 Q. What about the applicant and the
18 examiner in the prosecution history? Are
19 you --
20 A. As --
21 Q. Go ahead.
22 A. As far as I can recall, the file

1 history shows that the inventor did not use
2 a specific term called "curved side
3 surface." He might have used -- it had --
4 it had used specific terms like top side
5 surface when they wanted to specify a
6 particular side surface. And I don't
7 recall any correspondence in the file
8 history mention curved side surface and --
9 except in the claims of Claim 17.
10 Q. Other than the claims in
11 Claim 17, you can't identify any discussion
12 in the prosecution history about the curved
13 side surface; is that fair to say?
14 A. Other than the claims -- other
15 than the Claim 17, we're dealing with only
16 Claim 17 and Claim 19 here. Other than in
17 the Claim 17, a curved side surface is
18 mentioned in Claim 17.
19 Other than that, I don't recall
20 any prior art references in the course of
21 the file history discuss or appear to show
22 curved side surface.

1 And so that's my answer to your
2 questions.
3 Q. So you don't recall any
4 correspondence in the file history that
5 mentioned a curved side surface?
6 A. I don't recall any
7 correspondence. But if you can give me --
8 it's been a while that I review the
9 document and the file history. And so if
10 you can provide the file history and upload
11 it in the link, I can answer your questions
12 more clearly.
13 But at this point as I sit here
14 today, I don't recall mentioning the word
15 "curved side surface" in the correspondence
16 perhaps except for the term in the claim
17 language.
18 Q. Okay. Let's go to
19 paragraph 90 -- paragraphs 94 through 97 --
20 A. Yes.
21 Q. -- of your declaration.
22 A. Yes.

1 Q. In performing your analysis, you
2 use the plain and ordinary meanings of the
3 terms in the '666 patent, correct?
4 A. That's what it says there.
5 Q. You didn't apply any special
6 definitions to any claim term, correct?
7 A. I did not provide any claim
8 construction or any explicit or give any
9 explicit definition of any claim term.
10 Q. Okay.
11 A. And the words, as I --
12 Q. And you didn't identify any terms
13 that require claim construction?
14 A. So in paragraph 97, I clearly --
15 so it's my opinion that the terms of '666
16 patent's claims do not require further
17 construction and can be afforded their
18 plain and ordinary meaning for the purpose
19 of the analysis of prior art that I'm
20 conducting in this declaration.
21 Q. All right. So, Dr. Lee, in your
22 declaration you're arguing three different

1 grounds of obviousness; is that fair?
2 A. Yes. Ground 1, 2 and 3 as listed
3 in the table of content.
4 Q. Let's turn to paragraph 135 of
5 your declaration.
6 A. Let me get there.
7 Q. Are you there, Dr. Lee?
8 A. Yeah, is there a question?
9 Q. Yeah. So the first ground of
10 obvious that you claim are that Claims 17,
11 19 and 20 are obvious over Kim, correct?
12 A. Yes.
13 Q. You have not offered an opinion
14 that the claims of the '666 patent are
15 anticipated by Kim, correct?
16 A. No, I did not.
17 Q. Okay. Let's go to paragraph 157.
18 Are you there?
19 A. Yes.
20 Q. Paragraph -- in paragraph 157 and
21 158, you offer the opinion that the
22 limitation, "A plurality of layer stacks,

1 each layer stack comprising an insulating
2 layer disposed over a first portion of a
3 conductive layer is taught by Kim,"
4 correct?
5 A. That's what I wrote in
6 paragraph 157 and 158 at Claim 17 -- well,
7 "Requires plurality of layers stack. Each
8 layer stack in this plurality must include
9 insulating and conductive layer. The
10 insulating layer must be disposed over the
11 first portion -- a first portion of the
12 conductive layer."
13 And in paragraph 158, I said, "In
14 my opinion, this is taught by Kim."
15 Q. So let's go then to
16 paragraph 186.
17 Are you there?
18 A. Yes.
19 Q. In paragraph 186, you opine that,
20 "Kim, in view of the knowledge of a POSITA,
21 renders the limitation wherein a second
22 portion of the conductive layer comprises a

1 curved side surface in contact with a side
2 surface of the insulating layer obvious,"
3 correct?
4 A. That's what is written there.
5 Q. Okay. So you do not opine that
6 this limitation, limitation 17.C.2 is
7 "taught by Kim," correct?
8 ATTORNEY HERMAN: Objection.
9 Form.
10 THE WITNESS: I don't know what
11 you mean by "taught by Kim."
12 BY ATTORNEY WATSON:
13 Q. Well, with regards to the
14 limitation 17.C.1, you say, Kim teaches
15 this limitation, right?
16 A. Which paragraph?
17 Q. So previously for all the other
18 limitations, you say this limitation is
19 taught by Kim.
20 Do you see that in paragraph 158?
21 A. 158, I need to go there. Sorry.
22 Q. In paragraph 158, you say, the

1 limitation is "taught by Kim," fair?
2 A. Sorry. Let me go there. Sorry.
3 158?
4 Q. Uh-huh. Do you see that? Are
5 you at paragraph 158?
6 A. Yes. I see that. And that means
7 that...
8 Q. Where does it mean that the
9 limitation is taught by Kim?
10 ATTORNEY HERMAN: Objection.
11 Form.
12 THE WITNESS: I'm sorry. I'm
13 trying to search word -- I think that
14 what I meant is that Kim expressly or
15 inherently disclose that limitation
16 17.C.1. And because each layer stack
17 comprises an insulating layer disposed
18 over the first portion of the
19 conductive layer.
20 So it is clearly shown in
21 Figure 4B and clearly discuss in the
22 specifications of Kim. And, at worse,

1 would make it obvious.
2 But 17.C.2, Kim does not
3 expressedly or inherently disclose the
4 curved side surface. But a person of
5 ordinary skill in the art reading Kim
6 in view of his knowledge would render
7 this limitation obvious.
8 BY ATTORNEY WATSON:
9 Q. So it's your opinion that
10 limitation 17.C.2 is obvious in view of
11 Kim, correct?
12 A. Yes. 17.C.2 that a person of
13 ordinary skill in the art reading Kim in
14 view of his knowledge would render this
15 limitation 17.C.2 obvious.
16 Q. It is also your opinion that Kim
17 does not expressly or inherently disclose
18 limitation 17.C.2, correct?
19 A. Let me think about that. Sorry.
20 Q. Well, for the other limitations,
21 you rely for -- you rely on it being
22 taught, correct?

1 (Pause in testimony.)
2 BY ATTORNEY WATSON:
3 Q. Let me -- let me --
4 A. That is correct that when I say
5 that Kim in view of the knowledge of the
6 POSITA render this obvious means that Kim
7 alone does not expressedly or inherently
8 disclose this claim limitation.
9 A person of ordinary skill in the
10 art with the knowledge and would find it
11 obvious to render this limitation
12 invalid -- render this limitation obvious.
13 Meaning that it would be obvious
14 to implement the missing features without
15 extensive or undue experiments or
16 experimentation.
17 Q. Kim alone does not expressly or
18 inherently disclose limitation 17.C.2,
19 correct?
20 A. I think I answered that, that Kim
21 alone does not expressly or inherently
22 disclose every element of that limitation

1 17.C.2 --
2 Q. Okay.
3 A. -- exactly as claimed.
4 Q. Now let's go to -- let's talk
5 about Kim a little bit, if that's okay.
6 A. Sure.
7 Q. All right. Let's turn to
8 paragraph 144 of your declaration.
9 A. Okay.
10 Q. In paragraph 144 of your
11 declaration, you include an annotated
12 version of Figure 4B of Kim, correct?
13 A. Yes.
14 Q. And you labeled the top surface
15 in Figure 4B, correct?
16 ATTORNEY HERMAN: Objection.
17 Form.
18 THE WITNESS: Yes.
19 BY ATTORNEY WATSON:
20 Q. Now, this is a cross-sectional
21 view, correct?
22 A. That is -- that is correct. So

1 based on the description of Kim, that it is
2 understood that this three-dimensional
3 structure is extended into -- from this
4 cross-section into the -- into the screen
5 or into the board of the picture.
6 So, therefore, with that in mind,
7 a person of ordinary skill in the art would
8 understand that -- that it extend into
9 the -- into the x-y plane.
10 In fact, Kim -- also if I -- if
11 you can upload Kim, they -- Kim also
12 disclose -- discloses three-dimensional
13 drawing of the structure, which
14 demonstrates that the cross-sectional view.
15 Even though it is a
16 two-dimensional cross-sectional view,
17 looking at those three-dimensional
18 schematic, a person of ordinary skill in
19 the art reading Kim would understand what
20 it look like in the three-dimensional
21 perspective even though some of the figures
22 only show two-dimensional cross-section.

1 Q. Now, this top surface in Kim that
2 you identify, is that a horizontal plane?
3 A. Yes. It is a horizontal plane
4 parallel to the surface of the substrate.
5 Q. And the top surface of the
6 substrate in Kim is not a vertical plane,
7 correct?
8 A. When you say "vertical," it means
9 that it's in the z direction?
10 Q. Correct.
11 A. No, it is not a vertical plane.
12 Q. Okay. Let's turn to
13 paragraph 193 of your report.
14 Are you there, Dr. Lee?
15 A. Yes.
16 Q. In paragraph 193 of your report,
17 you annotate a version of Figure 4B from
18 Lee -- or from Kim, correct?
19 A. That's right.
20 Q. And in this Figure 4B, you
21 identify the insulating layer in blue,
22 correct?

1 A. Yes.
2 Q. The insulating layer you identify
3 stops in the x direction at the contact
4 pad, correct?
5 A. Yes. As shown in Figure 4B in
6 paragraph 193, that I show that the
7 insulating layer including element 110 and
8 element 122 and it stop -- is shown to stop
9 at the contact pad.
10 Q. So the insulating layer in Kim
11 does not include element 122 that's on the
12 far right of the contact pad, correct?
13 ATTORNEY HERMAN: Objection.
14 Form.
15 THE WITNESS: What I illustrate
16 there is that -- see, the insulating
17 film or insulating layer, a person of
18 ordinary skill in the art reading the
19 claims would understand that the
20 insulating layer is part of the
21 staircase layer that define the contact
22 holes.

1 Based on Kim, a specific
2 insulating layer that define the
3 contact holes is the border line, which
4 is 110 and a portion of 122.
5 Now, you could -- a person of
6 ordinary skill in the art, understand
7 that depending on the -- well,
8 understanding that the contact pad is
9 defined not only on the left side, the
10 left -- the portion of 122 on the left
11 side of the contact pad shown in
12 Figure 4B in paragraph 193 but also a
13 portion of 122 on the right side of the
14 contact pad highlighted in brown.
15 But what I'm trying to illustrate
16 in paragraph 193 and subsequent
17 paragraph is that the second portion of
18 the conductive layer comprises a curved
19 side surface in contact with a side
20 surface of the insulating Layer.
21 So I did that, because I simply
22 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

1 layer in green, correct?
2 A. Entirety of a particular step in
3 the staircase region? Because entirety
4 could mean -- you know, various things.
5 Entirety from across the entire chip? When
6 you say "entirety," I'm not sure what you
7 mean by that.
8 Q. Let me clarify, if that's okay.
9 I'll clarify that, okay?
10 A. Yeah. Please, please.
11 Q. The first portion of the
12 conductive layer you identify covers the
13 entire x direction of the stair of the
14 conductive layer, correct?
15 A. The first portion of the
16 conductive...
17 Q. Would you like me to rephrase
18 that? Can I rephrase that, Jack -- or
19 Dr. Lee? Sorry.
20 A. Sure.
21 Q. Okay. The first portion of the
22 conductive layer expands the entirety of

1 the x direction of the conductive layer in
2 the stair?
3 ATTORNEY HERMAN: Objection.
4 Form.
5 THE WITNESS: The first portion
6 is the gate electrode 300. And the
7 attached base pad being identified as
8 pad_b. Again, in green, okay? So in
9 paragraph 193, I clearly explain what I
10 mean by first portion and second
11 portion.
12 If you go to 193, I said that,
13 "As shown by annotated Kim's device
14 including both conductive layer, (one
15 such layer is annotated in green) with
16 both a first portion, [as read]" which
17 is the "gate electrode 300 and attached
18 base pad pad_b, again" highlighted in
19 green.
20 BY ATTORNEY WATSON:
21 Q. Okay. So --
22 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?

