

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICRON TECHNOLOGY, INC.,
Petitioner

v.

YANGTZE MEMORY TECHNOLOGIES COMPANY, LTD.,
Patent Owner

Case No. IPR2025-00189
U.S. Patent No. 11,145,666 B2

VIDEOTAPED DEPOSITION OF KONSTANTINOS P. GIAPIS

APPEARING VIA VIDEOCONFERENCE FROM

LOS ANGELES, CALIFORNIA

WEDNESDAY, NOVEMBER 12, 2025

9:23 A.M. - 12:56 P.M.

STENOGRAPHICALLY REPORTED BY:
CHERYL ASADA
CA CSR NO. 13496
JOB NO. 2025-1004078

DEPOSITION OF KONSTANTINOS P. GIAPIS,
APPEARING VIA VIDEOCONFERENCE FROM LOS
ANGELES, CALIFORNIA, TAKEN ON BEHALF OF
PLAINTIFF, COMMENCING AT 9:23 A.M. AND
CONCLUDING AT 12:56 P.M. WEDNESDAY,
NOVEMBER 12, 2025, BEFORE CHERYL ASADA,
CALIFORNIA CERTIFIED SHORTHAND REPORTER
NO. 13496.

* * *

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I N D E X

W I T N E S S :

KONSTANTINOS GIAPIS

PAGE

EXAMINATION BY MR. HERMAN

4

I N F O R M A T I O N R E Q U E S T E D :

(N O N E)

Q U E S T I O N S I N S T R U C T E D N O T T O A N S W E R :

(N O N E)

E X H I B I T S

N U M B E R

D E S C R I P T I O N

P A G E

Exhibit 1001

U.S. Patent No. 11,145,666

10

Exhibit 1005

U.S. Patent No. 10,229,929

61

Exhibit 1006

U.S. Patent Application No.
US 2018/0026046 A1

69

Exhibit 2008

Silicon VLSI Technology by
James Plummer, Michael Deal,
and Peter Griffin

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Exhibit 2023

Declaration of Konstantinos
Giapis In Support of Patent
Owner's Response

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HELD VIA VIDEOCONFERENCE

WEDNESDAY, NOVEMBER 12, 2025

9:23 A.M. - 12:56 P.M.

* * *

THE COURT REPORTER: In accordance with
AB 3252, we are on the record. My name is Cheryl Asada,
CSR No. 13496. I will now swear in the witness.

KONSTANTINOS GIAPIS,
HAVING BEEN DULY ADMINISTERED AN OATH,
WAS THEREUPON EXAMINED AND TESTIFIED AS FOLLOWS:

THE WITNESS: I do.

THE COURT REPORTER: Thank you.

EXAMINATION

BY MR. HERMAN:

Q. Good morning. Do you mind please stating your
name for the record.

A. Good morning. My name is Konstantinos Giapis,
K-o-n-s-t-a-n-t-i-n-o-s; last name G-i-a-p-i-s.

Q. And would you prefer to be referred to as -- as
Mr. Giapis? Dr. Giapis? Professor Giapis?

Do you -- do you have a preference?

A. Professor Giapis.

Q. Okay. Thank you.

1 A. If possible. Thank you.

2 Q. So, Professor Giapis, have you been deposed
3 before?

4 A. Yes, I have.

5 Q. And many times?

6 A. What does "many" mean?

7 Q. More than ten. Have you been deposed more than
8 ten times?

9 A. Probably more than ten, yes.

10 Q. So regardless of that past experience, I'm
11 going to go through a few basic ground rules just to make
12 sure that we're on the same page here today.

13 The first is that it's important that we not
14 talk over each other so that the reporter has a clear
15 record. So I'll try to do my best to wait for you to
16 finish answering before asking another question. And I
17 ask that you wait until I'm done with my question before
18 answering and -- and then pause for a moment before
19 providing your answer to give your attorney time to
20 object.

21 Is that okay?

22 A. That's fine, yes.

23 Q. Next, you're entitled to a question you
24 understand. So if anything I ask is unclear, please let
25 me know. Otherwise, I'll assume we're on the same page.

1 Is that okay?

2 A. That's okay, too.

3 Q. Next, I ask that you not look at anything
4 during the deposition besides the documents that I give
5 you, which I have given you already. And if you do look
6 at anything else, I ask that you tell me.

7 Is that okay?

8 A. That's okay, too, yes.

9 Q. And I ask that you have no side conversations
10 or use technology to chat or communicate with anyone
11 during the deposition.

12 Is that okay?

13 A. That's okay, too.

14 Q. Now, is there anything that would prevent or
15 interfere with your ability to testify today?

16 A. Well, as I -- as my counsel mentioned, I have
17 this slight vision problem right now. When I see you,
18 there is a dark cloud that goes in front of my eyes. And
19 so I see you now and then I see you not a second later.

20 So that makes it very difficult for me to read
21 anything. It usually goes away after 30 minutes to an
22 hour. It happens, you know, periodically to me. And my
23 ophthalmologist has no answer to that effect, but it just
24 happened, and I should be fine in 30 minutes to an hour.

25 So with -- with the exceptions of that, you

1 know, so -- so for that, I may need, in the beginning,
2 more time if you ask me to read anything or if I need to
3 read anything to sort of figure out, you know, what I am
4 and what it is that I'm reading.

5 Q. Okay. So I will do my best to -- to read
6 verbally to you what I'm referring to --

7 A. Okay.

8 Q. -- in the hopes that that helps, and you will
9 have copies of the documents. So take the time that you
10 need to -- to look at them and review them.

11 A. Thank you. I also want to add, since we talk
12 about documents, that I have a hardcopy of my
13 deposition -- of my declaration, which is unmarked,
14 freshly copied. And I may use this instead of the
15 screen, especially in the beginning.

16 Q. That's completely fine. So just please refer
17 to that if it's easier for you.

18 A. Thank you.

19 Q. Now, moving on. You have authored two
20 declarations in this proceeding. Correct?

21 A. I believe that is correct.

22 Q. Now, one of those predates the board's
23 institution decision, and another came after that
24 institution decision. Correct?

25 A. I believe that is correct.

1 Q. Now, the paper document you have in front of
2 you, is that designated Exhibit 2023?

3 A. Yes, that's what I read on the front page.

4 Q. And what is Exhibit 2023?

5 A. Well, as it say -- as it's written on the first
6 page, it's a Declaration of Konstantinos Giapis in
7 Support of Patent Owner's Response.

8 Q. And that's your second, more recent declaration
9 in this proceeding. Correct?

10 A. Yes, that is correct.

11 Q. And the declaration relates to U.S. Patent
12 Number 11,145,666. Correct?

13 A. That's what's written on the cover page. So,
14 yes, that is correct.

15 Q. Is it okay if today I refer to that patent as
16 the '666 patent?

17 A. That's fine.

18 (Exhibit 2023 was marked for
19 identification.)

20 BY MR. HERMAN:

21 Q. Is it okay if I refer to Exhibit 2023 as your
22 '666 patent declaration?

23 A. That's fine, too.

24 Q. Or occasionally, your declaration. Is that
25 fine?

1 A. It is if you don't ask me anything from my
2 first declaration. If you do that, then you have to
3 specify -- you have to make it clear that's what you're
4 asking.

5 Q. I don't intend to ask about your first
6 declaration. We'll only be referring to this
7 declaration, Exhibit 2023 today.

8 So with that proviso, would it be okay if I
9 refer to Exhibit 2023 as your declaration?

10 A. That's perfectly fine. Thank you.

11 Q. Now, is there anything in your declaration that
12 you believe to be inaccurate?

13 A. Well, as I sit here today, I don't know of
14 anything that is inaccurate. There may be typos that I
15 didn't catch, multiple readings. You know, I have
16 learned, in my professional career, that there is no
17 perfect document. But as I sit here today, this
18 declaration contains all my positions and I believe it is
19 accurate.

20 Q. Okay. And, again, declaration relates to the
21 '666 patent. Correct?

22 A. I believe I answered that.

23 Q. Yeah.

24 A. But, yes.

25 Q. Now, another of the exhibits I've -- I've given

1 you is Exhibit 1001. If you could take a brief look at
2 that.

3 A. Yes, I opened 1001.
4 (Exhibit 1001 was marked for
5 identification.)

6 BY MR. HERMAN:

7 Q. Now, that's the '666 patent. Correct?

8 A. That's what the first page indicates.

9 Q. And it's the '666 patent that you reviewed in
10 connection with your declaration. Correct?

11 A. Yes, that is correct.

12 Q. Now, I'd like you to get your declaration back
13 out again. That's Exhibit 2023. And, again, the paper
14 copy is fine.

15 A. Okay. Then I have it in front of me.

16 Q. And if you could turn to Paragraph 32 of your
17 declaration, which starts on the page that's labeled 15.

18 A. Yes, I'm there.

19 Q. Now, that Paragraph 32 continues on to Page 16.
20 Correct?

21 A. Yes, it does.

22 Q. And I'd like to draw your attention to -- to
23 the first full sentence on Page 16, and that reads that:

24 "A dielectric material is then
25 deposited onto the staircase structure so

1 that the ensuing 'Layer 620 has poor step
2 coverage on staircase structure 500.'

3 Do you see that sentence on Page 16?

4 A. Yes, I see that sentence.

5 Q. So that -- that sentence refers to Layer 620.

6 Correct?

7 A. Yes, it does.

8 Q. Now, that Layer 620 eventually becomes the
9 '666 patent's landing pads after further processing
10 steps. Right?

11 A. That's right, yes.

12 Q. So the next sentence reads:

13 "A POSITA" -- P-O-S-I-T-A -- "would
14 have understood what the '666 patent
15 meant by 'poor step coverage.'"

16 Do you see that sentence?

17 A. Yes, I see that sentence.

18 Q. The sentence following that reads:

19 "The term describes the non-conformal
20 profile of the layer deposited on
21 patterned surfaces when the flux of
22 reactive gas [sic] molecules arriving at
23 the patterned surface has both a
24 directional and an isotropic component."

25 Right?

1 MR. WATSON: Objection. Misstates the
2 document. Form.

3 THE WITNESS: Please repeat the question.

4 BY MR. HERMAN:

5 Q. So the -- the next sentence reads:

6 "The term describes the non-conformal
7 profile of the layer deposited on
8 patterned surfaces when a flux of
9 reactive gas [sic] molecules arriving at
10 the patterned surface has both a
11 directional and an isotropic component."
12 Do you see that sentence?

13 MR. WATSON: Objection. Form. Misstates
14 document.

15 MR. HERMAN: Did I read it wrong twice?

16 MR. WATSON: You did, that's why.

17 MR. HERMAN: I'm not going to try a third time.

18 MR. WATSON: Yeah, it's okay.

19 MR. HERMAN: Did I get it, basically, right,
20 the sentence?

21 MR. WATSON: Mostly.

22 BY MR. HERMAN:

23 Q. Do you see that sentence, Professor?

24 A. Yes, I see that sentence.

25 Q. So what -- what do you mean when you use the

1 word "directional" in that sentence?

2 A. To grow a layer on a surface using gas-phase
3 techniques you need to bring molecules that contain the
4 components of the layer down onto the surface and have
5 them react with the surface and incorporate into the
6 surface, become part of the surface. As these things
7 accumulate, that's how you build up the layer.

8 The direction of motion of these gas-phase
9 molecules, as they arrive on the surface, matters not
10 only in terms of the position rate and reactions on the
11 surface, but also in terms of were these molecules --
12 what can happen to these molecules if you have patterned
13 surfaces.

14 So on an absolutely flat surface, generally,
15 the only thing that matters is the directionality of
16 these molecules. On -- on a patterned surface, there are
17 other things that come into play.

18 But, basically, the bottom line here, in -- in
19 very general terms, is -- is that the direction of the
20 molecules affects the profile that you will get on -- the
21 topographic profile that you get on a surface, depending,
22 again, on -- on what is on the surface.

23 So -- so this -- this sentence, basically,
24 distinguishes between a directional component and an
25 isotropic component. The directional component means

1 that there is ballistic motion of the molecules.

2 The isotropic component means that the
3 directions change. So by the time they arrive on the --
4 on the surface, they can actually have different angles
5 of approach. So I know this is a little bit complicated.

6 So the way a person of ordinary -- ordinary
7 skill would understand this term and the way I teach in a
8 class that I teach it at Cal Tech, is that the direction
9 of motion of the molecules matters in terms of the
10 deposited layer and in terms of the profile of that layer
11 in a complex surface topography.

12 And the two extremes in that motion is, you
13 know, whether something is moving in a straight line or
14 whether something is encountering a lot of collisions
15 that can change its -- its direction and trajectory.

16 Does it make sense?

17 Q. So would it be fair to say that the term
18 "directional" refers to gas-phase molecules that are
19 arriving at a surface in one direction, whereas isotropic
20 is referring to gas-phase molecules arriving at a surface
21 from many possible directions?

22 MR. WATSON: Objection. Form.

23 THE WITNESS: Please repeat the question.

24 BY MR. HERMAN:

25 Q. So it would be fair to say that the word

1 "directional" in this sentence refers to gas-phase
2 molecules arriving at a surface from one direction,
3 whereas the word "isotropic" in this sentence refers to
4 gas-phase molecules arriving at a surface from different
5 directions?

