UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS)
INDUSTRIES, LLC,)
)
)
Petitioner,)
)
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vs.)
)
)
GREENTHREAD, LLC,)
)
)
Patent Owner.)

Case IPR2023-01242
U.S. Patent No. 11,121,222
Case IPR2023-01243
U.S. Patent No. 10,510,842
Case IPR2023-01244
U.S. Patent No. 11,121,222

DEPOSITION OF ALEXANDER GLEW, PHD
July 16, 2024

Reported by: Dana Peabody, RDR, CRR, CSR No. 6332
Pages 1 through 153
Job No. HOU 6760791

Veritext Legal Solutions
346-293-7000

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Semiconductor Components Industries, LLC v. Greenthread LLC
IPR2023-01243

Deposition of Alexander Glew, PhD, taken on behalf of Petitioner, at Baker Botts, 1001 Page Mill Road, Building One, Suite 200, Palo Alto, CA 94304-1007, commencing at 9:14 a.m., on July 16, 2024, before Dana Peabody, CSR No. 6332, via Zoom.

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I N D E X

E X A M I N A T I O N S

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E X H I B I T S

EXHIBIT	DESCRIPTION	PAGE
Exhibit 1100	Figure 5B from the '222 patent, with hand-drawn additions	38

PROCEEDINGS

ALEXANDER GLEW, PHD,
having been duly sworn, or affirmed, was examined and testified as follows:

MR. SPEEGLE: This is Mark Speegle with Baker Botts for Petitioner Semiconductor Components Industries. With me, remotely, is also Dan Anderson from Newman Jones and Ellyar Barazesh from Baker Botts.

MR. WHITEHURST: And good morning, everyone. This is Alan Whitehurst from McKool Smith for the patent owner, Greenthread, and also for the witness.

And I'm just going to note on the record that there is a video camera here in the room with us, but I've been instructed by counsel that the video camera is just for the convenience of our court reporter, who is remote this morning, and that no video recording of this deposition is being made.

MR. SPEEGLE: We confirm our understanding there is no video being made or recording being made.

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EXAMINATION

BY MR. SPEEGLE:

Q. Good morning. Could you please state your name and address for the record.

A. Alexander Glew, G-L-E-W. My home address is 970 Aura Way, Los Altos, California, 94024.

Q. Thank you, Dr. Glew.

You understand you're under oath today?

A. Yes.

Q. Have you testified in depositions before?

A. Yes.

Q. Okay. So you're familiar with the ground rules for these kind of proceedings?

A. Generally, yes.

Q. Just to refresh you, we'll be having a series of questions and answers, and the court reporter will be taking down our answers on a transcript.

Because the court reporter is taking down everything we say, we need to give verbal answers, not just head nods or head shakes.

Does that make sense?

A. Yes, it does.

Q. Is there any reason why you cannot testify fully and truthfully today?

A. Not that I'm aware of.

Q. Okay. If you need a break -- I'll try to take a break every hour or so, but if you need a break at any time, will you let me know?

A. Yes.

Q. And if you ever do not understand my question or need clarification on something, will you please let me know that too?

A. Yes, I will try to do that.

Q. Okay. Dr. Glew, you've been retained by patent owner Greenthread in a series of inter partes reviews involving Semiconductor Components Industries, right?

A. Yes, I have.

Q. Okay. And in front of you, there's three documents. Do you recognize these documents as declarations you've submitted in inter partes reviews for Greenthread?

A. Yes, these are three declarations that I submitted.

Q. Okay. And these declarations are each Exhibit 2057, as you can see in the bottom right-hand corner, for three separate IPR proceedings that are IPR 2023-01242, IPR 2023-01243, and IPR 2023-01244. Is that right?

A. That is correct, yes.

Q. Okay. So if I refer to the -- your declaration in the 01242 IPR, will you know which document I'm referring to?

A. Yes.

Q. And same for the declaration in the 01243 proceeding?

A. Yes.

Q. And in the declaration -- your third declaration is from the 01244 proceeding, right?

A. Yes, that's the third one.

Q. Okay. And do the opinions that you're offering in these proceedings -- let me back up. Let me strike that.

You understand this deposition is a consolidated deposition for use in all three of the IPR proceedings that we just mentioned: The 01242, 01243, and 01244 proceeding?

A. That is my understanding.

Q. Okay. And if you ever need clarification about the patents or declarations between these different declarations as we go through this deposition, will be please let me know?

A. Yes, I'll try to do that.

Q. Okay. So, Dr. Glew, your declaration that

you submitted in the three IRPs that we just mentioned, do these declarations in front of you contain all of your opinions you intend to offer in these proceedings?

A. They contain a summary of the opinions that I had at the time I wrote them. As additional information becomes available, I may form new -- additional opinions.

Q. Are there any statements in any of your three declarations that you know are no longer your opinion now?

A. No, not that I'm aware of.

Q. Any mistakes or typos that you've become aware of in the declaration since you submitted them?

A. I believe in my "Background" section, I wrote that I had five patents. I think I have six.

Q. Okay. Anything else come to mind?

A. Not off the top of my head, no.

Q. Okay. Do you have a team of people assisting you in your work in this matter or are you working on your own?

MR. WHITEHURST: Object to form.

THE WITNESS: I generally work -- when I do this kind of work, I have an attorney -- I have

an engineer who works at my firm who helps me with stuff, as needed, and then I work with the attorneys also in preparation.

BY MR. SPEEGLE:

Q. Is your firm being paid hourly for your time in this matter?

A. Yes, it is.

Q. And if you look at -- we'll look at the 1243 declaration. I believe it's paragraph 3 on page 1 states that your rate is $700 per hour. Is that accurate?

A. Yes.

Q. And is the engineer that you mentioned on your team -- is he billing separately for this matter as well?

A. He bills through my firm as separate -- he bills as part of my firm, yes, so the billing is done by the firm.

Q. Do you have an estimate for the total number of hours that you've spent on the Greenthread IPR matters?

A. Not off the top of my head.

Q. More than a hundred hours?

A. It's kind of hard sometimes to differentiate in my head because I'm working on, I

guess, a federal case too at the same time. So just -- off the top of my head, certainly, I've put in more than a hundred hours on this case. I couldn't break it out by different patent or how much was IPR and how much was the other matter.

Q. Okay. You understand these declarations were submitted in support of Greenthread's patent owner responses in each of these IPR proceedings, right?

MR. WHITEHURST: Object to form.

THE WITNESS: I believe generally -- I mean, these are declarations that I've made on this matter. I understand that Greenthread had made a -- as a patent owner, had made a preliminary response and filed a response.

BY MR. SPEEGLE:

Q. Are you familiar with Greenthread's final response in any of these IRPs?

A. To some extent.

Q. Do you know if your declaration copied directly from Greenthread's patent owner response?

MR. WHITEHURST: Object to form.

THE WITNESS: I didn't see their document before it was submitted. I'm not sure -- I know, generally, the law firms look to the experts in

support of the documents the writings. I'm imagining there's got to be a fair amount of similar description or -- of the subject matter.

BY MR. SPEEGLE:

Q. I'm going to back up.

Can you tell me what your current job title is?

A. I am president and CEO of Glew Engineering Consulting.

Q. What kind of work does Glew Engineering Consulting do?

A. Well, it's a small engineering firm in Mountain View, California. We do, lately, mainly litigation support. We do also do some -- I would say computer modeling. We have three different computer-aided design programs. We use SolidWorks, the Autodesk products, Inventor and Pro/E Creo, which is 3D modeling for usually larger companies and military, kind of aerospace.

I'm a licensed mechanical engineer, and we also carry errors and omissions insurance, as engineers, similar to a doctor would have errors and omissions insurance.

So we do some work with different companies where we might place an engineering stamp

on things or review designs, that sort of stuff.

So, I'd say, it's mainly litigation support in high tech. We do a little bit of industrial and general engineering also. I've worked on everything from -- you know, as an engineer, soup to nuts sometimes.

Q. When you say "mainly litigation support," in terms of the percentage of revenue over the last five years for Glew Engineering, would you say litigation support is 75 percent of the revenue?

A. I'd say that's reasonable, yeah.

Q. Is it 90 percent of the revenue?

A. It depends on the years. During COVID, I think it was. Engineering pretty much dried up.

Q. Okay.

A. Yeah, but usually, it's about three-quarters.

Q. What was the last job you held outside of Glew Engineering?

A. Last job I held was Applied Materials. After I left Applied, I started Glew Engineering, and I've been at Glew Engineering since.

Q. When did you leave Applied?

A. Officially beginning of '97, but, really, end of '96.

Q. What made you leave?

A. I was returning to Stanford to finish a PhD in material science. I had taken all the coursework while I was at Applied and passed the qualifying exams, so I needed to write the dissertation.

Q. What was your dissertation?

A. I wrote a dissertation on plasma-enhanced chemical vapor deposition of diamond-like carbon and fluorinated amorphous carbon. These were dielectric materials that were being evaluated for use in electronics.

Q. Was your dissertation published in a peer-reviewed journal?

A. I published papers while I was in graduate school in peer-reviewed journals and then finished with the dissertation, yes.

Q. Have you published any peer-reviewed papers since you completed your PhD?

A. No, I've been in private practice.

Q. Are you currently running for any elected office?

A. Yes, I am.

Q. Which one?

A. I am a candidate in the general election

of November 2024 for Senate District 13 in California.

Q. Is it the first time you've run for an elected office?

A. No, I've run before.

Q. Have you ever held a position in government before?

A. I've been Commissioner of my city. That would be probably the only official capacity, yes.

Q. And how many times have you run for office before?

MR. WHITEHURST: Object to scope.

THE WITNESS: I didn't.

BY MR. SPEEGLE:

Q. Okay. How many times have you run for office?

A. I ran for -- this office, this is the second time. I ran four years ago and was top two also. I ran before that for State Assembly in what would be a sub -- half of this district essentially, and I was top two in that.

Q. Okay. Would you describe yourself as a politician?

MR. WHITEHURST: Object to scope.

THE WITNESS: No, not at all. I describe

myself as an engineer.

BY MR. SPEEGLE:

Q. Look at page 8 of your 1242 declaration.

A. What page?

Q. 8.

Can you see paragraph 17 and 18 of your 1242 declaration on page 8?

A. Yes, I do.

Q. Okay. And do these paragraphs address the level of ordinary skill in the art that you applied in making your opinions in this matter?

A. Yes, this is the level of one of ordinary skill in the art that I applied.

Q. And you opined in paragraph 18 that you would have had at least the qualifications of -- of a POSITA, person of ordinary skill in the art, since at least September 3rd, 2004. Is that right?

A. Yes.

Q. And would you compare that to page 9 of your 1243 declaration, page 8 of your 1244 declaration?

A. Which?

Q. 9 of the 1243 and 8 of the 1244.

While you're reviewing, I'll tell you, my question is going to be, if you applied the same

1 understanding of a person of ordinary skill in the
2 art in all three declarations.
3 A. I did apply the same standard of one of
4 ordinary skill in the art.
5 Q. I'm going to pass you what is Exhibit 1003
6 in the 1242 IPR.
7 And do you recognize OnSemi's Exhibit 1003
8 is the declaration of Travis Blalock?
9 A. Yes.
10 Q. Have you seen this declaration before?
11 A. Yes.
12 Q. Why don't you turn to page 22 and
13 paragraph 48. The page number is confusing here.
14 There's an exhibit page number, and then there's a
15 printed page number. I'm looking at printed page
16 22, which is exhibit page 28.
17 Do you see paragraph 48?
18 A. Yes.
19 Q. And you see the definition of the POSITA
20 that Dr. Blalock applied in his declaration?
21 A. Yes.
22 Q. Would you agree with me that his
23 definition of POSITA is similar, but not identical
24 to the definition of the POSITA that you applied in
25 all three of your declarations?

MR. WHITEHURST: Object to form.

THE WITNESS: It's substantially similar, yes.

BY MR. SPEEGLE:

Q. And would any of your opinions in this matter change if you used Dr. Blalock's definition of a POSITA instead of the one you provided in your declarations?

A. I haven't considered that before, but off the top of my head, they seem substantially similar. I don't imagine it having a big impact.

Q. Okay. Now, I think one difference between the definition of "POSITA" that she used in the definition from Dr. Blalock is that you included a longer list of potential degrees, putting things like computer engineering and chemical engineering, which Dr. Blalock did not include in his declaration.

Can you help me understand why you included those additional fields in your definition of a POSITA?

A. Based on my experience, chemical engineering is a very common degree in this field. I worked with a lot of chemical engineers. Chemical engineering is more of the applied chemistry, if you

will. So it's -- I think a common -- yeah, it's a relevant background from a technical sense, and from my experience, it's a common degree that people had in the field. That was the first question.

The second was electrical or computer engineering.

A lot of departments call their programs different things. For example, at Berkeley, it was electrical engineering and computer science, EECS. Other universities might call it electrical engineering. So I think it's not necessarily much difference to that.

Q. Turning back to your -- I'll introduce -- U.S. Patent Number 10510842 -- 8.

Do you see that?

A. Yes, I see the '842.

Q. Is this the patent that's at issue in the IPR 2023-01243 that you opined on?

A. Yes, the '842 is in the 1243.

Q. I'm going to hand you the 11121222 patent.

Do you see this?

A. Yes, I do.

Q. And the 11121222 patent is at issue in both IPR 2023-01242 and IPR 2023-01244, right?

A. Yes, the '222 patent is in the 1242 and

1244 IRPs.

Q. And there are different claims at issue from the '222 patent in the 1242 and 1244 IPR, right?

A. Yes, they address different --

Q. And the way I personally remember it is that Claim 44 is at issue in the 1244.

A. Yes, it's an easy way to remember it.

Q. Okay. So with these patents in hand, I want to direct you to paragraph 34 of your 1242 declaration, and this is spanning pages 13 and 14.

A. You said pages 13 to 14? Which paragraph?

Q. I'm looking at paragraph 34.

A. 34.

Q. Specifically, I'd direct you to the last sentence of paragraph 34, and this sentence says, "The claimed invention is clearly disclosed in EG Figures 5B-5C of the challenged patent and the corresponding parts of the specification."

Do you see that?

A. Yes.

Q. Do you still agree with that statement that the claimed invention is disclosed in Figure 5G -- sorry -- 5B, for example?

A. Yes.

Q. So I've handed you the patent there, and can you turn to Figure 5B?

What I'd like to do next is go through the claim language for Claim 1 of the '222 patent and understand your opinion here that Figure 5B discloses the claimed invention.

Are you able to do that?

A. Okay. Yes.

Q. Let's make it easier. Let's go ahead and tear Figure 5B out of the staple so that you can look at it at the same time.

A. Okay.

Q. So starting with the preamble of the Claim 1 of the '222 patent, do you agree that Figure 5B discloses what could be a VLSI semiconductor device?

A. Yes, it does. It describes, for example, CMOS and DRAM.

Q. Okay. The next element of Claim 1 of the '222 patent is, "A substrate of a first doping type at a first doping level having a surface."

Do you see that?

A. Yes.

Q. And is that disclosed in Figure 5B?

A. Yes, it describes the substrate.

Q. That -- the P minus sign substrate, what

you described as, "A" --

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. -- "substrate of a first doping type at a first doping level having a surface"?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, the bottom larger rectangular shape labeled "Substrate" is substrate.

