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Transcript of Dr. Alexander Glew

Date: February 5, 2025

Case: Monolithic Power Systems, Inc. -v- GreenThread, LLC (PTAB)

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WORLDWIDE COURT REPORTING & LITIGATION TECHNOLOGY

MPS EX. 1055

1
2 UNITED STATES PATENT AND TRADEMARK OFFICE
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD
4

5 MONOLITHIC POWER SYSTEMS, INC.,)
6 PETITIONER,)
7 VS.) CASE NO: IPR2
8 GREENTHREAD, LLC,) 024-00470
9 PATENT OWNER.) U.S. PATENT NO.
10 -----) 11,121,222
11)
12)
13)
14)

15 REMOTE VIDEOTAPED DEPOSITION

16 DR. ALEXANDER GLEW

17 WEDNESDAY, FEBRUARY 5, 2025

18 LOS ANGELES, CALIFORNIA
19
20
21
22

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24 REPORTED BY MICHAEL CAGLIATA

25 CSR #14491, RPR

Videoconference Deposition of

DR. ALEXANDER GLEW, held remotely:

Witness Location:

("CALIFORNIA.")

Pursuant to Notice, before Michael
Cagliata, Registered Professional Reporter, and
Certified Shorthand Reporter No. 14491 in and for the
State of California.

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1 P R O C E E D I N G S

2 * * * *

3 VIDEOGRAPHER: Here begins media number one
4 in the videotaped deposition of Dr. Alexander Glew,
5 in the matter of Monolithic Power Systems Inc. versus
6 Greenthread LLC (PTAB), in the United States Patent
7 and Trademark Office. Case number IPR
8 2024-00468:-00469:-00470. Today's date is
9 February 5th, 2025. The time on the video monitor is
10 10:22. The remote videographer today is Travis
11 Perry, representing Planet Depos.

12 All parties of the videotaped deposition
13 are attending remotely. Would counsel please voice
14 identify themselves and state whom they represent?

15 MR. BOMBACH: Miguel Bombach from Perkins
16 Coie, representing petitioner Monolithic Power
17 Systems.

18 MR. WHITEHURST: Good morning, everyone.
19 This is Alan Whitehurst from McKool Smith,
20 representing the patent owner Greenthread, as well as
21 the witness Dr. Glew. And with me remotely today is
22 my colleague Brandon Merrill.

23 VIDEOGRAPHER: The court reporter today is
24 Michael Cagliata, representing Planet Depos. The
25 witness will now be sworn.

10:21:31
10:21:33
10:21:36
10:21:46
10:21:49
10:22:03
10:22:09
10:22:12
10:22:17
10:22:19
10:22:22
10:22:25
10:22:28
10:22:32
10:22:36
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10:22:48
10:22:54
10:22:58
10:22:59
10:23:06

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1	(Oath given.)	10:23:08
2	EXAMINATION BY MR. BOMBACH	10:23:26
3	Q. Good morning, Dr. Glew.	10:23:26
4	A. Good morning.	10:23:28
5	Q. Where are you right now?	10:23:32
6	A. I'm in California.	10:23:35
7	Q. Okay. Are you in the room with another	10:23:38
8	person?	10:23:41
9	A. I am in a room with another person, yes.	10:23:46
10	Q. Is that person Mr. Alan Whitehurst?	10:23:49
11	A. Yes, I'm in a room with Alan Whitehurst.	10:23:55
12	Q. No offense to Mr. Whitehurst, but you	10:23:58
13	understand that he is not to influence your testimony	10:24:01
14	via passing notes or hand signals or verbally	10:24:07
15	informing you what to answer; correct?	10:24:11
16	A. Are you speaking to me or to him?	10:24:19
17	Q. To you.	10:24:23
18	A. Yes, I understand that.	10:24:24
19	Q. And if that occurs today, will you please	10:24:25
20	inform me?	10:24:30
21	A. Yes.	10:24:34
22	Q. Thank you. How many times have you been	10:24:35
23	deposed?	10:24:38
24	A. Hard to say. Somewhere between 75 and 100.	10:24:41
25	Q. So you're aware of the general ground	10:24:45

1	rules?	10:24:48
2	A. General ground rules, yes. Venues that	10:24:48
3	have different rules, but generally they're similar.	10:24:53
4	Q. Okay. Are there any reasons why you are	10:24:56
5	unable to testify truthfully today? Any medical	10:25:02
6	impediments? Medications or anything?	10:25:09
7	A. None that I'm aware of, no.	10:25:11
8	Q. You understand that you're under oath and	10:25:13
9	you're obligated to tell the truth today?	10:25:15
10	A. Yes, I have that understanding.	10:25:17
11	Q. Do you have any documents with you?	10:25:19
12	A. I have some binders of documents related to	10:25:22
13	this case, yes.	10:25:26
14	Q. Okay. And what would those binders have	10:25:28
15	within them?	10:25:33
16	A. Petitions, declarations, responses.	10:25:36
17	Q. Okay. And would those be effectively the	10:25:42
18	PTAB record including prior art and what not, or are	10:25:52
19	there additional items within there?	10:25:57
20	A. Most of it is not prior. That would be a	10:25:59
21	lot more documents. Most of it is my declarations,	10:26:04
22	maybe other experts' declarations, petitions, and	10:26:09
23	responses.	10:26:13
24	Q. And I saw Mr. Whitehurst had a notepad and,	10:26:14
25	as attorneys, we take notes. I request that you do	10:26:20

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1	not look at and refer to his notepad.	10:26:24
2	A. Not a problem. There's a large monitor --	10:26:27
3	my monitor between him and me. So --	10:26:30
4	MR. WHITEHURST: Counsel, just for the	10:26:39
5	record I'll confirm there will be no passing, no	10:26:40
6	showing of anything. We intend to fully comply with	10:26:46
7	the rules.	10:26:51
8	MR. BOMBACH: Okay. No shenanigans	10:26:51
9	confirmation.	10:26:55
10	MR. WHITEHURST: Confirmed.	10:26:56
11	Q. And I uploaded into the chat box what has	10:26:57
12	been premarked as Exhibit 2057.	10:27:01
13	(Exhibit 2057 marked for identification.)	10:27:05
14	Q. These were submitted by patent owner	10:27:08
15	Greenthread in IPR numbers 2024468, 2024469, 2024470.	10:27:10
16	If you could please download them and let me know	10:27:28
17	when you have them.	10:27:33
18	MR. WHITEHURST: I did that as we were --	10:27:36
19	Q. And I guess we can take them one at a time	10:27:40
20	and, apologies. This might be a bit mechanical or	10:27:49
21	repetitive. If you could look at the document that's	10:27:55
22	been premarked Exhibit 2057. IPR 2024468. And this	10:27:58
23	was for U.S. patent number 8,421,195.	10:28:07
24	With respect to this Exhibit 2057, this is	10:28:40
25	your declaration that you submitted in this matter;	10:28:52

1	correct?	10:28:55
2	A. Yes.	10:29:03
3	Q. Just to confirm, the other one that is	10:29:03
4	marked as Exhibit 2057 and IPR 2024-00469 which is	10:29:06
5	for U.S. patent 9,190,502, this is also a declaration	10:29:18
6	you submitted to the U.S. patent -- this is your	10:29:24
7	declaration; correct?	10:29:29
8	A. Yes.	10:29:35
9	Q. And the item, the document that's been	10:29:40
10	premarked Exhibit 2057 for IPR 2024-00470 which is	10:29:44
11	for U.S. patent number 11,121,222, this is also a	10:29:55
12	declaration that you had submitted for this case;	10:30:01
13	correct?	10:30:07
14	A. Yes. This is for the '222 patent.	10:30:08
15	Q. In these declarations, are you aware of any	10:30:13
16	mistakes right now that you would like to correct?	10:30:16
17	A. I think in the '222 patent there were some	10:30:22
18	cut and paste errors.	10:30:26
19	Q. Okay. Were these -- would you qualify them	10:30:27
20	as substantive or just typographical?	10:30:34
21	A. They included the word minority in the	10:30:39
22	description of headers and some language leading up	10:30:43
23	to a claim element I was discussing. The claim	10:30:49
24	element was correct as I pasted it from the patent,	10:30:52
25	but the text leading to that in the header had the	10:30:55

1	word minority in it. I think that's how I would	10:30:59
2	characterize it.	10:31:02
3	Q. Okay. And that doesn't change the	10:31:04
4	substance of your declaration with respect to the 22	10:31:07
5	patent. Does it? '222 patent.	10:31:13
6	A. No, not substantively. It does not change	10:31:16
7	my opinion or the substance of my opinion.	10:31:19
8	Q. Okay. Actually, are there any other errors	10:31:22
9	that you're currently aware of that you would like to	10:31:30
10	address before we jump into some substance?	10:31:33
11	A. Not off the top of my head. I don't know	10:31:37
12	of any others.	10:31:40
13	Q. Okay. I would like to upload each of these	10:31:41
14	patents, which have been premarked Exhibit 1001 and	10:31:43
15	IPR numbers 468, 469, and 470.	10:31:51
16	(Exhibit 1001 marked for identification.)	10:32:00
17	Q. If you could download them and open them.	10:32:02
18	I would just like to give you full access to your	10:32:12
19	declaration and the patents so you can refer to them	10:32:14
20	at any time during this deposition.	10:32:17
21	A. Thank you.	10:32:19
22	Q. What has been premarked as Exhibit 1001,	10:32:20
23	for U.S. patent number 8,421,195, you had reviewed --	10:32:36
24	and I will refer to this as the '195 patent. You've	10:32:45
25	reviewed the '195 patent; correct?	10:32:49

1	A. Yes, I have reviewed the '195 patent.	10:32:51
2	Q. And if you could in what is also -- has the	10:32:53
3	labelling Exhibit 1001, but it is U.S. patent	10:32:59
4	9,190,502, which I'll refer to as the '502 patent.	10:33:05
5	You've reviewed this patent in preparation for your	10:33:10
6	declaration as well; correct?	10:33:13
7	A. Yes.	10:33:15
8	Q. And if you could look at Exhibit 1001,	10:33:15
9	which is -- also 1001, but it is U.S. patent	10:33:22
10	11,12,222. You reviewed this patent prior to	10:33:28
11	preparing your declaration; correct?	10:33:31
12	A. Yes.	10:33:33
13	Q. And I'll refer to that as the '222 patent.	10:33:33
14	If at any time you need to refer to anything within	10:33:39
15	these patents or your declaration, please do so.	10:33:41
16	A. I'm having minor -- the patents, I'm having	10:33:45
17	an issue with. Give me one moment.	10:33:51
18	Q. Okay.	10:33:53
19	MR. WHITEHURST: So strangely I was able to	10:34:33
20	download the exhibits, but I did get a weird error	10:34:40
21	message, unfortunately.	10:34:44
22	THE WITNESS: I've downloaded the patents	10:34:45
23	but they won't open.	10:34:48
24	MR. BOMBACH: Are you able to open them,	10:34:54
25	Alan?	10:34:56

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1	MR. WHITEHURST: I am now.	10:34:56
2	MR. BOMBACH: Okay.	10:34:57
3	MR. WHITEHURST: We can stay on the record,	10:35:08
4	but let's give the witness just a little more time to	10:35:10
5	confirm that he's been able to download everything	10:35:15
6	and can successfully open it.	10:35:18
7	Q. Dr. Glew, please let me know when you've	10:35:38
8	been able to open them.	10:35:41
9	A. I'm going to delete them and re-download	10:35:48
10	them.	10:35:51
11	Oh. I'm unable to open them. Maybe we	10:36:35
12	should go offline for a moment.	10:36:55
13	MR. BOMBACH: Yeah. If we could go off the	10:36:57
14	record for a second.	10:36:59
15	VIDEOGRAPHER: Sorry. My microphone fell.	10:37:20
16	We are going off the record now.	10:37:23
17	(Recess taken.)	10:37:24
18	VIDEOGRAPHER: We're back on the record at	10:42:49
19	10:42.	10:42:52
20	Q. Dr. Glew, you were able to download the	10:42:53
21	'195, the '222, and the '502 patents; correct?	10:42:56
22	A. Yes.	10:43:03
23	Q. And you've reviewed those patents prior to	10:43:04
24	submitting your declarations; correct?	10:43:06
25	A. Yes.	10:43:09

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1	Q. Great. I'll have a couple more files, but	10:43:10
2	I'll upload them as we go. I just quickly want to	10:43:15
3	get into your qualifications generally. What's your	10:43:25
4	education?	10:43:29
5	A. I have a bachelor's of science and a	10:43:31
6	master's of science in mechanical engineering from UC	10:43:34
7	Berkeley. I have a master's of science and a PhD in	10:43:37
8	material science and engineering from Stanford	10:43:41
9	University.	10:43:47
10	Q. And material science, or mechanical	10:43:47
11	engineering, did you study materials of semiconductor	10:43:51
12	devices?	10:44:00
13	A. Yes.	10:44:01
14	Q. Can you briefly describe your educational	10:44:01
15	experience there?	10:44:05
16	A. Well, material science is generally	10:44:07
17	considered -- generally concerned with electrical,	10:44:14
18	optical, mechanical properties of materials.	10:44:20
19	Biological sometimes also. A big portion of the	10:44:23
20	curriculum at Stanford University relates to the	10:44:26
21	electronic properties of materials. I had a number	10:44:30
22	of courses with laboratory work associated with	10:44:32
23	basically semiconductors.	10:44:35
24	In Silicon Valley, Stanford is one of the	10:44:37
25	leading institutions participating in Silicon Valley	10:44:44

1	type activity.	10:44:48
2	Q. And what's your current job now?	10:44:49
3	A. I run a small engineering firm in Mountain	10:44:50
4	View, California, Glew Engineering.	10:44:56
5	Q. What does Glew Engineering do?	10:44:56
6	A. Lately we've been doing a lot of litigation	10:44:58
7	support. We also do -- we are licensed engineers and	10:45:02
8	keep CAD and finite element analysis. Over the years	10:45:05
9	we've done a lot of analyses of processing and	10:45:11
10	processing equipment for semiconductor and thin	10:45:14
11	films. I would say semiconductor, a lot of that.	10:45:17
12	Some solar, some photovoltaic. Things related to	10:45:20
13	thin film processing. Semiconductor is considered	10:45:38
14	thin film processing. These are very thin films.	10:45:44
15	Some general engineering, of course.	10:45:50
16	Q. And what percentage of your job would you	10:45:51
17	consider to be litigation consulting?	10:45:55
18	A. Since Covid, about 80 percent.	10:46:00
19	Q. How many -- you've submitted several	10:46:04
20	declarations in cases involving the patent owner	10:46:08
21	Greenthread; correct?	10:46:14
22	A. Yes. I have been involved in a number of	10:46:19
23	IPRs on this matter, on these patents.	10:46:23
24	Q. How many declarations would you say you	10:46:28
25	have submitted to -- well, on behalf of Greenthread	10:46:30

1	in total?	10:46:40
2	A. Well, I would say probably something on the	10:46:42
3	order of 20. There's about half-a-dozen patents and	10:46:52
4	I think there's been at least three declarations that	10:46:57
5	are substantially similar on every patent.	10:47:01
6	Q. And how many times have you been deposed	10:47:04
7	for your declarations not including today?	10:47:06
8	A. I would say roughly four times. It was in	10:47:25
9	about the last year. I did work on a Greenthread	10:47:29
10	matter about, I don't know, five or seven years ago.	10:47:33
11	I was deposed on that also, I think. I'm not sure.	10:47:41
12	I think I wrote a declaration.	10:47:44
13	Q. Okay. Have you testified at trial?	10:47:46
14	A. In general or relating to this?	10:47:51
15	Q. Oh. Yeah, I'll re-ask that. Have you	10:47:54
16	testified at any patent trial in your life?	10:47:58
17	A. Yes.	10:48:05
18	Q. How many times?	10:48:05
19	A. Maybe 10 or 12 times. I'm having a hard	10:48:08
20	time recalling which ones were patents and which ones	10:48:21
21	were just general technology issues.	10:48:24
22	Q. Okay. So what is a semiconductor dopant?	10:48:28
23	A. Well, a dopant is an atom that is different	10:48:33
24	than the semiconductor substrate or wafer. So	10:48:44
25	typically it would be an atom with a different number	10:48:48

1 of valence electrons. For homogeneous semiconductors 10:48:52
2 such as silicon, it could be something from the third 10:49:04
3 or fifth column typically of the periodic table, 10:49:06
4 potentially second or sixth column. Typically they 10:49:11
5 would be column three or column five elements for 10:49:16
6 silicon. 10:49:19
7 Q. And what is the purpose of introducing a 10:49:24
8 semiconductor dopant into semiconductor material? 10:49:28
9 A. A semiconductor can also be thought of as a 10:49:31
10 sometimes conductor. In its purest form, it's 10:49:41
11 usually fairly resistant. It does not conduct 10:49:45
12 current well. In order to make it conduct current 10:49:49
13 better, one introduces species into the silicon 10:49:52
14 crystal that have a different number of valence 10:49:58
15 electrons, thereby creating holes or electrons that 10:50:06
16 are more mobile than the intrinsic electrons of 10:50:10
17 silicon, thereby increasing conductivity. 10:50:13
18 Q. How are dopants integrated into 10:50:26
19 semiconductor material? 10:50:29
20 A. Are you asking me about processing method? 10:50:30
21 Q. Yes. 10:50:39
22 A. There are a few principal methods. 10:50:40
23 Initially, dopants were diffused from a gas phase. 10:50:46
24 So one would introduce a gas at a very high 10:50:52
25 temperature in a diffusion furnace. These are also 10:50:56

1 called tubes or ovens. They're usually long quartz
2 tubes that a boat of wafers went into, up to 200 at a
3 time, and one would have a boron or phosphorous
4 containing gas that would diffuse into the silicon
5 wafer. They were often called diffusions.

6 Later on, it became more prevalent among
7 the higher technology products to implant dopant ions
8 into the substrate using an ion implanter. When I
9 worked at Applied Materials we sold, for example, ion
10 implanters.

11 Q. And throughout your declaration you used
12 the word, "uniform." Let me know if you need to
13 refer to your declaration, but, just generally, what
14 do you mean by uniform integration of a dopant into a
15 semiconductor material?

16 A. I would have to look at the context of that
17 usage. I recall generally uniform being -- I believe
18 being used in the context of not varying in distance
19 or position, but I would have to look at the actual
20 usage to confirm it.

21 Q. Sure. And let's look at your declaration,
22 Exhibit 2057 for IPR number 468, paragraph 34. When
23 you go into overview of the challenge patent, that
24 will give some context.

25 A. Okay. Are you referring to the use in the

1	first sentence?	10:53:28
2	Q. Yes. I want to get a sense of what you	10:53:28
3	mean with respect to uniform.	10:53:32
4	A. In paragraph 34, I use the phrase, in the	10:53:35
5	second sentence or second line, "spatially uniform	10:53:46
6	concentration of dopants." That phrase means that	10:53:53
7	over a certain space or distance, the concentration	10:54:02
8	-- the number of dopants per volume is essentially	10:54:08
9	constant or uniform.	10:54:15
10	Q. How would you achieve uniform concentration	10:54:18
11	of dopants using diffusion?	10:54:24
12	A. Well, it would depend upon the structure	10:54:27
13	that existed. If there was a barrier, for example,	10:54:50
14	and one diffused dopant into a region from the top,	10:54:55
15	and at the bottom there's a barrier upon which the	10:55:03
16	dopants didn't go past easily, then upon heating for	10:55:06
17	enough time, the concentration in that region would	10:55:14
18	become uniform.	10:55:19
19	I will give a brief analogy. If one puts a	10:55:22
20	drop of ink in a pool on one side, it starts off on	10:55:25
21	one side. Given enough time, the ink will distribute	10:55:31
22	itself uniformly throughout the pool. Obviously, the	10:55:35
23	pool walls are barriers, so it's just limited to that	10:55:38
24	range. If one has a spa in the pool and one puts a	10:55:42
25	drop of ink in the spa then it would just stay in the	10:55:49

1	spa and eventually distribute itself evenly there.	10:55:50
2	It relies on having enough time and	10:55:53
3	temperature. Usually diffusion is exponentially	10:55:57
4	proportional to temperature. The hotter it is, the	10:56:01
5	faster it diffuses. Then, if it's stopped by	10:56:02
6	something, it will just eventually in that region	10:56:07
7	become uniform.	10:56:14
8	Q. And how would you perform uniformity using	10:56:14
9	ion implantation?	10:56:20
10	A. Ion implanters have a lot of adjustable	10:56:21
11	knobs, so to speak, on them. So one can adjust	10:56:27
12	current and one can adjust voltage of the implanted	10:56:30
13	species. Say, for example, Phosphine, a common	10:56:42
14	phosphorous dopant. So if one were to vary the	10:56:46
15	implantation accordingly, one could sequentially dope	10:56:49
16	different depths of the semiconductor. There's	10:56:59
17	generally an annealing or healing process after	10:57:04
18	implantation upon which one heats it, because	10:57:08
19	implantation damages the crystal structure. That	10:57:11
20	also could be used to smooth out any variations in	10:57:18
21	concentration due to implantation.	10:57:24
22	Q. And when you refer to uniformity, are you	10:57:27
23	referring to an absolute, perfect uniformity of	10:57:36
24	dopant concentration within the semiconductor	10:57:40
25	material?	10:57:42

1	MR. WHITEHURST: Object to form.	10:57:43
2	THE WITNESS: I generally don't refer to	10:57:44
3	anything being perfect in any way. A person of	10:57:58
4	ordinary skill of the art would understand that these	10:57:58
5	are processes performed by equipment, and there's	10:58:01
6	limitations as to accuracy. There's also variations	10:58:05
7	that are insignificant in terms of consequence or	10:58:11
8	performance. So I would generally say when I use the	10:58:15
9	term uniform, it's uniform as a person of skill in	10:58:20
10	the art would understand.	10:58:24
11	Q. Okay. So you referred to "annealing." Can	10:58:27
12	you explain that process?	10:58:34
13	A. Yes. Annealing generally means heating	10:58:36
14	with the purpose of fixing the damage to the silicon	10:58:42
15	crystal caused by implantation, and causing some	10:58:51
16	diffusion of dopants in the silicon crystal to smooth	10:58:54
17	out variations. So this annealing is in the context	10:59:02
18	of implantation?	10:59:10
19	Q. And you say "smoothing out variations."	10:59:13
20	When you're referring to smoothing out variations,	10:59:15
21	are you referring to a perfectly smoothing out of	10:59:18
22	variations of dopant to create perfect uniformity?	10:59:22
23	A. I don't presume that anything would be	10:59:27
24	perfectly uniform made by man. When I say make it	10:59:35
25	uniform, I -- or smoothing out, I use it in generally	10:59:40

1	the same way, you know, removing or minimizing	10:59:45
2	variations with position.	10:59:50
3	Q. And when there is a variation of dopant	10:59:52
4	concentration within the semiconductor material, what	10:59:58
5	occurs to an electron, for example?	11:00:01
6	A. If there is a variation in concentration	11:00:12
7	that one thinks of as a gradient, perhaps. It	11:00:19
8	depends. If there is sufficient force from this	11:00:24
9	variation, it may cause an electron to move in the	11:00:32
10	opposite direction of the electric field. So	11:00:34
11	generally if a field is generated a hole will move in	11:00:38
12	the direction of the field. If there is sufficient	11:00:40
13	force exerted an electron will move in the opposite	11:00:44
14	direction of the field.	11:00:51
15	All of this requires, of course, there's	11:00:52
16	variation in dopant concentration creates an electric	11:00:54
17	field that's strong enough to actually move a charge.	11:00:59
18	These are complicated structures of semiconductor	11:01:05
19	devices. So there are a number of counterbalancing	11:01:06
20	and opposing forces in a device that act upon a	11:01:09
21	charge carrier, wherever it is.	11:01:15
22	Q. And I'll ask you about some of those forces	11:01:19
23	in a bit, but with respect to the annealing	11:01:23
24	variations, are the annealing variations in dopant	11:01:31
25	concentrations, would you call them gradients?	11:01:39

1	MR. WHITEHURST: Object to form.	11:01:42
2	THE WITNESS: Let me try to parse that	11:01:45
3	question. You're asking, does the variation in	11:01:47
4	annealing cause -- or are you talking about -- are	11:01:57
5	you assuming that there is a variation in	11:02:02
6	concentration.	11:02:08
7	Q. I'll slow that down because I realize that	11:02:09
8	was a mouthful. You, and please correct me if I'm	11:02:12
9	wrong, but you had testified that there is not	11:02:15
10	perfect uniformity in dopant concentration via	11:02:18
11	implantation, diffusion, and annealing; correct?	11:02:28
12	MR. WHITEHURST: Object to form.	11:02:34
13	THE WITNESS: I believe, as I said	11:02:35
14	generally, I don't presume things are perfectly	11:02:39
15	uniform and that anything made by man would be	11:02:43
16	perfect. Your question, though, is -- yeah. Your	11:02:46
17	question is, am I assuming that it's perfect? My	11:03:00
18	answer would be, no, I don't assume it's perfect.	11:03:03
19	No.	11:03:06
20	Q. And then at the points where there's	11:03:07
21	imperfections, there would be variations in dopant	11:03:12
22	concentrations; correct?	11:03:15
23	MR. WHITEHURST: Object to form.	11:03:17
24	THE WITNESS: I believe I stated this	11:03:18
25	earlier, a person of skill in the art would	11:03:19

1 understand that a dopant concentration can be 11:03:23
2 considered essentially uniform if the effect or 11:03:29
3 impact of any variations is insignificant, without a 11:03:33
4 meaningful effect. The concentration variations that 11:03:42
5 exist for dopants exist over approximately five or 11:03:52
6 six orders of magnitude, a factor of a hundred 11:03:57
7 thousand or a million in variation. So in many 11:04:03
8 cases, what to a lay person may seem like a large 11:04:08
9 change in uniformity actually isn't. It's well 11:04:13
10 within what would be considered a dopant level, and 11:04:15
11 you have to have a significant change for there to be 11:04:20
12 any impact on the device. 11:04:23

13 Q. And is there a dividing line between what 11:04:26
14 you described as a variation and a gradient? 11:04:29

15 MR. WHITEHURST: Object to form. 11:04:35

16 THE WITNESS: I would have to look at the 11:04:40
17 particular scenario, but I give kind of a rough idea 11:04:47
18 of what I'm thinking. There are dopant 11:04:56
19 concentrations that are held at 10 to the 19 atoms 11:04:58
20 per centimeter cubed, and others that might be held 11:05:05
21 at 10 to the 16. That's a thousand times less. 11:05:09

22 So if it was 3 times 10 to the 16 or 4 11:05:17
23 times 10 to the 16, it would be basically noise, 11:05:22
24 difficulty to measure. One might say, "oh. Well, 11:05:26
25 that's a big change. That's a 33 percent change from 11:05:30

1	3 to 4 times 10 to the 16," but the reality is it's a	11:05:33
2	small change relative to something that has an	11:05:36
3	impact. You might need to be 2 or 3 orders of	11:05:39
4	magnitude higher to actually have some impact, or	11:05:42
5	order of magnitude. That's the way I'm thinking of	11:05:48
6	this.	11:05:52
7	Q. And what is a dopant gradient?	11:05:53
8	MR. WHITEHURST: Object to form.	11:06:00
9	THE WITNESS: Well, I'll start with the	11:06:03
10	word gradient. Gradient is a mathematical operator.	11:06:07
11	It refers to the derivative with respect to position	11:06:12
12	or distance. For example, if we have a function, F,	11:06:16
13	the first derivative of the function F with respect	11:06:23
14	to position X, often written DF over DX, that's the	11:06:27
15	first derivative or the gradient. Gradients actually	11:06:34
16	exist in three dimensions, X, Y, and Z. So that's a	11:06:38
17	gradient in a mathematical sense.	11:06:42
18	We look at gradients in concentration	11:06:44
19	essentially the same way. A gradient in a	11:06:50
20	concentration is the change that occurs in a specific	11:06:53
21	direction. For example, the change in the direction	11:06:57
22	of the depth of a semiconductor device would be a	11:07:05
23	common way to look at it.	11:07:09
24	Q. And what is the purpose of introducing a	11:07:12
25	dopant gradient into a semiconductor material?	11:07:21

1	MR. WHITEHURST: Object to form.	11:07:25
2	THE WITNESS: Are you asking me the purpose	11:07:26
3	in the context of the '195 patent?	11:07:34
4	Q. I'm asking in the context of your	11:07:40
5	understanding of as a POSITA as of the filing date of	11:07:43
6	these patents which, I believe, is around 2004.	11:07:52
7	MR. WHITEHURST: Object to form.	11:08:00
8	THE WITNESS: Well, I can answer the	11:08:12
9	question in two ways. One, in the context of the	11:08:16
10	'195 patent or, two, just in a general sense. Are	11:08:18
11	you asking me in a general sense or in the context of	11:08:22
12	the '195 patent family?	11:08:25
13	Q. I guess I'll ask both. First, in the	11:08:27
14	general sense, in the perspective of a POSITA. Why	11:08:31
15	would gradient be introduced into a semiconductor	11:08:39
16	material?	11:08:42
17	MR. WHITEHURST: Object to form.	11:08:43
18	THE WITNESS: In semiconductor devices,	11:08:44
19	there's a certain physical structure. There are	11:08:48
20	features with certain sizes, widths, and depths. So	11:08:53
21	one might be interested in doping, say, for example,	11:08:58
22	a source and drain, and the source and drain are only	11:09:02
23	so wide and so thick. So one would dope the source	11:09:06
24	and drain very heavily, counter dope them to the	11:09:09
25	material that they're embedded in.	11:09:15

1 For example, one might drain an N-type
2 source and drain in a P-type semiconductor. By
3 creating an N-type source and drain with a P-type
4 channel in between it, there is a gradient between
5 the source, the channel, and then another gradient
6 between the channel and the drain. So we're talking
7 about on the surface of a semiconductor device, one
8 has created gradients merely by depositing material
9 there, and that, you know, is the basis of junction
10 science.