6 MR. WATSON: Objection. Form.

7 THE WITNESS: Well, that's a very simplistic
8 way of actually describing it. Sort of one way to -- a
9 limited way, actually, to describe it, but perhaps is
10 more comprehensible, is to try to understand what is
11 happening in a specific deposition system, layer
12 deposition system.

13 So the gas molecules exist in the gas phase,
14 they're supplied in the gas phase, in a chamber where one
15 places the -- the -- the substrate onto which one wants
16 to deposit materials. And these -- these gas-phase
17 molecules collide with each other, and that changes their
18 trajectory.

19 And how fast they collide depends on -- on the
20 pressure. And the pressure, basically, also determines
21 how long they travel before they collide with each other.
22 But each collision changes their trajectory or can change
23 their trajectory.

24 So if you have really very many collisions, as
25 it happens at high pressures, then you are in a situation

1 that I call perfectly isotropic motion of the molecules.
2 In that case, they go to all directions with equal
3 probability. That's what it means, isotropic.

4 Directional means that you do something to them
5 so they can traverse longer distances without collision
6 so that they obtain that directionality. So that's,
7 basically, what this distinction implies.

8 Now, how they arrive on the surface is a more
9 complicated matter because then, it depends what it is --
10 what it is that they are. If they are ionized, for
11 example, as it happens in plasma-assisted CVD chambers or
12 chambers where you have iron, such as physical vapor
13 deposition involving Megatron, Megatron plasmas, then --
14 you know, then that directionality can translate into --
15 onto the surface.

16 So, in other words, you begin in the gas-phase,
17 you extract these ions because they have charge and you
18 can pull them and you can direct them perpendicularly
19 towards the surface. Even this is extreme because some
20 of them will encounter collisions and -- and their angle
21 of motion will actually change a little bit.

22 But -- but -- so this is one distinction where
23 you have a directional component from the gas-phase
24 translating into a specific angle of approach onto the
25 surface. If you have perfectly isotropic component,

17

1 then, you know, you cover all the angles of approach on
2 the surface. So molecules will impinge on the surface in
3 every direction, including some of them flying actually
4 parallel to the surface.

5 Q. Do you know of an example deposition techniques
6 that would entail that type of deposition? And by "that
7 type of deposition," I mean something that approaches
8 perfectly isotropic, like you just referred to.

9 MR. WATSON: Objection. Form.

10 THE WITNESS: Yes, I do. One such technique is
11 high pressure CVD high-pressure chemical vapor
12 deposition.

13 BY MR. HERMAN:

14 Q. Any other techniques?

15 A. Well, another technique very specific to
16 processing is atmospheric pressure chemical vapor
17 deposition. A third technique is atomic layer epitaxy,
18 which actually can be a low-pressure deposition
19 technique, but for other reasons can affect the profile
20 that you're trying to deposit.

21 Q. So isotropic techniques, I believe you just
22 identified high pressure CVD, atmospheric pressure CVD --
23 and you'll have to remind me of the third one, again.

24 A. Atomic layer epitaxy.

25 Q. So anything else you would characterize as

1 isotropic besides those three deposition techniques?

2 A. Well, semiconductor processing has evolved
3 through whatever decades. And, you know, there are
4 trepidations to other techniques that would be considered
5 to be directional, so that they can actually operate
6 under isotropic conditions.

7 So, for example, people frequently use plasmas
8 to break down these gas-phase molecules, which increases,
9 typically, the deposition rate and surfaces. And plasma
10 is, generally, related to more directional fluxes to a
11 substrate. But there are tricks that one can play to
12 prevent that from happening, divert the ions away.

13 In which case, it's only the isotropic
14 component of those plasmas that -- that -- that hits the
15 surface. So you can have a plasma-assisted CVD with
16 special, you know, modifications to the deposition
17 chamber where you can actually take advantage of the
18 bond-breaking properties of the plasma so that you,
19 basically, enhance the deposition of whatever it is that
20 you want to put down without having whatever, you know,
21 problems or benefits are associated with a more
22 directional component.

23 Q. And so even if you use a technique like
24 plasma-enhanced CVD, you can tailor the technique so it's
25 largely isotropic, as opposed to directional, if you were

1 so inclined. Correct?

2 MR. WATSON: Objection. Form.

3 THE WITNESS: Well, for -- you know, you asked
4 me if I know any other techniques. Right? So I gave you
5 one that I consider to be more at the forefront of
6 research. One that, you know, requires really special
7 knowledge of plasmas, more so than just, you know,
8 operating a commercial tool, so that you know what it is
9 that you are doing and how to modify it.

10 But from my perspective, and with my
11 experience, there are ways to actually do that. Now,
12 whether this is something that, you know, a memory
13 manufacturer or microprocessor manufacturer will actually
14 use in practice, that's a different story. That's -- you
15 know, that's at the forefront of -- of processing and
16 research.

17 So it can be done, but it requires really
18 specialized knowledge of, you know, how you manipulate
19 ion trajectory.

20 BY MR. HERMAN:

21 Q. Now, going back to your declaration, we've been
22 looking at Paragraph 32 on Pages 15 and 16. That -- that
23 paragraph continues onto Page 17. Right?

24 A. Yeah, it does.

25 Q. And there's a long sentence on Page 17 that

1 appears immediately before a figure.

2 Do you -- do you see that sentence?

3 A. Yes, I see that sentence.

4 Q. And it reads:

5 "To obtain such profiles, a POSITA
6 must select and optimize specific
7 gas-phase deposition techniques capable
8 of supplying both directional and
9 isotropic fluxes of depositing molecules
10 to the staircase structure, such as
11 plasma-enhanced CVD and directional
12 sputter deposition (PVD) among others."

13 Do you see that?

14 A. Yes, I see that sentence.

15 Q. Now, that sentence uses the word "fluxes."

16 Correct?

17 A. That's correct.

18 Q. The '666 patent does not use the word "fluxes."

19 True?

20 A. Well, if my search function on Adobe Acrobat
21 that I use to open the '666 patent works, it tells me
22 that it cannot find a match.

23 Q. And sitting here today, you don't have any
24 other recollection of the word "fluxes" appearing in the
25 '666 patent. Is that fair?

1 A. Well, I don't have a recollection of -- of that
2 word. But, you know, a person of ordinary skill who
3 tries to deposit any of these layers, including
4 Layer 620, would have known that depositing a layer, you
5 know, is, basically, something that relates to fluxes of
6 species arriving onto the surface.

7 It's -- it's, like, sort of -- you know,
8 it's -- it's -- it's basic knowledge. There is no other
9 way to grow materials from the gas-phase unless you --
10 you have these kind of fluxes arriving onto the surface.

11 Q. And that sentence in Paragraph 32 of your
12 declaration on Page 17 also uses both the words
13 "directional" and "isotropic." Correct?

14 A. That's what it says here.

15 Q. The '666 patent does not use either the word
16 "directional" or the word "isotropic." True?

17 A. Well, the '66 patent [sic] may not use these
18 words, but a person of ordinary skill looking at
19 Figure 6, for example, would immediately understand that
20 these overhangs that you see there and around it,
21 profiles, indicate the presence of both isotropic and
22 directional components in the gas-phase deposition
23 technique used to deposit Layer 620.

24 Q. So -- so in your view, one of ordinary skill in
25 the art looking at the just the pictures in the

1 '666 patent would immediately know that the structure
2 could be achieved using a deposition technique with both
3 directional and isotropic fluxes. Correct?

4 MR. WATSON: Objection. Form.

5 THE WITNESS: So the '666 patent has figures
6 that indicate that the deposited Layer 620 is obtained by
7 having gas-phase deposition techniques that have both
8 isotropic and directional fluxes. But also, the
9 '666 patent talks about a specific shape of Layer 620
10 that is obtained. That's in Column 8, lines 51 to 57,
11 where it talks about poor step-coverage on the staircase
12 structure.

13 And then it repeats it:

14 "For example, the poor step-coverage
15 includes a thickness of dielectric
16 Layer 620 that is substantially thinner
17 at a side of staircase structure 600 than
18 that at the [sic] top surface of
19 staircase structure 600."

20 So, you know, that verbiage there would tell a
21 person of ordinary skill what is going on here and what
22 technique to select so that one can actually obtain some
23 of the surfaces that are discussed in the '666 patent.

24 I teach this in my class. I have had
25 generations of students that have learned that, who have

1 learned to look at profiles and schematics or in images
2 or -- or read, eventually, the -- the correct language
3 to -- to know how to go about it.

4 BY MR. HERMAN:

5 Q. So your answer there, you just pointed to a
6 sentence that begins in Column 8 at line 51. Correct?

7 A. That's correct.

8 Q. And that sentence at Line 51 begins with the
9 clause, "In some embodiments." True?

10 A. Yes, that's true.

11 Q. Now, if you could get out Exhibit 2008, which I
12 believe you should have already. Let me know when you
13 have that available.

14 A. Yes, I opened it.

15 Q. What is Exhibit 2008?

16 (Exhibit 2008 was marked for
17 identification.)

18 THE WITNESS: It's a textbook by Plummer, Deal,
19 and Griffin called "Silicon VLSI Technology."

20 BY MR. HERMAN:

21 Q. And it's one of the exhibits that you rely on
22 in your declaration. Correct?

23 A. Yes, that's correct.

24 Q. Do you believe Exhibit 2008 accurately
25 describes deposition techniques available and used to

1 form memory devices at the time the '666 patent was
2 filed?

3 MR. WATSON: Objection. Form.

4 THE WITNESS: Well, this book describes --
5 this -- this book was published in 2000. So it describes
6 techniques known to person of ordinary skill at that
7 time. I think the '666 reference date is -- is August of
8 2017. So a lot more was known by person of ordinary
9 skills than what is in this book.

10 BY MR. HERMAN:

11 Q. And you cite Exhibit 2008 multiple times,
12 including in Paragraph 32 of your declaration, when
13 discussing how a person having ordinary skill in the art
14 would understand the '666 patent and its manufacturing
15 methods. Correct?

16 A. Well, yes, I do. But I take into
17 consideration, you know, what I teach. And in 2017, you
18 know, I was teaching my students, undergraduates and
19 graduate students, how to modify surfaces playing tricks
20 with these isotropic and directional component in
21 gas-phase deposition techniques.

22 So, you know, I haven't published a book on all
23 of these things, but I teach it. You know, my students
24 know about these things and they go and they work for a
25 semiconductor manufacturer and carrying that knowledge

1 and technology with them.

2 So, you know, I -- I need to reference what,
3 you know, sort of more established -- if you want
4 references in textbooks, because, you know, I'm writing a
5 technical document here. And, you know, Plummer is the
6 one I chose to reference, or -- or use publications with
7 later dates that incorporate some of these features. But
8 this is a lot more cumbersome and takes a lot more time.

9 So I -- I use Plummer as a basic reference,
10 with the understanding that a person of ordinary skill,
11 in 2017, would have known about additional ways to
12 manipulate these fluxes to accomplish profiles that are
13 needed.

14 Q. Now, if you can turn to Page 509 of the Plummer
15 text, which is on Page 94 of the PDF that you have.

16 A. Yes, I'm on that page.

17 Q. And that page begins a chapter entitled "Thin
18 Film Deposition." Correct?

19 A. That is correct.

20 Q. Now, if you look towards the middle of that
21 page, there's a paragraph that begins "A second issue."

22 Can you find that for me, please.

23 A. Yeah, I see the beginning of that paragraph.

24 Q. About halfway through that paragraph, starting
25 on the right-hand side of the page, there's a sentence

1 that reads:

2 "Coverage on the side of a step in
3 top -- in topography is called step
4 coverage."

5 Do you see that?

6 A. Yes, I see that.

7 Q. And that paragraph ends with the sentence that
8 reads:

9 "Conformal step coverage, or conformal
10 coverage, refers to uniform film
11 thickness on both horizontal and vertical
12 surfaces, or a step coverage of one."

13 Is that right?

14 A. Yes, that sentence concludes the paragraph you
15 have pointed to.

16 Q. Now, if you could turn to the next page,
17 Page 510.

18 A. Okay. I'm there.

19 Q. At the top of that page there's a Figure 9-1.
20 Do you see that?

21 A. Yes, I see that.

22 Q. And part of that figure is labeled (a), and
23 that's meant to show conformal step coverage. True?

24 A. As the caption says, this shows -- Part (a)
25 shows conformal step coverage. So yes, that's true.

1 Q. And then Part (b) is meant to show poor
2 step-coverage. Correct?

3 A. That is one depiction of the poor
4 step-coverage. There are, really, multiple, a myriad
5 of -- of poor step-coverages that one can see.

6 Q. Now, if you were intending to make a structure
7 like (b) that has poor step-coverage, then one in
8 ordinary skill in the art would use plasma-enhanced CVD,
9 a directional sputter deposition or some other technique
10 that has both directional and isotropic fluxes. Correct?

11 MR. WATSON: Objection. Form.

12 THE WITNESS: No, that's not correct. This is
13 too -- too general a question. When I invoke the
14 combination of isotropic and directional fluxes, I do
15 that because I want to give my students a way to control
16 the profile. Right? So if you understand how to
17 manipulate both of these components, you can change the
18 way this profile appears.