BY MR. SPEEGLE:

Q. Okay. The next element is, "A first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed."

Do you see that?

A. Yes.

Q. Is that disclosed in Figure 5B?

A. It's disclosed in the description, "CMOS complementary metal oxide semiconductor." So I know that for each NPN, there's a PNP transistor. What is shown visually here is an NPN -- NPN type transistor, but there are also PNP transistors since it's CMOS.

Q. Okay. Am I understanding correctly from your answer that you'd accept that a PNP transistor

is part of a first active region having a conductivity type opposite to a P substrate?

MR. WHITEHURST: Object to form.

THE WITNESS: Could you repeat that question?

BY MR. SPEEGLE:

Q. I'll break it down a little bit.

Am I understanding that you said Figure 5B discloses the first active region element from Claim 1 because the caption tells you it's a CMOS device, which would also have a PNP transistor? Did I understand that right?

A. Yes, that's essentially what I said.

Q. Okay. And you agree with me that Figure 5B does show an NPN transistor, right?

A. What is in the figure, the image, is, yes, a very small portion of CMOS circuit. It's showing an NPN transistor, as well as a storage capacitor as, you know, probably part of a DRAM.

Q. And you would not describe the NPN transistor shown in Figure 5B as having an opposite conductivity type from the p-type substrate?

MR. WHITEHURST: Object to form.

THE WITNESS: No, I wouldn't. The substrate is p-type, but the active region in which

the transistor is formed is also p-type, so they are not opposite.

BY MR. SPEEGLE:

Q. Okay. Can you explain to me why you think the NPN transistor has a -- doping type?

A. As I wrote in my report, Figures 5B and 5C -- you know, I take these together --

MR. WHITEHURST: Counsel, do you have a single-sided copy of the '222 patent? Because I think the witness is going back and forth from Figure 5A to 5B, and it's tough when they're on opposite sides of this same page. Or maybe you have an extra copy. Unfortunately, I've written on my copy, so it would be inappropriate.

MR. SPEEGLE: Here's my copy.

MR. WHITEHURST: I think it's helpful. Thank you.

BY MR. SPEEGLE:

Q. Let me ask my question again.

A. Yes, please.

Q. Okay. Why is an NPN transistor, as pictured in Figure 5B, not opposite in conductivity type to the p-type substrate in 5B?

A. Looking at Figure 5B, we see n-type source and drain. One of skill in the art, as well as one

1 looking at Figure 5A, would understand that there
2 are different types of active areas. Looking back
3 at 5A, one can see a p-well and an n-well.
4 Basically, sources and drains are of the opposite
5 type of well or active area they're formed in, so
6 wells -- sources and drains are counter-doped. So
7 if I have an n-type source and drain, it will be
8 formed in a p-type region. If I have a p-type
9 source and drain, it's formed in an n-type region.
10 So that is the basis for why I say that.
11 Q. Okay. And when you -- you're interpreting
12 the conductivity of the second doping type, as used
13 in Claim 1 of the '222 patent, to refer to the
14 doping type of the well in which the transistor is
15 formed. Is that right?
16 MR. WHITEHURST: Object to form.
17 THE WITNESS: Essentially, yes. It states
18 a first active region in the second claim element.
19 It states -- for example, in the fourth claim
20 element, transistors formed in at least one of the
21 first active regions or second active regions.
22 So the active region exists before the
23 transistors, the well exists before the transistors
24 are formed, it has a type, n or p, and then the
25 transistors are formed in that doped region.

BY MR. SPEEGLE:

Q. Thank you. That's helpful.

The next element in our claim, as we go down, refers to, "A second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed."

A. Yes.

Q. Is that disclosed in Figure 5B?

A. Figure 5B discloses that there's a CMOS substrate. I think Figure 5A discloses it better. Figure 5B shows active regions adjacent to each other, whereas Figure 5B is kind of a blow-up within one active region. It is a CMOS, so there has to be a complementary type formed.

Q. Is your understanding that the device, as claimed in Claim 1, has already been manufactured with a transistor actually doped into the device or is it referring to a device before the transistor is doped in?

MR. WHITEHURST: Object to form.

MR. SPEEGLE: You raised your hand for that.

MR. WHITEHURST: I wanted the witness to know the objection was coming, and it was clearly a

compound question, so I was just explaining my objection for him.

THE WITNESS: I would explain it like this: As the preamble describes, this as a device. So it's a form device. In reading the different elements of the claim, for example, the fourth one reads, "Transistors formed in at least one of the first active regions or second active regions."

So one can form an active region without forming transistors in it, according to the fourth claimed element.

So I think this claim, at its face, teaches us that there may be active regions, wells, if you will, something along those lines, tubs, there are different terms, that exist with or without transistors.

One of skill in the art would also understand that forming of the different PN regions is usually one of the first things done on a wafer before the transistors are formed.

You know, the language also describes the transistors are formed in the active region. So when they are formed in the active region, I think the active region has to be there.

You know, you -- that's my general

understanding.

BY MR. SPEEGLE:

Q. Okay. Thank you for that.

And when you say "the fourth element" in that answer, you're referring to the element that says, "Transistors formed in at least one of the first active region or second active region," right?

A. Yes.

Q. Okay.

A. That's the fourth.

Q. When the transistors are formed in an active region, dopants that create a source and drain are added to the active region, right?

A. Yes. I've used the term "counter-doping," but yes, sources and drains are formed by heavily counter-doping opposite the active region that's there.

Q. Okay. So when a transistor is formed in the first active region, per the fourth element, it's a p-type well; n-type dopants would be added to form the transistor, right?

A. Yes, n-type dopants are added to form the source and drain. There may be other doping steps involved. That's sort of a simplification. There could be a number of doping steps, but yes, the

source and drain are formed by counter-doping, doping opposite the active region.

Q. In terms of a spatial understanding, the source and drain are physically in the same space as the active region well, right?

MR. WHITEHURST: Object to form.

THE WITNESS: I'd say generally, yes, the source and drain are in the well in the active region.

BY MR. SPEEGLE:

Q. Would you consider the source and drain part of the active region?

MR. WHITEHURST: Object to form.

THE WITNESS: How should I put this?

The claim language describes transistors formed in at least one of the first active region or second active region. It describes the transistors as a device, and the active region is a region. So it's sort of like apples and oranges. They are certainly -- on the top portion, they're made of the active region. The active region is, for example, silicon. And dopants, you know, boron or phosphorous or something like that are added to the silicon substrate.

///

BY MR. SPEEGLE:

Q. Well, let's keep going through the claim language.

The fifth element here in Claim 1 of the '222 patent is, "At least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions."

Do you see that?

A. I see that, yes.

Q. Is that disclosed in Figure 5B of the '222 patent?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, it is.

BY MR. SPEEGLE:

Q. Can you explain to me how that's disclosed in Figure 5B?

A. Well, 5B has a label. In the middle rectangular area that says, "Graded dopant region to pull minority carriers from the surface," it shows the arrows starting in the region above it, which I would think of as an active region wherein the transistors are formed.

It's pulling things downward toward the bottom of the substrate. That is a region where there are -- which is not active.

Q. How do you know where the active region begins and ends?

A. Well, when one forms wells or doped areas, one generally isolates them from each other. They can't really touch too much.

So there are isolation areas that define the different wells.

Now, real estate is very expensive on transistors and silicon wafers. So the goal is to use nearly all of the active region with the transistors that one's forming.

So, you know, I would say most of the area between the isolation, it should be covered with electronic devices, transistors, and that is the active area. It's active because there's active region circuitry there.

For example, one can't put a contact lead down in that region without touching an electrical circuit. One can't run a metal line over it without touching an electrical circuit. So it's an active region. It's very different -- insulating regions are not active.

Q. Okay. When you talk about the real estate being expensive on a semiconductor device, are you talking about a planar surface real estate or are you talking about depth, up and down, real estate?

MR. WHITEHURST: Object to form.

THE WITNESS: I was talking, in that last instance where I spoke about the planar top, parallel to the large dimension of the wafer, not the vertical.

BY MR. SPEEGLE:

Q. Okay. You talked about isolating different wells. Would that be like isolating the PNP transistor from the NPN transistor in a CMOS device?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, one doesn't want current to flow from one to the other, so there is an insulator, an isolation between.

BY MR. SPEEGLE:

Q. Have you ever heard the phrase "a channel stopper region"?

A. Yes.

Q. Is that another way to describe that kind of isolation?

A. Well, that's a different type -- it is

isolation. It's a different type of isolation.

Q. Okay. That would be isolation between an NPN and a PNP?

A. Basically, to keep current away from the channels, yeah.

An active area can have multiple transistors in it. You know, it would typically have multiple transistors in it. One transistor alone doesn't occur a lot in logic. There are building the transistors. That only occurs in higher power devices usually.

Q. Okay. So I appreciate your answer, and it helps explain, you know, the planar difference between active regions.

How do you tell when you look at a device in a cross-section like in Figure 5B where an active region begins and ends depthwise?

A. Figure 5 is -- how should I put this -- a figure, an illustration. It's not a to-scale drawing.

So, typically, a substrate is about 500 microns thick. They might be thinned to 300 microns. By the time -- and there are some, but not a lot, flexible circuits that might be less -- well less than 50 microns. But most rigid circuits start

at 500 or 300 nowadays sometimes, and they might be thinned down.

The active area is the top couple microns.

So it's easy to tell that there's a substrate, which is potentially hundreds of microns thick, and then there's a couple of microns at the very top, which is where all the action takes place.

From that, one looks at the depth of the transistor elements; for example, the source and drain, specifically, and the general doping in the area.

Q. Okay. You referred to the annotations on Figure 5B and the label that says, "Graded dopant region to pull minority carriers from surface." Is that right?

A. Yes, I referred to that.

Q. And what's your understanding of what those arrows pointing down illustrate in Figure 5B?

A. The arrows were just a general indication of, I would say, force in motion in that direction.

The minority carriers were headed in that direction. The driving force would be in that direction.

Based upon the graded dopants, there would be a dopant gradient in that direction also.

Q. Okay. So let's talk about the last element of Claim 1 on the '222 patent.

It says, "At least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the VLSI semiconductor device."

Do you see that?

A. Yes.

Q. Is that element disclosed in Figure 5B?

A. Yes, it is.

Q. Help me understand where it's disclosed.

A. Well, we can look at 5B and, you know, 5A also, but 5B is sort of a blow-up of one well region -- one region of a wafer.

So on the top, we have an active region. And below that, there is a graded dopant region. The well region is below the active region on the top. The bottom P substrate, for example, does not have active regions. That's just the substrate or the wafer. It is described in the specification as a CMOS substrate or DRAM. These are digital logic

VLSI.

The aiding carrier movement is indicated, of course, by the arrows and the label, "Graded dopant to pull minority carriers from the surface." It shows them heading toward the bottom.

Q. I see you've got a pen there. Could you just draw a box on Figure 5B around the well?

MR. WHITEHURST: Object. We are not going to create new exhibits using pen today.

You can hand me the pen, sir. Thank you.

MR. SPEEGLE: So, Counsel, you're instructing the witness not to annotate the exhibits?

MR. WHITEHURST: You can ask the question, and he'll answer it, but I'm not going to have him draw pictures. You can ask him questions all you want.

MR. SPEEGLE: But you're instructing him not to create any annotations?

MR. WHITEHURST: I am instructing you to ask him questions and him to answer it to the best of his ability.

If you would like to mark on it, that's your prerogative, but to force the witness to annotate it is not proper. If you would like to

draw --

MR. SPEEGLE: I disagree that that's a proper instructions, but we'll move on.

MR. WHITEHURST: -- creating new evidence in the case, so --

MR. SPEEGLE: He's a testifying expert. Everything he says is new evidence.

MR. WHITEHURST: You can annotate this yourself, counsel. There's nothing preventing you from drawing on it.

MR. SPEEGLE: We disagree. But we'll move on.

BY MR. SPEEGLE:

Q. Dr. Glew, if you did have the pen that your counsel took away from you, would you be able to draw a box around where the well region is on Figure 5B?

A. Yes. 5B is showing a portion of a well. Again, 5B is a zoom-in of one transistor, which is a portion of the well. I could show where a portion of the well is, but yes.

Q. Okay. Would it be easier for you to show with a pen that your counsel took away from you or describe it verbally?

A. I can describe it verbally just as easily,

I think.

Q. Okay. Why don't you described as detailed as you can verbally where the well begins and ends on Figure 5B.

A. There are three rectangular regions in Figure 5B: A top one, middle one labeled "Graded dopant region to pull minority carriers from surface," and a P substrate.

I'm going to review the text for a moment.

Q. Okay.

A. I'll carry on with my answer.

I would describe the well region as the region in which the access transistor is formed. It is the area beneath the access transistor where there are arrows indicated.

Q. Thank you.

So does the well region begin at the upper surface of the device or does it begin somewhere below the upper surface?

MR. WHITEHURST: Object to the form.

THE WITNESS: Here, what I'm describing is that the transistors are comprising the very upper surface. So the transistors are on top.

If we refer to Figure 5A for reference, but we can see that active devices are on top of the

wells. So the active devices are formed in the wells, but then they end up being the top.

The active devices are doped. We spoke, for example, of the source and drain being heavily counter-doped.

So I would expect, of course, that the source and drain have a different doping than the well at that point because they've been altered.

So the well, as it was -- as it is described as a well is actually -- it's underneath the active devices.

BY MR. SPEEGLE:

Q. Okay. To help understand, I'm going to hand you what I've labeled here as Exhibit 1100.

(Exhibit 1100 marked for identification.)

BY MR. SPEEGLE:

Q. And do you see Exhibit 1100 is Figure 5B from the '222 patent that I've marked with a "1," a "2," and a "3"?

A. Yes.

Q. Do you see that?

And you see the 1, 2, and 3 on my Exhibit 1100 are next to horizontal lines?

A. Yes.

MR. WHITEHURST: Just so the record is

clear, these are -- this Figure 5B has been annotated by counsel, so counsel has added additional ink lines --

MR. SPEEGLE: And it's on the record.

MR. WHITEHURST: And referenced numerals to the figure.

BY MR. SPEEGLE:

Q. Dr. Glew, do you see the 1 and 3 that I've drawn on Figure 5B of the '222 patent?

A. Yes, I do.

Q. And is the horizontal line next to Number 1 in the region that you describe as the well region?

MR. WHITEHURST: Object to form.

THE WITNESS: How far horizontally does the 1 extend? This is important to understand because I don't know if it extends through the source and drain, which are counter-doped, or if you're referring to just that spot where you've put the dash.

BY MR. SPEEGLE:

Q. Let me edit it.

Okay. I've further added to Exhibit 1100 three dashes labeled "A," "B," and "C."

Do you see that?

A. Yes.

Q. And they are roughly parallel to 1, 2, and 3, but moved over, displaced horizontally. Is that right?

A. I can assume that A is parallel to 1, and B is parallel to 2, and C is parallel to 3.

Q. And I've drawn A, B, and C so that they overlap with an n-doped region in Figure 5B. At least A is entirely within the n-doped region in Figure 5B, B is partially within the n-doped region of Figure 5B, and C is outside of the n-doped region of Figure 5B. Is that right?

