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

Micron Ex. 1044, p. 1
Micron v. YMTC
IPR2024-00911

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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)

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WITNESS: WOODWARD YANG, PH.D.

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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

three documents are unmarked.

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

Is that okay?

A. Okay.

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

A. Certainly.

Q. Have you been deposed before?

A. Yes.

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

A. Yes.

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

A. Yes.

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

Is that okay?

A. Yes.

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

fully and truthfully today?

A. No.

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

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

Q. How many times did you meet with counsel?

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

In preparation before this?

Q. In relation to this deposition.

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

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

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

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

attorneys and yourself. Thank you.

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

BY MR. SAGDEO:

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

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

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

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

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

A. Pardon? I missed the last part.

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

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

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

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

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

A. Yes.

Q. What compensation are you receiving?

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

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

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

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

A. Yes.

Q. Roughly, how many times?

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

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

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

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

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

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

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

MR. CROSS: Objection. Form.

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

BY MR. SAGDEO:

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

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

cup; right?

MR. CROSS: Objection. Form.

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

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

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

BY MR. SAGDEO:

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

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

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

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

BY MR. SAGDEO:

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

A. No. Definitely not.

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

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

Q. How long have you been at Harvard?

A. It's almost 35 years now.

Q. What's your favorite --

A. As a faculty member.

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

what's currently your favorite restaurant in Harvard Square?

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

Q. When was your first experience with computer memory?

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

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

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

I would say probably the time that I had the

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

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

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

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

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

A. NAND flash probably happened a little bit

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

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

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

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

Q. So you mentioned textbooks, research reports.

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

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

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

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

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

MR. CROSS: Objection.

THE WITNESS: In which context?

BY MR. SAGDEO:

Q. In the context of NAND flash memory.

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

Q. What do you understand that term to mean?

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

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

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

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

MR. CROSS: Objection. Form.

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

BY MR. SAGDEO:

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

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

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

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

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

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

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

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

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

MR. CROSS: Objection. Form.

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

BY MR. SAGDEO:

Q. Let's see.

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

(Exhibit 1 was marked for identification.)

BY MR. SAGDEO:

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

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

A. Bigger?

Q. Sorry. I didn't --

A. Yes.

Q. -- catch the --

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

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

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

Q. And how would you describe it?

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

not sure what they are.

Q. Is there a substrate in this diagram?

MR. CROSS: Objection. Form.

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

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

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

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

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

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

BY MR. SAGDEO:

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

What does that stand for?

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

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

A. Yes. Yes, that's correct.

Q. What does "STI" stand for?

A. STI --

MR. CROSS: Objection. Form.

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

that is a shallow trench isolation.

BY MR. SAGDEO:

Q. What is a shallow trench isolation structure?

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

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

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

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

MR. CROSS: Objection. Form.

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

to have another form of isolation.

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

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

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

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

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

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

BY MR. SAGDEO:

Q. Good to know.

(Exhibit 2 was marked for identification.)

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

BY MR. SAGDEO:

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

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

Q. Sure.

A. -- I keep this as well?

Q. You can close it out or --

A. I can close it out. Okay.

Q. Yep.

A. Just not have too many windows.

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

A. Yes, it's also small.

Yes.

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

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

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

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

What do you understand that to mean?

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

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

I'm happy with that.

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

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

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

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

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

What would they represent?

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

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

A. Yes.

Q. What does that mean?

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

Q. What is a dielectric?

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

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

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

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

Could a dielectric be a conductor?

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

using here today is based on semiconductor.

So I'm just -- let me just leave it at that. Dielectric is usually an insulator and can be a semiconductor. Some semiconductors can act like a dielectric; depends on the temperature you use them and the magnitude of the electric field.

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

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

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

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

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

Is that fair to say?

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

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

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

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

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

MR. CROSS: Objection. Form.

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

not act as a dielectric.

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

(Exhibit 3 was marked for identification.)

BY MR. SAGDEO:

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

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

A. So I can close out this document?

Q. Yes.

A. Okay.

Okay.

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

A. Okay.

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

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

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

A. Photographs of a piece of paper.

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

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

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

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

Q. Would you construe it that way?

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

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

MR. CROSS: Objection. Relevance.