19 And that gives you control of the surface
20 topography so you can obtain, for example, a curved side
21 surface of the kind that the '666 patent talks about. To
22 do that, you need to do some experimentation. You need
23 to figure out what the optimal is, the sweet spot between
24 isotropic and -- and directional component. So you
25 can -- you know, you have control knobs that you can

1 actually do that.

2 So this depiction here is just a generic, you
3 know, caricature of some unmentioned deposition technique
4 that results in poor step-coverage. It's only one kind
5 of -- you know, one version of it. But you can do all
6 sorts of tricks if you have control of both isotropic and
7 directional flux components.

8 BY MR. HERMAN:

9 Q. Now, to produce the -- the structure that's
10 shown in -- in Part (a) of Figure 9.1 [sic], you would
11 use a technique that's largely isotropic. Is that true?

12 A. Please repeat the question.

13 Q. So to produce what's shown in Part (a) of
14 Figure 9-1, you would use a deposition technique that is
15 largely isotropic. Correct?

16 MR. WATSON: Objection. Form.

17 THE WITNESS: That's totally incorrect. A
18 perfectly isotropic deposition technique will actually
19 lead to poor step-coverage, with a profile that it is
20 what it is, whatever you get. You have no control over
21 it.

22 To obtain something like what is shown in
23 Figure 9-1 with perfect conformal step coverage, you need
24 something that deposits with equal probability on the
25 sidewalls, as well as on the top surfaces. And this is,

1 generally, very hard to obtain.

2 There is one technique that guarantees it, and
3 that -- that is this atomic layer epitaxy that I
4 mentioned earlier to you, which does not rely on a
5 balance between isotropic and directional component
6 because it takes advantage of surface reactions. In
7 which case, you allow for mobility of the depositing
8 species on the surface so they can go and deposit
9 everywhere with equal probability.

10 So that's a very specialized technique known to
11 persons of ordinary skill. It would have been known as
12 of the time of the '666 patent in 2017. And, again, I
13 expect persons of ordinary skill involved in this
14 business to -- to know about it. But -- yeah, that's my
15 answer.

16 BY MR. HERMAN:

17 Q. Let's turn down to Page 511 of the same
18 document.

19 A. Okay. I'm there.

20 Q. There's a section entitled, "Historical
21 Development and Basic Concepts."

22 A. Yes, I see that.

23 Q. And there's a paragraph below that. Correct?

24 A. Yes.

25 Q. And the second-to-last sentence in that

1 paragraph reads:

2 "CVD has historically been used in the
3 integrated circuit industry mainly for
4 silicon and dielectric deposition,
5 primarily due to its good film quality --
6 or good quality films and good step
7 coverage."

8 Do you see that sentence?

9 A. Well, I see that sentence, but now we're going
10 into the -- the details of how these techniques work.
11 You know, I told you that a person of ordinary skill
12 needs to know and understand how these techniques work,
13 and that's what I do in my class.

14 Atomic layer epitaxy is basically a chemical
15 vapor deposition technique. Okay? It has a different
16 acronym because it does something relating to how the
17 molecules that you're bringing down onto the surface
18 react with the surface.

19 CVD is a more generic term that encompasses,
20 you know, many, many techniques, including, you know,
21 plasma-assisted deposition, including chemical vapor
22 infiltration, including, you know, all sorts of -- of
23 things.

24 You need to understand that these are complex
25 processes that involve, also, other considerations.

1 That, again, I teach in my class. And that has to do
2 with the reactivity of the molecules on the surface, with
3 the ability of the molecules to diffuse on the surface,
4 et cetera, et cetera. So the story is more complicated.
5 There are other contributing factors that affect the
6 profile that you want.

7 So, for example, before the term "atomic layer
8 epitaxy" became, you know, a catchy term, became viral,
9 if you want, you know, people were using CVD techniques,
10 but selecting molecules that do not immediately react
11 with the surface, but rather can stick on the surface and
12 diffuse around so that they can find spots that have not
13 been -- have no material deposited on them. And, you
14 know, that's an additional control element that you can
15 use to modify your profile.

16 So what Plummer is referring to here, in my
17 opinion, is, you know, a situation where, you know, a
18 person of ordinary skill in 2000, that barely knew
19 anything about atomic layer epitaxy, they would have
20 known that perhaps I can do something to modify the
21 reactivity of these molecules on the surface.

22 And by doing so, then I can influence the
23 profile. So that's, again, an additional knob that you
24 can use, but that requires, you know, specific chemicals
25 that may not be available, et cetera, et cetera.

1 So -- so this is sort of, you know, a generic
2 statement here that does not tell you, really, how all of
3 these things go together. But it tells you that, yes,
4 CVD can perhaps be modified by additional knowledge to --
5 to give you a -- a more acceptable profile, a more
6 conformal profile.

7 Again, you're bringing in here the element
8 of -- you know, of -- of additional knowledge that you
9 will manipulate the deposition so that you can accomplish
10 what you want to accomplish. And, again, all of these
11 things are things that I cover in my class. In fact, I
12 teach a second class, you know, specific to reactivity on
13 surfaces at Cal Tech.

14 And -- and, again, these are tools that, you
15 know, a person of ordinary skill would have known. I
16 mean, there are undergraduates taking my class that go
17 and find jobs in -- in digital memory manufacturers
18 and -- and they know of these techniques.

19 So -- you cannot take a statement like this and
20 translate it into, you know, I guess all of this
21 knowledge. I mean, this is a generic statement under
22 historical developments, you know, which tells you that,
23 you know, Hey, some people were able to accomplish, you
24 know, more conformal deposition using CVD.

25 But if you look deeper into it, you realize

1 that actually, these people are epithelizing on what came
2 later as -- as atomic layer epitaxy.

3 So, again, it's a historical perspective.
4 Right? I -- you know, I can do what they -- they say in
5 here. So the manipulation of isotropic and directional
6 components is more involved. It's something that, again,
7 people -- you know, persons of ordinary skill would have
8 known. And that works better with more common chemicals,
9 for example, than those needed for atomic layer epitaxy.

10 So -- so I don't know to what degree this is
11 clear to you, but I want to conclude my answer here by
12 telling you that CVD is a very generic term. It
13 describes the use of chemicals from the vapor phase to
14 deposit materials down.

15 The more isotropic terms, the more -- you know,
16 the additional acronyms that came later -- PACVD or
17 ALE -- those describe more specific situations of how you
18 perform your deposition.

19 And, you know, what Plummer does here, in my
20 opinion, is they talk about, you know, look, I'm going to
21 make a distinction between CVD and PVD. And, you know,
22 they talk in general about these things. I write a book
23 about -- I mean, I can write a book about all of these
24 differences that I'm telling you here that are, you know,
25 described in a short paragraph.

1 Q. Were you -- were you done?

2 A. I am done. Thank you.

3 Q. Okay. That was a lot of words, but it seemed
4 like you agreed that one of ordinary skill in the art
5 would have known that CVD could be used for dielectric
6 deposition and could produce good step-coverage if
7 desired. Correct?

8 MR. WATSON: Objection. Form.

9 THE WITNESS: Well, now you made your -- your
10 question a lot more specific. You mentioned dielectric
11 deposition. So now, I need to know what dielectric
12 you're depositing, and then I need to consider what
13 chemicals are available to me for dielectric deposition
14 so that I can see if this statement can be true. Because
15 depending on what kind of molecules are available for me
16 to do the deposition, that statement may not be true.

17 BY MR. HERMAN:

18 Q. So Plummer states that CVD has historically
19 been used in the integrated circuit industry mainly for
20 silicon and dielectric deposition.

21 Is that false, in your view?

22 A. Well, where do you read this?

23 Q. The sentence where it states --

24 A. Oh, I see.

25 Q. (As read):

1 "CVD has historically been used in the
2 integrated circuit industry mainly for
3 silicon and dielectric deposition."

4 And then it goes on. Is that false?

5 A. Okay. So, now, this is the text, though,
6 from -- well, I guess it follows afterwards, the -- the
7 step-coverage issue. So generically, this statement is
8 true.

9 Q. And it's also generically true that CVD can --
10 was historically used primarily due to its good quality
11 films and good step-coverage. Correct?

12 A. Okay. Again, I -- I disagree with this. I --
13 I have worked extensively on how CVD influences the
14 deposition profile on the sidewalls. And I have several
15 publications where CVD actually is depositing a
16 non-conformal material on the sidewalls, which affects
17 the electrical properties of what it is that you are
18 trying to do.

19 I have publications on how you make digital
20 memories more DM-related, where, actually, the
21 non-conformal profile can actually kill your structure.
22 I have written a book chapter on this, on how the -- the
23 profile, basically, obtained by CVD methods can -- can
24 influence, you know, your -- your -- the -- the
25 reliability and -- and the electrical properties, you

1 know, of the structure you're trying to make.

2 So, you know, this is an absolutely generic
3 statement that says, yes, CVD has been used, in some
4 instances, to deposit perfectly conformal profiles,
5 absolutely, yes. But CVD, generally, produces
6 non-conformal profiles.

7 So something has been done here to allow
8 whoever, you know, used these techniques, to make them
9 more conformal. I told you repeatedly that -- that yes,
10 this is possible. It depends what it is that you're
11 doing and how well you understand the process.

12 But this doesn't apply widespread to all CVD
13 techniques. Generally, CVD techniques, especially those
14 run at higher pressures, give you non-conformal profiles,
15 generally. You can lower the pressure and obtain a more
16 conformal profile. And guess what, you can -- you know,
17 if you do it properly with the correct chemicals, you
18 will get a perfectly conformal profile.

19 Well, my students know all about it. So all
20 they need to do is decide what it is that they want to
21 do. Do I want a perfectly conformal profile? Then I
22 have different tools that I will use to obtain it.
23 They're all CVD. Okay?

24 Some of them will give me, you know, conformal
25 profiles. Some will -- some of them will give me

1 horrible profiles, you know, extremely poor coverage.

2 And some of them will give me something in between.

3 I can do this by manipulating the isotropic and
4 directional components and I can do this by manipulating
5 the surface chemistry, by selecting different species, by
6 selecting different temperatures so that I can actually
7 obtain what it is that I want.

8 It does require some experimentation, but if
9 you know all the tools that are available to you, you can
10 make progress. And you can use it in actual processing
11 of devices. So I -- I -- you know, I'm going to stop
12 there because I don't know how better to answer your
13 question.

14 Yes, this statement says what it says. But I
15 actually -- as an expert in the field, I'm telling you
16 that, you know, CVD can give me horrible profiles,
17 non-conformal profiles. If you spend the time, you can
18 actually, you know, improve on that profile and make it
19 appear more conformal. If you know what you're doing,
20 you don't need to spend as much time as someone who
21 doesn't know what they're doing. End of answer.

22 Q. So I think one of the things that you mentioned
23 in your answer is that you can control the pressure
24 employed during CVD in an effort to obtain a more
25 conformal deposition. Is that right?

1 MR. WATSON: Objection. Form.

2 THE WITNESS: I believe I said that pressure is
3 one of the parameters that you can manipulate to modify
4 the sidewall profile. Make it more or less conformal.

5 BY MR. HERMAN:

6 Q. So could you use low-pressure CVD, for
7 instance, to obtain a more conformal deposition?

8 MR. WATSON: Objection. Vague.

9 THE WITNESS: Okay. So your question is
10 extremely broad and general. I contend that you can do
11 both. You can use low pressure CVD to deposit
12 non-conformal profiles, as well as conformal profiles.
13 Again, because, you know, there is a lot more going on
14 here then just manipulating the pressure.

15 So I'll be happy to tell you more about it, but
16 now we need to get very specific. You can tell me what
17 it is that you're trying to do and then I'll give you a
18 way to actually do it using CVD.

19 BY MR. HERMAN:

20 Q. So it seems like you agree that it is possible
21 to use low pressure CVD to produce a non- -- or a
22 conformal coating. Correct?

23 MR. WATSON: Objection. Form.

24 THE WITNESS: Okay. So -- so nowadays,
25 including, you know, as of 2017, people would use a

1 different term for this process that you're describing.
2 They wouldn't call it CVD. They would call it atomic
3 layer epitaxy. And that term has proliferated to
4 describe something very specific.

5 So -- so, again, generally, you can do
6 things -- you can move in a particular direction with
7 every technique. If you tell me specifics what it is
8 that you're trying to deposit and, you know, what profile
9 you're trying to obtain, then I can zoom in into a
10 specific technique that will actually do that profile.

11 But, you know, there are limits to what it is
12 that you're doing. So I mean, I cannot give you an
13 answer "yes" or "no" in -- in -- in what you're asking me
14 because there are so many parameters at play here that
15 one can manipulate to obtain one or the other.

16 And -- and it may not be possible to obtain
17 what you're asking me with a particular technique if, for
18 example, the chemicals are not available for
19 accomplishing what it is that you accomplished. In that
20 case, you know, you cannot lift your hands and say, oh,
21 all pressure CVD cannot -- cannot give me a conformal
22 profile. Right?

23 You know, there are limits to all of these
24 techniques. So you need to look at something very
25 specific, more specific. So give me specifics and I'll

1 try to answer your -- your question. But the answer can
2 be sometimes yes; sometimes no. Sometimes you've got to,
3 you know, decide what is acceptable in terms of
4 conformality.