11 Semiconductors are sometimes called the
12 junction devices. It's the junction between a P and
13 an N device that creates the magic of a
14 semiconductor. One could say also, well, I've
15 created a P -- an N-type source and drain, so I've
16 created a gradient around it, because it's N and the
17 things around it aren't N. They are, in fact, P or,
18 as I heat it it might diffuse a little bit from the
19 body of the source and drain inadvertently as I
20 perform additional processing on the semiconductor
21 transistor structures.

22 That could also create a gradient, a change
23 in concentration of dopants from the source drain to
24 the surrounding material.

25 Q. And the source itself, would that -- the

1 source region. Would that be at a general uniformity 11:11:13
2 of dopant concentration? 11:11:24

3 MR. WHITEHURST: Object to form. 11:11:26

4 THE WITNESS: I would say the main body of 11:11:27
5 the source drain is substantially uniform. However, 11:11:34
6 the edges of the source drain are going to be 11:11:37
7 touching semiconductors in different concentrations. 11:11:42
8 Specifically, it would be in a P-type substrate or a 11:11:48
9 P-type well. So there would be a gradient between 11:11:51
10 the source drain and the P-well that it's in. 11:11:54

11 There's also a gradient between the edge of 11:11:57
12 the source with the channel. 11:12:02

13 Q. And excluding the source and drain and 11:12:19
14 focusing on, for example, the well itself, in the 11:12:25
15 general sense, why would a POSITA introduce a 11:12:30
16 gradient into -- a dopant gradient into that portion? 11:12:34

17 MR. WHITEHURST: Object to form. 11:12:40

18 THE WITNESS: This is in a general sense, 11:13:08
19 not in the context of the '195 patents? 11:13:10

20 Q. Correct. 11:13:13

21 A. The general purpose of the well is merely 11:13:14
22 to provide somewhere to make a transistor. So for 11:13:18
23 example, an NMOS device is made in a P-well. So the 11:13:26
24 purpose is to have sources and drains that are 11:13:32
25 electrically isolated around them with a P-type 11:13:36

1 channel between them. So there isn't necessarily a 11:13:41
2 reason for a typical P-type well to be graded in its 11:13:48
3 concentration in order to form an NMOS device. 11:13:57

4 The channel itself between the source and 11:14:02
5 the drain has some complex doping that goes on 11:14:06
6 sometimes in order to set the threshold voltage. 11:14:10
7 Meaning, the voltage required to turn on and off the 11:14:16
8 transistor. Say, for example, one-and-a-half volts. 11:14:19
9 So there is some doping done in the channel region to 11:14:24
10 fix the threshold voltage, but generally the well as 11:14:27
11 a whole is just there at a general doping level to 11:14:31
12 provide a P background to form the NMOS device. 11:14:36

13 Q. So if I understand it, are you stating that 11:14:40
14 the P-well would be uniformly doped in -- 11:14:43

15 MR. WHITEHURST: Object to form. 11:14:49

16 THE WITNESS: I would say in a general 11:14:55
17 sense, the region around the transistor is simply 11:14:56
18 there to provide a P-type structure, a silicon 11:15:08
19 crystal, in order to form the transistor. 11:15:15

20 Q. Okay. And is it from the perspective of a 11:15:21
21 POSITA in 2004, would the well always be uniformly 11:15:35
22 doped? 11:15:41

23 MR. WHITEHURST: Object to form. 11:15:45

24 Q. From the perspective of a POSITA in 2004, 11:15:47
25 would the well region always be uniformly doped? 11:15:53

1	MR. WHITEHURST: Object to form.	11:15:56
2	THE WITNESS: I think, as I stated	11:16:06
3	previously, the general concern for the well was that	11:16:08
4	it exists as an opposing type of silicon material in	11:16:13
5	order to form a transistor. Now, wells are made	11:16:20
6	before transistors. So the wells exist, and the	11:16:24
7	wells can be exposed to as much annealing as one	11:16:29
8	wishes because there's no structure to damage yet.	11:16:33
9	So implanted or doped wells are annealed	11:16:36
10	reasonably well, and the transistors could be formed	11:16:44
11	in the subsequent processing. The main concern, as I	11:16:47
12	said, is simply that the area in the vicinity of the	11:16:50
13	transistor be sufficient in order to make the source	11:16:53
14	drain to channel.	11:16:59
15	Q. Okay. Let me ask in context of -- well, if	11:17:00
16	you can look at the '195 patent, please. What was	11:17:06
17	the purpose of introducing a gradient to the	11:17:27
18	semiconductor dopant -- let me start over. What was	11:17:30
19	the purpose of introducing a dopant gradient into the	11:17:35
20	semiconductor material in the '195 patent?	11:17:41
21	MR. WHITEHURST: Object to form.	11:17:44
22	THE WITNESS: There are different examples,	11:17:47
23	different types of structures described that have	11:17:52
24	different benefits from this. One type of example	11:17:54
25	would be a CMOS device. So a CMOS device requires	11:18:04

1	that -- actually, let's talk about a specific one.	11:18:18
2	An NMOS device in a CMOS structure -- an NMOS device	11:18:25
3	has electrons in the source and drain. In order for	11:18:35
4	the device to function, electrons have to maneuver	11:18:40
5	from the source and drain. So the channel has to be	11:18:43
6	enriched with electrons between the source and drain,	11:18:49
7	and depleted of holes.	11:18:54
8	So let me see if I can cite something from	11:18:57
9	the patent. So at column 3, line 41, the patent	11:19:07
10	states, quote, "The graded dopant can also be	11:19:28
11	implemented in a surface channel MOS device to	11:19:39
12	accelerate majority characters toward the drain."	11:19:43
13	End quote.	11:19:48
14	It goes on to describe advantages in	11:19:48
15	non-volatile devices such as memory flash. So	11:19:52
16	basically, in order to get this transistor to turn on	11:19:57
17	faster, one needs to be able to have more electrons	11:20:01
18	and fewer holes, and the channel in the graded dopant	11:20:06
19	profile aids in that effort.	11:20:12
20	Q. What's your understanding of an alpha ray	11:20:20
21	and its effect on a semiconductor material?	11:20:27
22	MR. WHITEHURST: Object to form.	11:20:29
23	THE WITNESS: Alpha rays and alpha	11:20:31
24	particles are essentially synonymous. An alpha	11:20:40
25	particle, alpha ray is something typically on the	11:20:45

1 order of three megavolts or greater. For example, a 11:20:48
2 helium atom with electrons stripped off, basically 11:20:53
3 two neutrons and two protons, runs about 2.8 11:20:57
4 megavolts. So these are -- you know, these are alpha 11:20:59
5 particles that are being used. I've used these for 11:21:07
6 probing materials. 11:21:11

7 They also come from the sun. The sun gives 11:21:12
8 off alpha rays that actually make -- very few, but 11:21:14
9 some do make it through the atmosphere. When these 11:21:18
10 impact silicon, they travel a certain distance. 11:21:22
11 Eventually, they will impact and interact with atoms 11:21:32
12 and release electrons. 11:21:37

13 Q. And what portions of a semiconductor device 11:21:43
14 do alpha rays hit? 11:21:48

15 MR. WHITEHURST: Object to form. 11:21:50

16 THE WITNESS: I'll use, just for quick 11:21:57
17 reference since I have it open, Figure 5B from the 11:22:05
18 '195 patent. If we look at Figure 5B, we see 11:22:11
19 something called "substrate." Typically substrate or 11:22:16
20 silicon wafers are around 525 microns thick. Half a 11:22:22
21 millimeter, roughly. A human hair is 60 to 100 11:22:29
22 microns. Something on the order of 10 human hairs. 11:22:36

23 We look at the top portion where the 11:22:40
24 transistors are, that's usually a few microns. So 11:22:43
25 right off the bath, 99.5 percent of a silicon device 11:22:46

1 is substrate. So even if there were uniform 11:22:52
2 absorbing, which there isn't, 99.5 percent of the 11:23:01
3 volume is substrate for a device. However, these are 11:23:06
4 very energetic particles, so they have to penetrate a 11:23:09
5 certain distance before they're actually going to 11:23:13
6 interact. The probability of interaction with atoms 11:23:17
7 is fairly low. The crystal is largely nothing. It's 11:23:21
8 largely space. 11:23:26

9 So in order for an alpha particle or an 11:23:28
10 alpha ray to interact, it has to get a certain depth 11:23:34
11 in. So a very small fraction of the alpha particles 11:23:36
12 or rays are going to interact anywhere near the 11:23:43
13 surface. Most of it is going to be in the substrate. 11:23:49

14 Q. Referring to Figure 5B, where it identifies 11:23:52
15 the substrate, what is your basis for stating that 11:23:56
16 the substrate composes -- I believe you said 11:24:01
17 99.5 percent of the volume of the device? 11:24:07

18 A. Well, I've worked in semiconductor 11:24:10
19 processing for 37 years now. I've bought and used 11:24:12
20 and handled numerous silicon wafers. For -- silicon 11:24:19
21 wafers came in standard sizes in terms of diameter. 11:24:25
22 Initially, they were 1 inch, 2 inch, 3 inch, 4 inch, 11:24:31
23 5 inch, 6, 8, 12. We use millimeters now, but just 11:24:38
24 for ease of reference. And they all had certain 11:24:45
25 thicknesses. 11:24:49

1 More recently, wafers have been thinned a 11:24:49
2 bit. But in order for processing and equipment to be 11:24:52
3 able to handle wafers, they were of well-known size 11:24:56
4 and shape. So 525 microns was pretty standard for a 11:25:02
5 long, long time for wafer thicknesses. 11:25:13

6 Q. And is that information in the '195 patent? 11:25:17

7 MR. WHITEHURST: Object to form. 11:25:26

8 THE WITNESS: You mean wafer dimensions? 11:25:31

9 Q. Yes. 11:25:34

10 A. I don't recall seeing standards for wafer 11:25:41
11 dimensions in the '195 patent, or references thereof. 11:25:44
12 This is something that a person of skill in the art 11:25:47
13 would understand. 11:25:50

14 Q. Is the '195, '502, or '222 patents -- do 11:25:52
15 any of them have sizing restrictions for the 11:25:59
16 substrate? 11:26:02

17 MR. WHITEHURST: Object to form. 11:26:07

18 THE WITNESS: Well, if I read the field of 11:26:29
19 the invention, it describes it as semiconductor 11:26:31
20 devices and systems. So I think a person of skill in 11:26:34
21 the art reading this would understand that this 11:26:38
22 relates to semiconductor processing, which is, you 11:26:41
23 know, performed on wafers. Obviously, the substrate 11:26:45
24 upon which processing is formed must be of sufficient 11:27:03
25 mechanical robustness in order to survive the 11:27:06

1 processing and processing equipment handling. 11:27:14

2 Anything less than 50 microns in silicon 11:27:19
3 sort of will roll up like paper. Wafers and 11:27:25
4 processing need to have flat substrates to function. 11:27:32
5 The lithography is immensely difficult and of very 11:27:36
6 fine resolution. 11:27:43

7 Q. Beyond that general understanding, do the 11:27:48
8 '195, '502, or '222 patents provide any specific 11:27:52
9 limitations to the substrate size? 11:27:57

10 MR. WHITEHURST: Object to form. 11:28:01

11 THE WITNESS: If you're asking me if there 11:28:02
12 are claim limitations for the substrate size, I would 11:28:18
13 have to review it for that. I don't recall seeing it 11:28:20
14 in the claims in suit. 11:28:23

15 Q. Do you recall the specification of the 11:28:25
16 '195, '502, or '222 patents providing any specific 11:28:29
17 limitations to the substrate size, or any specific 11:28:33
18 description of the substrate size? 11:28:38

19 MR. WHITEHURST: Object to form. 11:28:42

20 THE WITNESS: When reading the 11:28:43
21 specification for the '195 patent family, I note that 11:29:13
22 it does refer to substrates and general semiconductor 11:29:19
23 processing. I understand that a person of skill in 11:29:25
24 the art would understand that the processes described 11:29:30
25 herein would need to be viably performed upon the 11:29:33

1	substrate. So it would have to at least be stiff	11:29:38
2	enough to function as a substrate in semiconductor	11:29:42
3	devices.	11:29:48
4	Q. Are you familiar with the term punch	11:29:49
5	through breakdown voltage?	11:29:57
6	A. Generally.	11:30:00
7	Q. And what is it?	11:30:09
8	A. There is a voltage beyond which current	11:30:11
9	will not be stopped, basically. Undesired current	11:30:24
10	flow will occur.	11:30:31
11	Q. When would undesired current flow in a	11:30:34
12	semiconductor device?	11:30:40
13	A. Well, in semiconductor devices, the main	11:30:51
14	area of undesired current flow that usually one is	11:30:54
15	concerned with is across a transistor. A transistor	11:30:58
16	should be off when it's off and on when it's on, at	11:31:02
17	least in a CMOS type device. So when the potential	11:31:06
18	between the source and the drain cause a channel to	11:31:21
19	start passing current in an undesired way, that would	11:31:24
20	be a current of concern.	11:31:30
21	Beyond that, you're going to have to give	11:31:32
22	me a little more in your hypothetical.	11:31:34
23	Q. In your experience, have you ever dealt	11:31:36
24	with lessening a punch through break down voltage?	11:31:43
25	A. Well, what I often work with is optimizing	11:31:48

1 equipment and processes for the people designing the 11:31:54
2 chips to deal with this sort of problem. So 11:31:57
3 basically, as the geometry of the chips shrink, punch 11:31:59
4 through becomes more of a problem, so one needs to 11:32:06
5 increase the quality of the materials and films that 11:32:10
6 are being deposited oftentimes to minimize problems 11:32:12
7 like this. 11:32:17

8 So we would work with, you know, the large 11:32:17
9 teams that work on this together to enhance 11:32:22
10 properties. 11:32:25

11 Q. And what properties would be enhanced? 11:32:27

12 A. Well, it just depends very much upon the 11:32:34
13 scenario, what was causing the punch through problem. 11:32:37
14 Was it related to contamination level, a background 11:32:40
15 level of something in the film that was leading to 11:32:47
16 this? It could vary depending upon the scenario. 11:32:49

17 Q. What is latch up resistance? 11:32:54

18 A. Latch up is when something sort of turns 11:33:03
19 itself on and latches when it shouldn't. So the 11:33:08
20 ability for a circuit not to inadvertently engage 11:33:11
21 itself and the resistance thereto. 11:33:20

22 Q. How does a circuit inadvertently engage 11:33:24
23 itself? 11:33:28

24 A. Well, sometimes if there's a current leak 11:33:29
25 and a current starts flowing, it's sort of like an 11:33:32

1	avalanche effect. And then the device turns on and	11:33:39
2	then there's usually a breakdown.	11:33:43
3	Q. And with current, it's a general flow of	11:33:48
4	electrons; correct?	11:33:53
5	A. Yeah. When I say current, I -- one could	11:33:54
6	think of it as a flow of electrons. One could think	11:33:58
7	of it as a flow of holes. That's how one could think	11:34:02
8	of it. Electrons and holes are opposite charge	11:34:06
9	carriers.	11:34:33
10	Q. I guess while we're on it, what's a	11:34:45
11	minority carrier?	11:34:48
12	A. Well, you know, it depends on the context	11:34:54
13	of what we're looking at. But there's a minority	11:34:58
14	carrier as opposed to majority carrier. As I cited	11:35:02
15	to at the '195 patent in column 3, it describes at	11:35:06
16	341, quote, "The graded dopant can also be	11:35:15
17	implemented in surface channel of MOS devices to	11:35:18
18	accelerate majority carriers towards the drain." End	11:35:24
19	quote.	11:35:28
20	So in a MOS device, the majority carrier is	11:35:29
21	the electron if it's an NMOS device. Column 1 also,	11:35:32
22	for example, describes that at column 1, line 43, "In	11:35:39
23	contrast to BJTs MOS device is a majority carrier	11:35:52
24	device for conduction. The conduction is channel	11:35:56
25	dominated." End quote.	11:36:00

1 So basically in a MOS device, the majority 11:36:02
2 carrier in an NMOS device would be electrons. 11:36:06
3 Electrons flow from an N-type source to an N-type 11:36:12
4 drain. 11:36:17

5 Minority carriers would be the holes. So 11:36:17
6 when one applies voltage to the gate which sits on 11:36:21
7 top of the channel, one inverts the layers so that 11:36:25
8 holes are -- a positive voltage pushes holes away 11:36:29
9 from the surface and attracts electrons to the 11:36:34
10 surface. That way, there is a connection between the 11:36:37
11 source and drain which have electrons, and now the 11:36:40
12 channel has electrons, and the carriers are that 11:36:44
13 majority carrier -- excuse me, the electrons in that 11:36:48
14 channel are the majority carrier, and the P -- the 11:36:52
15 holes represented by the symbol P are pushed away, 11:36:56
16 and those are the minority carriers. 11:37:03

17 Q. I guess, referring to the '195 patent at 11:37:06
18 column 3, lines 1 through 6, if you could look at 11:37:13
19 that briefly, please. 11:37:17

20 A. Sure. Okay. I've reviewed it. 11:37:19

21 Q. This section references a drift region. 11:37:44
22 How is the drift region created? 11:37:55

23 MR. WHITEHURST: Object to form. 11:38:02

24 THE WITNESS: Well, lines 1 through 6 11:38:08
25 describe different layers of dopant regions for wafer 11:38:54

1 to wafer bonding. This is an IGBT device, insulated
2 gate bipolar transistor. It's very different than an
3 NMOS or PMOS that we've been discussing. I don't
4 think there's any IGBT prior art that's been put
5 forward in this matter. So this is something that I
6 don't think anybody would review in much detail. It
7 does describe a bonding.

8 Q. But I guess my question is more general.
9 How does the '195 patent describe creating a drift
10 region?

11 MR. WHITEHURST: Object to form.

12 THE WITNESS: Well, this patent that you've
13 described or you've asked me to look at, just
14 describes bonding of different materials. It says,
15 "Different layers of dopant regions can be
16 transferred through wafer to wafer bonding or other
17 similar transfer mechanisms for eventual device
18 fabrication."

19 That's all that I see in this passage.

20 Q. Do you view drift region as different than
21 a drift field? To give you context, you can look at
22 column 3, lines 30 to 35.

23 MR. WHITEHURST: Object to form.

24 THE WITNESS: When I hear the word "field,"
25 I think electrical field. When I hear the word

1	"region," I think of space. You know, a volume. So	11:41:34
2	I would say in a general sense, that's how I would	11:41:39
3	understand those terms.	11:41:42
4	Q. And column 3, lines 30 to 35 of the 15	11:41:46
5	patent, how does it describe creating a drift field	11:41:51
6	to sweep unwanted minority carriers into the	11:41:56
7	substrate?	11:42:00
8	MR. WHITEHURST: Object to form.	11:42:14
9	THE WITNESS: Column 3, line 33 describes	11:42:16
10	in a preferred embodiment, the sub train N-layer has	11:42:30
11	a graded donor concentration to sweep the minority	11:42:37
12	carriers deep into the substrate. It goes on to	11:42:42
13	describe one or more such layers can be implemented	11:42:45
14	through wafer to wafer bonding or through transfer	11:42:50
15	mechanisms.	11:42:55
16	Q. The '195 patent references a graded donor	11:42:55
17	concentration in the subterranean N-type layer;	11:43:01
18	right?	11:43:05
19	A. Generally, yes. Column 3 in 33 describes,	11:43:06
20	quote, the subterranean N-layer has a graded donor	11:43:15
21	concentration. This is in the context, I think, of	11:43:19
22	some different types of circuits but, yes.	11:43:26
23	Q. And how does the '195 teach its graded	11:43:33
24	donor concentration in the layer?	11:43:38
25	MR. WHITEHURST: Object to form.	11:43:42

1	THE WITNESS: In this particular preferred	11:43:56
2	embodiment that we were discussing, I quote 3, lines	11:43:58
3	1 through 35, the '195 patent teaches a subterranean	11:44:05
4	N-layer with a graded donor concentration.	11:44:13
5	Q. How does the donor concentration implanted	11:44:20
6	within -- let me start over. What process is used to	11:44:29
7	implant the dopants to create the graded donor	11:44:33
8	concentration?	11:44:40
9	A. You're using the word "implant," but	11:44:45
10	implant is a specific process. So your question is	11:44:50
11	confusing me.	11:44:52
12	Q. Okay. How is the graded dopant -- graded	11:44:53
13	donor concentration introduced into the subterranean	11:45:00
14	N-layer as described in the '195 patent?	11:45:07
15	A. In this paragraph at column 1 -- excuse me,	11:45:11
16	column 3, roughly in the area of lines 30 through 49,	11:45:17
17	it describes a couple of methods.	11:45:25
18	Q. Can you describe them?	11:45:27
19	MR. WHITEHURST: Sorry, I don't mean to	11:45:29
20	interrupt. But counsel, we have been going for a	11:45:31
21	while. I don't know if you're reaching a good break	11:45:33
22	point, but if you are, we would appreciate it. I	11:45:38
23	don't want to interrupt your questions.	11:45:42
24	MR. BOMBACH: No. We can pick up -- yeah.	11:45:44
25	We can take a break. We can pick up when -- let's go	11:45:47

1	off the record.	11:45:52
2	VIDEOGRAPHER: All right. We're going off	11:45:52
3	the record now at 11:45.	11:45:54
4	(Recess taken.)	11:45:57
5	VIDEOGRAPHER: We're back on the record at	11:59:50
6	11:59.	11:59:58
7	Q. Dr. Glew, during the break did you speak	11:59:59
8	about the substance of your testimony with anybody?	12:00:02
9	A. No.	12:00:06
10	Q. Returning back to the '195 patent, it's --	12:00:07
11	how is a graded donor concentration introduced into	12:00:20
12	the subterranean N-layer as a POSITA would understand	12:00:26
13	by looking at the '195 patent?	12:00:32
14	A. Prior to the break we were looking	12:00:40
15	specifically at column 3, the paragraph starting at	12:00:42
16	line 14. There are a number of examples given here.	12:00:47
17	It describes, quote, at line 330, "Hence, a novel	12:01:02
18	technique has been described." So forth and so on.	12:01:08
19	End quote.	12:01:12
20	It says at 35, one or more such layers can	12:01:15
21	also be implemented through wafer to wafer bonding or	12:01:19
22	similar transfer mechanisms. That was at column 3,	12:01:23
23	line 35. So that is where one literally takes thin	12:01:27
24	layers and heats them up together and bonds them	12:01:33
25	together. That's known as bonding. It describes at	12:01:36

1	approximately line 35 or 37, excuse me, quote, "This	12:01:43
2	N-layer can be a deeply implanted layer. It can also	12:01:49
3	be an epitaxial layer."	12:01:53
4	It describes implantation and epi to do	12:01:56
5	this. It also describes at roughly 38, quote, "The	12:02:03
6	N-well and P-well can also be graded or retrograded	12:02:08
7	in dopants as desired." End quote.	12:02:12
8	Q. And how would the -- strike that. How	12:02:18
9	would a POSITA understand the implantation process to	12:03:02
10	be implemented to introduce a graded donor	12:03:07
11	concentration into the semiconductor layer?	12:03:10
12	A. A person of skill in the art would	12:03:25
13	understand ion implantation has as variables, depth	12:03:27
14	and concentration. Essentially, implanters have a	12:03:41
15	voltage and a current of implantation. So the	12:03:47
16	voltage is going to determine how deeply something	12:03:51
17	implants, and the current determines how much. So by	12:03:55
18	adjusting voltage of current of the implanter, one	12:04:01
19	adjusts depth and concentration of the implant.	12:04:06
20	Q. And looking at the '195 patent, from the	12:04:10
21	perspective of a POSITA, they would understand how to	12:04:19
22	create a graded donor concentration in a layer via	12:04:24
23	implantation?	12:04:30
24	A. I believe a person of skill of the art who	12:04:40
25	understands implantation would understand how to	12:04:45

1	control the implant for both depth and concentration.	12:04:48
2	As I stated previously, the implant voltage and the	12:04:54
3	implant current will determine respectively the depth	12:05:03
4	and the number of ions that are implanted. The ions	12:05:07
5	are the buildings.	12:05:13
6	Q. Do you consider yourself a POSITA as of the	12:05:16
7	time of filing of the '195 patent? Rather, strike	12:05:21
8	that. Were you a POSITA as of the time of filing the	12:05:26
9	'195 patent?	12:05:29
10	A. Yes.	12:05:31
11	Q. When the '195 patent was filed in	12:05:32
12	September 2004, was this the first time -- have you	12:05:42
13	heard of using ion implantation to create a graded	12:05:45
14	donor concentration?	12:05:51
15	MR. WHITEHURST: Object to form.	12:05:54
16	THE WITNESS: I worked at Applied Materials	12:05:56
17	from 1987 to 1997 and we sold ion implanters. So I	12:06:03
18	was very familiar with implantation parameters. So I	12:06:13
19	understood that one could select the depth and the	12:06:25
20	current, or the depth and the number of ions/dopants	12:06:28
21	that were implanted. For example, if one uses	12:06:35
22	phosphine as a phosphorous dopant, one ionizes	12:06:45
23	phosphorous. So the electron has a charge and then	12:06:49
24	one puts a certain voltage on it, say, 15000 volts.	12:06:54
25	That would determine how deep it goes.	12:06:59

1 There are high voltage implanters. There
2 are high current implanters. Depending on whether
3 one has a very heavy dosage to implant or wants to
4 implant very deeply. There are medium current
5 implanters. So yes, these were parameters that I was
6 familiar with and I think a POSITA would be familiar
7 with. How to create a dopant profile.

8 Q. Prior to 2004 -- strike that. Prior to
9 September 2004, as a POSITA you would have understood
10 how to create a graded dopant concentration in a
11 semiconductor layer; correct?

12 A. I think prior to 2004, a POSITA would have
13 understood how to create a desired profile with an
14 implanter. Implanters were commercially available
15 devices that one used to implant a certain number of
16 dopants to a certain depth. One, for example, would
17 create a retrograde dopant profiles where it was --
18 the concentration was greater below the surface than
19 at the surface.