1 A. Again, you use the word "entire."
2 I'm not sure what you mean by that.
3 Q. The incidence --
4 A. The insulating.
5 Q. Let me clarify. Should I clarify
6 for you?
7 A. Sure.
8 THE STENOGRAPHER: Excuse me,
9 Dr. Lee. Can you move your hand so I
10 can better understand?
11 THE WITNESS: I'm sorry. I'm
12 sorry.
13 BY ATTORNEY WATSON:
14 Q. The insulating layer is not
15 disposed over pad_b, correct?
16 ATTORNEY HERMAN: Objection.
17 Form.
18 THE WITNESS: Again, I don't know
19 what you mean by that the insulator --
20 the insulating layer, as I explain, is
21 the -- is the layer 110 and layer 122
22 together correspond to the claimed term

1 insulating layer. And I don't think
2 there's need to compare that to the
3 conductive layer.
4 But as shown in Figure 4B in
5 paragraph 193, that you're right, that
6 the blue section seems to be shorter
7 than the green section.
8 Now, once again, I could have
9 include portions of 122 on the right
10 side of the contact pad. Either way,
11 it is -- I just want to illustrate the
12 contact -- the point of contact of the
13 insulating layer and the contact pad.
14 BY ATTORNEY WATSON:
15 Q. Would you agree with me that the
16 first conductive portion -- strike that.
17 Would you agree with me that the
18 first portion of the conductive layer is
19 directly beneath the second portion of the
20 conductive layer in certain places?
21 A. Yeah, because the second portion
22 is the protrusion pad, p-a-d_P annotated in

1 orange and brown.
2 So, yeah, it is sitting on top of
3 the first portion of the conductive layer.
4 Q. And where the second portion of
5 the conductive layer is on top of the first
6 portion of the conductive layer, the
7 insulating layer is not above that second
8 portion of the conductive layer, correct?
9 ATTORNEY HERMAN: Objection.
10 Form.
11 THE WITNESS: The insulating
12 layer in Kim is the element 122
13 together with 110, because those two
14 pieces cooperate to define the whole in
15 which the contact -- the conductive pad
16 resides.
17 In other words, those two pieces
18 together cooperate to define the
19 contact hole. So as you can see in
20 illustrations of Figure 4B, region 110
21 and 122 is not what you say, covering
22 the contact pad.

1 BY ATTORNEY WATSON:
2 Q. So regions 110 and 122 are not
3 disposed over the contact pads?
4 A. I think I said that, that
5 elements 12.
6 (Stenographer requests
7 clarification and colloquy will
8 not be captured on the written
9 record.)
10 THE WITNESS: 122 and 110, those
11 two pieces together cooperate to define
12 the contact hole. And as illustrated
13 in Figure 4B in Kim, the insulating
14 layer do not dispose over the contact
15 pad.
16 BY ATTORNEY WATSON:
17 Q. All right.
18 A. So --
19 Q. All right.
20 A. You're breaking up.
21 Q. Sorry. Let's move on to
22 column 12 of Kim. Let's put Kim on the

1 screen. That's Exhibit 1005.
2 A. Column 12.
3 Q. So Figure 12 in Kim describes a
4 photosensitive resin pattern M formed on
5 the auxiliary insulating layer 122,
6 correct?
7 A. Are you referring to -- hold on
8 one second.
9 Q. Oh, sorry. Let me make sure you
10 have that in front of you. Can you turn to
11 column 12, lines 61 -- starting at line 61.
12 Are you there?
13 A. Yes.
14 Q. Referring to Figure 12, a
15 photosensitive resin pattern M being
16 formed -- is being formed on the auxiliary
17 insulating layer 122, correct?
18 A. That's what it says there in
19 column 12 line 61 to 62.
20 Q. And the photosensitive resin
21 pattern M is formed so that the
22 predetermined regions of auxiliary

1 insulating layer 122 are exposed?
2 A. Yes. That's what it says there.
3 Q. The regions of auxiliary region
4 122 exposed by the photosensitive resin in
5 pattern M may include a region 122_I,
6 correct?
7 A. That's what it says in column 12.
8 Q. And that exposed region 122_I is
9 doped with predetermined ions?
10 A. That's what it says in column 12,
11 lines 65.
12 Q. So let's pull up Figure 12 of
13 Kim.
14 ATTORNEY WATSON: Can we rotate
15 this, this one?
16 BY ATTORNEY WATSON:
17 Q. Dr. Lee, do you see Figure 12 in
18 front of you?
19 A. Yes.
20 Q. So in Figure 12, there's a bunch
21 of arrows pointing down.
22 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

1 the ions into the opening by the -- the
2 opening that is formed by the
3 photoresist M and inject those ions
4 into the exposed 122 region.
5 It doesn't deposit anything.
6 BY ATTORNEY WATSON:
7 Q. Fair. Fair. I'll use the word
8 "inject" going forward.
9 So those arrows depict the
10 vertical injection of ions, fair?
11 A. That is correct.
12 Q. And the exposed insulating
13 layer 122 is exposed along the horizontal
14 plane, correct?
15 ATTORNEY HERMAN: Objection.
16 Form.
17 THE WITNESS: I'm not sure what
18 you mean by that, because this is a
19 three-dimensional structure. So are
20 you saying that the bottom surface of
21 the exposed 122 and the top surface of
22 the exposed 122 is parallel to the top

1 surface of the substrate?
2 Is that what you mean by your
3 question?
4 BY ATTORNEY WATSON:
5 Q. No. Let me -- let me try it
6 again.
7 The shape of the x-y surface is
8 determined by the shape of the openings in
9 the photosensitive pattern M?
10 A. The shape of the x-y, can you
11 repeat that again.
12 Q. The shape of the x-y surface is
13 determined by the shape of the openings in
14 the photosensitive pattern M?
15 A. X-y surface of what? Do you mean
16 that the exposed region of 122 is
17 determined by the pattern of the
18 photosensitive region? And if that's your
19 question, yes.
20 Q. So the shape of the exposed -- of
21 the x-y surface in the exposed region of
22 122 is determined by the shape of the

1 openings in the photosensitive pattern M?
2 A. Yeah, let me explain how the
3 photoresist work. You put on the
4 photoresist and you expose the photoresist
5 with UV light. And then you develop the
6 photoresist such that the exposed
7 photoresist region will dissolve and so you
8 left behind an opening.
9 And that opening, of course, is
10 determined by your mask that is used to
11 define the photoresist pattern. And so,
12 yeah, the exposed region is determined by
13 the pattern of the mast defining the
14 photoresist pattern.
15 Does that make sense?
16 Q. So the shape of the horizontal
17 surface of the exposed surface -- let me
18 strike that. I'm trying to make sure I
19 understand your testimony here in a simple
20 way.
21 The shape of the horizontal
22 surface of the exposed region of insulating

1 layer 122 is determined by the openings in
2 the photosensitive pattern M?
3 A. Yeah, I don't think you need to
4 use the word "horizontal." Because the
5 exposed region is the opening defined by
6 the photoresist.
7 Q. The opening that's defined by the
8 photoresist is a horizontal surface,
9 correct?
10 A. No. The opening is a
11 three-dimensional structure. The opening
12 is a trench, is a whole.
13 So are you -- are you saying that
14 from the top view -- from the top view --
15 point of view, the opening is -- let's say
16 a rectangle or a square. And from the top
17 view the opening is square, then that
18 opening pattern will be transferred to the
19 exposed regions of 122.
20 Subsequently when you do the ion
21 injections, those ion injections, it only
22 occur within that -- within that square

1 opening.
2 But the opening is not a
3 two-dimensional structure. You can see
4 that it's adept to it. So your question
5 doesn't make sense.
6 Q. So the opening of the
7 photosensitive mask, is that a square?
8 A. Well, we don't know, because we
9 only see the cross-section.
10 Q. What else could the opening of
11 the photosensitive mask be if it's not a
12 square?
13 A. Well, it could be an oval shape.
14 It could be a rectangular shape. It
15 doesn't show the three-dimensional
16 structure. Three-dimensional -- it doesn't
17 show the mask that you -- that is used to
18 define the opening in the photoresist
19 region.
20 Q. But the top of the mask is some
21 shape in the horizontal direction, correct?
22 A. The top of the mask is a shape

1 defined by the process engineer and is
2 defined by the shape on the mask. It could
3 be a rectangle. It could be a square. It
4 could be an oval shape.
5 But all we see here is a
6 cross-section in the -- in a particular --
7 all we see here is a cross-section in the
8 z-x plane. We don't know what's the other
9 perspective in the -- into the board.
10 In fact, it could be a circle.
11 It could be an oval shape.
12 Q. But the shape that it is, is a
13 shape along the horizontal direction,
14 correct? It's not a vertical shape?
15 A. Yeah. From the top view you see
16 the opening defined by the mask. And,
17 yeah, you could say that this is a
18 horizontal top view of the opening. But
19 even the opening, like I said, is a
20 three-dimensional structure.
21 The whole is not a
22 two-dimensional structure. It's a

1 three-dimensional structure. All we see in
2 Figure 12, it's just a cross-section.
3 Q. So in Figure 12 of Kim, that's
4 what you refer to in your declaration as an
5 ion implantation step?
6 A. Where you try to say that?
7 Q. Paragraph 234 of your
8 declaration.
9 A. 234. Wait. In my declaration,
10 234?
11 Q. Yes.
12 A. Okay. Let me go there. Sorry.
13 Right.
14 Q. So Figure 12 shows an ion
15 implantation step, correct?
16 A. Yes. In paragraph 234, I said,
17 in particular, the ion implantation step
18 shown in Figure 12 of Kim, yes.
19 Q. Okay. So let's turn back to
20 Figure 12 of Kim.
21 A. Okay.
22 Q. So Kim performs the ion

1 implantation step --
2 A. Yes.
3 Q. -- through photosensitive resin
4 pattern M onto the auxiliary insulating
5 layer 122 formed on the top of the
6 sacrificial layer?
7 A. Yes.
8 Q. And the surfaces are doped along
9 the x-y plane in Figure 12?
10 A. What do you mean by that, along
11 the x-y plane? Because a dope region is
12 also a three-dimensional structure.
13 There's a -- a dope region when you implant
14 certain ions onto -- onto the -- onto the
15 substrate.
16 You can have a -- you can implant
17 it in such a way that it is uniform
18 throughout the depth of the structure of
19 the implant regions.
20 Or you can tailor it to form the
21 dope region with a curve rather than
22 straight sides as I discuss in

1 paragraph 234.
2 And with that simple step, the
3 rest of the process would proceed the same
4 way and you would result in a contact pad
5 with a curved side view from the
6 cross-sectional x-z plane.
7 Q. Okay. So let's talk a little bit
8 about -- about the -- this Figure 12 a
9 little more, okay? Are you with me?
10 You got Figure 12 in front of
11 you?
12 A. Yeah, yeah, I see it.
13 Q. Okay. So the ions injected only
14 reach the exposed regions of 122_I of the
15 auxiliary insulating layer, correct?
16 ATTORNEY HERMAN: Objection.
17 Form.
18 THE WITNESS: Can you repeat that
19 question again?
20 BY ATTORNEY WATSON:
21 Q. The ions injected only reach the
22 exposed regions 122_I of the auxiliary

1 insulating layer?
2 ATTORNEY HERMAN: Same objection.
3 THE WITNESS: Well, the opening
4 in the photoresist is defined by the
5 mask. And as shown in Figure 12, when
6 you inject or implant the ion, you
7 inject it on the entire surface and the
8 photoresist basically block the
9 injected ions.
10 And the injected ion only go
11 through the opening and inject it into
12 the exposed 122. And Kim refer those
13 region as 122_I, because those region
14 is now dope with the implant ions.
15 BY ATTORNEY WATSON:
16 Q. So the regions 122_I become doped
17 regions compared to the rest of the
18 insulating layer 122?
19 A. Yes. And the purpose of that is
20 so that when you -- when you etch a
21 sacrificial layer in the subsequent steps,
22 that the implanted region will be etched

1 out while the unimplanted region of 122
2 will be -- will remain.
3 And that's the reason why they
4 implant.
5 And by adjusting the -- by
6 tailoring the implant profile, one can
7 easily achieve a curve structure in the
8 cross-sectional view. And by defining the
9 mask in a certain geometry, a circle or
10 oval shape, one can then achieve a curved
11 side contact from the top view, meaning
12 from the x-y plane.
13 Q. Okay. So once the ions are
14 injected into regions 122_I, those regions
15 122_I have a different etching ridge --
16 ratio compared to the rest of the auxiliary
17 insulating layer, correct?
18 A. Yes. That's what I explain just
19 now.
20 Q. Okay. I thought so. I just
21 wanted to make it clear, make sure that was
22 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

1 ion. You don't change the material.
2 Q. After the ion injection step in
3 Kim, Kim teaches removing the mask pattern
4 and placing insulating layer 215 over the
5 step y structure, correct?
6 A. As shown in Figure 13.
7 Q. Okay. And once Step 13 of --
8 strike that.
9 Once Figure 13 of Kim occurs, the
10 sacrificial layers 120 can be removed,
11 correct?
12 Strike that question. Let me
13 ask --
14 A. You -- I think you skip a few
15 steps. You jump to Figure 16, which is
16 fine. Yeah.
17 Q. Let me ask --
18 A. Go ahead.
19 Q. The sacrificial layers are then
20 removed from the etching process?
21 The sacrificial layers 120 are
22 removed during an etching process, correct?