5 You know, so it may not be perfectly conformal,
6 but -- but it may be acceptable for the structure that
7 you are doing. And, you know, then -- then it's fine.
8 And so there is a degree of conformality. So are we
9 talking about 100 percent conformal? Only ALD can do
10 that. ALD is a CVD technique.

11 Okay. So it can be used at high pressure and
12 occasionally it's used also at low pressure. So -- so
13 what are we talking about now? Right? This is something
14 very specific. A person of ordinary skill will
15 distinguish between CVD and atomic layer epitaxy.

16 BY MR. HERMAN:

17 Q. Now, if you could get the '666 patent out
18 again. That's Exhibit 1001.

19 A. Yeah, I opened that exhibit.

20 Q. And if you could turn to Column 9 for me.

21 A. Yes, I am on that column. The other part of
22 this.

23 Q. Starting at line 2, the patent says:

24 "Dielectric Layer 620 can be formed
25 using deposition techniques including..."

1 Do you see that?

2 A. I'm sorry, can you read the sentence you just
3 started reading again?

4 Q. It's at line 2, and it begins:

5 "Dielectric Layer 620 can be formed
6 using deposition techniques including,"
7 and then there's a comma.

8 A. Yes, I see that.

9 Q. The sentence goes on to list:

10 "Plasma-enhanced CVD, low-pressure
11 CVD, physical vapor deposition,
12 high-density plasma, atomic layer
13 deposition, and any suitable deposition
14 techniques, or combinations thereof."
15 Right?

16 A. That's what's written there, yes.

17 Q. All right. So among the techniques that the
18 '666 patent identifies as acceptable, is low-pressure
19 CVD. True?

20 A. Well, I mean, this is written by, I think,
21 people who meet the definition of a person of ordinary
22 skill here, who know and understand that all of these
23 techniques can be used to actually deposit the kind of a
24 profile that they stipulate.

25 And as I told you earlier, yes, I mean, again,

1 you have a lot of knobs to control here that, you know,
2 allow you to manipulate the profile.

3 The -- you know, so -- so, yes, I mean,
4 low-pressure CVD is one of those that you can use. As I
5 told you earlier, you know, that -- if you tell me more
6 specifically what you want to do, I'll be able to tell
7 you whether it can give you a perfectly conformal profile
8 or -- or a very poor profile.

9 Q. So the -- the '666 patent does not limit the
10 deposition techniques that are -- are to be used to guess
11 plus plasma-enhanced CVD and PVD. True?

12 A. Well, the '666 patent does not limit itself to
13 those two techniques. I limited myself to those two
14 techniques coming from the perspective of, you know, a
15 professor who's teaching the subject matter to -- to his
16 students.

17 And, you know, those are the kinds of
18 techniques that allow you to manipulate the fluxes in --
19 in -- in a relatively, you know, in an appropriate way,
20 if you want, to -- to form the profile that you want.
21 But as I said earlier, you know, other techniques have
22 also additional knobs that you can use.

23 So, actually, I don't think I'm limiting myself
24 in -- in my report to that. I said techniques such as
25 plasma-enhanced CVD and directional is part of the

1 deposition, among others, on Page 17 of my report, of my
2 declaration.

3 Q. But your report does not include an explanation
4 of how low-pressure CVD would be used to produce poor
5 step-coverage. True?

6 MR. WATSON: Objection. Form.

7 THE WITNESS: Well, plasma-enhanced CVD is a
8 low-pressure technique, if you are going to be, you know,
9 specific here. It has an additional element there called
10 plasma, but it is a low-pressure CVD because plasmas do
11 not obey at higher pressures, at least easily.

12 But I don't go into details of these
13 techniques. I -- you know, I mentioned, generically, the
14 isotropic and directional components, which exist also in
15 low-pressure CVD.

16 BY MR. HERMAN:

17 Q. Where do you state that in your declaration,
18 that there are directional components in low-pressure
19 CVD? Which paragraph specifically?

20 A. Okay. Well, the end of my Paragraph 32, on
21 Bates 17, it says:

22 "...specific gas-phase deposition
23 techniques capable of supplying both
24 directional and isotropic fluxes of
25 depositing molecules to the staircase

1 structure, such as plasma-enhanced CVD
2 and directional sputter deposition PVD,
3 among others."

4 Okay?

5 "Such as, among others."

6 What I had in mind here is, you know, all the
7 gas-phase techniques that, you know, have eventually,
8 knobs that you can turn to manipulate these -- these
9 fluxes. And low-pressure CVD is one of them that I had
10 in mind when I was writing this sentence.

11 Q. But you did not actually include that in the
12 sentence, even though it's specifically mentioned in the
13 '666 patent. True?

14 MR. WATSON: Objection. Form.

15 THE WITNESS: Well, you know, my declaration is
16 my writing. And I -- you know, I decided not to repeat
17 everything that is in the patent, you know, verbatim. So
18 I limited myself to these techniques, but I hedged my
19 bets because I say, Such as, techniques such as, among
20 others.

21 So I had in mind, you know, all of those that
22 are mentioned in -- in the '6 -- '666 patent. And by the
23 way, the atomic layer epitaxy that we talk about,
24 actually, is described in the patent as ALD, atomic layer
25 deposition. And as you noticed, I extensively mention

1 that.

2 So since I teach all of these techniques in my
3 class, it's sort of -- to me, it's part of the background
4 of the person of ordinary skill. In other words, they
5 know all of these techniques, they know what their
6 advantages are. They know what their controlling
7 parameters are and they know what to manipulate to -- to
8 obtain the desired profile.

9 MR. HERMAN: And so I feel like we've been
10 going for slightly more than a hour. Would you like to
11 take a short break before we move on?

12 THE WITNESS: Okay.

13 MR. HERMAN: Maybe -- does five minutes work
14 for you, or do you want longer than that?

15 THE WITNESS: Yeah, five minutes should be
16 fine.

17 MR. HERMAN: So why don't we resume at about
18 1:45, my time. So I think that would be -- I'm not going
19 to be able to subtract three from that.

20 MR. WATSON: 10:45.

21 MR. HERMAN: 10:45 your time.

22 MR. WATSON: Sounds good.

23 May we go off the record. Just wanted to make
24 sure.

25 (Recess.)

1 BY MR. HERMAN:

2 Q. So if you could get the '666 patent out again,
3 that's Exhibit 1001. And if you could turn to Column 4
4 for me.

5 A. Okay. I'm there.

6 Q. So Column 4 is part of a portion of the
7 '666 patent that discusses the meaning of certain terms.
8 Correct?

9 MR. WATSON: Objection. Form.

10 THE WITNESS: Column 4 does that, but it's not
11 the only one that actually talks about meaning of various
12 terms. I think Column 3 does the same thing. And maybe
13 this spills over to Column 5.

14 BY MR. HERMAN:

15 Q. So -- so you're referring to -- to -- in
16 Column 3, at about line 41, there's a paragraph that
17 states:

18 "It is noted that references in the
19 specification to 'one embodiment,' 'an
20 embodiment,' 'an example of embodiment,'
21 'some embodiments,' et cetera, indicate
22 that the embodiment described can include
23 a particular feature," and so on.

24 Is that what you're referring to?

25 A. That's one part of what I was referring to.

1 Q. And then in Column 3, at Line 55, there's
2 discussion of the term -- or phrase "one or more."

3 Were you referring to that as well?

4 A. Yes.

5 Q. And in that same paragraph, there's discussion
6 of the terms "a," "an," and "the."

7 Were you referring to that as well?

8 A. Among other things, yes.

9 Q. So there's -- the discussion of the meaning of
10 terms continues from Column 3 into Column 4, and on to
11 Column 5, as you noted. Correct?

12 A. I believe it does, yes.

13 Q. So for instance, at the top of Column 4, the
14 '666 patent discusses the meaning of the terms "on,"
15 "above," and "over." Correct?

16 A. Yeah, that's correct.

17 Q. And in a paragraph that starts at line 10, the
18 patent discusses the meaning of the terms "beneath,"
19 "below," "lower," "above," and "upper." True?

20 A. Yeah. It looks like that's what's happening in
21 that paragraph.

22 Q. And there's a paragraph at about line 36 that
23 discusses the meaning of the term "layer." Correct?

24 A. That appears to be true, too.

25 Q. And if we turn over to Column 5, starting at

1 line 3, the '666 patent discusses meaning of the terms
2 "horizontal," "horizontally," "lateral," and "laterally."
3 Correct?

4 A. Well, it appears that that short paragraph,
5 that's what it does. I guess I disagree with the use of
6 "lateral" in that sentence, but that's what it does.

7 Q. And then at about line 11 in Column 5, there's
8 a sentence that discusses the meaning of the term
9 "vertical" or "vertically."

10 Do you see that?

11 A. Yes, I see that.

12 Q. So is it fair to say that in the '666 patent,
13 from Column 3, starting at about line 41 and carrying
14 through to Column 5, there's a section that discusses and
15 provides definitions for a number of terms?

16 A. That's fair to say.

17 Q. Now, nowhere in that section of the '666 patent
18 is a definition of the word "curved" provided. Correct?

19 A. Well, scrolling through the text identified, I
20 don't see a definition of the word "curve" or "curved."

21 Q. In fact, you'll agree that the only place the
22 word "curve" appears in the '666 patent is in the claims.
23 Right?

24 A. Well, the word "curve" seems to appear only in
25 the -- in the claims, but several figures are curved

1 surfaces. So a person of ordinary skill does not, you
2 know, look only at the text. They look, also, in the
3 figures to inform themselves about what is it that is
4 being taught in this -- in this patent.

5 And I believe a person of ordinary skill in
6 the -- in the art would -- would, you know, know that
7 there is -- there are curved surfaces that are part of
8 the disclosure here.

9 Q. And the reason you're saying that is because in
10 your view, the figures show curved surfaces, not because
11 the word "curved" appears in the text of the
12 specification. Correct?

13 MR. WATSON: Objection. Form.

14 THE WITNESS: Well, on my first read of this
15 patent, I still recall, you know, reading the
16 specification, of course, consulting with the figures,
17 trying to understand what it describes. And, you know, I
18 mean, in my mind, I saw these curves immediately and I
19 knew what the story was, if you want.

20 So I mean, I don't think a person of ordinary
21 skill looks at this patent, you know, just -- just
22 reading the text. I mean, if you don't get the figures,
23 you can't follow what is going on in here. It talks
24 about all sorts of layers, all sorts of -- you know, of
25 surfaces, sides, et cetera, et cetera. So you need to

1 read it together with the figures.

2 And though the word -- the word "curve" is not
3 mentioned in the specification, I think as you read
4 through, you see the -- the -- the surfaces that, you
5 know, that are being made. And you know that there is
6 curvature somewhere. Right? At various layers, and you
7 make connections, then.

8 You -- you know, you've had a bachelor's degree
9 and took Electricity 101, you know what matters in this
10 case, you know that there are voltages applied in the --
11 in the -- you know, in the final, you know, product and
12 you know that surfaces matter when you have voltages
13 going through various, you know, lines.

14 So I don't believe a person of ordinary skill
15 can just, you know, again, look at the specification only
16 with -- without, you know, the figures. And once you
17 include the figures, you have top knowledge that there is
18 curvature in various places.

19 BY MR. HERMAN:

20 Q. Now, the word "curve" does appear in -- in the
21 claims. Correct?

22 A. Yeah, I believe it does, about seven times.

23 Q. So for instance, it's in Claim 9. True?

24 A. Yeah, I see that word mentioned once in
25 Claim 9.

1 Q. It's also in Claim 17. Correct?

2 A. That is correct.

3 Q. But it is not in Claim 1. True?

4 A. I don't see the word "curve" in Claim 1.

5 Q. Now, turn back to the portion of the
6 '666 patent that provides definitions in Columns 3, 4,
7 and 5, and let me know when you're there.

8 A. I am in Column 3.

9 Q. Now, that portion of the '666 patent does not
10 provide an explicit definition of either the term "side"
11 or the phrase "side surface." Correct?

12 MR. WATSON: Objection. Form.

13 THE WITNESS: Please repeat your question.

14 BY MR. HERMAN:

15 Q. So Columns 3, 4, and 5 define a number of
16 terms, but they do not include an explicit definition of
17 either the term "side" or the phrase "side surface."
18 Correct?

19 MR. WATSON: Objection. Form.

20 THE WITNESS: Well, the word "side" is
21 mentioned seven times in Column 4. The word "surface" is
22 mentioned eight times.

23 BY MR. HERMAN:

24 Q. But there is not an explicit definition of
25 either term provided in Columns 3, 4, and 5. True?

1 MR. WATSON: Objection. Form.

2 THE WITNESS: I mean, these terms are taken to
3 mean -- taken at their common and ordinary meaning. I
4 think it's pretty clear what they're talking about over
5 there. So I don't see a reason why they would have a
6 definition of these two terms, but I don't see a
7 definition. No, I don't see a definition.

8 BY MR. HERMAN:

9 Q. Now, if you can go back to Column 5, starting
10 at line 3.

11 A. Three, okay.

12 Q. The -- the patent states that "horizontal"
13 means nominally parallel to a lateral surface of a
14 substrate. Right?

15 A. This is what this paragraph says. And as I
16 stated earlier, that's not the way I use the word
17 "lateral," but this is what some of the inventors are
18 saying here.