A. Yes.

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. So let's assume that these dashes are not extending any further than they are drawn here. Would you describe the dash next to the 1 on Exhibit 1100 as in the well region for Figure 5B?

MR. WHITEHURST: Object to form.

THE WITNESS: There is a condition or two to answer that question.

Essentially, the well at one point in time extended all the way to the top surface. Then it was modified to form transistors. And the

modifications for the transistors, at least the source and drain will change the doping type to the opposite type.

So to the extent that the area of 1 is unaltered, then it would be substantially similar to the well that was -- that exists elsewhere.

BY MR. SPEEGLE:

Q. You said "substantially similar to the well." Would it be in the well?

MR. WHITEHURST: Object to form.

THE WITNESS: At one point in time, it was the well. The well did extend to the top. Then the top of the well was altered to make the transistors.

So the doping in the active area is very specific to make transistors. It's no longer doped like the well is, a transistor, on top of the well now.

BY MR. SPEEGLE:

Q. So your understanding is that after the well region is doped to have a source and drain region, regions that are now part of the source and drain are no longer in the well?

MR. WHITEHURST: Object to form.

THE WITNESS: They are formed in the well, but they have different doping in the well at that

point in time. So they have a different structure than the rest of the well.

BY MR. SPEEGLE:

Q. Does that mean they're no longer part of the well?

MR. WHITEHURST: Object to form.

THE WITNESS: The way one typically would refer to it, I think, is shown in Figure 5A where the active devices are shown on top of the well. It's basically created a new structure, a transistor, or, in this case, a transistor and a storage capacitor for the DRAM. And these are not a well anymore. It's a completely different structure on top of the well. It was formed in the well, though. It used to be well, at least where the source and drain are.

The gate portion never was in the well. It's on top of the well.

And the -- as this is drawn, this particular storage capacitor appears to be on top of the well. There used to be ones that were down into the well, but this looks like it's on top.

BY MR. SPEEGLE:

Q. Okay. So, just so I understand, it's your opinion that when the surface of a device is doped

with -- or counter-doped, as you said, with dopants to create sources and drains in the well, that entire depth of the device no longer constitutes a well, right?

MR. WHITEHURST: Object to form.

THE WITNESS: I would say that it's structurally different than the well. It's now a transistor, whereas it's a device.

So in the context of the '122 patent, for example, Figure 5A, it shows that the devices are on top of the well.

One understands, of course, that they are formed in the well of well material, at least for the source and drain and channel.

MR. SPEEGLE: We've been going about an hour. Time for a break.

MR. WHITEHURST: Sounds good.

THE WITNESS: That would be fine.

(Recess.)

MR. SPEEGLE: 10:31.

BY MR. SPEEGLE:

Q. Dr. Glew, do you still have that Exhibit 1100 you're looking at?

A. Yes.

Q. And just to refresh, I believe we were

discussing what I've drawn as lines 1 and line A on Exhibit 1100.

Those would, at some point, be in the well before an active region and transistor is formed in the device. But after an active region and a transistor is formed, you would no longer consider what I have as Exhibit -- on Exhibit 1100 as lines A and line 1 as being within the well, right?

MR. WHITEHURST: Object to the form.

THE WITNESS: I would say they are formed in the well. So they are formed in the well, literally. But they are now of a different structure than the well, so they aren't going to behave like the rest of the well.

BY MR. SPEEGLE:

Q. So when you say "formed in the well," is that a -- are you using "formed" as a verb, meaning there's an act when they are formed in the well or are you describing their static position as formed in the well over time?

MR. WHITEHURST: Object to form.

THE WITNESS: I guess, both. They are physically processed and manufactured out of well material, and then subsequent to that, they exist and are surrounded by the well. They are in the

well.
BY MR. SPEEGLE:
Q. So you would describe what I have identified as line 1 as in the well at all times? Is that what you're saying?
MR. WHITEHURST: Object to form.
THE WITNESS: It's -- in the well, but not structurally the well anymore. It's now a transistor.
BY MR. SPEEGLE:
Q. But it is still in the well?
A. Yes, it's formed in the well, and it's surrounded by the well.
Q. Okay.
A. Actually, in this point, it's -- it's on top of the well, really.
You know, if we look at Figure 5A, that sort of gives a nice pictogram of it. And the active devices are, you know, on top of unaltered well material. There may be well -- unaltered well material surrounding it that -- transistors don't necessarily take up the entire well. They'll take up a lot of it, but there will be potentially unaltered well material around them also.
Q. Okay. And let's just -- you know, if you

saw -- if there's a carrier, electron, at the location that I've identified as 1 on Exhibit 1100, would you describe that carrier as in the well or not?

MR. WHITEHURST: Object to form.

THE WITNESS: 1's -- I'd say 3 is a well. 1's a little more difficult because this is a schematic -- it's an illustration. It's not a CAD drawing or electron micrograph. It's just a general illustration. It's hard to know, you know, what's happened underneath the storage capacitor that's formed on top of it.

I would generally describe 1 as being in the active area. You know --

BY MR. SPEEGLE:

Q. Maybe I can clarify.

Is -- if a carrier is in the active region, does that necessarily mean that that carrier is not in the well?

MR. WHITEHURST: Object to form.

THE WITNESS: If the carrier is in the active region -- I should -- it's sort of simple. It's in the active region. It's going to be acted upon by the doping in the electrical fields that exist within the transistor.

So the transistor controls the electrons and charges in the active area.

Below the transistor, charges are going to be controlled by the well.

BY MR. SPEEGLE:

Q. So it sounds like -- am I right to interpret your answer as saying that electrons that are in the active region should not be considered in the well?

MR. WHITEHURST: Object to form.

THE WITNESS: I'd say for -- in a physical sense, the carriers in the active region, in the transistor areas, are controlled by the transistors.

So the well surrounds -- you know, it comes up to the transactive area, they can surround the active area, the transistors are formed in the active area.

The source and drain are a little different than the channel and the transistor.

BY MR. SPEEGLE:

Q. How so?

A. The source and drain are heavily doped, counter-doped, opposite the well, whereas the channel is of the same type as the well. So the channel --

Q. Would you describe an electron in the channel as in the well?

MR. WHITEHURST: Object to form.

THE WITNESS: I would describe carriers, electrons or holes, in the channel as subject to influence from the well, whereas the source and drain, they -- the doping levels are so high, they swamp it out, they swamp out the effect from the well and the source and drain. That's the whole point of the counter-doping.

BY MR. SPEEGLE:

Q. I thank you for that. And I understand what you're saying in terms of what physical effects will control.

Just from a spatial definition, would you still say that the -- let me ask it this way: Would you say that the source is in the well?

MR. WHITEHURST: Object to form.

THE WITNESS: The source and drains are modifications so that it's not structurally a well anymore, it's an active device. It was formed from the well at one point, but at this point, it's an active region.

BY MR. SPEEGLE:

Q. Okay. That brings up a good question.

I'd like to understand. I think -- it sounds like the definition of these terms kind of changes over time. So let's talk about the manufacturing process.

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. I'll rephrase.

MR. WHITEHURST: That was an argument, narrative. I don't want to detract from the deposition, but object to form.

BY MR. SPEEGLE:

Q. Okay. These devices start as blank silicon, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Generally, there's a wafer, yeah. Wafers come in p or n-type, but they're essentially blank, yes.

BY MR. SPEEGLE:

Q. Okay. The silicon would be doped to form a well, right?

A. The doping is subsequent processing on the silicon after it's received, yes. There are insulating isolation areas also separating the wells that are formed, yes. That's one of the first things that start the wafer is well formation.

Q. Just so we can be consistent with what we're talking about, let's talk about the spot that I've identified as dash Number 1 on Exhibit 1100.

A. Yes.

Q. So that spot would originally be a blank silicon spot on the wafer, right?

A. Yes.

MR. WHITEHURST: Give me a second to object.

Object to form.

BY MR. SPEEGLE:

Q. And then subsequent processing would dope that area to form a well, right?

A. Most of the time. There's one other case I described in my report, and it's also shown in these figures.

Q. Are we talking about IGBT?

A. No. Maybe it's not in here.

Early processing, they used just a single well. They might only have p-wells if it was an N wafer or vice versa. But as time went on, and things became more advanced, they went to twin wells, p and n-type.

Q. Okay. After the doping that makes dash 1 in a well, would something happen to make that part

of an active region?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes. As, I would say, generally indicated in Figure 5A, there's a lot of processing done to form active devices, transistors, and these active devices alter the structure of the upper surface of the well.

BY MR. SPEEGLE:

Q. Okay. And is that -- is that additional processing that you're describing that alters the upper surface of the well -- is that creating the source and drain regions?

A. It would be -- that would be part of it. The creation of the source and drain would be some of that processing.

Q. What else is in that processing?

A. Well, there are -- source and drains could be doped with titanium to form a silicide, a metal on top of it, which kind of acts like a welding or solder point for contacts.

The channel region can be further enhanced so that it has better electrical properties than the well as a whole.

You know, this patent is a simplification of the semiconductor processing. Full device can

have thousands of process steps. Modern technology may have 25 different doping steps. So there can be additional doping of the channel region. There has to be a formation of a gate on top of the channel region. We see something like an access transistor, but the top of the gate can be oxidized or say the top of the channel can be oxidized or -- can be deposited.

Electrodes are put on top of that.

This Figure 5B shows storage capacitors being formed for memory.

Q. Now, if I'm recalling, when you talked about the elements of Claim 1 of the '222 patent that referred to a first active region and a second active region, I believe you mentioned that transistors had not yet been formed when these become active regions. Is that right?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, as the fourth claim element describes transistors formed in at least one of the first active regions or second active regions. So the active region may not have transistors formed in it.

BY MR. SPEEGLE:

Q. Okay. What processing steps have to occur

before a well region would be considered an active region in the parlance of the patent?

MR. WHITEHURST: Objection. Form.

THE WITNESS: An active region isn't a region in a general sense, not in the context of the '222 patent, but, say, in a general industrial sense.

An active region is a region that you can't touch with an electrical contact because it will -- it's somehow going to allow current flow. Something's going to happen.

So an active region is, for design purposes, understood to be a place where you can't touch it with a metal contact.

BY MR. SPEEGLE:

Q. How is that disclosed in the Figure 5B?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, what we see in 5B is an active region on top of a well region. We see -- there's area here next to the transistor that is active. So that's a region that would not be, for example, open to contacts, metal layers and lines.

We see in 5C also, for example, this is NAND, which is a string of 32 or more transistors in series. So there's multiple transistors in an

active region. But there's still regions that aren't covered by transistors. So those are areas that you shouldn't touch electrically. Metal shouldn't go there.

BY MR. SPEEGLE:

Q. So there are some transistors, but there doesn't have to be a transistor in all of the active regions? Is that what you're saying?

A. I'd say that you can't cover all of the active region, necessarily, with transistors.

Active regions are typically rectangular, sometimes like a polygon, a tilted rectangle. And transistor's goal is to not waste space, to occupy as much of the active area, but you still don't want to drop metal contacts down next to the transistor in the active region.

Q. Okay. Is it possible to have an active region that has no transistors?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, Claim Element 4 describes a situation wherein transistors are formed in at least one of the first active regions or second active regions. It contemplates that there are no transistors potentially. One could put capacitors, which aren't transistors. One could put

resisters, that aren't transistors.

BY MR. SPEEGLE:

Q. So how would a POSITA recognize a region as an active region if there are no transistors in that region?

MR. WHITEHURST: Object to form.

THE WITNESS: A lot of the doping is done -- or some of the doping is done -- let me rephrase that. Some of the doping is done before a lot of the structure exists. So there may be doping of the wafer -- blanket doping of all -- of a bunch of active areas, all the active areas, before transistors are laid out. And so these would be potentially active.

BY MR. SPEEGLE:

Q. Let's step to Claim 44 in the '222 patent.

A. Where?

Q. Claim 44 of the '222 patent.

And I am going to keep asking about Figure 5B.

A. Yes, Figure 44. I am there.

Q. The third element of Figure 44 says, "An active region, including a source and a drain," right?

A. Yes, it does.

Q. All right. Is that a different usage of the phrase "active region" than you were interpreting in Claim 1?

MR. WHITEHURST: Object to form.

THE WITNESS: I don't believe so, no.

BY MR. SPEEGLE:

Q. So you do think that the source and drain are part of the active region in Claim 1 as well?

MR. WHITEHURST: Object to form.

THE WITNESS: I think the source and drain are formed in the active region or can be formed in the active region, yes.

BY MR. SPEEGLE:

Q. So you think the active region includes the source and drain?

MR. WHITEHURST: Object to form.

THE WITNESS: If there is a source and drain, it's in the active region, yes.

BY MR. SPEEGLE:

Q. Okay. And would you -- with reference to Figure 5B, is there any change to how you would describe 5B imbibing the active region of Claim 44 compared to the active region in Claim 1?

A. No.

Q. Okay. The next element in Claim 44 is, "A

single drift layer disposed between the other surface of the surface layer and the substrate, the drift layer having a graded concentration of dopants extending between the surface layer and the substrate, the drift layer further having a first static unidirectional electric drift field to aid the movement of carriers from the surface layer to an area of the substrate where there are no active regions."

Did I get that right?

A. Yes.

Q. Is that disclosed in Figure 5B?

A. Yes, it is.

Q. Can you describe for me how that is present in Figure 5B?

A. There is a single drift layer indicated by the arrows in Figure 5B. It's between the surface layer above it, and it's described as graded dopant region, so it has a graded concentration of dopants. It extends between the surface layer and the substrate, so these arrows are between the surface layer above it and the substrate, labeled "substrate" below it.

This describes, "Having a first static unidirectional electric field -- unidirectional

electric drift field to aid the movement of carriers from the surface area to the substrate to an area of the substrate where there are no active regions."

So the description below the arrows describe pulling minority carriers from the surface, so that is the movement of carriers from the surface. It shows them headed toward the substrate where there are no active regions. It is showing it in one directional -- in one direction; that is, unidirection.

Q. Okay. And the last element is, "At least one well region disposed in the single drift layer, the well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of carriers from the surface layer to the area of the substrate where there are no active regions."

Is that right?

A. That's what that says, yes.

Q. Is that disclosed in Figure 5B?

MR. WHITEHURST: Also, you're free to go back and look at your report as well, if that would help.

Do you have the report for the '222 patent, which is 01244? I know you have a lot of

pages.

THE WITNESS: Yes. Could you repeat the question?

BY MR. SPEEGLE:

Q. Sure. We were looking at the last element of Claim 44, right?

A. Uh-huh.

Q. And my question was does Figure 5B disclose this element?

A. Yes.

Q. Okay. Can you explain for me how Figure 5B discloses this element?

A. Well, the well region is the region below the active region at the surface. So the well region has -- is included within the area indicated by the arrows showing the electric field or the motion of the gradient to pull minority carries from the surface.

Q. That's what you identified as the single drift layer in a prior element as well?

A. Well, the single drift -- there is a single drift layer underneath the active -- underneath the channel region of the active devices that will extend down into the well. And then areas are pulled in that direction, and so the -- the

previous element describes a single drift layer disposed between the other surface of the surface layer. So the surface layer has a top and a bottom. So the bottom of the surface layer --

MR. WHITEHURST: Sir, you're under oath. Why don't you read the entire claim before you answer the entire question.

MR. SPEEGLE: Alan, you need to let the witness answer the questions.