1 A. Yes. As shown in Figure 16.
2 Q. Okay. Let's go to Figure 16.
3 A. That originally you have 120,
4 which is a sacrificial layer. Okay. And
5 now with an isotropic etch, meaning in all
6 direction, you left all the region -- all
7 the sacrificial region completely etch out
8 and you left with trench -- trenches.
9 And then because of the dope
10 region has a different etch rate compared
11 to the undoped region, the dope region of
12 the 122 is also removed by the isotropic
13 etch.
14 Q. Will the doped region at 122_I
15 have the same etch rate?
16 A. As what?
17 Q. Well, will they have the same
18 etch rate as other areas of the doped
19 region I22_I [as spoken]?
20 A. Wait. Wait a minute.
21 ATTORNEY HERMAN: Objection.
22 Form.

1 BY ATTORNEY WATSON:
2 Q. So --
3 A. Wait. 122_I is the dope region.
4 Q. So there's multiple doped regions
5 -- correct? -- where each hole is formed in
6 the photomask region?
7 A. There's multiple dope region,
8 because these are steps. Each step has one
9 dope region.
10 Is that what you mean?
11 Q. Yes.
12 A. Yeah. So...
13 Q. And because those regions 122_I
14 are made of the same material, they'll have
15 the same etch rate, correct?
16 A. Yeah. Most likely that the etch
17 rate would be the same, because this is
18 done by iso -- isotropic etch.
19 However, of course, the detail is
20 slightly different, because those etch has
21 to go all the way down from the top to the
22 bottom of the stack and go into the etching

1 the sacrificial layer and then go up to
2 etch the dope 122 region.
3 So one of the difficult part
4 about forming 3D NAND is that the stack are
5 very tall. So it takes time for the
6 etching to go all the way down and go
7 sideway through the sacrificial layer and
8 then go on top to the dope 122 regions.
9 So but in theory, all the 122 --
10 dope 122 region, so-called 122_I has the
11 same etch rate with each other. It doesn't
12 have to be the same etch rate of the
13 sacrificial layer.
14 Q. But the exposed areas 122_I will
15 all have the same etch rate compared to
16 each other?
17 A. Yes. Ideally.
18 Q. Okay. So after the exposed area
19 122_I is etched, the sacrificial layers
20 120 -- and opening 122_O are filled with
21 conductive materials to form gate
22 electrodes 300, correct?

1 A. Well, it is not just a gate
2 electrode material filled with a gate
3 electrode, but also formed a contact pad.
4 Q. The portion of the openings 122_O
5 and filled by the conductive material are
6 called by Kim the protrusion pad, pad_p; is
7 that right?
8 A. Yes. Where are you reading?
9 Q. I believe it's 14 -- Kim 14/12
10 through 15.
11 A. Yes. The protrusion pad PE --
12 pad_p.
13 Q. And the longer portion protrusion
14 pad_p, which is not covered by insulating
15 layer 120 is referred to as base pad,
16 pad_b, correct?
17 A. Yes. So base pad, pad_b is
18 basically the region underneath the
19 contact -- contact pad. And so I discuss
20 that in my declaration very thoroughly.
21 Q. Okay. So the entire protrusion
22 pad_p will be made of the same conductive

1 material, correct?
2 A. As what?
3 Q. Well, the entire pad_p will all
4 be the same conductive material, correct?
5 A. You mean all the conductive pad
6 are of the same material?
7 Q. The entire pad_p will be the same
8 conductive material, correct?
9 A. What do you mean the entire P --
10 you mean the -- every -- there's so --
11 multiple contact pad.
12 Are you saying that all these
13 multiple contact pad in many steps of the
14 staircase region are made of the same
15 material -- same conductive material?
16 Q. Yes.
17 A. Is that -- yes, the answer is
18 yes. In fact, it very likely to be the
19 same as --
20 ///
21 ///
22 ///

(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?

1 A. What do you mean "each pad
2 individually"?
3 You're saying that by having a
4 protrusion pad, p-a-d_p, by having that,
5 the total thickness will be greater than
6 just a base pad, p-a-d_b?
7 Is that your question?
8 Q. Yes.
9 A. Yeah, obviously, yes.
10 Q. And that increases -- that
11 increases the thickness in the vertical
12 direction, correct?
13 A. Yeah, that -- yeah, because
14 you're adding something on top. Obviously
15 that increases the thickness of the overall
16 layer.
17 Q. Does increasing the thickness of
18 the pad help prevent damage to the pad
19 during the manufacturing process?
20 A. Yes. Of course.
21 Q. Okay.
22 A. Because those pads are eventually

1 used to form the conductive veer, meaning
2 the vertical conduit. And if the pad is
3 thin, that it can -- you know, first you do
4 an oxide etch of the field oxide, and then
5 you deposit the -- the content material,
6 conductive material.
7 Those process, if the contact pad
8 is thin, can easily damage the contact
9 region and such that the -- you would have
10 a potential shorting issues.
11 Q. Okay.
12 A. And the reliability of the memory
13 cell would not be -- will be degraded.
14 ATTORNEY WATSON: Okay. Let's
15 take a break. We've been going for,
16 what? About an hour and a half. Let's
17 take a break.
18 THE WITNESS: Sure.
19 THE STENOGRAPHER: Off the
20 record.
21 (Whereupon, a recess was taken at
22 1:59 p.m.)

1 THE STENOGRAPHER: We're back on
2 the record.
3 BY ATTORNEY WATSON:
4 Q. Welcome back, Dr. Lee.
5 A. Thank you.
6 Q. Let's turn to Kim column 7. And
7 let's put Kim on the screen. And let's
8 turn to line 63 through 67.
9 Do you see that?
10 A. 63 to 67?
11 Q. Yep.
12 A. Hold on. Let me get there.
13 Okay. They are referring to -- is that
14 Figure 5?
15 Q. Figures 4B and 5, I think.
16 A. Yeah.
17 Q. Okay. So my question for you is:
18 Kim teaches that the pad unit pad and the
19 adjacent pad unit -- strike that.
20 Kim teaches that, "The pad unit
21 pad and the adjacent pad unit pad may not
22 overlap with each other," correct?

1 A. Wait. Where are you reading?
2 Q. Line 66 and 67.
3 A. "The pad unit PAD and the
4 adjacent pad may not overlap with each
5 other."
6 Q. Do you see that?
7 A. Yes.
8 Q. So there's no overlap in the
9 adjacent pad and the pad unit pad in Kim,
10 right?
11 ATTORNEY HERMAN: Objection.
12 Form.
13 THE WITNESS: One second, please.
14 (Pause in testimony.)
15 THE WITNESS: Can you ask the
16 question again? I'm sorry.
17 BY ATTORNEY WATSON:
18 Q. So there's no overlap in the
19 adjacent pad and the pad unit in Kim?
20 ATTORNEY HERMAN: Objection.
21 Form.
22 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

1 curve contact pad, but Kim explained that
2 in column 8 that the protrusion pad, PAD_p
3 has a rectangular parallel shape and that
4 the protrusion pad PAD_p is not limit to --
5 is not limited thereto and may have a shape
6 including a curve surface based on
7 virtual -- based on a virtual rectangular
8 parallel shape, cylindrical shape or any
9 shape.
10 This is in column 8, line 29 to
11 34.
12 Q. That didn't quite answer my
13 question.
14 My question was: Figure B does
15 not show a curved side surface as claimed
16 in the '666 patent, correct?
17 A. I think I answered your question
18 in my answer just given previously. It's
19 not Figure B. In Figure 4B, Figure 4B does
20 not show a curved -- curved region;
21 however, the specification of Kim clearly
22 express -- expressly stated that the side

1 surface is curve.
2 So a person of ordinary skill in
3 the art would understand Kim actually
4 wanted and embraces the curve side surface
5 when viewed either from the top or from the
6 side.
7 Q. Let's -- let's talk a little bit
8 about the rectangular parallel shape that
9 you mentioned, okay?
10 A. Sure.
11 Q. Okay.
12 A. Go ahead.
13 Q. Let's go to column 8, lines 29
14 through 34.
15 A. Yeah.
16 Q. Are you there?
17 A. Line what?
18 Q. Lines 29 through 34.
19 A. Yes.
20 Q. Okay. So this is the rectangular
21 parallel shape you were referring to in
22 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.

1 A. Thank you.
2 Q. Do you have paragraph 234 in
3 front of you?
4 A. Yes, I do.
5 Q. So you opine that the ion
6 implantation step shown in Figure 12 of Kim
7 would be simpler -- simply be tailored to
8 form a doped region I -- or 122_I with
9 curved rather than straight sides, correct?
10 A. Right. See --
11 Q. So it's your --
12 A. Let --
13 Q. Maybe my next question will
14 get -- get where you're going.
15 So a person of ordinary skill in
16 the art would be able to form the curved
17 side preference using the same process
18 described in Kim except for changing the
19 ion implantation step shown in Figure 12 of
20 Kim; is that fair?
21 A. I wouldn't say changes. I would
22 say that the person of ordinary skill in

1 the art understanding the -- Kim's
2 disclosed fabrication process, particularly
3 the ion implantation steps in Figure 12 can
4 easily tailor so that the implanted damage
5 in the region 122_I has a curve boundary
6 instead of a straight -- instead of a
7 straight one.
8 And when that happens, during the
9 etching, the subsequent etching of the
10 sacrificial layer and etching of 122_I will
11 result in a curve side surface. The
12 contact with the contact pad. In other
13 words, the point of contact would be curved
14 rather than a straight one.
15 Q. So the way you get a curved side
16 surface in Kim is by tailoring the ion
17 implantation step?
18 A. It's a very simple change as I
19 explain in paragraph 134. And I explain in
20 subsequent paragraphs, there are other ways
21 that you can form a curve shape such as, as
22 I mentioned earlier.

1 And in paragraph 241 of my
2 declaration, you can also define the
3 opening of the mask in Figure 12 such that
4 you have a circular structure or elliptical
5 structure and so on.
6 Q. Okay. So let's go to
7 paragraph 241 of your declaration.
8 A. 241, okay.
9 Q. So in this paragraph you mention
10 a cylindrical contact pad, correct?
11 A. I think there's more than that.
12 Q. Well, let me talk about this
13 paragraph, in particular.
14 In paragraph 241, you state, "Kim
15 does not include any figure showing
16 cylindrical contact pads," correct?
17 A. That is -- that is what I wrote
18 there, yes.
19 Q. Okay. And a cylindrical pad
20 would look like one of the three shapes you
21 include in the figure at the bottom of
22 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

1 x-z direction. Because I want to delineate
2 the discussions using tailor implant
3 regions and also using the -- the shape of
4 the opening.
5 And I could have a person of
6 ordinary skill in the art would
7 understood -- would have understood that
8 you could combine both techniques so that
9 you have curve side from the top view as
10 shown in Figure 41 -- 241A of --
11 paragraph 241 as well as the curve side --
12 curve side from the cross-sectional view
13 that's discussed in paragraph 234.
14 Q. So the way you would get these
15 cylindrical pads shown in paragraph 241 is
16 by changing the shape of the openings in
17 the photosensitive mask; is that right?
18 A. Kim -- I don't think he has
19 discussed the shape of the opening. And
20 Kim does not show any figure so in the
21 cylindrical contact pad.
22 Nevertheless, a person of

1 ordinary skill in the art would have
2 understood that these pad can be shape with
3 the side opening. And it's not changing
4 the design. It's simply implementing these
5 design.
6 Q. All right. Let's turn to Kim --
7 let's just do a quick couple of things with
8 Kim. So let's go to Exhibit 1005.
9 A. Okay.
10 Q. Let's go to Kim, column 9,
11 lines 46 through 49.
12 A. 46 to 49.
13 Q. Uh-huh.
14 "By using the mass pattern to
15 form pad_p in precise locations, Kim
16 ensures that the protrusion pad_p -- pad_p
17 is inside from the edge of a surface of the
18 base pad, pad_b to prevent the short
19 circuit between the pad units pad
20 positioned at different rows," correct?
21 ATTORNEY HERMAN: Objection.
22 Form.