19 Q. And starting at Line 11, there's a sentence
20 that says that the term "vertical" means nominally
21 perpendicular to the lateral surface of a substrate.
22 Right?

23 A. Yeah, that's what this paragraph says.

24 Q. Now, Claim 17 does not use either of the word
25 "horizontal" or "vertical." True?

1 A. Please repeat your question.

2 Q. Claim 17 does not use either the word
3 "horizontal" or the word "vertical." Correct?

4 A. Well, Claim 17 does not use these specific
5 words explicitly, but it's -- it -- it talks about a top
6 surface, which I can find many references in the
7 specification as meaning a horizontal surface. So I
8 don't see a reason why, you know, you can use one term
9 versus the other term, because a top surface is a
10 horizontal surface.

11 As far as the word "vertical," again, though
12 that is not mentioned there, there is a mention of a
13 curved side surface in contact with a side surface of the
14 undulating layer.

15 And as I state in my declaration, in -- in
16 Paragraphs 40 through 61, that curved side surface is a
17 vertical surface. At least that's what a person of
18 ordinary skill would understand.

19 Q. But the word "vertical" does not appear in the
20 claims. True?

21 A. The specific word "vertical," it does not
22 appear in -- in Claim 17.

23 Q. Nor does the phrase "nominally perpendicular."
24 Correct?

25 MR. WATSON: Objection. Vague.

1 THE WITNESS: Well, again, while this -- this
2 sentence or these -- these words don't appear in
3 Claim 17, I see the word "top surface" and I see the word
4 "curved side surface." Well, these are three words and
5 two words, but -- or two words and three words.

6 But -- so these, to me, have meaning. Right?
7 One is horizontal, the other one is vertical. So once I
8 know that there is a horizontal surface, I know that
9 there is a vertical -- a vertical vector, which is
10 perpendicular to the horizontal surface. So, you know,
11 to me, these words have meaning.

12 BY MR. HERMAN:

13 Q. Now, "top surface" refers to the substrate, not
14 the second portion of the conductive layer. True?

15 MR. WATSON: Objection. Vague.

16 THE WITNESS: Well, the claim language may be
17 referring to -- to the substrate as having a top surface,
18 but, you know, a person of ordinary skill knows that this
19 is the surface that defines horizontality [sic] in these
20 structures. So any layer you put up on top on that
21 surface will have a horizontal part.

22 So, you know, we're looking at claims now.
23 We're looking at one limitation. But, you know, a person
24 of ordinary skill would understand that this top surface
25 is defining horizontality and, you know, how additional

1 layers, the plurality of layers, stacks that follow in a
2 subsequent element of this -- a subsequent limitation of
3 this claim that these will have horizontal surfaces.

4 BY MR. HERMAN:

5 Q. Now, Claim 17 also does not use the phrase
6 "Z axis." Correct?

7 A. I'm sorry, I didn't hear the -- those two words
8 that you mentioned.

9 Q. Z --

10 A. Please repeat your question.

11 Q. The -- Claim 17 does not use the phrase
12 "Z axis." Correct?

13 A. I'm sorry. Z axis.

14 Q. Yes.

15 A. Oh, Z axis? Z as in zebra?

16 Q. Zebra, yes.

17 A. A Z axis?

18 Q. Yes. But that phrase does not appear in
19 Claim 17. Correct?

20 A. Claim 17 does not use the word "Z axis."
21 However, you know, Z axis appears explicitly in all
22 figures. I mean, Figures 1 through -- through 8. And --
23 and it's mentioned several times in the specification.

24 Q. Now, you mentioned the eight figures of the
25 '666 patent in that answer. Right?

1 A. Yes.

2 Q. Each of those figures show a cross-section in
3 the X/Z plane. Is that right? I guess with the
4 exception of Figure 9.

5 A. Yes, I believe that is correct.

6 Q. There are no figures in the '666 patent showing
7 the structure of the patent's memory in either the Y/Z or
8 the X/Y planes. Correct?

9 A. Well, I don't see any figures in -- in these
10 other renditions. But, you know, a person of ordinary
11 skill, you know, reads these cross-sections as extending
12 into the page and out of the page.

13 In other words, a person of ordinary skill
14 knows that these are three-dimensional structures that
15 have also a Y direction and generally has an
16 understanding of how these layers -- what -- what it is
17 that they look like.

18 Q. Now, if we could go back to your declaration,
19 that's Exhibit 2023. And if you could turn to
20 Paragraph 24 for me.

21 A. Yes, I'm there.

22 Q. That paragraph is part of a section entitled
23 "Overview of 3D NAND Memories." Right?

24 A. That's right.

25 Q. And Paragraph 28 is part of the same section.

1 Correct?

2 A. Yes, that is correct.

3 Q. And Paragraph 28 includes a sentence that
4 reads:

5 "A potential problem with the
6 staircase structure is the possibility of
7 a device malfunction by way of a
8 short-circuit."

9 And then there's quoted language from the
10 '666 patent. Right?

11 A. Yeah, that's correct.

12 Q. Now, the language you quote from the
13 '666 patent does not use the -- the term "short-circuit."
14 True? You added that to this particular sentence.
15 Correct?

16 MR. WATSON: Objection. Form.

17 THE WITNESS: While -- while that sentence or
18 that term is not mentioned there, this is a basic reason
19 that -- that enables the formation of 3D NAND memories.
20 And a person of ordinary skill at the time, 2017, would
21 have known about this. This was an absolute requirement
22 because you needed the -- the landing pads to form on top
23 of the word lines. Otherwise, you would have had shorts.
24 And, of course, that affected the -- the yield and -- and
25 the -- and -- and complexity and cost.

1 So in particular, yield and cost are affected
2 huge by this -- this problem. So in -- in my knowledge
3 of the subject, these structures cannot exist without
4 these landing pads. You absolutely need to thicken the
5 material there.

6 So, you know, this is -- this goes hand in hand
7 with the presence of a staircase that -- that -- and the
8 way you're patterning that staircase and the way you're
9 making, you know, electrical contact to the staircase.

10 And, you know, I -- I selected a paragraph that
11 talks about demand for higher storage capacity would
12 generally mean you need to have smaller, you know,
13 features and more vertical levels, because that
14 relates -- goes hand in hand with, you know, the need
15 for -- for thicker pads to prevent short-circuit.

16 BY MR. HERMAN:

17 Q. So you'll agree that one of ordinary skill in
18 the art, when the '666 patent was filed, would have known
19 that a landing pad and staircase structure that included
20 that landing pad needs to be designed in a way that
21 avoids short-circuits. Correct?

22 MR. WATSON: Objection. Form.

23 THE WITNESS: Please repeat the question.

24 BY MR. HERMAN:

25 Q. So you'll agree that one of ordinary skill in

1 the art, at the time the '666 patent was filed, would
2 have known that a staircase structure and the landing
3 pads on that staircase structure need to be designed in a
4 way that avoids short-circuits. True?

5 MR. WATSON: Objection. Form.

6 THE WITNESS: I think that's what I stated in
7 my previous answer. You're putting it in much fancier
8 words. The idea here is to create thicker pads to avoid,
9 eventually, the contact holes from penetrating through
10 the words lines and touching the short-circuits
11 underneath.

12 There are, of course, other issues associated
13 with a staircase structure in the shape of these landing
14 pads, et cetera, et cetera, that would also have been
15 known.

16 BY MR. HERMAN:

17 Q. So if you turn to Paragraph 29, which I believe
18 is the paragraph after the one we're looking at?

19 A. Okay.

20 Q. That paragraphs ends with a sentence that
21 reads:

22 "One way to prevent this is to
23 increase the thickness of each stair
24 step, which however, brings the step
25 closer to the upper word line, creating

1 the potential for electrical breakdown
2 (i.e., a short-circuit), even in the
3 presence of insulating material between
4 the word lines."

5 Do you see that sentence?

6 A. Yes, I see that sentence.

7 Q. So you're not quoting the '666 patent -- or you
8 also don't provide a citation to the '666 patent at the
9 end of that sentence. True?

10 A. Well, I do not provide a quotation to this
11 sentence, a reference to this sentence. But, you know,
12 to me, this is a very well-known aspect of -- of 3D NAND
13 memories. You definitely want a thicker, you know,
14 landing pad. But -- but -- that brings you closer to the
15 upper, you know, landing pads, and that creates a
16 breakdown problem. It was very, very well known.

17 So that's why additional steps need to be taken
18 to actually optimize the structure. So I -- I think this
19 is general knowledge of -- of -- general knowledge that a
20 person of ordinary skill would possess about, you know,
21 stair step structures.

22 Q. And is it knowledge that a person of ordinary
23 skill in the art would have possessed before the
24 '666 patent was filed?

25 MR. WATSON: Objection. Vague. Form.

61

1 THE WITNESS: Well, while I cannot opine on the
2 timeline, you know, I -- I think this is knowledge that a
3 person of ordinary skill would have had. You know, when
4 you think about, you know, thickening these pads, of
5 course, there is the issue of, you know, how thick are
6 you going to make them.

7 Expanding in a particular direction, especially
8 when there is other circuitry in place, you know, is --
9 can become very problematic. So I think it's something
10 that a person of ordinary skill should have known.

11 BY MR. HERMAN:

12 Q. All right. I'd like to shift gears a little
13 bit. And if you could get out Exhibit 1005 for me.

14 (Exhibit 1005 was marked for
15 identification.)

16 THE WITNESS: Yes, I have opened that exhibit.

17 BY MR. HERMAN:

18 Q. Now, Exhibit 1005 is a prior art reference to
19 Kim, that you reviewed in connection with your
20 declaration. Correct?

21 A. Yes, that's correct.

22 Q. And if you turn to Paragraph 62 of your
23 declaration, which is numbered Page 38.

24 A. Okay. I'm there.

25 Q. That paragraph begins the discussion of the Kim

1 prior art reference. Correct?

2 A. I believe that is correct.

3 Q. Now, turn down to Paragraph 70 for me.

4 A. Yeah, I'm there.

5 Q. Paragraph 70 starts by -- with the -- the text:

6 "Kim also explains that, 'in some
7 embodiments,' PAD_P may have a shape
8 including a curved surface based on a
9 virtual rectangular parallel shape, a
10 cylindrical shape, or any shape."

11 Right?

12 A. Yes, that's what I have written there.

13 Q. And below that paragraph, you produce figures
14 with orange annotations. Right?

15 MR. WATSON: Objection. Form.

16 THE WITNESS: Well, I produced shapes provided
17 by Dr. Lee below this paragraph.

18 BY MR. HERMAN:

19 Q. Is it your understanding that the orange
20 annotations are -- are meant to highlight examples of
21 Kim's pad?

22 A. I believe this is what Dr. Lee claimed. So
23 that's my understanding, based on what he wrote in his
24 declaration.

25 Q. Now, do you agree that all three of those

1 figures provide examples of what Kim means when it says
2 that its landing pad can include a curved surface?

3 MR. WATSON: Objection. Form.

4 THE WITNESS: Please repeat the question.

5 BY MR. HERMAN:

6 Q. Do you agree that those three figures provide
7 examples of what Kim means when it says that its landing
8 pad can include a curved surface?

9 MR. WATSON: Objection. Form.

10 THE WITNESS: Well, again, these are three
11 examples offered by Dr. Lee. They are consistent with
12 the way Kim makes them. They have a curved surface in
13 the X/Y plane, which is, again, consistent with the
14 teaching of -- of Kim. So I would agree that these are
15 three examples of the possible shape that pads can have
16 under Kim.

17 BY MR. HERMAN:

18 Q. And turning down to Paragraph 71, Paragraph 71
19 discusses, at least in part, Kim's pad manufacturing
20 method. Correct?

21 A. I believe that is correct, yes.

22 Q. And in this paragraph, you're showing, with an
23 annotated figure, how Kim's process would be used to make
24 a pad with a circle shape. Correct?

25 A. Well, here, I go through the first step of what

1 needs to be done to create pads with circular shape. And
2 the depiction shows a top view of the photoresist with --
3 with openings at some locations where eventually, the
4 contact holes will -- will be made -- sorry, not contact
5 holes, but where the holes would be made that -- that
6 will create the -- the pad shape desire at a later
7 instance.

8 Q. So you show holes that are circular through
9 Kim's mask, M, in your annotated figure. Correct?

10 A. Well, I selected one of the examples above
11 discussed by Dr. Lee, which is the -- the figure on the
12 left, which to me appears to be a circular pattern. So I
13 tried to -- to create, you know, circular holes.

14 Q. So if you wanted to make an oval contact pad,
15 you -- you would make an oval hole in your annotated
16 figure in Paragraph 71. True?

17 A. Well, if I wanted to make an elephant shape, I
18 would make an elephant shape. I can do whatever I please
19 on -- on -- on -- using photo -- photography.

20 Q. So that's the only modification that needs to
21 be made to Kim's manufacturing process to produce a
22 circular, an oval, or an other-shaped landing pad that
23 curves in the X/Y plane, simply making the right shaped
24 whole in the photoresist. Correct?

25 MR. WATSON: Objection. Form.

1 THE WITNESS: Well, the mask defines the shape
2 on the opening, and that is controlled by the operator.
3 So this will create, you know, pads that in top view,
4 follow the opening of the mask.