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

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

BY MR. SAGDEO:

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

A. Okay.

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

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

Q. Does this paper airplane have wings?

MR. CROSS: Objection. Relevance.

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

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

BY MR. SAGDEO:

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

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

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

MR. CROSS: Objection. Relevance.

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

BY MR. SAGDEO:

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

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

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

BY MR. SAGDEO:

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

A. There's reason to --

Q. -- to throw it.

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

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

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

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

Q. Okay. Well --

A. I'm not trying to be --

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

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

Does -- does that help you answer the question?

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

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

BY MR. SAGDEO:

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

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

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

BY MR. SAGDEO:

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

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

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

Q. Okay. Fair -- fair enough.

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

MR. CROSS: Objection. Relevance. Scope.

Form.

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

BY MR. SAGDEO:

Q. Right.

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

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

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

Q. And I see that --

A. They're --

Q. Oh, go ahead.

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

Q. So I notice that --

A. Or how --

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

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

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

Do you see that?

A. Yes.

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

MR. CROSS: Objection. Form. Relevance.

THE WITNESS: I think --

MR. CROSS: Scope.

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

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

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

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

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

BY MR. SAGDEO:

Q. Fair enough.

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

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

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

BY MR. SAGDEO:

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

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

MR. CROSS: Objection. Form.

THE WITNESS: Sure. Yes.

BY MR. SAGDEO:

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

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

Could you provide some context here again for me?

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

A. Skill in the art of what?

Q. Flash memory.

A. Flash memory. Okay.

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

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

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

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

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

A. No. Not really.

MR. CROSS: Objection. Form.

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

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

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

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

BY MR. SAGDEO:

Q. Can a neighborhood have a structure?

MR. CROSS: Objection. Relevance. Scope.

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

BY MR. SAGDEO:

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

MR. CROSS: Objection.

THE WITNESS: A wall --

MR. CROSS: Form.

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

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

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

(Exhibit 4 was marked for identification.)

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

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

BY MR. SAGDEO:

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

A. Yes.

Q. What does this photo depict?

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

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

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

BY MR. SAGDEO:

Q. Let me be more specific.

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

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

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

BY MR. SAGDEO:

Q. Well, let me ask you.

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

A. I see --

MR. CROSS: Objection. Relevance.

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

BY MR. SAGDEO:

Q. Which things?

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

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

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

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

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

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

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

A. Oh, you can't?

Q. Okay. Now I can.

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

MR. CROSS: Appears to be a building.

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

BY MR. SAGDEO:

Q. Is that fair?

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

Q. Okay.

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

Q. Okay.

A. I think.

Okay?

Q. Uh-huh.

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

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

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

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

MR. CROSS: Objection. Form. Relevance.

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

BY MR. SAGDEO:

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

(Exhibit 5 was marked for identification.)

BY MR. SAGDEO:

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

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

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

A. Yes.

Q. What does this photo depict?

A. The interior of a building.

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

MR. CROSS: Objection. Form.

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

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

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

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

BY MR. SAGDEO:

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

Can you describe the components of this staircase structure?

MR. CROSS: Objection. Form. Lacks foundation.

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

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

//

BY MR. SAGDEO:

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

MR. CROSS: Objection. Form. Lacks foundation.

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

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

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

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

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

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

if, Allen, that works for you too?

MR. CROSS: Yep, that works.

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

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

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

BY MR. SAGDEO:

Q. Welcome back, Dr. Yang.

A. Hello.

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

A. Yes.

Q. Was it about the substance of the deposition?

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

Q. Fair enough.

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

A. Is it the staircase?

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

wall.

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

I closed it out, but I'll open it again, yes.

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

A. I have it now.

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

A. Probably the --

MR. CROSS: Objection. Form.

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

BY MR. SAGDEO:

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

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

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

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

(Exhibit 6 was marked for identification.)

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

BY MR. SAGDEO:

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

A. Okay.

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

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

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

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

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

BY MR. SAGDEO:

Q. So just to restate.

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

MR. CROSS: Objection. Asked and answered.