1 THE WITNESS: So you just read
2 column 9 from row 46, right?
3 BY ATTORNEY WATSON:
4 Q. Uh-huh.
5 A. To 49, that's what you read?
6 Q. Yes. Do you want me to ask you
7 the question again?
8 A. Yeah. I didn't think that you
9 had. I thought -- sorry about that. I
10 thought you just read the --
11 Q. Pretty close, but let me ask the
12 question again.
13 "By using the mask pattern to
14 form pad_p in precise locations, Kim
15 ensures that the protrusion pad, pad_p is
16 inside from the edge of a surface of the
17 base pad, pad_b to prevent the short
18 circuit between the pad units pad
19 positioned at different rows."
20 A. Yeah. Essentially that what it
21 read there.
22 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

1 and 20 are obvious over Nam, correct?
2 A. So, wait a minute. Let me go
3 back to your last question. Okay. Let me
4 go back to your last question there you ask
5 about Kim.
6 Q. Okay.
7 A. I want to point out that what we
8 just read is that Kim identified short
9 circuit risk and proposed mitigations --
10 right? -- proposed solutions.
11 In other words, Kim is attune to
12 short circuit risk when you design the
13 staircase -- staircase region. So a person
14 of ordinary skill in the art would
15 understand that Kim is very aware of the
16 short circuit risk.
17 And even though it proposed a
18 certain solution, it might not get to
19 100 percent --
20 Q. Okay.
21 A. -- completely solved.
22 Q. Okay.

1 A. So motivated to make additional
2 modification to further reduce shorting a
3 risk.
4 Q. I don't think I asked a question
5 about any of that. But thank you for that.
6 Let's go to paragraph 260. I'll
7 move to strike that last answer.
8 A. 260 --
9 ATTORNEY HERMAN: Objection to
10 form.
11 BY ATTORNEY WATSON:
12 Q. Let's go to paragraph 260.
13 A. Okay.
14 Q. The second ground of obviousness
15 you identified is that Claims 17, 19 and 20
16 are obvious over Nam.
17 Do you see that?
18 A. Yes.
19 Q. Okay. You have not offered an
20 opinion that the claims of the '666 patent
21 are anticipated by Nam, correct?
22 A. No. It's based on obviousness.

1 Although, certain elements are taught by
2 Nam, meaning that it is expressly disclosed
3 by Nam including Claim 19.
4 Q. But not every element of the
5 claims of the '666 patent are disclosed by
6 Nam, correct?
7 A. Not every element in Claim 17 are
8 disclosed by Nam --
9 Q. Let's go --
10 A. -- but there's a number --
11 there's a number of claim limitation are
12 taught by Nam. And I disclose -- disclose
13 that in my declarations. And I also state
14 that Claim 19 is taught by Nam.
15 Q. Dr. Lee, let's go to
16 paragraph 296.
17 Do you see that?
18 A. Yes.
19 Q. Your opinion is Nam renders
20 limitation 17.C.2 obvious, correct?
21 A. Yes.
22 Q. So Nam does not teach wherein a

1 second portion of the conductive layer
2 provides a curved side surface in contact
3 with a side surface of insulating layer?
4 ATTORNEY HERMAN: Objection.
5 Form.
6 THE WITNESS: It does not
7 expressly disclose the claim element
8 17.C.2; however, it is my opinion that
9 Nam render this claim limitation
10 obvious.
11 BY ATTORNEY WATSON:
12 Q. Okay. Let's go to paragraph 326
13 of your expert report.
14 A. 326. Let me get there. Sorry.
15 Yes.
16 Q. In paragraph 326, you bold the
17 word "insulating layer," correct?
18 A. Yes.
19 Q. And then after that, you put in
20 parentheses "the portion of insulating
21 layer 271 adjacent to the contact pad
22 annotated below."

1 A. Sorry. Let me...
2 A portion -- yeah, the portion of
3 insulating layer 271 adjacent to the
4 contact pad. And so what I shown here --
5 is there a question?
6 Q. So in this figure, figure -- the
7 figure in paragraph 326 of your report,
8 does that show the entirety of the
9 insulating layer you were labeling?
10 A. Highlighted in blue?
11 Q. Yes.
12 A. No. What I show there, I just
13 want to show that I just wanted to
14 highlight the point of contact that is
15 curve side surface.
16 And that a person of ordinary
17 skill in the art would understand that in
18 Nam, the two pieces of insulating layer are
19 responsible to define the contact holes
20 and, therefore, are together meet the claim
21 term insulating layer.
22 And those two elements are 248

1 and 271 as shown in -- you know, in this
2 figure on page -- on paragraph 326. And as
3 I discuss earlier, that the blue should
4 have extended all the way to cover the
5 brown/yellow regions.
6 You understand?
7 And the reason why I didn't do
8 that is because what I wanted to show is
9 just highlight the point of contact between
10 the insulating layer, which is 248, which
11 is one of the element 240. 240 is
12 basically all the word lines. And each
13 step -- each level has labeled different
14 numbers, 248, 249 and so on.
15 And so in this figure is 248 and
16 271. And as I describe at the beginning of
17 my deposition, that in paragraph 240 --
18 245, if you can turn to paragraph 235.
19 Q. 235?
20 A. Sorry. 345.
21 Q. All right. That makes more
22 sense. Okay.

1 A. Yeah. Sorry.
2 That the top blue region, the
3 insulating layer on top of the conductive
4 layer, the blue should extend to covered
5 the brown and gold region.
6 In other words, should extend all
7 the way to the vertical, the left vertical
8 red line, that vertical red dash line.
9 So, in other words, that the
10 figure in -- what paragraph was that? --
11 314 -- was not -- you know, to be more
12 complete should have drawn the blue, should
13 have drawn all the way to the end of the
14 second portion of the conductive layer.
15 I didn't do that, because the
16 purpose of that drawing is simply highlight
17 the point of contact.
18 Q. Is there a single figure
19 annotated in your declaration of Nam that
20 highlights the entire insulating layer as
21 you've described it?
22 A. The wording in my declarations is

1 accurate, okay? And in paragraph 345,
2 okay, the insulator, which is the blue
3 region underneath the green region, you can
4 see that it is shown all the way to cover
5 the entire contact pad.
6 The -- so that's -- that one is
7 very clear. And as I explain at the
8 beginning of the deposition, that I wanted
9 to clarified in the drawing to make it more
10 clear that the insulating layer should
11 extend such that it would cover the contact
12 pad, in other words, the 230 -- 237.
13 Q. Dr. Lee, I don't think that was
14 an answer to my question.
15 My question was simply: Is there
16 a single figure annotated in your
17 declaration that highlights the entire
18 insulating layer you're relying on?
19 ATTORNEY HERMAN: Objection --
20 THE WITNESS: Yes.
21 ATTORNEY HERMAN: -- asked and
22 answered. And also mischaracterizes

1 the witness's testimony.
2 THE WITNESS: Yes.
3 BY ATTORNEY WATSON:
4 Q. Where --
5 A. In figure -- may I?
6 Q. Yeah.
7 A. Yeah. In paragraph 345, you see
8 that the insulating layer underneath the
9 green area, the conductive layer, show that
10 the insulating layer extend all the way and
11 covered the contact pad.
12 And so there is one graph, one
13 schematic annotated figure that illustrate
14 that. And then --
15 Q. Sorry.
16 A. Finish?
17 Q. Well, I was just gonna ask a
18 follow-up question on that, if that's okay.
19 A. Sure. Go ahead.
20 Q. So what you're -- the figure in
21 paragraph 345 -- let me start this question
22 again.

1 What you identify as the
2 insulating layer in paragraph -- the figure
3 in paragraph 345 is not complete, but the
4 adjacent insulating layer shows the
5 entirety of the insulating layer?
6 ATTORNEY HERMAN: Objection.
7 Form.
8 THE WITNESS: Well, I wouldn't
9 say it's not complete. I would say
10 that -- that's why I want to clarify
11 that. Again, the wording of the -- my
12 declaration is 100 percent correct.
13 And that the figures should have
14 been -- I could have drawn it more
15 clearly to the top blue region should
16 extend and include the insulating layer
17 248 and 271 to cover the contact pad,
18 the gold blue region.
19 BY ATTORNEY WATSON:
20 Q. Okay. Let's go to paragraph 329,
21 because you said that -- you mentioned the
22 text explains this.

1 A. 329?
2 Q. Yep. Dr. Lee, is it your opinion
3 that both layers 248 and layer 271 together
4 form Nam's insulating layer?
5 A. Yes. It is my opinion that the
6 layer at the element 248 and element 271
7 together form the Nam -- Nam's insulating
8 layer. And the reason is that those two
9 pieces together define the contact hole.
10 Q. Okay. Let's --
11 A. Ask --
12 Q. -- put up what I've marked as --
13 we'll mark it as Lee Exhibit 5. And that's
14 Figure 8A of Nam annotated.
15 (Whereupon, Exhibit 4 is marked
16 for identification.)
17 DOCUMENT TECHNICIAN: And figure
18 8A Nam annotated part 2 and one is that
19 not --
20 ATTORNEY WATSON: Just part --
21 just part 1.
22 Let's put that all the way on the

1 screen so it's fully visible. Is this
2 Lee Exhibit 4, sorry. We'll mark this
3 as Lee Exhibit 4.
4 Can we make that full screen?
5 THE WITNESS: What you've done is
6 incorrect.
7 ATTORNEY WATSON: We'll get
8 there.
9 Can we make this full screen so
10 we can see the whole figure?
11 DOCUMENT TECHNICIAN: One second.
12 I think there's a bug.
13 ATTORNEY WATSON: Okay.
14 DOCUMENT TECHNICIAN: Can you see
15 it now?
16 ATTORNEY WATSON: Yes.
17 BY ATTORNEY WATSON:
18 Q. So, Dr. Lee, do you recognize
19 this as an annotated figure of Figure 8A of
20 Nam?
21 A. Yes.
22 Q. Okay. And in this figure, 248

1 and 271 have both been colored in blue,
2 correct?
3 ATTORNEY HERMAN: Objection.
4 Form.
5 THE WITNESS: Yes. But that
6 it's -- what you've shown there is
7 incorrect.
8 BY ATTORNEY WATSON:
9 Q. Why is 248 and 271 not the
10 entirety of the insulating there?
11 A. No. You have to understand, for
12 the claim term insulating layer, it is
13 discussed -- it is a person of ordinary
14 skill in the art would understand that the
15 claim term insulating layer are the portion
16 of the insulating layer whether it's one
17 insulating layer or multiple pieces of
18 insulating layer that define the contact
19 holes, okay?
20 So, therefore, a person of -- of
21 ordinary skill in the art would
22 understand -- would understand that the

1 part of the element 240 and 271 or 248 and
2 271 that define the contact hole is not at
3 the bottom of the pad.
4 It's on the top, because a person
5 of ordinary skill in the art understanding
6 the technology would understand that the
7 pattern that defined a hole is from the
8 top. It's not from the bottom.
9 So, therefore, the correct way of
10 shading the portion of the 248 and 271 is
11 simply on top of the contact pad from
12 the -- from the right side all the way to
13 where the second portion of the end of the
14 second portion of the conductive layer.
15 Because that is what define the contact
16 hole.
17 The insulating layer underneath
18 the contact pad does not define that
19 particular contact hole in that particular
20 step, okay?
21 In that particular step in that
22 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.

1 (Whereupon, Exhibit 5 is marked
2 for identification.)
3 ATTORNEY WATSON: Let's put that
4 on the screen, if you don't mind.
5 DOCUMENT TECHNICIAN: Stand by.
6 BY ATTORNEY WATSON:
7 Q. Dr. Lee, do you recognize Lee
8 Exhibit 5 as an annotated version of
9 Figure 8A of Nam?
10 A. Yes.
11 Q. Does this accurately reflect what
12 you're considering the insulating layer?
13 A. No.
14 Q. Why does this not reflect it?
15 A. Because you still include part of
16 the 271 underneath 237. So it would be
17 correct only if you include the portions of
18 the blue area above the 237.
19 Q. So would -- the areas above 237A
20 and 237B -- strike that.
21 The portions of insulating layer
22 248 and 271 that are above 237A and 237B

1 are what you consider the insulating layer?
2 A. It's not what I consider. It is
3 a person of ordinary skill in the art
4 reading the '666 patent and the claims
5 regarding the claim term insulating layer
6 that -- so if you can modify that and you
7 move the bottom part of the -- of the
8 shaded blue region, can you try that?
9 Q. How about after the break. Let's
10 take a break right here, and I'll see if I
11 can get you an image like that.
12 A. Okay. Thank you.
13 ATTORNEY WATSON: Let's take a
14 break.
15 THE STENOGRAPHER: We're off the
16 record.
17 (Whereupon, a recess was taken at
18 3:00 p.m.)
19 THE STENOGRAPHER: All right.
20 We're back on the record.
21 BY ATTORNEY WATSON:
22 Q. Dr. Lee, I'm going to put on the

1 screen what we'll mark as Lee Exhibit 6.
2 Let's go put that up. I just added what
3 we'll mark as Lee Exhibit 6 to the chat.
4 Can you put that up?
5 Dr. Lee, do you see what's been
6 marked as Lee Exhibit 6?
7 A. Yes.
8 (Whereupon, Exhibit 6 is marked
9 for identification.)
10 BY ATTORNEY WATSON:
11 Q. Okay. And is Lee Exhibit 6
12 annotated version of Figure 8A from Nam?
13 A. Yes.
14 Q. Does Lee Exhibit 6 show your
15 opinion of where the claimed insulating
16 layer is in Nam?
17 A. Hold on one second. Sorry.
18 Not exactly. The -- you see that
19 on the right side, that -- you seem to
20 include the region curving upward.
21 Do you see that?
22 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