5 BY MR. HERMAN:

6 Q. So -- so you'll agree that any of those three
7 example pad shapes shown in Paragraph 70 could be
8 produced just by forming the right shaped hole in Kim's
9 photosensitive resin Pattern M. Correct?

10 A. Well, I believe that these three shapes can be
11 defined by the photoresist and you can make it using
12 the -- using Kim's process.

13 Q. Now, if you turn down to Paragraph 83 for me.

14 A. Okay. I'm there.

15 Q. At the end of that paragraph, you have a figure
16 that's been colored. Correct?

17 A. Well, I do have a figure there, a colored
18 figure, showing one of the -- the pad, the circular pad
19 will form in the -- in the -- top oxide that covers
20 the -- whatever the -- the word line there.

21 Q. By top oxide, you're referring to Kim's
22 Auxiliary Insulating Layer 122. Correct?

23 A. Yes, that is correct.

24 Q. So the blue in that figure in Paragraph 83
25 is -- is meant to show Kim's Auxiliary Insulating

1 Layer 122. Correct? Or at least the portion of it in
2 the vicinity of the orange highlighted pad. True?

3 MR. WATSON: Objection. Form.

4 THE WITNESS: What I've shown in Figure 8 of
5 Kim, this is what is being modified. In other words,
6 auxiliary dielectric 122, basically, is -- is modified to
7 create PAD_P.

8 BY MR. HERMAN:

9 Q. Now, as you've depicted it here, that Auxiliary
10 Insulating Layer 122 is in contact with the orange
11 highlighted pad. Correct?

12 A. Well, the -- the processing technology, the
13 implantation technology defines the hole into the
14 dielectric. So once you modify this dielectric and later
15 on, you replace it with a conductive material, that will
16 be in contact with the -- with the dielectric material
17 that has been modified.

18 Q. Now, if you could get out Exhibit 1005, again,
19 for me. That's the Kim reference.

20 A. Okay. Yeah, I have it open.

21 Q. And if you could turn to Figure 9 of Kim for
22 me.

23 A. Okay. I'm there.

24 Q. And the figure includes, among other things,
25 two dimensions. One indicated by W1 and another

1 indicated by W2.

2 Do you see those dimensions?

3 A. Yeah, I see those dimensions.

4 Q. So is Kim showing that its landing pads can
5 have different width in the X direction?

6 MR. WATSON: Objection. Form.

7 THE WITNESS: I believe that's one embodiment
8 that Kim teaches. He also teaches other embodiments that
9 here, these dimensions are equal to each other.

10 BY MR. HERMAN:

11 Q. Now, to achieve pads that have different
12 widths, one would have to make the holes through Kim's
13 Mask M either larger or smaller. Correct?

14 A. Well, the mask pattern determines what the hole
15 will look like, so I -- I believe that is true.

16 Q. So if the hole is made smaller, the resultant
17 contact pad will be smaller. And if the hole is made
18 larger, the resultant contact pad will be made larger.
19 Correct?

20 MR. WATSON: Objection. Form.

21 THE WITNESS: Well, again, the mask shape
22 determines the size -- the mask pattern, to be more
23 precise, determines the -- the size and shape of these
24 holes. So I suppose that is correct.

25 ///

1 BY MR. HERMAN:

2 Q. And the mask pattern also determines the area
3 that is subject to ion implantation. Correct?

4 A. I would agree with that.

5 Q. So a smaller hole through Mask M will produce a
6 smaller area of ion implantation, while a larger area or
7 larger hole will produce a larger area of ion
8 implantation. True?

9 MR. WATSON: Objection. Form.

10 THE WITNESS: Well, this is not true in all
11 instances. There is a minimum size of a hole that you
12 can pattern using the technology of Kim. So this is not
13 always true, but in some instances it will be true.

14 MR. HERMAN: So I think we've been going for
15 another hour. Would you like another five-minute break?

16 THE WITNESS: Sure. Okay.

17 MR. HERMAN: It would be 2:50 my time, 11:50
18 your time.

19 MR. WATSON: Okay. That works.

20 THE WITNESS: So five -- five minutes?

21 MR. HERMAN: Is that enough, or do you need
22 more than that?

23 THE WITNESS: Yeah, that should be fine.

24 MR. HERMAN: Okay.

25 THE WITNESS: Thank you. Off the record?

1 (Recess.)

2 BY MR. HERMAN:

3 Q. So, Professor, if you could get out
4 Exhibit 1006 for me. And Exhibit 1006 is a prior art
5 reference to Nam that you reviewed in connection with
6 your declaration. Right?

7 A. Yeah that's right.

8 (Exhibit 1006 was marked for
9 identification.)

10 BY MR. HERMAN:

11 Q. Now, if you could turn to Paragraph 112 of your
12 declaration.

13 A. Okay. I'm there.

14 Q. That begins a discussion of the Nam reference.
15 Correct?

16 MR. WATSON: Objection. Form.

17 THE WITNESS: Well, this is where I reference
18 Ground 2, which is, basically, in reference to Nam.

19 BY MR. HERMAN:

20 Q. Now, if you could turn down to Paragraph 118
21 for me.

22 A. Okay. I'm there.

23 Q. And at the end of Paragraph 118, there's a
24 version of Figure 8A of Nam that has blue coloring on it.
25 Correct?

1 A. Yeah, that is correct.

2 Q. So in that version of Figure 8A, Element 248 is
3 shown in blue. True?

4 A. Well, part of 248 is shown in blue.

5 Q. The part that's in Figure 8A. Correct? Or at
6 least this portion of Figure 8A?

7 A. Yes, but the blue includes also an additional
8 part of another layer.

9 Q. So 248, Element 248 is one of the instances of
10 Nam's Insulating Layer 240. Correct?

11 A. Please repeat the question.

12 Q. Element 248 in Figure 8A is one of the
13 instances of Nam's Insulating Layers 240. Correct?

14 MR. WATSON: Objection. Vague.

15 THE WITNESS: Well, you know, I don't know why
16 you chose this figure to discuss, this question. Because
17 of the presence of the blue, they are extending, you
18 know, into another layer, which complicates the picture.

19 Would you restating your question in view of
20 Figure 8A on Page 75 of my report?

21 BY MR. HERMAN:

22 Q. No. I would rather discuss what's -- what's
23 after Paragraph 118.

24 So my question was: In Paragraph 118, is
25 Element 248 an instance of Nam's Insulating Layer 240?

1 MR. WATSON: Objection. Vague.

2 THE WITNESS: I didn't hear the last number
3 that you mentioned in your question. Please repeat your
4 question slowly.

5 BY MR. HERMAN:

6 Q. Is Element 248 in Figure 8A an instance of what
7 Nam calls Insulating Layer 240?

8 MR. WATSON: Objection. Form.

9 THE WITNESS: Okay. So I hear you saying 240.
10 You conclude your sentence with 240, and I'm a little
11 confused because I don't see a 240 anywhere in this
12 figure.

13 BY MR. HERMAN:

14 Q. So why don't we look at the Nam reference.

15 A. Okay. Sure.

16 Q. And maybe this can clarify the confusion.

17 A. Okay.

18 Q. So why don't you get that out.

19 A. Yeah, I have the Nam reference open. And what
20 figure do you want me to go?

21 Q. Actually, the specification, the -- the text of
22 the reference. Why --

23 A. Oh, the specification.

24 Q. The text part of the reference. Because the
25 text discusses both the Reference Number 240 and the

1 Reference Number 248.

2 So if you could turn to Paragraph 98 for me --
3 or actually, earlier in the specification. Why don't --
4 why don't you turn to Paragraph 63, which is Page 44.

5 A. I'm sorry. Am I looking at my declaration now
6 or...

7 Q. Of Nam. The Nam reference. So Nam reference,
8 Paragraph 63.

9 A. Okay. Sixty-three. Okay.

10 Q. Paragraph 63, let me know when you're there.

11 A. Yeah. I am there, yeah. I just reached that
12 point.

13 Q. It starts with the sentence of plurality of
14 Gate Electrode Layers 231 to 238. And then in
15 parentheses says:

16 "Gate electrode layers 230."

17 Do you see that?

18 A. Yes, I see that.

19 Q. So Nam refers to the gate electrode layers
20 generically with the numeral 230 and specifically, with
21 the more specific numbers 231 to 238?

22 A. Okay.

23 Q. And then at the end of the paragraph, Nam
24 references a plurality of Insulating Layers 241 to 248,
25 and then in parentheses, has the reference number 240.

1 Do you see that?

2 A. Okay. I see that.

3 Q. So Nam is referring to the insulating layers
4 that appear between gate electrode layers generically
5 with the number 240 and then more specifically, with the
6 numbers 241 through 248. True?

7 A. As confirmed by Figure 7, that appears to be
8 true.

9 Q. So now, if we go back to Paragraph 118?

10 A. Okay.

11 Q. Part of Insulating Layer 248 is -- is
12 highlighted in -- in that Figure 8A. Correct?

13 A. Yes. Part of 248 shown in this figure is -- is
14 highlighted, but the highlight extends also to other
15 layers.

16 Q. And -- and as we just noticed in
17 Paragraph 60 -- was it 69? -- 63, sorry -- 63 of Nam,
18 Layer 248 is an instance or one of Nam's Insulating
19 Layers 240. Correct?

20 A. That appears to be correct.

21 Q. And that Insulating Layer 248 is between Gate
22 Electrode Layers 238 and 237. True?

23 MR. WATSON: Objection. Form.

24 THE WITNESS: I would agree that 248 is between
25 238 and 237 in Figure 8A of Nam.

1 BY MR. HERMAN:

2 Q. Now, that colored version of Figure 8A, part of
3 Element 271, is also shown in blue. Correct?

4 A. Yes, that is correct.

5 Q. And Element 271 is Nam's interlayer insulating
6 layer. Correct?

7 MR. WATSON: Objection. Form.

8 THE WITNESS: Can you please point out to me
9 where Nam calls 271 an interlayer insulating layer? That
10 has a very specific meaning in these structures and I
11 want to know where he references that.

12 BY MR. HERMAN:

13 Q. So if you look at Paragraph 67 of Nam.

14 Let me know when you're there.

15 A. Yeah, I am there.

16 Q. That paragraph begins by stating:

17 "On the other hand, a first Interlayer
18 Insulating Layer 271 and may include" --
19 and then it continues.

20 Correct?

21 A. Okay. Yeah, I see that. So this is the first
22 interlayer insulating layer because the final structure
23 has an additional layer, insulating layer that at least
24 happens to common structures. Now, I don't recall if --
25 if Nam explicitly discusses this, but yeah. But it says

1 so in Paragraph 67, yes.

2 Q. And that -- that second interlayer insulating
3 layer that you're referring to is 272. Correct?

4 A. That is correct, yes.

5 Q. Now, going back to -- to Paragraph 118, though,
6 a portion of insurance layer 271 is -- is showing blue in
7 Figure 8A. Correct?

8 A. I think I answered that.

9 Q. So that is, yes, a portion of 271 is -- is
10 shown in blue. Is that what you said before?

11 A. Yes.

12 Q. And that portion of Insulating Layer 271 that's
13 shown in blue is adjacent to the blue highlighted
14 Layer 248. True?

15 MR. WATSON: Objection. Form.

16 THE WITNESS: Can you define "adjacent"?

17 BY MR. HERMAN:

18 Q. They're next to one another. Correct?

19 A. Well, the highlighted portion of Layer 271 is
20 adjacent to 248.

21 Q. Now, that blue highlighted insulation is all
22 also located below the plane formed by the bottom of
23 Conductive Layer 238, ignoring the contact pad that its
24 end, and above the plane formed by the top of Conductive
25 Layer 237. Again, excluding the contact pad at its end.

1 Right?

2 MR. WATSON: Objection. Form.

3 THE WITNESS: Well, this is an arbitrary
4 portion of Layer 271. I mean, 271 extends, you know,
5 about 238 and extends below 237. And as I'm showing
6 in -- in -- in the annotated Figure 7 on Page 75 of my
7 declaration, you know, it's, basically, something that
8 covers the entire structure.

9 I -- you know, I find the -- the -- the choice
10 of that portion of the 271 layer extremely arbitrary. So
11 I -- you know, I see no reason why someone would consider
12 only that portion of 271, for whatever purpose, so.

13 So -- so you're asking me now to -- to agree to
14 something that, you know, I don't see a reason why this
15 is selected like that on the inside. So I -- I -- I
16 don't know how to answer your question, frankly.

17 BY MR. HERMAN:

18 Q. So you do not know how to answer the question
19 of whether the blue insulation that's shown on the page
20 is located below the plane formed by the bottom of
21 Conductive Layer 238 and above the plane formed by
22 Conductive Layer 237? That is not a question that you
23 have considered and is a question that you now refuse to
24 consider. True?

25 MR. WATSON: Objection. Form.

1 THE WITNESS: Okay. So -- okay. The way I see
2 this figure is that the 271 portion that is highlighted,
3 it has an upper surface that is actually higher than the
4 bottom surface of the 238, you know? That's the way I
5 see it. So -- so the top surface of the 271 portion
6 highlighted in blue is about the bottom plane of -- of
7 238. And it's obvious to me here. I see it.