20 So this type of thing was understood.

21 Q. And a graded concentration would also be
22 understood; correct?

23 A. I think the very general concept of graded
24 concentrations was understood. That's different than
25 particular benefits associated with it as described

1	in the '195 patent. But I think the general concept	12:09:37
2	of dopant profiles being graded or non-uniform was	12:09:41
3	understood.	12:09:48
4	Q. Did you have any experience prior to 2004,	12:09:51
5	September, in creating graded dopant profiles in a	12:09:57
6	semiconductor layer?	12:10:02
7	A. I would characterize it that prior to 2004	12:10:22
8	my experience with implantation was such that one	12:10:27
9	would understand that profiles could be non-uniform,	12:10:31
10	could be graded. For example, as I mentioned	12:10:44
11	previously, retrograde implantations were common	12:10:47
12	where the concentration was greater below the	12:10:53
13	surface. The ions didn't stop at the surface. They	12:10:56
14	would keep going and eventually the silicon had	12:11:01
15	enough stopping power to stop the ions.	12:11:04
16	They would accumulate at a distance below	12:11:08
17	the surface. It resulted in non-uniform and the	12:11:11
18	graded dopant profiles. This is a similar concept to	12:11:15
19	alpha particles not stopping at the surface.	12:11:19
20	Eventually, something has to stop a particle or ion.	12:11:21
21	And so retrograded implantations were well	12:11:25
22	understood.	12:11:32
23	Q. Why were retrograded implantations	12:11:33
24	introduced into a layer from your understanding as a	12:11:43
25	POSITA in 2004?	12:11:47

1	MR. WHITEHURST: Object.	12:11:48
2	THE WITNESS: There are different reasons	12:11:50
3	depending on where in the semiconductor device the	12:11:58
4	implantation is being done. There are sources and	12:12:00
5	drains which are very different than channels.	12:12:09
6	Channels in a horizontal current motion required a	12:12:18
7	lot of finesse. So there would be reasons to try to	12:12:33
8	create a density at the lower portion of the channel	12:12:42
9	so that it was thick enough.	12:12:52
10	Q. Were retrograde dopant profiles introduced	12:12:55
11	into layers to control the flow of minority carriers,	12:12:59
12	as your understanding of a POSITA in 2004?	12:13:07
13	MR. WHITEHURST: Object to form.	12:13:10
14	THE WITNESS: Can you repeat the question?	12:13:12
15	Q. Yeah. Were retrograde dopant profiles	12:14:22
16	introduced into layers to control the flow of	12:14:26
17	minority carriers, as of your understanding of a	12:14:28
18	POSITA in 2004?	12:14:32
19	MR. WHITEHURST: Object to form.	12:14:34
20	THE WITNESS: The patent describes in the	12:14:35
21	background retrograde at column 1, line 64.	12:14:41
22	"Retrograde and halo wells have also been attempted	12:14:51
23	to improve refresh times in DRAM's access memories,	12:14:54
24	as well as reducing dark current of background noise	12:15:00
25	and enhance RGB, red, green, blue, color resolution	12:15:05

1 in digital camera ICs." Most of these techniques 12:15:11
2 either divert the minority carriers away from the 12:15:16
3 active region of charge storage nodes in the surface, 12:15:18
4 or increase minority carrier density as the 12:15:22
5 particular application requires." End quote. 12:15:24

6 So the background mentioned describes 12:15:28
7 retrograde and halo implants. Accordingly, halo is a 12:15:32
8 high angle, low depth. So it kind of -- you might 12:15:40
9 think of it as an implant coming in from the side. 12:15:47

10 Q. I get -- but my question is more specific 12:15:51
11 to your understanding as a POSITA in 2004, and your 12:15:55
12 understanding with respect to retrograde dopant 12:15:59
13 profiles. From that perspective, were retrograde 12:16:02
14 dopant profiles introduced into layers to control the 12:16:07
15 flow of minority carriers? 12:16:10

16 MR. WHITEHURST: Same objection. 12:16:12

17 THE WITNESS: How are you using the term 12:16:31
18 "flow of minority carriers"? 12:16:34

19 Q. How would you understand the flow of 12:16:37
20 minority carriers? 12:16:39

21 A. I don't understand how you're using it. 12:16:41

22 Q. You understand what a flow means; right? 12:16:44

23 A. I understand flow of carriers generally as 12:16:53
24 current flow. 12:16:57

25 Q. Prior, you said flow of electrons or holes 12:17:01

1	dependent upon the material; correct?	12:17:06
2	A. Yes, generally. Yes, of course.	12:17:08
3	Q. And from your perspective as a POSITA in	12:17:11
4	2004, were retrograde dopant profiles used to control	12:17:15
5	the flow of electrons or holes in a semiconductor	12:17:25
6	material?	12:17:31
7	MR. WHITEHURST: Object to form.	12:17:33
8	THE WITNESS: As I stated, I have the	12:17:40
9	understanding that the patent discloses retrograde	12:17:44
10	and halo dopant profiles to be used, for example, "To	12:17:48
11	divert the minority carriers away from the active	12:18:03
12	regions of critical charge storage at the surface."	12:18:18
13	End quote.	12:18:30
14	So the patent discloses this. It's my	12:18:31
15	understanding as a POSITA that they were used for	12:18:34
16	storage nodes.	12:18:41
17	Storage nodes would typically be, for	12:18:44
18	example, capacitors in DRAM circuits. That it was	12:18:47
19	used to -- used for those purposes, at least.	12:18:58
20	Q. And from your perspective as a POSITA in	12:19:03
21	2004 prior to the '195 patent's filing, were graded	12:19:08
22	dopant concentrations used to control the flow of	12:19:15
23	electrons or holes in a semiconductor material?	12:19:20
24	MR. WHITEHURST: Object to form.	12:19:26
25	THE WITNESS: The '195 patent also	12:19:27

1	describes at column 1, lines 34 roughly, quote,	12:20:10
2	"Efforts have been made in graded based transistors	12:20:22
3	to create an aiding drift field to enhance the	12:20:28
4	diffusing minority carrier's speed from emitter to	12:20:32
5	collector." End quote.	12:20:37
6	So I understand there was also work done	12:20:42
7	for -- bipolar junction transistors as it describes	12:20:45
8	in the sentence prior to this for that purpose of	12:20:53
9	enhancing the diffusion of minority carrier's speed.	12:21:01
10	Q. So if I understand correctly you're	12:21:43
11	stating, before the '195 patent, a POSITA would not	12:21:50
12	have known that a graded dopant profile was used to	12:21:59
13	control the flow of electrons or holes; is that	12:22:06
14	correct?	12:22:14
15	MR. WHITEHURST: Object to form.	12:22:14
16	THE WITNESS: I'm sorry. Your question	12:22:20
17	seems to have changed. You asked me about carriers,	12:22:22
18	but now you're talking about holes specifically?	12:22:26
19	Q. Oh. Carriers. Electrons or holes.	12:22:28
20	MR. WHITEHURST: Counsel, it was a	12:22:36
21	confusing question. Can you --	12:22:38
22	MR. BOMBACH: Yeah. I'll ask the	12:22:41
23	questions. I want to have a clean record.	12:22:46
24	Q. As I understand your testimony, you're	12:22:48
25	saying that a -- prior to the filing of the '195	12:22:53

1 patent, a graded dopant -- it was unknown that a 12:22:57
2 graded dopant concentration -- it was not known that 12:23:03
3 a graded dopant concentration would be used to 12:23:09
4 control the flow of electrons or holes; is that 12:23:12
5 correct? 12:23:20

6 MR. WHITEHURST: Object to form. 12:23:20

7 THE WITNESS: I gave two examples from the 12:23:21
8 specification of the background of the specification, 12:23:35
9 listing applications, I think, of graded fields 12:23:44
10 enhancing minority carriers. 12:23:53

11 Q. And when you say "enhancing minority 12:23:59
12 carriers," what do you mean? 12:24:01

13 A. Well, at column 1, line 35 uses the 12:24:03
14 language, in the '195 patent, quote, "To enhance the 12:24:14
15 diffusing minority carrier's speed from emitter to 12:24:22
16 collector." End quote. 12:24:25

17 So enhancing the speed of carriers is to 12:24:27
18 increase the current flow. 12:24:34

19 Q. And "increase the current flow" just means 12:24:42
20 -- rather, strike that. By "increase the current 12:24:52
21 flow," do you mean increasing the flow of electrons 12:24:56
22 or holes? 12:24:58

23 MR. WHITEHURST: Object to form. 12:25:00

24 THE WITNESS: This describes them as 12:25:03
25 minority carriers, not whether they are electrons or 12:25:06

1	holes, but I presume that it's obviously at least one	12:25:15
2	or the other. Yes.	12:25:22
3	Q. And let me -- give me one second. If you	12:25:23
4	could please look at column 2, lines 35 to 50, just	12:25:39
5	to give you some context for some of the questions.	12:25:46
6	If you could take a second just to reacquaint	12:25:49
7	yourself with that.	12:25:52
8	A. You want me to read the paragraph starting	12:25:53
9	at 35?	12:25:56
10	Q. Yeah, to yourself. Just to reacquaint	12:25:58
11	yourself. I understand we don't have photographic	12:26:01
12	memory of everything.	12:26:04
13	A. Okay. I've reviewed that.	12:27:12
14	Q. I want to focus you more particularly on	12:27:14
15	column 2, lines 42 to 44 where it states, "The	12:27:17
16	relative slope of a donor concentration throughout	12:27:23
17	the base creates a suitable electric heating	12:27:28
18	adrift" -- well, I may have misspoke. "Creates a	12:27:32
19	suitable aiding drift electric field."	12:27:36
20	Do you see that?	12:27:39
21	A. I see that, yes.	12:27:40
22	Q. Do you agree with -- actually, I cut it	12:27:41
23	off. Do you agree with the full statement and	12:27:46
24	disclosure on column 2, lines 42 to 45, that the	12:27:50
25	relative slope creates a suitable electric --	12:27:55

1	suitable aiding drift electric field to help holes	12:27:59
2	transverse?	12:28:05
3	MR. WHITEHURST: Object to form.	12:28:07
4	THE WITNESS: The way I understand that	12:28:17
5	sentence to read is essentially that there needs to	12:28:22
6	be a suitable relative slope -- a sufficient relative	12:28:25
7	slope to be suitable for aiding drift -- to aid the	12:28:33
8	drift electric field to help holes move between	12:28:38
9	emitter and collector.	12:28:46
10	Q. I want to provide some context for some of	12:28:51
11	the questions that I'm going to ask. Let me -- give	12:28:53
12	me one second. I don't want to take any of your	12:29:02
13	statements out of context. I just want to refer to	12:29:15
14	it.	12:29:18
15	If you could turn to your declaration 2057	12:29:52
16	in the 468 proceeding, in paragraph 56 you list	12:29:57
17	several forces including temperature capacitance	12:30:06
18	effects of PN junction imperfections and the inherent	12:30:12
19	resistance of silicon. With the listing of those	12:30:21
20	forces that you referenced, are any of them described	12:30:57
21	in the '195 patent as a factor that would affect the	12:31:00
22	minority carrier movement?	12:31:06
23	MR. WHITEHURST: Object to form.	12:31:09
24	THE WITNESS: I have some things in mind	12:32:28
25	here. The language at column 2, line 40, describes a	12:32:30

1 relative slope. So there is -- it is understood that 12:32:44
2 the slope is important. At column 2, lines 56 12:32:49
3 through 58, it describes, quote, "The average base 12:33:03
4 resistance is optimized so that conductivity and 12:33:11
5 modulation and lifetime for minority carriers in the 12:33:15
6 base region are not compromised." End quote. 12:33:20

7 So a POSITA would understand that, for 12:33:25
8 example, resistance is a problem when it's too great, 12:33:28
9 and the patent describes, for example, that 12:33:33
10 resistance is potentially an issue for conductivity 12:33:35
11 and carrier lifetime, and it could compromise those. 12:33:42
12 That would be one example from the specification. 12:33:51

13 Q. Outside of column 2, lines 56 to 58, is 12:33:54
14 resistance mentioned anywhere else? 12:33:59

15 MR. WHITEHURST: Object to form. 12:34:03

16 THE WITNESS: As I sit here right now, I 12:34:04
17 don't see other mentions of resistance. 12:35:25

18 MR. WHITEHURST: Were you done answering 12:35:37
19 the question? 12:35:39

20 THE WITNESS: Yes. 12:35:45

21 Q. Does the '195 patent describe how to 12:35:45
22 calculate a suitable relative slope of donor 12:35:52
23 concentration? 12:35:56

24 A. Well, it isn't necessary that one calculate 12:36:20
25 a suitable donor slope. One could also measure a 12:36:24

1 suitable donor slope. A POSITA would understand that 12:36:33
2 the relative slope would depend upon the transistor 12:36:36
3 in which the slope existed. The slope in the dopant 12:36:40
4 concentration gradient. 12:36:50

5 Q. At what point does a relative slope go from 12:36:54
6 suitable to control the flow of minority carriers to 12:36:57
7 unsuitable to control the flow of minority carriers? 12:37:06

8 A. Well, in this example given at column 2, in 12:37:20
9 the paragraph starting at line 35 it describes that 12:37:26
10 there is an improvement in the current gain. It 12:37:32
11 describes improvement in cutoff frequency. So one 12:37:42
12 could fabricate, for example, a device without the 12:37:47
13 gradient for graded dopant profile, and then one 12:37:53
14 with, and then observe whether or not there was an 12:37:59
15 increase in the cutoff frequency. 12:38:05

16 It gives the example of gains as large as 12:38:07
17 two or five. This is for a PNP transistor. It's a 12:38:14
18 bipolar junction transistor. It describes that one 12:38:21
19 could also do it for an NPN transistor. This example 12:38:27
20 in this paragraph is specific to bipolar junction 12:38:31
21 transistors. 12:38:35

22 Q. Does the '195 patent provide disclosure to 12:38:37
23 a POSITA to where they can understand how to create a 12:38:43
24 suitable relative slope to control the flow of 12:38:49
25 minority carriers in a layer? 12:38:53

1	MR. WHITEHURST: Object to form.	12:38:58
2	THE WITNESS: Well, I think right here in	12:39:04
3	this paragraph it describes, at least for this	12:39:10
4	scenario, the holes in this transistor, that the	12:39:19
5	relative slope could result in a cutoff frequency net	12:39:31
6	unity gain of two to five X. So this is -- unity	12:39:40
7	gain means that it can pass the signal but perhaps	12:39:49
8	increase the current, but at what maximum frequency	12:39:55
9	can the BJT pass a frequency and increase the	12:40:03
10	current.	12:40:11
11	So improvements in that resulted from the	12:40:13
12	sufficient relative slope could be observed in the	12:40:21
13	order of as large as two up to five.	12:40:32
14	Q. I guess, parsing that, are you stating in	12:40:36
15	the specific device disclosed in the '195 patent,	12:40:42
16	that the magnitude of the slope disclosed does create	12:40:47
17	a suitable aiding drift electric field to help	12:40:52
18	minority carriers transverse?	12:40:59
19	MR. WHITEHURST: Object to form.	12:41:04
20	THE WITNESS: I think I've answered this	12:41:06
21	question a couple of times already, so I'm struggling	12:41:26
22	with how this is different than the last question.	12:41:31
23	Column 2, paragraph 35 through 50, describes that the	12:41:37
24	relative slope that is sufficient will result in an	12:41:47
25	increase in the cutoff frequency at a unity gain of	12:41:52

1 one. That increase in cutoff frequency would be as 12:42:02
2 large as 2X or 5X. This is because it creates, 12:42:09
3 quote, "A suitable aiding drift electric field to 12:42:16
4 help the holes PNP transistor transverse from emitter 12:42:28
5 to collector." End quote. 12:42:29

6 So NPN devices are minority carrier to a 12:42:32
7 large extent, as opposed to NMOS or PMOS, which are 12:42:37
8 majority carrier. 12:42:41

9 So this paragraph in column 2 starting at 12:42:43
10 line 35 does describe the benefit and result of a 12:42:46
11 relative slope as such. 12:42:52

12 Q. As I understand, you're saying, yes. The 12:42:56
13 specific device disclosed in the '195 patent provides 12:43:06
14 sufficient disclosure where the slope of the donor 12:43:10
15 concentration, the magnitude and the slope, would 12:43:24
16 create a suitable aiding drift electric field to help 12:43:28
17 minority carriers transverse from emitter to 12:43:33
18 collector? 12:43:40

19 A. The relative slope of the doping 12:43:41
20 concentration would do such. It would result in this 12:43:43
21 increase in cutoff frequency from 2X to 5X for this 12:43:49
22 type of device. Yes. 12:43:53

23 Q. And the '195 patent, it's not necessary to 12:43:56
24 -- well, I'll strike that. In the '195 patent, is it 12:44:05
25 necessary to calculate forces by capacitance, 12:44:13

1	imperfections, or temperature?	12:44:16
2	MR. WHITEHURST: Object to form.	12:44:19
3	THE WITNESS: I would suggest that if one	12:44:29
4	wanted to accommodate them, there are at least two	12:44:37
5	ways to do it. One is to do it empirically. For	12:44:44
6	example, one could simply construct a slope and	12:44:54
7	measure the cutoff frequency here and increase the	12:44:55
8	slope until the cutoff frequency was 2X or whatever	12:44:58
9	was desired. That slope would depend, of course, on	12:45:01
10	how big the device was and how much power it handled,	12:45:07
11	and other factors.	12:45:10
12	That would accommodate the forces	12:45:12
13	previously mentioned. I think, capacitance,	12:45:16
14	imperfections, dislocations, and that sort of stuff.	12:45:20
15	Temperature. If one wanted to calculate it, that	12:45:24
16	would be an alternative way to do it. I think in the	12:45:30
17	end one would probably still want to build it, but	12:45:36
18	the chance of success on the first time out is higher	12:45:45
19	if one does the calculations first.	12:45:48
20	Q. Why do you believe it was sufficient	12:45:51
21	written -- well, let me start over. Do you believe	12:46:00
22	that it is sufficient written description disclosure	12:46:02
23	in the '195 patent to describe the relative slope of	12:46:07
24	the concentration without calculating all those	12:46:13
25	forces you mentioned?	12:46:18

1	MR. WHITEHURST: Object to form.	12:46:23
2	THE WITNESS: I think POSITA would	12:46:24
3	understand that one would need to account for	12:46:38
4	whatever forces existed. That's something that	12:46:43
5	POSITA would do. For example, knowing the resistance	12:46:48
6	of the silicon, one could try to determine the	12:46:52
7	voltage potential necessary to speed up the electron	12:46:58
8	flow to accommodate a higher cutoff frequency.	12:47:02
9	So one need not disclose this information	12:47:07
10	to a POSITA. Alternatively, one could also run an	12:47:09
11	experiment, which would be common in the	12:47:14
12	semiconductor industry, whereby one created different	12:47:18
13	dopant profiles, five levels of dopant profiles, for	12:47:21
14	example, and see how that affected the cutoff	12:47:30
15	frequency. Then, zero in on a solution from the	12:47:33
16	experiments. We would call that determining it	12:47:39
17	empirically.	12:47:42
18	Q. Does the '195 patent describe these	12:47:52
19	empirical tests?	12:48:13
20	A. Similar to the answer I gave previously, a	12:48:22
21	person of skill in the art would be familiar with	12:48:30
22	running empirical tests to determine parameters as a	12:48:32
23	routine and normal course of one's job duties and	12:48:43
24	business. In this case, there's essentially one	12:48:50
25	variable described, the relative slope. So that's a	12:48:55

1	fairly simple experiment that we're contemplating	12:48:58
2	here.	12:49:06
3	Q. Let's shift gears a little bit back to	12:49:17
4	Exhibit 2057 in proceeding 468.	12:49:20
5	A. 468?	12:49:24
6	Q. Yes. And I will, just to brief you, I will	12:49:25
7	reference this declaration. At any point you need to	12:49:33
8	refer to any of your other declarations to answer the	12:49:36
9	question, please do so, but I believe most of the	12:49:40
10	material will overlap.	12:49:49
11	If you could turn to paragraph 34, which is	12:49:58
12	on page 14 of the -- page 14 of the document.	12:50:01
13	A. Okay.	12:50:12
14	Q. And there you state, "Most semiconductor	12:50:13
15	devices relied on spatially uniform concentration of	12:50:16
16	dopants." Do you see that?	12:50:23
17	A. Yes.	12:50:25
18	Q. What do you mean by "most"?	12:50:25
19	A. I think the language is fairly plain. Most	12:50:40
20	as in more than a majority.	12:51:01
21	Q. Which devices did not rely on a spatially	12:51:10
22	uniform concentration of dopants?	12:51:19
23	A. Off the top of my head, I couldn't tell	12:51:45
24	you. It's my understanding that most were uniform.	12:51:48
25	There would potentially be some out there that	12:51:52

1 weren't.

12:51:55

2 Q. What was your basis for that statement on
3 paragraph 34 that most semiconductor devices relied
4 on spatially uniform concentration of dopants?

12:51:55

12:52:00

12:52:08

5 A. Well, I would say at least the following.
6 The first sentence in the abstract of the '195 patent
7 starts with, "Most semiconductor devices manufactured
8 today have uniform dopant concentrations either in a
9 lateral or vertical device." So forth and so on.

12:52:26

12:52:32

12:52:39

12:52:39

12:52:44

10 My experience in industry was that uniform
11 dopant concentrations were common.

12:52:48

12:52:56

12 Q. My question -- strike that. Why would one
13 put in an extra processing step to make a dopant
14 concentration uniform as opposed to not uniform?
15 What is the benefit?

12:53:11

12:53:18

12:53:23

12:53:31

16 A. Well, it isn't necessarily that way. That
17 question isn't exactly proper in its assumption.
18 Say, for example, one is creating wells, and wells
19 are created first before the transistors. If one
20 anneals the wells long enough that the concentration
21 prorates throughout the wells for the dopants, then
22 one knows exactly what one has.

12:53:38

12:53:42

12:53:49

12:53:59

12:54:04

12:54:11

12:54:16

23 Now, that's not an extra step. That's just
24 running the annealing step long enough so that you
25 know that there's a uniform result. If one runs a

12:54:19

12:54:21

12:54:26

1 shorter anneal, it may be that there is a non-uniform
2 concentration gradient. However, it's not
3 necessarily easier to control. So it could be just
4 the opposite that by going with a sufficient anneal
5 that results in uniform well concentration, one has a
6 known environment for processing further aspects of
7 the transistor.

8 Q. What would a POSITA see as a benefit for a
9 uniform dopant concentration in a semiconductor
10 layer?

11 A. I essentially answered that question in the
12 previous one, but maybe it wasn't clear. In the
13 semiconductor processing environment, having a known
14 result is often desirable. So if I know that the
15 well is uniform, then I can design subsequent
16 processes based on a known material composition or
17 properties. If I anneal it a shorter time and it's
18 not uniform, it may also not be same from wafer to
19 wafer. So it's sort of like mixing things. If I mix
20 something long enough, I can be assured that it's
21 evenly mixed, but if I want something that's half
22 mixed, it's a little trickier.

23 So having a fully annealed well would be
24 reasonably easy to achieve compared to a more
25 complicated profile and more reproducible. In its

1	reproduce ability, its attractive for a downstream	12:56:55
2	processing of the semiconductor.	12:57:00
3	Q. Would a uniform dopant concentration have	12:57:06
4	any -- rather, would a uniform dopant concentration	12:57:10
5	affect the movement of minority carriers?	12:57:16
6	A. Do you mean would it affect it in any way,	12:57:42
7	or with respect to a specific aspect?	12:57:48
8	Q. In any way, the layer itself.	12:57:50
9	A. Well, the possibility exists that doping of	12:57:54
10	any sort affects the circuit and the performance of	12:57:58
11	carriers. A uniform concentration or substantially	12:58:03
12	uniform concentration doesn't produce a voltage field	12:58:09
13	of any significance. There could be other aspects of	12:58:18
14	impact. For example, whether something is highly	12:58:31
15	doped or has a low level of doping, that would affect	12:58:36
16	other aspects of the carriers.	12:58:42
17	Q. Would a non-uniform doping concentration	12:58:44
18	introduce any -- in a layer, introduce any forces	12:58:50
19	that would affect the movement of minority carriers?	12:58:55
20	MR. WHITEHURST: Object to form.	12:59:07
21	THE WITNESS: A non-uniform doping	12:59:23
22	concentration could potentially affect the motion of	12:59:25
23	carriers. It would depend upon the magnitude of any	12:59:30
24	field it created, as well as the concentration.	12:59:39
25	Q. Would a non --	12:59:46

1	A. For example, if one created a highly P	12:59:49
2	doped region that was non-uniform, known as P-doping,	01:00:02
3	then if the minority carriers were N-type, they would	01:00:15
4	probably just recombine in the P. Holes and	01:00:18
5	electrons recombine. So that alone would affect,	01:00:22
6	potentially, minority carriers if electrons were the	01:00:29
7	minority carriers. Holes could be minority carriers.	01:00:34
8	That's a different issue.	01:00:36
9	That's aside from the fact that they could	01:00:38
10	be field generated.	01:00:44
11	Q. Would -- parsing that. A field would be	01:00:45
12	generated; correct?	01:00:53
13	A. A concentration gradient of dopants that	01:01:00
14	went up and down could create fields that went up and	01:01:14
15	down also. So there might be not any effective	01:01:17
16	field, but the field would have to be of sufficient	01:01:24
17	magnitude to overcome countervailing or counter	01:01:27
18	balancing fields from other structures and materials	01:01:32
19	in the semiconductor device.	01:01:36
20	Q. Okay. Would a concentration -- let me	01:01:42
21	start over. Would a graded concentration of dopants	01:01:49
22	create a field that affects -- strike that. Would a	01:01:55
23	graded concentration of dopants create an electric	01:02:02
24	field that exerts a force onto a minority carrier?	01:02:06
25	MR. WHITEHURST: Object to form.	01:02:12

1	THE WITNESS: The graded concentration	01:02:19
2	gradient of dopants of the opposite type of the	01:02:22
3	carrier may actually just recombine with the opposite	01:02:25
4	carrier. So there may not be any opposite carriers	01:02:30
5	left. If the dopant gradient is of the same type of	01:02:34
6	the carrier, then it would produce a field	01:02:42
7	proportional to the gradient. However, that field	01:02:50
8	may not be sufficient to actually exert a force on	01:02:54
9	the carrier that resulted in motion.	01:03:00
10	Whether or not there was motion due to one	01:03:04
11	specific force depends upon the other forces that	01:03:09
12	exist in the semiconductor device. There may be	01:03:12
13	greater forces that exert force in the opposite	01:03:22
14	direction. Forces need to be added up or summed, and	01:03:27
15	the net sum of the forces determines whether there is	01:03:30
16	motion and in what direction that motion occurs.	01:03:33
17	All of this, of course, requires that the	01:03:38
18	carrier not recombine, which is very probable with	01:03:42
19	high concentrations of the opposite carrier present.	01:03:48
20	Q. I guess -- well, let me slow down. A	01:03:56
21	graded concentration of dopants would create a force,	01:04:05
22	and that force may or may not be sufficient to move a	01:04:19
23	minority carrier?	01:04:26
24	MR. WHITEHURST: Object to form.	01:04:30
25	Q. Is that right?	01:04:33

1	A. Well, more properly, a graded concentration	01:04:34
2	of dopants, a graded dopant concentration, creates an	01:04:44
3	electric field. That electric field, when it acts on	01:04:49
4	a charged particle, creates a force. That force may	01:04:52
5	not be sufficient to cause current flow, depending	01:04:56
6	upon what other forces are present or what other	01:05:02
7	fields are present in the semiconductor device.	01:05:07
8	These forces and fields, we've recited	01:05:11
9	before. Examples are imperfections such as crystal	01:05:17
10	dislocations, impurities, temperature. Stress is	01:05:22
11	also a force. So forth and so on. Junctions create	01:05:27
12	pretty high forces also in their capacitance.	01:05:38
13	Junction is a rather abrupt change in concentration	01:05:47
14	in gradient of dopants or of carriers. So that has a	01:05:50
15	very large effect.	01:05:53
16	So all of these determine in their sum	01:05:54
17	whether or not there is a net motion and in what	01:05:58
18	direction it occurs. A lot of things are engineered	01:06:02
19	not to move at all. When we look at a circuit, it's	01:06:07
20	not on -- every part of the circuit is not on all the	01:06:10
21	time. So clearly, we have the ability to restrict	01:06:13
22	current flow. And then, other times, current flows	01:06:18
23	and the circuit is on. So this balance is just an	01:06:21
24	inherent part of any integrated circuit.	01:06:25
25	Q. Okay. I guess to -- well, strike that. To	01:06:29

1 get to what I believe you're stating, if you can look 01:06:36
2 at column 4, lines 22 to 24. It says, "Electric 01:06:42
3 drift field to aid the movement of minority 01:06:57
4 carriers." 01:07:04

5 To meet this limitation, as I understand 01:07:04
6 it, you're stating that any force introduced by the 01:07:09
7 graded concentration of dopants must be sufficient to 01:07:13
8 cause a movement of a minority carrier; is that 01:07:19
9 right? Considering all the other forces of the 01:07:31
10 device. 01:07:33

11 A. Yes. Essentially there has to be movement 01:07:34
12 of the minority carrier. It has to actually move. 01:07:48
13 And this unidirectional field is aided. Meaning, it 01:07:52
14 needs to push in the direction of the motion. To use 01:08:02
15 an example, you're pushing a car uphill. The car has 01:08:05
16 to actually go uphill, and you have to actually be 01:08:10
17 pushing uphill. You're aiding the motion of the car. 01:08:13

18 If the car rolls back over you, you didn't 01:08:16
19 aid its motion up the hill. 01:08:20

20 Q. Okay. If you could please look at page 17 01:08:22
21 of Exhibit 2057. Here you have a graphic. It looks 01:08:39
22 like the arrows are actually from the patent. In 01:08:59
23 your graphic, are the arrows depicting gradient and 01:09:07
24 electric field or a flow direction of minority 01:09:12
25 carriers? 01:09:16

1 On page 17 of Exhibit 2057, there are
2 arrows. Do those arrows depict gradients, electric
3 fields, minority carriers, or some other element?

4 A. The arrows are from the original patent
5 figure. So let me confirm as they're described in
6 the patent.

7 Q. Dr. Glew, while you're doing that, if you
8 need a lunch break at any moment please -- I'm fine
9 to keep going. I'm sure the videographer, court
10 reporter, and my counterparts might want food as
11 well. So at any time you want it.

12 A. Okay. Yeah. In the near future. In
13 figure -- your question was, what do the arrows
14 represent?

15 Q. Yes.

16 A. The text underneath the arrows, I think,
17 gives a reasonable description of, at least in part,
18 what they represent, which is, quote, "graded dopant
19 regions to pull minority carriers from the surface."

20 So this is, in Figure 5B, an NMOS device.
21 It has an N-type source and drain. That requires
22 that electrons flow between the source and drain.
23 The source and drain are labelled N T in little
24 letters.