1 top, yeah. It should -- it should be
2 extended horizontally to the -- to cover
3 the -- the brown and gold region.
4 The way you draw it in Exhibit 6,
5 Lee 6 seems to suggest that they continue
6 going up. Here -- here I want highlight in
7 this particular figure in paragraph 230 --
8 326, I just want to highlight the
9 contact -- point of contact.
10 And I also don't want to give the
11 impression that this 271 that define the
12 contact hole for this particular level
13 extend upward toward the next level to the
14 top.
15 So to be more precise in your --
16 in your exhibit Lee 6, I wouldn't draw the
17 blue -- blue region to go all the way to
18 the top.
19 You understand what I'm saying?
20 Q. I'll try in a second.
21 You do not include any figures
22 with that annotation in your declaration,

1 correct?
2 A. Like I -- if you go to
3 paragraph 345.
4 Q. Okay. Let me change my question.
5 A. No, no.
6 Q. You --
7 A. Let me answer your question
8 first.
9 Q. Okay. Go ahead.
10 A. If you go to 345.
11 Q. Okay.
12 A. Okay? 345. Not 343.
13 Q. 345. Okay.
14 A. Okay. And you enlarge it.
15 Q. Yes, I can enlarge it as much --
16 A. Okay.
17 Q. Can we make this bigger? I don't
18 know why I keep losing my thing here that I
19 can control.
20 Paragraph 345, okay.
21 A. 345.
22 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

1 a specific -- a particular level of the
2 staircase region.
3 And so, for example, in this
4 particular figure, Figure 7 in
5 paragraph 345, to be more clearer, the blue
6 region above the contact layer, the green
7 region, should be drawn to extend all the
8 way toward the vertical dash red line on
9 the left, okay?
10 But not have the blue region
11 extended upward as is shown in Lee
12 Exhibit 6.
13 You understand what I'm saying?
14 Q. I think so. You do not include
15 anywhere in your declaration a drawing of
16 the insulating layer that shows that,
17 correct?
18 ATTORNEY HERMAN: Objection.
19 Form. Also repeatedly asked and
20 answered.
21 THE WITNESS: As I mentioned,
22 that the wording in my declaration and

1 my opinion has not changed.
2 I just want to clarify that --
3 that some of the drawing to be more
4 clearer, that all the insulating layer
5 should be drawn similarly to the
6 adjacent insulating layer as shown in
7 Figure 7 in paragraph 345.
8 And, of course, they're not the
9 same. The name are different. And
10 that -- but it's similar in the sense
11 that, for example, the blue region
12 above the green region should extend
13 horizontally to cover the contact pad
14 shown at the brown and orangey color.
15 BY ATTORNEY WATSON:
16 Q. Why do you divide insulating
17 layer 271 such that the entire 271 is not
18 the insulating layer?
19 A. The reason is not the entire
20 271 -- do not -- does not define the
21 contact hole. Only a portion of 271 define
22 hole -- the contact hole, define the hole

1 in which conductive pad resides in.
2 Q. Are you labeling --
3 A. So that is the reason.
4 Q. Are you labeling the insulating
5 layer 271 based on your understanding of
6 the '666 patent?
7 A. Absolutely.
8 Q. Okay.
9 A. Each -- each level has the
10 corresponding insulating layer, okay?
11 Q. Let's --
12 A. So --
13 Q. Oh, you're still going. Sorry.
14 I'm just trying to get answers to my
15 questions, Doctor.
16 A. You cannot say the entire 271 is
17 the insulating layer, because for each
18 level, a person of ordinary skill in the
19 art would understand that only a portion of
20 271 is defining the contact hole and,
21 therefore, only the portion -- a portion of
22 271 together with 248 meet the claim

1 limitations of insulating layer of Claim 17
2 and Claim 18.
3 Q. Only a portion of layer 271
4 together with 248 meet the claim limitation
5 of an insulating layer from Claim 17 of the
6 '666 patent, correct?
7 A. That is correct. That for each
8 level, the pieces are different.
9 So you can modify the Lee
10 Exhibit 6.
11 Q. Okay. We'll go back and do that
12 at the next break. But let's go -- let's
13 go to paragraph 315 of your declaration.
14 A. 315?
15 Q. 315.
16 A. 315, are you going --
17 Q. Paragraph 315 of your
18 declaration.
19 Okay. In paragraphs 315 through
20 325 of your declaration, you describe how
21 the structure in Nam is formed, correct?
22 A. Yes.

1 Q. Okay. So in paragraph 16, you
2 state that, "To begin this process, Nam
3 forms an alternating stack of sacrificial
4 layers 220 and insulating layers 240,"
5 correct?
6 A. Yes.
7 Q. In paragraph 17, 317, you state,
8 "Then the steps are formed in the
9 sacrificial and insulating layers,"
10 correct?
11 A. You're reading it right, yeah.
12 Q. Yeah, okay.
13 And the steps of alternating
14 stack and sacrificial layers 2020 and
15 insulating layers 240 are shown in
16 Figure 31 of Nam.
17 A. Actually.
18 Q. What's that? Go ahead.
19 A. I'm sorry. Which paragraph are
20 you reading?
21 Q. Paragraph 317?
22 A. 317, okay.

1 Q. So next, the sacrificial and
2 insulating layers are formed, correct?
3 A. Where are you? I'm sorry.
4 Q. In 317, "The steps are formed in
5 these layers"?
6 A. Okay.
7 Q. After forming the steps of
8 alternating -- strike that. Let me try
9 that again.
10 After forming the sacrificial
11 layers 220 and insulating layers 240, the
12 steps are covered with a first interlayer
13 insulating layer 271, correct?
14 A. Okay.
15 Q. Are insulating layers 240 and
16 first insulating layer -- interlayer --
17 strike that.
18 Are insulating layers 240 and
19 first interlayer -- insulating layer 271
20 formed separately in Nam?
21 A. Hold on. Let me go there.
22 If you look at Figure 30 and 31,

1 you see that the 248 is formed first and
2 then 271 is formed second. Yes, it is
3 separate steps.
4 Q. Okay. So figures -- so the
5 insulating layer 240 and first interlayer
6 insulating layer 271 are formed
7 sequentially?
8 A. Well, I don't know about
9 sequentially, but it's different steps.
10 271 is formed after 240.
11 Q. Okay. Let's pull up Nam real
12 quick. That's Exhibit 1006.
13 (Whereupon, Previously Marked
14 Exhibit 1006 is identified for
15 the record.)
16 BY ATTORNEY WATSON:
17 Q. Dr. Lee, you recognize
18 Exhibit 1006 as --
19 A. Yes.
20 Q. -- the Nam reference?
21 A. Yes.
22 Q. Okay. Let's go down to

1 paragraph 82.
2 DOCUMENT TECHNICIAN: I'll let
3 you do that.
4 ATTORNEY WATSON: You want me to
5 handle that? Okay. We'll go down to
6 paragraph 82 of Nam.
7 BY ATTORNEY WATSON:
8 Q. So the first interlayer
9 insulating layer -- actually, let's go to
10 paragraph 98. Sorry.
11 A. Wait, 98?
12 Q. We're at paragraph 98 of Nam.
13 Sorry.
14 A. Hold on. Let me go there.
15 Q. Yeah.
16 A. Okay.
17 Q. The "first interlayer insulating
18 layer 271 is made of silicon oxide or the
19 like," correct?
20 A. Wait. You said 98?
21 Q. Yes. Paragraph 98.
22 A. There's nothing about 271.

1 Q. Go to the bottom of paragraph 98.
2 A. Oh, I see, okay. Yeah, okay.
3 Q. So let me repeat my question.
4 The first interlayer insulating
5 layer 271 includes silicon oxide or the
6 like?
7 A. Okay.
8 Q. Agreed?
9 A. That's what it says there, yes.
10 Q. Okay. And would you agree with
11 me that layer 271 is -- the entirety --
12 strike that.
13 Would you agree with me that the
14 entirety of layer 271 is made of the same
15 material?
16 A. Yes.
17 Q. Okay. How would a person of
18 ordinary skill in the art deposit the first
19 interlayer insulating layer 271?
20 A. Well, there's various different
21 ways of doing that.
22 Q. Would a person of ordinary skill

1 in the art use high density plasma to
2 deposit first insulating layer 271?
3 A. You could do that if you want.
4 But you don't -- there's one method.
5 There's another method, simply CBD process,
6 chemical vapor deposition or plasma
7 enhanced CBD.
8 Q. Could you use tetraethyl silicate
9 oxide to deposit the first interlayer
10 insulating layer 271?
11 A. Yes.
12 Q. By adding the insulating layer
13 271 by these processes, does that result in
14 insulating layer 271 conforming around each
15 step in the staircase structure?
16 A. You mean does it result in what
17 is shown in Figure 31?
18 Q. Yes.
19 A. Yes.
20 Q. And in Figure 31, layer 271 is
21 conformal around the staircase structure,
22 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

1 aspect ratio.
2 So I don't think one can conclude
3 whether it is wider than height or taller
4 than width.
5 Q. Let's go back to paragraph 318 of
6 your declaration.
7 A. 318.
8 Q. Are you there?
9 A. I'm there.
10 Q. Okay. You say, "Next a multistep
11 ion implantation process is performed to
12 create a damaged region DA1 surrounding the
13 ends of the sacrificial layers 220,"
14 correct?
15 A. That's right. That's what I
16 wrote there.
17 Q. And Figures 32 and 33 of Nam show
18 that implantation process, correct?
19 A. Yes.
20 Q. Let's go to paragraph 319 of your
21 declaration.
22 A. Okay.

1 Q. "This damaged region is more
2 susceptible to etching -- is more
3 susceptible to etching," correct?
4 A. That's the first part of the
5 first sentence -- well, the only sentence.
6 Q. Okay. You agree with that, the
7 damaged region is more susceptible to
8 etching?
9 A. Well, there -- that is what Nam
10 describe --
11 Q. Okay.
12 A. -- in paragraph 66, 90 and 103.
13 Q. And this damaged region is
14 located at the interface between the
15 sacrificial layer and the interlayer
16 insulating layers?
17 A. Yes.
18 Q. And this damage region has the
19 shape of the intended contact pad, correct?
20 A. Yes. That's what I wrote here in
21 paragraph 319.
22 Q. Let's go to Figure 330 -- or

1 Figure 34 of Nam.
2 A. Okay.
3 Q. What is Figure 34 of Nam showing?
4 A. Well, it's showing the general
5 locations of ion implantation.
6 Q. What do the dotted lines
7 represent in Figure 34?
8 A. It's showing different locations
9 -- hold on one second.
10 (Pause for reading/reviewing.)
11 THE WITNESS: Hold on. [Speaking
12 sotto voce].
13 So the dotted line is simply
14 showing the damage region DA. And
15 basically shows the extent of the
16 degraded region in the sacrificial --
17 sacrificial layers.
18 BY ATTORNEY WATSON:
19 Q. The dotted lines represent where
20 the ions are implanted during the ion
21 implantation process; is that fair?
22 A. You can say that, but it's

1 really -- I believe it's DA, meaning that
2 damage area, damage region. So it's really
3 showing the damage region. Because the
4 damage region have a different etch rate
5 compared to the non-damage regions.
6 As a result, when you etch the
7 sacrificial layer, you end up with the
8 figure as shown in Figure 36 of Nam.
9 Q. Now, if you look at Figure 34,
10 the damage region extends into parts of the
11 sacrificial layers 220, correct?
12 A. That is correct.
13 Q. And the damage --
14 A. Wait, wait. Hold on one second.
15 Can you repeat the question
16 again?
17 Q. Sure.
18 The damaged area extends into
19 some of the sacrificial layers 220?
20 A. Well, it's mainly in the 220, and
21 it's also part of it in 271.
22 Q. So some of the damaged area is

1 also found in insulating area 271?
2 A. As shown in Figure 34.
3 Q. Now, Figure 34, the ions are
4 implanted using three different energy
5 levels, correct?
6 A. Yes.
7 Q. And the ions penetrate the
8 insulating and sacrificial layers to the
9 various dotted lines, correct?
10 A. You can say that. But basically
11 that the Nam discuss about damage with --
12 let me see. Let me -- sorry.
13 So you are say -- you are
14 asking -- I want to look for the -- so
15 you're asking whether Nam uses different
16 ion implantation energy at different steps
17 to control how deep and where the damage
18 region is?
19 Q. Yes.
20 A. The answer is yes.
21 By adjusting the ion implantation
22 energy, a low energy will concentrate the