MR. WHITEHURST: It's not a memorization case. It's a consolidated deposition about three different IRPs. He's got lots of reports in front of him. He's got lots of papers. And he's -- as you know, it's not a memorization test, and he is reading the materials so that he can answer the question to the best of his ability.

MR. SPEEGLE: Cutting the witness off in his answer to tell him to go read the --

MR. WHITEHURST: I have not told him anything other than to read the claim and his report. Nothing more. That is not coaching the witness.

THE WITNESS: Can you repeat the question?

(The requested portion was read back.)

MR. WHITEHURST: Object to form. I think

it's probably best if you just reask your question because I think you were referring back to a previous question.

Does the question stand?

MR. SPEEGLE: I'll ask a new question.

BY MR. SPEEGLE:

Q. Is the, at least, one well region different from the single drift layer described in Claim 44?

A. The single drift layer is larger than the well region, as the claim describes. The well region is in the single drift layer. The single drift layer, however, extends from above.

The fourth claim element, a single drift layer disposed between the other surface of the surface layer and the substrate, so forth and so on. The drift layer having a graded concentration. And then it says that the well regions within the drift layer in the fifth and final element. At least one well region disposed in the single drift layer, the well region having a graded concentration.

So the well region's in the drift layer. The drift layer can be above the well, potentially, as well as below.

Q. Can you identify any portion of Figure 5B

that would be part of the single drift layer, but not part of the well region?

MR. WHITEHURST: Object to form.

THE WITNESS: The area under the channel could be part of the single drift layer, whereas the source and drain are counter-doped to the opposite height of the channel, is the same type as the drift -- as the well. So, at some point, the channel ends. The channel's fairly thin. When the channel ends, then it's going to be similar in composition to the rest of the well. Maybe some slight difference in doping, but similar type. So the drift field could start just below the well, and then just below the transistor channel, and then extend down into the well.

BY MR. SPEEGLE:

Q. I'm being confused now. Is the well bigger than the drift layer or is the drift layer bigger than the well?

A. The last claim element describes at least one well region disposed in the single drift layer. So the drift layer could potentially be bigger than the well, yes.

Q. Okay. Are you saying that the channel region is part of the drift layer, but not part of

the well?

MR. WHITEHURST: Object to form.

THE WITNESS: I was talking about the area under the channel area.

BY MR. SPEEGLE:

Q. You described that as part of the single drift layer, but not part of the well?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, the area under the channel layer could potentially be still in the active region, but part of the drift layer.

BY MR. SPEEGLE:

Q. Because it's part of the active region, you would not call it part of the well?

MR. WHITEHURST: Object to form.

THE WITNESS: It's formed in the well, but it could possibly have different doping than the well. For example, if it's a p-well, it could have additional p-type doping under the channel.

BY MR. SPEEGLE:

Q. And that would make it part of the single drift layer, but not part of the well, Claim 44?

MR. WHITEHURST: Object to form.

THE WITNESS: It would be part of the drift layer. I think -- the channel is clearly in

the active region. Source and drain are in the active region. The area that is to the depth of the source and drain, you know, at least is the active region.

But the channel's not usually as deep as the source and drain. So the area under the channel that's not functionally a channel could be part of the drift region.

BY MR. SPEEGLE:

Q. Okay. Is the second static unidirectional electric field in Figure 5B different from the first static unidirectional electric field in Figure 5B?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, it describes a first and a second, so I imagine they are different fields, yes.

BY MR. SPEEGLE:

Q. Does Figure 5B disclose different fields?

MR. WHITEHURST: Object to form.

THE WITNESS: It's schematic or pictorial. It just discloses region pulling carriers. It's not very detailed in that regard.

BY MR. SPEEGLE:

Q. Fair to say, Figure 5B is not detailed enough for you to tell if it practices Claim 44?

MR. WHITEHURST: Object to form, argumentative.

THE WITNESS: As one of skill in the art, I would understand that the region under the channel is going to be slightly different than the well, at a bare minimum. So, to me, it's reasonable that there be a variation in doping concentrations from just under the channel to the well.

BY MR. SPEEGLE:

Q. So any time you see a channel in a well region, you would understand that there would be two different static unidirectional electric fields in that configuration?

MR. WHITEHURST: Objection to form.

THE WITNESS: I wouldn't say any time, but it's reasonable -- it can happen.

BY MR. SPEEGLE:

Q. Do you think that's the most likely inference from the schematics that you see in 5B?

MR. WHITEHURST: Objection to form.

THE WITNESS: I think I would need to read Claim 44 and the figure together.

BY MR. SPEEGLE:

Q. What do you mean by that?

A. Well, Claim 44 is part of the patent, and

it describes the invention. As one skilled in the art, I understand that channels are doped typically. They're not counter-doped, but they are doped usually to enhance -- further enhance the properties for electrical conductivity so that it has enhanced mobility. The charges move faster between the source and the drain to the channel, so channels are not -- not in this day and age, they're not left just like the well. They're doped.

So it's been that way for a long time. Certainly at the time of this invention, the channels were routinely doped.

So I would expect that the concentration, as one who is skilled in the art -- that the concentration under the channel would be different than the well.

Q. Is there any disclosure in the specification about the channel region being different from the well and this doping type?

MR. WHITEHURST: Object to form.

THE WITNESS: The specification describes at column 3, line 64 in a paragraph discussing illustrations 5A, B, and C. "Graded dopants can also be implemented in a surface channel MOS devices." It goes on to describe the channel

pinch-off is controlled by a graded channel at column 4, line 4 roughly.

BY MR. SPEEGLE:

Q. Just to pause there, that's for a junction field effect transistor, right?

A. Yes.

Q. Is that the same thing as we have in Figure 5B?

A. Yeah, these are -- MOSFET is a metal oxide semiconductor field effect transistor. So it's -- there's bipolar, and there's MOS -- there's FET.

Q. Okay.

A. It also describes, of course, for bipolar graded bases in the text, and it also shows as prior art Figure 1 that there are graded dopant concentrations in the base of bipolar devices.

Q. What is a channel pinch-off?

A. Pinch-off means to restrict current flow, essentially.

Q. Well, and how would that be --

A. Where are you now?

Q. This is the same sentence at the top of column 4 you're talking about? "The graded dopant can also be used to fabricate superior junction field-effect transistors where the channel pinch-off

is controlled by a graded channel instead of a uniformly doped channel."

A. Right.

Q. Is this what's described in Claim 44, in your view?

MR. WHITEHURST: Objection to form.

THE WITNESS: Well, this is related in a way that I see. I understand that channels are doped, so this is an example of doping channels. As one skilled in the art, I understand that there are -- in this day and age, and even back then, there were numerous implant steps to make a transistor: High angle, low-depth implants, halo implants for the -- there are all kinds of implants done, extensions of the source drain to get them a little closer to the channel. There's a lot of implant engineering that goes into transistors, MOSFETs and bipolar.

But the MOSFETs had, you know, even at that time, a dozen implants wouldn't be unusual.

This is an example here in column 4 mentioning that they did dope the channels. So it was commonplace to dope channels.

And then, of course, along with the implantation is the annealing, the heating, part of

the doping process.

BY MR. SPEEGLE:

Q. We've talked a lot about Figure 5B, and Figure 5C shows the graded dopant concentration pushing carriers in the opposite direction, right?

A. Yes, Figure 5C is a NAND flash device. So this is about getting charges stored on a floating gate, I guess, essentially.

Q. And because this pushes carriers up towards the active regions, it would not practice Claim 1 or Claim 44 of the '222 patent, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Figure 5C doesn't necessarily aid carrier movement to an area where there is no active region. It's accelerating carriers toward the active region during programming. That's what's described in 5C.

BY MR. SPEEGLE:

Q. So it does not practice Claim 1 or Claim 44?

MR. WHITEHURST: Object to form.

THE WITNESS: It would show some of the claim elements in 1 and 44, but it doesn't show the last claim element in 1 and 44. It's illustrative for some purposes, but not for the last claim

element, no.

BY MR. SPEEGLE:

Q. This field that we're looking at in Figure 5C that accelerates carriers towards the surface, would that be electrons or holes?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, it's an n-channel device. It's N source and drain, so it's pulling -- in order to conduct, it's going to have to pull electrons. I believe this is probably pulling electrons up until floating gate.

BY MR. SPEEGLE:

Q. So that field would accelerate holes down, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, but if it was accumulating -- how should I put this? The general effect of an electric field is to act in opposite directions on different -- opposite charges. So to the extent that it's carrying electrons up, it will have some effect on holes; however, this device functions by storing one type on a floating gate. Presumably -- I mean, gate controls -- yeah, it's kind of -- it's just a schematic. It's not very detailed. But yeah, presumably, it's a floating

gate, so it stores charge to stay on.

Let me read.

The question again, please?

BY MR. SPEEGLE:

Q. You know, I think you answered my question. Let's move on.

MR. WHITEHURST: Are we at a good stopping point?

MR. SPEEGLE: Sure.

(Luncheon recess.)

BY MR. SPEEGLE:

Q. All right, Dr. Glew, I would like to turn to the '842 patent, if you have that in front of you.

A. Let me clear some stuff.

Q. Make sure we keep Exhibit 1100 separate from the rest of those. I think that's the bottom paper in your hand.

And I'll start by asking you if Figure 5B in the '842 patent is the same as Figure 5B that we've been talking about in the '222 patent?

A. It should be, yes.

Q. And if we look at Claim 1 of the '842 patent, does Figure 5B also disclose what's in Claim 1 of the '842 patent?

A. Similar to before. 5B generally discloses it. It's a blow-up, so it's further disclosed in adjacent figures to that.

Q. Okay. Is there any substantial difference -- well, we'll just go through this.

5B shows a semiconductor device, right?

A. Yes, Figure 5B shows a semiconductor device.

Q. And it has a substrate of a first doping type, at a first doping level, having a first and second surfaces?

A. Excuse me.

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, it has a substrate of a first doping type at a first doping level. I mean, second surface.

BY MR. SPEEGLE:

Q. And the second element refers to a first active region in Claim 1 of the '842 patent, right?

A. Yes, it refers to a first active region.

Q. And the first active region, is it similar to what we discussed in Claim 1 of the '222 patent, has a opposite doping type from the substrate?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, generally, that's --

BY MR. SPEEGLE:

Q. Is it generally the same as what we discussed with Claim 1 of the '222 patent for Claim 1 of the '842?

A. For this claim element, yes, generally.

Q. And I believe you said before that because Figure 5B shows an NPN device, that would have the same doping type, in your view, as the p-type substrate, but the CMOS complement would have the PNP, which would be opposite to the p-type substrate.

Am I reading that right?

A. Yes, as well as being shown in Figure 5A.

Q. Okay. And the third element in Claim 1 of the '842 is a second active region.

Do you see that element?

A. Yes.

Q. And is that disclosed in Figure 5B similar to what we discussed for Claim 1 of the '222 patent?

A. Yes, it's similar. 5B is CMOS and shown in -- shown better in 5A.

Q. Okay. And the next element here are, "Transistors formed in at least one of the first active region or second active region," right?

A. Yes, that's what it says.

Q. Is that also shown in Figure 5B of '842?
A. Yes, it is.
Q. And the last element is, "At least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate."
Do you see that?
A. I see that, yes.
Q. Is that disclosed in Figure 5B?
A. Yes.
Q. And it's your understanding that the graded dopant region disclosed in Figure 5B extends into the active region?
MR. WHITEHURST: Object to form.
THE WITNESS: I have to review my report.
As indicated in Figure 5B, and as I've indicated on page 17 of my declaration, on the '842 patent, IPR 01243, I've indicated the field starts at the bottom of the -- the graded dopant region pulls minority carriers from the bottom of the active region, underneath the channel, downward.
BY MR. SPEEGLE:
Q. And the minority carriers in the annotation you directed me to on page 17, are those

holes or electrons?

A. In this case, the channel needs to be formed out of N, electrons, so the holes would then be minority carriers. So the majority carriers -- majority carrier for an N source drain is an N.

Q. Would you describe this graded dopant region pointed to in this figure as pulling carriers from the source to the drain?

MR. WHITEHURST: Object to form.

THE WITNESS: Are you referring to the arrows, the downward-facing arrows? I don't think I understand your question.

BY MR. SPEEGLE:

Q. Okay. Let's do it this way:

Would the graded dopant region described in Figure 5B pull minority carriers between the source and the drain of the transistors shown in 5B?

MR. WHITEHURST: Object to form.

THE WITNESS: The direction of pull is downward, toward the area away from the active area, active region. They may originate between the source and drain, but the direction of the pull is downward.

BY MR. SPEEGLE:

Q. Okay. At the end of paragraph 37, it

extends to the next page you have in front of you, you cite column 3, line 38 through 43 of the '842 patent to support the statement that, "This improves the speed and performance of the transistor."

Do you see that?

A. I see my text, yes.

Q. And my question is isn't the text that you cite to here on column 3, lines 38 through 43 -- is that described in the operation of an IGBT?

MR. WHITEHURST: Object to form.

THE WITNESS: The specific example given is for an IGBT, although the last sentence in that citation, "This can improve Toff -- Ton and Toff in the same device," is essentially the idea I'm trying to get across here, which is it will enhance on/off speed.

BY MR. SPEEGLE:

Q. Prior sentence in column 3, the -- for example, and I -- let me start over.

"For example, in an n-channel IGBT, electrons can be swept from source to drain rapidly while at the same time, holes can be recombined closer to the n+ buffer layer."

Did I read that right?

A. You read that correctly, yes.

Q. And can you explain why electrons being swept from source to drain would improve Ton and Toff?

MR. WHITEHURST: Object to form.

THE WITNESS: This is a MOSFET, not a bipolar device or IGBT, so it behaves a bit differently.

General concept here is that the on/off time, in this instance, would also be improved. This type of invention is used for improving speed -- on/off speed of a transistor.

BY MR. SPEEGLE:

Q. The physical mechanism by which on/off time for an IGBT or a MOSFET would be improved is different, right?

A. Yes, they are different mechanisms, physically.

Q. And the physical mechanism that's being described in the passage from the patent you've cited is from actually accelerating electrons between the source and drain, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, the IGBT functions differently. Its speed is enhanced in a different mechanism.

///

BY MR. SPEEGLE:

Q. Okay. And the '842 patent doesn't say that the on/off time for a MOSFET would be improved by using the device, does it?

MR. WHITEHURST: Object to form.

THE WITNESS: The patent describes at column 4, line 19, "Moreover, single-well and triple-well CMOS fabrication techniques can also be optimized to incorporate these embodiments individually and collectively."

As one of skill in the art, I understand that the mechanism for Figure 5B is as I described.

BY MR. SPEEGLE:

Q. Okay. And why would that mechanism in Figure 5B improve on/off time?

A. Well, the gate -- the gate voltage -- the gate electrode that provides the voltage has a job, which is to, in this case, attract electrons to the channel region and push away the holes. That's done with a voltage. Any additional voltage that is provided, for example, from a gradient, would aid the effect of allowing conduction from the source to the drain by enhancing the electron concentration in the channel region.

Q. So the graded dopant concentration is

going in the same direction as the electric field applied by the gate transistor? I'm sorry. Let me say that again.