25 So P-type is the minority, and that would

01:09:26

01:09:30

01:09:40

01:09:53

01:09:56

01:10:00

01:10:08

01:10:11

01:10:14

01:10:18

01:10:21

01:10:25

01:11:50

01:13:12

01:13:13

01:13:14

01:13:22

01:13:28

01:13:33

01:13:36

01:13:42

01:13:51

01:13:55

01:13:58

01:13:58

1	be pulled down to the substrate in order to affect	01:14:03
2	desired results. Obviously, with P-type minority	01:14:16
3	carriers, the holes, the P-type will be also in the	01:14:24
4	direction of the electric field. So the direction of	01:14:33
5	the electric field and the P-type are essentially	01:14:37
6	synonymous in that case.	01:14:39
7	Q. Just to -- well, strike that. To slow down	01:14:47
8	a little, assuming electrons will flow in the	01:14:51
9	opposite direction of the electric field current	01:15:00
10	created; right?	01:15:09
11	A. Yes. Holes flow in the direction of the	01:15:11
12	field, electrons flow in the opposite direction. We	01:15:12
13	can thank Benjamin Franklin for creating this	01:15:13
14	confusing scenario.	01:15:23
15	Q. Let me upload another exhibit. This is	01:15:24
16	Exhibit 1002.	01:15:30
17	(Exhibit 1002 marked for identification.)	01:15:31
18	Q. It has been filed in IPR 202400468. Let me	01:15:33
19	know if you are able to download it and open it.	01:15:44
20	A. I'm looking at a document that starts -- it	01:16:22
21	says, "MPS Exhibit 1002, 391."	01:16:27
22	Q. Yes.	01:16:33
23	A. Okay.	01:16:34
24	Q. And to give you context, this is the	01:16:35
25	prosecution history of the '195 patent that was	01:16:39

1	submitted in MPS's petitions against the '195, '222,	01:16:42
2	and '502 patents. Did you review Exhibit 1002 prior	01:16:52
3	to preparing your declaration?	01:17:08
4	A. I reviewed file histories in this matter	01:17:10
5	before some of the declarations. I didn't	01:17:21
6	necessarily re-review it before all the declarations.	01:17:27
7	Q. But it's safe to say that you reviewed the	01:17:31
8	prosecution history, or at least portions of it for	01:17:35
9	the '195 prior to preparing your declarations?	01:17:38
10	A. Yes, portions of it. Yes.	01:17:42
11	Q. If you could jump ahead to page 298.	01:17:43
12	MR. WHITEHURST: Counsel, is that page 298	01:18:06
13	--	01:18:09
14	MR. BOMBACH: 289. I'm sorry. 289 of --	01:18:09
15	well, I guess the PDF and the page labelling actually	01:18:13
16	match on this one. So 289 of 391.	01:18:17
17	MR. WHITEHURST: Okay.	01:18:29
18	THE WITNESS: I am on page 289.	01:18:37
19	Q. If you could actually go back to page 284	01:18:40
20	to give you context as to what this portion is. This	01:18:46
21	reads, "In response to the nonfinal office action of	01:18:57
22	December 20th, 2011, applicant submits this following	01:19:02
23	amendment," and then the applicants, which would be	01:19:07
24	Greenthread, commentary follows. Do you see that?	01:19:13
25	A. Yes.	01:19:21

1	Q. You understand this is a Greenthread	01:19:21
2	response to a U.S. patent office rejection; right?	01:19:27
3	A. Generally, yes. It says it's a nonfinal	01:19:38
4	office action. It's amended the claims with respect	01:19:41
5	to the patent office's action.	01:19:46
6	Q. And if you could just scroll down to 289.	01:19:49
7	Scroll so you can see it's part of that continuous	01:19:57
8	amendment or response. Then, on page 289 at the	01:20:00
9	bottom -- are you on 289?	01:20:09
10	A. Yes.	01:20:14
11	Q. Can you take a second to please read the	01:20:14
12	paragraph of -- at the bottom of 289 that continues	01:20:21
13	to 290? If you need to review more details to	01:20:28
14	reacquaint yourself, please do, and let me know when	01:20:33
15	you're done.	01:20:36
16	A. Okay. I have read it.	01:22:23
17	Q. There's a statement within here that	01:22:26
18	states, "The graded dopant concentration itself	01:22:30
19	creates a built in electrical field that forces the	01:22:37
20	movement of carriers into a particular direction,	01:22:42
21	whereby the direction of the electrical field and the	01:22:46
22	resulting direction of the carrier movement depends	01:22:49
23	solely on the slope of the graded concentration of	01:22:53
24	dopant."	01:22:57
25	Do you agree or disagree with that	01:22:58

1	statement?	01:23:03
2	MR. WHITEHURST: Object to form.	01:23:06
3	THE WITNESS: I think the statement in the	01:23:07
4	context of the discussion makes sense. The slope of	01:24:32
5	the graded concentration of dopants is an important	01:24:51
6	factor in the resulting field.	01:24:59
7	Q. So as I understand it, you agree with this	01:25:11
8	statement?	01:25:13
9	MR. WHITEHURST: Object to form.	01:25:15
10	THE WITNESS: I agree that the dopant	01:25:48
11	concentration gradient creates the direction and the	01:25:50
12	magnitude of the electrical field. I don't see an	01:26:02
13	issue with that statement as that. That's how I	01:26:05
14	understand what you're saying. Yeah.	01:26:08
15	Q. And then, the second part that follows with	01:26:11
16	the and states, "The resulting direction of a carrier	01:26:21
17	movement depends solely on the slope of the graded	01:26:25
18	concentration of dopant."	01:26:28
19	Your answer did not reference that portion.	01:26:32
20	Do you agree -- and that's on page 290. Do you agree	01:26:39
21	with that statement as well? I said too many thats,	01:26:46
22	so I'll start over.	01:26:49
23	On page 290 it says, "The resulting	01:26:54
24	direction of the carrier movement depends solely on	01:27:00
25	the slope of the graded concentration of the dopant."	01:27:03

1	Do you agree with that statement?	01:27:08
2	A. As I understand this from the context of	01:27:23
3	the discussion and as POSITA, the electric field is a	01:27:28
4	vector that has a direction and a magnitude, and that	01:27:46
5	the field created by the gradient and the dopants	01:27:50
6	will have a direction and a magnitude. I think one	01:27:53
7	would understand that obviously there are factors at	01:27:56
8	work in an integrated circuit, but the aspect of the	01:28:03
9	motion or the potential motion due to the gradients	01:28:12
10	in the dopants is due to the electric field vector	01:28:19
11	caused by the slope.	01:28:30
12	Q. And then, on page 289 the middle paragraph	01:28:45
13	states, "The unidirectional drift electric field	01:28:55
14	necessarily affects all the present minority carriers	01:29:02
15	in the same way, moving all minority carriers in the	01:29:04
16	same direction because of the unit directional drift	01:29:09
17	due to the existence of the electric field."	01:29:13
18	Do you see that statement on page 289 of	01:29:17
19	Exhibit 1002?	01:29:21
20	A. Yes.	01:29:29
21	Q. Do you agree or disagree with that	01:29:29
22	statement?	01:29:31
23	A. Well, I understand it in the context of its	01:29:31
24	usage generally. This is a quote from Grove physics	01:29:34
25	and technology and semiconductor devices. An	01:29:43

1 electric field acts on everything in its area. Where 01:29:46
2 the field exists, it acts on charged particles, and 01:29:56
3 it acts on all charged particles of a certain 01:30:02
4 polarity in the same way. It will act on particles 01:30:07
5 of opposite polarity in the opposite direction. 01:30:11

6 All other things being equal, if there were 01:30:13
7 no other forces at work, it would move all of them in 01:30:16
8 the same direction of the same type. If there were 01:30:19
9 other forces at work then, of course, those would 01:30:22
10 have to be accounted for. But without any other 01:30:26
11 forces present, everything in the field is affected 01:30:32
12 by the electric field in the same way if it has the 01:30:35
13 same polarity. 01:30:39

14 Q. If no other forces existed on the device 01:30:49
15 but for the graded dopant, as I understand your 01:30:52
16 answer, the force would be sufficient to cause 01:30:59
17 carrier -- minority carrier movement; is that 01:31:05
18 correct? 01:31:09

19 MR. WHITEHURST: Object to form. 01:31:09

20 THE WITNESS: I don't have the textbook in 01:31:32
21 front of me that it's citing from. My understanding 01:31:33
22 is that the electric field acts on all particles of 01:31:36
23 the same polarity in the same way that are in the 01:31:39
24 electric field. If there is sufficient force to move 01:31:45
25 a particle, then it would move as directed by the 01:31:53

1	electric field accordingly to the polarity.	01:32:00
2	Q. In a typical semiconductor device, how much	01:32:09
3	force is required to move an electron?	01:32:16
4	MR. WHITEHURST: Object to form.	01:32:32
5	THE WITNESS: Well, there's different	01:32:37
6	aspects to that question. It depends on what part of	01:32:39
7	the semiconductor device the electrons are present	01:32:50
8	in. What other biasing voltages are present. If we	01:33:02
9	look at a transistor, the threshold voltage for	01:33:07
10	turning on a transistor is on the order of a	01:33:11
11	volt-and-a-half to .8 volts in modern circuits.	01:33:15
12	Then, electrons move from source to drain.	01:33:19
13	But there's a voltage, you know, and a	01:33:22
14	ground on the source and drain to cause them to move.	01:33:27
15	You know, the channel region that has been doped in a	01:33:31
16	certain way and has an inversion layer in it, that	01:33:36
17	would be different than in an undoped version of the	01:33:40
18	semiconductor where it's almost nearly -- I don't	01:33:43
19	want to say it's extremely difficult or impossible,	01:33:47
20	but it's very hard to get current to flow in undoped	01:33:50
21	silicon. It's basically a very good resistor.	01:33:55
22	There will be little to no flow as opposed	01:33:59
23	to highly doped areas where resistance is very low.	01:34:03
24	Q. Is doped silicon highly resistive?	01:34:09
25	A. I'm sorry. Does --	01:34:15

1	Q. Is a doped semiconductor material highly	01:34:17
2	resistive?	01:34:20
3	A. Undoped silicon is highly resistive. The	01:34:36
4	resistance drops as the doping level increases, so it	01:34:42
5	depends on the doping level. At extremely highly	01:34:43
6	doped poly silicon, which is poly crystalline, it	01:34:47
7	acts almost like a metal. It's used to conduct.	01:34:56
8	Single crystal silicon, like a wafer, it varies	01:34:59
9	between the two, basically, depending on the doping	01:35:09
10	levels.	01:35:12
11	Q. In your opinion, does resistance impart a	01:35:18
12	force into a semiconductor device?	01:35:22
13	A. I'm sorry. Does what impart force?	01:35:27
14	Q. A device's resistance.	01:35:31
15	A. One can think of resistance as an opposing	01:35:46
16	or impeding force against current flow. So the more	01:35:49
17	resistance, the less current flows given the same	01:35:54
18	voltage potential. At an infinite resistance, a	01:35:58
19	voltage causes no current flow. At a very low	01:36:03
20	resistance that same voltage could cause high current	01:36:09
21	flow. It's not a force in the Newtonian sense, but	01:36:14
22	we're using the term force as sort of a resisting	01:36:19
23	force against current flow.	01:36:23
24	Q. In a doped semiconductor device, would the	01:36:29
25	resistance be described as infinite? Actually, let	01:36:33

1	me start over. In a doped semiconductor layer, would	01:36:45
2	you consider the resistance to be equivalent to	01:36:55
3	infinite?	01:36:58
4	A. In an extremely pure semiconductor, one	01:37:00
5	might treat it as having very high resistance. But	01:37:08
6	as the doping level increases, generally the	01:37:14
7	resistance drops. However, there are some subtleties	01:37:21
8	to this. If one has a highly doped P-region, one	01:37:26
9	can't necessarily pass electrons through it because	01:37:32
10	they simply recombine. That's how a transistor	01:37:34
11	works.	01:37:38
12	For example, the channel between a source	01:37:38
13	and drain is P on an NMOS. So electrons can't run	01:37:41
14	the gauntlet because there aren't enough electrons	01:37:52
15	and they just get absorbed. So in a, for example,	01:37:55
16	P-type doping environment, the resistance for holes	01:38:04
17	is low. Electrons have the problem that they will	01:38:13
18	very likely have a very short traveling distance	01:38:21
19	before they recombine.	01:38:24
20	Q. Dr. Glew, would you like a lunch break now?	01:38:28
21	I usually don't eat lunch so I am good to continue.	01:38:43
22	I was just going to ask about more forces.	01:38:43
23	A. Yeah. I'm okay with a lunch break now	01:38:48
24	unless you're finishing in five minutes.	01:38:53
25	Q. No. No.	01:38:54

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1	VIDEOGRAPHER: All right. We're going off	01:38:59
2	the record now at 13:39.	01:39:00
3	(Lunch taken.)	01:39:06
4	VIDEOGRAPHER: All right. We are back on	02:31:43
5	the record at 14:31.	02:31:45
6	Q. During the break, Dr. Glew, did you discuss	02:31:48
7	your testimony -- substance of your testimony with	02:31:52
8	anybody?	02:31:57
9	A. No.	02:31:57
10	Q. If we can -- before we broke, we were	02:31:57
11	talking about forces and I would like to redirect you	02:32:04
12	to paragraph 56 of Exhibit 2057 where you discuss the	02:32:08
13	forces. Please let me know when you have that open.	02:32:17
14	A. I am there.	02:32:24
15	Q. You list forces that may include	02:32:25
16	temperature. Can you describe the force that a	02:32:31
17	temperature would impart upon a minority carrier in a	02:32:35
18	semiconductor device?	02:32:45
19	A. There are a couple aspects to that.	02:32:52
20	There's something known as a coefficient of thermal	02:32:56
21	expansion, CTE. There's another parameter -- another	02:33:03
22	discipline known as strain engineering. So for	02:33:14
23	example, channels in NMOS and channels in PMOS might	02:33:16
24	be put on tension and compression respectively	02:33:25
25	because they will aid the mobility of electrons or	02:33:28

1	holes.	02:33:31
2	So as devices are warmer or cooler,	02:33:32
3	different materials, especially metal in dielectric	02:33:39
4	layers expand differently and put the material under	02:33:46
5	stress depending on the coefficient of thermal	02:33:49
6	expansion. Glass or silicon is very low expansion.	02:33:56
7	Metals have a very high expansion. Silicon is pretty	02:34:04
8	low, but more than glass or insulators.	02:34:07
9	So as the devices heat up and cool down in	02:34:11
10	operation, various stresses and strains are put on	02:34:17
11	the chips due to thermal expansion, and these	02:34:23
12	stresses and strains cause either contraction or	02:34:28
13	dilation of the silicon crystal, which changes the	02:34:33
14	mobility of carriers. It's utilized routinely in the	02:34:37
15	channels. It's also a by-product of operation.	02:34:41
16	Q. When you say "changes the mobility of	02:34:45
17	carriers," what do you mean?	02:34:48
18	A. The mobility is the measure of the velocity	02:34:50
19	versus the electric field. So the lower the	02:34:58
20	mobility, the slower the carriers go with the same	02:35:00
21	electric field. Electrons have maybe three times the	02:35:04
22	mobility of holes to begin with. So the voltage on	02:35:06
23	the electron makes it move at a certain speed. The	02:35:12
24	same volts are on hole is the third of the speed.	02:35:16
25	But that mobility changes with the stress in the	02:35:19

1	silicon lattice, in the silicon crystal.	02:35:22
2	That would be one example of how	02:35:27
3	temperature affects performance of devices. I think	02:35:30
4	it's understood that these are normal by-products of	02:35:32
5	operation of heating up during use.	02:35:45
6	Q. Would a certain temperature value --	02:35:52
7	actually, I'll take that back. In the Newtonian	02:36:00
8	sense, does temperature impart a force that would	02:36:08
9	move an electron backwards or forwards in space?	02:36:11
10	A. Well, the temperature does two things.	02:36:21
11	One, it impedes the motion by the expansion or	02:36:25
12	contraction of the silicon crystal. So it makes it	02:36:29
13	harder for it to move, or easier. Also, it creates	02:36:32
14	stress fields around any of the impurities. So	02:36:54
15	phosphorous, for example, and Boron have different	02:37:00
16	sizes than the silicon crystal lattice. They also	02:37:06
17	are affected by temperature.	02:37:13
18	Imperfections also have affected by	02:37:14
19	expansion, thermal expansion. These are drag,	02:37:19
20	essentially, on current.	02:37:25
21	Q. Would the drag on current be larger or	02:37:30
22	smaller with a colder temperature?	02:37:37
23	A. It depends. Like I said, you know, one	02:37:39
24	carrier likes tension; the other likes compression.	02:37:47
25	Channels are either tension or compression depending	02:37:52

1 on whether it's an electron or a hole. So it affects 02:37:55
2 them differently. Also, it depends on the 02:37:59
3 impurities. The elements that are in the crystalline 02:38:07
4 lattice, if they're smaller than silicon versus if 02:38:11
5 they're bigger than silicon. They put a stress on 02:38:14
6 the crystal, but with temperature they behave 02:38:19
7 differently also. 02:38:22

8 Q. Under normal operation, would you view 02:38:22
9 temperature as a significant impact in impeding 02:38:27
10 electron flow? 02:38:31

11 A. It can be. There's another aspect to it 02:38:36
12 too, which is the number of electrons and the number 02:38:39
13 of holes increases as the crystal gets hotter. There 02:38:44
14 are more carriers. Intrinsically they liberate more 02:38:49
15 carriers. But the problem becomes if you're trying 02:38:54
16 to run electrons through an area that now has more 02:38:57
17 holes, then the holes and the electrons recombine 02:39:00
18 more quickly, or vice versa. So it affects 02:39:03
19 recombination also. 02:39:07

20 Q. Are you aware of any literature as of the 02:39:11
21 filing date of the 2024 '195 patent, which is around 02:39:15
22 September 2004, where temperature was used in a 02:39:24
23 semiconductor device to impede the flow of electrons 02:39:26
24 or otherwise described? 02:39:30

25 A. I would put it this way. Stresses and 02:39:31

1	strains were well-known, and there's numerous	02:39:37
2	literature in '04 for strain engineering of channels.	02:39:41
3	It was well understood how strain affected the	02:39:45
4	mobility of electrons and holes. The stresses and	02:39:47
5	strains I was talking about came about from thermal	02:39:52
6	consequences.	02:39:56
7	So one would understand the strain	02:39:58
8	engineering impacts of temperature changes.	02:40:06
9	Q. You reference on paragraph 56, capacitance	02:40:13
10	effects at a PN junction as imparting a force. Can	02:40:22
11	you please expand upon that concept?	02:40:27
12	A. A PN junction is actually an abrupt or	02:40:35
13	fairly abrupt change in gradient, in dopant	02:40:47
14	concentrations. On one side it's holes and on the	02:40:53
15	other side it's electrons. So what one has there is	02:40:56
16	a fairly large change in dopant concentration. The	02:41:00
17	charges separate there, positive and negative, so	02:41:09
18	what happens with separation of charge is the build	02:41:13
19	up of capacitance, which makes it difficult for	02:41:15
20	anything to pass.	02:41:26
21	It also has the compound effect of --	02:41:29
22	there's a potential at a junction. There's actually	02:41:32
23	a voltage at a junction. Semiconductors are often	02:41:34
24	called junction science, but it's that -- you know,	02:41:38
25	that junction between P and N, that is a lot of the	02:41:41

1	magic between semiconductors.	02:41:45
2	Q. And as I understand your answer, the	02:41:47
3	capacitance effect at a PN junction would in part	02:41:53
4	force it in the Newtonian sense onto the	02:42:00
5	semiconductor device; is that right?	02:42:02
6	A. Yes, it effectively acts like a wall or	02:42:05
7	large repellant force. Junctions are part of	02:42:09
8	semiconductors. They're a big advantage. They	02:42:23
9	provide a lot of what the semiconductor is, but they	02:42:27
10	also have the flip side of the coin also acting too.	02:42:31
11	Q. How can the magnitude of the field	02:42:37
12	generated by a PN junction be calculated?	02:42:43
13	A. Well, oftentimes you can measure them. You	02:42:48
14	can literally measure them with CV meters. You can	02:42:53
15	measure the capacitance, you can measure the voltage	02:42:53
16	with instruments meant to do so. It's obviously hard	02:43:03
17	to do on very small things. So usually the	02:43:06
18	measurements are made on test structures that are	02:43:10
19	large enough to measure.	02:43:12
20	Q. How can the magnitude of the field	02:43:14
21	generated by a PN junction be calculated if it were	02:43:17
22	simply discussed in literature as opposed to actually	02:43:23
23	testing a physical device?	02:43:29
24	MR. WHITEHURST: Object to form.	02:43:32
25	THE WITNESS: Well, PN junctions have been	02:43:34

1	measured in a number of pieces of literature. I	02:43:56
2	would probably start with that.	02:44:01
3	Q. Is there a way to measure the magnitude of	02:44:07
4	the force based on what you're --	02:44:11
5	A. Yeah. One can create test structures and	02:44:18
6	use the appropriate meters to measure capacitance and	02:44:24
7	voltage of these devices. Sometimes test structures	02:44:29
8	are the only way to do it. Other times there's	02:44:39
9	different ways. For example, if it's really small,	02:44:51
10	it's too small of a number to measure, people will	02:44:53
11	make one hundred of them in a row and then just add	02:44:56
12	up their effect. That kind of approach.	02:44:59
13	Or they make them larger, large enough to	02:45:02
14	access, and then measure and scale down for the	02:45:06
15	model. Other ways are to measure building in little	02:45:11
16	circuitry that actually performs a measurement for	02:45:20
17	you. It's obviously not the kind of thing you do in	02:45:23
18	a production environment. On every product you would	02:45:25
19	make, you would characterize it once and then	02:45:29
20	manufacture it.	02:45:32
21	Q. Aside from -- you answered with respect to	02:45:35
22	test structures, how can the force be calculated	02:45:44
23	based on dopant concentrations at the P and N	02:45:52
24	junction?	02:45:58
25	A. I believe that there are some technical CAD	02:46:03

1	or TCAD programs that will do some calculations.	02:46:08
2	There's different types of CAD. ECAD for designing	02:46:13
3	circuits, TCAD for simulating properties of circuits.	02:46:19
4	ACAD for architectural, MCAD for mechanical. TCAD	02:46:23
5	allows some simulation of circuit and materials	02:46:30
6	performance.	02:46:37
7	Q. And you continue with imperfections e.g.,	02:46:39
8	dislocations and vacancies as imparting a force. Can	02:46:46
9	you please expand upon what that means?	02:46:51
10	A. If I interrupted you, please continue.	02:47:01
11	Q. No. Please continue. Sorry.	02:47:03
12	A. Dislocations are aspects of a crystal that	02:47:05
13	are perfect. So a silicon crystal, imagine that one	02:47:13
14	had just a bunch of squares, and within that square	02:47:17
15	you have another square a quarter of the way in	02:47:21
16	that's missing half of its A point. It only has four	02:47:25
17	points. It's called a diamond cubic structure.	02:47:31
18	So a silicon wafer is in theory a single	02:47:35
19	crystal. It's just one big crystal. It's made from	02:47:39
20	a cylinder and it's just chopped out of it. But it's	02:47:43
21	not a perfect crystal. There are a lot of times	02:47:45
22	where they don't line up. So there will be a missing	02:47:48
23	row. So that missing row is known as a dislocation.	02:47:51
24	There are a lot of dislocations in even	02:47:55
25	perfect silicon. They're characterized by the length	02:47:58

1 in centimeters per cubic centimeter. So how many
2 centimeters long of dislocations are there in cubic
3 meters silicon? It can be pretty big. The more
4 dislocations, the more resistance.

5 Each of the dislocations obviously is
6 missing atoms. So it's harder for an electron to get
7 from atom to atom when there's missing atoms. So
8 that's a dislocation. Other imperfections are like
9 point defects such as, instead of an entire missing
10 row, there could be a missing atom. There could be
11 an extra atom, an interstitial atom.

12 So these create stress field, and the
13 stress fields will typically impact motion of
14 electrons or holes. Obviously, I'm -- a perfect
15 silicon wafer is going to handle a bit different.
16 Perfect doesn't exist.

17 Q. And do designers attempt to create devices
18 -- rather, strike that. Do designers attempt to
19 create wafers that minimize dislocations in
20 vacancies?

21 MR. WHITEHURST: Object to form.

22 THE WITNESS: The companies that
23 manufacture and sell silicon wafers attempt to create
24 high quality wafers. The longer that one takes
25 making a crystal, oftentimes the better they are and

1	more effort put into removing impurities from those	02:49:48
2	base material, however, that's also more expensive.	02:49:53
3	So there's a balance between the quality of silicon	02:49:56
4	necessary for the device and the cost.	02:49:59
5	Q. In an ideal -- rather, looking at a wafer,	02:50:04
6	what direction would you state that the dislocations	02:50:26
7	-- let me start over.	02:50:31
8	Looking at a wafer, what direction of force	02:50:33
9	would you say that dislocations in vacancies imparts	02:50:37
10	upon the wafer?	02:50:43
11	A. That depends upon the dislocation. An	02:50:54
12	extra row or a missing row creates tension or	02:51:01
13	compression irrespectively, but those are in the	02:51:10
14	vicinity of the dislocations themselves. That's kind	02:51:20
15	of a complex computation.	02:51:24
16	Q. Okay.	02:51:31
17	A. But it's generally -- it's a local effect.	02:51:32
18	Q. Have you -- as of the filing of the '195	02:51:41
19	patent, which is September 2004, have you been	02:51:43
20	involved in the fabrication of wafers?	02:51:52
21	A. I had a client around that time who sold	02:51:59
22	equipment that was used in -- actually, I had a wafer	02:52:08
23	fabrication client on a case that I worked on.	02:52:12
24	Around 2000s, but I don't recall the exact date. It	02:52:17
25	would have Mitsubishi silicon.	02:52:34

1	Q. Would a POSITA have understood dislocations	02:52:37
2	in vacancies to typically apply an electric field in	02:52:40
3	a certain direction during manufacturing runs?	02:52:46
4	A. I think one thinks of dislocations as	02:53:01
5	providing elastic fields, stress fields. Those	02:53:05
6	stress fields interact with the mobility of carriers.	02:53:13
7	There are many -- there are different forms of	02:53:16
8	energy. An electric field is a form of energy. A	02:53:19
9	thermal field is a form of energy. An elastic or	02:53:22
10	stress field is a form of energy.	02:53:27
11	All of these interact with the silicon	02:53:29
12	lattice, the crystal, and can affect the mobility of	02:53:33
13	carriers.	02:53:39
14	Q. In a piece of literature that does not	02:53:40
15	describe the impact of imperfections, how would one	02:53:43
16	calculate the field effect of those imperfections	02:53:52
17	onto the device?	02:53:56
18	MR. WHITEHURST: Object to form.	02:53:59
19	THE WITNESS: Without knowing the level of	02:54:24
20	imperfections, I don't think one could calculate the	02:54:28
21	effect on mobility.	02:54:32
22	Q. I'm uploading into the chat box -- let me	02:54:37
23	see what number this is. What has been premarked as	02:54:51
24	Exhibit 1042.	02:54:56
25	(Exhibit 1042 marked for identification.)	02:54:57

1	Q.	It has been submitted as Exhibit 1042 in	02:55:01
2		proceedings 468, 469, and 470. Dr. Glew, can you	02:55:04
3		please download that document and let me know when	02:55:10
4		you have it open?	02:55:15
5	A.	Is this ONODA.	02:55:18
6	Q.	This is ONODA. O-N-O-D-A. Dr. Glew, prior	02:55:37
7		to preparing your declaration you reviewed ONODA;	02:55:49
8		correct?	02:55:56
9	A.	Yes.	02:55:56
10	Q.	Actually, I would like to note on the final	02:55:56
11		page, an OCR appears to have inverted the	02:56:05
12		certification. I just want to flag that for you.	02:56:12
13	MR. WHITEHURST:	I'm sorry, counsel. What	02:56:22
14		do you mean by "inverted the certification"?	02:56:24
15	MR. BOMBACH:	So the -- an OCR inverted the	02:56:26
16		page of what I uploaded.	02:56:31
17	MR. WHITEHURST:	I understand the last page	02:56:34
18		is upside down?	02:56:35
19	Q.	You reviewed ONODA prior to preparing your	02:56:43
20		declarations in 468, 469, 470; right?	02:56:48
21	A.	Yes. That was one of the three key	02:56:54
22		references.	02:56:59
23	Q.	Were you able to -- did you venture to	02:56:59
24		calculate the forces of ONODA that you referenced in	02:57:16
25		paragraph 56 of your declaration, including	02:57:21

1	temperature, capacitance effects at a PN junction,	02:57:23
2	imperfections, and silicon resistance?	02:57:28
3	A. No, I don't recall doing so. I don't think	02:57:39
4	it would be possible to do so because there's too	02:57:43
5	much missing information.	02:57:47
6	Q. Do you believe that ONODA's disclosure of	02:57:48
7	that necessary information that you referenced is a	02:57:58
8	requirement to address the aid the carrier movement	02:58:03
9	limitations of the '195, '502, and '222 patents?	02:58:10
10	MR. WHITEHURST: Object to form.	02:58:16
11	THE WITNESS: I would say generally, yes.	02:58:17
12	Without knowing counteracting forces, one can't	02:58:32
13	understand whether or not there is going to be	02:58:37
14	sufficient field force to motivate current flow.	02:58:41
15	Q. If you could please turn to page 31 of the	02:58:58
16	ONODA document and look at Figure 11.	02:59:10
17	A. I see Figure 11 on page 31.	02:59:26
18	Q. You understand this to be a downward	02:59:31
19	sloping gradient from around approximately zero to a	02:59:33
20	little before five UM; right?	02:59:41
21	A. No.	02:59:44
22	Q. How would you describe this gradient?	02:59:46
23	A. The dopant file is shown on an X scale of	02:59:54
24	zero to six micrometers, UN or UM. The initial	03:00:11
25	portion on the left side approximately half a micron	03:00:16

1	appears to be flat. I don't see a downward slope.	03:00:22
2	Subsequent to the first half micron, it does slope	03:00:27
3	downward. Then, beyond five microns, the dopant	03:00:31
4	profile.	03:00:47
5	Q. The downward sloping portion, are you able	03:00:50
6	to discern the impact that the force generated by	03:00:52
7	that slope would have on an electron in the ONODA	03:00:57
8	device?	03:01:04
9	MR. WHITEHURST: Object to form.	03:01:04
10	THE WITNESS: One can't determine the net	03:01:15
11	effect without knowing all of the forces. This is	03:01:17
12	one potential, one force, but any other counteracting	03:01:24
13	or aiding forces that act in the same direction would	03:01:33
14	have to be accounted for also in order to understand	03:01:39
15	if there was any motion due to this or in this	03:01:43
16	direction.	03:01:51
17	Q. When would the force generated by the	03:01:52
18	gradient of Figure 11 overcome other forces resident	03:01:59
19	in the device to have an electron move?	03:02:06
20	MR. WHITEHURST: Object to form.	03:02:10
21	THE WITNESS: I'm sorry. Could you repeat	03:02:31
22	that question?	03:02:32
23	Q. Yeah. When would the force generated by	03:02:33
24	the gradient of Figure 11 overcome the other forces	03:02:40
25	that are resident in the device of ONODA to have an	03:02:46

1	electron move?	03:02:52
2	MR. WHITEHURST: Object to form.	03:02:53
3	THE WITNESS: Figure 11 is described on	03:02:58
4	page 28 as a diagram showing the dopant profile in	03:03:39
5	the B part of the cross-section in Figure 8. So it	03:03:48
6	would have to overcome any of the counteracting	03:04:14
7	forces present in Figure 8 at the B5 cross-section.	03:04:23
8	B, B prime, the cross-section in Figure 8 doesn't	03:04:32
9	provide much detail of what else is present, so it	03:04:38
10	would be impossible to understand or determine what	03:04:46
11	the other forces were acting on the carrier in that	03:04:56
12	vicinity.	03:05:04
13	MR. WHITEHURST: Are you finished with your	03:05:10
14	answer?	03:05:11
15	THE WITNESS: Yes.	03:05:12
16	MR. WHITEHURST: I just want to provide	03:05:13
17	something for the court reporter. The real time says	03:05:14
18	page 28. I don't know if the witness said page 28 or	03:05:17
19	paragraph 28. You can continue, Miguel.	03:05:23
20	Q. Yeah. Yeah. I'm just thinking. Thank	03:05:40
21	you. Looking at the dopant profile in Figure 11, in	03:05:43
22	the devices of ONODA, what would you assume the net	03:05:55
23	lateral force to be imparted upon a minority carrier,	03:06:01
24	an electron? Up, down, or canceling out?	03:06:09
25	MR. WHITEHURST: Object to form.	03:06:18

1 Q. I misspoke. Let me just re-ask. In the 03:06:40
2 vertical direction, looking at Figure 11, how would 03:06:56
3 you presume a force to be applied onto an electron in 03:06:59
4 the device of ONODA? Would it be upwards force, 03:07:10
5 downwards force, or net canceled? So zero force. 03:07:14

6 MR. WHITEHURST: Object to form. 03:07:20

7 THE WITNESS: To begin with, in the region 03:07:21
8 of zero to about half-a-micron in Figure 11, the 03:07:32
9 concentration appears to be flat or constant, 03:07:42
10 roughly, in terms of concentration. So there would 03:07:47
11 be no force in the first half-micron exerted by this 03:07:54
12 -- by a field generated by this dopant profile. 03:08:01
13 Beyond half-a-micron, the concentration decreases. 03:08:06

14 So an electric field would point -- from 03:08:14
15 this concentration, would point upward toward the 03:08:20
16 surface of the semiconductor device. As for net 03:08:22
17 effect, it'd be impossible to know if there was any 03:08:27
18 net effect at all. The net -- in that the electric 03:08:32
19 field is pointing upwards, that would pull downward 03:08:42
20 on a negative electron. If we look at Figure 15, if 03:08:52
21 that relates to Figure 11 and Figure 8, that shows 03:08:59
22 that there is an NMOS device in Figure 15. So that 03:09:05
23 would rob the NMOS device of its electrons, the 03:09:11
24 majority carrier. So it would either render the NMOS 03:09:20
25 non-functional or degrade its performance. 03:09:24

1 So it's impossible to know that there's any
2 effect because we have no idea of what the other
3 forces at hand are in this system. However, if it
4 actually did have an effect, the only effect would be
5 deleterious to the NMOS shown in Figure 15, and be
6 undesirable.