1 damage near the top of the sacrificial
2 layer, higher energy will push the damage
3 deeper into the regions.
4 So by adjusting the tailor, the
5 shape and the depth of the damage regions,
6 then damage region they call it DA, D-A.
7 So that when the damage material is later
8 etch -- right? -- together with the
9 sacrificial layer, it will produce the --
10 the desire -- what they call -- what Nam
11 call the curve -- I think bullnose profile,
12 right?
13 And at least -- going back to my
14 dep -- declaration -- sorry.
15 Yeah. So to answer your
16 question, yeah, they use a multi ion
17 implantation step.
18 Q. Okay. Now, will the amount of
19 dope be the -- relatively uniform across
20 the x direction of the damaged area?
21 A. You have to understand how ion
22 implantation work. Ion implantation is not

1 like a laser scanning across a wafer. It
2 is implanted the entire wafer at the same
3 time at different energy and at different
4 dosage.
5 So, therefore, you know, of
6 course the top surface might be patterned
7 by a photoresist or a hard mask.
8 So, therefore, that -- the ion
9 implantation dosage can be changed with
10 respect to z axis, can be changed, like I
11 said, the higher energy will be -- the ion
12 implant would go deeper, the lower energy
13 would go closer to the top. And it depends
14 on the dosage, the dosage could also vary
15 vertically. But it doesn't change
16 horizontally.
17 Q. The damaged area doesn't have a
18 different amount of dopant horizontally,
19 correct?
20 A. Yes. In other words, in
21 Figure 34 the damage in the top level --
22 right? -- 228 is the same as the damage in

1 227, 226 all the way to 221.
2 And so, in general, ideally, you
3 know, all the process steps, depending on
4 the tolerance of the equipment, it might
5 change slightly. But ideally and, in
6 general, it is very accurate that the
7 damage in each level and the profile is
8 exactly the same.
9 Q. Now, in Figure 34, the ions only
10 get implanted to the bottommost dotted line
11 in Figure 34, correct?
12 A. I don't understand your question.
13 Q. Well, let me try this. Let's
14 pull up what we'll mark as Lee Exhibit 6.
15 (Whereupon, Exhibit 7 is marked
16 for identification.)
17 THE WITNESS: You already have 6,
18 I think.
19 BY ATTORNEY WATSON:
20 Q. Oh, Lee Exhibit 7. Let's pull up
21 -- let's pull up what we'll mark as Lee
22 Exhibit 7. That will be the Figure 34 of

1 Nam annotated.
2 ATTORNEY WATSON: So this is --
3 we're going to mark this as Lee
4 Exhibit 6 [sic].
5 BY ATTORNEY WATSON:
6 Q. Dr. Lee, do you recognize Lee
7 Exhibit 6 as an annotated version of
8 Figure 34 of Nam?
9 DOCUMENT TECHNICIAN: Sorry,
10 Counsel. I believe we're on 7. I'm
11 looking at the last --
12 ATTORNEY WATSON: Oh, perfect.
13 That's what I need to know. Perfect.
14 Let's -- let's change that.
15 BY ATTORNEY WATSON:
16 Q. Dr. Lee, do you recognize Lee
17 Exhibit 7 as an annotated version of
18 Figure 34 of Nam?
19 A. Yes.
20 Q. Okay. And in Figure 34, you see
21 there's a bunch of red boxes?
22 A. You annotated those red boxes.

1 Q. Okay. When the ion implantation
2 process occurs in Nam Figure 34, no ions
3 penetrate into these boxes, correct?
4 A. It is designed that it does not
5 go through into the red boxes.
6 Q. And so these areas marked in red
7 boxes will not be etched away during their
8 replacement process, correct?
9 ATTORNEY HERMAN: Objection.
10 Form.
11 THE WITNESS: I don't understand
12 what you mean. Because those
13 sacrificial layer within -- for
14 example, if you look at the second
15 level from the top, 227, okay? Can you
16 point to that 227?
17 BY ATTORNEY WATSON:
18 Q. Uh-huh.
19 A. When you etch 227, the region
20 within the red box on the far left would
21 still be etched in 227. Why wouldn't it be
22 etched?

1 Q. Let me change my question. I
2 understand what you're saying. Okay.
3 So when replacing the damaged
4 areas in Figure 34, there will not be a
5 replacement of anything in the red boxes?
6 A. I don't understand your question.
7 What do you mean by
8 "replacement"?
9 Q. Well, after -- so let me -- let
10 me continue.
11 So during the process described
12 in Nam, Nam forms damaged areas, correct?
13 A. Yes.
14 Q. Okay. Let's turn to
15 paragraph 320 of your declaration. We'll
16 go to that.
17 A. 320?
18 Q. 320, yep.
19 A. Right.
20 Q. Okay. You say in paragraph 320
21 that, "Per Nam, the implanted impurities
22 can be diffused into the surrounding

1 insulating layer 271 via the application of
2 heat," correct?
3 A. That's what I wrote there.
4 Q. What does it mean that the
5 impurities are diffused by heat?
6 A. Well, diffusion is a process in
7 which the particle will diffuse from a high
8 concentration area toward the low
9 concentration area.
10 In other words, if I give you a
11 bucket of water -- okay -- if I give you a
12 bucket of water and you drop some ink, a
13 blue ink in one corner of the bucket of
14 water, eventually it will -- because you
15 have higher concentration of blue ink in
16 one corner and very low concentration of
17 blue ink in other places due to random
18 motions, that these blue ink will collide
19 and eventually will diffuse from high
20 concentration to low concentration region
21 until the entire bucket of water has the
22 same concentration.

1 In other words, it will diffuse
2 toward the entire bucket of water until it
3 is entirely blue, okay?
4 Now, of course, how fast it
5 diffuse depends on the temperature. The
6 higher the temperature, the faster these
7 particle will diffuse.
8 Similarly, the -- in
9 paragraph 320, the implanted impurity was
10 implanted primarily in the -- in the
11 sacrificial layer, okay? So, therefore,
12 there's a high concentration of impurity in
13 that region while 271 does not have a --
14 you know, when they deposit it, they didn't
15 have any implant damage.
16 So as a result of the diffusion
17 mechanism, that it diffuse -- the implant
18 would diffuse into the surrounding
19 insulating layer 271 via the application of
20 heat.
21 In other words, if you don't
22 apply heat, the impurity would not diffuse.

1 Q. Okay. Will the damaged region
2 diffuse in both the x and z directions?
3 A. The damage region -- the impurity
4 will diffuse from low concentration -- from
5 high concentration to low concentration.
6 So it depends on what the concentration is
7 in the z direction and -- but, in general,
8 it would diffuse into the surrounding
9 insulating layer.
10 Q. And will the rate of diffusion in
11 the left and right on the x direction, will
12 that rate of diffusion be constant?
13 A. What do you mean by "constant"?
14 Constant with time? Constant with
15 precision?
16 Q. How about this: The damage
17 region -- will the damage region -- strike
18 that.
19 Let me start that again.
20 Will the damage region diffuse to
21 the same rate to the left as to the right
22 of the stair?

1 A. So the diffusion not only depends
2 on the concentration gradient but also
3 depends on the media that the diffusion
4 occurs. And the sacrificial layer, in
5 general, made by silicon nitride and the
6 271, I believe is -- let's see.
7 So 271 is -- yeah, we read that
8 before, and you mentioned that before is --
9 can be formed by HET or TEOS. So it's
10 SiO2. So it's different material. So the
11 diffusion will be different to the left and
12 to the right.
13 Q. Will it diffuse faster to the
14 left or to the right?
15 A. Assuming that the sacrificial
16 layer -- let's see. Hold on. 227, 228.
17 We're looking for Nam. I believe that is
18 like a polysilicon region. So 220 is
19 polysilicon.
20 So your question is whether
21 impurity diffuse faster in oxide versus
22 polysilicon.

1 Well, it depends. In -- it
2 depends on what is the polysilicon composed
3 of, how big are the -- how big is the grain
4 and how big -- you know, what is the --
5 polysilicon could be dope, what is the dope
6 and -- and, but, in general -- and also
7 oxide, you know, how dense is the oxide.
8 But, in general, is -- impurity
9 usually diffuse much faster in polysilicon
10 than oxide.
11 Q. Let's go to paragraph 322 of your
12 declaration.
13 A. Yeah. That's -- but I don't
14 think it matters in the way that Nam
15 describe how to form a bullnose contact
16 pad.
17 What paragraph you looking for?
18 Q. I'm -- right now I'm going
19 paragraph 322 of your declaration.
20 A. 322. Okay.
21 Q. All right. So after this
22 diffusion step, "Both the sacrificial

1 layers and the damage regions are etched to
2 form opening regions OP in the shape of a
3 gate electrodes and contact pads," correct?
4 A. That's what I wrote there.
5 Q. And if you'll turn to
6 paragraph 90 of Nam.
7 Do you have paragraph 90 of Nam
8 in front of you?
9 A. About Figure 17 to 20? Is that
10 right? Is that what you mean?
11 Q. Yes. It starts with "then." But
12 go towards the middle of the paragraph.
13 A. Okay.
14 Q. So --
15 A. Hold on. Let me read that.
16 Q. Yep.
17 (Pause for reading/reviewing.)
18 THE WITNESS: Okay. It uses two
19 different damage -- two separate ion
20 implantation steps, right?
21 BY ATTORNEY WATSON:
22 Q. But -- yeah, so I actually have a

1 question about I think the next sentence.
2 A. I'm sorry.
3 Q. The sacrificial and --
4 A. Wait. Hold on. Where are you?
5 What line are you?
6 Q. I'm going to the paragraph that
7 says -- or the sentence that says the
8 "damage regions DA1 and DA2."
9 A. Yeah.
10 Q. Okay. "The damage regions DA1
11 and DA2 and surrounding areas have film
12 characteristics with damage caused by the
13 impurities, and thus, may be removed more
14 rapidly when an etching solution such as
15 phosphoric acid or the like is introduced
16 thereto."
17 Do you see that?
18 A. Yes.
19 Q. So phosphoric acid is used to
20 help etch these damage regions out?
21 A. Okay. This is a different figure
22 now.

1 Q. Well, let me just ask this
2 question: Would you use phosphoric acid to
3 etch out damaged areas?
4 A. Well, it depends on what material
5 you are. And phosphoric acid generally is
6 used to etch out silicon nitride. And so I
7 have to look back and see Figure 17 to 20,
8 what is the material.
9 So even though, in general,
10 phosphoric acid is a standard selective wet
11 etch for silicon nitride, but it can also
12 be used in etching particularly damage
13 polysilicon in such a way that it will --
14 it will etch the damaged sacrificial region
15 much faster than the undamage sacrificial
16 layer.
17 So, therefore, because of that
18 differential etch rate, you end up with the
19 bullnose contact pad that Nam describes.
20 ATTORNEY WATSON: Okay. Well,
21 let's take a -- let's take a break real
22 quick for, I don't know, five minutes.

1 THE WITNESS: Sure.
2 In the meantime, can you -- would
3 you mind changing the Nam -- I mean the
4 Lee Exhibit 6 or 7. Remember we talked
5 about that?
6 ATTORNEY WATSON: Sure, yeah, I
7 plan on coming back with an updated
8 version, so we'll talk about that after
9 the break.
10 THE WITNESS: Okay. Thank you.
11 THE STENOGRAPHER: Off the
12 record.
13 (Whereupon, a recess was taken at
14 3:59 p.m.)
15 (Whereupon, Exhibit 8 is marked
16 for identification.)
17 THE STENOGRAPHER: Back on the
18 record.
19 BY ATTORNEY WATSON:
20 Q. Dr. Lee, I'm putting on the
21 screen what's been marked as Lee Exhibit 8.
22 Do you see that?

