

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 Nos. IPR2024-00788 & IPR2024-00909

U.S. Patent No. 10,658,378

DEPOSITION OF WOODWARD YANG, PH.D.

CONDUCTED REMOTELY

Tuesday, April 22, 2025

2:02 p.m. Pacific Time

Job No. 981040

Stenographically Reported By:

Lorie Rhyne, CSR, RPR, CRR

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U.S. Patent No. 10,658,378

REMOTE DEPOSITION OF WOODWARD YANG, PH.D.,
taken by Petitioner, held remotely via Zoom, before
Lorie Rhyne, a Certified Shorthand Reporter No. 12905,
Registered Professional Reporter and Certified Realtime
Reporter, in and for the State of California, commencing
on Tuesday, April 22, 2025, 2:02 p.m. Pacific Time.

(All Appearances via Videoconference)

APPEARANCES OF COUNSEL:

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BETSY GOMEZ

I N D E X

WITNESS: WOODWARD YANG, PH.D.

EXAMINATION	PAGE
By Mr. Sagdeo	6
By Mr. Cross	122

E X H I B I T S

EXHIBIT	DESCRIPTION	PAGE
Exhibit 1	Image	21
Exhibit 2	Diagram	26
Exhibit 3	7 pages, paper folded into an object	32
Exhibit 4	Photograph, hut and trees	44
Exhibit 5	Photograph, stairs	48
Exhibit 6	Image, children	53
Exhibit 7	Photograph, mayor of Boston	55
Exhibit 8	U.S. Patent 10,658,378	59

P R O C E E D I N G S

THE VIDEOGRAPHER: We are on the record on
April 22nd, 2025 at approximately 2:02 p.m. Pacific
Daylight Time for the remote video deposition of
Dr. Woodward Yang, Day 1, in the matter of
Micron Technology, Incorporated, vs. YMTC, Limited.

My name is Betsy Gomez, and I am the
videographer on behalf of Lexitas.

Will counsel please introduce themselves and
the party they represent beginning with the party
noticing this proceeding?

MR. SAGDEO: Parth Sagdeo with Orrick,
Herrington, representing Micron Technologies [sic].

MR. CROSS: Allen Cross with Ropes & Gray on
behalf of Yangtze Memory.

THE VIDEOGRAPHER: Will the court reporter
please swear in the witness?

THE STENOGRAPHER: Good morning. My name is
Lorie Rhyne. I am a California Certified Shorthand
Reporter and the deposition officer for today's
deposition. My CSR license number is 12905.

WOODWARD YANG, PH.D.,
having been duly sworn, testified as follows:

EXAMINATION

BY MR. SAGDEO:

Q. Hello, Dr. Yang.

A. Hello.

Q. Where are you at the moment?

A. I'm currently in Bangkok, Thailand.

Q. What time is it in Thailand?

A. 4:04 a.m.

Q. Uh-huh. Thank you for waking up or staying
up late for this.

What brings you to Thailand?

A. I actually have a second home in Thailand,
and so I travel back and forth between my home in
Boston to my second home here in Bangkok, back and
forth a lot. And currently I am on sabbatical.

Q. Is there anybody in the room with you?

A. No.

Q. Do you have any computers or documents or
other information in your presence right now other
than, I guess, the computer that's -- that you're using
to --

A. There is an iPad that is next to me as well
that is connected, and on it I have three documents
which are unmarked. It's the '378 patent and my two
declarations which are related to this matter, and all

1 three documents are unmarked.

2 Q. Because I'm not there with you, I'll ask
3 that you not look at that iPad unless I ask you to
4 specifically.

5 Is that okay?

6 A. Okay.

7 Q. And if you look at any documents besides a
8 document that I'm asking about, will you let me know?

9 A. Certainly.

10 Q. Have you been deposed before?

11 A. Yes.

12 Q. Do you understand that you've been
13 administered an oath?

14 A. Yes.

15 Q. Is it your understanding that you're obliged
16 to testify fully and truthfully as if you were in
17 court?

18 A. Yes.

19 Q. If I ask a question and you don't understand
20 it, please let me know and I'll either repeat it or
21 rephrase it.

22 Is that okay?

23 A. Yes.

24 Q. Are you under the influence of any drugs or
25 medication that would influence your ability to testify

1 fully and truthfully today?

2 A. No.

3 Q. Dr. Yang, how did you prepare for this
4 deposition?

5 A. Reviewed the documents very, very carefully.
6 Reviewed the materials -- reviewed my declaration,
7 reviewed the materials associated with the preparation
8 of my declaration again, and then I had some meetings
9 and discussions with counsel as well.

10 Q. How many times did you meet with counsel?

11 A. I don't -- I don't know what the context of
12 that is.

13 In preparation before this?

14 Q. In relation to this deposition.

15 A. In relation to this deposition. One, two --
16 two -- two and a half times.

17 Q. And what do you mean by "half"?

18 A. I think it was a very brief, five-minute
19 Zoom chat. So I don't know if that really counts as a
20 meeting, but that was kind of the -- the "half" time
21 that we met.

22 MR. CROSS: Dr. Yang, I'm going to object on
23 privilege to the extent that it call -- these questions
24 call for privileged information, so I ask that you
25 don't reveal any content of the discussions between the

1 attorneys and yourself. Thank you.

2 THE WITNESS: Yes, I'm trying to be careful.

3 BY MR. SAGDEO:

4 Q. Besides counsel, is there anyone you have
5 met with to discuss this case?

6 A. I'm not sure what the definition of
7 "counsel" is, but aside from anybody who's associated
8 with Ropes & Gray, no.

9 Q. And who at Ropes & Gray did you meet with in
10 the two and a half meetings that you mentioned earlier?

11 A. I met with Allen, I met with Chris Bonny and
12 I met with their associate, Mehmet Dogan. I hope
13 (crosstalk) --

14 Q. Who are you engaged by for your work on this
15 matter?

16 A. Pardon? I missed the last part.

17 Q. So you're -- you're -- are you in any sort
18 of contractual relationship regarding your work for --
19 on this matter?

20 A. Contractual relationship. Yes, I believe
21 that I'm being retained by YMTC through Ropes & Gray to
22 be their expert witness in this matter. I'm not sure
23 if that's what you mean by "contractual relationship."

24 Q. Did you sign a contract in relation to that
25 agreement?

1 A. Yes. There's a -- there's a -- there's a --
2 I don't know -- I -- I guess there's some sort of
3 document. I don't know if that -- I guess -- I don't
4 know. I'm not a lawyer. I don't know if that
5 constitutes contract, but there's a -- there's an
6 agreement between the two of us regarding the matter,
7 yes.

8 Q. Are you being compensated for your work on
9 this case?

10 A. Yes.

11 Q. What compensation are you receiving?

12 A. Roughly, the terms of it are \$900 an hour.

13 Q. Other than that hourly rate, is there any
14 compensation, either now or in the future, that you
15 might get in connection with this case?

16 A. No, no. It's only that. And it's only
17 related to perhaps additional expenses that I might
18 incur for things like travel related to this case.

19 Q. Have you been an expert in a patent case
20 before this one?

21 A. Yes.

22 Q. Roughly, how many times?

23 A. I -- I haven't counted directly. More than
24 10. Let's say less than 30 for patent and IP-related
25 cases.

1 Q. Are you familiar with the laws or the
2 standards around claim construction?

3 A. I'm not a lawyer, but I do understand some
4 things about the law, and with respect -- with regards
5 to this case, I've been informed by Ropes & Gray about
6 the aspects of the law that I should be aware.

7 Q. What do you understand the word "comprising"
8 to mean when it's used in a claim?

9 A. Comprising -- let's see. I'm not a lawyer,
10 so I'll try to get this correct.

11 Comprising means that it consists of
12 something but can also consist of something else.

13 Q. So, in your understanding, if a claim says
14 "a cup comprising water," that doesn't prevent the cup
15 from also including oil; right?

16 MR. CROSS: Objection. Form.

17 THE WITNESS: Yes, I think that's my
18 understanding of how the word "comprise" is used in
19 patent terminology.

20 BY MR. SAGDEO:

21 Q. And if -- if the claim says "a cup
22 comprising water," that doesn't prevent the cup -- or
23 sorry. Strike that.

24 If a claim says "a cup comprising water,"
25 that doesn't prevent water from existing outside of the

1 cup; right?

2 MR. CROSS: Objection. Form.

3 THE WITNESS: Yeah -- okay. So now you're
4 giving me sort of hypotheticals, and I think that's an
5 open-ended hypothetical.

6 If you have a claim construction, you'd have
7 to look at the overall specifications and sort of
8 understand what else was required in the specification.

9 But just the word "comprising" doesn't put
10 additional constraints. But you'd have to understand
11 how that word appeared within the claim within the
12 specification to understand whether there might be
13 other restrictions that are required. But the word
14 itself does not.

15 BY MR. SAGDEO:

16 Q. Okay. So just, I guess, putting aside any
17 other restrictions that come from elsewhere, I'll just
18 say -- you know, let's say in the specification or
19 the -- another part of the claim, if I have --
20 putting -- putting that aside.

21 If I have a claim that says "a cup
22 comprising water," that doesn't prevent water from
23 existing outside the cup; right?

24 MR. CROSS: Objection. Form. Asked and
25 answered.

1 THE WITNESS: I -- I think I answered that
2 already. I think that if you said -- just looking at
3 that phrase and nothing else, "cup comprising water,"
4 there is no constraint on what else could be part of
5 the cup or that water could be somewhere else.

6 BY MR. SAGDEO:

7 Q. Dr. Yang, would you say that being a
8 technical expert is your primary occupation?

9 A. No. Definitely not.

10 Q. What would you say is -- is your primary
11 occupation?

12 A. My primary occupation is that I am a faculty
13 member at Harvard University where I teach electrical
14 engineering and computer science. And I also pursue
15 sort of educational and -- or I should say work in
16 trying to develop curriculum that's related to teaching
17 technology as it's related to business, as it's related
18 to politics, as it's related to economics and things
19 like that.

20 Q. How long have you been at Harvard?

21 A. It's almost 35 years now.

22 Q. What's your favorite --

23 A. As a faculty member.

24 Q. Okay. I'm just curious -- you know, I know
25 it's probably changed a lot in the last 35 years -- but

1 what's currently your favorite restaurant in
2 Harvard Square?

3 A. Yeah, it's changed a lot, but probably
4 Pammy's. It's not in Harvard Square per se, it's just
5 off, but Pammy's is a very nice restaurant, but...

6 Q. When was your first experience with computer
7 memory?

8 A. I'm not sure what you mean by constitutes --
9 what constitutes "computer memory." I think my first
10 experience was probably working with a computer when I
11 was still extremely young. That would probably make
12 me -- I don't know -- junior -- junior high,
13 high school, and the computer had memory, so I'm not
14 sure what you mean by "computer memory." I mean that
15 was a long, long time ago.

16 Q. What about your first experience working,
17 what I might say as, under the hood, understanding --
18 you know, working on the memory itself and -- and how
19 it's designed, how it's put together?

20 A. Again, that's a very difficult thing to talk
21 about because, you know, my education, all the way
22 through college, involved all sorts of aspects of how
23 chips are designed, how those circuits work and how
24 those things are put together.

25 I would say probably the time that I had the

1 closest look, as you might say, quote, unquote, under
2 the hood, was probably when I was working at
3 Hyundai Electronics, which is now called Hynix,
4 SK Hynix, and I was a senior fellow there, and I
5 started probably in 1993 or so.

6 And at that time, I was privy to how DRAM
7 was manufactured, and the DRAM manufacturing
8 facility -- and I actually was -- I actually am the
9 originator of a lot of CMOS image sensor technology,
10 and what I did there was I actually modified the
11 manufacturing line for DRAM in order to make CMOS and
12 new sensors.

13 And so I would say at that time, that's
14 probably when I got my -- I rolled up my sleeves and
15 got my hands really dirty under the hood of a memory
16 manufacturing facility in how it's designed and
17 manufactured actually.

18 But before then -- you know, clearly my
19 education involved all sorts of aspects. You couldn't
20 do that without having an education before then.

21 Q. What about -- so I guess you mentioned DRAM
22 and -- and CCDs, but what about NAND flash memory?
23 What was -- when was your first experience with -- with
24 NAND flash?

25 A. NAND flash probably happened a little bit

1 later, probably in the late 1990s. And at that time, I
2 was working with Hyundai Electronics as well in order
3 to improve some of the circuitry that was involved with
4 their NAND flash and working on understanding the
5 reliability of their NAND flash and how it would
6 operate and things like that.

7 So I was looking at things like charge pumps
8 and its amps, and I was looking at kind of what was the
9 rewrite -- erase capabilities of their NAND flash, so
10 that probably started in the -- five or six years
11 later. Then I started with the DRAM and CMOS image
12 sensor.

13 Q. And when was your first experience with 3D
14 NAND flash memory?

15 A. 3D NAND flash memory is something that
16 happened a little bit later. It started -- I started
17 to become aware of what they were doing and what was
18 going on probably, I guess, in the later 2010s. And
19 that's when I was less involved with SK Hynix, and so
20 my involvement there has been not so much under the
21 hood but looking peripherally at things like
22 publications and textbooks about how those things are
23 done and reading other people's research reports.

24 Q. So you mentioned textbooks, research
25 reports.

1 Have you ever designed or, you know, worked
2 on a design of a 3D NAND flash memory?

3 A. I -- I don't know what you mean by "worked
4 on." Worked with. I don't think I was ever directly
5 in charge as much as I was, like, in charge of the CMOS
6 image sensor, but the design of 3D NAND flash, I have
7 been analyzing and looking at the circuitry and the
8 structures that are in 3D NAND flash for now several
9 years. Now it's become quite common, so it's something
10 to look at and discuss. It's actually something that I
11 teach in one -- in one of my courses, about how 3D NAND
12 flash was actually fabricated and manufactured.

13 Q. Are you comfortable answering questions
14 about the state of the art in flash memory as of 2018?

15 A. As of 2018? I think that I'm familiar. I
16 can't say I know everything. I don't think anybody
17 knows all the trade secrets that are involved, but I
18 believe I'm familiar with roughly where the state of
19 the art was for 3D NAND flash in 2018, yes.

20 Q. In that context, had -- have you ever heard
21 the term "substrate"?

22 MR. CROSS: Objection.

23 THE WITNESS: In which context?

24 BY MR. SAGDEO:

25 Q. In the context of NAND flash memory.

1 A. Yes. It's a -- it's a common term used in
2 semiconductor manufacturing.

3 Q. What do you understand that term to mean?

4 A. So just generally speaking in the context of
5 semiconductor manufacturing?

6 Q. Right. What -- what do you understand that
7 term to mean?

8 A. In the general terms of semiconductor
9 manufacturing, substrate, in general, refers to kind
10 of, like, the wafer. It refers to kind of the
11 substrate, the wafer, the thing on which processing
12 is -- is sort of performed. Things are done to it in
13 order to generate the final manufactured product.

14 Q. What is the substrate typically made out of
15 in the context of flash memory?

16 MR. CROSS: Objection. Form.

17 THE WITNESS: I think that if you're talking
18 about flash memory, meaning commercial semiconductor 3D
19 NAND flash devices, usually the starting wafer is
20 composed of something like silicon, but it can be
21 com- -- it can have additional materials with it. It
22 really depends on kind of what type of device you're
23 trying to make.

24 BY MR. SAGDEO:

25 Q. And what's the purpose of the substrate?

1 A. The purpose of the substrate is kind of
2 like -- it's the starting material on which further
3 processing is done, or it's the kind of ongoing piece
4 of work which has continually work being done to it.