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

BY MR. SAGDEO:

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

MR. CROSS: Objection. Form.

BY MR. SAGDEO:

Q. -- right?

MR. CROSS: Asked and answered.

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

BY MR. SAGDEO:

Q. Is the answer yes?

MR. CROSS: Objection. Form.

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

(Exhibit 7 was marked for identification.)

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

BY MR. SAGDEO:

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

A. Can I close this one?

Q. Yes.

A. Yes.

Q. Do you know who this photo is of?

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

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

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

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

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

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

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

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

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

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

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

//

BY MR. SAGDEO:

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

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

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

BY MR. SAGDEO:

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

But have you heard of someone called Joan of Arc?

A. Yes. I believe a historical figure.

Is that who you're talking about?

Q. Yes.

A. Okay.

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

A. I don't recall exactly, no.

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

Is she still Joan of Arc?

MR. CROSS: Objection. Relevance. Scope.

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

BY MR. SAGDEO:

Q. So that is --

A. What's in the name, right?

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

MR. CROSS: Objection. Relevance. Scope.

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

Could I give you a counterfactual?

//

BY MR. SAGDEO:

Q. Sure.

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

Q. I think she was, but go ahead.

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

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

Q. Okay.

(Exhibit 8 was marked for identification.)

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

BY MR. SAGDEO:

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

A. Yes.

Can I close the previous one?

Q. Yes, please.

A. Okay.

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

A. Yes, it appears to be.

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

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

Q. Have you read the '378 patent?

A. Since then, yes, many times.

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

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

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

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

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

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

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

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

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

A. Yes.

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

A. Yes.

Q. Do you see a label "110"?

A. Yes.

Q. What is 110?

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

Q. Go ahead.

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

Q. Sure. Take your time.
A. Thank you.
So the exact wording that's used is NAND string regions.
Q. So the figure -- I'm going back to Figure 1B. The figure includes a label "112" inside region 110.
Do you see that?
A. Yes.
Q. What is 112?
A. Again, please permit me to get the exact wording.
Q. Go ahead.
A. NAND strings is what they call those.
Q. What are the purpose of NAND strings 112?
A. The NAND strings in 112, or in this 3D memory here that's being described, is actually a series string of transistors, and each one of those transistors in that NAND string can store some memory. Sometimes it's one bit. Sometimes it's up to two or three bits that can be stored per cell.
And so that string -- we're looking at the top of it -- is a string of memory cells.
Q. And what function, I guess, do the NAND strings 112 serve?

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

Q. Figure B -- strike that.

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

Do you see that?

A. Yes.

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

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

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

MR. CROSS: Objection. Form.

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

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

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

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

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

BY MR. SAGDEO:

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

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

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

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

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

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

Do I have that right?

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

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

Q. Does the '378 patent describe that last

purpose that you mentioned?

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

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

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

Q. Okay. So --

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

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

Do you see that?

A. Yes.

Q. What is 122?

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

Q. Sure.

A. So 122 goes by two different names; just

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

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

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

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

So I think spacing as well as physical support.

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

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

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

a bit more about what that function is?

A. Sure.

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

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

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

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

Q. Does the NAND string region 110 also include

an alternating conductor dielectric layer stack?

MR. CROSS: Objection. Form.

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

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

BY MR. SAGDEO:

Q. Got it.

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

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

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

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

Q. Yeah.

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

A. "TAC region 102"?

Q. Yep.

A. Yes.

Q. So do you see where it says:

"TAC region 102 includes NAND string regions 110"?

A. Yes.

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

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

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

"TAC region 102 includes NAND strings 110 and" -- not "and," comma:

-- "a TAC region 120 and top select [sic] (TSG) stare gate [sic] region 130."

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

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

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

Q. So is --

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

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

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

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

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

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

actually also call the TAC region.

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

A. Yes.

Q. Do you see element 210?

A. Tell me where 210 is.

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

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

Figure 2, 210, yes.

Q. So what -- what is element 210?

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

Q. Sure.

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

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

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

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

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

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

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

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

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

Well, its function is to be here.

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

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

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

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

Is that -- is that fair to say?