7 Q. Give me one second to orient myself. I'm
8 going to upload into the chat box Exhibit 1046.

9 (Exhibit 1046 marked for identification.)

10 Q. This is submitted in IPR 468, 469, and 470,
11 which is a patent by Nishizawa. Dr. Glew, please let
12 me know when you've been able to open this document.

13 A. Okay. I have Nishizawa open.
14 Exhibit 1046.

15 Q. Okay. And prior to preparing your
16 declaration -- rather, prior to preparing your
17 declarations in this matter, you reviewed Nishizawa;
18 correct?

19 A. Yes.

20 Q. Give me one second to jump around. To give
21 you context, looking at Exhibit 2057, paragraphs 59
22 and 60 of your declaration. In paragraph 60, I'll
23 quickly paraphrase, but please review it if you need
24 to, you state that, "The PN junction in Nishizawa
25 does not aid."

1	Do you see that? "Does not aid in the	03:12:57
2	movement of minority carriers," rather.	03:13:03
3	Do you see that?	03:13:06
4	A. I don't see that exact language. I see	03:13:07
5	references to PN junctions.	03:13:09
6	Q. Yes. I may have misspoken.	03:13:14
7	A. You're summarizing. Okay.	03:13:26
8	Q. Yes. Yes.	03:13:28
9	A. Okay. I can go ahead and review the	03:13:30
10	paragraph quickly.	03:13:32
11	Q. Okay. Thank you.	03:13:33
12	A. Okay. I have reviewed it.	03:14:46
13	Q. What PN junction of Nishizawa are you	03:14:48
14	specifically referring to in paragraph 60?	03:14:58
15	A. In that I'm rebutting Dr. Campbell, I might	03:15:00
16	need to look at Dr. Campbell's declaration to put	03:17:52
17	better light on this. In general -- I'll give this	03:18:00
18	one more minute. Nishizawa is generally concerned	03:18:11
19	with, among other things, spurious electrons	03:18:58
20	generated by events, external events, and has created	03:19:09
21	a shield of sorts underneath the transistor.	03:19:28
22	Q. And I don't mean to interrupt you, Dr.	03:19:32
23	Glew, but you referenced Dr. Campbell's declaration.	03:19:35
24	Just so you have that to reference to, I will upload	03:19:40
25	into the chat box Exhibit 1003. It was submitted in	03:19:43

1	IPR 2024-0046.	03:19:51
2	(Exhibit 1003 marked for identification.)	03:19:54
3	Q. This was also submitted in 00469 and 00470.	03:19:56
4	Go ahead and reference that if necessary, Dr. Glew.	03:20:10
5	Just waiting for your review, Dr. Glew.	03:22:07
6	A. This could take a few minutes. I'm just	03:22:11
7	trying to cross reference Dr. Campbell's with my	03:22:14
8	rebuttal.	03:22:17
9	Q. I understand. I've just had a few	03:22:17
10	depositions where people sat and stared at each other	03:22:18
11	for a few minutes waiting for each other.	03:22:19
12	A. Been there, done that.	03:22:22
13	Okay. The graded concentration gradient,	03:29:04
14	33A in Nishizawa, is in Figure 35. 33A is not in	03:31:34
15	Figure 16, which he shows here. He notes in his	03:31:57
16	footnote on page 56 of his report that the discussion	03:32:01
17	focuses on 35. But 33A is described as a graded	03:32:12
18	concentration, not 33. So looking at Figure 35,	03:32:23
19	there is a -- and on page 15 of 32 of Nishizawa,	03:32:27
20	there is a PN junction shown there.	03:32:35
21	Q. I don't mean to interrupt you. For the	03:32:42
22	clarity of the record, you're referring to 33A and	03:32:44
23	13N junction?	03:32:52
24	A. Yes. 33A in Nishizawa. That would be one	03:32:57
25	example there.	03:33:01

1	Q. Okay. And --	03:33:09
2	A. And to the extent that the whole purpose of	03:33:10
3	that feature 33A in Figure 35 is to keep electrons	03:33:18
4	from entering the transistor region and interfering	03:33:24
5	with the operation of NMOS device shown in 35, it is	03:33:32
6	a barrier to electrons entering from the substrate	03:33:37
7	upward. If it were to pull electrons down from the	03:33:45
8	operating transistor that would be, as I described	03:33:57
9	previously, deleterious to the functioning of an NMOS	03:34:00
10	device, robbing it of the majority of its electron	03:34:03
11	carriers, which are required for operation. So	03:34:08
12	either it would render it non-functional if it pulled	03:34:10
13	them down, or degrade the speed or performance of the	03:34:11
14	NMOS device.	03:34:14
15	I would love to take a break soon, too.	03:34:22
16	Q. Yeah. We can take a break right now and go	03:34:25
17	off the record.	03:34:28
18	A. Thank you.	03:34:28
19	VIDEOGRAPHER: All right. We're going off	03:34:29
20	the record now at 15:34.	03:34:31
21	(Recess taken.)	03:34:38
22	VIDEOGRAPHER: All right. We're on the	03:47:30
23	record. 15:47.	03:47:31
24	Q. Dr. Glew, during the break did you speak	03:47:34
25	about the substance of your testimony with anybody?	03:47:38

1	A. No.	03:47:42
2	Q. Looking at Exhibit 1046, which is the	03:47:42
3	Nishizawa reference, can you please look at Figure 35	03:47:50
4	and the PN junction between 33A and 13?	03:47:54
5	A. I see that, yes.	03:47:58
6	Q. How can -- did you calculate the force that	03:48:00
7	is imparted upon an electron at that junction?	03:48:05
8	A. No, I did not. I don't believe I did the	03:48:11
9	values of this for 13.	03:48:17
10	Q. Would the force exert downward or upward	03:48:20
11	field on the electron?	03:48:29
12	MR. WHITEHURST: Object to form.	03:48:31
13	THE WITNESS: Generally, there should be a	03:49:12
14	capacitance and a repulsive force between the two.	03:49:15
15	Q. And by repulsive force, you mean a force	03:49:19
16	that would push electrons downward?	03:49:33
17	MR. WHITEHURST: Object to form.	03:49:37
18	THE WITNESS: No. There's a junction	03:49:57
19	between the two that would generally repulse charge.	03:50:00
20	So basically, holes get pulled to the positive --	03:50:13
21	holes get pulled to the N, electrons get pulled to	03:50:17
22	the P, and that creates a separation of charge which	03:50:22
23	creates a junction, a PN junction.	03:50:25
24	Q. If you could look at column 18, lines 35 to	03:50:33
25	42, please.	03:51:04

1	A. Okay. I've generally reviewed it.	03:52:41
2	Q. In your understanding, Nishizawa, to your	03:52:44
3	knowledge, is that electrons within the P-type agreed	03:52:51
4	region 33A would diffuse toward the N-type region 13?	03:52:59
5	A. Well, it also acknowledges that it's trying	03:53:10
6	to prevent that 46. In order to prevent such flow,	03:53:13
7	it is necessary to form an impurity concentration	03:53:16
8	gradient, so forth and so on. So they're trying to	03:53:21
9	prevent the flow of electrons from P to N and they	03:53:25
10	think they're doing it -- I believe they think	03:53:30
11	they're doing that substrate from whatever it was, a	03:53:33
12	solar electrical event, they don't want going into	03:53:47
13	the end.	03:53:52
14	So they use the P-type substrate to somehow	03:53:53
15	prevent that. And again, 18 at 46, in order to	03:53:57
16	prevent such flow of electrons, it is only necessary	03:54:06
17	to form an impurity concentration gradient. So it's	03:54:09
18	repelling electrons.	03:54:20
19	Q. I wanted to take that piece by piece. In	03:54:23
20	column 18, lines 37 to 38, it is describing electrons	03:54:25
21	created by alpha particle in the P-type buried region	03:54:34
22	33A; right?	03:54:40
23	A. Where were you? 18?	03:54:42
24	Q. 18, lines 37 through 38. It says, "Created	03:54:43
25	by alpha particle in the P-type varied region 33A."	03:54:49

1	A. Yes, okay. I see that.	03:54:57
2	Q. And you had cited 1846. It says, "In order	03:54:58
3	to prevent flow of electrons, it is only necessary to	03:55:07
4	form impurity P-type buried region 33."	03:55:16
5	Do you see that portion?	03:55:24
6	A. Yes.	03:55:26
7	Q. On your review of Nishizawa, and in	03:55:26
8	reference to Figure 35 and that discussion on column	03:55:34
9	15, what occurs to an electron that's created by	03:55:39
10	alpha ray within the buried region 33A of Figure 35?	03:55:45
11	MR. WHITEHURST: Object to form.	03:55:55
12	THE WITNESS: What the specification	03:56:10
13	describes is at 46 that it's preventing a flow of	03:56:11
14	electrons. Basically, it's protecting against the	03:56:24
15	alpha particle generated electrons.	03:56:31
16	Q. What occurs to the electron that is	03:56:34
17	generated by an alpha particle in the buried region	03:56:39
18	33A with the concentration gradient described in	03:56:44
19	Nishizawa?	03:56:47
20	A. As I cited to earlier, at 1846 it	03:56:51
21	describes, in order to prevent such flow of	03:56:57
22	electrons, it is only necessary, et cetera. So it's	03:57:01
23	preventing the flow of electrons.	03:57:04
24	Q. So electron in space created in 33A, would	03:57:06
25	the electron have a force going upwards, downwards,	03:57:14

1	or would the electron have its forces canceled out?	03:57:17
2	MR. WHITEHURST: Object to form.	03:57:23
3	THE WITNESS: What it's describing is a PN	03:57:28
4	junction that is doped in Figure 35 that repels	03:57:36
5	electrons from the junction in order that the	03:57:45
6	electrons do not flow into Figure 35. I'm still --	03:57:48
7	let me look at this one second. Figure 35, which is	03:57:55
8	on sheet 18, sheet 17 --	03:58:17
9	Q. 15.	03:58:26
10	A. 15. There we go. Yeah. Figure 35 shows	03:58:30
11	the P region 33A in contact with the N region 13. It	03:58:34
12	describes also, I believe, somewhere else where this	03:58:47
13	would -- I saw it -- this is going to discharge the	03:58:53
14	memory storage, or something to that effect, in that	03:58:57
15	region. I know -- I don't see it handily, but there	03:59:02
16	is some bad effect with the electrons reaching the	03:59:54
17	source drain 13.	03:59:57
18	Q. And you had not -- Nishizawa acknowledges	04:00:00
19	via column 18, 37, lines 37 to 38, that an electron	04:00:06
20	will be created by an alpha particle in the P-type	04:00:14
21	buried region; correct?	04:00:19
22	MR. WHITEHURST: Object to form.	04:00:23
23	THE WITNESS: Yes. Generally, it describes	04:00:42
24	alpha particles created in region 33A.	04:00:50
25	Q. An alpha parallel hits region 33A and an	04:00:58

1	electron is generated. What occurs physically in	04:01:05
2	space for that electron to prevent -- for it to be	04:01:11
3	prevented to flow --	04:01:17
4	MR. WHITEHURST: Object to form.	04:01:19
5	Q. -- upwards to the N-type region?	04:01:20
6	A. Well, it describes at 46, column 18, "In	04:01:22
7	order to prevent such flow of electrons, it is only	04:01:56
8	necessary to prevent an impurity concentration	04:02:00
9	gradient in the P-plus buried region."	04:02:03
10	Q. Would the electron generated by an alpha	04:02:14
11	particle in the P-type buried region be prevented	04:02:22
12	physically from going upwards?	04:02:26
13	A. What it states is that it will stop the	04:03:27
14	flow of electrons into the source drain 13. I don't	04:03:29
15	know if it makes it to that junction and is stopped	04:03:38
16	or if it's stopped before the junction, necessarily	04:03:43
17	from the description. It just describes that the	04:03:47
18	source drain 13 will not have electrons entering it	04:03:50
19	that were generated by solar events. That has some	04:03:56
20	sort of bad effect upon the performance, discharging	04:04:06
21	memory or something to that effect.	04:04:10
22	Q. Okay. So if I understand what you said	04:04:11
23	correctly, the electron may go up but is prevented	04:04:16
24	from entering element 13?	04:04:26
25	A. I would say generally that's correct, yes.	04:04:32

1	It stops the flow of solar -- of alpha particle	04:04:35
2	generated electrons from entering the source drain 13	04:04:40
3	and then causing some bad effect upon memory or other	04:04:44
4	circuitry.	04:04:51
5	Q. And how, in your understanding of reading	04:04:52
6	Nishizawa and, more specifically, column 18, lines 46	04:04:54
7	through 54, how would the graded dopant concentration	04:05:02
8	accomplish that scenario you just described?	04:05:15
9	A. Well, effectively there's a force --	04:05:53
10	there's an electric field probably pointing upward,	04:05:57
11	which means electrons would be pulsed downwards. So	04:06:01
12	electrons would be pushed away from 13. It does not	04:06:08
13	want electrons entering source drain 13, so it would	04:06:11
14	have to have a field that pushed electrons away,	04:06:15
15	meaning field -- a repulsion of sorts.	04:06:21
16	Q. What field would be pushing electrons	04:06:38
17	towards source drain 13 in the case that there is a	04:06:41
18	dopant -- graded dopant concentration as described in	04:06:48
19	1846 through 53?	04:06:53
20	A. As I understand column 1846 describes, in	04:07:00
21	order to prevent such flow of electrons, it is only	04:07:05
22	necessary to form this impurity gradient. So this	04:07:08
23	impurity gradient somehow repulsing electrons from	04:07:12
24	entering 13.	04:07:16
25	Q. And I'm asking about specific electrons	04:07:20

1	being generated by alpha particle radiation in 33A,	04:07:24
2	which Nishizawa acknowledges occurs in 18, 36 to 38?	04:07:31
3	What force acts upon an electron once it hits 33A to	04:07:43
4	prevent that electron from entering N-type region 13	04:07:52
5	as described in 18, 47 through 53 of Nishizawa?	04:07:59
6	MR. WHITEHURST: Object to form.	04:08:08
7	THE WITNESS: Could you repeat the	04:08:59
8	question?	04:10:34
9	Q. Yes. I'm asking about specific electrons	04:10:34
10	being generated by alpha particle radiation in 33A,	04:10:39
11	and Nishizawa acknowledges that it occurs in column	04:10:45
12	18, 36 through 38. What force acts upon an electron	04:10:49
13	once it hits 33A to prevent that electron from	04:10:55
14	entering N-type region 13, as described in column 18,	04:10:59
15	lines 47 through 53?	04:11:08
16	MR. WHITEHURST: Object to form.	04:11:11
17	THE WITNESS: Column 18, 46 describes	04:11:30
18	creating a concentration gradient, so forth and so	04:11:33
19	on. It goes into details through the rest of the	04:11:39
20	paragraph. Then, this concentration gradient helps	04:11:44
21	to prevent the flow of the electrons from the solar	04:12:03
22	electron generated in 33A from entering 16 -- excuse	04:12:07
23	me. 13 source drain region and extinguishing the	04:12:13
24	memory. So wiping out the memory. It describes	04:12:22
25	that.	04:12:26

1	At 46 -- No. 47, perhaps. Electrons will	04:12:26
2	flow into the N-type region 13 and constantly cause	04:12:33
3	the extinction of memory. So this is mitigated by	04:12:39
4	this concentration gradient exerting some type of	04:12:43
5	electrical field to stop this flow of electrons	04:12:49
6	generated via solar event, alpha particle, from	04:12:54
7	wiping out the memory bit.	04:12:59
8	Q. I'll ask this more simply. Looking at	04:13:15
9	Nishizawa column 18, lines 35 through 54, are you	04:13:18
10	able to tell me whether an electron generated by an	04:13:27
11	alpha particle hitting region 33A goes up, down, or	04:13:32
12	is fixed in place?	04:13:41
13	MR. WHITEHURST: Object to form.	04:13:43
14	THE WITNESS: Column 18 at the paragraph	04:13:45
15	beginning at line 35 describes that the electron that	04:13:55
16	enters region 33A is stopped from entering source	04:13:58
17	drain region 13. So to some extent, it is hindered	04:14:03
18	from vertical entry into the region 13.	04:14:16
19	Q. Does that electron go up, down, or does it	04:14:26
20	remain in place once it is generated by an alpha	04:14:30
21	particle in the P typed buried region 33A?	04:14:34
22	MR. WHITEHURST: Object to form.	04:14:38
23	THE WITNESS: Well, the electron is stopped	04:14:41
24	from going up into 13. That's what this describes.	04:14:43
25	Q. I'll ask -- but that doesn't answer the	04:14:48

1	question. Does an electron -- are you able to state	04:14:53
2	today whether an electron generated by an alpha	04:14:57
3	particle in the P-type buried region would go up,	04:15:03
4	down, or stay in place in context of the disclosure	04:15:10
5	in Nishazawa's column 18, lines 46 through 54?	04:15:16
6	MR. WHITEHURST: Object to form.	04:15:24
7	THE WITNESS: This Nishizawa patent doesn't	04:15:25
8	give enough detail to describe that. It only gives	04:15:32
9	enough detail to describe that it stops it from	04:15:36
10	entering 13. So to some extent, it eventually stops	04:15:40
11	vertical motion by stopping the solar or alpha	04:15:44
12	generated --	04:15:50
13	Q. The --	04:15:54
14	A. 13.	04:15:56
15	Q. Once the electrons generated in 33A of	04:15:57
16	Figure 35, and region 33A has a dopant concentration	04:16:06
17	that is graded, what forces act upon that electron?	04:16:12
18	To move it up, down, or to lock it in place?	04:16:17
19	MR. WHITEHURST: Object to form.	04:16:23
20	THE WITNESS: There are forces generated by	04:16:24
21	the concentration gradient. I don't know, and it	04:16:34
22	doesn't describe in this paragraph or passage whether	04:16:38
23	or not that electrical force alone is sufficient to	04:16:43
24	stop the electron, but the electrical force generated	04:16:46
25	by that as well as any junction effect going out from	04:16:50

1 the PN junction together will stop the electron from 04:16:54
2 entering the source drain region 13 of N-type. That 04:16:57
3 is what is described in that paragraph. 04:17:02

4 Presumably, that has the beneficial effect 04:17:06
5 of stopping the extinction of memory that is attached 04:17:16
6 to that transistor. 04:17:20

7 Q. Column 18 states, "In order to prevent such 04:17:21
8 flow of electrons, it is only necessary to form an 04:17:30
9 impurity concentration gradient in the P-type varied 04:17:34
10 region 33A." 04:17:38

11 Do you acknowledge that Nishizawa states 04:17:40
12 it's only necessary to form that impurity 04:17:42
13 concentration? 04:17:44

14 MR. WHITEHURST: Object to form. 04:17:46

15 THE WITNESS: I acknowledge that it writes 04:17:48
16 that passage in the context of 35 where that P buried 04:17:52
17 region is connected to an N region 13. Yes. 04:18:01

18 Q. In context of that statement, I will ask 04:18:08
19 simply again, an alpha particle generated in P-type 04:18:18
20 buried region 33A, when Nishizawa acknowledges, "In 04:18:23
21 order to prevent such flow of electrons it is only 04:18:30
22 necessary to form an impurity concentration gradient 04:18:33
23 in the P-type buried region 33A." 04:18:34

24 What occurs to that specific electron that 04:18:38
25 is generated in P-type buried region 33A? Does it go 04:18:43

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1	up? Does it go down? Or is it locked in place?	04:18:47
2	MR. WHITEHURST: Object to form.	04:18:54
3	THE WITNESS: This passage certainly	04:18:56
4	expresses concern about it going up and entering	04:19:02
5	region 13, but describes that it is precluded from	04:19:04
6	entering region 13. That's the extent of the	04:19:08
7	disclosure in that paragraph.	04:19:12
8	Q. Okay. I guess, can you answer the question	04:19:15
9	whether the electron will go up, down, or lock in	04:19:22
10	place?	04:19:25
11	MR. WHITEHURST: Object to form.	04:19:27
12	THE WITNESS: I don't believe there's	04:19:34
13	enough information to answer that question. It	04:19:35
14	depends on the energy. Remember that a solar event,	04:19:40
15	an alpha particle is about 3 million volts plus. So	04:19:44
16	one doesn't really know the exact energy level of the	04:19:48
17	electron generated by this alpha particle. So in	04:19:51
18	that it is energetic and can be very energetic, it	04:19:59
19	may in fact go up. The passage doesn't describe	04:20:05
20	whether it goes up or not, merely that it's able to	04:20:07
21	stop it from getting into source drain 13.	04:20:13
22	Q. Okay. Let's change gears. Let me upload	04:20:18
23	the next reference. Give me one second. Uploading	04:20:32
24	into the chat box Exhibit 1007.	04:20:43
25	(Exhibit 1007 marked for identification.)	04:20:46

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1	Q. This was submitted in IPR 468, 469, 470.	04:20:49
2	This is the Kawagoe reference. Dr. Glew, please let	04:20:54
3	me know when you've had an opportunity to open that.	04:21:13
4	Were you able to open that document?	04:22:09
5	A. Yes, I just have a bunch of Adobe files	04:22:12
6	open right now. I'm trying to --	04:22:18
7	Q. Yeah. I think you can close a bunch of	04:22:20
8	them except the declaration. I mean, if you want to	04:22:24
9	reference the patents. Declaration Kawagoe. I think	04:22:27
10	we'll be limited to that. Please let me know when	04:22:31
11	you're ready.	04:22:55
12	A. Okay. I have Kawagoe open.	04:22:59
13	Q. In paragraph 62 of your declaration, which	04:23:03
14	is Exhibit 2057, you said "Kawagoe impedes the	04:23:10
15	movement of minority carriers."	04:23:19
16	Do you see that portion?	04:23:22
17	A. I'm on page 37, paragraph 61.	04:23:31
18	Q. And 62. Starts with "impede."	04:23:36
19	A. Oh. You're on 62. All right. Yes.	04:23:42
20	Q. How practically does Kawagoe impede the	04:23:59
21	movement of minority carriers?	04:24:06
22	MR. WHITEHURST: Object to form.	04:24:10
23	THE WITNESS: I wrote in -- I think you	04:24:11
24	misrepresented what I wrote. I wrote that Kawagoe	04:24:33
25	teaches the concentration -- I believe you	04:24:37

1	mischaracterized what I wrote. I wrote that Kawagoe	04:24:47
2	teaches the following, starting on the third line	04:24:52
3	from the bottom of page 38. Quote, "Kawagoe teaches	04:24:57
4	using a concentration gradient to impede carrier	04:25:01
5	movement. Kawagoe is concerned with naturally	04:25:05
6	occurring alpha rays striking the semiconductor	04:25:08
7	device and generating free electrons in the	04:25:13
8	substrate. Kawagoe's free electrons can disrupt the	04:25:17
9	operation of the device during a single event." End	04:25:20
10	quote.	04:25:27
11	Q. Actually -- sorry. Go ahead.	04:25:28
12	A. Those aren't necessarily minority carriers.	04:25:31
13	We're talking about electrons.	04:25:35
14	Q. Okay. So if we could look at Kawagoe on	04:25:36
15	16, line 7 through 13. There are two statements	04:25:40
16	separated by an and. I'll read it. "The electrons	04:25:48
17	produced by the alpha ray are attracted to the	04:26:01
18	substrate body by that concentration gradient."	04:26:04
19	A. I'm sorry. I'm not following you. I'm in	04:26:12
20	the 114 patent.	04:26:15
21	Q. Yes. I will slow down.	04:26:17
22	A. Column 16, line 16. Where are you?	04:26:20
23	Q. No. Column 16, line 7 through 13.	04:26:23
24	MR. WHITEHURST: As a courtesy to me, I'm	04:26:31
25	trying to catch up as well. It takes us a minute to	04:26:38

1	open these documents and get to the relevant portion.	04:26:42
2	I believe you said column 16, lines 7 through 13.	04:26:46
3	I'm not there yet. I'm still trying to catch up with	04:26:49
4	you.	04:26:56
5	Q. Okay. Dr. Glew, can you gist look at it	04:26:57
6	really quickly and let us know when you're there.	04:27:00
7	I'll give Mr. Whitehurst a chance to look as well.	04:27:01
8	MR. WHITEHURST: Okay. I am there now.	04:27:04
9	Thank you, counsel.	04:27:06
10	Q. And it states, "The electrons produced by	04:27:13
11	the alpha ray are attracted to the substrate body 2S	04:27:15
12	by that concentration gradient." The state -- and	04:27:21
13	then it continues, and. The statement that says,	04:27:25
14	"Attracted to the substrate body 2S, as a POSITA in	04:27:30
15	2004," how would you understand -- what would you	04:27:34
16	understand attracted to mean?	04:27:39
17	A. Well, it describes electrons that are below	04:27:50
18	the P-well. They don't want them entering the	04:28:00
19	P-well. So electrons below the P-well are acted upon	04:28:04
20	by a field so that they stay in substrate.	04:28:09
21	Q. Looking at Kawagoe -- actually, I think you	04:28:19
22	have a drawing of it in your declaration. Yeah.	04:28:26
23	Let's look at page 42 of your declaration, which is	04:28:31
24	Exhibit 2057 which depicts Figure 16 of Kawagoe.	04:28:38
25	A. Okay. Yes. I see page 42, Figure 16	04:28:45

1	annotated.	04:28:53
2	Q. Does the sun discriminate as to where in	04:28:54
3	Kawagoe alpha rays hit?	04:28:59
4	A. The sun doesn't discriminate where alpha	04:29:11
5	rays hit. However, the device discriminates where	04:29:14
6	electrons are generated.	04:29:20
7	Q. How does the device discriminate where	04:29:23
8	electrons are generated by an alpha particle hitting	04:29:26
9	the device?	04:29:30
10	A. Two-fold. One, substrates in excess of	04:29:34
11	500 microns thick, the active area, the wells are a	04:29:42
12	couple of microns. So 99 percent plus of the	04:29:49
13	substrate is -- 99 percent of the device is silicon	04:29:54
14	substrate. Furthermore, there's a statistical	04:29:58
15	probability that alpha rays don't hit anything at all	04:30:03
16	until they have passed a certain number of atoms.	04:30:07
17	Atoms are mainly just space.	04:30:13
18	So there has to be a certain penetration	04:30:15
19	depth of an alpha particle to actually interact and	04:30:17
20	remove an electron. So this device will generally be	04:30:22
21	seeing spurious electrons generated in the substrate.	04:30:25
22	Furthermore, there are multiple levels of metal on	04:30:32
23	top of the transistors, which do provide some	04:30:38
24	shielding.	04:30:46
25	Q. I want to make sure your testimony is	04:30:47

1	captured correctly. Did you say in excess of	04:30:50
2	500 microns thick?	04:30:55
3	A. Yes. Typical wafers are 525-530 microns.	04:30:59
4	That would be a piece of silicon.	04:31:06
5	Q. Can you please -- actually, as I understand	04:31:28
6	your testimony, looking at page 42 of Exhibit 2057,	04:31:34
7	you're stating that alpha rays will not generate	04:31:42
8	electrons in the P-well 6P; is that correct?	04:31:48
9	A. Sorry. Where are you pointing towards?	04:31:58
10	Q. Sorry. I'll start over. As I understand	04:32:00
11	your testimony, looking at Exhibit 2057, page 42	04:32:03
12	which depicts Kawagoe Figure 16, as I understand your	04:32:10
13	testimony, you are stating that alpha rays hitting	04:32:14
14	6P, which is the P-well, will not generate electrons?	04:32:21
15	MR. WHITEHURST: Object to form.	04:32:31
16	THE WITNESS: On page 44 I describe in a	04:32:32
17	little more detail that it's extremely low	04:32:57
18	probability that alpha rays are creating electrons	04:33:03
19	near the surface.	04:33:07
20	Q. So electrons will be created near the	04:33:11
21	surface; correct?	04:33:15
22	MR. WHITEHURST: Object to form.	04:33:17
23	THE WITNESS: As I've written at the bottom	04:33:22
24	of page 43, I'm citing back to Nishizawa here,	04:33:24
25	Exhibit 1046 five lines from the bottom of page 43,	04:33:39

1	Exhibit 1046, 19, 21 through 34, also see at column	04:33:47
2	20, lines 19 through 22, "The amount of electrons	04:33:54
3	created which adversely affect the memory action is	04:33:59
4	no greater than only 10 percent of the stored	04:34:02
5	electric charge and thus can be disregarded."	04:34:05
6	So in order to have any effect on the	04:34:08
7	memory, you would have to generate 10 percent of the	04:34:11
8	memory charge and anything generated by solar events	04:34:14
9	can be disregarded, according to Nishizawa.	04:34:21
10	Q. Are you able to answer my question about	04:34:25
11	Kawagoe without reference to Nishizawa?	04:34:27
12	MR. WHITEHURST: Object to form.	04:34:30
13	THE WITNESS: Nishizawa is rather vague	04:34:33
14	about where alpha particles create particles -- or	04:34:39
15	electrons. Nishizawa provides more detail. I think	04:34:48
16	the best way to answer that question is to cite to	04:34:52
17	elsewhere in my report, in the same section of my	04:34:55
18	report where I describe the basis for my statement or	04:34:58
19	opinion that insignificant number of solar electrons	04:35:03
20	would be generated near the surface.	04:35:15
21	Q. Are you equating low probability with will	04:35:23
22	not happen?	04:35:26
23	MR. WHITEHURST: Object to form.	04:35:28
24	THE WITNESS: I'm sorry. Can you direct me	04:35:29
25	to where in my report where I stated that or wrote	04:35:34

1	that.	04:35:37
2	Q. No, I'm asking you right now. You state,	04:35:39
3	"There is a low probability of electrons being	04:35:42
4	generated at the surface."	04:35:45
5	Does that mean that electrons will not be	04:35:49
6	generated at the surface via an alpha particle?	04:35:52
7	A. What I'm saying is that such a low number	04:35:57
8	of electrons would be generated near the surface that	04:36:05
9	they can be disregarded.	04:36:09
10	Q. Okay. So in your report, you're	04:36:11
11	disregarding the electrons at the surface?	04:36:15
12	MR. WHITEHURST: Counsel, you cut him off.	04:36:17
13	I don't think he was through answering.	04:36:19
14	THE WITNESS: No, I wasn't. So what's the	04:36:21
15	word I ended on?	04:36:26
16	So the presumption that there's any need to	04:36:28
17	deal with electrons generated near a surface is not	04:36:34
18	reasonable.	04:36:41
19	Q. So it was not reasonable to consider	04:36:45
20	electrons generated at the surface of Kawagoe via	04:36:49
21	alpha rays?	04:36:54
22	MR. WHITEHURST: Object to form.	04:36:57
23	THE WITNESS: That's not what I said. It's	04:36:58
24	not reasonable to imagine that Kawagoe necessarily	04:37:00
25	deals with electrons near the surface because	04:37:05

1 electrons near the surface generated by alpha

04:37:08

2 particles are insignificant and can be discarded,

04:37:12

3 according to Nishizawa.