5 Q. What -- what do you mean by work continuing
6 [sic] being done on it? In particular, I guess -- I
7 guess, could you give some examples of what you mean by
8 that?

9 A. I think you can -- I don't -- I'm not really
10 sure why we're sort of hashing this over, but to step
11 away from semiconductor manufacturing, you could think
12 of substrate as like a piece of wood if you were doing
13 woodworking. And so you can think of this original
14 piece of wood, and now you're going to do something to
15 it. Maybe you're going to drill a hole to it. Maybe
16 you're going to slice it. Maybe you're going to trim
17 an edge off. Maybe you're going to chisel a piece out.
18 Maybe you're going to put something else on it.

19 And so you can think of the substrate as an
20 original piece of wood, and as that piece of wood is
21 continuing to be developed into the final form that you
22 want it, has additional work being done it.

23 Does that help to explain, or would you like
24 me to explain it in terms of semiconductors? I'm --
25 I'm not really sure what it is you're trying to drive

1 at and, you know, I don't know how far back I have to
2 take -- take this. Do I have to go back to the
3 original meaning of words? I'm not sure exactly where
4 you want to go with this.

5 Q. I'm just trying to understand in the context
6 of, I guess, the -- the knowledge of a person of skill
7 what they -- what they understood a substrate to be
8 in -- in flash memory.

9 And kind -- kind of with that context, would
10 that -- would you amend anything about what you just
11 said?

12 MR. CROSS: Objection. Form.

13 THE WITNESS: So substrate -- in terms of
14 semiconductor manufacturing, of which 3D memory is
15 formed using semiconductor manufacturing technology,
16 substrate usually refers to some type of starting
17 material, like the wafer, and it refers to that wafer
18 as it continues to have work done to it. So it's --
19 for example, the '378 refers to the substrate as
20 something that has additional layers added to it or
21 patterned or -- or additional work being done to it.
22 So it's kind of like the starting wafer as well as kind
23 of its intermediate stages in between.

24 BY MR. SAGDEO:

25 Q. Let's see.

1 So, Dr. Yang, I've uploaded to the chat what
2 I'll mark as Exhibit 1.

3 (Exhibit 1 was marked for identification.)

4 BY MR. SAGDEO:

5 Q. It's -- it's an image.

6 Could you open it and let me know when you
7 have?

8 A. Bigger?

9 Q. Sorry. I didn't --

10 A. Yes.

11 Q. -- catch the --

12 A. Yes. It's a little small, but, yes, I'm
13 looking at it.

14 Q. Oh, okay. So do you understand what's being
15 illustrated in this diagram?

16 A. Roughly. I would say I'm familiar with
17 something that looks like this, yes.

18 Q. And how would you describe it?

19 A. It looks like an NMOS transistor and a PMOS
20 transistor. That's what the -- NMOS, that is, and the
21 PMOS, that is. And it looks like it has various pieces
22 of the structure of the NMOS transistor and PMOS
23 transistor labeled. I -- I believe I understand what
24 those are since those are terms that are sometimes
25 used, but there are also some unlabeled spaces that I'm

1 not sure what they are.

2 Q. Is there a substrate in this diagram?

3 MR. CROSS: Objection. Form.

4 THE WITNESS: I think that you have to be
5 very careful with how substrate is used, and you need
6 to understand when a person of skill in the art might
7 call something a substrate, and it refer -- it's
8 important to understand the context in which it's being
9 used.

10 So someone might refer to this as something
11 being -- a substrate is something like the gray thing
12 being the substrate. Some people might refer to the
13 entire thing, including the STI and the N+ and the P+
14 and the N-Tub and the P-Tub as being the substrate.
15 Some people might refer to the entire thing as being a
16 substrate, and it's important to understand the context
17 in which the term "substrate" is being used.

18 So, for example, if you want to talk about
19 this in terms of how this originally started, people
20 might say, Oh, this originally started with a silicon
21 substrate, which was not exactly shown there because
22 it's had stuff done to it.

23 Or they might refer to the entire thing as
24 being a substrate because they might be looking at the
25 entire thing and saying they want to actually do, like,

1 a multichip structure, in which case, the entire thing,
2 including stuff that's not even labeled, like the stuff
3 in gray, is also the substrate because they're talking
4 about the whole thing as being kind of a flip chip or
5 something that they want to attach to.

6 So I think that substrate is something that
7 a person of skill in the art would understand, but it
8 depends on the context in which it's being used.

9 BY MR. SAGDEO:

10 Q. Do you see on the -- I guess it's kind of at
11 the top on the left, NMOSFET?

12 What does that stand for?

13 A. I think I said that, NMOS. N, as N-type,
14 metal-oxide-semiconductor field-effect transistor, NMOS
15 effect. It's a mouthful.

16 Q. And so I guess the -- on the right, it would
17 be P-type metal-oxide-semiconductor field-effect
18 transistor; is that right?

19 A. Yes. Yes, that's correct.

20 Q. What does "STI" stand for?

21 A. STI --

22 MR. CROSS: Objection. Form.

23 THE WITNESS: STI usually -- and in this
24 particular figure, from the way that it's drawn, a
25 person of skill in the art probably would think that

1 that is a shallow trench isolation.

2 BY MR. SAGDEO:

3 Q. What is a shallow trench isolation
4 structure?

5 A. Well, it's supposed to mean literally what
6 it is, a shallow trench, although it doesn't look so
7 shallow. It actually looks kind of deep, but from the
8 way that it's manufactured, it's called a shallow
9 trench isolation.

10 And so a hole is dug into a semiconductor
11 substrate, and that hole is then subsequently filled
12 with oxide, and then something called chemical
13 mechanical polishing is done to flatten it back down.
14 And so you basically get this hole filled with oxide,
15 and that's called shallow trench isolation.

16 It's a way of separating -- in this
17 particular case, you could understand that it's a way
18 of separating the NMOS transistor so it doesn't
19 interfere with the operation of the PMOS transistor.

20 Q. What would happen if we didn't have a
21 shallow trench isolation, the -- the STI here, if it
22 didn't exist?

23 MR. CROSS: Objection. Form.

24 THE WITNESS: Yeah, that's sort of a
25 hypothetical. If you didn't have the STI, you'd have

1 to have another form of isolation.

2 Before shallow trench isolation, there was a
3 form of isolation that was called field oxide, and so
4 you just grow very thick oxide between them. If you
5 didn't have shallow trench isolation, you could
6 actually separate the two NMOS and PMOS transistors
7 very, very far away from each other, and then they
8 wouldn't interfere with each other.

9 If you were just to remove the shallow
10 trench isolation, just remove the oxide from it -- I
11 don't know. It depends on kind of what were the
12 surface conditions of that shallow trench isolation as
13 far as what would happen.

14 But, in general, the purpose of the shallow
15 trench isolation in this particular context is to
16 prevent -- if you look at this, you could see the N+ on
17 the right side of the NMOS transistor and you can see
18 the P-Tub, which is a P-type, and you can look at the
19 N-Tub. And if you look at that, that's actually an NPN
20 transistor.

21 And if you look at the PMOS transistor, if
22 you look at the P+ on the left side, that's P+, and
23 there's an N-Tub and there's P-Tub; that's actually a
24 PNP transistor. And if you actually look at the
25 circuit and how they're interconnected, it can actually

1 create a positive feedback loop, and that's something
2 called CMOS flash shot. And that can cause the entire
3 structure to sort of catch fire and literally burn.
4 And so the purpose of the isolation is to prevent that
5 from happening.

6 It's not funny, actually. It actually is a
7 cause for really serious problems when you put, for
8 example, these types of chips into space.

9 BY MR. SAGDEO:

10 Q. Good to know.

11 (Exhibit 2 was marked for identification.)

12 MR. SAGDEO: I've uploaded to the chat an
13 exhibit that I've marked Exhibit 2.

14 BY MR. SAGDEO:

15 Q. Could you open that up and let me know when
16 you have?

17 A. Can I put this away, or should --

18 Q. Sure.

19 A. -- I keep this as well?

20 Q. You can close it out or --

21 A. I can close it out. Okay.

22 Q. Yep.

23 A. Just not have too many windows.

24 Q. And I apologize if this is -- ends up being
25 small too, but if -- you can zoom in.

1 A. Yes, it's also small.

2 Yes.

3 Q. So what's being illustrated in this diagram?

4 A. Hard to say exactly because, again, this is
5 being taken out of context. It looks like this is kind
6 of the electric fields around what you would call a
7 capacitor, where you have two metal plates and a
8 dielectric in between, and it seems to be a capacitor.

9 But it's hard for me to say because you
10 require sort of the overall context. It could be just
11 two pieces of metal floating in the air.

12 Q. So one of the pieces of metal seems to be
13 labeled "Conductor (+)," and there's a bunch of plus
14 signs drawn on it.

15 What do you understand that to mean?

16 A. A conductor with plus signs on it. But, I
17 mean -- I mean, if you're saying what a person of skill
18 in the art in electrical engineering would look at this
19 or a person in physics would look at this, they would
20 guess that there's some positive charge on that
21 conductor. But, again, this is a figure without a
22 caption, so, you know, I -- I -- I'm reluctant to -- to
23 go much further than that.

24 If you tell me that's a conductor -- that's
25 representing a conductor with positive charge on it,

1 I'm happy with that.

2 Q. Okay. And -- and that would sort of match
3 your intuition as a person of skill, that it would be a
4 conductor with positive charge on it?

5 A. As a person with skill and who's looked at
6 thousands, if not maybe millions, of these diagrams, I
7 know not to say too much about the diagram that doesn't
8 have a caption on it because I've seen all sorts of
9 weird things being drawn in weird ways.

10 So that -- I'm just telling you what I would
11 guess. I just want to be careful and cautious about
12 what I testify to.

13 Q. Okay. Well, you know, you mentioned that
14 one -- and correct me if I'm wrong -- one possibility
15 is that this is a capacitor.

16 And if that is the case, then what do the
17 arrows -- I think -- you know, there's some arrows in
18 blue here.

19 What would they represent?

20 A. They seem to represent "E-field," for
21 electric field, as labeled in -- in the figure.

22 Q. Do you see where the figure says
23 "dielectric"?

24 A. Yes.

25 Q. What does that mean?

1 A. It seems to imply that there's a dielectric
2 between those two plates.

3 Q. What is a dielectric?

4 A. A dielectric is a material that is an
5 insulator and can have a different dielectric
6 permittivity than space.

7 So the material -- because it is not just
8 empty space, it's composed of atoms, those atoms have
9 nuclei and electric -- electrons circulating them, so
10 an electric -- electric field around them, they can
11 align with the electric field, and they can influence
12 the electric field or the electric displacement. And
13 so that's why they're called dielectrics.

14 They're typically insulators, and I'm
15 guessing it's indicating that there's a dielectric in
16 the area that's slightly shaded.

17 Q. You mentioned that the die- -- that
18 dielectrics are typically insulators.

19 Could a dielectric be a conductor?

20 A. Well, dielectric insulator is something that
21 usually goes together. There's this weird thing in
22 between that's called a semiconductor, which is between
23 an insulator and a conductor. And that's kind of a
24 lousy dielectric, but it has all sorts of interesting
25 properties. And basically all the electronics we're

1 using here today is based on semiconductor.

2 So I'm just -- let me just leave it at that.

3 Dielectric is usually an insulator and can be a
4 semiconductor. Some semiconductors can act like a
5 dielectric; depends on the temperature you use them and
6 the magnitude of the electric field.

7 I believe that some conductors can act as
8 dielectrics as well if you take them down to
9 sufficiently low temperatures and freeze things out and
10 do some strange things.

11 So, you know -- and there's -- my colleagues
12 do all sorts of interesting research which can change
13 how certain properties behave.

14 So let's just say a dielectric is usually an
15 insulator.

16 Q. Let me sort of pick at that a little bit.

17 It's -- what it sounds like when you're
18 saying a conductor can be a dielectric, it seems more
19 like, you know, if you make the conductor, in effect,
20 into an insulator by freezing it or doing something to
21 it, either an insulator or something other than a
22 conductor, then it can be a dielectric.

23 Is that fair to say?

24 A. I'm just saying the materials that are
25 typically classified as insulator or conductor or

1 semiconductor, depending upon how they're used,
2 depending upon the conditions that they're used and --
3 sometimes change their electric properties. And so you
4 would need to understand how they're being used to say
5 whether that is -- that material is going to act as a
6 dielectric or not.

7 And just because it's labeled as a conductor
8 under certain conditions doesn't mean that it may not
9 be a dielectric under other conditions.

10 Q. Let me pick an example. Let's, you know --
11 I'm going to try to pick an example that I think is
12 very clearly a conductor, something like copper or
13 something.

14 If we put copper where it's labeled
15 "Dielectric," would this figure work as it's -- it's
16 sort of illustrated?

17 MR. CROSS: Objection. Form.

18 THE WITNESS: I'm -- I'm not sure because
19 that's incomplete. I believe that if we're talking
20 about room temperature and we're talking about electric
21 fields that are in the range that normal people use
22 today, like, you might find an electro- -- electric --
23 a normal electrical device, like your computer, I think
24 that copper then acts as a conductor. And so copper in
25 that particular case would be a conductor, and it would

1 not act as a dielectric.

2 I think that the condition that I'm talking
3 about is -- for example, there are materials such as
4 germanium, which is a semiconductor, and if you take it
5 up to something rather hot, it acts more like a
6 conductor than it does a dielectric. And that
7 semiconductor, if you make it very cold, will act
8 probably more like a dielectric than as a conductor.

9 (Exhibit 3 was marked for identification.)

10 BY MR. SAGDEO:

11 Q. So, Dr. Yang, I've uploaded to the chat
12 something I've marked as Exhibit 3.

13 Could you open that up and let me know when
14 you have?

15 A. So I can close out this document?

16 Q. Yes.

17 A. Okay.

18 Okay.

19 Q. So there are, I believe, seven pages in this
20 document.

21 A. Okay.

22 Q. Could you flip through and let me know when
23 you have?

24 A. Okay. So one, two, three, four, five, six,
25 seven, yes. I think I see seven -- seven photos, yes.

1 Q. And what -- as a whole, I guess, what --
2 what does this document appear to show, in your view?

3 A. Photographs of a piece of paper.

4 Q. Okay. And the final photo -- what does that
5 look like to you?

6 A. It looks like a piece of paper that's been
7 folded into some type of object.

8 Q. Would it -- would you disagree that it sort
9 of looks like a paper airplane?

10 A. I believe that one could construe that as
11 being a paper airplane.

12 Q. Would you construe it that way?

13 A. Perhaps, but I think you have to be careful
14 and -- right. I don't want to leap to conclusions. I
15 take it for what it is.

16 Q. Okay. Based on your, I guess, expertise in
17 engineering, would you expect that it would function as
18 a paper airplane?

19 MR. CROSS: Objection. Relevance.

20 THE WITNESS: I don't think I'm an expert on
21 paper airplanes. I don't know if this end object at
22 the end is really the sequence of everything that was
23 shown. I can't say I know exactly where the center of
24 mass of that thing is. I don't know if it would really
25 fly. I don't -- I think there's many -- there's many

1 open questions. I -- I just am looking at the document
2 for the first time, and so I just want to be careful.

3 BY MR. SAGDEO:

4 Q. Okay. Let me -- let me represent or ask you
5 to assume for -- for present purposes that it is a
6 paper airplane.

7 A. Okay.

8 Q. This -- this paper airplane is made of a
9 single sheet of paper; right?

10 A. I believe that the sequence of photos tries
11 to demonstrate that, yes.

12 Q. Does this paper airplane have wings?

13 MR. CROSS: Objection. Relevance.

14 THE WITNESS: I -- I think you want me to
15 assume a lot of things here about kind of what is a
16 wing or what is not a wing -- what's a wing; what's a
17 flap; what's a fuselage. I guess it has some things
18 that you could call wings, sure.