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

Q. Are there any functions that I missed?

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

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

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

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

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

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

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

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

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

Did I get that right?

A. Yes.

Q. What do you understand that sentence to mean?

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

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

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

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

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

MR. CROSS: Objection.

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

BY MR. SAGDEO:

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

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

THE STENOGRAPHER: Wait. Can you slow down?

Can you slow down just a little bit?

MR. SAGDEO: Oh, I'm sorry.

BY MR. SAGDEO:

Q. In some --

(Stenographer clarification.)

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

BY MR. SAGDEO:

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

So --

A. I believe -- yes.

Q. Go ahead.

A. Okay. Go ahead.

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

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

A. That's correct.

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

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

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

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

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

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

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

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

There's a lot of design details.

BY MR. SAGDEO:

Q. Got it.

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

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

MR. CROSS: Objection. Form.

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

BY MR. SAGDEO:

Q. Got it.

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

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

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

memory cells you have.

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

Q. Got it.

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

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

A. The number of active NAND strings, yes.

Q. Okay. The number of active NAND strings.

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

A. Sorry. Just...

Yes. I'm looking at Figure 2.

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

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

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

we just talked about it. I guess element 200?

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

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

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

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

Q. What is element 202?

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

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

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

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

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

MR. CROSS: Objection. Form.

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

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

BY MR. SAGDEO:

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

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

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

MR. CROSS: Object to form.

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

silicon wafer.

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

BY MR. SAGDEO:

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

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

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

There's many factors involved in choosing it.

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

serve?

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

Q. By the -- go ahead.

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

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

Q. You mentioned some electrical functions.

Could you say more about that?

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

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

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

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

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

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

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

MR. CROSS: Objection. Form.

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

//

BY MR. SAGDEO:

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

MR. CROSS: Objection. Form.

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

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

BY MR. SAGDEO:

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

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

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

MR. CROSS: Objection. Form.

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

BY MR. SAGDEO:

Q. And why is that?

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

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

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

Q. Do you see in Figure 2 element 232?

A. So many pieces here.

Yes.

Q. What -- what is element 232?

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

MR. CROSS: Parth, will we have an

opportunity to take a break soon or --

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

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

BY MR. SAGDEO:

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

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

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

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

MR. CROSS: Sounds good.

THE WITNESS: Yes.

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

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

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

and we are going on the record.

BY MR. SAGDEO:

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

What is the dielectric structure made out of?

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

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

A. I believe they mentioned silicon dioxide.

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

A. Yes, Column 10.

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

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

Did I get that right?

A. Yes.

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

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

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

(Crosstalk.)

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

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

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

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

Q. Are there any other purposes?

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

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

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

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

Q. So one of the functions that I think you

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

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

Q. Sure.

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

Q. Okay.

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

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

Q. Got it.

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

A. The conductor material --

Q. No --

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

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

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

A. Not exactly right.

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

Q. Got it.

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

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

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

structure.

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

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

A. Yes.

Q. So do you see element 233?

A. Yes.

Q. And -- and what is element 233?

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

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

So it's called multiple different things, yes.

Q. You mentioned shallow trench isolation structure.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

the way it's kind of being used there.

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

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

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

Pardon me.

MR. SAGDEO: Should we take a break?

MR. CROSS: We can go off the record.

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

THE WITNESS: Sorry.

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

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

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

Sorry.

MR. SAGDEO: It's okay.

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

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

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

BY MR. SAGDEO:

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

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

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

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

Q. Got it.

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

Do I have that right?

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

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

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

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

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

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

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

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

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

A. Yes.

Q. Do you see element 224?

A. So many elements here.

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

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

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

Q. So what -- what is element 224?

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

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

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

So what does "etch" mean?

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

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

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

Q. Got it.

And what does "plug" mean?

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

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

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

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

A. Right. Well --

MR. CROSS: Objection. Form.

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

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

it to impact and damage the NAND string.

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

BY MR. SAGDEO:

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

A. Yes.

Q. Okay.

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

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

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

Let me just get the exact wording of that.

236.

NAND string contact 236.

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

Would it be more accurate to say that what

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

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

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

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

A. Yes.

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

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

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

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

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

and 12; is that right?