The graded dopant concentration applies an electric field in the same direction as when the gate is active on the transistor?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, essentially, it would have, you know, a similar effect, yes, of pushing electrons up, pulling electrons down.

BY MR. SPEEGLE:

Q. Wouldn't that slow down the off time?

A. Well, on and off or on and -- on and off are two different things.

Q. So it would help the on time, but it would hurt the off time?

MR. WHITEHURST: Object to form.

THE WITNESS: Generally, yeah, that's -- you can optimize one or the other.

BY MR. SPEEGLE:

Q. So the statement in column 3 that you cited about improving both Ton and Toff in the same device, that would not apply to the mechanism in 5B because Toff would not be improved by the graded dopant concentration we discussed?

A. Well, with a MOSFET device, you're going to probably improve one or the other, bipolar different structure.

Q. And I want to direct you to column 3, lines 48 and 50. There's --

A. Column 3 at 48, 50?

Q. There's a sentence that starts with, "Spurious minority carriers."

Do you see that?

A. Yes.

Q. And this is talking about specifically the configuration, the MOSFETs for 5B, right?

A. It's talking, I think, specifically about -- well, it makes a reference to NAND flash and DRAM, so I'd have to look more at the context, if you have a question.

Q. And do you agree with the patent says in this paragraph about, "The graded dopant concentration assisting with spurious minority carriers"?

A. It does say -- it says spurious minority carriers can be generated. The passage you cited hasn't -- this paragraph eventually gets to other subject.

That particular passage you cited, I

think, just mentions that spurious carriers are generated by switching.

Q. Okay. And the next sentence says that -- it describes the down side of spurious carriers; that they "can discharge dynamically held actively high nodes." Is that right?

A. Yes.

Q. And then towards the bottom of the column 3, there's a sentence -- this is the next-to-last sentence in column 3 says, "In a preferred embodiment, the subterranean N layer has a graded donor concentration to sweep the minority carriers deep into the substrate."

Do you see that?

A. I see that passage.

Q. Do you agree that the graded dopant concentration would assist with the spurious minority carriers described here?

MR. WHITEHURST: Object to form.

THE WITNESS: I believe that this is one of the possible benefits, yes.

BY MR. SPEEGLE:

Q. Are you familiar with the idea of spurious minority carriers as a problem in transistors prior to your work on this matter?

A. Yes, as it describes, just the act of switching creates complications, noise, yeah, it's memory -- the problem with memory is the amount of time that it holds and refresh, noise and the image sensors is common, so those are routine problems.

Q. How many carriers would be -- would need to be present before they created an issue in the noise that you're talking about?

MR. WHITEHURST: Object to form.

THE WITNESS: It depends on the device. That's a very -- it's an incomplete hypothetical.

I would say, in general, the smaller the device, the fewer it takes to create problems.

NAND is, you know, generally more sensitive than DRAM with image sensors. Again, it depends on how -- how high performance the sensor is.

BY MR. SPEEGLE:

Q. Do the claims specify a number of carriers that have to be impacted to practice the claims?

MR. WHITEHURST: Object to form.

THE WITNESS: I don't recall seeing a limitation regarding the number of holes or electrons that need to be transported, no.

///

BY MR. SPEEGLE:

Q. I saw you reviewed that '842 patent to give that answer. Would your answer be the same for the '222 patent?

A. I've never looked for that. Based upon a brief review, I don't see a follow-up for the number of electrons or holes that need to be moved.

Q. Okay. Let's go to paragraph 33 in your declaration for the 01243 -- the '842 declaration.

A. Paragraph 32?

Q. 33.

A. 33.

Q. At the end of this paragraph 33, you describe a phenomenon that you call carrier drift. Is that right?

A. Yes.

Q. And can you explain what carrier drift is to me?

A. Well, as I've described in paragraph 33, charged carriers that move in a direction of the gradient, with the appropriate polarity, have the net effect of drifting in one direction, the direction of the gradient.

Q. And how does the -- how does a graded dopant concentration relate to the idea of carrier

drift?

MR. WHITEHURST: Object to form.

THE WITNESS: There's really two things that go on, but one is the gradient of a charge causes electrical -- electrical field.

And I'll give a simple example. If you accumulate charges, if you were to take a hundred electrons and put them in one place, they give off an electric field, they radiate an electric field. If you increase the number of charges in one area, then it increases the electric field around it. So if I had a pile of a million electrons and a pile of 900,000 electrons and I work my way down to zero, I would have a change in the charge density, which would result in the change in the field given off over a distance.

The gradient is just the first derivative. It's a differential operator. So it's the slope, literally.

So the slope of the charge densities are proportional to the field that's given off. So this charge gradient produces a field which will act upon other charge particles.

BY MR. SPEEGLE:

Q. So when dopants are implanted in silicon

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at differing concentrations, that creates an imbalance in net charge over that piece of silicon --

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. -- right?

A. I wouldn't call -- I wouldn't say that, no. What I'd say is the charge neutrality condition prevails, which means that in the end, everything's neutral overall.

But what happens is there are either extra electrons or extra holes in an area which are free to float about and -- or relatively free. There are three kinds of materials. There are insulators, in which case an electric field doesn't cause anything to move. It's an insulator. There's no current flow. Nothing perceptible. No material is perfect, but we'll say the perfect insulator, no current.

A metal, on the other hand, has what's known as a sea of electrons. There are electrons that are basically -- extremely loosely tied to the atoms from which they originate.

So an electric field in a metal will cause motion of electrons current, not -- I mean, it's got to be beyond just minuscule, but, you know, any

reasonable electric field and a metal will cause motion.

Semiconductor is in between. A perfect semiconductor is a pretty good insulator. A highly doped semiconductor. We're not really talking about anything at this level here. It acts like a metal. In the middle, it acts like -- a doped semiconductor acts like a variable resistor, essentially. The resistance changes based upon the doping levels.

There's sort of a threshold voltage which it takes for anything to move, and then when it does move, there's a significant amount of resistance compared to a metal.

Wafers, for example, that aren't doped, they're just basically insulators.

When you buy doped wafers, you buy them by resistance action. What's the resistance of this wafer?

So I wouldn't say that there's a net charge per se. It's just -- it's a local phenomenon where there's either extra electrons or extra holes that are free -- relatively free, notwithstanding their threshold voltage and their resistance to move.

Q. Okay. Thank you for that detailed

description.

Is it accurate to say that the doping of a silicon at different concentrations through some mechanism results in a static electric field within the silicon?

MR. WHITEHURST: Object to form.

THE WITNESS: It can, yes. This is a local phenomena. Again, if there are a number of charges piled up in an area and a different number next to it, a gradient, a slope, then, yeah, the voltage that charges give off varies with concentration in the charges that are accumulated.

BY MR. SPEEGLE:

Q. Is that what's creating the downward force we talked about in Figure 5B?

A. That's part of it. Mainly, what we talk about, there is a diffusion, diffusional force too. But, you know, if you think of a drop of ink in a pool, you put it a corner, it doesn't stay there. It will eventually diffuse out.

If I had a pile of electrons or holes in one area, and I didn't have them -- I had a dearth next to it, then there's a little bit of diffusional driving force to get them to move. Usually they don't move, really, on their own without some other

force, like a little bit of a temperature to activate or a little bit of voltage, but there is a diffusional force also.

There's other -- there's other forces that cause things to happen that we're not discussing here: Stress, energy. Any form of energy can cause things to happen, potentially.

Q. Okay. So I'm trying to understand the sentence you have in paragraph 33 that says, "When the dopant concentration is graded in a particular direction, other charge carriers will move in the gradient direction or opposite direction, depending on the charges -- charge carrier's polarity."

How does that relate to the forces you were just describing?

A. Well, if I, say, pushed some electrons out of a channel because I wanted it to be hole rich to turn on or something, when these electrons see a gradient that's friendly to them, a gradient in charge, then it will see an electric field. And if that field, you know, is pointing in the right direction, it sort of pulls or pushes the electrons along the gradient in the concentration of the dopants because that's creating this electric field that points in that direction, either points down or

up, you know.

Q. Okay. So the graded dopant concentration creates a field that exerts force on charge carriers?

MR. WHITEHURST: Object to form.

THE WITNESS: The graded dopant -- the graded dopant concentration creates a potential that can act on charge carriers, you know, bearing in mind there is -- there is a threshold voltage. They can't necessarily -- the charge carriers that are free can't necessarily jump from atom to atom without -- without overcoming a certain threshold voltage.

BY MR. SPEEGLE:

Q. Is that the recombination rate?

A. That's a different problem, yeah.

So, basically, if there wasn't a threshold voltage, everything would equilibrate immediately. It doesn't happen, you know. There's what's -- you know, for an electron to get from one atom to the next atom, there's a resistance. It's very low in a metal, but in an insulator, it's insurmountable, and in a semiconductor, it's surmountable, but only under certain conditions. Otherwise, you know, there would be instantaneous motion of all material

in a semiconductor, which doesn't happen, zero resistance. You know, it's not a superconductor.

So charge carriers have to have enough potential on them to actually jump from atom to atom to atom to atom, you know, in a crystal. So crystal -- like, silicon is a crystal. It's actually a single -- it's one big single crystal. Kind of think of it like a diamond ring is one crystal maybe. A semiconductor is one big crystal. And that's why it has the properties it has. Generally, all semiconductors are crystal.

So it's going to have this threshold to get from one position to the next position. And, you know -- and even if it does that, there's a certain energy loss or resistance that goes into the motion.

Q. You said the recombination raises a different problem. What does the recombination rate have to do with?

A. Well, if an electron and a hole meet, what happens, essentially, a hole is a vacancy in a valence band. So there's -- you know, if you have an atom with, let's say -- we'll do a round number -- eight electrons in its valence -- in its valence shell, these are not electrons that are

free, they're bound to the electron. If one of those is missing, that's a hole.

Now, if an extra electron comes along and meets this missing spot in a valence, the best way for the electron to reduce its energy is to drop into the valence shell. So they cancel each other out.

I don't want to say it's like credit and debit, but, basically, the electron and the hole meet, and that can -- that is known when they recombine as the recombination.

Q. Atom photon?

A. Yes, it could.

Q. Could that photon potentially knock another electron out of the valence layer?

MR. WHITEHURST: Object to form.

THE WITNESS: It depends on what it's doing. It can emit photons, it can emit phonons. So phonons are lattice vibrations. You might think of it as heat, making the crystal vibrate, get warmer.

So it can do phonons, it can do photons. This is all quantum mechanics. The energies have to line up, and so yeah, there's limitations.

///

BY MR. SPEEGLE:

Q. You said that a graded dopant concentration creates a potential. Am I remembering that right?

MR. WHITEHURST: Object to form.

THE WITNESS: Essentially, something like that, yes.

BY MR. SPEEGLE:

Q. Is that the same as creating an electric field?

MR. WHITEHURST: Object to form.

THE WITNESS: Yeah, you know, the field -- electric field has a potential to it, a potential energy. We use the term sometimes similarly.

BY MR. SPEEGLE:

Q. Okay. Electric fields are vectors, right? They have a magnitude and a direction?

A. An electric field generally, yes, has X, Y, and Z components.

Gradient is the same. A gradient is actually the derivative with respect to each direction, X, Y, or Z. Or if you're in a different coordinate system, that coordinate system.

Q. Is the -- is magnitude to the electric field proportional to the magnitude of the gradient?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes. As I said earlier, you know, the -- I believe I said that earlier, the field -- the drift force, however you want to think of it, is going to be proportional to the change in charge -- charge density, which is the -- that changes the gradient, and it's literally a vector in each direction.

BY MR. SPEEGLE:

Q. Okay. Referring to paragraph 36, you say that, "Positive electric field repels the positive holes downwards while the negative electrons, red circles, are attracted to move into the blue surface layer."

Did I read that right?

A. Yes, I believe so.

Q. All right. So am I understanding correctly that the direction in which an electric field would move a carrier has to do with the polarity of the carrier?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, the direction of force -- whether the force is sufficient to move the carrier or not is another question, but the direction of force is opposite for opposite

polarities.

BY MR. SPEEGLE:

Q. You're talking about the -- this particular quote that I was reading on paragraph 36 is talking about an electric field from the gate, which you've illustrated on, I believe, it's page 16 of your '842 declaration. Is that right?

A. I'd have to double-check that, but -- I'm not sure if I'm talking about 16 or 17 here yet.

I think 36 is directed toward the figure at the end of it or in the middle of it.

Q. Okay. The one on page 17?

A. Yeah.

Q. Okay. That electric field that's being described, and I believe it's annotated with little plus signs above the oxide. Is that right?

A. There are plus signs above the oxide, yes. Those are positive.

Q. Okay. That's a positive electric field coming from that gate, correct?

A. Yes, the gate electrode provides, in this case, it looks like a positive potential.

Q. Okay. All right. Is it accurate to state that positive electric field from the gate would impede the positive carriers moving up towards the

gate?

MR. WHITEHURST: Object to form.

THE WITNESS: I mean, I think of it more like it repels -- it literally pushes them away. So there's an oxide underneath the gate, so that -- and no current can go through the oxide, but the field, the electric field, goes through the oxide.

Think of oxide is also thought of as glass or something. So the electric field goes right through, but the electrons don't. So the electric field pushes -- goes through the oxide and then pushes away positive charge and attracts the negative charge up. This is known as the field effect. That's why we call it FET.

BY MR. SPEEGLE:

Q. Does an electric field exert a force on all charge particles in the field or just some of them?

MR. WHITEHURST: Object to form.

THE WITNESS: Can you repeat the question?

BY MR. SPEEGLE:

Q. Does an electric field in a given space exert a force on all charge particles in that space or only some of the particles?

MR. WHITEHURST: Object to form.

THE WITNESS: That's a complicated question. The electric field starts at one end of it or one side of it, and it interacts with the charge particles in the field or in the region. Eventually the field is canceled out. So at some point, the field no longer exists. It reads -- it basically balances itself out.

You know, if you look at, like, the transistor here as an example, the -- when enough electrons accumulate underneath the oxide, they start repelling any other electrons that might come close. So it's kind of really complex interaction between all of the charges in the region and an electric field, and eventually they have to balance out.

BY MR. SPEEGLE:

Q. Let me ask it this way: Will charge particles that create an electric field interact with all other charge particles in a given space or will charge particles only interact with some other charge particles?

MR. WHITEHURST: Object to form.

THE WITNESS: Again, complicated. The charge particles interact to a certain distance, and then at some point, that distance can be canceled

out or the charge is canceled out so they're no longer -- interact.

You know, does -- and at some point, you know, the field is -- the field is complicated. You can apply an external field, and then the charges build up a field of their own, but the charge is over a sphere. So it goes -- it drops off as radius cubed, volume of sphere.

BY MR. SPEEGLE:

Q. So the charges are R-cubed or R-squared?

A. Well, the surface is squared. The volume is cubed. So eventually the charge has to diminish that come from the --

Q. I would have sworn Coulomb's Law is R-squared again. Maybe I misspoke. I'm sorry. I'm trying to put this in --

MR. WHITEHURST: This transcript is getting messy. I'm not sure if there's a Q -- question and answer, so --

THE WITNESS: Eventually -- so the charge from the -- the field from the charges eventually dies off. It drops off for distance, and it interacts with the other charges.

The field that was external that was applied to one side interacts with the charges.

So that's about, you know -- that's kind of a simple description of what's going on.