19 I'm not really sure where you want to go
20 with this.

21 BY MR. SAGDEO:

22 Q. Well, I mean, I'm just asking as someone --
23 I -- I don't even think you necessarily need to be,
24 like, a person of skill to answer this question.

25 But I -- I think -- I just wanted to know,

1 like, does it -- does it look like it has wings? I
2 mean, are you able to just, like, say one way or the
3 other whether this thing that is in page 7 of -- of
4 Exhibit 3 -- whether that thing looks like it has
5 wings?

6 MR. CROSS: Objection. Relevance.

7 THE WITNESS: I think that I'm here to give
8 rather serious testimony about a patent that's at
9 issue. But if you want me to talk about a paper
10 airplane as sort of a normal person who's just walked
11 off the street and is looking at a picture of a paper
12 airplane on a desk, yes, it looks like a paper airplane
13 that has wings.

14 BY MR. SAGDEO:

15 Q. And what would the purpose of those wings
16 be?

17 MR. CROSS: Objection. Form. Relevance.
18 Scope.

19 THE WITNESS: It depends what you want to
20 use this paper airplane for.

21 BY MR. SAGDEO:

22 Q. Well, let's say I want --

23 A. There's reason to --

24 Q. -- to throw it.

25 A. There's -- exactly. So I hope you

1 understand you're giving me incomplete hypotheticals,
2 and I'm trying to answer you precisely as a person
3 should, as I'm under oath to do. I'm trying to answer
4 you precisely with your questions. Your question here
5 is very open-ended.

6 What is a wing for? Well, it could be to
7 help it fly to give it lift. It could be to make it
8 look good. Maybe this is more an origami thing. It
9 could be as an exhibit in a deposition for a trial.

10 So I'm not really sure what it is you want
11 to do with this. So if you gave me a little bit more
12 context, then I can try to give you a little bit more
13 of a description. I'm just trying to be careful to
14 limit my answer to the context that you're giving me.
15 That's all.

16 Q. Okay. Well --

17 A. I'm not trying to be --

18 Q. And if there is context you feel is
19 necessary to answer the question, let me know.

20 And to -- to answer the question -- I guess
21 answer the question that you posed, let's say the
22 context is this is a paper airplane. Its purpose is I
23 want to throw it, and I want it to go far away and fly.

24 Does -- does that help you answer the
25 question?

1 MR. CROSS: Objection. Form. Relevance.
2 Scope.

3 THE WITNESS: It can. I'm not sure what the
4 question is, though.

5 BY MR. SAGDEO:

6 Q. Okay. Given the context I've given you
7 about it being a paper airplane and it's -- it being
8 functional, not just some sort of origami thing that
9 looks cool, in that -- with that context, what are the
10 purpose of the plane's wings?

11 MR. CROSS: Objection. Form. Relevance.
12 Scope. Lacks foundation.

13 THE WITNESS: It's -- the purpose of the
14 wings -- probably to give it lift so it can fly.

15 BY MR. SAGDEO:

16 Q. I seem to see there's also a nose of -- or I
17 don't know. You might call it something else.

18 But essentially the front of the -- the
19 plane, which I'll call a nose; right?

20 A. Okay. If we assume the front of the plane
21 is on the left, yes.

22 Q. Okay. Fair -- fair enough.

23 And so given the context that I've
24 mentioned, what's the purpose of the plane's nose?

25 MR. CROSS: Objection. Relevance. Scope.

1 Form.

2 THE WITNESS: Within the context that you'd
3 like this to fly?

4 BY MR. SAGDEO:

5 Q. Right.

6 A. As -- my understanding is of someone who's
7 played with paper airplanes before, you probably need
8 to adjust where the center of mass is. And so the
9 purpose of the nose is probably to make sure that it's
10 aerodynamically streamlined so you're not creating too
11 much drag.

12 The other thing is to probably adjust where
13 the center of mass of the airplane is so it's properly
14 balanced. So you can make sure that the center of mass
15 is properly adjusted to where you're going to get the
16 lift forces on the wings.

17 And so, you know, the nose can have many
18 purposes.

19 Q. And I see that --

20 A. They're --

21 Q. Oh, go ahead.

22 A. They're all interrelated as far as how it
23 functions, so...

24 Q. So I notice that --

25 A. Or how --

1 Q. Okay. Sorry. I don't mean to interrupt
2 you. Go ahead.

3 A. Or how it's meant to function. I'm not even
4 sure if it functions.

5 Q. So the wings -- at the ends of the wings,
6 there seem to be -- there seems to be another fold, and
7 I think you might have called it a flap. I might call
8 it, like, a wing tip.

9 Do you see that?

10 A. Yes.

11 Q. Given the context that I mentioned earlier,
12 what -- what purpose do these wing tips serve?

13 MR. CROSS: Objection. Form. Relevance.

14 THE WITNESS: I think --

15 MR. CROSS: Scope.

16 THE WITNESS: I think they can serve many
17 different purposes. You can think of them perhaps as
18 trying to provide some directional -- I don't know what
19 it's called -- directional stability so it's -- it's
20 flying straight.

21 I believe that if you actually look at those
22 wing tips, you can see similar types of wing tips on,
23 for example, real commercial jetliners, and those
24 purposes are actually to reduce vertices that come off
25 the edge -- edges of the wing tips. I don't think a

1 paper airplane goes so fast that you need to worry
2 about this, but this is not my area of expertise. I
3 would refer instead to my colleagues who teach fluid
4 dynamics and aerodynamics, but I believe that is a
5 concern that they do have.

6 So I believe that they don't serve just one
7 function. They can serve multiple functions. And it
8 depends on how all those things are sort of integrated
9 and how it all sort of behaves together.

10 So it's hard to assign one particular
11 function to one particular thing that you observe in a
12 photograph.

13 BY MR. SAGDEO:

14 Q. Fair enough.

15 I -- you know, I guess is it fair to say
16 that these different parts of the -- the plane have
17 different functions?

18 MR. CROSS: Objection. Form. Relevance.
19 Scope.

20 THE WITNESS: Yeah. I think you can say for
21 any type of device that it has different parts. How
22 those different parts are put together affects how it
23 functions. And those functions need to somehow be
24 symbiotic or compatible in order for the entire device
25 to sort of fulfill its design or desired objectives.

1 BY MR. SAGDEO:

2 Q. All right. I think you can -- you can close
3 out of Exhibit 3. Just have some other questions.

4 Dr. Yang, have you ever heard the word
5 "structure" in ordinary conversation?

6 MR. CROSS: Objection. Form.

7 THE WITNESS: Sure. Yes.

8 BY MR. SAGDEO:

9 Q. How do you define the word "structure"?

10 A. As what? As in ordinary conversation? As a
11 dictionary would define it? As the '378 uses it?

12 Could you provide some context here again
13 for me?

14 Q. Let's say as someone who is of skill in the
15 art but let's say hasn't seen the '378 patent or is
16 just talking in sort of a general context.

17 A. Skill in the art of what?

18 Q. Flash memory.

19 A. Flash memory. Okay.

20 So we're talking about somebody who's of
21 skill in the art in semiconductor manufacturing
22 technology. A structure, then, for them would be
23 probably -- just talking about it, you would just say
24 that that was -- that was the gate structure that was
25 the -- whatever structure -- so it's -- it's probably

1 something that has been put together. It's the result
2 of some type of sequence of fabrication processes.

3 So -- and somehow it's some type of -- if
4 you say "a structure," it implies that it's going to be
5 something that's kind of a unit or put together.

6 Or if it's going to be multiple structures,
7 then, you know, it starts to get into some nuances
8 about structure, structures, but something that's
9 somehow manufactured and put together.

10 Q. What about in sort of common parlance,
11 not -- not necessarily in the, like, semiconductor
12 context, but just as, you know, speaking casually?
13 Would you change your definition in any way?

14 A. No. Not really.

15 MR. CROSS: Objection. Form.

16 THE WITNESS: No. Not really. I think that
17 you just have to be careful, right.

18 So if I look at a house, you can say it's
19 the structure of a house. But if now I was looking at
20 an entire neighborhood and I was looking at how that
21 neighborhood had been damaged by a tornado, I would say
22 multiple house structures were damaged, right? So it's
23 not just the one structure.

24 So I think you have to be careful about
25 whether a structure is one thing or whether it's

1 multiple things. It is something that is some -- put
2 together or constructed.

3 BY MR. SAGDEO:

4 Q. Can a neighborhood have a structure?

5 MR. CROSS: Objection. Relevance. Scope.

6 THE WITNESS: Or you can talk about kind of
7 the overall hierarchy of things. Structures are things
8 that have hierarchies. So -- but you'd have to then
9 identify that I'm talking about the structure of a
10 neighborhood, not the structure of a house.

11 BY MR. SAGDEO:

12 Q. Is -- is a wall an example of a structure?

13 MR. CROSS: Objection.

14 THE WITNESS: A wall --

15 MR. CROSS: Form.

16 THE WITNESS: A wall can be an example of a
17 structure, but, again, it depends upon what it is you
18 want to talk about because a wall could be composed,
19 for example, of -- what do they call it? -- the gypsum
20 board, right, you know, that has paper on two sides and
21 the plaster in the middle. So that also is a structure
22 in and of itself as well.

23 So structures can be composed of structures,
24 and so I would want to be careful about what you might
25 want to call a structure. But a structure is something

1 that is sort of put together, seen as a unit, and it
2 can be composed of other structures. It's a very
3 general term.

4 (Exhibit 4 was marked for identification.)

5 MR. SAGDEO: So I've -- let's see.

6 I've uploaded to the chat a photo that I've
7 marked Exhibit 4.

8 BY MR. SAGDEO:

9 Q. Dr. Yang, could you open that one up?

10 A. Yes.

11 Q. What does this photo depict?

12 MR. CROSS: Objection. Form. Relevance.

13 Scope.

14 THE WITNESS: Seems like it's a picture of
15 something outside. There seems to be trees. There
16 seems to be some things made out of wood. There seems
17 to be some kind of -- I don't know -- house type of
18 thing.

19 I'm not exactly sure how you want me to
20 describe it. It's just -- right, in terms of what? In
21 the context of what?

22 BY MR. SAGDEO:

23 Q. Let me be more specific.

24 Can you describe the components of the wall
25 structure in this photo?

1 MR. CROSS: Objection. Lacks foundation.
2 Relevance. Scope.

3 THE WITNESS: Could you identify what you
4 mean as "the wall structure"?

5 BY MR. SAGDEO:

6 Q. Well, let me ask you.

7 I mean, just looking at the photo, can
8 you -- do you see anything that appears to be a wall
9 structure?

10 A. I see --

11 MR. CROSS: Objection. Relevance.

12 THE WITNESS: I see many things that appear
13 to be a wall structure.

14 BY MR. SAGDEO:

15 Q. Which things?

16 A. Well, I -- I mean, I'm just giving you this
17 off the fly. I believe that the building in back seems
18 to have some type of wall structure. I -- I don't
19 know. It would be easiest if I can point. I don't --
20 can I -- is it possible for me to point in -- in this
21 deposition?

22 Q. I am not exactly sure, but if you want to
23 share your screen and then use your mouse.

24 A. Okay. I'm -- I'm fine with that.

25 Q. And we'll try to make sure that we describe

1 things in a way that the court reporter can pick up.

2 A. Okay. So can you see this? So there's this
3 white thing that has writing on it.

4 Q. Sorry. I can't see anything right now.

5 A. Oh, you can't?

6 Q. Okay. Now I can.

7 A. Can you see the cross where my mouse is?
8 Can you see this white thing with the writing on it in
9 the building in back?

10 MR. CROSS: Appears to be a building.

11 MR. SAGDEO: Yeah, so just for the record,
12 this is -- it looks like it's a building, and then
13 there's an -- like, an opening into the building. And
14 then around the opening into the building is -- is
15 something that Dr. Yang is -- is pointing to.

16 BY MR. SAGDEO:

17 Q. Is that fair?

18 A. All right. Yes. There's a white -- it's
19 white; and then the thing that's next to white is kind
20 of, I guess, earth in color.

21 Q. Okay.

22 A. And it -- it's that structure that could be
23 considered a wall, I think.

24 Q. Okay.

25 A. I think.

1 Okay?

2 Q. Uh-huh.

3 A. I believe that there are these kind of
4 wooden posts here (indicating) that seem to be pieces
5 of trees, right, trunks of trees. This whole thing
6 could be considered a type of wall or a fence. I'm not
7 sure what you want to call a wall, what definition of
8 "wall" is.

9 I believe that this over here (indicating),
10 where you have these stakes in the ground in the front
11 and you have sort of these smaller branches sort of
12 woven in between them, this could also be considered a
13 type of wall as well.

14 So I think it depends on what your
15 definition of "wall" is. And so I'm just -- just
16 trying to be careful about what I call a wall and not
17 being off the cuff.

18 Q. So to just focus on the second wall
19 structure you identified, it sounds like the components
20 of that wall structure are the vertical wooden posts;
21 is that right?

22 MR. CROSS: Objection. Form. Relevance.

23 THE WITNESS: I would say a component of
24 that are the wooden posts, yes. The wall -- how about
25 this? The wall is comprised of wooden posts.

1 BY MR. SAGDEO:

2 Q. I like that. Getting back to something we
3 covered earlier.

4 (Exhibit 5 was marked for identification.)

5 BY MR. SAGDEO:

6 Q. So, Dr. Yang, I have uploaded -- I hope I
7 got this numbering right. I think I -- I think I did.

8 I've uploaded what I've marked as Exhibit 5.

9 Could you open that up? You can close the
10 previous exhibit, and you can open that one up. And
11 just let me know when you have.

12 A. Yes.

13 Q. What does this photo depict?

14 A. The interior of a building.

15 Q. Do you see a staircase structure in -- in
16 this photo?

17 MR. CROSS: Objection. Form.

18 THE WITNESS: I would say it appears to be a
19 staircase, but form doesn't always follow function. It
20 might be a decoration.

21 I've worked with architects. You have to be
22 very careful. Sometimes what they -- what they build
23 isn't actually functional.

24 It seems to be a staircase. It would be a
25 staircase if it would -- if it was used to get to

1 another floor, which there appears to be, but I think
2 that there's a lot of contexts and a lot of assumptions
3 for what it is. If you represent to me that it's a
4 staircase, I'm -- I'd be willing to accept that.

5 BY MR. SAGDEO:

6 Q. I'll -- I'll represent to you that it's used
7 to get from one floor to another.

8 Can you describe the components of this
9 staircase structure?

10 MR. CROSS: Objection. Form. Lacks
11 foundation.

12 THE WITNESS: I think it's hard for me to
13 say all the components of the staircase because I don't
14 actually know the insides and how it's constructed. So
15 just looking at the picture, it might be difficult to
16 tell you all the components.

17 But I believe that the staircase is
18 comprised of what you might see as kind of those wooden
19 steps that are those horizontal brown things going
20 across and kind of at an angle going up. It's
21 comprised of that, but it's comprised of other things
22 as well. But it's hard for me to tell what they are
23 because they're sort of buried in the wall, and I don't
24 know what the -- everything else is.

25 //

1 BY MR. SAGDEO:

2 Q. Would you -- I guess what's your sense for
3 what other things could be in the staircase structure?

4 MR. CROSS: Objection. Form. Lacks
5 foundation.

6 THE WITNESS: I'm just guessing, but I don't
7 think these wooden things float there by themselves or
8 just are glued to the wall. There probably needs to be
9 a rather strong anchoring structure built into the
10 wall. Perhaps these are pieces of steel, steel beams
11 that are built into the wall that are then subsequently
12 covered by the wall so you can't see them. Those would
13 probably be integral to the staircase structure.