04:37:16

4 Q. Does Kawagoe say that electrons generated
5 near the surface can be disregarded?

04:37:17

04:37:20

6 MR. WHITEHURST: Object to form.

04:37:23

7 THE WITNESS: Well, Kawagoe says that it
8 keeps electrons from entering through the P-well. So
9 it never mentions that it's dealing with alpha
10 particle generated electrons above the P-well. It
11 just says that it's stopping them from entering
12 through the P-well. So it's consistent with that.

04:37:29

04:37:38

04:37:45

04:37:51

04:37:53

04:37:56

13 Q. In Kawagoe, what occurs to an electron that
14 is generated in the P-well 6P, looking at Figure 16?
15 Let me start over. Looking at Kawagoe, what occurs
16 to an electron that is generated via alpha ray
17 radiation in P-well 6P in Figure 16?

04:38:02

04:38:08

04:38:15

04:38:19

04:38:25

18 MR. WHITEHURST: Object to form.

04:38:32

19 THE WITNESS: Well, as I quoted on page 39
20 of my report, in paragraph 62 I've pasted the portion
21 from column 16 up to lines 15, and basically it says
22 -- specifically -- and I'm at line 7 column 16,
23 "Specifically the electrons produced by the alpha ray
24 are attracted to the substrate body 2S by that
25 concentration gradient, and prevented from entering

04:39:03

04:39:06

04:39:13

04:39:28

04:39:32

04:39:34

04:39:37

1	the P-well 6P so that soft errors can be reduced in	04:39:40
2	case the MIS memory of the DRAM or the like is formed	04:39:46
3	in the P-well 16 -- excuse me. 6P.	04:39:51
4	So it just describes that electrons are	04:39:57
5	precluded from entering the P-well. If they did	04:39:59
6	enter the P-well, Nishizawa teaches they could be	04:40:05
7	disregarded. There's so few generated in the upper	04:40:09
8	region that they can be disregarded.	04:40:14
9	Q. Okay. Can you answer me today, what occurs	04:40:18
10	to an electron when it hits -- I'll start over. Can	04:40:28
11	you please answer, what occurs when an alpha ray hits	04:40:31
12	Kawagoe's P-well 6P of Figure 16? Will the electron	04:40:39
13	generated move up, move down, be locked in place, or	04:40:48
14	can you not answer that question?	04:40:57
15	MR. WHITEHURST: Object to form.	04:41:00
16	THE WITNESS: The most likely scenario for	04:41:02
17	an alpha ray entering the P-well is that it continues	04:41:06
18	through the P-well into the substrate. There's a	04:41:11
19	penetration depth before an alpha particle actually	04:41:15
20	interacts with an atom, the atoms are occupying a	04:41:20
21	very small fraction of space. We may think of	04:41:25
22	something as a solid, but to an alpha particle, the	04:41:28
23	silicon lattice is like a sieve. It's pretty much	04:41:34
24	nothing with isolated material.	04:41:43
25	So to sum that up, the most likely event is	04:41:49

1 that the alpha particle just keeps going. 04:41:56

2 Q. Can you please point me to the section in 04:41:59

3 Kawagoe which supports your statement that an 04:42:01

4 electron hitting -- alpha ray hitting the P-well 6P 04:42:04

5 of Kawagoe's Figure 16 will not generate an electron? 04:42:11

6 A. I relied on Nishizawa, that the alpha 04:42:19

7 particle is far more likely to generate an electron 04:42:24

8 in the 500-micron thick substrate, and that very few 04:42:30

9 would be generated in the upper region P-well, for 04:42:36

10 example. The few that would be generated are so few 04:42:43

11 that they could be disregarded. That is what I 04:42:46

12 pointed to earlier in Nishizawa. 04:42:48

13 Q. Looking at Kawagoe Figure 16, the lower P 04:43:09

14 layer which is depicted is substantially smaller than 04:43:13

15 the P-well 6P. 04:43:21

16 Looking at Kawagoe Figure 16, the lower P 04:43:46

17 layer is depicted as substantially smaller than the 04:43:50

18 P-well 6P. 04:43:54

19 Do you see that? 04:44:01

20 A. Yes, I see the illustration. However, I 04:44:02

21 understand that illustrations are not to scale. As a 04:44:07

22 person of skill in the art, silicon wafers are 04:44:12

23 approximately 500 microns thick. They could be 04:44:18

24 thinned a bit but they are still vastly thicker than 04:44:21

25 the P-well and the active area and metallization on 04:44:23

1 top. If this were drawn to scale, the bottom P
2 portion could take 30 more pages. It wouldn't add
3 anything in the illustration.

4 Q. And assuming that an alpha particle does
5 generate an electron in Figure 16's P-well region 6P,
6 are you able to answer me today whether that electron
7 would be attracted upwards, downwards, or locked in
8 place?

9 MR. WHITEHURST: Object to form.

10 THE WITNESS: What I can't do is identify
11 the net sum of forces acting upon that electron in
12 the P-well. The patent is specific and clear that
13 below the P-well there's sufficient forces to keep
14 the electron from entering the P-well. It doesn't
15 make that same claim or assertion in the P-well or
16 active area. As I cited to on page 39 of my report,
17 from column 16, line 7 on, "Those electrons are
18 precluded from entering the P-well, those generated
19 by the alpha ray or alpha particle."

20 Q. Does Kawagoe's concentration gradient have
21 any effect on -- any force effect on electrons in the
22 device?

23 MR. WHITEHURST: Object to form.

24 THE WITNESS: As I recently spoke, Kawagoe
25 at column 16, starting at the top, describes that

1 there's a concentration gradient and this 04:48:41
2 concentration precludes electrons from entering the 04:48:49
3 P-well. So it does have that effect. That is, the 04:48:53
4 electrons generated by the alpha rays or alpha 04:49:07
5 particles. 04:49:11

6 Q. But my question is a little simpler. It 04:49:12
7 is, does Kawagoe's concentration gradient generate a 04:49:15
8 force on an electron? 04:49:18

9 MR. WHITEHURST: Object to form. 04:49:23

10 THE WITNESS: I'm confused. You previously 04:49:27
11 said does it have any effect? Now you're asking, 04:49:29
12 does it generate force on the electrons? 04:49:33

13 Q. I said any force effect, but I'll restart. 04:49:36
14 Does Kawagoe's concentration gradient generate any 04:49:40
15 force effect on electrons in the Kawagoe devices -- 04:49:43

16 MR. WHITEHURST: Object to form. 04:49:49

17 Q. Of Figure 16. 04:49:51

18 A. Kawagoe describes that the gradient stops 04:49:53
19 electrons from entering the P-well from the 04:50:16
20 substrate. So it provides some sort of force to that 04:50:20
21 effect. If we look at Kawagoe in Figure 17, page 10 04:50:25
22 of 36 in the patent, we see that the gradient 04:50:32
23 impurity concentration extends just past the well 04:50:46
24 into the substrate. 04:50:49

25 Q. And I'll ask again because I don't think 04:50:55

1 you answered the question. Does Kawagoe's

04:50:57

2 concentration gradient generate any force effect on

04:51:00

3 electrons in the Kawagoe device of Figure 16?

04:51:03

4 MR. WHITEHURST: Object to form.

04:51:07

5 THE WITNESS: I believe I answered that

04:51:08

6 question. I will answer it again. Figure 16 and

04:51:19

7 Figure 17, one can see a structure and one can see a

04:51:24

8 concentration gradient. The specification describes

04:51:30

9 that this concentration gradient precludes electrons

04:51:39

10 generated in the substrate body from entering the

04:51:44

11 P-well. It provides sufficient force to mitigate the

04:51:48

12 entry of these solar alpha rays generated electrons

04:51:53

13 from entering into the well of the transistors.

04:52:02

14 Q. Looking at Kawagoe's Figure 17, which

04:52:10

15 depicts the concentration gradient, and comparing it

04:52:28

16 to Figure 16, looking at Figure 16, at the point

04:52:36

17 between 2E and 2S which is indicated by the dashed

04:52:48

18 line, what would the concentration gradient impart?

04:52:52

19 A downward force on an electron or an upward force on

04:53:04

20 an electron?

04:53:11

21 MR. WHITEHURST: Object to form.

04:53:12

22 THE WITNESS: The concentration or impurity

04:53:15

23 concentration gradient shown in Figure 17 is

04:53:34

24 decreasing to the right. Therefore, the field would

04:53:39

25 point to the left. So holes would experience a

04:53:42

1 potential force in the left direction, or upward, and 04:53:48
2 electrons would be pushed potentially in the opposite 04:53:55
3 direction to the right or downward. This is an 04:54:01
4 effect in isolation. 04:54:05

5 Whether there was actually any motion or 04:54:09
6 net effect would depend upon other forces acting upon 04:54:14
7 the electron also. 04:54:18

8 Q. Looking at Kawagoe, does it describe the 04:54:25
9 force effects that you described, I believe, which 04:54:41
10 are temperature capacitance effects at a PN junction 04:55:04
11 imperfections or resistance? 04:55:08

12 A. Well, Kawagoe does show where junctions 04:55:20
13 exist. For example, on Figure 17 we look at WE on 04:55:23
14 the horizontal access, and WW. These are where 04:55:32
15 there's changes in material. So Kawagoe's well aware 04:55:34
16 of at least where the bottom of the well is. They 04:55:39
17 don't specifically, I recall, talk about temperature, 04:55:46
18 other than annealing temperatures. 04:56:01

19 You asked also about dislocations? I don't 04:56:10
20 recall dislocations or imperfections. They don't 04:56:16
21 talk about dislocations and they don't talk about 04:56:26
22 defects. They do talk about impurities obviously. 04:56:31
23 Figure 17 refers to the dopant impurities. 04:56:42

24 Q. Did you calculate force effects on an 04:56:53
25 electron in P-well 6P, introduced by temperature 04:56:58

1	capacitance effects at the PN junction, imperfection	04:57:04
2	and resistance?	04:57:09
3	A. One could not do -- I did not do that. One	04:57:15
4	could not do that. There is insufficient information	04:57:20
5	provided in the specification regarding those	04:57:24
6	parameters.	04:57:26
7	Q. In your opinion, must one calculate those	04:57:27
8	parameters which are temperature, capacitance effects	04:57:33
9	at a PN junction, imperfections and inherent	04:57:40
10	resistance to silicon in order to address whether the	04:57:46
11	claim limitation to aid the movement of minority	04:57:50
12	carriers from said surface layer to said substrate is	04:57:54
13	rendered obvious, or otherwise met?	04:57:58
14	A. There's two parts to that question, or two	04:58:06
15	parts to my answer to that question. The first one	04:58:09
16	is that when there are a number of forces acting on a	04:58:12
17	charged particle, if one wishes to know the net	04:58:16
18	effect of those forces, one needs to accommodate or	04:58:21
19	account for the forces. If one knows only one force,	04:58:24
20	then one doesn't know the total sum of forces. One	04:58:28
21	doesn't even know one force in the matter here. The	04:58:32
22	concentration isn't given. One only knows that there	04:58:49
23	is sufficient gradient below the P-well to affect	04:58:52
24	electrons.	04:58:59
25	I'm looking at Figure 17 and, as we	04:59:00

1 discussed previously, the concentration gradient
2 decreases downward to the right. I'll call that the
3 X axis. Therefore, the electric field points upward.
4 The upward force of the electric field would take
5 holes, which are the minority carrier in an NMOS
6 device and well 6P, and an upward force of minority
7 carriers. The upward force due to the concentration
8 gradient would only push holes minority carriers
9 upward toward the surface. So it would not sweep
10 holes, minority carriers, downward.

11 So to sum that up, the gradient's in the
12 wrong direction to actually move minority carriers
13 towards the substrate and, secondly, one doesn't have
14 enough information to do calculations on the other
15 forces to determine the net force. But it's
16 unnecessary because one knows the gradient is in the
17 wrong direction for the claims at issue.

18 Q. Let me parse that. A downward gradient,
19 dopant gradient in the P-well 6P, what direction
20 would the electric field be in with reference to
21 Figure 17?

22 A. The downward gradient produces an
23 electrical field that points upward, which has the
24 effect of pushing electrons away, which is a desired
25 effect. It wants to take alpha particle generated

1 electrons and push them away from the well. So 05:01:00
2 that's what it does. But electrons and holes move in 05:01:03
3 the opposite direction. 05:01:07

4 So as the field points upward, or to the 05:01:08
5 left on Figure 17, it would push electrons against 05:01:11
6 the field and draw holes with the field upward. So 05:01:13
7 the direction is wrong to actually carry minority 05:01:17
8 carriers toward the substrate. The field is carrying 05:01:21
9 minority carriers toward the surface where half the 05:01:26
10 devices are and moving electrons below the well 05:01:27
11 downward. 05:01:32

12 Q. In the well 6P, is a minority carrier an 05:01:34
13 electron or a hole? 05:01:42

14 MR. WHITEHURST: Object to form. 05:01:46

15 THE WITNESS: In the minority carrier 6P, 05:01:47
16 there's an NMOS device, and so in the NMOS device the 05:01:54
17 majority carriers are the electrons, the minority 05:02:00
18 carriers are holes. As I wrote in my declaration on 05:02:04
19 page 18, column 35, I believe we reviewed this 05:02:13
20 earlier, I cite to Exhibit 1001, the '195 patent, at 05:02:17
21 column 3, line 10. 05:02:29

22 "Electrons can be swept from source to 05:02:31
23 drain at 341 to 343, and accelerate majority carriers 05:02:35
24 toward the drain." And the majority carriers have to 05:02:43
25 be N to get from the source to the drain. The '195 05:02:48

1 patent describes even in the background in column 1, 05:02:52
2 of course, that MOS devices are necessarily majority 05:02:58
3 carriers. At column 1, line 43. In contrast to 05:03:05
4 BJTs, MOS devices are majority carrier devices for 05:03:14
5 conduction. 05:03:19

6 Q. You had a very long answer but my question 05:03:21
7 is far simpler. In the P-type material of P-well 6P 05:03:24
8 in Figure 16, is the minority carrier an electron or 05:03:35
9 a hole? 05:03:42

10 MR. WHITEHURST: Object to form. 05:03:44

11 THE WITNESS: I just answered this 05:03:46
12 question. In the PMOS area, the only carrier is a 05:03:48
13 carrier associated with the transistor. 05:03:54

14 Q. You're not answering my question. It's 05:03:59
15 actually extremely simple. In the P-type material of 05:04:01
16 P-well 6P in Figure 16, is the minority carrier an 05:04:08
17 electron or a hole? There's two possible answers. 05:04:12

18 MR. WHITEHURST: Object to form. Asked and 05:04:17
19 answered. 05:04:23

20 THE WITNESS: The carrier is the carrier in 05:04:23
21 a transistor. The only transistor in that region is 05:04:26
22 an NMOS device. Therefore, the carrier in an NMOS 05:04:34
23 device is an electron. 05:04:39

24 Q. And let me ask that more simply. In the 05:04:43
25 P-type material, P-well 6P in Figure 16, is the 05:04:49

1	minority carrier an electron or a hole?	05:04:54
2	MR. WHITEHURST: Object to form.	05:04:56
3	THE WITNESS: The question makes no sense	05:04:58
4	because there is no carrier unless there's device.	05:05:00
5	Where would this electron be carrying something? You	05:05:03
6	know, to carry it has to go from A to B. There's	05:05:06
7	nowhere for an electron to carry in this. The term	05:05:10
8	carrier as it's used in the '195 patent is very	05:05:16
9	clearly associated with a specific device type, and	05:05:20
10	with the NMOS device type shown in that figure, the	05:05:25
11	majority carrier in the language used in the '195	05:05:31
12	patent is an electron.	05:05:36
13	Q. I will reference you to paragraph 16, lines	05:05:37
14	2 to 7.	05:05:45
15	A. Which document?	05:05:48
16	Q. Of the Kawagoe reference. "Thus, the	05:05:49
17	impurity concentration of the P-well 6P is given that	05:05:53
18	such a gradient that gradually lowering the device	05:05:58
19	direction from the device surface. So the influence	05:06:02
20	caused by the carriers for electrons due to the alpha	05:06:05
21	ray is lowered."	05:06:08
22	So in Kawagoe Figure 16, what is the	05:06:24
23	minority carrier in Figure 16 P-well 6P? Is it an	05:06:33
24	electron or a hole?	05:06:40
25	MR. WHITEHURST: Object to form.	05:06:43

1 THE WITNESS: You gave me a cite and asked 05:06:44
2 me a question and you used the so in between them. 05:07:07
3 So I presume there's a connection. The cite on 16 05:07:10
4 says there's a carrier, an electron. Okay. It 05:07:12
5 doesn't use the word majority or minority. The term 05:07:14
6 minority or majority carrier as relevant to the '195 05:07:18
7 patent is as it would be used in the '195 patent, 05:07:24
8 which I cited to, and which is also consistent with 05:07:27
9 my understanding as POSITA. 05:07:32

10 So in the NMOS device shown in the P-well, 05:07:34
11 NMOS devices are formed in P-wells, the majority 05:07:40
12 carrier from NMOS device is an electron. 05:07:43

13 Q. So you're stating that the minority carrier 05:07:50
14 in the P-well 6P of Figure 16 is a hole; correct? 05:08:00

15 A. What I'm saying is the minority carrier in 05:08:11
16 the NMOS device would be considered P. The majority 05:08:14
17 carrier in the NMOS device in the P-well is an 05:08:22
18 electron. 05:08:28

19 Q. Okay. Looking at 6N of Figure 16, would 05:08:33
20 the minority carrier in 6N be an electron or a hole? 05:08:56

21 A. 6N is a well you're referring to. So with 05:09:15
22 the -- the question with respect to a well doesn't 05:09:33
23 really have an answer in the context of the '195 05:09:36
24 patent. 05:09:41

25 Q. I'm asking about Kawagoe, though, and I'm 05:09:42

1	asking a simple question. It's A or B in those	05:09:47
2	specific wells. Figure 16 is a minority carrier in	05:09:52
3	N-well 6N, an electron or a hole?	05:10:03
4	A. The term majority or minority character as	05:10:14
5	used in the patents in suit relates to an electronic	05:10:16
6	structure such as a transistor, not to a chunk of raw	05:10:20
7	material such as a well.	05:10:25
8	Q. You recognize that there is a transistor	05:10:27
9	there, that Figure 16 depicts an NMOS and PMOS;	05:10:34
10	right?	05:10:44
11	MR. WHITEHURST: Objection. Scope.	05:10:44
12	MR. BOMBACH: Scope to Figure 16 of Kawagoe	05:10:51
13	describing an NMOS and PMOS?	05:10:53
14	MR. WHITEHURST: Yes. Stating my	05:10:58
15	objection. Do you want me to expand on the record or	05:11:03
16	keep it succinct?	05:11:06
17	MR. BOMBACH: Keep it succinct.	05:11:09
18	THE WITNESS: I'm sorry. Can you repeat	05:11:50
19	your question?	05:11:51
20	Q. You stated, the term minority -- majority	05:11:52
21	character refers to an electronic structure such as a	05:12:02
22	transistor, and I stated, Figure 16 of Kawagoe	05:12:08
23	identifies NMOS and PMOS transistors; right?	05:12:12
24	A. I would say generally, yes.	05:12:37
25	Q. Okay. And I'm asking very simply, and I	05:12:41

1	understand if you refuse to answer, Kawagoe	05:12:45
2	Figure 16, N-well 6N which is an N-type material, is	05:12:52
3	a minority carrier of that an electron or a hole?	05:13:01
4	MR. WHITEHURST: Objection. Scope.	05:13:08
5	THE WITNESS: I don't believe I opined in	05:13:21
6	my report on 6N or anything in that region.	05:13:24
7	Q. You're a POSITA. Are you aware of the	05:13:35
8	minority carrier of 6N?	05:13:38
9	MR. WHITEHURST: Counsel, we've been going	05:13:48
10	about an hour-and-a-half. Are you getting close to a	05:13:50
11	stopping point?	05:13:55
12	MR. BOMBACH: Yeah. I mean, we can take a	05:13:56
13	break once this simple question is answered.	05:13:58
14	MR. WHITEHURST: Okay. Why don't you	05:14:02
15	re-ask the question.	05:14:04
16	THE WITNESS: I can answer it. So as I	05:14:05
17	stated previously, the minority/majority carriers	05:14:08
18	have to do with transistors and different transistor	05:14:14
19	types, not just a chunk of material.	05:14:19
20	Q. Figure 16 --	05:14:24
21	A. So I answered the question and we'll take	05:14:25
22	our break now.	05:14:28
23	Q. No. This is --	05:14:30
24	MR. WHITEHURST: Well, counsel --	05:14:32
25	MR. BOMBACH: Hold on. I'll state for the	05:14:35

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1	record that I'm asking very simple questions on	05:14:36
2	specific claim elements and I'm getting scope	05:14:40
3	objections and refusals to answer. We can take a	05:14:43
4	break, but this is far beyond the pail.	05:14:46
5	MR. WHITEHURST: Counsel, this is	05:14:50
6	unprofessional. We've been going for an	05:14:52
7	hour-and-a-half.	05:14:53
8	MR. BOMBACH: I said let's take a break.	05:14:54
9	MR. WHITEHURST: Thank you.	05:14:56
10	VIDEOGRAPHER: All right. We're off the	05:14:57
11	record now at 17:14.	05:14:59
12	(Recess taken.)	05:15:43
13	VIDEOGRAPHER: All right. We're back on	05:25:18
14	the record at 17:25.	05:25:26
15	Q. Dr. Glew, if you could please look at the	05:25:30
16	'195 patent, lines 33 to 35.	05:25:34
17	A. Which column?	05:25:47
18	Q. Oh. Sorry. Column 3, lines 33 through 35.	05:25:49
19	A. Yes, I see that.	05:26:15
20	Q. In the inlay, it refers to minority	05:26:16
21	carriers. Are the minority carriers electrons or	05:26:21
22	holes in column 3, lines 33 to 35?	05:26:31
23	A. Let me look at the paragraph as a whole.	05:26:40
24	Column 3, lines 33 roughly describes an N-layer	05:27:55
25	deeply implanted. This looks generally like what	05:28:05

1	could be described, for example, in Figure 5A. With	05:28:10
2	respect to minority and majority, that relates to	05:28:20
3	active devices.	05:28:30
4	Q. Column 3, lines 33 through 35 states, "In a	05:28:45
5	preferred embodiment, the subterranean N-layer has a	05:28:51
6	graded donor concentration to sweep the minority	05:28:57
7	carriers deep into the substrate."	05:29:01
8	Are you able to tell me whether those	05:29:04
9	minority carriers referred to in that passage are	05:29:06
10	electrons or holes?	05:29:13
11	A. If the N-layer was acting on P-wells, there	05:29:23
12	are N-type devices in a P-well, and in an N-type	05:30:04
13	device, the carrier -- minority carrier would be	05:30:14
14	P-type in an NMOS. That would be an example.	05:30:22
15	Q. Is that an electron or a hole which is the	05:30:27
16	minority carrier?	05:30:32
17	A. For NMOS, the minority carrier is P. For	05:30:40
18	PMOS, a minority carrier would be N.	05:31:05
19	Q. That's not my question. My question is, is	05:31:08
20	the minority carrier an electron or a hole in	05:31:12
21	describing the preferred -- when the patent describes	05:31:17
22	the preferred embodiment in column 3, lines 33	05:31:21
23	through 35?	05:31:24
24	MR. WHITEHURST: Object to form.	05:31:27
25	THE WITNESS: Well, layers -- the N-layer	05:31:28

1	and implanted layer -- the N-layer, the implanted	05:31:41
2	layer, or epitaxial layer can be graded in either	05:31:53
3	direction depending on what one wishes to act on.	05:32:02
4	The electric field would have to be chosen and the	05:32:05
5	gradient would have to be chosen for the minority	05:32:08
6	carrier of interest.	05:32:15
7	Q. You didn't answer the question. Is the	05:32:16
8	minority carrier an electron or a hole?	05:32:23
9	MR. WHITEHURST: Object to form.	05:32:29
10	Q. Referring to column 3, lines 33 through 35.	05:32:38
11	There is a reference in sweeping minority carriers in	05:32:44
12	the subterranean N-layer. Is the '195 patent	05:32:48
13	referring to minority carriers that are electrons or	05:32:54
14	holes in that passage?	05:32:58
15	MR. WHITEHURST: Counsel, I believe you	05:33:00
16	just asked him the exact same question. Object to	05:33:02
17	form.	05:33:05
18	THE WITNESS: I've answered this question:	05:33:06
19	The claim or the patent isn't limited to one	05:33:12
20	particular configuration. A person of skill in the	05:33:18
21	art would understand that whether the gradient	05:33:21
22	increased or decreased would determine the direction	05:33:28
23	of the electrical field, which one would choose	05:33:37
24	accordingly depending on whether one wanted to pull	05:33:44
25	down minority carriers of P-type or minority carriers	05:33:47

1	of N-type.	05:33:51
2	So the answer is, it could be either	05:33:52
3	depending on how one implemented it.	05:33:54
4	Q. Okay. What is a minority carrier of	05:33:57
5	P-type? Is it an electron or a hole?	05:34:02
6	MR. WHITEHURST: Object to form.	05:34:06
7	THE WITNESS: When you say P-type, do you	05:34:10
8	mean just a well, or are you talking about a	05:34:13
9	transistor?	05:34:17
10	Q. I'm using the exact language that you used	05:34:19
11	in your answer. You said, which one would choose	05:34:21
12	accordingly depending on whether one wanted to pull	05:34:28
13	down minority carriers of P-type or minority carriers	05:34:31
14	of N-type. I asked very simply, are the minority	05:34:36
15	carriers of P-type electron or hole?	05:34:39
16	MR. WHITEHURST: Counsel, I know it's	05:34:45
17	getting late in the day and we're getting frustrated,	05:34:46
18	but please don't yell at the witness.	05:34:49
19	MR. BOMBACH: I'm not yelling. I'm	05:34:53
20	actually very calm. I don't know why you put that on	05:34:54
21	the transcript.	05:35:00
22	Q. I will repeat, when you say P-type, do you	05:35:01
23	mean just a -- rather, strike that. I ask again very	05:35:04
24	simply, are the minority carriers of P-type electron	05:35:12
25	or hole?	05:35:19

1	MR. WHITEHURST: Object to form.	05:35:20
2	THE WITNESS: When I use the term N-type	05:35:21
3	I'm referring to electron. When I use the term	05:35:24
4	P-type I'm referring to holes. This is standard	05:35:27
5	nomenclature.	05:35:33
6	Q. I'll ask again because that doesn't	05:35:33
7	actually answer. Are the minority carriers of P-type	05:35:35
8	electron or hole?	05:35:43
9	MR. WHITEHURST: Object to form.	05:35:45
10	THE WITNESS: A hole or P-type minority	05:35:51
11	carrier is a minority carrier in an NMOS device, an	05:35:56
12	NMOS transistor. On the other hand, an electron or	05:36:02
13	N-type carrier would be the minority in a PMOS	05:36:15
14	device.	05:36:23
15	Q. And again, I'll ask because it wasn't	05:36:29
16	actually answered. Are the minorities of a P-type an	05:36:35
17	electron or a whole?	05:36:41
18	MR. WHITEHURST: Object to form. Asked and	05:36:45
19	answered.	05:36:47
20	THE WITNESS: I answered this a number of	05:36:49
21	times. I'm not sure how to answer it.	05:36:50
22	Q. If you did -- what is it? A or B?	05:36:52
23	MR. WHITEHURST: Counsel --	05:36:55
24	Q. Electron or whole?	05:36:57
25	MR. WHITEHURST: Counsel, I'm not going to	05:36:58

1	allow you to yell at the witness.	05:37:01
2	MR. BOMBACH: I'm not yelling. I would	05:37:02
3	just -- we could just end this line of questioning if	05:37:04
4	it's just answered, electron or hole. It's kind of	05:37:07
5	simple.	05:37:10
6	MR. WHITEHURST: Counsel, he is giving you	05:37:10
7	honest and full answers. You may not like his	05:37:12
8	answer, but that doesn't mean he has not answered it.	05:37:15
9	You can continue to ask him the same question. Why	05:37:20
10	don't ask you him. Do you have anything additional	05:37:24
11	to add? If he says, no, move on. But you just	05:37:26
12	asking him the same question over and over again is	05:37:30
13	not going to get a different answer. So you're	05:37:33
14	badgering the witness.	05:37:37
15	MR. BOMBACH: I'm not badgering the	05:37:40
16	witness. I'm asking a very simple question, A or B.	05:37:42
17	I'm getting a refusal to answer. The refusal to	05:37:43
18	answer will be reflected in our papers that we file	05:37:47
19	to PTAB. So I guess I will ask one final time.	05:37:53
20	Q. The '195 patent refers to subterranean	05:37:59
21	N-layer, and it references minority carriers on	05:38:12
22	column 3, lines 33 through 35. Are you able to tell	05:38:20
23	me what the minority carrier in an N-layer is? Is it	05:38:24
24	an electron or a hole?	05:38:29
25	A. The question is sort of problematic at a	05:38:35