8 BY MR. HERMAN:

9 Q. I asked you, in my question, to exclude the
10 contact pad at the ends.

11 Did you hear that part of my question? Your
12 answer did not do that. True?

13 MR. WATSON: Objection. Form.

14 THE WITNESS: Sorry. This is so -- so
15 arbitrary. I mean, why would I exclude the -- the pad?
16 I mean, what kind of a question is this?

17 BY MR. HERMAN:

18 Q. Have you read the definition of "layer" in the
19 '666 patent?

20 A. Yes, I have read the definition of "layer" in
21 the '666 patent.

22 Q. Can you answer this question for me: The blue
23 that is in Figure 8A, is all of that blue below the plane
24 formed by the bottom of Conductive Layer 238, excluding
25 the contact pad at its end, and above the plane formed by

1 Conductive Layer 237, again, excluding the contact pad at
2 its end, is all of the blue between those two planes?

3 MR. WATSON: Objection. Vague.

4 THE WITNESS: So which part of 238 am I
5 excluding? What do you mean by excluding the -- the end?
6 Which part of the end?

7 BY MR. HERMAN:

8 Q. The contact pad at the end. Do you know what
9 I'm referring to when I say the contact pad the at the
10 end of 238 and the contact pad at the end of 237?

11 It's labeled in the figure. There's a portion
12 of 237 that has a thickness T1 and another portion that
13 has a thickness T2. I'm asking you to exclude the
14 portion that has the thickness T2 and has -- and only
15 include the portion that has the thickness T1.

16 Can you do that?

17 MR. WATSON: Objection. Vague.

18 THE WITNESS: Okay. Well, I'm -- I'm still
19 confused. Okay. So now, I look at these thicknesses,
20 which you didn't mention earlier. So you're asking me to
21 consider where the blue layer, is the combined blue
22 layer, with respect to 237 and 238, excluding what?
23 Excluding the entire bulge?

24 BY MR. HERMAN:

25 Q. Yes.

1 A. Both the one shown in full here and the one
2 shown partially above it?

3 Q. That's right.

4 A. Okay. Okay. So Figure 8A is part of Figure 7
5 above it in the patent. So would you put your question
6 in view of Figure 7 to me, please?

7 Q. So the top surface of the electrode 237 has a
8 portion that has a thickness T1. Correct?

9 A. Yes, I believe that is correct.

10 Q. And that surface forms a plane that extends
11 infinitely in all directions as a geometric concept.
12 True?

13 A. Well, I -- I disagree with that. I don't think
14 it extends infinitely. The layer has a specific, so to
15 say, depth in the -- in the Y direction.

16 Q. I'm talking about the geometric plane that is,
17 basically, flush with the top surface. That geometric
18 plane extends infinitely in all directions. Correct?

19 MR. WATSON: Objection. Vague.

20 BY MR. HERMAN:

21 Q. That's what a plane is, as a geometric concept.
22 True?

23 A. Okay. But you're asking me to exclude the
24 bulge. Right? So that plane cannot extend into the
25 bulge. So it's not infinite. It's limited at the bulge.

1 Q. I'm not asking you just to consider the top
2 surface. I'm asking you to consider the plane that
3 includes the top surface.

4 Do you understand what I'm asking?

5 A. Well, but that plane cannot extend to the right
6 because it intersects the bulge.

7 Q. So as a geometric concept, planes go on
8 forever, regardless of whether there's structure in
9 between. Correct?

10 A. Well, I would agree with that, but you're
11 asking me to exclude features that are part of this
12 structure. So I -- you know, I don't find this
13 appropriate.

14 Q. So this is not a question that you've
15 considered before. Whether you can identify planes in
16 Nam's figure and draw conclusions about insulation that
17 are located between planes. This is not an exercise that
18 you've engaged in before sitting here today? That seems
19 to be the impression that you're trying to leave with
20 your answers. True?

21 MR. WATSON: Objection. Form. Argumentative.

22 THE WITNESS: I -- I am trying to give you a
23 complete answer to your question. Right? So I've --
24 I've got to consider all the parameters that you're
25 giving me here. And you want me to consider a plane

1 there that is, basically, only a portion of Layer 237.

2 And then you tell me to exclude a part of Layer 237, an
3 integral part of it.

4 And, you know, I mean, I can think in terms of
5 geometrical, you know, grounding here, but -- but you're
6 limiting how this plane is extending. So, you know, if
7 your question, later on, includes whether it is about a
8 particular layer, you know, I've got to establish the
9 correct parameters that you are -- you want me to answer
10 your question to. I'll be happy to answer it, as long as
11 I understand what is it that you're including and what is
12 it that you're excluding.

13 BY MR. HERMAN:

14 Q. So in arriving at your opinions about Nam, have
15 you already engaged in the exercise of identifying the
16 plane that's formed by the top of Conductive Layer 237?
17 Have you done that already?

18 A. Well, that's a very specific question. I don't
19 remember what I've done in Nam. So give me some time to
20 consider what I have in here. Can I have ten minutes?

21 Q. Can you -- if you need that much time, you're
22 welcome to it.

23 A. Okay.

24 THE WITNESS: Okay. I don't know where we left
25 that, but I think your last question was if I have

1 considered the horizontal planes that define layer 237.

2 Am I correct in that?

3 BY MR. HERMAN:

4 Q. Yes.

5 A. Okay. So my recollection here is that I have
6 considered these planes before the bulge formation.

7 Q. And where is that --

8 A. When -- when these things are very clear. In
9 other words, what the structure looks like before you
10 form the bulges. Right? And you know how the bulges are
11 being made. So to begin with, we have Layer 237
12 extending all the way to the end of the bulge without the
13 bulge present. And then you put Layer 271 on top of it.

14 So this is a different structure from what is
15 shown in Figure 7. So in that case, the planes are very
16 well defined. There, you can, you know, argue, well, you
17 know, I'll be happy to answer your question, you know,
18 relating to that structure.

19 Once the bulges form, how you extend the plane
20 is -- is somewhat -- you know, it makes me uncomfortable.
21 I -- you know, I -- I see the plane intersecting the
22 bulge. So -- so do you want me to make an entirely
23 hypothetical argument in the absence of essential parts
24 of the structure to give you an answer? Is that what you
25 want me to do?

1 Q. Yes.

2 A. Okay. Well, then -- then -- then it's no
3 longer Nam. And it's, basically, a random structure
4 coming from, you know, an unrelated, you know, textbook
5 or -- or paper that describes a staircase structure.

6 And then it does not really -- it should not
7 really include Layer 271. So I can give you an answer,
8 if we consider Layers 237 and Layers 238 without the
9 bulges, okay, in the presence of Layer 248 and 247,
10 extending out, but the structure looks very, very
11 different from what is shown in Figure 7 or Figure 8A.
12 There, everything is clear geometrically.

13 Q. And in that hypothetical that you're talking
14 about, some of Layer 271 would be below the plane formed
15 by 238 and above the plane formed by 237. Correct?

16 A. Okay. So Layer 271 covers the entire
17 structure. It covers everything. Okay? It's a first
18 interlayer dielectric. It covers everything. So part of
19 it will always be above any plane relating to the contact
20 lines and always below any plane relating to the contact
21 line, you know.

22 If you care to go to Page 75 of my report,
23 where I highlighted Layer 271, you can see my argument
24 here. Because that layer covers the entire structure, so
25 it will always be a part above any plane you can see here

1 of the conductive lines and one always below, except for
2 maybe, you know, the -- the bottom structure -- I mean,
3 the -- the bottom right side of the annotated Figure 7 on
4 Page 75 of my report.

5 Q. So my question was a little bit different. My
6 question was whether there is a portion of 271 that is
7 both below the plane formed by the bottom of 238 and
8 above the plane formed by the top of 237.

9 Is there a portion of 271 that satisfies both
10 of those conditions?

11 A. Okay. May I restate your question the way I
12 understand it.

13 Q. Sure.

14 A. So I believe you're asking me whether a portion
15 of 271 layer is above Layer 237 before the bulge is
16 formed, above the upper surface of Layer 237, before the
17 bulge is formed. That's one part of your question.

18 And the second part is whether a portion of
19 271 -- and you need to tell me if this is the same
20 portion that we're talking about -- is below the bottom
21 surface of Layer 238, in its original form, without the
22 bulges?

23 Is that what you're asking me to do?

24 Q. Yes. Yeah. And, again, both of those
25 conditions need to be satisfied by the same portion.

1 Is there a portion that satisfies both of those
2 conditions?

3 A. Okay. Well, in the absence of bulges, talking
4 about the very hypothetical structure or maybe the
5 original structure of Nam, before the bulges are
6 forming -- I have to think a little bit more about it.

7 But -- but in -- in -- for that geometric
8 situation, there is a portion that seems to meet those
9 criteria, but you cannot extend this in the case of
10 bulges.

11 Q. Now, if we go back to Paragraph 118 of your
12 declaration, is the portion of 271 that's shown in blue
13 touching the contact pad at the end of Nam's
14 Electrode 237?

15 A. I'm sorry, I -- I just couldn't follow your
16 question. Please repeat it slowly.

17 Q. In that annotated version of Figure 8A that
18 appears in your Paragraph 118, is the blue annotated part
19 of Insulation 271 touching the contact pad at the end of
20 Nam's gate Electrode 237?

21 MR. WATSON: Objection. Form.

22 THE WITNESS: Okay. So now, this -- this
23 question is unrelated to what I said before because I was
24 referencing a structure that looks very different from
25 this figure. So this becomes very, very confusing.

1 Because the bulges are not supposed to be present, so

2 there are no contact pads in -- in my previous answer.

3 There are no contact pads in my previous answer.

4 So here now, you're asking me to -- to answer a
5 question that relates to the presence of the contact
6 pads.

7 BY MR. HERMAN:

8 Q. Yes. Different question.

9 A. Okay. Please restate the question, then, if it
10 is different.

11 Q. All right. So my different question is whether
12 in -- the figure in Paragraph 118, whether the blue
13 highlighted part of insulating Layer 271 is touching
14 Nam's contact pad at the end of Gate Electrode Layer 237?
15 Is it touching or is it not touching?

16 A. Well, I didn't highlight this -- this portion
17 here or this figure here. This was highlighted by
18 Dr. Lee -- or maybe I did. I'm now forgetting, I'm
19 sorry.

20 Okay. So when you talk about the end of 271,
21 do you mean that protrusion there, that peaks -- the peak
22 that points down? Is that what you're talking about?

23 Q. Anywhere. Is any of the blue highlighted
24 portion of 271 touching the contact pad at the end of
25 Layer 237?

1 MR. WATSON: Objection.

2 THE WITNESS: Well, what -- what -- what is --
3 sorry.

4 MR. WATSON: My objection, sorry.

5 Objection. Form.

6 Go ahead.

7 THE WITNESS: So what is the end of 271?

8 BY MR. HERMAN:

9 Q. I wasn't asking anything about the end of 271.
10 I just wanted to know whether there's contact between 271
11 and the contact pad at the end of 237. That's my only
12 question.

13 Is there contact between those two structures?

14 MR. WATSON: Objection. Form.

15 THE WITNESS: Well, 271 is the first interlayer
16 dielectric that is deposited on the original 237 line.
17 The one that excludes the -- the pad. Then there are
18 various processing steps that are purported to create an
19 etchable region that bulges out into the first interlayer
20 dielectric.

21 And when all of that is being removed, then you
22 are forming a layer there, which would have an interface
23 with whatever remains of the 271. You know, that
24 interface has been modified by the etching processes that
25 you are doing. So I'll -- so I think there is contact,

1 but it's mediated by an interface that may have different
2 properties from the original Layer 271.

3 BY MR. HERMAN:

4 Q. Excuse me. Now, if you could turn down to
5 Paragraph 123 for me.

6 A. Okay.

7 Q. You have another annotated figure at the end of
8 that paragraph.

9 Do you see that?

10 A. Yes, I do.

11 Q. And you've included an arrow and the words:
12 "Side surface of purported 'insulating layer.'"

13 Do you see that?

14 A. Yes, I see it.

15 Q. In your opinion, is that the only side surface
16 of the purported insulating layer?

17 A. Well, I think I mentioned it multiple times
18 that -- stated in my report that these are arbitrary
19 definitions or arbitrary selections of -- of parts of
20 Layer 271 with hindsight. You know, I disagree with
21 this.

22 I mean, if you want to consider 271, you have
23 to consider it in its entirety. You cannot just stop the
24 layer, you know, wherever you want. But my understanding
25 is that this -- this is what Dr. Lee claimed in his

1 deposition, that this is a new interpretation that he
2 came up to define, eventually, the combination of 248 and
3 a new part of 271 that defines, eventually, a dielectric
4 layer.

5 Well, I mean, if you take that definition, what
6 other side surface do I see? Yes, this is the only side
7 surface that I see here.

8 Okay. I disagree with all this approach. I
9 think it's completely, you know, hand-waving based on
10 your side. Yeah, I know, I'm looking, you know, for a
11 side surface here. And okay, well, if you select that,
12 that's the only side surface that I see.

13 Q. Now, if you could get out Exhibit 2008 again
14 for me. That's the Plummer textbook.

15 A. Yeah, one second.

16 Did you say 2008?

17 Q. Yeah, the Plummer textbook.

18 A. Okay. I opened it.

19 Q. And if you could turn to Page 563 for me. And
20 by 563, I mean 563 using the textbook's numbering, which
21 is on Page 148 of the PDF.