So there is interaction, but it's a complex interaction.

BY MR. SPEEGLE:

Q. You're familiar with Coulomb's Law, right?

A. Generally.

Q. It's the force between two charge particles --

A. Yeah.

Q. -- constant times --

MR. WHITEHURST: Wait. You guys are talking over each other. We need a question, and we need an answer. Otherwise, this transcript is going to be a mess.

MR. SPEEGLE: Okay.

BY MR. SPEEGLE:

Q. You recall that Coulomb's Law is a description of the force between two charge particles, correct?

A. Yes.

MR. WHITEHURST: Give me a chance to object.

Go ahead.

///

BY MR. SPEEGLE:

Q. All right. Coulomb's Law holds true for any two particles interacting with each other, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Assuming they're interacting with each other, yeah. They're not screened from each other or something, yeah.

But what's going on in the -- well, if you're just asking about Coulomb's Law -- what's going on here is there's other charge particles in between each other, so -- and there's also -- there is a dielectric effect potentially where, you know, the electric field changes when it goes through an imperfect dielectric.

BY MR. SPEEGLE:

Q. What do you mean by that?

A. A -- some dielectrics pass the field pretty well. Other dielectrics kind of interfere with the passing of an electric field.

Q. We've been looking at this page 17 and Figure 36 of your declaration. This is describing the impact of electric fields on carriers specifically in the active region, right?

MR. WHITEHURST: Object to form.

THE WITNESS: I think paragraph 36 is talking specifically about the channel.

BY MR. SPEEGLE:

Q. Do you consider the channel part of the active region?

A. The channel would be considered part of the active region, yes.

Q. Okay. That's not the only place there's going to be carriers in a semiconductor device, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, yeah, I mean, it's a big electronic circuit. There's carriers throughout the circuitry. In this figure, we're looking at the channel -- the charges shown in the channel region.

BY MR. SPEEGLE:

Q. Let's look at paragraph 37, I guess, which is the next paragraph there.

And you say in the first sentence of paragraph 37, "It is possible to pull carriers from the silicon's surface," right?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, it says "to pull carriers."

///

BY MR. SPEEGLE:

Q. And am I right that it's an electric field that is pulling carriers, in this context?

A. Essentially, yes. And then the sentence describes it as a graded concentration of dopants resulting in a drift layer, yes. That's a, I believe, field that's pulling.

Q. Let's turn -- I'm actually looking at -- I think it's the same content, but I'm actually looking at your '222 declaration in the 01242 patent.

MR. WHITEHURST: Which of the declarations do you want us to look at?

MR. SPEEGLE: The first one. The 1242.

MR. WHITEHURST: Is there a particular inquiry?

BY MR. SPEEGLE:

Q. Do you see at the bottom of page 26, there's a section where you say, "There are three possibilities." Do you see that section?

MR. WHITEHURST: You're looking at page 27?

MR. SPEEGLE: Yes, paragraph 49, bottom of page 26.

THE WITNESS: Yes.

BY MR. SPEEGLE:

Q. You're saying here that the -- given dopant concentration field can either teach that the gradient -- concentration gradient aids carrier movement, the concentration gradient impedes carrier movement, or silent as to what the concentration gradient aiding or impeding carrier movement. Is that right?

A. I've written that essentially, yes.

Q. What do you mean by that?

A. Well, in some cases, the dopant concentration can perform different functions. In some cases, it may be interested in moving charge from one point to another.

A simple example would be, we talked about earlier, and I'm trying to pick things that are non -- not an issue here, really. A graded channel may help move a charge from a source to a drain.

On the other hand, sometimes they use charges as barriers to keep charges from entering a well or something.

They used to try -- it doesn't work real well, and it was a long time ago, but they'd use barriers around wells to keep the wells separate.

In the end, nothing worked better than an

isolation trench, a dielectric between the wells. But they try to have a barrier to keep, you know, like a gate to keep things out, to keep charge out. Or it could be simply it doesn't tell you what it's doing.

Q. Would you agree with me that a given electric field can both impede movement and help movement?

MR. WHITEHURST: Object to form.

THE WITNESS: It would depend upon the context of what was going on. You know, in a channel, for example, once the gate turns on, the gate electrode is powered up, has a potential, there's a certain type of carrier in the channel, and then the graded channel would -- it would -- there would only be one type of carrier there. Its only purpose would be to move the carriers from the source to the drain.

BY MR. SPEEGLE:

Q. Okay. And an electric field that aids movement of an electron in a given direction would resist movement in the opposite direction by the same electron, right?

MR. WHITEHURST: Object to form.

THE WITNESS: I would say generally an

electric field acts opposite on an electron -- or positive in a negative charge. A positive -- negative field will attract a positive charge and repel a negative charge.

BY MR. SPEEGLE:

Q. That's a good way to say it.

So if I have a positive electric field going from X equals 0 to X equals 1, and I have an electron trying to move from X equals 0 to X equals 1, the positive field is going to pull that electron opposite of the way the electron is trying to move, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Like I said earlier, basically, a positive field attracts electrons and repels positive charges.

BY MR. SPEEGLE:

Q. Right.

A. That's just basic electrical field.

Q. So if an electron has a velocity going in the -- away from a positive electric field, the positive electric field will impede that motion --

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. -- right?

A. A positive electric field will attract the electron toward it.

Q. Which is the opposite in my hypothetical. The opposite direction of my electron's current velocity, so it would be a breaking force on the electron, right?

MR. WHITEHURST: Object to form.

THE WITNESS: In that language, a positive charge, assuming, A, a positive field attracts a negative charge, so yeah, if you fired an electron in one direction, you can potentially decelerate it with a positive charge.

BY MR. SPEEGLE:

Q. And if it was a negative electric field, I fired my electron in the same direction, my negative electric field would accelerate that electron going away from the field, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Generally, yeah, the -- negative field will repel a negative charge.

BY MR. SPEEGLE:

Q. And so whether the electron is repelled or -- let me put it this way: Whether the electron is accelerated or decelerated by a given electric field depends on the alignment of the field and the

electron's intended velocity, right?

MR. WHITEHURST: Object to form.

THE WITNESS: The electric field direction provides either a positive -- either an attractive or repelling force on a charge, depending on the direction of the field.

BY MR. SPEEGLE:

Q. And you need to know the direction of an electron's velocity to know whether that force will accelerate or decelerate the electron, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Not exactly.

BY MR. SPEEGLE:

Q. How can you know if the -- if an electric field will accelerate or decelerate an electron if you don't know the electron's velocity relative to the electric field?

A. Well, electric field provides a force on a charge. The force will be in the direction of the electrical vector. The velocity can have multiple directions to it. It doesn't -- you know, the force is only going to act on the -- in the direction of the electrical field vector.

Q. Right. So the electric -- if the electrical field vector is in the same direction as

the electron's velocity, that will result in accelerating the electron, right?

MR. WHITEHURST: Object to form.

THE WITNESS: It doesn't matter what direction it's going in. The electric field will act in that direction.

BY MR. SPEEGLE:

Q. Whether the speed, which is the scaler, increases or decreases will depend on if the current velocity and the electric field vector are aligned, right?

MR. WHITEHURST: Object to form.

THE WITNESS: No.

BY MR. SPEEGLE:

Q. Why not?

A. Well, the electric field will act on the charge and provide it with an acceleration velocity in the direction of the electric field. That electric particle -- that particle, if it previously had a velocity vector, now has a new velocity vector, which is a combination of the old one and the new one, so it has more velocity, unless it was 180 degrees opposed.

Q. Right. If the direction is 180 degrees opposed, it would slow down based on the application

in the electric field vector?

MR. WHITEHURST: Object to form.

THE WITNESS: If it was 180 degree opposed, yes, then it would slow down.

BY MR. SPEEGLE:

Q. You have to know the direction of the velocity to know whether it's going to speed up or slow down because if it is 180 degrees opposed, it will slow down?

MR. WHITEHURST: Object to form.

THE WITNESS: 180 degrees opposed would slow down, yes. The others would actually accelerate.

BY MR. SPEEGLE:

Q. So when you talk about in paragraph 49 a concentration gradient aiding carrier movement or impeding carrier movement, that cannot be agnostic to the direction of the carrier movement, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, a field will provide a force in a direction aiding -- direction -- aiding movement in the direction of the force. That's just basic physics. I'm not sure what --

BY MR. SPEEGLE:

Q. Unless --

MR. WHITEHURST: I don't think he had finished the answer. You cut him off. Do you want to let him finish?

BY MR. SPEEGLE:

Q. Please finish.

A. I'm not sure, beyond that, what there is to say, you know. The field -- the force of the electric field and its direction provide -- aids movement in the direction of the field.

Q. And it impedes movement in the opposite direction?

A. Yeah, in -- the 180 degree opposite direction, yes, it will repel, and it pushes it away.

MR. SPEEGLE: We've been going about an hour. Let's take a break.

(Recess.)

BY MR. SPEEGLE:

Q. Dr. Glew, could you turn to page 28 in your 1242 declaration.

A. Yes.

Q. And at the top of page 28, you have an excerpt from the Kawagoe reference, right?

A. Yes.

Q. I've just handed you what's been marked in

each of these proceedings as Exhibit 1007.

Do you see that?

A. Yes.

Q. And this is the Kawagoe reference that's issued in these IRPs, right?

A. Yes.

Q. Now, on page -- on the excerpt that you have from column 16 of Kawagoe, I'm looking at page 28 of your declaration, there's a statement at the top about, "The impurity concentration of the p-well 6P is given such a gradient that it is gradually lowered in a depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers or electrons due to alpha ray is lowered."

Do you see that?

A. Yes.

Q. If you look at Figure 17 in Exhibit 1007, does the graph in Figure 17 show the reduction in the impurity concentration in the p-well that's being described in the quote from column 16 of Kawagoe?

A. Yes, as described in column 15, this paragraph is discussing Figure 16 and 17. So the question specifically was is this the p-well?

Q. Well, the -- I'm just trying to figure out if the graph on Figure 17 reflects the features that appear in the paragraph you quoted in your declaration.

MR. WHITEHURST: Object to form.

THE WITNESS: I would say yes. Generally, starting at column 15, lines 61, roughly, through column 16, line 40 discusses Figure 16 and 17. I've cited to a portion of that at page 20 of my report.

BY MR. SPEEGLE:

Q. Okay. So the impurity concentration shown in Figure 17, the slope of the thick line identified as NW, that's what reflects the dopant concentration, right?

A. Let me review the text again briefly.

Column 16, line 27 describes, "The well concentration NW of the p-well 6p," so forth and so on.

Q. It's also at column 16, line 1 and 2, right, the "impurity concentration NW"?

A. Yes, I was citing from the next paragraph, which says specifically, "In Figure 17," so.

Q. Got it.

And when this says "impurity," is that another word for dopant, like, we talk about a

gradient dopant concentration?

A. Yes, dopants are basically another term -- "impurities" and "dopants" are used almost synonymously.

Q. Okay.

A. A good impurity is a dopant. A bad impurity is a contamination.

Q. Okay. The slope shown in Figure 17, it's -- is a nonzero slope beginning at depth zero until past depth WW, right?

A. Yes, there is a nonzero slope in NW.

Q. And it's a consistently negative slope, right?

A. Yes, in that, yes, it points downward.

Q. And so based on what we discussed earlier, throughout that entire depth where there is a nonzero slope, there would be a corresponding electric field, right?

A. The gradient in the concentration shown in NW should result in a field, yes.

Q. And that field would not change directions at any point in between 0 and WW, right?

MR. WHITEHURST: Object to form.

THE WITNESS: It's -- it's not linear. There's a slight curvature to it, it looks like, but

it's general -- it is always generally pointed downward, yes.

BY MR. SPEEGLE:

Q. And relative to 0 and WW on this depth, which direction would the resulting electric field point?

A. Well, this is -- an electric field is the negative of the derivative; that it's -- you know -- pushing downward basically.

Q. Pushing electrons downward?

A. Pushing electrons downward, yes.

Q. So throughout the depth in Kawagoe from 0 past WW, there is an electric field pushing electrons downward?

A. Yes, there's that field shown in Figure 17.

Q. And then in the section you quoted in column 16, this is in the middle at lines 7 through 9, this says, "Specifically, the electrons produced by the alpha ray are attracted to the substrate body 2S or the concentration gradient and prevented from entering the p-well 6p."

Do you see that?

A. Yes, I see that.

Q. And what does it mean that, "Electrons

1 produced by the alpha ray are attracted to the
2 substrate body 2S"?
3 A. Well, they are pushed away. They were
4 repelled by the gradient we see in Figure 17, which
5 basically stops almost at the body, the substrate.
6 So below the well, the field stops, so it pushes
7 them downward, so the well -- the well has a force
8 away, and then the substrate doesn't, so they just
9 end up, you know, at the lowest energy point, which
10 is the substrate.
11 Q. The second half of that --
12 MR. WHITEHURST: I'm sorry. Did you
13 finish your answer?
14 MR. SPEEGLE: Sorry.
15 MR. WHITEHURST: Are you done?
16 THE WITNESS: Yeah, I'm done.
17 BY MR. SPEEGLE:
18 Q. The second half of that sentence says,
19 "And prevented from entering the p-well 6p."
20 Is that referring to motion in the
21 opposite direction?
22 A. I think the language speaks for itself.
23 It's basically trying to keep the electrons from
24 entering the p-well by using the gradient
25 established in Figure 17 shown by line NW.

Q. Okay. Does Kawagoe talk about any forces that would be strong enough to overcome that field and push electrons into the p-well?

A. I don't recall rebutting a point like that. I don't recall that point being made. Yeah, if it's in there, please point it out.

Q. I'm -- so the only statement in Kawagoe about what happens to his electrons is that this electric field from the gradient is sufficient to prevent electrons from going up into the p-well, right?

A. That's all I recall, off the top of my head, without a total review of the document.

Q. Okay. You didn't cite anything in Kawagoe that would talk about electric fields going in a different direction, right?

A. I don't recall that, no.

Q. Sitting here today, you don't recall anything in Kawagoe that would be a stronger electric field than what's created by the gradient in Figure 17?

A. Well, you know, what else is going on in the Kawagoe -- I'm not sure how it's pronounced, but I pronounce it Kawagoe. But whatever else is going on in Kawagoe, I was addressing the aspect of the

gradient to repel solar-generated electrons from the well. I don't recall examining it for that point you brought up.

Q. I want to make sure I understand what you're referring to.

What do you mean by solar-generated electrons?

MR. WHITEHURST: Object to form.

THE WITNESS: Alpha rays are solar generated, so alpha rays come from outer space, enter the atmosphere. Some actually make it through and end up hitting the --

BY MR. SPEEGLE:

Q. Okay. I think, looking at Footnote 4 on page 27 of your declaration, is it right that you have been familiar with alpha rays and have experience with them in the time period preceding 2004?

A. I worked with -- I worked alpha particles, so, you know, 2.8 megavolt kind of stuff, on silicon for analytical purposes as a technique, so I'm generally familiar with how alpha energy reacts with silicon.

Q. And that includes before 2004?

A. Yes, I did this before 2004.

Q. Let's look at page 31 of your '222 declaration.

A. Page 31?

Q. Page 31 of the -- I'm sorry -- of the 1242 declaration, the one you have in front of you.

A. Yes.

Q. All right. And there's a figure in the middle of the page annotated with a yellow box that says "Kawagoe Carriers."

Do you see that?