1 A. Yes.
2 Q. Okay. Lee Exhibit 8 is an
3 annotated version of Exhibit -- of
4 Figure 8A from Nam?
5 A. Yes.
6 Q. Does the blue in this figure Lee
7 Exhibit 8 reflect your opinions of what the
8 insulating layer is?
9 A. Yes. The blue area is --
10 including the element 248 in portion of
11 271, that portion together, these two
12 pieces together cooperate and define the
13 contact hole, which is what the claim term
14 insulating layer means.
15 So, therefore, what you have
16 drawn there is -- is correct that that is
17 the region in which the blue region is the
18 region in which the element 248 and portion
19 of 271 together meet the claim term
20 insulating layer.
21 As I discussed before, that is
22 similar to the figure that I drawn in

1 paragraph 345.
2 Q. So can I ask one follow-up
3 question, just a yes or no?
4 A. Sure.
5 Q. Lee Exhibit 8 depicts the
6 insulating layer you identify for purposes
7 of your obviousness analysis for the '666
8 patent, correct?
9 A. Nam --
10 Q. Let me -- let me change the
11 question.
12 A. Sorry exhibit -- sorry -- I
13 forgot what the number is. 1006.
14 Q. Lee Exhibit 6 -- or, sorry.
15 Strike that.
16 Lee Exhibit 8 depicts in blue the
17 insulating layer you rely on in your
18 obviousness analysis for the '666 patent?
19 A. For the prior art Nam.
20 Q. Yes.
21 A. Yes.
22 Q. Okay. Let's take that off the

1 screen for now.
2 And let's pull up Dr. Lee's
3 declaration.
4 Dr. Lee, you offer a third ground
5 in paragraph 351, correct?
6 A. Let me go there.
7 Q. Sure. Let's go to paragraph 351.
8 A. Yes.
9 Q. Your third ground of obviousness
10 is that Lee, when modified in view of Park
11 and knowledge of a POSITA renders
12 Claims 17, 19, and 20 of the '666 patent
13 obvious.
14 A. Yes.
15 Q. You have not offered an opinion
16 that the claims of the '666 patent are
17 anticipated by Lee, correct?
18 A. Some of the claims are taught by
19 Lee, in other words, are expressedly
20 disclosed by Lee -- some of the claim
21 element is disclosed by Lee.
22 For example, 17.3 -- claim

1 limitation 17.B -- sorry, 17.A, 17.B and
2 17.C as well as 17.C.1.
3 Q. Okay.
4 A. And I think those are the ones
5 that are taught by Lee -- oh, and including
6 Claim 19 is also taught by Lee.
7 Q. Okay. Limitation 17.C.2 is not
8 taught by Lee, correct?
9 A. Let me go there.
10 Yeah. That's the only claim
11 limitation that Lee does not teach, so I
12 rely on obviousness to invalidate claim
13 limitation 17.C.2.
14 Q. In your opinion, is
15 Claim 17.C.2 -- is obviousness when Lee is
16 modified in view of Park, correct?
17 A. In paragraph 401, I said that a
18 POSITA would -- would have consider it
19 obvious to make the side surface of Lee
20 second portion of the conductive layer
21 curved in view of Park's teaching.
22 Q. So you rely on the teachings of

1 Park to form a curved side surface in
2 ground three, correct?
3 A. That's right.
4 Q. Okay. Let's pull up Park.
5 Park's Exhibit 1008.
6 A. Okay.
7 (Whereupon, Previously Marked
8 Exhibit 1008 is identified for
9 the record.)
10 BY ATTORNEY WATSON:
11 Q. And let's turn to column 12,
12 line 16.
13 A. Column 12, line what?
14 Q. 16.
15 A. 16 to...
16 Q. We will go 16 to 23.
17 A. Hold on one second. This is
18 regarding Figure 9B, right?
19 Is there a question?
20 Q. Give me one second. Let me just
21 make sure I have the right question here.
22 A. 9 --

1 Q. Let's go to paragraph 405 of your
2 declaration first, actually.
3 A. Okay. 405.
4 Q. Are you there?
5 A. Yes.
6 Q. "Park explains that it achieves
7 its rounded contact pad by ion implanting
8 impurities into an insulating layer and
9 performing an oxidation step to create an
10 additional sacrificial layer having a
11 higher etching rate than the surrounding
12 insulation"?
13 A. Right. That's what I read --
14 written there.
15 Q. So in Park, the oxidation is
16 performed on the sacrificial layer
17 patterns, correct?
18 ATTORNEY HERMAN: Objection.
19 Form.
20 THE WITNESS: This is --
21 BY ATTORNEY WATSON:
22 Q. Let me direct your attention to

1 column 12, line 6. Actually, column 12,
2 line 9, starting there, that sentence.
3 I'll give you a second to read it.
4 A. Okay. In Figure 9B, right?
5 Q. Uh-huh.
6 A. Line what?
7 Q. Line -- let's go to line 16.
8 A. Okay. I thought you said that.
9 Q. Sorry. I must have misspoken.
10 Yeah, line 16.
11 A. Yes.
12 Q. "In Park, the oxidation is
13 performed on the sacrificial layer
14 patterns," correct?
15 ATTORNEY HERMAN: Objection.
16 Form.
17 THE WITNESS: So Figure 9D, it
18 shows that Park formed additional
19 insulating layer 66 -- right? -- by
20 thermally oxidizing the exposed surface
21 on the top as well as the side surface
22 of the sacrificial layer pattern 62A,

1 B, C, D, E, F that are not covered by
2 the interlayer insulating layer 52A,
3 52B, 52C all the way to 52F.
4 BY ATTORNEY WATSON:
5 Q. So Park --
6 A. Yeah, so Park used thermal
7 oxidation to form the additional insulating
8 layer 66.
9 Q. So Park thermally oxidizes the
10 exposed surface of the sacrificial layer
11 patterns to form the additional insulating
12 layer 66, correct?
13 A. That is what I just said, yes.
14 And the oxidation process can round off one
15 end of the additional insulating layer 66.
16 Q. Okay. Now let's go to the bottom
17 of column 11, the last sentence where it
18 starts, "The sacrificial layer patterns."
19 Do you see that?
20 A. Sorry. Sorry. Let me go there.
21 The last paragraph -- last --
22 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

1 material that can selectively etch relative
2 to silicon dioxide, I think such as silicon
3 nitride or polysilicon.
4 So you're right that the
5 interlayer insulating layer pattern 52A
6 through 52F are made of silicon dioxide
7 whereas the sacrificial layer 62A to 62F
8 are made of either silicon nitride or
9 polysilicon.
10 Q. How is the silicon nitride or
11 polysilicon oxidized in Park's process?
12 A. Well, let's see. There's a
13 Figure 9B.
14 Well, when you expose polysilicon
15 to oxygen, it will oxidize. And so that's
16 how you can oxidize the sacrificial layer
17 such as polysilicon.
18 Is that what you -- what you're
19 asking?
20 Q. Sure. So let me try the question
21 this way.
22 In Park, the sacrificial layers

1 are oxidized by applying an oxygen gas to
2 the sacrificial layers?
3 A. One can do that, yes.
4 Q. And by applying the oxygen gas to
5 the silicon nitrate in Park, that layer is
6 then oxidized to form silicon dioxide,
7 correct?
8 A. Yes.
9 Q. Now let's turn to Figure 9B real
10 quick of Park.
11 Are you there?
12 A. Yes.
13 Q. In Figure 9B, none of the
14 sacrificial layers are being removed by
15 adding the oxidant, correct?
16 A. None of the what?
17 ATTORNEY HERMAN: Objection.
18 Form.
19 BY ATTORNEY WATSON:
20 Q. None of the sacrificial layers --
21 let me repeat the question.
22 In Figure 9B, none of the

1 sacrificial layers are being removed by
2 adding the oxidant, correct?
3 A. What do you mean by "removed"?
4 Q. Well, does adding an oxidant
5 remove an insulating layer?
6 A. It's not an insulating layer.
7 It's -- it's a polysilicon layer. The
8 sacrificial layer is polysilicon.
9 Are you asking during the --
10 during the oxidation, whether the
11 polysilicon such as 62A through 62F, would
12 it be consumed? Is that what you're
13 asking?
14 Q. Yes.
15 A. It will be consumed. So this
16 picture, it's just showing a cartoon photo,
17 cartoon illustration. But when you expose
18 a silicon region -- right? -- to oxygen
19 such as what you shown here, polysilicon is
20 simply a silicon region just like a silicon
21 substrate.
22 When you expose to oxygen,

1 silicon plus oxygen would form SiO2. But
2 where does the silicon come from? The
3 silicon is coming from the silicon
4 substrate and in this case is coming from
5 the polysilicon line and so, therefore, the
6 oxygen is actually react with the silicon
7 to form SiO2.
8 So, therefore, when you grow an
9 oxide such as you -- let's say you form a
10 hundred angstroms of oxide. 40 percent
11 is -- around 40 percent is actually consume
12 in the original silicon layer.
13 And then 60 percent is grow on
14 top. So, therefore, to answer your
15 question, yes, some of the polysilicon
16 layer is consumed. Because in order to
17 have the reaction of silicon plus O2 equal
18 to SiO2, the silicon got to come from
19 somewhere.
20 And that silicon is coming from
21 the polysilicon layer.
22 Q. Let's go to paragraph 236 of your

1 declaration.
2 A. Okay. Let me find it. 236.
3 Yep.
4 Q. So you claim in 236 that, "Park
5 details how oxidation and ion implantation
6 is used to form a raised pad portion with
7 rounded sides [as read]." Correct?
8 A. Yes.
9 Q. Now, you also say, "In
10 particular, an additional sacrificial
11 layer 44 with a desired rounded shape is
12 formed by both an oxidation process and ion
13 implanting impurities 42 into an additional
14 insulating layer 40," correct?
15 A. Okay. This -- this is regarding
16 which -- which figure is this?
17 Q. Which figure are you referring to
18 in paragraph 236?
19 A. I'm trying to see. Figure 6D.
20 Q. Okay. So based on what you said
21 in paragraph 236, Park requires the use of
22 both oxidation and ion implantation to form

1 the rounded surfaces, correct?
2 A. Right. The implantation is
3 adjusting the -- so first Park oxidize the
4 sacrificial layer to grow additional
5 sacrificial layer 44 and, therefore, would
6 have a rounded profile due to the oxidation
7 mechanism, faster oxidation in the convex
8 etches, okay?
9 And then Park implant impurity 42
10 in the -- in the additional insulating
11 layer 40, which has a higher etch rate
12 compared to the surrounding oxide.
13 And --
14 Q. Let me -- oh, sorry.
15 A. So the oxidation is achieved -- a
16 rounded profile, and the implantation is to
17 adjust the etch rate, subsequent etch rate.
18 Q. Let's -- let's go turn now -- I
19 want to talk a little bit about Lee, okay?
20 Are you with me? Do you know what I'm
21 referring to --
22 A. Are you talking about ground 3?

1 Q. Ground 3, yes.
2 A. Okay. Go ahead.
3 Q. Okay. Lee is what's marked as
4 Exhibit 1007. So let's pull that up real
5 quick.
6 (Whereupon, Previously Marked
7 Exhibit 1007 is identified for
8 the record.)
9 THE WITNESS: Can you upload
10 that, please? Unless you don't think
11 it's necessary.
12 BY ATTORNEY WATSON:
13 Q. We're going to actually go more
14 to your declaration, if that's okay. I
15 just want to have this available for you.
16 Can you turn to your declaration
17 in paragraph 390.
18 Are you there?
19 A. Not yet.
20 Okay.
21 Q. Okay. In paragraph 390, you
22 describe -- or starting at 389, you

1 describe the process Lee uses to form the
2 pad, correct?
3 A. Yes.
4 Q. Okay. In paragraph 391, you say,
5 "The layers 21, which will eventually be
6 replaced by Lee's conductive layers are
7 formed of materials having a high etch
8 selectivity with respect to the second
9 material layers 22."
10 Do you see that?
11 A. Yes. That's what I -- yeah.
12 Q. So material layer 21 will
13 eventually become a conductive layer,
14 correct?
15 A. Hold on. Let me go there.
16 Sorry.
17 390...
18 Okay.
19 Q. So the conductive layer 21 will
20 eventually be -- strike that. Let me --
21 let me go -- try that again.
22 The material layer 21 will

1 eventually become the conductive layer,
2 correct?
3 A. Yes. That's what I said in
4 paragraph 90.
5 Q. And in paragraph 391 of your
6 declaration, you say that the second
7 material layers 22 are an insulating layer
8 such as an oxide layer?
9 A. That's right.
10 Q. So the insulating layer simply
11 include an oxide?
12 A. Yes.
13 Q. And then paragraph 392, you say,
14 "Lee then employs an ion implantation
15 process to implant impurity regions 23 into
16 the insulating layers 22" --
17 A. Yes.
18 Q. -- correct?
19 A. Yes.
20 Q. Then let's go to paragraph 385 --
21 or 395.
22 A. 395, okay.

1 Q. Yeah. You say, "Then, Lee etches
2 layers 21 using an isotropic etch step"?
3 A. Right.
4 Q. "Then Lee performs a second wet
5 etch step to remove the impurity regions 23
6 to form recessed regions RC between the
7 remaining portions of the insulating layers
8 22 [as read]," correct?
9 A. Okay.
10 Q. All right. Now let's go to
11 paragraph 397 to your declaration.
12 Are you there?
13 A. Yep.
14 Q. Okay. Now, after you perform
15 these steps, openings are formed as shown
16 in Figure 5B of Lee, correct?
17 A. Okay.
18 Q. Is that right?
19 A. That's what I written there.
20 Q. Now let's turn to paragraph 411
21 of your declaration.
22 A. 411, yes.