1	base level. The N-layer is an implanted layer. It's	05:38:47
2	not a device. The minority and majority carriers	05:38:52
3	relate to transistors that are at the surface level.	05:38:56
4	The N-layer can be doped, the subterranean N-layer	05:38:59
5	can be doped either increasing or decreasing in order	05:39:05
6	to provide an electric adapter that points upwards or	05:39:05
7	downwards.	05:39:14
8	An electric vector that points upwards	05:39:14
9	would pull electrons down. An electric vector that	05:39:17
10	points downwards would pull holes down. So it can be	05:39:22
11	configured either way.	05:39:28
12	Q. Okay. Then, I will be more specific. A	05:39:29
13	device that has a P doped drain, a P doped source in	05:39:37
14	an N doped well, what would the minority carrier be?	05:39:50
15	Would it be an electron or a whole?	05:39:58
16	A. You said P source and drain and N-well?	05:40:03
17	Q. Yes.	05:40:09
18	A. A P source and drain requires holes for	05:40:10
19	conduction in a PMOS device. Therefore, the majority	05:40:11
20	holes and N electrons are the minority in a PMOS	05:40:20
21	device.	05:40:25
22	Q. Okay. In a device that has an N doped	05:40:26
23	drain and an N doped source in a P doped well, are	05:40:33
24	the minority carriers electrons or holes?	05:40:42
25	A. In an NMOS device with an N-type source and	05:41:03

1	drain in a P-well, the majority carriers in an NMOS	05:41:10
2	device are electrons. The minority carriers are	05:41:16
3	holes.	05:41:20
4	Q. Okay. And taking your answer to Figure 16	05:41:21
5	of Kawagoe, the minority carriers of the well 6N,	05:41:24
6	according to your testimony, are electrons; correct?	05:41:40
7	A. A well doesn't have a minority/majority. A	05:42:08
8	transistor has a minority/majority carrier. It	05:42:11
9	carries from the source to the drain. So you're	05:42:16
10	asking me about a PMOS device, P source drain in an	05:42:24
11	N-well; is that correct?	05:42:28
12	Q. I'm asking specifically about the N	05:42:32
13	material 6N of Kawagoe's Figure 16 which the P doped	05:42:38
14	source and P doped drain are implanted thereon. What	05:42:46
15	would the minority carrier be there?	05:42:53
16	MR. WHITEHURST: Object to form.	05:42:58
17	THE WITNESS: As I've stated previously,	05:42:59
18	the term, concept of carrier has meaning in a context	05:43:08
19	of a transistor or device. The current is carried	05:43:12
20	from the source to the drain. The PMOS device with a	05:43:16
21	P source in a P drain has holes as the majority	05:43:24
22	carrier and electrons as the minority.	05:43:31
23	Q. Okay. So were you answering in general or	05:43:52
24	with respect to Kawagoe Figure 16, the source and	05:43:59
25	drain 4PB, 4PD implanted into well 6N? I'm just	05:44:06

1	asking specifically about that section and device.	05:44:15
2	Is the minority carrier an electron or a hole?	05:44:20
3	MR. WHITEHURST: Object to form. Counsel,	05:44:23
4	you're going around and around here.	05:44:28
5	THE WITNESS: In a PMOS device, in an	05:44:34
6	N-well, the majority carrier is holes. The minority	05:44:41
7	carrier is electrons. This would be true for PMOS	05:44:48
8	devices in N-wells in every case that I know of. I	05:44:52
9	would be happy to look at another case if you want to	05:44:57
10	put it in front of me, but that's my understanding.	05:45:00
11	Q. You were deposed in other proceedings;	05:45:02
12	correct?	05:46:19
13	A. Yes.	05:46:22
14	Q. I would like to upload a few of those	05:46:23
15	transcripts.	05:46:28
16	MR. WHITEHURST: Counsel, we're going to	05:46:29
17	object to the introduction of evidence from other IPR	05:46:30
18	proceedings in light of the positions the board has	05:46:36
19	taken, and this is improper. We're going to seek to	05:46:41
20	exclude.	05:46:45
21	Q. I'm uploading into the chat box two	05:47:01
22	documents, which are transcript of Dr. Glew in IPR	05:47:07
23	2023-1242, 1243, 1244, which is labelled as	05:47:31
24	Exhibit 1052.	05:47:38
25	(Exhibit 1052 marked for identification.)	05:47:40

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1	Q. Do you see that?	05:47:42
2	A. Yes, I see that.	05:47:46
3	Q. Is this -- you were deposed in a matter	05:47:48
4	Semiconductor Components Industries versus	05:47:59
5	Greenthread; right?	05:48:02
6	MR. WHITEHURST: Counsel, we're still	05:48:10
7	downloading these. Counsel, can I say that it looks	05:48:12
8	like to me that you dropped in two; is that correct?	05:48:20
9	MR. BOMBACH: Yes, that is correct. I'm	05:48:23
10	going one at a time.	05:48:26
11	Q. One is from the Cirrus Logic proceeding.	05:48:27
12	One is from the OnSemi proceeding.	05:48:31
13	MR. WHITEHURST: Which one is the document	05:48:36
14	that is labelled 1052.	05:48:40
15	MR. BOMBACH: That is the semiconductor	05:48:42
16	component industries. Just for a clear record, which	05:48:44
17	is -- I've uploaded Exhibit 1052 from IPR 202301242	05:48:48
18	which states, "deposition of Dr. Glew."	05:48:58
19	MR. WHITEHURST: We'll just say on the	05:49:05
20	record that we object to the introduction of these	05:49:07
21	exhibits. We'll just say on the record that we	05:49:10
22	object to the introduction of these exhibits and	05:49:19
23	their use during this deposition.	05:49:24
24	Q. And with respect to Exhibit 1052, you	05:49:37
25	reviewed this transcript after you were deposed;	05:49:43

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1	correct?	05:49:47
2	A. I'm not sure. If I submitted errata to it,	05:49:48
3	then I did. If I didn't submit errata, then I'm not	05:50:09
4	sure I reviewed it in detail.	05:50:24
5	Q. Did you truthfully testify when you were	05:50:29
6	deposed on July 16th, 2024?	05:50:32
7	MR. WHITEHURST: Objection. Scope.	05:50:38
8	THE WITNESS: I always testify truthfully.	05:50:42
9	Whether my testimony is taken out of context or not	05:50:46
10	is another matter.	05:50:52
11	Q. Does this document, to the best of your	05:50:56
12	knowledge, accurately reflect your testimony given on	05:51:00
13	July 16th, 2024?	05:51:05
14	MR. WHITEHURST: Objection. Scope.	05:51:07
15	Objection. Form.	05:51:10
16	THE WITNESS: I have no reason to believe	05:51:22
17	it doesn't.	05:51:24
18	Q. And if you could please turn to what I've	05:51:26
19	uploaded as Exhibit 1063.	05:51:34
20	(Exhibit 1063 marked for identification.)	05:51:38
21	Q. This is a transcript of Dr. Glew in IPR	05:51:40
22	20240001. You were deposed in the case of Cirrus	05:51:43
23	Logic versus Greenthread on October 16th, 2024;	05:52:00
24	correct?	05:52:03
25	A. That's what this appears to be.	05:52:05

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1 Q. Did you testify truthfully when you were 05:52:08
2 deposed on October 16th, 2024? 05:52:11

3 A. Yes. I testified truthfully. Whether my 05:52:18
4 testimony has been taken out of context is another 05:52:22
5 matter. 05:52:24

6 Q. This document, to the best of your 05:52:25
7 knowledge, accurately reflects your testimony given 05:52:27
8 on October 16th, 2024. 05:52:31

9 MR. WHITEHURST: I'll just once again state 05:52:33
10 an objection to scope, objection to form, and 05:52:35
11 objection to the use of evidence from another IPR 05:52:38
12 proceeding. Counsel, do you want to ask him about a 05:52:49
13 particular question that he was asked during that 05:52:51
14 deposition, that's one thing. But to just try to get 05:52:55
15 a blanket introduction of everything that happened 05:52:59
16 during a deposition is inappropriate. 05:53:02

17 MR. BOMBACH: Your objection is noted and 05:53:08
18 your statement that you will seek to exclude it is 05:53:10
19 noted. 05:53:13

20 Q. Is there anything in -- are you aware of 05:53:14
21 anything in either transcript that you would like -- 05:53:20
22 Exhibit 1052 or 1063 that you would like to correct 05:53:23
23 for the record at this moment? 05:53:28

24 A. Off the top of my head, I can't think of 05:53:48
25 anything I would like to correct. I could review it 05:53:50

1	to confirm that.	05:53:52
2	Q. And if we could just turn back to your	05:53:54
3	declaration, 2057. If you could please turn to	05:54:01
4	paragraph 30 through 32. Here you state the standard	05:54:19
5	for obviousness. If you could take a quick second to	05:54:29
6	review that to yourself and let me know when you	05:54:38
7	finish.	05:54:41
8	A. Okay. I reviewed those three paragraphs.	05:55:02
9	Q. Dr. Glew, are you aware of what secondary	05:55:05
10	considerations is?	05:55:11
11	A. Generally. I've opined on it a few times.	05:55:16
12	I'm not an attorney, but I have a general idea.	05:55:20
13	Q. I note that secondary considerations are	05:55:24
14	not listed in your standards for obviousness and not	05:55:27
15	discussed in your declaration; is that a fair	05:55:32
16	assessment?	05:55:37
17	MR. WHITEHURST: Objection to form.	05:55:39
18	THE WITNESS: I don't recall forming a	05:55:49
19	secondary consideration analysis here. I don't	05:55:57
20	recall this in my declaration. If you want to point	05:56:02
21	me to it, I would be happy to look at it, but I do	05:56:07
22	not believe it's in there.	05:56:10
23	Q. I do not believe it's in there as well, and	05:56:11
24	is there a reason why secondary considerations was	05:56:18
25	not addressed in your declaration?	05:56:22

1	A. As an expert, I only perform analyses my	05:56:27
2	client requests. I don't recall a request to perform	05:56:32
3	a secondary condition on non-obviousness as a work	05:56:35
4	assignment.	05:56:42
5	Q. How many cases -- actually, in your	05:56:46
6	estimation, how many hours have you charged to	05:56:52
7	Greenthread for -- in total, for review of its	05:56:56
8	patents, submissions of declarations, participation	05:57:02
9	in litigations in this and all other matters for	05:57:05
10	Greenthread?	05:57:17
11	A. I couldn't tell you off the top of my head.	05:57:20
12	A few hundred. There's been three or four	05:57:23
13	depositions and a number of declarations.	05:57:29
14	Q. Are you engaged in litigation as well of --	05:57:31
15	strike that. Are you engaged in Greenthread's	05:57:38
16	district court litigations as well?	05:57:41
17	A. I believe I am. I might have to double	05:57:45
18	check that, but I thought I was deposed on an eastern	05:57:47
19	district of Texas matter.	05:57:56
20	Q. Okay. I think that is about it from my	05:58:09
21	end. I'll pass the witness to Mr. Whitehurst.	05:58:28
22	MR. WHITEHURST: Thank you, counsel.	05:58:34
23	EXAMINATION BY MR. WHITEHURST	05:58:36
24	Q. I don't know if the court reporter got it,	05:58:36
25	but I just said that I have a few questions to ask	05:58:54

1	the witness, and I was commenting that he has a large	05:59:00
2	monitor in front of him. So it's very difficult for	05:59:06
3	me to see him over the monitor. So let me slide my	05:59:09
4	chair a little bit just so it feels a little more	05:59:16
5	natural.	05:59:20
6	Dr. Glew, I know it's been a long day but I	05:59:23
7	do have a few questions I want to go over with you	05:59:27
8	that relate to your testimony earlier today. I would	05:59:31
9	like to start with the '195 patent, which I believe	05:59:36
10	was Exhibit 1001 from the IPR 2024-00468. Do you	05:59:42
11	have a copy of the '195 patent in front of you.	05:59:57
12	A. Yes, I have MPS Exhibit 1001. Sorry. Long	06:00:02
13	day. Yes. I have MPS Exhibit 1001, 14 pages.	06:00:13
14	Q. Terrific. If you could please turn to	06:00:19
15	column 4 of the '195 patent, it's the second to last	06:00:22
16	page.	06:00:30
17	A. I'm there.	06:00:33
18	Q. Do you see where claim 1 begins?	06:00:34
19	A. Yes.	06:00:38
20	Q. Do you understand what the preamble of	06:00:39
21	claim 1 is?	06:00:43
22	A. Yes.	06:00:45
23	Q. Can you please read the preamble aloud?	06:00:46
24	A. "A CMOS semiconductor device comprising."	06:00:53
25	Q. Do you have an opinion whether claim 1 is	06:00:58

1	directed to a CMOS semiconductor device?	06:01:01
2	A. Yes, I understand claim 1 is directed	06:01:07
3	toward a CMOS semiconductor device.	06:01:13
4	Q. Now, if we look at claim 1, you'll see that	06:01:17
5	in two places there's a reference to minority	06:01:23
6	carriers. I believe the first one is column 4,	06:01:26
7	line 23. Do you see that?	06:01:38
8	A. Yes, I see that.	06:01:40
9	Q. And then, I believe the next reference to	06:01:41
10	minority carriers is column 4, line 28. Do you see	06:01:45
11	that?	06:01:55
12	A. Yes, I see that.	06:01:55
13	Q. Do you understand what a minority carrier	06:01:56
14	is?	06:02:02
15	A. Yes. In the context of a CMOS device it's	06:02:05
16	the opposite of a majority carrier.	06:02:09
17	Q. Do you have an opinion whether these	06:02:12
18	minority carriers that are mentioned in claim 1 are	06:02:17
19	the minority carrier of the CMOS semiconductor	06:02:25
20	device?	06:02:29
21	A. Yes. They are the minority carrier of a	06:02:31
22	CMOS semiconductor device, and it's consistent and	06:02:38
23	makes sense because a CMOS semiconductor device is	06:02:42
24	functionally a majority carrier. So the majority	06:02:46
25	carriers provide the carrier that goes from the	06:02:49

1 source to the drain. This could be differentiated 06:02:55
2 from other types of transistors where they 06:02:59
3 principally work with the minority carriers, like the 06:03:02
4 bipolar junction transistors are understood to be 06:03:09
5 minority carrier devices. So that would be very 06:03:14
6 different. 06:03:17

7 Q. Do you have an opinion whether a minority 06:03:20
8 carrier may or may not be different in a CMOS 06:03:23
9 semiconductor device versus a different type of 06:03:30
10 semiconductor device? 06:03:34

11 A. Well, in a semiconductor device, one 06:03:42
12 understands that certain types of carriers do the 06:03:49
13 work. One might understand, as I think I've alluded 06:03:55
14 to, that bipolar transistors are typically minority 06:04:01
15 functioning devices, whereas MOS devices are majority 06:04:06
16 carrier devices. Structures are different. The MOS 06:04:12
17 device is also channel dominated. 06:04:19

18 Q. Do you remember being asked numerous 06:04:29
19 questions about majority and minority carriers 06:04:34
20 earlier today? 06:04:38

21 A. Yes, generally. 06:04:41

22 Q. And do you remember your testimony about 06:04:42
23 how the majority and minority carriers relate to the 06:04:48
24 device? 06:04:52

25 A. Yes. 06:04:53

1	Q. And do you remember being asked questions	06:04:56
2	about the well regions?	06:04:58
3	A. Yes.	06:05:02
4	Q. Now, when you were talking about a CMOS	06:05:02
5	semiconductor device like the one claimed in claim 1	06:05:07
6	of the '195 patent, do you have an opinion whether it	06:05:15
7	makes sense to talk about the majority carrier or the	06:05:20
8	minority carrier of the well region?	06:05:25
9	A. No, it doesn't because that's the exact	06:05:30
10	opposite of what one would want. If one looks at	06:05:33
11	claim 1 it describes moving the minority carriers	06:05:37
12	from the surface. That would be removing it from the	06:05:41
13	device. So if one understands in an NMOS device that	06:05:43
14	holes are the minority and the electrons are the	06:05:50
15	majority of the carriers, that makes for a more	06:05:53
16	functional device. The faster one gets electrons in	06:05:56
17	place, the faster the NMOS transistor can turn on.	06:06:01
18	Whereas NMOS device are in a P-well and	06:06:06
19	there are more holes than electrons, if one for some	06:06:09
20	crazy reason thought that electrons are the minority	06:06:14
21	just because it's a P-well and there's fewer	06:06:17
22	electrons than holes, then if one pulled the minority	06:06:19
23	carriers out of the transistor, it would either, one,	06:06:24
24	work slower or, two, not work at all. With all the	06:06:28
25	minority carriers, it would be a non-functional NMOS	06:06:34

1	transistor. So the only reading of claim 1 of the	06:06:37
2	'195 patent that makes sense and is consistent with	06:06:40
3	both the specification and the understanding of one	06:06:43
4	in skill of the art, is that the minority carriers	06:06:48
5	are different than the source drain in the CMOS	06:06:53
6	device. Simply, an NMOS transistor has an N-type	06:07:00
7	source drain and the majority is NMOS. A PMOS has a	06:07:04
8	P-type source drain, the majority is a P-type or	06:07:08
9	holes.	06:07:20
10	Q. Now, if we could go back to column 1 of the	06:07:23
11	'195 patent. You let me know when you're at column	06:07:32
12	1.	06:07:39
13	A. I am on column 1.	06:07:39
14	Q. If you would please direct your attention	06:07:40
15	to lines 43 and 44 of column 1.	06:07:44
16	A. I am there.	06:07:52
17	Q. Can you see two sentences where the first	06:07:52
18	sentence reads, "In contrast to BJTs, MOS devices are	06:07:56
19	majority carrier devices for conduction." And the	06:08:08
20	next sentence reads, "The conduction is channel	06:08:15
21	dominated."	06:08:18
22	Do you see those two sentences?	06:08:21
23	A. Yes, I do.	06:08:23
24	Q. Are these two sentences relevant to your	06:08:24
25	answer to my previous question?	06:08:29

1	MR. BOMBACH: Objection. Leading.	06:08:33
2	THE WITNESS: Yes. These are relevant. In	06:08:35
3	fact, I quoted one of those sentences already. The	06:08:38
4	conduction is channel dominated. I was looking at	06:08:42
5	this as I answered the question.	06:08:47
6	Q. So let's now go to column 3 of the '195	06:08:49
7	patent. Do you see at line 14 a reference to figures	06:08:55
8	5A, 5B, and 5C?	06:09:11
9	A. Yes, I do.	06:09:15
10	Q. And do you see a reference in line 7 to	06:09:16
11	"spurious minority carriers"?	06:09:28
12	A. I see that at 17.	06:09:34
13	Q. Yes. Let me make sure the record is clear.	06:09:36
14	Do you see a reference in column 3, line 17 to	06:09:40
15	"spurious minority carriers"?	06:09:49
16	A. Yes, I see that.	06:09:53
17	Q. Okay. Let's take a look at Figure 5B. And	06:09:54
18	I don't know if it's possible for you to look at	06:10:06
19	Figure 5B and column 3 at the same time, but I'm	06:10:09
20	going to ask you about the Figure 5B and to identify	06:10:14
21	what your understanding of spurious minority carriers	06:10:23
22	is. I just want to give you a second to get	06:10:27
23	Figure 5B in front of you. Please let me know when	06:10:31
24	you do.	06:10:34
25	A. I have 5B.	06:10:35

1	Q. Now, does -- in your 5B show a transistor?	06:10:38
2	A. Yes, it shows a transistor. It shows an	06:10:47
3	NMOS type transistor with a storage element or image	06:10:57
4	sensor.	06:11:11
5	Q. Can you describe the well region in	06:11:11
6	Figure 5B?	06:11:23
7	A. The well region is the region in which the	06:11:32
8	transistors are formed.	06:11:35
9	Q. Are you familiar with the terms P-well and	06:11:37
10	N-well?	06:11:48
11	A. Yes.	06:11:49
12	Q. For the NMOS transistor shown in Figure 5B,	06:11:49
13	would the well be a P-well or an N-well?	06:11:56
14	A. An NMOS transistor would be formed in a	06:12:02
15	P-well so that the channel between them would be	06:12:05
16	P-type.	06:12:09
17	Q. Now, I want to go back now that we've had a	06:12:10
18	chance to look at Figure 5B and look at column 3	06:12:14
19	again. Do you see where we were looking at column 3,	06:12:20
20	line 17 and the reference to spurious minority	06:12:31
21	carriers?	06:12:34
22	A. Yes, generally.	06:12:36
23	Q. Do you have an opinion what the spurious	06:12:38
24	minority carriers would be in Figure 5B?	06:12:46
25	A. Figure 5B is an NMOS device. So it would	06:12:57

1	store and pass electrons to spurious minority	06:13:05
2	carriers -- would be holes, or P.	06:13:13
3	Q. And can you explain what this sentence is	06:13:18
4	saying about the spurious minority carriers?	06:13:24
5	A. Basically, it says that they can be	06:13:33
6	generated by other circuitry. For example, clock	06:13:38
7	switching and logic and memory. It says that these	06:13:41
8	carriers can discharge the dynamically held --	06:13:49
9	actively held high nodes. So if a device is storing	06:13:54
10	electrons, for example, as a pixel for an image or as	06:14:01
11	a memory bit, and one introduces holes into the	06:14:05
12	storage element, it will bleed all the electrons and	06:14:12
13	the signal disappears. Holes and electrons combine	06:14:15
14	and cancel each other.	06:14:18
15	Q. Do you see how on line 18 there's a	06:14:30
16	sentence that reads, "these unwanted carriers"?	06:14:36
17	Do you see that?	06:14:41
18	A. Yes.	06:14:43
19	Q. Do you have an opinion whether the words,	06:14:44
20	"these unwanted carriers," are referring back to the	06:14:50
21	previous sentence where it says, "spurious minority	06:14:54
22	carriers"?	06:14:59
23	A. Yes. It relates to the previous and the	06:15:04
24	following sentence. It says that the spurious	06:15:09
25	minority carriers can be generated. It says that	06:15:13

1 these can -- in that sentence you read, that they can
2 discharge the actively held high nodes. So DRAM is,
3 you know, actively held high and requires power to
4 keep it refreshed. It goes on to say that statically
5 held nodes, while they're just held at a fixed
6 voltage, they aren't generally affected. It says,
7 then, "degradation of refresh time in DRAMs is one of
8 the results because the capacitor holds charge
9 dynamically."

10 So DRAM stands for dynamic ram. It gets
11 dynamically refreshed millions of times a second to
12 keep its value.

13 Q. Why were-- strike that. Why are the
14 minority carriers unwanted?

15 A. Minority carriers are unwanted because they
16 will combine with a majority carrier to erase the
17 data that's being stored. Holes and electrons
18 combine when they're put together and wipe each other
19 out. An electron goes into the hole and the hole is
20 just a missing spot on an atom. Then, the data is
21 gone. So a memory bit or an image bit could be a
22 number of electrons stored. It could be a couple
23 hundred electrons or less. It's not that much
24 signalling.

25 Q. Do you have an opinion whether the majority

1	carriers -- before I ask that question, can you go	06:17:18
2	back and look at Figure 5B where you identified an	06:17:27
3	NMOS transistor in a P-well?	06:17:35
4	A. Yes.	06:17:38
5	Q. Can you explain what the majority carrier	06:17:39
6	would be?	06:17:46
7	A. Yes. This is an NMOS transistor shown	06:17:46
8	because the source and drain are labelled N and T.	06:17:50
9	So an NMOS transistor requires electrons to connect	06:17:56
10	the N-type source and drain. So electrons are the	06:18:04
11	majority carrier N-type and the minority carriers are	06:18:09
12	holes or P-type.	06:18:13
13	Q. Do you have an opinion whether in an NMOS	06:18:14
14	transistor the majority carrier electron would be	06:18:22
15	wanted or unwanted?	06:18:31
16	MR. BOMBACH: Objection. Leading.	06:18:34
17	THE WITNESS: The majority carrier	06:18:35
18	electrons are wanted. They are desired, because that	06:18:39
19	is what is required to turn it on. There's typically	06:18:45
20	a challenge to turn things on faster and faster so	06:18:47
21	that the faster one can assemble electrons in the	06:18:52
22	channel. The faster the transistor turns on -- also,	06:18:55
23	it's sending those electrons somewhere. If it's	06:19:00
24	sending it just as data, it goes somewhere else. If	06:19:03
25	it's storing it for DRAM or for image pixel, then it	06:19:05

1	needs the electrons to put in the storage element.	06:19:11
2	Q. When you read column 3 and you look at	06:19:13
3	Figure 5B, do you have an opinion whether it makes	06:19:22
4	sense to want to get rid or to get rid of the	06:19:29
5	majority carrier which is -- strike that. When you	06:19:38
6	read column 3 and you look at Figure 5B, does it make	06:19:46
7	sense to want to pull the majority carriers from the	06:19:58
8	surface?	06:20:03
9	MR. BOMBACH: Objection. Leading.	06:20:06
10	THE WITNESS: As I've stated I think a few	06:20:07
11	times today, the majority carriers are necessary for	06:20:11
12	the functioning of the transistor. The majority	06:20:14
13	carriers must be assembled between the source and	06:20:18
14	drain and the channel in order to connect the source	06:20:22
15	and drain and channel. Further, the majority	06:20:25
16	carriers, once they're flowing through the	06:20:30
17	transistor, have to go somewhere. So there would be	06:20:34
18	no reason to remove majority carriers. Removing	06:20:37
19	majority carriers would slow down the turning on of	06:20:41
20	the transistor, or it would rob the stored signal	06:20:45
21	from the storage elements or data signal too.	06:20:49
22	Q. I believe he was saying too, as in also.	06:21:15
23	T-O-O. Looking at column 3, line 30, do you see a	06:21:24
24	sentence that begins, hence?	06:22:16
25	A. Yes.	06:22:26

1	Q. And do you see where it says, "Creating a	06:22:27
2	drift field to sweep these unwanted minority carriers	06:22:33
3	into the substrate as quickly as possible from the	06:22:41
4	active circuitry at the surface"?	06:22:44
5	Do you see that?	06:22:47
6	A. Yes.	06:22:48
7	Q. And I believe you testified previously that	06:22:48
8	these unwanted minority carriers would be holes in	06:22:55
9	Figure 5B?	06:23:02
10	A. Yes. Figure 5B is NMOS, so electrons are	06:23:03
11	majority and holes are minority carriers.	06:23:10
12	Q. Why would you want to sweep holes into the	06:23:12
13	substrate as quickly as possible from the active	06:23:16
14	circuitry at the surface?	06:23:20
15	A. The faster the holes for minority carriers	06:23:24
16	are swept from the channel region, the faster the	06:23:29
17	transistor turns on. It must create an inversion	06:23:33
18	layer at the surface where majority carriers for the	06:23:37
19	transistor, which are actually the least common in	06:23:42
20	the well, are attracted to the surface, and the	06:23:45
21	minority carriers for the transistor which are the	06:23:48
22	main species in the well are pushed away.	06:23:52
23	Q. Now, for the NMOS transistor shown in	06:24:01
24	Figure 5B, does it make sense to want to sweep	06:24:05
25	electrons into the substrate as quickly as possible	06:24:11

1	from the active circuitry at the surface?	06:24:15
2	A. No. If we look at Figure 5B, what we see	06:24:18
3	is an N source and drain which requires electrons	06:24:22
4	connected to. We see an access transistor labelled	06:24:28
5	above it. That access transistor will be providing a	06:24:31
6	positive voltage. It will attract electrons to the	06:24:35
7	surface. It will push away holes. And if there's a	06:24:40
8	drift field below that will help pull away holes	06:24:48
9	also, it will turn on faster.	06:24:51
10	Q. Do you have an opinion whether Figure 5B	06:24:53
11	shows an electric field?	06:24:57
12	A. Yes, it does. It's shown as arrows there.	06:25:01
13	Q. Do you have an opinion whether this	06:25:06
14	electric field is pointing in a particular direction?	06:25:09
15	A. Yes. The electric field is pointing	06:25:14
16	downwards, and that electric field would pull holes	06:25:17
17	or minority species downward away from the NMOS	06:25:24
18	device.	06:25:28
19	Q. Now, for the minority carrier holes, would	06:25:28
20	the electric field shown in Figure 5B pull the holes	06:25:34
21	from the surface?	06:25:41
22	A. The electric field shown in 5B would pull	06:25:45
23	holes from the surface. It works in coordination	06:25:56
24	with the gate voltage which pushes the holes away	06:25:58
25	from the surface, and the drift field will aid it and	06:26:04

1 pull holes faster away from the surface. It's not 06:26:09
2 meant to pull away all the time, otherwise the 06:26:12
3 transistor would be on all the time. It's meant to 06:26:15
4 assist when the access -- when the gate electrode 06:26:18
5 receives a positive voltage. 06:26:24

6 Q. Now what effect, if any, would the electric 06:26:28
7 field shown in Figure 5B have on an electron? 06:26:31

8 A. Figure 5B shows an electric field pointed 06:26:36
9 downward. So it would pull holes downward and push 06:26:44
10 electrons upward in the opposite direction. The 06:26:49
11 electric field acts in opposite direction on carriers 06:26:52
12 of opposite polarity. Thanks to Ben Franklin, 06:26:57
13 electrons go in the opposite direction of the 06:27:10
14 electric field. 06:27:13

15 Q. Looking at Figure 5B, would the electric 06:27:14
16 field in Figure 5B be capable of pulling electrons 06:27:25
17 from the surface? 06:27:32