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

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

A. Oh, the etch stop plug?

Q. Right.

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

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

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

And then the even more difficult thing to

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

A. 15; right?

Q. Right.

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

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

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

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

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

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

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

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

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

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

A. Let me do a quick search.

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

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

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

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

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

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

Q. So you mentioned the epitaxial plug.

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

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

both.

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

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

A. Okay.

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

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

MR. CROSS: Objection. Form.

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

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

BY MR. SAGDEO:

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

MR. CROSS: Objection. Lacks foundation.

THE WITNESS: Could you repeat the question again?

BY MR. SAGDEO:

Q. Let me rephrase.

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

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

MR. CROSS: Objection. Form.

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

etch, which damages the 3D channel.

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

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

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

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

THE WITNESS: Okay.

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

THE WITNESS: Okay.

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

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

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

and we are going on the record.

BY MR. SAGDEO:

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

Do I have that right?

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

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

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

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

MR. CROSS: Objection. Form.

THE WITNESS: It's difficult to say because

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

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

BY MR. SAGDEO:

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

MR. CROSS: Objection. Form.

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

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

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

BY MR. SAGDEO:

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

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

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

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

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

Q. Shifting gears a little bit.

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

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

In my -- did I get that right?

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

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

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

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

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

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

myself.

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

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

So turning to the etch stop plugs.

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

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

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

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

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

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

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

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

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

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

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

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

Does that make sense?

Q. Got it.

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

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

MR. SAGDEO: Okay.

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

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

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

EXAMINATION

BY MR. CROSS:

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

A. Yes.

Q. And turn to Column 4, line 41.

A. Yes.

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

A. Yes.

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

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

uses the term "substrate"?

MR. SAGDEO: Objection. Leading.

THE WITNESS: Yes.

BY MR. CROSS:

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

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

MR. SAGDEO: Objection. Leading.

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

BY MR. CROSS:

Q. Oh.

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

MR. SAGDEO: You can answer.

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

BY MR. CROSS:

Q. I can rephrase if you'd like.

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

Q. Yeah, please answer the question.

Is this the -- did you use the language at

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

MR. SAGDEO: Objection. Leading. Scope.

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

Am I allowed to answer at this point?

BY MR. CROSS:

Q. Yes.

MR. SAGDEO: You can.

BY MR. CROSS:

Q. Yeah.

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

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

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

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

patterned in how it's used. So.

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

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

A. Yes.

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

A. Yes.

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

MR. SAGDEO: Objection. Leading.

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

MR. SAGDEO: Yes.

BY MR. CROSS:

Q. Yes.

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

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

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

just one view.

Q. Right. And so because of this one view, you can't see the other side; correct?

MR. SAGDEO: Objection. Leading.

THE WITNESS: No, I can't see the other side.

MR. CROSS: Okay. No further questions.

MR. SAGDEO: No recross.

THE VIDEOGRAPHER: The time is 5:32 p.m., and we are going off the record.

Thank you, everyone.

THE STENOGRAPHER: And, Mr. Cross, would you like a copy of the transcript?

MR. CROSS: If you don't mind contacting the paralegal.

THE STENOGRAPHER: Sure.

MR. CROSS: Okay.

THE STENOGRAPHER: I will.

MR. SAGDEO: So, Lorie, do you have our order?

THE STENOGRAPHER: I do. I do have your order.

It's regular and then a rough draft; right?

MR. SAGDEO: Perfect, yeah.

THE STENOGRAPHER: Okay. Perfect.

THE VIDEOGRAPHER: Would you like video, Counsel?

MR. SAGDEO: Let's put that in for now, but I think I'm going to check in on that, and I will e-mail you.

And also, Allen, I will e-mail you, too, shortly if -- if we're not actually using that also about Thursday.

MR. CROSS: Great. Appreciate it.

THE STENOGRAPHER: And then should I check on the rough too, Allen?

MR. CROSS: Yeah. That would be great.

THE STENOGRAPHER: Okay. All right. I'll reach out to your paralegal.

(Time noted: 5:33 p.m.)

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.

Lori Rhyne

LORIE RHYNE

CSR No. 12905