A. Yes.

Q. What is that yellow box indicating?

A. It indicates carriers generated by the alpha rays in the substrate.

Q. You're not trying to suggest that's the only place where there's electrons in Kawagoe's device, right?

MR. WHITEHURST: Object to form.

THE WITNESS: What I'm suggesting here is that that is where the vast majority, and the significant ones, are generated. So the substrate is typically 500 microns thick, and the electronics at the top are 2. If that's the case, then one -- you know -- one out of 250 of the thickness is at the top, but the top also has all the metal

lines and silicon nitrate passivation, and it's hardened compared to the back side of the silicon. So the vast majority of particles are generated in the substrate.

BY MR. SPEEGLE:

Q. You're talking about alpha ray-generated particles, right?

A. Yes, alpha ray-generated electrons.

Q. Okay. Electrons from a variety of sources would be found throughout the Kawagoe device, right?

MR. WHITEHURST: Object to form.

THE WITNESS: There are other electrons generated from other things, yes. I'm just addressing here the -- SEU-produced electrons.

BY MR. SPEEGLE:

Q. We discussed the spurious carriers created by switching, right?

A. Switching can't create carriers.

Q. Those would be up in the active region?

MR. WHITEHURST: Object to form.

THE WITNESS: If, to the extent that they existed, if it wasn't designed to eliminate those, then they would be generated where there was circuitry, yes.

///

BY MR. SPEEGLE:

Q. Okay. And there have to be electrons in order for a semiconductor to, in fact, have its gate turn on, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Are you talking about the gate electrode voltage or the channel region? I'm sorry.

BY MR. SPEEGLE:

Q. In the channel region, there has to be electrons for the -- there's a combination of both electrons and holes in the channel region of every semiconductor transistor, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Generally, one thinks of the region as one type, but there will be still electrons and holes.

BY MR. SPEEGLE:

Q. So if we look at Figure 17 again, is there any point on -- and I'm sorry. This is Figure 17 in Kawagoe -- whether or not from alpha particles or a different source, there would be electrons found at all of these depths from 0 to WW, right?

MR. WHITEHURST: Object to form.

THE WITNESS: This is a p-well, so this is

1 going to be essentially P, but even within P, there
2 are some holes. There's a minority in a p-well.
3 Excuse me. Let me completely rephrase
4 that. It's getting late in the day.
5 Your question was are there electrons or
6 are there holes?
7 MR. WHITEHURST: So the record is clear,
8 why don't you have him ask the question.
9 MR. SPEEGLE: I'll restate the question.
10 BY MR. SPEEGLE:
11 Q. For the device shown in Figure 17 of
12 Kawagoe, along the depth 0 to WW, is there any
13 region where there would not be electrons?
14 MR. WHITEHURST: Object to form.
15 THE WITNESS: This is a p-well, so it is
16 substantially holes. There are electrons as
17 minority species.
18 BY MR. SPEEGLE:
19 Q. And those minority electrons would be
20 throughout the depth?
21 MR. WHITEHURST: Object to form.
22 THE WITNESS: They are largely swamped,
23 meaning, you know, there's a minimum of typically a
24 thousand times as many holes as electrons. It's
25 intrinsic, meaning the undoped is 10 of the 14, and

the doped is 10 of the -- 16 or 17. There's hundreds and thousands of times as many holes. So they largely are recombined. They exist in greater number when the electrode is turned on, so there's really only a significant number of electrons in the channel region when the voltage is applied to the gate electrode. There are electrons, of course, in the source and drain, but they're essentially isolated from largely leaking out, you know.

BY MR. SPEEGLE:

Q. And this electric field resulting from the graded dopant concentration of Figure 17 would sweep those electrons from the active region down into the substrate?

MR. WHITEHURST: Object to the form.

THE WITNESS: It doesn't disclose that it does that.

BY MR. SPEEGLE:

Q. Whether the electrons actually move or not, you would agree that the resulting electric field from this greater dopant concentration exerts a force that would push the electrons in that direction, right?

MR. WHITEHURST: Object to form.

THE WITNESS: The electric field may not

be sufficient to actually move them. The patent -- the Kawagoe patent is silent about any effect that this field designated or brought about by the dopant gradient NW as shown in Figure 17 affects anything within the well.

The patent only describes that this dopant gradient is able to keep SEU electrons out of the well. It doesn't tell you what's happening in the well.

BY MR. SPEEGLE:

Q. Is there any reason, based on Figure 17, to conclude that the field would be substantially stronger in the well or out of the well?

A. The gradient he has shown here, basically in the well, just barely leaving it, so most of the gradient, and most of the field, would be in the well, and it would present itself up to and just beyond the well.

Q. And it says that that part is sufficient to attract to the substrate body 2S the electrons, right?

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. I'm reading directly to the middle of the column 16 quote that's on page 28 of your

declaration.

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, the way they've written it is how they've written it. Figure 17, I think, makes it clear that the gradient is in the well, so that's where the field's going to be largely. So it's going to push things away, and then the lowest energy potential is going to be in the substrate where the gradient is flat. It's just going to what's called NS, which I think is the concentration of the substrate. That's the wafer concentration as purchased.

So the electrons are attracted to the absence of this -- absence of the field generated by the gradient NW.

BY MR. SPEEGLE:

Q. Okay. I'm going to hand you what has been previously marked as Exhibit 2060.

Do you recognize Exhibit 2060?

A. Generally, yes.

Q. And this is a reference that you cited to suggest that there are not electrons in the active region, right?

A. Generally, yes.

Q. Looking at page 34 of your declaration, do

you see the quote from column 19 of Nishizawa that you have there?

A. Yes.

Q. And I believe the suggestion here is that they're not many electrons created in the active region. Is that what you're suggesting?

A. Yes, generally.

Q. All right. So this passage of Nishizawa, I think you're quoting from column 19, lines 21. I want to read to you the figure that corresponds to that section. I believe it's Figure 35, but why don't you take a look at Figure 35, and see if it corresponds to what you're quoting.

A. I'm confused with your question. 21 starts off, "As shown in Figure 33"?

Q. Figure 33, if you turn and look at it, is a graph, and Figure 35 -- yeah, Figure 35 is the device cross-section. And if you look at the rest of that column 19, there are references to things like the n+ type regions 12 and 13. I'd like to understand if the n+ regions 12 and 13 in column 19 is the same as the n+ regions 12 and 13 on Figure 35.

MR. WHITEHURST: Object to form.

THE WITNESS: Okay. This will take a

minute.

I think Figure 35 is relevant to this discussion, yes.

BY MR. SPEEGLE:

Q. Okay. So would you agree with me that the n+ regions 12 and 13 in Figure 35 correspond to an active region?

MR. WHITEHURST: Object to form.

THE WITNESS: I would say, generally, these look to be part of an active region, yes.

BY MR. SPEEGLE:

Q. And if you look at column 19, line 41, 42, this is just after the discussion you cited in your report, right?

A. Same column, same paragraph, I think, yes.

Q. And there's a sentence at line 41 that says, "In other words, several ten thousand electrons will flow into the n+ type region 13" --

A. Yes.

Q. -- is that right?

So this is saying that several ten thousand electrons will flow through the active region as a result of the alpha ray strike?

MR. WHITEHURST: Object to form.

THE WITNESS: What it says is that several

ten thousands out of the -- compared to the 3 million that are stored is essentially insignificant.

BY MR. SPEEGLE:

Q. But they would be tens of thousands of electrons in that region, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Essentially what it says is yeah, when vertically radiated, I mean, directly vertical at about .8 microns down, it will generate perhaps that number, several ten thousands. When -- yeah, and that that number, given this capacitor they've described of 3 million, is an insignificant number, thus will not exhibit errors due to alpha particles. It will exhibit orders -- errors even when the memory cell was made ten times smaller.

BY MR. SPEEGLE:

Q. Nishizawa actually does propose further adjustment to account for alpha ray-induced electrons in n+ 13, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Could you elaborate?

BY MR. SPEEGLE:

Q. Why don't you look at the column 20, lines 25 through 30.

And do you see that talks about "the p-type buried region 33a"?

A. Yes.

Q. And Nishizawa is teaching to include this p-type 33 -- p-type buried region 33a, "To eliminate the adverse effect caused by those electrons excited by alpha ray particles in the bit line at the time of read-out operation," right?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, they do describe Item 33 in that figure, a buried item.

BY MR. SPEEGLE:

Q. And that item is being arranged that way because of adverse effects from alpha ray-created electrons in the n+ 12 region, right?

MR. WHITEHURST: Object to form.

THE WITNESS: It's not clear why they are -- or -- from your -- your comment -- or question isn't necessarily supported by this specification entirely.

At column 20, line 19 immediately preceding the comment about Figure 35 in the p-type barrier region 33, the patent describes at 20 -- column 20, 19, "That is the amount of electrons created which adversely affect the memory action is

no greater than only 10 percent of the stored electric charge, and thus it can be disregarded," end quote.

So they've essentially analyzed worst case and decided that it's -- can still be disregarded.

Nonetheless, they go on and, you know, describe this thing they've invented.

I'm not sure that the specification supports that they created this invention is going to solve necessarily a problem. But they have created the structure.

BY MR. SPEEGLE:

Q. Let's turn to page 38 of -- page 37 of your 1242 declaration.

A. Page 38?

Q. 37. I'm going to ask you about the questions on 37 and 38.

Do you see the section here that talks about the "first active region with the second doping type opposite conductivity to the first doping type"? Do you see that?

A. Yes.

Q. And you concluded that Kawagoe did not disclose a first active region with the second doping type opposite in conductivity to the first

doping type, right?

A. I concluded Dr. Blalock's analysis of Kawagoe was incorrect regarding this.

Q. Do you think that Kawagoe discloses a first active region with a second doping type opposite in conductivity to the first doping type?

MR. WHITEHURST: Object to form.

THE WITNESS: In the example that Dr. Blalock analyzed, which I rebutted, it does not disclose that.

BY MR. SPEEGLE:

Q. Are you referring to the figure on page 38 that's annotated as an NMOS transistor?

A. Yes, that would be the region.

Q. And you concluded that an NMOS transistor was not in the -- opposite doping type for a p-type substrate?

A. What I concluded was that the regions that he pointed to were not of opposite doping type to the substrate. There was a specific claim element limitation requiring an opposite doping type to the substrate. He pointed to a p-type region, and the substrate was p-type also.

Q. You understand Dr. Blalock pointed to the NMOS transistor 4N, right?

A. Yes.

Q. And you would consider the doping type of the NMOS transistor to be P?

A. The well is P, the channel is P, yes, that's what he pointed to.

Q. Okay. You see on the left-hand side of this figure on 38, there's a PMOS transistor there, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, there's a transistor there.

BY MR. SPEEGLE:

Q. It's a PMOS transistor on the left side?

(The requested portion was read back.)

MR. WHITEHURST: Object to form.

THE WITNESS: I don't believe I analyzed that transistor.

BY MR. SPEEGLE:

Q. Well, you see it's identified on the bottom left, in the left-hand corner of that well, as an n-type well, right?

MR. WHITEHURST: Object to form, object to scope. This deposition is limited to the scope of his declaration. You're going outside the scope of his declaration.

MR. SPEEGLE: I'm asking about a figure in his declaration.

MR. WHITEHURST: You can ask, but objection. Scope.

MR. SPEEGLE: Okay.

THE WITNESS: I see the letter N.

BY MR. SPEEGLE:

Q. Yes, and for an n-type well, that would mean this is a PNP transistor on the left side, right?

MR. WHITEHURST: Object to form, object to scope. This witness is not required to form opinions about things that are not in his declaration. You know the rules, and you're breaking the rules.

MR. SPEEGLE: I disagree with your characterization.

MR. WHITEHURST: Objection to scope. The deposition is about opinions in his declaration. He's already said on the record he hasn't formed any opinions about this transistor.

MR. SPEEGLE: Your objection is noted. You don't need to keep coaching him.

MR. WHITEHURST: I'm just saying we can shut this down. We can shut the deposition down if

you're going to break the rules. You know the rules.

MR. SPEEGLE: Alan, you've been coaching this whole time.

MR. WHITEHURST: I'm not coaching him about anything. You're breaking the rules, and that's improper, and you know it. He already answered your question.

MR. SPEEGLE: Your objection is noted. We can disagree on the record. Let the witness take his time.

MR. WHITEHURST: Let's take a break. We've been going for an hour.

MR. SPEEGLE: There's a question pending. I'd like an answer to the question.

MR. WHITEHURST: Answer the question so we can take a break, sir.

THE WITNESS: I don't believe I analyzed this.

MR. SPEEGLE: Great.

MR. WHITEHURST: That's it.

(Recess.)

BY MR. SPEEGLE:

Q. Dr. Glew, I was asking you about the figure on page 38 of your 1242 declaration.

Do you see that?

A. Yes.

Q. And below that figure, you have a statement that says, "A POSITA would have understood that the channel in a CMOS transistor has the same doping type as the well in which the source and drain are formed."

Is that sentence describing this figure on page 38?

MR. WHITEHURST: Object to form.

THE WITNESS: This -- I would say a general statement that, you know, the channel journal is a -- the same as the well type.

BY MR. SPEEGLE:

Q. And would you agree that the device shown on page 38 is a CMOS device?

A. I analyzed the NMOS transistor on the right. I didn't analyze the other one, so I couldn't answer that.

Q. This is Figure 23 of Kawagoe. I think you say that, right below it, you say, "It's citing Exhibit 1007, Figure 23"?

A. Yes, I'm referring to Figure 23.

Q. And can you turn to paragraph 65 on the next page of your declaration. And in paragraph 65,

you recognize that Dr. Blalock "annotated Figure 23 of Kawagoe and maps Kawagoe's source/drain 4Na/4Nb and channel of NMOS 4N to the claimed first active region and maps Kawagoe's source/drain 4Pa/4Pb and channel of PMOS 4P to the claimed second active region," right?

A. I see that, yes.

Q. You understand that, at least according to Dr. Blalock, Figure 23 includes both the PMOS and NMOS device, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, that is Dr. Blalock's position.

BY MR. SPEEGLE:

Q. I believe when we were discussing Figure 5B earlier, you agreed that a PNP PMOS transistor would have an opposite doping type from a p-type substrate?

A. I'm sorry, you said Figure 5B?

Q. Figure 5B of the '222 and '842 patent.

Do you remember we were discussing that this morning?

MR. WHITEHURST: Object to form.

THE WITNESS: Actually, no. Yeah, we discussed 5B quite extensively.

BY MR. SPEEGLE:

Q. Right.

And you told me that you believed that Figure 5B did have an active region conductivity type that was opposite to the p-type substrate?

MR. WHITEHURST: Object to form.

THE WITNESS: Yes, you view Figure 5B along with, of course, 5A, and the description that says it's a CMOS substrate, it has both types.

BY MR. SPEEGLE:

Q. How is Figure 23 disclosure in Kawagoe different from Figure 5B in -- in regards to the conductivity of the active region?

MR. WHITEHURST: Object to form.

THE WITNESS: Which aspect or part of Kawagoe Figure 23 are you referring to?