14 I think that, you know, just because it's
15 sticking out of the wall doesn't mean I want to step on
16 it, right. It might collapse.

17 So what is it -- what else is there? It's
18 hard to say. But what's obv- -- what's clearly
19 visible, you can say -- the visible part is -- is the
20 wooden brown steps.

21 So I think we've been going for about an
22 hour.

23 Would it be possible to take a break at some
24 point?

25 MR. SAGDEO: Sure. Now would be a good time

1 if, Allen, that works for you too?

2 MR. CROSS: Yep, that works.

3 THE VIDEOGRAPHER: The time is 3:05 p.m.,
4 and we are going off the record.

5 (A brief recess is taken from 3:05 p.m. to
6 3:16 p.m.)

7 THE VIDEOGRAPHER: The time is 3:16 p.m.,
8 and we are going on the record.

9 BY MR. SAGDEO:

10 Q. Welcome back, Dr. Yang.

11 A. Hello.

12 Q. Did you speak with Counsel at all during the
13 break?

14 A. Yes.

15 Q. Was it about the substance of the
16 deposition?

17 A. No. It was kind of like, What's the weather
18 like in D.C.? It's still before sunrise here in
19 Bangkok.

20 Q. Fair enough.

21 I'd like to ask you to turn back to
22 Exhibit 4, which was the -- yeah, I think you should
23 probably still have it in the Zoom chat. Nothing else.

24 A. Is it the staircase?

25 Q. No. It's the one -- we had talked about a

1 wall.

2 A. Oh, the wall. The -- oh, oh. Okay. Yes.

3 I closed it out, but I'll open it again,

4 yes.

5 Q. Thanks. Just let me know when you have it.

6 A. I have it now.

7 Q. The one thing I wanted to just follow up on
8 is you've mentioned that the -- the wall structure
9 comprises these wooden posts. And I wanted to ask if
10 there's anything else in -- in the wall.

11 A. Probably the --

12 MR. CROSS: Objection. Form.

13 THE WITNESS: I mean, it -- it depends on
14 what your definition of "wall" is. But the wooden
15 posts are not standing up by themselves. They're
16 embedded in the earth, it appears. And so it would
17 seem like the earth is an important aspect of that
18 wall, but, again, it's going to depend upon what your
19 definition of "wall" is. But I believe that the ground
20 and the earth play a role in how deep those stakes are
21 in the earth.

22 BY MR. SAGDEO:

23 Q. Would you say that the earth is part of the
24 wall?

25 A. I think we'll have to be careful about what

1 you mean "part of" and what are the other parts, so
2 it's all an issue of context.

3 I think it's fair to say that if the stakes
4 weren't embedded into the earth, if the sticks were
5 just sort of -- those stakes were just sort of standing
6 there, they'd probably fall over. Probably fall over.
7 I -- I don't know. I'm -- you have to be careful. I
8 don't want to overstep my bounds.

9 (Exhibit 6 was marked for identification.)

10 MR. SAGDEO: So I've uploaded another
11 exhibit to the chat. This is Exhibit 6.

12 BY MR. SAGDEO:

13 Q. Could you open it up and let me know when
14 you have?

15 A. Okay.

16 Q. Dr. Yang, would you say that in this photo,
17 the boy is with the girl?

18 MR. CROSS: Objection. Form. Relevance.
19 Lacks foundation.

20 THE WITNESS: I -- I think that it depends
21 exactly what -- the context, right. What -- what does
22 "with" mean in this particular case? You could also
23 say the boy is holding hands with the girl. You could
24 say the boy is accompanying the girl. You can say the
25 girl is accompanying the boy.

1 So, you know, it's a -- it's a particular
2 image. . It's taken out of context. I would like to
3 understand exactly how "with" is being used and the
4 context of "with."

5 But if we were just talking just kind of out
6 in the open, just kind of normal conversation, yes, I
7 think you could say "with."

8 BY MR. SAGDEO:

9 Q. So just to restate.

10 In normal conversation, it would be fair to
11 say that the boy is with the girl?

12 MR. CROSS: Objection. Asked and answered.

13 THE WITNESS: Right. With no other context,
14 you could say that they are walking together, even.

15 BY MR. SAGDEO:

16 Q. Sure. I'm just trying to, you know, get a
17 direct answer to my question, which is, in ordinary
18 conversation, we could say that the boy is with the
19 girl --

20 MR. CROSS: Objection. Form.

21 BY MR. SAGDEO:

22 Q. -- right?

23 MR. CROSS: Asked and answered.

24 THE WITNESS: I think I've already answered
25 it.

1 BY MR. SAGDEO:

2 Q. Is the answer yes?

3 MR. CROSS: Objection. Form.

4 THE WITNESS: No. It -- I think the answer
5 is -- my previous answer, we've said without any other
6 context, just looking at this in normal conversation
7 without also understanding how "with" has been
8 previously used, you could say that the boy is with the
9 girl.

10 (Exhibit 7 was marked for identification.)

11 MR. SAGDEO: I've uploaded to the chat a
12 photo that I've marked Exhibit 7.

13 BY MR. SAGDEO:

14 Q. Dr. Yang, could you open that photo and let
15 me know when you have?

16 A. Can I close this one?

17 Q. Yes.

18 A. Yes.

19 Q. Do you know who this photo is of?

20 A. I'm not confident. I can guess. I'm not
21 sure. I don't know -- I don't know the person.

22 Q. Well, let me represent it's of Michelle Wu,
23 who is the mayor of Boston.

24 A. Yes, that's what I thought, but I didn't
25 want to -- I didn't want to guess and be wrong.

1 Q. Maybe you're spending too much time in
2 Thailand; I don't know. Never mind. Strike that.

3 But do you -- so my question is -- let's say
4 that Mayor Wu travels to Washington, D.C., to meet with
5 President Trump.

6 When she is at the White House, is she still
7 mayor of Boston?

8 MR. CROSS: Objection. Form. Relevance.
9 Scope.

10 THE WITNESS: I -- I don't think -- I don't
11 know. It depends how "mayor of Boston" -- I don't -- I
12 don't know what you mean by "mayor of Boston."

13 Does "mayor of Boston" come with certain
14 rights and privileges and -- and abilities? I don't
15 know -- I'm not familiar with kind of what
16 jurisdictional law is.

17 Are you just talking about this as kind of a
18 label, right? Is she still Michelle Wu if she goes to
19 another country? I don't know. They might call her a
20 different name if she goes -- they might call her by
21 her Chinese name, for example, if she goes to China.

22 So it all depends on what you mean by the
23 context of the label "mayor of Boston" and what comes
24 with that label.

25 //

1 BY MR. SAGDEO:

2 Q. Just in ordinary conversation, if you saw
3 her walking around in D.C., would you say, Oh, hey,
4 that's the mayor of Boston?

5 MR. CROSS: Objection. Form. Relevance.
6 And scope.

7 THE WITNESS: Probably in normal
8 conversation you can say, Oh, I saw Michelle Wu, the
9 mayor of Boston, walking around in D.C. I think you
10 could say that. That would be just sort of the label
11 of what the person is. It's not of which Michelle Wu
12 that is. Maybe not talking about what sort of legal
13 rights and privileges she might have, which may or may
14 not apply in D.C. or in the White House.

15 BY MR. SAGDEO:

16 Q. Let me, you know, provide another example.
17 I don't have a photo this time.

18 But have you heard of someone called
19 Joan of Arc?

20 A. Yes. I believe a historical figure.

21 Is that who you're talking about?

22 Q. Yes.

23 A. Okay.

24 Q. Do you know where Joan of Arc is from?

25 A. I don't recall exactly, no.

1 Q. Let me represent that she's from Arc. And
2 let's say Joan of Arc is going to battle the English
3 near Paris, which is outside of her hometown of Arc.

4 Is she still Joan of Arc?

5 MR. CROSS: Objection. Relevance. Scope.

6 THE WITNESS: It depends on what -- I mean,
7 if you say that the name is an identifier, then her
8 identity usually doesn't change if her location
9 changes. But it all depends upon what is the meaning
10 of that identifier and what is the location and, you
11 know, kind of what is the function that she's
12 performing. She might have a different name or a
13 different thing depending upon where she is and what
14 people say she's doing at that particular time.

15 BY MR. SAGDEO:

16 Q. So that is --

17 A. What's in the name, right?

18 Q. I guess let me ask you just, like, you know,
19 would it be fair to call her Joan of Arc if she is near
20 Paris and not in Arc?

21 MR. CROSS: Objection. Relevance. Scope.

22 THE WITNESS: In normal conversation, it
23 seems fair, yes.

24 Could I give you a counterfactual?

25 //

1 BY MR. SAGDEO:

2 Q. Sure.

3 A. So let's say Joan of Arc were sainted.

4 Q. I think she was, but go ahead.

5 A. So if she is then Saint Joan and -- just
6 referring to her as "Joan of Arc" might be improper.

7 Do -- do you understand what I'm saying?
8 It's the same -- technically speaking, we can say
9 that's a label for that person. That label is
10 appropriate. But how you're supposed to address them
11 might change within the context of where they are.

12 Q. Okay.

13 (Exhibit 8 was marked for identification.)

14 MR. SAGDEO: I've uploaded to the chat
15 another exhibit which I've marked Exhibit 8.

16 BY MR. SAGDEO:

17 Q. Dr. Yang, could you open that one up?

18 A. Yes.

19 Can I close the previous one?

20 Q. Yes, please.

21 A. Okay.

22 Q. So is it -- is this the '378 patent?

23 A. Yes, it appears to be.

24 Q. When was the first time that you saw the
25 '378 patent?

1 A. Last year, 2024 sometime. I don't recall
2 the exact date.

3 Q. Have you read the '378 patent?

4 A. Since then, yes, many times.

5 Q. Would you say that you understand the '378
6 patent?

7 A. I would say that I've tried my best to
8 understand it, yes.

9 Q. Having tried your best, would you say that
10 you do understand it?

11 A. I'm sure you've read this patent many times
12 as well, and one of the things that I'm always struck
13 by is that every time I read a patent over and over
14 again, it sort of reveals a little bit more, and
15 there's just a little bit more precise way of
16 understanding them.

17 And so I would say -- I'm going to be very
18 careful to say I completely understand it. I'm going
19 to say I've tried to develop my best understanding
20 possible and that, as I read it and understand it, I
21 try to understand it more and more.

22 There can be new information that comes to
23 light after you read a patent that can change your
24 understanding of it; for example, prior art. In
25 addition, there could be things like claim

1 constructions, which, as a lawyer, you would understand
2 are a matter of law and, therefore, are -- are not a
3 technical matter. And so as that matter of law, I then
4 have to understand what that claim construction is. So
5 it can then change my understanding of what the patent
6 is when the Court says that I must adopt that claim
7 construction.

8 So I would say I have an understanding. I'm
9 not going to say it's absolute nor complete, nor do I
10 think anybody can honestly say that they have an
11 absolute and complete understanding of the patent.

12 Q. Did you review the '378 patent in preparing
13 for this deposition?

14 A. Yes.

15 Q. Dr. Yang, can you turn to Figure 1B? And
16 let me know when you're there.

17 A. Yes.

18 Q. Do you see a label "110"?

19 A. Yes.

20 Q. What is 110?

21 A. Okay. I'd -- I'd like to look at the patent
22 specifically and -- and go through it to get the exact
23 wording because exact wording is important.

24 Q. Go ahead.

25 A. I don't want to just go off --

1 Q. Sure. Take your time.

2 A. Thank you.

3 So the exact wording that's used is NAND
4 string regions.

5 Q. So the figure -- I'm going back to
6 Figure 1B. The figure includes a label "112" inside
7 region 110.

8 Do you see that?

9 A. Yes.

10 Q. What is 112?

11 A. Again, please permit me to get the exact
12 wording.

13 Q. Go ahead.

14 A. NAND strings is what they call those.

15 Q. What are the purpose of NAND strings 112?

16 A. The NAND strings in 112, or in this 3D
17 memory here that's being described, is actually a
18 series string of transistors, and each one of those
19 transistors in that NAND string can store some memory.
20 Sometimes it's one bit. Sometimes it's up to two or
21 three bits that can be stored per cell.

22 And so that string -- we're looking at the
23 top of it -- is a string of memory cells.

24 Q. And what function, I guess, do the NAND
25 strings 112 serve?

1 A. That's the flash memory. That's where your
2 picture goes. They program those cells to be the
3 various bits that encode every pixel of your picture.

4 Q. Figure B -- strike that.

5 Figure 1B also includes a label "114" inside
6 region 110.

7 Do you see that?

8 A. Yes.

9 Q. What is 114? And feel free to look at the
10 specification.

11 A. 114 -- specifically the wording they use is
12 slit structures.

13 Q. What are the purpose of the slit structures
14 114?

15 MR. CROSS: Objection. Form.

16 THE WITNESS: The problem with the slit
17 structures is it that -- in the '378, is they're just
18 roughly described as being there, and they have a
19 multirange of purposes.

20 And so reading the '378 and also had --
21 being a person of skill in the art -- a person of skill
22 in the art would understand slit structures serve
23 multiple purposes. One of the purposes is that they
24 serve as the axis point for the gate replacement
25 process.

1 So they serve as the process for replacing a
2 sacrificial dielectric layer and then replacing it with
3 a metal. So that can be that word -- word line or
4 conductive plate.

5 And the other thing they can also serve for
6 is they can also serve after some additional --
7 post-processing, they can also serve as a contact to
8 something that's called the common source. So down to
9 the substrate, they can act as an additional contact
10 down there. So they serve multiple purposes.

11 They also serve the purpose of breaking up
12 the memory array structure into blocks. So they
13 actually end up cutting the word lines, and so they end
14 up cutting the memory array into blocks as well. So
15 they serve multiple functions amongst -- that's just a
16 few of them. I think they serve -- I think they have
17 more. I -- that's just the ones that come off the top
18 of my head.

19 BY MR. SAGDEO:

20 Q. In the -- in the '378 patent, are there any
21 other functions or purposes that slit structures 114
22 serve?

23 A. Yes. I think the slit structures are also
24 used to separate -- sometimes they're used to separate
25 the top select gates, I believe. I mean, they can --

1 they serve many functions. I just gave you the -- the
2 main ones that they do.

3 It's sort of an integral element. It's
4 doing many different things. And it serves those
5 functions in particular, but probably more, and it
6 depends.

7 The '378 may not talk about them, but a
8 person of skill in the art may use them in different
9 ways as well.

10 Q. Okay. And just to get a -- sort of an
11 accounting of the -- I think you mentioned four
12 purposes: an axis point for gate replacement, to
13 provide a common source contact, breaking up memory
14 array structures into blocks and providing access for
15 the top select gates.

16 Do I have that right?

17 A. The last one, no. I think it helps to split
18 the memory array into top select gates, I -- sometimes.

19 They can also serve as additional contacts
20 to the substrate, so not only to the common source but
21 also to different other functions inside down into
22 substrates, so they can serve almost as something like
23 a through array contact as well, depending upon how
24 they're post-processed.

25 Q. Does the '378 patent describe that last

1 purpose that you mentioned?

2 A. I think they mention that they can be used
3 that way. Or even if they don't mention it, I think a
4 person of skill in the art would also know that they
5 could be used that way as well.

6 Q. Are there any other purposes or functions
7 that you can think of, of -- of the slit structures?

8 A. It's hard to say in sort of a vacuum, but I
9 think that if -- and just -- and just in looking at
10 Figure 1B. But I think that if I were to see more
11 designs, I could maybe see how the -- the slit
12 structure is maybe being used for other functions as
13 well.