22 A. Yeah, I'm there.

23 Q. There's a section that begins on 563 entitled
24 "Silicon Dioxide Deposition." Correct?

25 A. Yes, I see that.

1 Q. And that section begins by noting that
2 deposited films of silicon dioxide are utilized
3 throughout silicon microelectronic structures, as
4 described in the CMOS process flow in Chapter 2, and
5 there's a parenthetical. Right?

6 A. I see that, yes.

7 Q. And that same paragraph that I just read from
8 goes on to state that:

9 "Silicon dioxide films are used for
10 dielectric to electrically separate
11 conducting regions, as well as for masks
12 against implantation and diffusion."

13 Is that right?

14 A. I read that, too, yes.

15 Q. The next paragraph says that:

16 "Most oxide films today are deposited
17 at relatively low temperatures, from 200
18 degrees celsius to 500 degrees celsius,
19 using CVD techniques."

20 Right?

21 A. I see that, too, yes.

22 Q. Now, turn over to the next page, 564.

23 A. Okay.

24 Q. There's a paragraph that begins:

25 "Silicon dioxide films deposited."

1 I think it's about the third full paragraph
2 down.

3 A. Okay.

4 Q. Then it goes on to say:

5 "Using LPCVD or APCVD at low
6 temperatures (less than 500 degrees
7 C)" --

8 A. Okay.

9 Q. (As read):
10 -- "can be nonstoichiometric and are
11 often porous."
12 Right?

13 A. I see that, yes.

14 Q. Now, silicon dioxide that is stoichiometric
15 will have exactly one atom of silicon for every two atoms
16 of oxygen. Correct?

17 A. Well, that describes a fully oxidized stable
18 oxide. That's correct.

19 Q. Now, the sentence I read in the middle of
20 Page 564 uses the word "nonstoichiometric." Correct?

21 A. That is correct, yes.

22 Q. A silicon oxide film that includes less than
23 two atoms of oxygen per atom of silicon would be
24 considered nonstoichiometric. True?

25 A. Well, you know, when these reactions occur,

1 there are bonds that, you know, are forming. And in the
2 end, you're supposed to get a material that, you know, is
3 stable and happy if you want to use it in this business.

4 So in this case, we're talking about,
5 basically, an -- a reaction that does not form a fully
6 oxidized oxide. Okay? So that means that there are
7 unhappy bonds there that will need to be -- to become
8 happy. They will need to bond to something. And what
9 they bond depends on your deposition chemistry.

10 So when we talk about nonstoichiometric oxide,
11 we're talking about an oxide that contains also an
12 additional element. For example, if you grow it from
13 silane, s-i-l-a-n-e, it will contain hydrogen. So it's
14 an amorphous hydrogenated silicon oxide, whose properties
15 will be different from a fully oxidized material.

16 So this material, for example, is extremely
17 defective. It has a band gap of 2.5 electro volts, as
18 compared to the fully oxidized silicon oxide, which has a
19 band gap of 9 electro volts. The smaller band gap means
20 that it's easier to produce electrons that can move in
21 this oxide.

22 So guess what, if you use this type of an oxide
23 in a 3D NAND structure, you're done. The structure will
24 never work because it will not be able to withstand the
25 electric fields that are forming during operation. It

1 will conduct and it will corrupt all your information.

2 So yes, you can form nonstoichiometric oxide,
3 no problem. But this is -- it will be a disaster if you
4 use it in 3D NAND structures or any structure where you
5 require a good dielectric. The only reason why silicon
6 works so well in microelectronics and nothing has been
7 able to surpass it, is the quality of the oxide that it
8 formed.

9 So in NAND structure, a 3D NAND structure,
10 similar to the ones at issue here, would not operate, in
11 my opinion, if you created a dielectric layer of, you
12 know, of a substance oxide. So that's all I will say.

13 So this just talks about, you know, a material
14 that actually is very interesting and, in fact, I have
15 done work on. Because depending on how you make it -- it
16 may have very different properties for an oxide. It may
17 be much more interesting because of that lower band gap,
18 because of its porosity. The porosity is actually key to
19 doing other things in -- in -- in -- in nanoscience and
20 nanoengineering, which I have done in my lab.

21 So yes, you know, okay. Well, I mean, so this
22 reference here just talks about the ability to form a
23 nonstoichiometric oxide, in general, for other research
24 reasons or maybe even practical reasons, if you really
25 want a highly defective oxide. But it has nothing to do

1 with a NAND structure. It will never be used in a NAND
2 structure. And I have been instructed never to say
3 "never" in depositions. But, you know, here is one that
4 I will stand my ground.

5 Q. So this is part of a textbook chapter that's
6 referring to deposited films of silicon oxide that are
7 utilized throughout silicon microelectronic structures.
8 Correct?

9 A. Well, I -- there are applications for amorphous
10 hydrogenated silicon oxide, similar to what is described
11 here. In the end, this is a textbook that describes the
12 entry to various forms of material. Yes, you can form,
13 you know, this kind of a material, but it's incompatible
14 with the structures we're talking here. That's the only
15 thing I'm pointing out.

16 I agree with what it's saying in here, that
17 this material, you know, can be made, can be deposited.
18 But it will never be on a -- on a NAND structure. It's
19 just incompatible. It's an unstable oxide. It's one
20 that when you hit the top, it will plaster and it will
21 form, you know, silicon nanocrystals and it will form
22 nonstoichiometric silicon oxide around them.

23 In other words, it's -- it's a metastable
24 material that is highly defective, highly porous. And,
25 again, porous incompatible with the structures that we're

1 talking about here.

2 Q. So this particular paragraph, in fact, this
3 entire section of this textbook says nothing about the
4 fact that a silicon dioxide film that is
5 nonstoichiometric will -- has the problems that you just
6 articulated. True?

7 A. Well, I am an expert in this field. I have
8 worked extensively with these materials and I am also
9 ground in chemistry and I -- that's my opinion.

10 Q. So your expertise allowed you to arrive at that
11 opinion? How about one of ordinary skill in the art
12 reading this that says silicon dioxide films can be
13 nonstoichiometric? Does the paragraph --

14 A. Okay.

15 Q. -- say anything beyond that?

16 MR. WATSON: Objection. Form.

17 THE WITNESS: All right. I'll answer that. So
18 when we begin any class on microelectronic, you begin
19 with silicon. You talked about its properties, about its
20 band gap, about why it's a good material. And -- and on
21 the same lecture during that beginning and introductory
22 lecture, you mention how important silicon dioxide is for
23 that material.

24 And it's the combination of the two, the
25 stability of the silicon dioxide with the silicon

1 properties that make this functional, that makes it
2 successful. There are a lot of other semiconductors that
3 behave better than silicon in various metrics, but they
4 don't have good oxides, so you can't do anything with
5 them.

6 So -- so a person of ordinary skill gets
7 drilled upon, hammering upon that, you know, the quality
8 of oxide you're going to make on any of these structures
9 has to be of that quality, unless you're targeting some
10 specific application where you need the porosity of
11 something unrelated to, eventually, some of the more
12 common structures that we talk about.

13 This is still the same subject. Okay. So
14 here, they mention it, you know, trying to cover, you
15 know, all bases and say that, yes, you can form, you
16 know, a -- a -- a suboxide if you want, which actually,
17 it's a different material. It's -- it's -- it's not
18 silicon oxide. Okay? Let's get that right.

19 What he is describing here is not a silicon
20 oxide material. Plummer is describing here, a material
21 that contains hydrogen in it. That's very different from
22 a material that contains silicon and oxygen. I told you
23 already some of the key properties that -- you know,
24 that -- that are different between these two materials.

25 So this is a different material that can be

1 used in some applications. Okay? I mean, if -- if I sit
2 here, I will give you a few applications of this
3 material, too. I told you I worked on it extensively on
4 this material because actually, the porosity is extremely
5 useful for other applications.

6 So -- okay. Well, I mean, this is a statement
7 in a textbook. They try to tell you that this material
8 is possible and they leave it up to you, to a person of
9 ordinary skill to use it. But a person of ordinary skill
10 who works on microelectronics and the kinds of devices
11 that we talk about, right, transistors that require
12 dielectric, the dielectric has to be super high quality,
13 you know, depending on where it goes, of course. Right?

14 And, you know, this whole case is about 3D NAND
15 structures and there, you want the -- the best quality
16 oxide you can get. In fact, I think -- I don't remember
17 now if it's the prior art of if it is the '666, but they
18 stipulate that you can use aluminum oxide because of its
19 stability, its extra stability.

20 So you want something that is compatible with
21 this technology. So in the abstract sense, yes, you can
22 make these things. I can make these things. I have
23 worked with this material. It's lovely when you're
24 doing, you know, porous structures, but it's unstable and
25 you have to deal with it, too.

1 So, okay. Well, you know, I see what you're
2 saying in this text. But, you know, I think this is
3 incompatible with the structures at issue here.

4 BY MR. HERMAN:

5 Q. So for instance, that sentence that we read,
6 "Silicon dioxide films deposited using LPCVD or APCVD at
7 low temperatures can be nonstoichiometric and are often
8 porous," does not reference hydrogen. Correct?

9 A. Well, that's correct, but there is a chemistry
10 that is forming this material. Right? And there are,
11 basically, chemistries that -- here, are prevalent in --
12 in doing this material. Although, there are additional
13 chemistries that, you know, people use.

14 So one is using saline. The other one is using
15 TEOS. The triortho- -- I forget now, the acronym. I'm
16 forgetting the acronym. Sorry. There is a chemical with
17 one silicon atom, four oxygen atoms and four ethylene
18 molecules that is call TEOS, tetraethyl orthosilicate,
19 TEOS, T-E-O-S.

20 And that material, guess what? Depending on
21 how you use it, it can actually incorporate carbon in the
22 oxide. So is this an oxide? Yes, it is an oxide that
23 contains carbon and hydrogen. Or depending on how you
24 run it, it can actually form pure silicon oxide.

25 All of these methods use CVD to deposit these

1 materials, whether it is LPCVD or APCVD. And, again,
2 depending on the temperature and how you run your
3 reactor, you can form solid oxides with good dielectric
4 properties or defective oxide that contains hydrogen,
5 contains carbon.

6 Okay. When we talk about a -- how -- a
7 nonstoichiometric oxide -- when we talk about a
8 nonstoichiometric oxide -- first of all, this is not
9 silicon dioxide. Right? Despite what this sentence
10 says. This sentence is wrong. It says:

11 "Silicone dioxide films deposited
12 using LPCVD and APCVD at low temperatures
13 can be nonstoichiometric."

14 You know, strictly speaking, this is incorrect
15 because silicon dioxide is stoichiometric. You said that
16 earlier in one of your, you know, questions.

17 However, if it's nonstoichiometric here, first
18 of all, why is it nonstoichiometric? And as I told you,
19 this will not be, you know, just one silicon and, you
20 know, one oxygen or any other, you know, substance here
21 because this thing is unstable, this thing is unhappy.
22 It's grown by -- by gas-phase molecules that contain
23 other stuff. That stuff becomes incorporated.

24 Person of ordinary skill know that, and they
25 get really indoctrinated on it because you -- you know,

1 depending on what you're doing, you don't want any of
2 these contaminants. Those contaminants tend to allow for
3 leakages and shorting. And they're incompatible with,
4 you know, transistors, incompatible with, you know,
5 microprocessors, incompatible with digital memories, all
6 digital memories that require a very good dielectric.

7 So, okay. Well, I mean, as a chemist, I
8 disagree with this sentence here. Right? This is not
9 silicon dioxide. But, you know, this is written by
10 electrical engineers who say, Okay, well, I mean, we
11 consider this to be nonstoichiometric. And then they
12 don't tell you what else is happening here, why they're
13 using this. And, you know -- okay. That's my position.

14 MR. HERMAN: So that's it. I don't have any
15 further questions.

16 MR. WATSON: I don't have anything further.

17 (Whereupon, at the hour of 12:56 p.m.,
18 the proceedings concluded.)

19 * * *
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KONSTANTINOS P. GIAPIS (Date)

STATE OF CALIFORNIA)
) ss.
COUNTY OF LOS ANGELES)

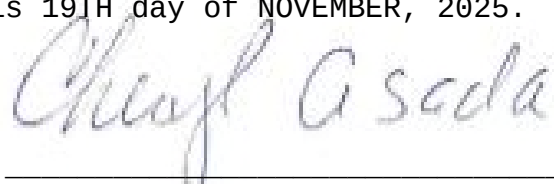
I, CHERYL ASADA, CSR No. 13496, certify: That
the foregoing proceedings were taken at the time and
place herein set forth; at which time the witness was
duly sworn; and that the transcript is a true record of
the testimony so given.

The dismantling, unsealing, or unbinding of the
original transcript will render the reporter's
certificate null and void.

I further certify that I am not financially
interested in the action, and I am not related to any of
the parties in this case.

Witness review, correction, and signature was
() By Code (X) Requested () Not requested.

Dated this 19TH day of NOVEMBER, 2025.



CHERYL ASADA, CSR 13496

	57:20	44 72:4
(	2023 8:2,4,18,21 9:7,9 10:13 56:19	
(a) 26:22,24 28:10,13	2025 4:2	5
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