BY MR. SPEEGLE:

Q. Let's talk about the PMOS.

A. Are you referring to the portion on the left of Kawagoe?

Q. Yes.

MR. WHITEHURST: Object to form.

THE WITNESS: I didn't analyze that, so I really couldn't tell you the difference. I restricted my analysis to rebutting Dr. Blalock's

position.
BY MR. SPEEGLE:
Q. So sitting here today, you're not prepared to identify any distinction between those two?
A. I didn't analyze the transistor on the left of Figure 23 in Kawagoe, so without further analysis, which I haven't performed, I wouldn't be comfortable analyzing or giving opinions on something I haven't analyzed yet.
I do recall that there were a number of typos and idiosyncrasies/contradictions in the Kawagoe specifications, so I'd be very careful in reviewing that again, if I had to, if I was asked to analyze that.
Q. Do you agree that the n-type source and drain in the NMOS of -- on the right-hand side of Kawagoe, that the source and drain are opposite in doping type to the p-type substrate, right?
MR. WHITEHURST: Object to form.
THE WITNESS: I didn't analyze the transistor on the left side of Kawagoe.
BY MR. SPEEGLE:
Q. That's the right side.
A. The right side. Repeat your question, please.

Q. The n-type source and drain for the NMOS on the right-hand side of Kawagoe, an n-type source and drain is opposite in conductivity type to a p-type substrate, right?

MR. WHITEHURST: Object to form.

THE WITNESS: An n-type source and drain is n-type. A p-type substrate is a p-type, so they would be opposite, yes.

BY MR. SPEEGLE:

Q. Would you say that the source and drain are part of the active region?

MR. WHITEHURST: Object to form.

THE WITNESS: Sources and drains are part of the active region, yes.

BY MR. SPEEGLE:

Q. Let's look at paragraph -- well, let's look at page 40 of the 01242 declaration.

A. Page 40?

Q. Yes, page 40. This is typed page 40, not exhibit page.

And do you see the figure at the top of page 40 that's, again, an annotated version of Figure 23 from Kawagoe?

A. Yes, I see the figure at the top of page 40. I believe this was -- yes.

Q. Okay. What's your understanding of the function of Isolation Region (3) highlighted in yellow on that figure?

A. The Kawagoe patent '114 describes at column 8, line 40, quote, "Over the principal surface of epitaxial layer 2E, there is formed a field insulating film 3, which is made of silicon dioxide (SiO2), for example."

So this is described thusly: A field insulating film of field oxide, a FOX sometimes it could be called. It's an insulating layer of dielectric around a well.

Q. What's its purpose?

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. I can ask a better question.

Are you familiar with insulating films like insulating film 3, in general?

A. In general, yes.

Q. And, in general, what is the general purpose of an insulating film like that?

MR. WHITEHURST: Object to form.

THE WITNESS: Generally, insulating film electrically isolates one thing from another.

///

BY MR. SPEEGLE:

Q. Would insulating film 3 in Kawagoe electrically isolate the 4P and 4N in Figure 23?

MR. WHITEHURST: Object to form.

THE WITNESS: We're looking at this in two directions -- I mean, in two dimensions. It's actually a three-dimensional structure, and we're just looking at a cross-section.

I'm assuming that 3 would isolate the well, for example, from whatever was around it, on all sides, all four sides. That's normally how something like this works.

BY MR. SPEEGLE:

Q. So you're saying you would isolate it from -- let me ask it different. You're saying insulating film 3 would isolate, for example, 4P from 4N and from other things on the front and back into the page?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, it's only on the surface. So, as we see, it doesn't really isolate when they're touching. What it does provide at the surface, on the top, it would usually -- usually these kind of things are rectangular, and then the -- you know, something like 3 would probably go

around the perimeter of the rectangle.

BY MR. SPEEGLE:

Q. What is LOCOS in terms of semiconductor manufacturing?

MR. WHITEHURST: Object to form.

THE WITNESS: Local oxidation of silicon, LOCOS.

BY MR. SPEEGLE:

Q. Do you know how LOCOS works?

A. It's a usually either steam or ozone -- high-temperature oxygen oxidation of a silicon -- areas of a silicon substrate.

Q. Okay. And does it -- if you make a film using LOCOS, would that resulting film just sit on the surface of your silicon wafer or would it go into the body of the silicon wafer?

MR. WHITEHURST: Object to form.

THE WITNESS: It typically is what's known as a formed oxide, not a deposited oxide. So it consumes the silicon that is formed from, so you mix it with oxygen or steam, which has oxygen in it, something like that, ozone maybe, which is 03, very reactive. And it consumes a portion of the silicon and works its way downward. It doesn't get very deep, but it does consume some of the surface

silicon downward.

BY MR. SPEEGLE:

Q. Why don't you look at Kawagoe, column 11, line 28 through 35.

MR. WHITEHURST: Which column? Which line?

MR. SPEEGLE: Column 11, line 28 through 35.

BY MR. SPEEGLE:

Q. And let me know when you've had a chance to look at it.

A. I have read that paragraph.

Q. Okay. Does this paragraph tell you that the insulating film 3 would actually be deposited inside of the silicon and not deposited on top of the silicon?

MR. WHITEHURST: Object to form.

THE WITNESS: Well, what it describes is insulating film 3 made of silicon oxide, or the likeness, formed over the principal surface of the epitaxial layer 2E by the LOCOS method or the like.

So, to me, it's clear that it's over the surface. It's -- "formed" often means, like I said, that it's -- it's not deposited, per se. It uses oxygen, and then the silicon is already there to

react it to form downward -- you know, over the top and downward a bit.

BY MR. SPEEGLE:

Q. You say in paragraph 66 of your 1242 declaration -- you say at the first and second -- are you there?

A. Yes.

Q. Okay. You say, "A POSITA would have understood that the first and second active regions extend to about the depth of the epitaxial layer 2E and abut each other laterally."

Do you see that?

A. Yes.

Q. Would a channel stopper region below insulating film 3 prevent -- I'm sorry. I lost my place. I'll ask that question again.

Would a channel stopper region below insulating film 3 prevent the first and second active regions from abutting each other laterally?

MR. WHITEHURST: Object to form.

THE WITNESS: It would depend how deep the channel stopper region went.

BY MR. SPEEGLE:

Q. From a design perspective, is there any reason you would have a channel stopper region that

did not encompass the entire active region depth?

MR. WHITEHURST: Object to form.

THE WITNESS: Essentially, its purpose is to stop errant carriers from migrating from one transistor to another. It needs to be deep enough to do that, but not deeper.

So, generally, the purpose is just that.

So they make them adequate for the purpose. It depends on what the performance level is, how large things are, how close they are as to the geometry of this particular design feature.

BY MR. SPEEGLE:

Q. All right. Let's shift gears and go to your 1244 declaration.

I'm going to direct you specifically to paragraph 56. That's not right. Oh, yes, it's paragraph 56, page 30. Are you there?

A. Yes.

Q. So paragraph 56 is where you begin discussing the Payne only ground in the 1244 IPR, right?

A. Yes, that's Payne reference.

Q. And continuing through from paragraph 56 through paragraph 58, it's your position that, "The magnitude of the slope is essential to determine the

magnitude of the force the dopant gradient places on the carrier and thus the net force." Is that right?

A. In this context, yes.

Q. After that paragraph, do you see paragraph 59, you have some arguments about Wang and single-event upsets.

Do you see that paragraph 59?

A. Yes.

Q. Is that anything to do with Payne?

A. Let me see if this was an errant paragraph.

MR. WHITEHURST: Which paragraph are we looking at?

MR. SPEEGLE: Yeah, it's paragraph 59, and it continues all the way to the end of the declaration, but there's discussion of Kawagoe and single-event upsets, and I'm asking if those have any relationship to Payne.

THE WITNESS: It appears this needs a header. It lost its header.

BY MR. SPEEGLE:

Q. So the Payne arguments are confined to paragraphs 56 through 58, and the remainder relate to Kawagoe again?

A. Yes.

Q. So focusing again on paragraph 58 -- well, let me introduce, Dr. Glew, I've handed you what's OnSemi Exhibit 1005 in the 1244 IPR.

Do you see that?

A. Yes.

Q. And this is the Payne reference, right?

A. Yes, it is.

Q. And you're discussing in paragraph 58, "The magnitude of the slope is essential to determine the magnitude of the force the dopant gradient places on the carriers."

Now, is that slope and dopant gradient reflected on Figure 11 of Payne?

MR. WHITEHURST: Object to form.

THE WITNESS: The gradient is generally reflected on 11. As I point out, it's absent actual values, though.

BY MR. SPEEGLE:

Q. And do you agree that the gradient dopant concentration reflected in Figure 11 of Payne would exert some force on carriers in those regions of Payne?

MR. WHITEHURST: Object to form.

THE WITNESS: To the extent that carriers are not shielded from the field, it would act on the

carriers, not necessarily in a manner sufficient to cause any motion or current flow, but it would be normal for fields to act on charges that they aren't shielded from.

BY MR. SPEEGLE:

Q. Okay. And you didn't identify any disclosure of shielding in Payne, right?

MR. WHITEHURST: Object to form.

THE WITNESS: I don't believe I mentioned the source of shielding.

BY MR. SPEEGLE:

Q. And you didn't identify any contrary forces that would act opposite of the graded dopant concentration in Payne?

MR. WHITEHURST: Object to form.

THE WITNESS: One with skill in the art would understand these are semiconductors, so there's always some resistance to a semiconductor.

BY MR. SPEEGLE:

Q. But you did not identify anywhere in Payne that discusses contrary forces going in the opposite direction?

MR. WHITEHURST: Object to form.

BY MR. SPEEGLE:

Q. Did you?

A. No, I was rebutting Dr. Blalock. He didn't actually fill any aid of movement in the carriers. There wasn't much to rebut there.

Q. All right. Let's turn to your -- the 1243 on the '842, and I'm going to point you to paragraph 58.

A. I am at 58.

Q. Okay. And this is part of your analysis regarding the Wieczoerek grounds in the '842 patent, right?

A. Yes, this is the Wieczoerek analysis.

Q. Let me introduce -- so I've handed you what was marked as OnSemi Exhibit 1006 in the 1242 and 1243 IRPs.

Do you recognize Exhibit 1006?

A. Yes.

Q. And I see the last sentence of paragraph 58 in your '842 declaration says, "The magnitude of the slope is essential to determine the magnitude of the force the dopant gradient places on the carrier and thus the net force."

Do you see that sentence?

A. I see that sentence, yes.

Q. Is that substantially the same as the paragraph 59 we just looked at in the 1244?

A. I think, yeah, it's a similar argument, that without any knowledge of the actual concentrations of the gradient, it's difficult to assert that they are doing something.

There are -- you know, if you manufacture it yourself, you might know the values, but if you're just looking at a printout of a chart, you need to know the values on the chart.

Q. Can you look at paragraph 60 in the 1242 declaration?

A. We're going back to 1242?

Q. Yes, for a second. Paragraph 60.

Is it right that your arguments regarding Wieczoerek in the 1242 and the 1243 IPR are substantially identical?

MR. WHITEHURST: Object to form.

THE WITNESS: They should be. Let me confirm this. Yes.

BY MR. SPEEGLE:

Q. All right. So if you look at Figure 2B of Wieczoerek, does Figure 2B reflect the slope and dopant gradient that you're referring to in the last sentence of paragraph 60 of the 1242 declaration and paragraph 58 of the 1243 declaration?

MR. WHITEHURST: Object to form.

THE WITNESS: As in the last reference, it shows slope in a -- say a general schematic form, but without concentration and depth values, one can't actually know the gradient.

BY MR. SPEEGLE:

Q. You don't dispute that this slope would exert some force on carriers in that region, right?

MR. WHITEHURST: Object to form.

THE WITNESS: Let me briefly review.

In general, the gradient of the dopants would provide some field and result in force on charge particles. The magnitude and the effect is what I can't determine without additional information.

BY MR. SPEEGLE:

Q. Okay. Do you see in Wieczoerek the Figure 2A and 2B? On the left-hand, 2A is called "as implanted," and 2B is "after anneal."

Do you see that?

A. Yes.

Q. What does "anneal" mean?

A. Annealing is heating, so the ion implantation is literally firing ions at very high energy velocity, anywhere from 20,000 to half a million volts typically, and they go into a

1 different depth depending on the energy and the mass
2 of the ion.
3 But they cause a lot of damage to the
4 crystal. And they also have a fairly sharp -- often
5 have a sharp profile, like one sees on the left.
6 That's the implantation.
7 The heating, or annealing, allows two
8 things to occur. It is the healing of the crystal,
9 so the crystal -- the silicon itself can reform into
10 its crystallin structure and repair the damage. And
11 the dopants then also diffuse. It sort of smooths
12 out the profile. They spread out based upon
13 diffusion. So there's annealing and now rapid
14 thermal annealing.
15 This is -- basically it would -- I'm not
16 familiar with ion implantation without annealing.
17 Q. As long as they've been doing ion
18 implantation, they've been doing annealing to spread
19 out the dopant curves?
20 MR. WHITEHURST: Object to form.
21 THE WITNESS: For a long time. Maybe in
22 the early days, but it causes -- let me back that
23 up. There is -- there might be some implantation --
24 just a modern implantation that's actually just done
25 on top of the silicides, the contacts, but it's not

into the silicon exactly. It's sort of very odd implantation. Maybe that is annealed, but, generally, when it's damaging the crystal, it needs to be annealed.

BY MR. SPEEGLE:

Q. Okay. And in the Wieczoerek arguments you have, were 1242 and 1243 declarations, you don't identify any contrary forces that would act in the opposite direction from the graded dopant concentrations in Wieczoerek, do you?

MR. WHITEHURST: Object to form.

THE WITNESS: No, I was just rebutting Dr. Blalock's opinions, and there wasn't any evidence of aiding carrier movement or magnitude of analysis of the gradient.

MR. SPEEGLE: Okay. And if we could take a quick break, I may be about to wrap up.

(Recess.)

MR. SPEEGLE: No further questions.

MR. WHITEHURST: Dr. Glew, I don't have any further questions either.

Thank you for your time today. We certainly appreciate your testimony.

I know it's been a long day, but the good news is this concludes your deposition. So with

that, we can go off the record.

(At 3:48 p.m. the proceedings were concluded.)

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CERTIFICATE

I, Dana Peabody, a California Certified Shorthand Reporter, do hereby certify:

That prior to being examined, the witness in the foregoing proceedings was by me duly sworn to testify to the truth, the whole truth, and nothing but the truth;

That said proceedings were taken before me at the time and place therein set forth and were taken down by me in shorthand and thereafter transcribed into typewriting under my direction and supervision;

I further certify that I am neither counsel for, nor related to, any party to said proceedings, nor in any way interested in the outcome thereof.

In witness whereof, I have hereunto subscribed my name at Yuma, Arizona, this 29th day of July, 2024.

Dana Peabody

_____

Dana Peabody

CSR No. 6332

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Dr. Alexander Glew Date

ACKNOWLEDGEMENT OF DEPONENT

I, Dr. Alexander Glew, do hereby declare that I have read the foregoing transcript, I have made any corrections, additions, or changes I deemed necessary as noted above to be appended hereto, and that the same is a true, correct and complete transcript of the testimony given by me.

_____ _____

Dr. Alexander Glew Date

*If notary is required

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

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Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the court reporter. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the court reporter and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

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