14 Q. Okay. So --

15 A. I just -- I can't -- I can't come up with
16 them right off the top of my head right now.

17 Q. Okay. So just getting back to Figure 1B. I
18 see that region 110 also includes a label for "122."

19 Do you see that?

20 A. Yes.

21 Q. What is 122?

22 A. So if you don't mind, I'd like to just get
23 the exact wording.

24 Q. Sure.

25 A. So 122 goes by two different names; just

1 to -- just want to confirm this: nonelectrically
2 functional channel structures and dummy channel
3 structures.

4 Q. What is the purpose of the -- I'll just call
5 them dummy channel structures?

6 A. I think that they serve multiple purposes.
7 One is that they can just serve as kind of a natural
8 spacing because contacts aren't made to -- for -- made
9 to them.

10 The other thing is that they serve as --
11 they also serve as sort of structural support. So by
12 making the channel in them, they help support the --
13 the replacement dielectric layer that has to be etched
14 out and put back in. It provides sort of a physical
15 support for that sort of alternating dielectric
16 structure during that intermediate replacement process.

17 So I think spacing as well as physical
18 support.

19 They're nonelectrically connected, so they
20 don't serve any sort of electrical function as far as
21 actually storing memory. That's why they're called
22 dummy.

23 Q. What do you mean by -- I think you used the
24 phrase "natural spacing" or just "spacing."

25 Like, why -- I mean -- I guess could you say

1 a bit more about what that function is?

2 A. Sure.

3 One of the tightest things to make in
4 contact -- in a NAND array to make things as small as
5 possible, one of the pitch-limiting things is the --
6 the pitch of the bit lines. And the bit lines in this
7 particular case, you can see from Figure 1B, are
8 running vertically in the BL direction.

9 And so these -- you need to put basically
10 four of them -- roughly four of them over one
11 particular NAND cell -- so you can imagine the bit
12 lines are extremely small -- and then they need to go
13 down to touch the NAND string.

14 And so in order to do that, that's making
15 really, really tiny holes in a really, really tight
16 space. And having kind of that natural space of dummy
17 cells kind of occurring every fourth kind of allows
18 some sort of relaxation, and it gives sort of a buffer
19 for how you might want to slap over the contacts and
20 the bit lines. And so it's -- it's a little bit useful
21 to have that as well, as well as having the physical
22 support.

23 That's what I mean by the natural spacing.
24 You put them there, but you don't need to contact them.

25 Q. Does the NAND string region 110 also include

1 an alternating conductor dielectric layer stack?

2 MR. CROSS: Objection. Form.

3 THE WITNESS: In the finally produced
4 device, that region that's labeled as 110 in Figure 1B
5 will have in the z-direction, going down into the page,
6 an alternating conductor dielectric stack. That's
7 where the NAND strings will be.

8 I have to look a little bit more carefully
9 to understand if Figure 1B is simply kind of an
10 intermediate step or not or is -- or are they referring
11 to the final device. But in the final device, there
12 will be an alternating conductor dielectric stack in
13 the final device in that region.

14 BY MR. SAGDEO:

15 Q. Got it.

16 So is it fair to say that -- there are more
17 than just NAND strings in region 110; right?

18 A. Certainly. I mean, you can see that there
19 are slit structures, there are NAND strings and there
20 are dummy channel structures, at least.

21 Q. Dr. Yang, could I have you turn to Column 5,
22 lines 65 to 67? Could you let me know when you're
23 there?

24 A. Could -- could you tell me the line numbers
25 again?

1 Q. Yeah.

2 Column 5 and -- I guess the sentence
3 starting on line 65.

4 A. "TAC region 102"?

5 Q. Yep.

6 A. Yes.

7 Q. So do you see where it says:

8 "TAC region 102 includes NAND
9 string regions 110"?

10 A. Yes.

11 Q. So what this means is everything in NAND
12 string region 110 is in TAC region 102; right?

13 A. No. I think that this is -- this is an
14 example of some unfortunate wording in the '378 patent.

15 And if you just follow the next word over,
16 it goes "a TAC region 120." So it's a little bit
17 confusing where it goes:

18 "TAC region 102 includes NAND
19 strings 110 and" -- not "and," comma:
20 -- "a TAC region 120 and top
21 select [sic] (TSG) stare gate [sic]
22 region 130."

23 And so you can see they've labeled "TAC
24 region" twice: TAC region 102 and a TAC region 120. I
25 think -- so this is why I said, you know, your --

1 your -- your evolution -- your understanding of a
2 patent evolves over time as you read it more and more
3 carefully.

4 I think what they were trying to say is this
5 102 represents the overall -- represents the kind of
6 exemplary idea of where a TAC region is.

7 Q. So is --

8 A. That's actually -- that's actually referring
9 to 1A, not 1B.

10 Q. Okay. So in -- in 1A, it sounds like there
11 are essentially two things described as TAC regions,
12 TAC region 102 and TAC region 120; is that right?

13 A. That's -- that's fair, yes.

14 Q. And when we're just talking about TAC region
15 102, that TAC region includes NAND string regions 110?

16 A. I think what they mean -- and a person of
17 skill in the art would understand what they mean -- is
18 they're trying to show an exemplary sort of region that
19 incorporates a TAC.

20 And in reading and understanding the whole
21 specification of '378, a person of skill in the art
22 would understand that a TAC region, which is
23 specifically a claim ele- -- a claimed element within
24 the claims, is actually 120, and that should be inside
25 of 120, which is the dielectric structure, which they

1 actually also call the TAC region.

2 Q. Could you turn back to, I guess, Figure 2
3 and let me know when you're there?

4 A. Yes.

5 Q. Do you see element 210?

6 A. Tell me where 210 is.

7 Q. It's in the -- on the left side --

8 A. Oh. Oh, Figure 2. I'm sorry. I thought
9 you said "1B," so yeah.

10 Figure 2, 210, yes.

11 Q. So what -- what is element 210?

12 A. If you don't mind, I'd like to just make
13 sure I get the exact wording.

14 Q. Sure.

15 A. Alternating conductor/dielectric stack is
16 what they call 210.

17 Q. What is the -- the purpose of the
18 alternating conductor/dielectric stack?

19 A. The purpose of -- well, one of the purposes
20 of the alternating conductor/dielectric stack is that
21 it helps to form those string of sort of transistors in
22 the NAND string channel. And so that's one of its
23 purposes.

24 So the conductor is actually forming a gate,
25 and the dielectric is forming the spacing between the

1 individual devices. That's one of the functions it
2 performs.

3 Q. Are there any other functions you can think
4 of?

5 A. Sure. The conductors have to serve as word
6 lines. The dielectrics need to separate the word
7 lines; otherwise, the word lines would be shorted.

8 I mean the fact that it's a staircase
9 also -- I mean the fact that it's a stack also means
10 that there has to be a staircase structure. So the
11 fact that it's a stack also necess- -- makes a
12 convenient way of attaching to the stack the staircase.

13 So, I mean, we're talking about a piece and
14 how -- what its function is. It's hard to say that it
15 has a single function. All these things need to fit
16 together, right. It's like a puzzle. So this piece is
17 here. Why is it here?

18 Well, its function is to be here.

19 Well, no. It's actually there because
20 something else needs to fit to it.

21 So that -- that's all I'm trying to explain,
22 is that whole context.

23 Q. Okay. So just to enumerate some of the
24 things you mentioned, the functions of the stack
25 include essentially serving as the gates for the -- for

1 the transistors that are storing data. They are a --
2 conductors that it -- that form word lines, and
3 eventually they -- I guess they end up as a staircase,
4 which lets you connect those word lines to elsewhere, I
5 guess.

6 Is that -- is that fair to say?

7 A. Yes. I think that's -- that's a reasonable
8 sort of summary of the -- of some of the functions that
9 I've mentioned.

10 Q. Are there any functions that I missed?

11 A. So I'll -- I'll reword that.

12 Those are a fair summary of the functions
13 that I mentioned. I believe that there might be more.
14 There could be more if I want to sit here and sort of
15 think about this a little bit more, but...

16 Q. Just kind of based on your familiarity with
17 the '378 patent, are you able to identify any other
18 functions, you know, at the moment?

19 A. I can't say that there's anything that
20 immediately comes to mind, but I want to just say that
21 any particular element that you're looking at, such as
22 the alternating conductor/dielectric stack, is kind of
23 a piece of the whole device. And so, you know, with
24 respect to something else, some -- the function of it
25 can become immediately apparent.

1 But I -- I -- just looking at it now,
2 there's just so many pieces it's hard for me to say
3 what is the function of the conductor/dielectric stack.
4 There's just too many -- too many possible things to
5 think about. I -- I don't want to just sort of go down
6 some rat hole and just sort of -- I mean, if you were
7 to give me something more specific, I could tell you
8 what its function is with respect to something else.

9 Q. Could you turn to Column 8, line 19? And
10 just let me know when you're -- when you're there.

11 A. The sentence that starts "In some
12 embodiments"?

13 Q. Right. So the sentence reads, and correct
14 me if I'm wrong:

15 "In some embodiments, the number
16 of the conductor/dielectric layer pairs
17 in the alternating conductor/dielectric
18 stack 210 (e.g., 32, 64 or 96) defines
19 the number of memory cells in 3D memory
20 device 200."

21 Did I get that right?

22 A. Yes.

23 Q. What do you understand that sentence to
24 mean?

25 A. That's related to what I talked about before

1 as far as the alternating conductor/dielectric stack
2 forms the gates in the string.

3 So if you wanted to say, for example, how
4 many -- this is a perfect example. If you wanted to
5 say, How many memory cells are there? well, the
6 conductor/dielectric stack defines the number.

7 And so, you know, there's just too many
8 things to sort of say everything. But, you know,
9 that's obvious, and that's related to what I said as
10 far as the conductor/dielectric stack forms the gates.
11 Each one of them forms a device.

12 Q. So is it accurate to say that if there are
13 32 layer pairs as -- you know, as one of the examples
14 given, then the entire 3D memory device 200 has 32
15 memory cells?

16 MR. CROSS: Objection.

17 THE WITNESS: The entire memory device 200?
18 Could you tell me what you mean by "200" and where?

19 BY MR. SAGDEO:

20 Q. Well, so the sentence says -- and I'll just
21 read it again:

22 "In some embodiments, the number
23 of the conductor/dielectric layer pairs
24 in alternating" --

25 THE STENOGRAPHER: Wait. Can you slow down?

1 Can you slow down just a little bit?

2 MR. SAGDEO: Oh, I'm sorry.

3 BY MR. SAGDEO:

4 Q. In some --

5 (Stenographer clarification.)

6 MR. SAGDEO: I'll -- I'll just start from --
7 from the beginning of the sentence.

8 BY MR. SAGDEO:

9 Q. "In some embodiments, the number
10 of the conductor/dielectric layer pairs
11 in alternating conductor/dielectric
12 stack 210 (e.g., 32, 64, or 96) defines
13 the number of memory cells in 3D memory
14 device 200."

15 So --

16 A. I believe -- yes.

17 Q. Go ahead.

18 A. Okay. Go ahead.

19 Q. I guess my question is -- so I'll just --
20 and I think your question, Dr. Yang, was what is 3D
21 memory device 200? And I think that is shown in
22 Figure 2.

23 So if -- I'll have you turn to Figure 2, and
24 then 200 is -- is just this arrow that, I think, points
25 to just the whole thing.

1 A. That's correct.

2 Q. So if there are 32 layers in this
3 alternating stack, does that mean that the memory
4 device as a whole has 32 cells?

5 A. There's a lot of implementation details that
6 are involved in there. And I think it's -- means
7 30- -- not 32 layers, but it probably is referring to
8 32 layer pairs because each pair makes one device. It
9 may or may not have 32 memory cells. It's going to
10 depend exactly on how the NAND string is configured.

11 So you can actually see this in the
12 Figure 2. So it seems as though the lowest pair seems
13 to be sticking into the epi region pedestal. And it
14 might actually being -- being used to serve as select
15 gate or not. I don't know.

16 Usually the topmost layer, the one that's
17 closest to the 204, that one might also be used as a
18 top select gate, which is used to decide which part of
19 the memory array is being accessed. And so then the
20 sub- -- subset of the 32 layer pairs are actually used
21 for memory.

22 And I believe that it's not accurate to say
23 that 200 means that the entire thing only has 32 memory
24 cells or 96 memory cells. Again, the top and the
25 bottom may or may not be used as memory cells. In

1 addition, that's only referring to a -- one given
2 string in 200. So that might refer to only maybe the
3 string on the left or the string on the right. That
4 would have -- if it were 32 layers -- I didn't count --
5 but if there are 32 layers, maybe the top and the
6 bottom one aren't -- are being used for selects, so
7 it's only 32 are actually being used for memory cells,
8 and it would only refer to 30 memory cells in a given
9 NAND string.

10 But that's roughly the idea of what's going
11 on, and a person of skill in the art would understand
12 that's -- that's the way you would use it because
13 that's the efficient way to use it.

14 Strictly speaking, I guess you could use 32
15 memory cells, but you'd be wasting a lot of other
16 circuitry on peripheral circuitry in order to use the
17 extra cell at the top and the extra cell at the bottom
18 rather than being clever.

19 There's a lot of design details.

20 BY MR. SAGDEO:

21 Q. Got it.

22 So I think what I'm hearing you say is
23 although the sentence says that the number of layers
24 defines the number of cells and, you know, uses the
25 word "defines," really what it's saying is that the

1 number of layers is one factor in determining the
2 number of cells in the whole device; right?

3 MR. CROSS: Objection. Form.

4 THE WITNESS: I would say the number of
5 layers defines the maximum number of cells possible in
6 a string in 200. That would be the more accurate way
7 of saying that. But a person of skill in the art would
8 understand that that's what they were talking about.

9 BY MR. SAGDEO:

10 Q. Got it.

11 So then when we're talking about the number
12 of cells in the whole memory device, it's -- you take
13 the -- the number of layer pairs, but there may be
14 fewer than that number of cells per string, and of
15 course you're going to have many, many strings in a
16 real device.

17 So the number of cells is -- is definitely
18 not going to be any one of those numbers listed as
19 examples: 32, 64, 96?

20 A. I think that you should take the 32, 64 and
21 96 as a maximum number of cells possible. And so what
22 actually would get implemented would be 32 minus N,
23 where N is a small number: 2, 3 or 4. And so that
24 gives you idea, oh, 32 minus N times the number of
25 strings in a block gives you the idea about how many

1 memory cells you have.

2 Now, each memory cell could store one bit,
3 two bits or up to three bits, so then you get to
4 multiply that by 3. So now you get a rough idea about
5 how the NAND -- 3D NAND memory array can start to store
6 a large amount of memory in a small amount of area.

7 Q. Got it.

8 So just to -- just so I have it right, the
9 number of cells -- we'll put aside the number of bits
10 just for now.

11 The number of cells would be the number of
12 layer pairs minus N, where N is the number -- number
13 that you're using for other purposes, times the number
14 of NAND strings?

15 A. The number of active NAND strings, yes.

16 Q. Okay. The number of active NAND strings.

17 So, Dr. Yang, could you turn again to
18 Figure 2? I'm sorry. I'll --

19 A. Sorry. Just...

20 Yes. I'm looking at Figure 2.

21 Q. And we can -- you know, if -- if a break
22 would be helpful --

23 A. Just swallowed something the wrong way.
24 That's all.

25 Q. So in Figure 2, do you see element -- well,

1 we just talked about it. I guess element 200?