1 Q. Okay. In paragraph 411, you
2 state in the last sentence, "To achieve a
3 rounded, rather than straight-sided contact
4 pad, oxidant would be introduced into the
5 openings."
6 A. Yes.
7 Q. Okay. So per your opinion, a
8 person of ordinary skill in the art would
9 be able to form a rounded side by
10 introducing oxidant into the openings shown
11 in Figure 5B of Lee, correct?
12 A. Yes.
13 Q. Okay. Let's go up to
14 paragraph 397 of Lee -- of the declaration.
15 Sorry.
16 Are you there?
17 A. Yep, I'm there.
18 Q. Paragraph 397 shows Figure 5B of
19 Lee, correct?
20 A. Yes.
21 Q. Where are the openings in
22 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.

1 So just because you have a solid
2 oxide doesn't mean that you cannot further
3 increase the thickness by thermal
4 oxidation.
5 Q. What are the conditions necessary
6 to oxide a solid oxide?
7 ATTORNEY HERMAN: Objection.
8 Form.
9 THE WITNESS: It just like
10 anytime you have heat and introducing
11 oxidants such as O2 or O3 ozone, you
12 can also use plasma -- plasma enhance
13 oxidations. You can use, you know,
14 simple thermally -- thermal oxidations.
15 Just expose the opening with oxygen.
16 Just because you have no oxide
17 region doesn't mean that you cannot
18 oxidize further.
19 BY ATTORNEY WATSON:
20 Q. So it's your testimony that you
21 can oxidize a solid oxide using oxygen gas?
22 A. I do that all the time in my lab.

1 You have a thin oxide, you want to grow
2 more, so you expose it to oxygen. And that
3 it will grow oxide. Simple as that.
4 Q. What if you --
5 A. Sure.
6 Q. So in order to oxidize a solid
7 oxide using oxygen gas, you need to start
8 with a thin oxide to begin with?
9 ATTORNEY HERMAN: Objection to
10 form.
11 THE WITNESS: Well, no, not
12 necessary. Depending on the thin of
13 the oxide, obviously you can oxidize
14 much more easily. The thicker oxide
15 you can still oxidize as long as you
16 given enough time and temperature.
17 It's explained in any textbook in
18 semiconductor fabrications in
19 undergraduate classes or graduate
20 classes. I taught it at UT, and I
21 taught it in short courses in industry.
22 It's a very simple process.

1 BY ATTORNEY WATSON:
2 Q. Did you cite any of those
3 textbooks in your declaration?
4 A. It's a very well-known oxidation
5 process. And it is -- it's a simple
6 oxidation process as anyone, a person of
7 ordinary skill in the art would understand
8 it when you expose a region with oxygen, it
9 will oxidize.
10 Q. Did you cite to any exhibits to
11 support your position that when you expose
12 a region to oxide, it will oxidize even if
13 that region is already a solid oxide?
14 ATTORNEY HERMAN: Objection.
15 Form.
16 THE WITNESS: You make it sound
17 like an oxide cannot be further
18 oxidized. And a person of ordinary
19 skill in the art would -- so think
20 about this. Think about it,
21 Mr. Watson.
22 When you grow an oxide on

1 silicon, you didn't start out with any
2 oxide, let's say. And you grow an
3 oxide and you want it to be a hundred
4 angstroms. When you grow the oxide,
5 halfway is 50 angstroms -- you already
6 have 50 angstroms, and you still
7 continue to grow 200 angstroms.
8 Wow. How do you do that? So
9 think about it. Let's say you grow an
10 oxide on top of silicon substrate. You
11 grow an oxide to 50 angstroms and you
12 continue to grow to 100 angstroms or
13 you grow an oxide to 50 angstroms
14 bringing down to the -- bringing -- out
15 the chamber, exposure to air, brought
16 it back in, you continue to grow it
17 just like what you have done earlier.
18 So you don't need any -- I don't
19 need any exhibit or prior art or
20 textbook to explain this. This is a
21 simple thermal oxidation process.
22 Otherwise are you saying that

1 when you growing the oxide on the plain
2 silicon substrate, it will be -- there
3 will be a limit? You can't grow any
4 thicker once you grow a certain
5 thickness. That's ridiculous.
6 BY ATTORNEY WATSON:
7 Q. I didn't ask most of that.
8 I just wanted to know: Did you
9 cite an exhibit in your declaration to
10 support your position that you could
11 thermally oxidize an oxide?
12 A. You don't need to. I don't need
13 to, because this is as simple as one plus
14 one.
15 Q. Okay.
16 A. A person of ordinary skill in the
17 art would understand that when you grow a
18 thermal oxide, when you expose the oxygen,
19 it will grow an oxide depending on
20 temperature and depending on the
21 concentration of oxygen and depends on how
22 long you -- you leave the wafer in the

1 chamber.
2 Q. What is formed when you oxidize
3 silicon dioxide?
4 A. Silicon dioxide, that is what is
5 form.
6 Q. So if you already are silicon
7 dioxide, you're further oxidizing it into
8 more silicon dioxide?
9 A. Yes. Again, think about it.
10 When you have a plain substrate, you expose
11 to oxygen halfway to 50 angstroms. It's
12 not going to stop or it's not gonna be
13 like, oh, you already have a solid oxide,
14 how can you -- how can you grow even
15 further?
16 You have oxide that's 100
17 angstrom, 3,000 angstrom, easily in the
18 semiconductor integrated circuit.
19 So just because you have a
20 solid -- you call it solid -- yeah, it's a
21 solid oxide doesn't mean that you cannot
22 further oxidize that layer.

1 Q. So what would the chemical
2 equation be for that oxidation?
3 A. Same as before. You react a
4 silicon with oxygen to form SiO2. And that
5 silicon exist in silicon dioxide and also
6 exist in the underlying substrate.
7 Q. So if I started with silicon
8 dioxide and I added oxygen to it, what
9 would the end product be? Silicon dioxide?
10 A. Silicon dioxide, yes.
11 Q. Okay. All right.
12 A. And -- and as I explained in the
13 paragraph 412 and 413, I explain why that
14 the oxidation not only depends on how
15 fast -- how much -- what the temperature is
16 and how long you leave it in, but also
17 depends on the topography of the substrate.
18 If it is a corner, depends on
19 whether it's exterior corner or interior
20 corner. It will oxidize faster and slower
21 compared to what? Compared to the planar
22 surface on the substrate.

1 In other words, that differential
2 in oxidation rate at the corner versus the
3 planar surfaces causes both type of corners
4 to round off.
5 And that's what I tried to
6 explain in paragraph 413. And that as I
7 explained early in the deposition, that
8 drawing could have been drawn more
9 accurately. And I didn't intend it to
10 imply the corner would be --
11 (Stenographer requests
12 clarification and colloquy will
13 not be captured on the written
14 record.)
15 THE WITNESS: Eaten away by the
16 oxidation process. I just want to
17 try -- I was trying to show that the
18 shape of the corner would be curved.
19 BY ATTORNEY WATSON:
20 Q. Oxidation is an additive process,
21 correct?
22 A. It is, yes.

1 ATTORNEY WATSON: Okay. All
2 right. Let's take a break. I'm just
3 about wrapped up. So if I have
4 questions, it will be a few last
5 questions. Let's take a break right
6 now.
7 THE STENOGRAPHER: Okay. We're
8 off the record.
9 (Whereupon, a recess was taken at
10 4:51 p.m.)
11 (Whereupon, Exhibit 9 is marked
12 for identification.)
13 THE STENOGRAPHER: All right.
14 We're on the record.
15 BY ATTORNEY WATSON:
16 Q. Dr. Lee, did you discuss the
17 substance of your testimony with anyone
18 during the break?
19 A. No.
20 Q. Okay. I'm putting on the screen
21 what's been marked as Lee Exhibit 9.
22 Do you see that?

1 A. Yes. That's what you showed
2 earlier.
3 Q. Uh-huh. The insulating layer is
4 labeled in blue, correct?
5 A. Yes.
6 Q. Where is the top surface of
7 insulating layer?
8 A. Well, it is 271, that what you
9 drawn up there.
10 Q. Do you mind if I do some drawing
11 real quick?
12 Is the top layer of the
13 insulating layer what I've drawn in green
14 here?
15 ATTORNEY HERMAN: Objection.
16 Form.
17 THE WITNESS: Again, the
18 insulating layer is a
19 two-dimensional -- a three-dimensional
20 structure, and you're drawing a
21 one-dimensional line.
22 And the reason why 248 and 271

1 are together and meet the claim
2 limitations of insulating layer,
3 because those two pieces together
4 cooperate to define the contact holes.
5 BY ATTORNEY WATSON:
6 Q. Now, this green line, if you
7 extended it in the y-plane, would that be
8 the top surface of the insulating layer?
9 A. So we don't have the -- Nam did
10 not provide, if I -- Nam did not provide
11 any three-dimensional picture, I don't
12 think. I don't -- I don't recall.
13 Q. What -- what is the side surface
14 of insulating layer in Nam?
15 A. Well, it depends on what the --
16 depends on what the design of the structure
17 is. And so without talking about --
18 without having the three-dimensional
19 picture, I'm not sure if -- if one can
20 determine what the side is.
21 Because that really depends on
22 whether the entire pad take over -- took

1 over the -- the entire conductive layer.
2 So to answer your question, a
3 person of ordinary skill in the art, I
4 don't think -- I don't think that Nam
5 describe the three-dimensional
6 illustrations of what this structure look
7 like.
8 Q. Oh, okay.
9 So in Exhibit -- or strike that.
10 In Figure 8A, you cannot identify
11 the side surface of insulating layer,
12 correct?
13 ATTORNEY HERMAN: Objection.
14 Form.
15 That's inconsistent with the
16 witness's testimony.
17 THE WITNESS: Figure 8A shows a
18 two-dimensional cross-section of a
19 three-dimensional structure.
20 So unless information have been
21 given on what the -- what the
22 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

1 to do anything. I'm trying to get him
2 to answer my question, and he's not
3 been doing it.
4 ATTORNEY HERMAN: Yes, he has.
5 ATTORNEY WATSON: So let me ask
6 this last question.
7 ATTORNEY HERMAN: You're not
8 being clear.
9 BY ATTORNEY WATSON:
10 Q. Dr. Lee, let me ask you this
11 question --
12 A. Mr. Watson, actually, your
13 question does not make sense at all. I
14 already discuss side surface, and now you
15 twist it around and say the side surface in
16 the certain -- certain plane.
17 The -- I already discuss how the
18 side surface is curved in my declaration
19 and especially Nam. So I don't understand
20 the confusing question that you have.
21 Q. Well, this is my last question,
22 so we'll end with this, okay? Are you

1 ready? That wasn't my last question,
2 but...
3 A. Okay. Oh, you already asked a
4 question, you ready.
5 Q. In this Lee Exhibit 9, can you
6 identify the bottom surface of the
7 insulating layer?
8 A. And what do you mean by the
9 "bottom surface"? The blue regions shows
10 the bottom follow the contour of the
11 contact pad.
12 Is that what you mean?
13 Q. Sure.
14 A. Well, if that's what you mean,
15 then the bottom of the layer is following
16 the contour of the blue region. Your
17 question is very confusing.
18 ATTORNEY WATSON: Okay. That's
19 my last question, unless, Patrick, you
20 have any --
21 ATTORNEY HERMAN: No, I don't
22 have any further questions.

1 ATTORNEY WATSON: Okay. Thank
2 you so much, Dr. Lee. I appreciate
3 your time.
4 THE WITNESS: Thank you.
5 ATTORNEY WATSON: Patrick, thank
6 you for your time as well.
7 THE STENOGRAPHER: We're off the
8 record.
9 (Time noted: 5:04 p.m.)
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1 REPORTER CERTIFICATE
2 I, the undersigned, do hereby certify:
3
4 That JACK C. LEE, PH.D., the witness
5 whose Deposition is hereinbefore set forth, was duly
6 sworn by me before the commencement of such deposition
7 and that such deposition was taken virtually and is a
8 true record of the testimony given by such witness.
9
10 I further certify that the adverse party,
11 MICRON TECHNOLOGY, INC., was represented by counsel at
12 the deposition.
13
14 I further certify that the deposition of
15 JACK C. LEE, PH.D., occurred virtually, on
16 Wednesday, August 13th, 2025, from 9:01 a.m. to 5:04
17 p.m..
18
19 I further certify that I am not related to any
20 of the parties to this action by blood or marriage, I am
21 not employed by or an attorney to any of the parties to
22 this action, and that I am in no way interested,

1 financially or otherwise, in the outcome of this matter.
2
3 IN WITNESS WHEREOF, I have hereunto set
4 my hand this 17th day of August, 2025.
5
6 _____
7 JESSICA R. WAACK
Registered Diplomate Reporter
8 Certified Realtime Reporter
New York Realtime Court Reporter
9 New York Association Court Reporter
Notary Public, State of New York
10 CCR-NJ (No. 30XI008238700) CSR-TX (No. 11958)
CCR-WA (No. 21007264), CSR-CA (No. 14420)
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