2 So element 200 is 3D memory device 200;
3 right?

4 A. Yes. 200 is referred to, an exemplary 3D
5 memory device.

6 Q. And that's essentially what Figure 2 is
7 depicting; right?

8 A. It's depicting a portion of a 3D memory
9 device -- or the cross-sec- -- the vertical
10 cross-section of one.

11 Q. What is element 202?

12 A. Unfortunately, when I do string -- search
13 "202," it's just like "2020."

14 Q. Oh, that's -- that's rough.

15 A. No, no. It's fine. I found it.

16 So within the '378, 202 is called a
17 substrate.

18 Q. What is the purpose of the substrate in the
19 3D memory device?

20 MR. CROSS: Objection. Form.

21 THE WITNESS: Well, in this particular case,
22 202 is referring to a substrate which they say can be
23 single crystals. So it can be many other different
24 things, but in this particular case, they said they
25 were depicting a single crystal silicon wafer.

1 And a person of skill in the art would
2 understand that they were starting with a rather
3 standard semiconductor manufacturing process where they
4 started with a -- a blank wafer. And that blank wafer
5 was subsequently processed, just like we were talking
6 about before. And so they ended up with the exemplary
7 memory device 200 built on top of the starting wafer
8 202 substrate.

9 BY MR. SAGDEO:

10 Q. So I think you -- maybe you were reading
11 from the -- the specification when it -- where it talks
12 about the substrate being made of a single crystal
13 silicon or another elementary semiconductor.

14 Why -- why is it important that substrate
15 202 -- or what is the purpose of substrate 202 being
16 made of a single crystin -- crystal -- sorry -- that
17 substrate 202 be made of a single crystal silicon or
18 another elementary subs- -- semiconductor?

19 A. I don't think it's --

20 MR. CROSS: Object to form.

21 THE WITNESS: Why is it important? Or I
22 think if there's -- they said it's exemplary. It could
23 mean other things. I believe that a -- a person of
24 skill in the art understands that we typically start
25 with a silicon wafer, a sili- -- a single crystal

1 silicon wafer.

2 And it's a rather pure, rather clean
3 substance, extremely clean substance, one of the
4 cleanest in the world, one -- purest in the world.
5 It's a single crystal. It has very well-behaved --
6 some mechanical/chemical/electrical properties, and so
7 it's a common starting material for a -- in the
8 semiconductor manufacturing process.

9 BY MR. SAGDEO:

10 Q. Is it at all relevant or important that it's
11 a semiconductor?

12 A. I think it's somewhat important. It's not
13 absolutely necessary.

14 There are, for example, sapphire wafers
15 where some semiconductor devices are built. Sapphire
16 is an insulator, and so some people -- don't have to
17 always be a semiconductor. It's just that it happens
18 to be for its purity and for its cost and for its wide
19 availability, silicon is perhaps one of the most
20 cost-effective starting materials for a semiconductor
21 process.

22 There's many factors involved in choosing
23 it.

24 Q. In the context of the 3D -- 3D memory device
25 shown in Figure 2, what purpose does the substrate

1 serve?

2 A. One of the purposes that it serves is it
3 seems to be what they show here. A person of skill in
4 the art would understand that it was the base material
5 on which a lot of the 3D memory was built upon.

6 Q. By the -- go ahead.

7 A. So it serves as sort of the physical
8 underlying foundation of it, and it also serves some
9 electrical purposes as well by being the physical
10 underlying foundation. It also helps that it's very
11 pure so it doesn't contaminate or cross-contaminate
12 other process steps that happen in between.

13 I mean there's -- there's sort of many
14 functions that it sort of performs. It's -- it's a
15 piece of a puzzle that's interconnected.

16 Q. You mentioned some electrical functions.
17 Could you say more about that?

18 A. Yes. In particular, in the device shown in
19 Figure 2, you can actually see that there is a slit
20 structure, which is -- 226, I believe, is the slit
21 structure. And so you can see -- you could understand
22 that's a conducting post that goes all the way down.

23 And you can see at the bottom, there is this
24 half-circle shape kind of that's sort of kind of marked
25 as kind of with a -- kind of horizontal lines through

1 it as 228. You could understand that that would --
2 might be a doped region.

3 And so that slit structure is acting to
4 electrically connect to the substrate. And so that
5 substrate 202, it's electrically connected to it. So
6 it serves as kind of an electrical connection for
7 pieces of the 3D memory structure.

8 Q. Are the NAND strings connected to the
9 substrate as well, electrically?

10 A. They appear to be electrically collected --
11 connected as well through 222. So you can see the NAND
12 structure is 218 -- or that's the string -- the NAND
13 string. And at the bottom, there is this 222, which I
14 believe is described as an epi or pedestal structure
15 which connects to the substrate.

16 Q. And if the substrate were made out of an
17 insulator instead of a semiconductor, could you have
18 those connections?

19 MR. CROSS: Objection. Form.

20 THE WITNESS: You still could. It just
21 depends on how the substrate was formed. Perhaps the
22 substrate, even if it was made of an insulator, had a
23 piece of metal in that area connecting the channel to
24 the slit structure.

25 //

1 BY MR. SAGDEO:

2 Q. If the substrate were just a uniform
3 insulator without any metal, without any semiconductor
4 essentially added to it, would those functions work
5 that you mentioned?

6 MR. CROSS: Objection. Form.

7 THE WITNESS: Again, that's -- I'm not going
8 to say it's impossible. The reason is, is you have to
9 see how everything else is connected together. And if
10 they were completely insulating and there was -- you
11 were only contacting one side of the NAND string, you
12 couldn't get the NAND string to work. It wouldn't
13 function as a memory.

14 So people would figure out a way to connect
15 the top of the NAND string and the bottom of the NAND
16 string electrically. So what they might do is they
17 might convert kind of the very bottom layer of the
18 conducting dielectric stack, the very -- the one at the
19 very bottom. They might figure out how to make use of
20 that as a connection and then connect that under the
21 slit structure.

22 BY MR. SAGDEO:

23 Q. So my -- my question was a little bit
24 different.

25 I guess I'm -- you know, what I'm wondering

1 is if you did nothing to figure 200 except replace 202
2 with an insulator, would that device function?

3 MR. CROSS: Objection. Form.

4 THE WITNESS: If you did that, no, I don't
5 think it would function as desired as a 3D memory
6 device.

7 BY MR. SAGDEO:

8 Q. And why is that?

9 A. Probably because -- I don't think that
10 there'll be an electrical connection at the bottom of
11 the NAND string.

12 Q. And I guess there would also not be a
13 connection at the bottom of the slit structure; right?

14 A. Probably. It's also questionable whether
15 you could have even manufactured the entire thing
16 because, again, the substrate serves various purposes.
17 And changing the substrate may change the way the rest
18 of the whole manufacturing process works as well.

19 Q. Do you see in Figure 2 element 232?

20 A. So many pieces here.

21 Yes.

22 Q. What -- what is element 232?

23 A. I just want to make sure I get the exact
24 wording right.

25 MR. CROSS: Parth, will we have an

1 opportunity to take a break soon or --

2 MR. SAGDEO: Yeah, you know what? I think
3 probably now would be a good time if that's -- you
4 know, Dr. Yang, if -- if that works for you, and -- and
5 Lorie.

6 THE WITNESS: Would you like me to answer
7 the question or just leave it?

8 BY MR. SAGDEO:

9 Q. I think, you know, might -- we might as well
10 finish the current question.

11 So there's -- the question was what -- what
12 is element 232?

13 A. In particular, it's referred to as a
14 single-material dielectric structure, but it's also
15 said that they want -- thereafter refer to it as
16 dielectric structure 232.

17 MR. SAGDEO: Okay. Could we take maybe five
18 minutes, if that works for folks?

19 MR. CROSS: Sounds good.

20 THE WITNESS: Yes.

21 THE VIDEOGRAPHER: The time is 4:11 p.m.,
22 and we are going off the record.

23 (A brief recess is taken from 4:11 p.m. to
24 4:16 p.m.)

25 THE VIDEOGRAPHER: The time is 4:16 p.m.,

1 and we are going on the record.

2 BY MR. SAGDEO:

3 Q. So, Dr. Yang, before the break, we just
4 started talking about dielectric structure 232.

5 What is the dielectric structure made out
6 of?

7 A. Well, it's self-evident, but it's called a
8 dielectric structure, so probably a dielectric.

9 Q. To your knowledge, does the specification
10 provide any examples of the dielectric out -- out of
11 which it could be made?

12 A. I believe they mentioned silicon dioxide.

13 Q. Could you turn to Column 10 and let me know
14 when you're there?

15 A. Yes, Column 10.

16 Q. So do you see where -- starting at line 18,
17 it reads:

18 "As shown in Figure 2, dielectric
19 conductor/dielectric stack 210 is
20 'disrupted' by single-material
21 dielectric structure 232 (thereafter
22 'dielectric structure 232') along the
23 x-direction (and along the y-direction
24 not shown from Figure 2)"?

25 Did I get that right?

1 A. Yes.

2 Q. What does it mean for the
3 conductor/dielectric stack to be disrupted by the
4 dielectric structure?

5 A. It seems that they have -- if you go into
6 the sequence of the process steps, which are described
7 in -- well, they're described as the process of
8 Figure 3, 4, 5, 6, 7, 8. It describes sort of the
9 process of how that -- those are formed.

10 It seems to be -- disrupted seems to be the
11 process of actually etching through -- removing
12 those -- the conductor/dielectric pairs -- stack in
13 that region and replacing it with a dielectric. So I
14 think that's what they mean by disrupted; you cut them
15 and replace them.

16 (Crosstalk.)

17 Q. What is the -- what is the purpose of the
18 dielectric structure?

19 A. I don't think that there is a single
20 purpose. There are many purposes, as I had mentioned
21 before.

22 So one of the purposes of the dielectric
23 structure is that -- I believe it makes it easier and
24 more cost-effective to make through array contacts,
25 TACs, in that particular -- in -- through the

1 dielectric structure rather than having to have a
2 complex etch of -- etching through the
3 conductor/dielectric stack.

4 Q. Are there any other purposes?

5 A. Many purposes. So instead of having to do
6 that when that happens, it makes it simpler, so then
7 you don't require additional dielectric layers to
8 insulate the TAC. It sort of -- I think that it also
9 allows you to make TACs -- the '378 doesn't say this,
10 but a person of skill in the art also understands that
11 it also allows you to make the through array contacts
12 much smaller, so they become more efficient, so you can
13 take a much smaller area.

14 So if you take a smaller area, your chip is
15 smaller, so you can stick more of them on a wafer. So
16 then your manufacturing cost goes down.

17 And so I think that the dielectric structure
18 facilitates a lot of those things. And it's compatible
19 with the semiconductor -- overall semiconductor
20 manufacturing process. It doesn't cause things to fall
21 apart.

22 You know, there's just many sort of
23 functions that it performs. It's not just the
24 function.

25 Q. So one of the functions that I think you

1 mentioned was it means you don't have to have a
2 distinct or individual layers between each TAC and the
3 alternating stack to insulate the TAC; is that right?

4 A. Yes. Actually, I think -- if you give me a
5 moment, I'd like to actually point to a specific part
6 of the '378 that actually says this.

7 Q. Sure.

8 A. And so if you could give me a little bit of
9 time. I'm sorry. It's going to take me a little time
10 to find the exact line.

11 Q. Okay.

12 A. Yes. So the exact line you can find in
13 Column 10 [sic] of the '378, and it starts about
14 line 20 -- or, no, not 20. 10, 11 -- 12, and it starts
15 with the sentence:

16 "Since TACs 234 are embedded in
17 dielectric structure 232, additional
18 layers of dielectric are not required
19 to insulate the conductor material."

20 Q. Got it.

21 So it sounds like the dielectric structure
22 is -- is performing the function of insulating the TACs
23 from the conductor material?

24 A. The conductor material --

25 Q. No --

1 A. -- the material in the dielectric conductor
2 stack, yeah.

3 Q. Right. Actually -- sorry. Let me clarify
4 because I think I probably misstated that.

5 The TACs -- because the TACs are embedded in
6 the dielectric structure, they -- the dielectric
7 structure is itself providing the function of
8 insulation of the conductor material, the conductor
9 material referring to the material that out of which
10 the TACs are made?

11 A. Not exactly right.

12 So what I would say is that because the TACs
13 are embedded in the dielectric structure 232, the
14 dielectric structure is insulating the TAC conductor
15 from the conductor material in the alternating
16 dielectric/conductor stack.

17 Q. Got it.

18 And is the -- is the dielectric structure
19 also serving the function of insulating one TAC from
20 another?

21 A. Yes. It also provides the function -- so if
22 you have multiple TACs within a given dielectric
23 structure, it also isolates them from the other TACs.

24 See, so you're -- you get the idea. There's
25 multiple functions happening with -- with one

1 structure.

2 Q. Is there anything, I guess, about the --
3 actually, let me strike that.

4 Let me direct you back to Figure 2, and let
5 me know when you're -- you're back there.

6 A. Yes.

7 Q. So do you see element 233?

8 A. Yes.

9 Q. And -- and what is element 233?

10 A. I think I know what it is, but just allow me
11 the chance to just get the exact wording.

12 It's called the isolation structure or
13 region, isolation region or structure. An example of
14 it is -- shallow trench isolation is an example. It's
15 exemplary. It's not limiting.

16 So it's called multiple different things,
17 yes.

18 Q. You mentioned shallow trench isolation
19 structure.

20 Does the shallow trench mean the same thing
21 as -- as what we talked about, I guess, a while back
22 looking at Exhibit 1?

23 A. It doesn't mean exactly the same thing. I
24 think it's referring to it being formed through a
25 similar process that we had mentioned about Exhibit 1,

1 but it is a structure, and structure can serve multiple
2 different functions.

3 In this particular case, it's not exactly
4 the same as what you've shown in Exhibit 1. In that
5 particular case, that shallow trench isolation
6 structure was, I believe -- in the context of what you
7 were showing me -- trying to serve some type of
8 electrical isolation.

9 In the particular case of the '378, it's a
10 shallow trench isolation structure. But if you
11 actually read in detail what the '378 describes it as
12 being, it's actually serving as a bit more of an etched
13 stop.

14 And anyway, it's a shallow trench isolation
15 structure, and a person of skill in the art would
16 understand it was formed in roughly the same way of
17 etching out cavity and substrate, filling it and then
18 sort of chemical mechanical-polishing it back.

19 Q. So it's called an isolation structure, and I
20 guess what's your sense for what that structure is
21 isolating?

22 A. I think that it's become sort of a term of
23 the art for a person of skill in the art. They just
24 call that thing shallow trench iso- -- STI -- oh, how
25 did you form it? STI.

1 So it's kind of this -- it's kind of this
2 recipe that we have in our head about how that's formed
3 through assess -- the sequence of steps. What it
4 actually does will depend on how it's being used.

5 Q. So I think, you know, I'll -- I'll frame my
6 question -- I've asked a similar question for a number
7 of other structures, but I'll -- I think I'll learn my
8 lesson, and I'll ask it in the plural and not the
9 singular.

10 But what are the -- what are the functions
11 of the isolation structure?

12 A. It depends on how it's being used, right.
13 So if it's being used like it was -- you showed me in
14 Exhibit 1, it's probably being used to perform some
15 electrical isolation.

16 In this particular case, as in the '378, as
17 it's described how it's being used, the STI, it's
18 probably serving more as a etch stop. A person of
19 skill would understand serving as an etch stop or how
20 the dielectric structure should be formed.

21 So when they actually cut down, they stop
22 the etch through -- that complex etch through the
23 alternating conductor/dielectric stack. They stop it
24 on top of the isolation structure. And they -- they
25 use that as sort of the etch stop layer. And so that's

1 the way it's kind of being used there.

2 And then eventually, in order to make the
3 contact, they have to -- the through array contact,
4 they have to blow through the dielectric structure as
5 well as going through the isolation structure
6 underneath.

7 So you can see that it serves multiple
8 functions. It depends on how it's being used.

9 So within the context of the '378 and the
10 specifications of how it's described, it's being used
11 as sort of an alignment, kind of a -- an etch stop
12 layer for the dielectric structure. So it's not
13 serving exactly an electrical function.

14 Pardon me.

15 MR. SAGDEO: Should we take a break?

16 MR. CROSS: We can go off the record.

17 MR. SAGDEO: Yeah, why don't we give
18 Dr. Yang a minute?

19 THE WITNESS: Sorry.

20 THE VIDEOGRAPHER: The time -- would you
21 like to go off the record, Counsel?

22 MR. SAGDEO: Is it -- yeah, why don't we
23 just take, like, five minutes, if that's okay,
24 Dr. Yang?

25 THE WITNESS: I'll get some tissues, yes.

1 Sorry.

2 MR. SAGDEO: It's okay.

3 THE VIDEOGRAPHER: The time is 4:29 p.m.,
4 and we are going off the record.

5 (A brief recess is taken from 4:29 p.m. to
6 4:33 p.m.)

7 THE VIDEOGRAPHER: The time is 4:33 p.m.,
8 and we are going on the record.

9 BY MR. SAGDEO:

10 Q. So, Dr. Yang, I think one thing we were --
11 we were talking about is when -- before we broke, was
12 one of the -- is -- is the functions or the purposes of
13 the isolation structure.

14 And I wanted to ask you is there any
15 electrical function or purpose of the isolation
16 structure?

17 A. Well, the isolation structure certainly
18 seems to -- at the -- at the bottom of the -- for
19 example -- I mean this is -- this is why you have to
20 look at a specific case to see exactly what it does.

21 So if we were to take a look at, for
22 example, Figure 13 of the '378 patent, you would see
23 that the bottom of the isolation structure is
24 continuing to provide electrical isolation between the
25 TAC on the left and the TAC on right.

1 Q. Got it.

2 And I think we discussed in -- in the
3 context of the substrate earlier that the substrate is
4 itself electrically active in the sense that it
5 connects the -- the NAND strings with the slit
6 structures.

7 Do I have that right?

8 A. In this particular implementation that's
9 shown in '378, yes, the substrate would act to -- well,
10 it would probably act -- I don't think it's quite
11 complete in what they've described, but the substrate
12 could act -- connect the NAND structure to the slit
13 structure.

14 Q. And the isolation structure -- I guess it
15 serves the function of preventing that electrical
16 interaction with -- from interfering with the signal
17 carried by the TACs; right?

18 A. I think the figure shown in Figure 13, which
19 is very much similar to the figure shown in Figure 2,
20 is somewhat incomplete as far as kind of what are the
21 other things that are going on?

22 So, for example, there's -- if you see -- in
23 Figure 13, there seems to be that doped region below
24 the TAC, which is below the TAC 226, and so there
25 probably needs to be some continuing -- continuation of

1 that doped region to somehow get to the NAND string. I
2 don't know what the -- type of -- the semiconductor
3 substrate is.

4 In this case, this is shown as 202. I don't
5 know if it's the same type or a different type. I
6 don't -- I believe that there's probably also going to
7 be a doped region underneath 1200, right.

8 And so -- and I don't know what the extent
9 of those dope regions are, so I think this figure is a
10 little bit incomplete to say exactly what's going on
11 and what's exactly isolated from what. I can say from
12 this figure, though, that the TAC that goes through
13 the -- I hope I didn't misspeak. I hope I didn't say
14 226 was a TAC. 226 is a slit structure, just in case
15 I -- I misspoke.

16 But 1200 is a TAC, and that's -- one on the
17 left and one on the right. 233, as I mentioned before,
18 you can say it's certainly electrically isolating one
19 TAC from another TAC in that whole region of where the
20 isolation region is. It's just I can't say exactly
21 what else it's isolating because the -- what's exactly
22 in -- in the semiconductor substrate isn't clearly
23 described in Figure 13.

24 Q. So, Dr. Yang, could you turn back to -- to
25 Figure 2 again?

1 A. Yes.

2 Q. Do you see element 224?

3 A. So many elements here.

4 Q. This one's a bit hidden, but I'll -- I'll
5 represent that it's -- if you start -- start from the
6 label Figure 2 and go up --

7 A. Oh, I see it, yes. No, no.

8 Yeah, I see it. It's above the NAND string,
9 yes.

10 Q. So what -- what is element 224?

11 A. If -- I think I know what it is, but I just
12 want to get the wording exactly right.

13 So 224 -- it's called an etch stop plug.

14 Q. And what is the -- sorry. Let me -- so let
15 me just take each of those words in sequence.

16 So what does "etch" mean?

17 A. Etch is the process of removing some
18 material, chemical processing. It can be a physical
19 process or a chemical process of removing a material.

20 Q. What does "stop" mean in this context?

21 A. "Etch stop" meaning something to make the
22 etch stop.

23 Q. Got it.

24 And what does "plug" mean?

25 A. Plug refers to the fact that it's kind of a

1 small section. So this happens to be in a small
2 section, and so its purpose is to stop the etch from
3 occurring on the plug.

4 Q. So its purpose is to stop the etch -- let me
5 see if I can restate that.

6 Is it -- is the etch stop plug's purpose to
7 stop the etch from occurring on itself, or is it, like,
8 protecting something else or -- I wasn't exactly sure
9 what you meant by the -- your last answer.

10 A. Right. Well --

11 MR. CROSS: Objection. Form.

12 THE WITNESS: Right. Well, that's why you
13 have to look at the whole term to understand what it
14 means. If you look at it individually, it's hard to
15 say.

16 So "etch stop plug" is -- is a plug, and the
17 function it serves is to be an etch stop. And so the
18 plug is the plug that's sitting on top of the NAND
19 string. NAND string is typically composed of
20 polysilicon or some semiconductor material. Inside
21 along the edges of it, there is a memory film, so you
22 want to protect all of that. That's very sensitive.
23 That's where you're going to put your stuff. So the
24 plug goes on top. And then there's an etch that comes
25 down, and then you want it to stop. And you don't want

1 it to impact and damage the NAND string.

2 So it's the plug that sits on top of the
3 NAND string and stops the etch from going down to
4 dama- -- when -- when you go to etch, it goes -- it
5 stops the etch from going into the NAND string. Etch
6 stop plug.

7 BY MR. SAGDEO:

8 Q. So I think you just said this, but the
9 thing, I guess, that is directly below the etch stop
10 plug is the -- is that the NAND string...

11 A. Yes.

12 Q. Okay.

13 A. It -- it -- yes, it is a NAND string.

14 Q. And what is the -- well, actually -- yeah,
15 and -- and what is the element directly above the etch
16 stop plug in Figure 2?

17 A. I believe that the equivalent of -- in
18 Figure 2 of what's above the etch stop plug is 224.
19 And the equivalent of that would be 236.

20 Let me just get the exact wording of that.
21 236.

22 NAND string contact 236.

23 Q. And just to turn back, I guess, to my -- my
24 previous question.

25 Would it be more accurate to say that what

1 is immediately below the etch stop plug is the channel
2 structure 216?

3 A. Sure. It's referred to as both. Each NAND
4 string includes the channel structure 216.

5 Q. And, Dr. Yang, could you please turn to
6 Figure 12?

7 And in Figure 12, do you see an element 224?

8 A. Yes.

9 Q. What's the purpose of the etch stop plug 224
10 in Figure 12?

11 A. Well, there are many -- many purposes. One
12 of the purposes is just -- I believe it's still called
13 the etch stop plug, but it also -- the etch stop plug
14 also needs to be conducting. So it needs to make sure
15 that they conduct elec- -- electrical current so that
16 the -- so that you can make electrical contact to the
17 NAND string channel structure.

18 Q. Is that essentially the same purpose as --
19 as in -- as the etch stop plug in Figure 2?

20 A. It's the same element, I believe, as in
21 Figure 2. The functions that it performs are at least
22 the two that I described: etch stop as well as
23 electrically conductive.

24 Q. And both of those functions are in both
25 figures -- are in the etch stop plugs in both Figures 2

1 and 12; is that right?

2 A. I -- I don't know if a function is there.
3 It's shown, and a person of skill in the art would
4 understand that those are the functions being performed
5 by it. Those are some of the functions being performed
6 by it.

7 Q. Are there any other functions that -- that
8 you can think of?

9 A. Oh, the etch stop plug?

10 Q. Right.

11 A. Etch stop plug is also -- I don't know if
12 it's a function, but a feature of it is that it's
13 something that has to be made quite small.

14 And so if you look -- the thing has to be so
15 small -- and you can understand how small it is by, for
16 example, looking at Figure 1. You can look at
17 Figure 1A or 1B, and you can see that the NAND strings
18 are all those little, tiny dots, and that's roughly to
19 scale.

20 So you'd have to make an etch stop plug as
21 small as all those round tiny dots, and you have to
22 make sure that they don't touch each other. Not such
23 an easy thing to do. And so making that etch stop plug
24 like that, not so easy.

25 And then the even more difficult thing to

1 do, and this is kind of the -- the determining step is
2 the 2- -- is kind of that 236. It's shown in Figure 2,
3 236 and 246. You would also understand, which is in
4 layer 242, those are the contacts from the etch stop
5 plug all the way up to the bit line. Those things you
6 see have to be made extremely small, and you get a
7 sense of how small the bit line is by looking at
8 Figure 2 and your looking at 250. Those are the bit
9 lines. And you'd understand that those lines are super
10 tiny.

11 So you see you're going to have to define
12 these really, really small things. And so being able
13 to find those really, really small things is one of the
14 key characteristics.

15 I don't know if it's a function, but it's a
16 key characteristic of what makes -- of any -- of what
17 you need to look at when you make the etch stop plug as
18 well as those successive structures 236 and 246, which
19 are the connections up to the bit line.

20 Q. I'd agree that's more of a feature than a
21 function, but I -- I guess are there any other
22 functions that you can think of?

23 A. Well, feature or function, hard to say,
24 right. Form versus -- form over function. But if it
25 didn't have the function of being able to be made very

1 small, it probably wouldn't have become the etch stop
2 plug, so...

3 Q. Okay. I mean, I guess just at the moment,
4 there's nothing else that comes to mind as -- in terms
5 of, I guess, a function or a purpose of the etch stop
6 plug other than what we've -- what you've already
7 mentioned?

8 A. I think I've -- I've mentioned a fair
9 number. I suppose, again, like I mentioned before, if
10 you point to something else, probably some -- probably
11 something else sort of pops up, it's kind of like, How
12 will these things fit together? I can't immediately
13 tell you exactly how all the -- all the
14 tongue-and-groove things fit together, but the -- the
15 critical thing here is that it's -- all fits together
16 and can all be manufactured. That's actually the key
17 thing.

18 Q. So we -- we talked about etch stop, and --
19 and I'm wondering what -- is there a distinction
20 between an etch stop and an etch stop plug, or are
21 those synonyms?

22 A. "Etch stop" refers to the thing of how an
23 etch is stopped. So there are -- and I think Dr. Lee
24 even mentioned it. There's -- there's different ways
25 of stopping an etch. One way of stopping an etch is

1 you just take away the chemicals, and so you basically
2 control the etch by how long you do the etch.

3 Another way of stopping an etch is by having
4 the chemical react, and it reacts, and it completely
5 dissolves something until it stops because it doesn't
6 dissolve another layer. And so there are -- there are
7 different ways of doing that.

8 "Etch stop" is kind of the desired outcome,
9 having the etch stop rather than going all the way
10 through or stopping at the right point.

11 Q. I think one -- one thing you mentioned about
12 the isolation structure, which is, I think, 233, is it
13 has -- it's an etch stop in the sense you etch down
14 through the -- through the alternating
15 conductor/dielectric layer stack, and then -- and then
16 it sort of stops at the isolation layer; is that right?
17 Am I characterizing that correctly?

18 A. Yes, you are characterizing that correctly,
19 and if you give me a little bit of time, I will find
20 the exact quote within the '378.

21 Q. If I might point you to Column 15, is that
22 perhaps what you're thinking of, Dr. Yang? I'm -- I'm
23 looking in particular at line, like, 17 starting with
24 "In other words."

25 A. 15; right?

1 Q. Right.

2 A. Yes, that's exactly what I was looking for.
3 I was just searching for the wrong term. Thank you
4 very much.

5 "In some embodiments, opening 600
6 may extend partially into STI 233. In
7 other words, the etch process used to
8 form opening 600 may also remove
9 (recess) portions of the top surface of
10 the STI structure. It is noted that
11 the opening 600 can be extended in
12 size."

13 And so you would understand -- a person of
14 skill would understand that it's sort of acting as an
15 etch stop. It's a -- sort of a buffer zone.

16 Q. But would it fair -- be fair to say it's not
17 a plug -- it's -- it's an etch stop, but it's not a
18 plug?

19 A. It is -- it is a bit of a plug in the fact
20 that it's only on some certain area. It's actually
21 within the STI area. And actually the 600 is defined
22 as having to be within the STI.

23 So in this particular embodiment that's
24 enabled by the description in the '378, you would
25 understand that it's sort of an etch stop plug. The

1 alternative to an etch stop plug is an etch stop layer.
2 Etch stop is kind of the desired result. So you could
3 also have a blanket layer that serves as an etch stop.

4 The plug just refers to the fact that it
5 happens to only have, perhaps, a limited spatial extent
6 on the x and y-plane.

7 Q. Okay. Other than the -- I guess there's --
8 there's etch stop plug 224 in Figure 2 and etch stop
9 plug 224 in Figure 12.

10 Are you aware of any other etch stop plugs
11 described in the '378 patent?

12 A. Let me do a quick search.

13 Within the '378, there is only the etch stop
14 plug that's referred to as 224, but there's also an
15 epitaxial plug, which is at the bottom of the NAND
16 string. That's also referred to as a plug.

17 But the only etch stop plug is the 224, but
18 I believe that "etch stop plug" is actually a term
19 that's used a lot by persons of skill in the art, and
20 they understand that this is a way of also making
21 contacts.

22 You -- you would sort of create a hole; you
23 would fill it with some material that's going to resist
24 the etch, and then you would chemical --
25 chemical-polish it back down and then therefore fill

1 that and define -- kind of define where that material
2 is in sort of an XY-plane, like where the 224 is, and
3 then it becomes a plug.

4 And so it's sort of a well-known recipe that
5 persons of skill in the art know, just like a shallow
6 trench isolation is sort of a recipe. And a shallow
7 trench isolation can be seen to be quite familiar --
8 similar to the way an etch stop plug is formed in the
9 fact that you create this hole in the sub- -- in the
10 substrate; you fill with a blanket of oxide over the
11 top and then you etch that oxide layer back down to the
12 substrate by chemical mechanical polishing, and now you
13 have sort of a plug that's filled.

14 So in some sense, you know, it -- it shares
15 a lot of the similar process steps that -- the etch
16 stop plug.

17 Q. So you mentioned the epitaxial plug.

18 Does that serve as an -- I mean, does that
19 stop any sort of etch?

20 A. So give me -- give me a chance because
21 that -- that particular thing has many different
22 variations on how it's made, and I just want to make
23 sure about how it's specifically referred to in the
24 '378, and then I can talk about how it's generally
25 talked about. So I'd like to be able to talk about

1 both.

2 So if you'd give me a little time, I just
3 want to check -- make sure about how it's used in '378,
4 and then I can talk how it's used in '378 and how it's
5 used generally.

6 Q. Well, you know, just in the interest of
7 time, I'll -- I'll withdraw the question.

8 A. Okay.

9 Q. So there's one thing that I -- I think you
10 might have mentioned or alluded to is -- or I guess --
11 no, let me strike that.

12 What would happen if etch stop plug 224
13 didn't exist in figures -- in Figure 2? Like, would --
14 would there be any problems associated with that?

15 MR. CROSS: Objection. Form.

16 THE WITNESS: I'm not exactly sure what you
17 mean by "didn't exist."

18 If -- you mean they just skipped the
19 processing steps for 224 or --

20 BY MR. SAGDEO:

21 Q. Yeah. So let's say that, you know, a
22 channel structure is formed, and then typically you'd
23 have an etch stop plug formed on the channel structure;
24 right?

25 MR. CROSS: Objection. Lacks foundation.

1 THE WITNESS: Could you repeat the question
2 again?

3 BY MR. SAGDEO:

4 Q. Let me rephrase.

5 So I think -- let me -- and in particular,
6 I'll try to -- strike that.

7 If we -- let me know if you agree with this
8 statement. If we didn't have an etch stop plug, then
9 if we -- when we're etching for our NAND string
10 contacts 236, there would be a problem because those --
11 that etch, which is going through a dielectric, would
12 just keep going, and it would actually interfere with
13 the channel structures, some part of which is also a
14 dielectric. And so we need the etch stop plug to be of
15 a material not reactive to the etchant so that we don't
16 mess up our channel structures.

17 MR. CROSS: Objection. Form.

18 THE WITNESS: I believe that's roughly
19 correct. It all depends on what is the recipe that you
20 actually have for creating 236. So if the recipe that
21 you have, the particular chemical reaction you're
22 relying on, will etch the dielectric as well as the
23 channel structure without 224, you will have some yield
24 and reliability issues caused by either an incomplete
25 etch, if you're too cautious, or an overaggressive

1 etch, which damages the 3D channel.

2 And so having the etch stop there serves its
3 purpose to make it more manufacturable, improve yield,
4 make the whole process more reliable. Whether it's
5 impossible to do without is probably this more
6 complicated question about whether it's manufacturable
7 or not.

8 MR. SAGDEO: Can we take, like, a
9 five-minute break?

10 MR. CROSS: Is it a good time to have a
11 longer break so he can get maybe some breakfast or --
12 or do you want to come back and finish up a line of
13 questions and then take a longer break?

14 MR. SAGDEO: I am close to done, so I think
15 if I can let everyone go by taking a shorter break,
16 that would probably be better.

17 THE WITNESS: Okay.

18 MR. SAGDEO: All right. So let's just take
19 five minutes.

20 THE WITNESS: Okay.

21 THE VIDEOGRAPHER: The -- the time is
22 5:02 p.m., and we are going off the record.

23 (A brief recess is taken from 5:02 p.m. to
24 5:10 p.m.)

25 THE VIDEOGRAPHER: The time is 5:10 p.m.,

1 and we are going on the record.

2 BY MR. SAGDEO:

3 Q. So, Dr. Yang, you've mentioned that one of
4 the functions of the isolation structure in the '378
5 patent is electrically isolating the -- the TACs from
6 each other.

7 Do I have that right?

8 A. Yes. One of the functions of the isolation
9 structure in the '378 is to continue or -- continue to
10 provide electrical isolation of the TACs within the
11 same dielectric structure from each other.

12 Q. And just so we're sort of looking at the
13 same thing or we have the same context, could you turn
14 to Figure 2?

15 If we replaced the isolation structure
16 with -- with more of the substrate, in other words, we
17 sort of just used substrate 202 instead of diel- --
18 sorry. Maybe I misspoke.

19 If we used substrate 202 instead of
20 isolation structure 233, would it -- would that --
21 would the substrate also serve that purpose of
22 electrically isolating -- or insulating the TACs from
23 each other?

24 MR. CROSS: Objection. Form.

25 THE WITNESS: It's difficult to say because

1 it's incomplete because -- I don't believe that the
2 '378 patent describes what the semiconductor material
3 202 is exactly, meaning the doping type or the doping
4 concentration.

5 So it's a little difficult to say exactly
6 what might happen if you just deleted or just replaced
7 233 with 202. So I think it's a little difficult. I
8 don't know if it would be a ohmic contact, a Schottky
9 contact, so it's hard to say.

10 BY MR. SAGDEO:

11 Q. Would it provide -- generally speaking,
12 given what we know about the -- the substrate 202,
13 would it provide more or less or the same electrical
14 insulation between TACs compared to isolation structure
15 233?

16 MR. CROSS: Objection. Form.

17 THE WITNESS: I mean, if you told me what
18 202 was, I could probably answer it more specifically.

19 So can you tell me more exactly what 202 is?
20 And then I could then give you something a little --
21 because it just said it's a single crystal silicon. So
22 I -- I don't know what the doping is.

23 Do you want to tell me the orientation type?
24 Do you want to tell me the doping type? Do you want to
25 tell me the P-type, N-type, intrinsic?

1 BY MR. SAGDEO:

2 Q. Let's just say it's undoped, single crystal
3 silicon.

4 A. That's actually the most difficult thing to
5 tell. The reason is, is un- -- there's nothing --
6 there's nothing truly undoped. It's always a little
7 bit dope this, a little bit dope that. But that would
8 probably indicate that the through array contact is
9 probably going to form a Schottky barrier, probably. I
10 don't know exactly because there's -- there's too many
11 incompletes here.

12 And so depending upon the voltages that were
13 applied, the through array contacts -- they might be
14 still electrically insulated, or they might actually
15 sort of actually form a conducting path. Sort of
16 difficult to tell. Also don't know what the spacing
17 is. Don't know how far the minority carriers will
18 drift or diffuse.

19 So a little difficult -- also bias in
20 conditions. It's -- it's difficult to tell.

21 Probably if there were undoped silicon and
22 233 were silicon dioxide, as it was described, it's
23 probably not going to be as good as oxide.

24 Q. Shifting gears a little bit.

25 You'd mentioned, I think -- and correct me

1 if I'm wrong -- that one of the functions of the
2 dielectric structure, which is 232 in Figure 2, is
3 insulating the TACs from the alternating
4 conductor/dielectric layer stack, in particular the
5 conductor layers of that stack.

6 In my -- did I get that right?

7 A. Yes. It's -- it's also providing insulation
8 not only between the two TACs to each other in the same
9 dielectric structure, it's also providing insulation
10 to -- I think it's called layer 206 in the alternating
11 conductive/dielectric stack in Figure 2.

12 Q. Does the shallow trench -- or, yeah, I guess
13 it is described in various ways.

14 But basically does the isolation structure
15 233 provide that same function of isolating the TACs
16 from -- from the alternating layer stack?

17 A. I think that's a little bit difficult to say
18 because it's sort of not -- I -- I don't know what you
19 mean by -- exactly by that.

20 So if you were to remove it, what would
21 happen? I don't know what the dielectric stack, then,
22 would look like.

23 Could -- could you give me a little bit more
24 in that hypothetical? Or -- or could you restate the
25 question? Let's -- I think I'm getting way ahead of

1 myself.

2 Q. It was -- it was a bad question. I'll just
3 withdraw the question.

4 I'm just jumping around a little bit, so --
5 to get to stuff that I missed the first time around.

6 So turning to the etch stop plugs.

7 So we talked about etch stop plugs 224;
8 right? And those are above the channel structures,
9 which are, I think, 218 or 216 or both. I don't know.
10 It's -- is -- is that right?

11 A. Yes. It is 224. Etch stop plug is above
12 the NAND string, which I think is looking at the memory
13 film as well as the channel structure.

14 Q. Are there any etch stop plugs that are
15 performing that function but for the slit structures
16 226?

17 A. Could you clarify what you mean by "that
18 function"?

19 Q. So you'd mentioned -- or I think we -- we
20 had a bit of a back-and-forth where -- and correct me
21 if I'm mischaracterizing this -- but the etch stop plug
22 is at least sometimes important when it's above a
23 channel structure because you have oxides in the
24 channel structure that might potentially be damaged by
25 the etchant that's cutting through the dielectric. And

1 the etch stop plug essentially -- above the channel
2 structure prevents that damage.

3 I guess just to start, did I get that right?

4 A. That's -- that's roughly correct, yes.

5 Q. And so I guess is -- is there something
6 fulfilling that function but for the slit structures in
7 Figure 2?

8 A. So the slit structures, as I understand
9 them, are 226 in Figure 2. And the etch stop plug
10 function is -- its function is multiple, as we talked
11 about, right. But one of them is to stop the etch.

12 And one of the things you could actually say
13 about 226 -- and this is actually mentioned in the '378
14 patent -- is just the material composition of 226 in
15 and of itself can actually stop the etch that's
16 required for the formation of 238.

17 And so that's something that naturally
18 happens because of natural selectivity. 226 is
19 typically made of various conducting materials that
20 they mention in the '378. And so just by its natural
21 composition, it kind of serves as its own etch stop.

22 Does that make sense?

23 Q. Got it.

24 MR. SAGDEO: I think that's -- that's all I
25 have. No further questions.

1 MR. CROSS: Why don't we take a -- a
2 five-minute break?

3 MR. SAGDEO: Okay.

4 THE VIDEOGRAPHER: The time is 5:20 p.m.,
5 and we are going off the record.

6 (A brief recess is taken from 5:20 p.m. to
7 5:27 p.m.)

8 THE VIDEOGRAPHER: The time is 5:27 p.m.,
9 and we are going on the record.

10

11 EXAMINATION

12 BY MR. CROSS:

13 Q. Dr. Yang, can you open up the '378 patent?

14 A. Yes.

15 Q. And turn to Column 4, line 41.

16 A. Yes.

17 Q. Can you read to yourself the -- the first
18 two sentences?

19 A. Yes.

20 "As used herein, the term
21 'substrate' refers to a material onto
22 which subsequent materials are added or
23 otherwise 'disposed.' The substrate
24 itself can be patterned."

25 Q. Does that inform to you how the '378 patent

1 uses the term "substrate"?

2 MR. SAGDEO: Objection. Leading.

3 THE WITNESS: Yes.

4 BY MR. CROSS:

5 Q. Is this your understanding -- or is --
6 strike that.

7 Is this the understanding that you applied
8 when analyzing the '378 patent?

9 MR. SAGDEO: Objection. Leading.

10 THE WITNESS: Would you -- do you want me to
11 answer or --

12 BY MR. CROSS:

13 Q. Oh.

14 A. -- rephrase? I'm not sure what I'm supposed
15 to do.

16 MR. SAGDEO: You can answer.

17 THE WITNESS: I just don't want to -- I just
18 don't want to --

19 BY MR. CROSS:

20 Q. I can rephrase if you'd like.

21 A. Okay. Well, I don't know -- I don't know
22 what you think of the objection, but anyway. I'm just
23 trying to follow procedure.

24 Q. Yeah, please answer the question.

25 Is this the -- did you use the language at

1 Column 4, lines 41 through 43, in informing yourself
2 how the '378 patent uses the term "substrate"?

3 MR. SAGDEO: Objection. Leading. Scope.

4 THE WITNESS: I -- I don't know.

5 Am I allowed to answer at this point?

6 BY MR. CROSS:

7 Q. Yes.

8 MR. SAGDEO: You can.

9 BY MR. CROSS:

10 Q. Yeah.

11 A. Okay. I just didn't want to step on people.

12 So, yes, it did inform me. I mean, it's
13 clearly a part of the specifications, so I definitely
14 did read it. I -- this is actually the -- the set of
15 words I had wanted to read, but I didn't have the '378
16 patent available to me.

17 I believe when you showed me the example of
18 what is -- I think we had a discussion about what is
19 substrate. And so this is an example here specifically
20 of the terminology that the '378 uses for substrate.

21 Whereas I was talking about before sometimes
22 people want to talk about substrate as a blank wafer.
23 Typically it's generally considered -- it's whatever
24 this -- the material is on which subsequent materials
25 are deposited or somehow patterned. They can be

1 patterned in how it's used. So.

2 I think it's very clear here how the '378
3 uses the term "substrate" specifically.

4 Q. Can you turn to Exhibit 4? That's the --
5 one of the -- what was referred to as a hut-like
6 structure.

7 A. Yes.

8 Q. Okay. Do you recall talking about the --
9 the posts that appear in the middle of the figure?

10 A. Yes.

11 Q. In this image, are you able to see what's on
12 the other side of those posts?

13 MR. SAGDEO: Objection. Leading.

14 THE WITNESS: No, I'm -- I -- I can answer?

15 MR. SAGDEO: Yes.

16 BY MR. CROSS:

17 Q. Yes.

18 A. Okay. No, I can't see what's on the other
19 side of those posts. It's only one view.

20 Q. Can you tell me whether or not there's
21 anything on the other side of those posts that tie
22 those posts together?

23 A. Just -- just from this photograph, there
24 doesn't seem to be anything apparent, but I'm not an
25 expert at analysis of these sorts of pictures. It's

1 just one view.

2 Q. Right. And so because of this one view, you
3 can't see the other side; correct?

4 MR. SAGDEO: Objection. Leading.

5 THE WITNESS: No, I can't see the other
6 side.

7 MR. CROSS: Okay. No further questions.

8 MR. SAGDEO: No recross.

9 THE VIDEOGRAPHER: The time is 5:32 p.m.,
10 and we are going off the record.

11 Thank you, everyone.

12 THE STENOGRAPHER: And, Mr. Cross, would you
13 like a copy of the transcript?

14 MR. CROSS: If you don't mind contacting the
15 paralegal.

16 THE STENOGRAPHER: Sure.

17 MR. CROSS: Okay.

18 THE STENOGRAPHER: I will.

19 MR. SAGDEO: So, Lorie, do you have our
20 order?

21 THE STENOGRAPHER: I do. I do have your
22 order.

23 It's regular and then a rough draft; right?

24 MR. SAGDEO: Perfect, yeah.

25 THE STENOGRAPHER: Okay. Perfect.

1 - THE VIDEOGRAPHER: Would you like video,
2 Counsel?

3 MR. SAGDEO: Let's put that in for now, but
4 I think I'm going to check in on that, and I will
5 e-mail you.

6 And also, Allen, I will e-mail you, too,
7 shortly if -- if we're not actually using that also
8 about Thursday.

9 MR. CROSS: Great. Appreciate it.

10 THE STENOGRAPHER: And then should I check
11 on the rough too, Allen?

12 MR. CROSS: Yeah. That would be great.

13 THE STENOGRAPHER: Okay. All right. I'll
14 reach out to your paralegal.

15 (Time noted: 5:33 p.m.)

16

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ACKNOWLEDGEMENT OF DEPONENT

I, WOODWARD YANG, PH.D., do hereby acknowledge
that I have read and examined the foregoing testimony
and the same is a true, correct, and complete
transcription of the testimony given by me and any
corrections appear on the attached errata sheet signed
by me.

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WOODWARD YANG, PH.D.

CERTIFICATE OF COURT REPORTER

I, LORIE RHYNE, CSR No. 12905, RPR, CRR, a
Certified Shorthand Reporter, State of California, the
officer before whom the foregoing deposition was taken,
do hereby certify that the foregoing transcript is a
true and correct record of the testimony given; that
said testimony was taken by me stenographically and
thereafter reduced to typewriting under my direction;
that reading and signing was not waived; and that I am
neither counsel for, related to, nor employed by any of
the parties to this case and have no interest,
financial or otherwise, in its outcome.

Dated this 2nd day of May, 2025.



LORIE RHYNE

CSR No. 12905