18 A. No. The electric field at 5B is pointed 06:27:37
19 downwards. It only would pull holes downward. It 06:27:42
20 would push electrons upwards. It could not pull 06:27:46
21 electrons downward. 06:27:52

22 Q. Now, you've testified that for the NMOS 06:27:53
23 transistor shown in Figure 5B, the majority carrier 06:27:58
24 is an electron. Did I get that correct? 06:28:07

25 A. Yes. In Figure 5B, the majority carrier is 06:28:12

1	an electron. It's an NMOS device.	06:28:15
2	Q. Does it matter whether the transistor is on	06:28:19
3	or off?	06:28:22
4	A. No. The majority carrier for an NMOS	06:28:26
5	transistor is always an electron. Transistors are	06:28:32
6	meant to turn on and off. That's a normal part of	06:28:39
7	their operation.	06:28:42
8	Q. So a majority carrier -- strike that. So	06:28:43
9	for the NMOS transistor shown in Figure 5B, the	06:28:50
10	majority carrier is an electron regardless of whether	06:28:57
11	the transistor is on or off?	06:29:03
12	A. Yes. The majority carrier is always an	06:29:08
13	electron for NMOS transistor, regardless of its	06:29:11
14	state. It is channel dominated. And the only way to	06:29:15
15	get an electrical signal from the source to the drain	06:29:19
16	is to use electrons. The source is filled with	06:29:25
17	electrons, the drain is filled with electrons, and	06:29:28
18	the only way to connect the two is with electrons.	06:29:31
19	It never changes.	06:29:35
20	Q. Would your answer be the same for the	06:29:36
21	minority carrier for the transistor shown in	06:29:39
22	Figure 5B, would the minority carrier be a hole	06:29:44
23	regardless of whether the transistor is on or off?	06:29:52
24	A. Yes. Similar to my last answer, the	06:29:56
25	minority carrier for an NMOS transistor is always a	06:30:01

1	hole, regardless of whether it is on or off.	06:30:07
2	Q. If you could go back to claim 1 of the '195	06:30:12
3	patent.	06:30:19
4	A. I'm there.	06:30:32
5	Q. Do you see around line 27 where it says, "A	06:30:33
6	second static unidirectional electric drift field to	06:30:42
7	aid the movement of minority carriers from said	06:30:47
8	surface layer to said substrate"?	06:30:52
9	A. Yes.	06:30:59
10	Q. Do you have an opinion what it means to aid	06:30:59
11	the movement of minority carriers from said surface	06:31:08
12	layer?	06:31:12
13	A. Yes. The field must provide force in the	06:31:16
14	direction -- for the substrate, this minority carrier	06:31:25
15	moves from the surface layer to the substrate.	06:31:41
16	Q. Let's go to column 2. Do you remember	06:31:46
17	being asked questions earlier today about the	06:31:56
18	paragraph that begins on line 35 of column 2?	06:32:00
19	A. Generally. Not in great detail.	06:32:06
20	Q. Do you see a sentence that begins on	06:32:10
21	line 42 that reads, "the relative slope"?	06:32:15
22	Do you see that?	06:32:20
23	A. Yes.	06:32:21
24	Q. What does it mean when it says, "relative	06:32:21
25	slope"?	06:32:25

1	A. The relative slope is how steep it is.	06:32:28
2	It's the magnitude of the slope.	06:32:31
3	Q. And do you see a reference to creating a	06:32:35
4	suitable aiding drift electric field? Do you see	06:32:41
5	that?	06:32:45
6	A. Yes, I see that.	06:32:47
7	Q. Do you have an opinion what it means to be	06:32:48
8	a suitable aiding drift electric field?	06:32:53
9	A. Yes. The relative slope or magnitude of	06:33:01
10	the slope and the direction of the field generated	06:33:07
11	must be sufficient to help the holes travel from the	06:33:15
12	emitter to collector. So the magnitude and direction	06:33:21
13	have to actually help make the current flow happen.	06:33:26
14	We'll call that the vector, the magnitude and	06:33:33
15	direction.	06:33:44
16	Q. Do you see a reference here in this	06:33:46
17	paragraph to BJT?	06:33:53
18	A. Yes.	06:33:56
19	Q. Now, do you have an opinion whether the	06:33:59
20	relative slope of the donor concentration is relevant	06:34:03
21	to a BJT transistor?	06:34:09
22	A. The relative slope would be relevant to all	06:34:14
23	transistors. The relative slope provides the	06:34:18
24	magnitude of the electric field.	06:34:21
25	Q. Now, you see that claim 1 of the '195	06:34:25

1	patent is directed to a CMOS semiconductor device?	06:34:30
2	Do you see that?	06:34:39
3	A. Yes.	06:34:40
4	Q. Can you explain why this reference to	06:34:40
5	relative slope in column 2, line 42, would also be	06:34:48
6	relevant to a CMOS semiconductor device?	06:34:58
7	A. The relative slope is what is necessary to	06:35:01
8	aid the movement. So a sufficient relative slope or	06:35:09
9	magnitude helps the motion, in this case, of minority	06:35:14
10	carriers from said surface layer to said substrate.	06:35:20
11	Q. Do you have an opinion whether the relative	06:35:24
12	slope would be relevant to whether a unidirectional	06:35:30
13	electric drift field would aid the movement of	06:35:41
14	minority carriers from the surface layer to the	06:35:45
15	substrate?	06:35:47
16	A. Yes. The relevant slope -- the relative	06:35:50
17	slope is relevant to the motion. It must be	06:35:57
18	sufficiently steep, meaning the magnitude of the	06:36:04
19	electric drift field generated drives from the slope	06:36:10
20	or steepness of the concentration gradient. That	06:36:15
21	field must be adequate to help the carrier move from	06:36:23
22	the first point to the second point.	06:36:31
23	Q. Do you have an opinion whether the	06:36:32
24	language, suitable aiding drift electric field, would	06:36:34
25	be relevant to the CMOS semiconductor device claimed	06:36:40

1	in claim 1?	06:36:46
2	A. Yes. The magnitude and direction of the	06:36:48
3	electric drift field must be sufficient to help move	06:36:54
4	the carrier, minority carrier, from the surface layer	06:37:01
5	to the substrate.	06:37:08
6	Q. Would your testimony be the same if it just	06:37:10
7	said, "To aid the movement of carriers from the	06:37:17
8	surface layer to the substrate"?	06:37:20
9	A. Yes. The same would be necessary. It	06:37:28
10	would need to be sufficiently strong and in the right	06:37:38
11	direction, meaning the magnitude and the -- the	06:37:41
12	vector would have to be proper.	06:37:45
13	Q. Can you give me some examples of what would	06:37:47
14	be a suitable aiding drift electric field as opposed	06:37:52
15	to an unsuitable aiding drift electric field?	06:37:59
16	A. Well, in this example, in order to move	06:38:05
17	minority carriers, let's say, holes from the surface	06:38:09
18	layer to the substrate, the electric field would have	06:38:16
19	to be pointed downward. So in order for the field to	06:38:21
20	point downward, the concentration gradient would have	06:38:26
21	to be retrograde, larger under the surface, and	06:38:38
22	decreasing as it tended toward the surface.	06:38:42
23	Q. Now, do you remember being asked questions	06:38:46
24	today about the Kawagoe patent?	06:38:54
25	A. Yes.	06:38:59

1	Q.	And hopefully you have a copy of the	06:39:00
2		Kawagoe patent, which I believe is Exhibit 1007.	06:39:11
3	A.	Yes.	06:39:15
4	Q.	Can you please direct your attention to	06:39:22
5		Figure 17?	06:39:37
6	A.	Yes.	06:39:41
7	Q.	Do you remember being asked about SEU	06:39:41
8		electrons?	06:39:52
9	A.	Yes.	06:39:54
10	Q.	Do you have an opinion of what the dopant	06:39:54
11		concentration shown in Figure 17 were intended to do?	06:40:05
12	A.	It's my understanding in Kawagoe that the	06:40:14
13		dopant concentrations were intended to keep the alpha	06:40:20
14		ray generated electrons from entering the well, the	06:40:27
15		P-well. Electrons are a problem in a P-well. In an	06:40:32
16		N-well, it's already full of electrons. So not such	06:40:41
17		an issue. But the P-wells are subject to N-well --	06:40:45
18		to electron invitation.	06:40:50
19	Q.	So in Kawagoe, would it have been bad if	06:40:59
20		the SEU electrons had entered the P-well?	06:41:03
21	A.	Yes. The patent describes that as one of	06:41:10
22		the goals so as not to degrade memory bits and things	06:41:16
23		like that.	06:41:20
24	Q.	I can't remember your exact words, but do	06:41:21
25		you remember being asked questions about whether SEU	06:41:27

1	electrons in the P-well are relevant? I can't	06:41:33
2	remember your exact words. Let me ask this question	06:41:38
3	a different way. Do you remember being asked about	06:41:43
4	whether there are SEU electrons in the P-well?	06:41:49
5	A. I remember discussing and answering	06:41:59
6	questions about keeping SEU electrons out of the	06:42:03
7	P-well so as not to degrade memory and similar	06:42:07
8	problems.	06:42:19
9	Q. Can you tell from Figure 17 whether it	06:42:19
10	would have an effect and, if so, what that effect	06:42:22
11	would be on an SEU electron inside the P-well?	06:42:28
12	A. There's not enough information to know what	06:42:35
13	the net field effects are inside of a P-well. The	06:42:37
14	patent clearly states it can repel electrons from the	06:42:46
15	P-well, but what's actually happening inside the	06:42:49
16	P-well the patent is silent on. It's impossible to	06:42:52
17	know based on the lack of information disclosed in	06:42:56
18	the Kawagoe patent.	06:42:59
19	Q. Now, in Figure 5B of the '195 patent, we	06:43:00
20	were looking at an NMOS transistor in a P-well. Do	06:43:05
21	you recall that?	06:43:11
22	A. I have it in front of me now.	06:43:18
23	Q. Did I get it correctly that Figure 5B of	06:43:23
24	the '195 patent is showing an NMOS transistor in a	06:43:26
25	P-well?	06:43:30

1	A. Yes. That's correct. NMOS and a P-well in	06:43:31
2	Figure 5 B.	06:43:36
3	Q. I believe you've looked at Figure 23 before	06:43:37
4	of Kawagoe?	06:43:44
5	A. Yes.	06:43:50
6	Q. And do you see in Figure 23 on the	06:43:51
7	right-hand side a reference to a P-well?	06:43:56
8	A. Yes.	06:44:04
9	Q. And is the right-hand side of Figure 23	06:44:05
10	showing an NMOS transistor in a P-well?	06:44:13
11	A. Yes, the right side shows an NMOS and a	06:44:19
12	P-well.	06:44:24
13	Q. So Figure 5B of the '195 patent and	06:44:24
14	Figure 23 of Kawagoe are both showing an NMOS	06:44:30
15	transistor in a P-well?	06:44:35
16	A. Yes, they both show that.	06:44:39
17	Q. And do you remember your testimony about	06:44:41
18	why it makes sense to move holes from the surface of	06:44:47
19	the P-well into the substrate?	06:44:59
20	A. Generally, yes.	06:45:03
21	Q. And do you remember your testimony about	06:45:05
22	Figure 5B, that it does not make sense to move	06:45:11
23	electrons from the surface of the P-well into the	06:45:17
24	substrate?	06:45:22
25	A. Yes. It would slow down the transistor or	06:45:24

1	render it inoperable for its intended purpose.	06:45:27
2	Q. Do you have an opinion whether it would	06:45:30
3	make sense to want to move electrons from the surface	06:45:33
4	of the P-well in Kawagoe into the substrate?	06:45:40
5	A. It doesn't make sense to want to remove	06:45:52
6	electrons from the NMOS device in Kawagoe.	06:45:55
7	Q. Why does it not make sense to want to	06:46:42
8	remove electrons from the NMOS device shown on the	06:46:48
9	right-hand side of Figure 23 in Kawagoe?	06:46:55
10	A. Removing electrons from transistor 4N in	06:47:02
11	Figure 23 of Kawagoe would slow down the turn on	06:47:13
12	speed of the transistor, or if sufficient electrons	06:47:22
13	were removed it would render it inoperable. So it	06:47:28
14	would be deleterious to the intended operation of the	06:47:33
15	device. I think if we've been going two hours, I	06:47:39
16	should take a break. Five minutes?	06:47:45
17	MR. WHITEHURST: Is that okay with	06:47:50
18	everybody else if we take a five minute break?	06:47:52
19	VIDEOGRAPHER: I'll take us off the record.	06:47:55
20	Is that okay? We're going off the record now.	06:47:57
21	18:48.	06:48:04
22	(Recess taken.)	06:48:05
23	VIDEOGRAPHER: We're back on the record.	06:52:32
24	18:52.	06:52:41
25	Q. Dr. Glew, during the break just now, did I	06:52:42

1	talk to you at any time?	06:52:44
2	A. No, not a word.	06:52:47
3	Q. I want to ask you some questions regarding	06:52:50
4	Figure 17, which appears on page 10 of 36 of	06:52:56
5	Exhibit 1007. Do you have that in front of you?	06:53:06
6	A. Yes.	06:53:11
7	Q. Do you recall -- well, do you see a line	06:53:11
8	that begins on the left-hand side at NW?	06:53:17
9	A. Yes.	06:53:22
10	Q. And it looks like the line goes past WW.	06:53:22
11	Do you see that?	06:53:31
12	A. Yes.	06:53:32
13	Q. And do you remember your testimony earlier	06:53:32
14	today about Figure 17 keeps electrons in the	06:53:38
15	substrate? Do you recall that?	06:53:49
16	A. Yes. Generally, the line in Figure 17 has	06:53:53
17	an electric vector pointed to the left toward the	06:53:57
18	surface, which would push electrons toward the right	06:54:03
19	per the substrate. The specification is clear that	06:54:09
20	it's intended to keep electrons generated by alpha	06:54:12
21	particles out of the well.	06:54:15
22	Q. Do you remember being asked questions about	06:54:17
23	an electron inside the P-well?	06:54:20
24	A. Generally, yes.	06:54:27
25	Q. And just so the record is clear, do you	06:54:28

1	understand that when I say an electron in the P-well,	06:54:32
2	I mean between the region that starts in zero and	06:54:38
3	goes to WW?	06:54:45
4	A. Yes, that's the well region.	06:54:48
5	Q. And do you recall your testimony that you	06:54:51
6	couldn't tell what direction, if any, an electron in	06:54:55
7	the P-well would move?	06:55:00
8	A. Yes. Generally, there's not enough	06:55:05
9	information to accommodate the electrons' net force,	06:55:07
10	or the net force on the electrons. Furthermore, for	06:55:19
11	an NMOS device, it would be undesirable to move them.	06:55:29
12	So to the extent that anything did happen, it doesn't	06:55:35
13	sound like a good idea.	06:55:41
14	Q. Can you please explain why the line that	06:55:42
15	starts at NW and goes -- strike that. Can you please	06:55:48
16	explain how the line that begins at the Y axis, and	06:55:56
17	more specifically, at NW, can you please explain how	06:56:04
18	this line that begins at the Y axis at zero and goes	06:56:14
19	past WW on the X axis could keep electrons out of the	06:56:23
20	P-well but you can't tell what direction, if any,	06:56:36
21	they would move inside the -- strike that.	06:56:41
22	I'll re-ask the question. Dr. Glew, do you	06:56:56
23	see a line that intersects the Y axis at NW?	06:57:01
24	A. Yes.	06:57:09
25	Q. And do you see how this line goes from a	06:57:10

1 depth of zero past a depth of WW? 06:57:15

2 A. Yes, I see a line -- a solid line. 06:57:21

3 Q. Can you please explain how this line could 06:57:25

4 keep SEU electrons out of the P-well but it is 06:57:30

5 impossible to tell what direction, if any, this line 06:57:41

6 would cause an electron inside the P-well to move? 06:57:48

7 A. First, the specification clearly states 06:57:59

8 that this is intended to keep the alpha ray generated 06:58:02

9 electrons out of the P-well. So I understand it does 06:58:10

10 that. The concentration in the P-well decreases with 06:58:14

11 depth, which means that the electric vector points 06:58:23

12 toward the surface. That is, the left of the 06:58:29

13 Figure 17. So since the electric vector points to 06:58:35

14 the left, it would push holes to the right. 06:58:41

15 So it's consistent with this dopant profile 06:58:45

16 that electrons be repulsed from the well. There may 06:58:48

17 be a further interaction with the change in 06:58:53

18 concentration. Additionally, regarding the activity 06:58:59

19 of electrons within the well, there's not enough 06:59:04

20 information to make a determination of the net forces 06:59:09

21 of the device that acts upon electrons in the well. 06:59:14

22 So one cannot determine what happens. 06:59:22

23 Nonetheless, if electrons in the well were 06:59:24

24 removed from the NMOS, it would be deleterious to the 06:59:27

25 intended operation of the NMOS device. 06:59:37

1	Q. Now, do you recall that claim 1 of the '195	06:59:39
2	patent recites a surface layer?	06:59:49
3	A. Yes.	07:00:10
4	Q. And do you recall that it also recites an	07:00:10
5	active region including a source and a drain disposed	07:00:14
6	on one surface of said surface layer?	07:00:20
7	A. That is the third claim element. Yes.	07:00:26
8	Q. What is your understanding of whether the	07:00:30
9	active region is inside the surface layer?	07:00:37
10	A. The claim element describes that the active	07:00:43
11	region is on one surface of the surface layer. So	07:00:52
12	it's, as I understand it -- and it is shown in the	07:00:58
13	figures, it's at the top of the surface layer.	07:01:03
14	Q. Do you understand that the active region	07:01:05
15	was inside the surface layer?	07:01:08
16	A. Yes, it's on one surface of the surface	07:01:14
17	layer. There's another surface on the other side of	07:01:19
18	the surface layer on the bottom.	07:01:24
19	Q. Do you have an opinion whether Figure 17	07:01:27
20	would aid the movement of carriers from the surface	07:01:42
21	layer to the substrate? Let me ask that --	07:01:47
22	A. Are you asking about Figure 17? Kawagoe	07:01:58
23	now?	07:02:01
24	Q. Yes. Let me ask you a question. Can you	07:02:02
25	tell from Figure 17 whether Figure 17 would aid the	07:02:13

1	movement of electrons from the surface layer to the	07:02:21
2	substrate?	07:02:23
3	A. There isn't sufficient information in the	07:02:25
4	114 patent to determine the net sum of the forces	07:02:34
5	acting on the electrons in the well due to the	07:02:38
6	impurity concentration gradient, as well as any other	07:02:44
7	electromotive forces present. Nonetheless, it would	07:02:49
8	be undesirable to strip electrons out of the N-type	07:02:55
9	device because that would slow its start up speed or	07:03:00
10	hinder its performance.	07:03:06
11	Q. Now, I believe you testified earlier that	07:03:18
12	for an NMOS device, the minority carrier is a hole.	07:03:20
13	Do you recall that?	07:03:32
14	A. Yes.	07:03:33
15	Q. Is it possible for Figure 17 to move a hole	07:03:34
16	from the active region or surface layer to the	07:03:50
17	substrate?	07:03:57
18	MR. BOMBACH: Objection. Leading.	07:04:05
19	THE WITNESS: As I previously answered, the	07:04:06
20	impurity concentration gradient is intended to repel	07:04:16
21	electrons from the well. So it's an electric field	07:04:22
22	pointed toward the surface, or the left, in this	07:04:26
23	figure. Such a force would indeed repel electrons	07:04:30
24	from the well, but it would also draw holes toward	07:04:37
25	the surface, not away from the surface. So the	07:04:40

1	direction of the electric vector is wrong for that	07:04:43
2	intended purpose of -- that you had questioned taking	07:04:49
3	holes from the surface to the substrate.	07:04:56
4	Q. I'm going to try to speed this up. Dr.	07:05:03
5	Glew, I've been asking questions about '195, claim 1.	07:05:07
6	Would your testimony be the same for the '502 patent?	07:05:14
7	A. Generally, yes. Same specification.	07:05:22
8	Q. And would your testimony about the	07:05:28
9	electrons and Kawagoe be the same for claim 44 of the	07:05:34
10	'222 patent? Let me ask the question more	07:05:42
11	specifically. If you could pull up claim 44 of the	07:05:57
12	'222 patent. I'll direct your attention to claim 44.	07:06:03
13	A. Okay. I am there.	07:06:28
14	Q. Do you see towards the end of the claim a	07:06:31
15	reference to a second static unidirectional electric	07:06:38
16	drift field to aid the movement of carriers from the	07:06:45
17	surface layer to the area of the substrate where	07:06:48
18	there are no active regions?	07:06:53
19	A. Yes.	07:06:56
20	Q. Is there any way to tell whether Figure 17	07:06:59
21	of Kawagoe would be capable to move electrons from	07:07:12
22	the surface layer to the area of the substrate where	07:07:17
23	there are no active regions?	07:07:23
24	A. As I've stated previously, there's no way	07:07:29
25	to determine from the Kawagoe document the net sum of	07:07:31

1 forces acting on the electrons in the P row in 07:07:41
2 Figure 17. The information isn't there to make that 07:07:46
3 -- nonetheless, it would be a very bad idea to remove 07:07:57
4 electrons, as I've stated earlier. The vector 07:08:02
5 direction is wrong to move holes, but it shouldn't 07:08:08
6 remove electrons. So more likely than not, it does 07:08:17
7 not have that effect in the well because it would 07:08:19
8 degrade the performance of the device. 07:08:23

9 Q. And just so the record is clear, is there 07:08:24
10 any way to tell whether Figure 17 of Kawagoe would be 07:08:27
11 capable to move holes from the surface layer to the 07:08:33
12 area of the substrate where there are no active 07:08:37
13 regions? 07:08:41

14 MR. BOMBACH: Objection. Leading. 07:08:42

15 THE WITNESS: No, because the electric 07:08:47
16 vector in Figure 17 points toward the surface, which 07:08:49
17 is consistent with repelling electrons downward. 07:08:55
18 Electrons go against the direction of the electric 07:09:02
19 field holds with it. So this impurity concentration 07:09:04
20 shown in Figure 17 could only carry holes toward the 07:09:08
21 surface, not bring them away from the surface. 07:09:12

22 Q. I next want to direct your attention to the 07:09:15
23 ONODA patent, which is marked as Exhibit 1042. Do 07:09:20
24 you have a copy of the ONODA patent? 07:09:35

25 A. Yes. 07:09:37

1	Q. If you could please go to page 31 of 37.	07:09:48
2	It should be page 31 of the PDF.	07:09:54
3	A. I am there.	07:09:59
4	Q. Do you see Figure 11 in the lower left-hand	07:10:01
5	corner?	07:10:12
6	A. Yes.	07:10:12
7	Q. Do you understand Figure 11 to be showing a	07:10:21
8	P-well profile?	07:10:26
9	A. That text exists on the figure, yes.	07:10:28
10	Q. And what type of transistor would be in the	07:10:34
11	P-well?	07:10:39
12	A. An NMOS would be constructed in a P-well.	07:10:40
13	Q. So just like we saw in Figure 5B of the	07:10:43
14	patent, Figure 11 of ONODA is showing a dopant	07:10:49
15	profile for an NMOS transistor in a P-well?	07:10:59
16	A. That is my understanding, yes.	07:11:06
17	Q. And for an NMOS transistor, the majority	07:11:08
18	carrier would be an electron?	07:11:14
19	A. Yes, that is correct. NMOS has a majority	07:11:17
20	of electrons as the carriers.	07:11:27
21	Q. And what is the minority carrier?	07:11:28
22	A. The minority carrier for an NMOS is a hole.	07:11:30
23	Q. Do you have an opinion whether Figure 11	07:11:39
24	shows a flat or uniform or graded dopant profile in	07:11:50
25	the active region or surface layer?	07:11:59

1	A. As I stated previously, the dopant profile	07:12:03
2	appears to be flat or constant from zero to about .5	07:12:11
3	micrometers in depth. Additionally, flat from five	07:12:22
4	micrometers on.	07:12:29
5	Q. Now, if the dopant profile is flat or	07:12:30
6	constant in the active region or surface layer, is it	07:12:35
7	going to create an electric field in the active	07:12:42
8	region or surface layer?	07:12:47
9	A. The dopant profile portion that is flat	07:12:51
10	does not create an electric field because the	07:12:57
11	electric field arises from the gradient or change in	07:13:00
12	concentration with position depth in this case. To	07:13:04
13	the extent that the transistors are in that first	07:13:08
14	half micron, then there would be no effect of the	07:13:12
15	dopant profile on the -- no effect of the dopant	07:13:19
16	profile with regards to an electric field.	07:13:26
17	Q. Would the -- strike that. When the dopant	07:13:32
18	profile is flat in the active region or surface	07:13:42
19	layer, is it possible for the dopant profile to	07:13:50
20	create an electric field that's going to move a	07:13:56
21	carrier from the active region or surface layer?	07:13:59
22	A. If the dopant profile is flat, it will not	07:14:05
23	create an electric field to move carriers from the	07:14:12
24	surface if it's flat near the surface.	07:14:17
25	Q. Looking at Figure 11, is it possible to	07:14:23

1	tell whether Figure 11 is capable of aiding the	07:14:31
2	movement of electrons from the surface layer to the	07:14:46
3	substrate?	07:14:52
4	MR. BOMBACH: Objection. Leading.	07:14:58
5	THE WITNESS: No, because the dopant	07:15:01
6	profile is flat near the surface. It does not	07:15:04
7	provide an electrical field or electrical force to	07:15:07
8	move carriers from the surface.	07:15:11
9	Q. Looking at Figure 11, is it possible to	07:15:14
10	tell whether Figure 11 is capable of aiding the	07:15:22
11	movement of holes from the surface layer to the	07:15:29
12	substrate?	07:15:33
13	MR. BOMBACH: Objection. Leading.	07:15:35
14	THE WITNESS: Because the dopant profile is	07:15:36
15	flat, it does not generate an electric field near the	07:15:39
16	surface. It is flat near the surface. Thus, it	07:15:44
17	cannot move holes or electrons or any charged	07:15:49
18	carrier.	07:15:52
19	Q. Okay. Let's turn to another patent, which	07:15:59
20	is Nishizawa. I believe it was --	07:16:35
21	A. I have most of the files still open.	07:16:50
22	Q. What exhibit number does it have?	07:16:53
23	A. 1046.	07:16:56
24	Q. And can you please turn to Figure 35?	07:16:59
25	A. Yes, I see Figure 35.	07:17:20

1	Q. Do you recall being asked questions about	07:17:22
2	Figure 35 earlier?	07:17:25
3	A. To some extent, yes.	07:17:26
4	Q. Does Figure 35 show an NMOS transistor in a	07:17:27
5	P-well?	07:17:34
6	A. Yes, it describes that in Exhibit 35.	07:17:36
7	Q. So just like we saw in Figure 5B, the	07:17:40
8	majority carrier would be an electron?	07:17:59
9	A. Yes. It's an NMOS device so it would have	07:18:01
10	a majority carrier of N.	07:18:11
11	Q. And what would the minority carrier be?	07:18:13
12	A. The minority carrier would be holes, also	07:18:31
13	known as P in the symbols.	07:18:34
14	Q. Looking at Figure 35, is it possible to	07:18:39
15	tell whether Figure 35 is capable of aiding the	07:18:45
16	movement of electrons from an active region or	07:18:52
17	surface layer to somewhere else?	07:18:58
18	A. Did you ask me electrons or holes?	07:19:04
19	Q. I was going to start with electrons. In	07:19:07
20	Figure 35, is it possible to tell whether Figure 35	07:19:22
21	is capable of aiding movement of electrons from an	07:19:25
22	active region or surface layer to somewhere else?	07:19:29
23	A. This is similar to previous references.	07:19:33
24	There's not enough information to determine what is	07:19:39
25	occurring inside the active region. Devices intend	07:19:42

1	to keep alpha particle generated species from	07:19:52
2	entering that area, but once we're in that area, we	07:19:59
3	don't have much information.	07:20:02
4	Q. Is it possible to tell whether Figure 35 is	07:20:03
5	capable of aiding movement of holes from an active	07:20:09
6	region or surface layer to somewhere else?	07:20:14
7	A. Similarly, there's little to no information	07:20:23
8	regarding the net sum of forces in the active region.	07:20:26
9	Also, beware in mind the gradient dopant described in	07:20:30
10	33A doesn't actually -- well, it doesn't touch the	07:20:37
11	surface. It's described as below the transistors.	07:20:41
12	Q. When you talk about the active or surface	07:20:47
13	layer in a well, is the active region or surface	07:20:53
14	layer going to see additional fields that other parts	07:21:02
15	of the well might not see?	07:21:09
16	A. Yes.	07:21:12
17	MR. BOMBACH: Objection. Leading.	07:21:13
18	THE WITNESS: The channel is a complicated	07:21:16
19	region. Probably the most complicated region from a	07:21:23
20	dopant perspective in the entire circuit. So there's	07:21:27
21	a number of implants and dopants in the channel.	07:21:30
22	We've heard of payload dopants today as well as other	07:21:35
23	types. Furthermore there's a field generated by the	07:21:40
24	gate oxide. I think it's shown as 15 in Figure 35.	07:21:42
25	Then, there are potentials put in place by	07:21:48

1 the gate electrode on top of 15. Now, they're 07:21:50
2 commonly known as work function metals. But any 07:21:54
3 material up there can also change the performance of 07:21:57
4 the carriers in the channel. Additionally, there 07:22:00
5 are, of course, the junctions with the source drain. 07:22:05

6 Q. Do you have an opinion of whether you would 07:22:19
7 have to consider additional factors when determining 07:22:26
8 whether a carrier will move from the active region or 07:22:31
9 surface layer to the substrate as opposed to moving 07:22:39
10 it from an area below the surface layer to the 07:22:43
11 substrate? 07:22:47

12 MR. BOMBACH: Objection. Leading. 07:22:50

13 THE WITNESS: This is very similar to the 07:22:53
14 answers I've given previously. In substrate 11 in 07:22:54
15 Figure 35, what we see is something -- 33A, which is 07:23:00
16 a graded concentration of dopants intended to repel 07:23:12
17 alpha or solar generated electrons. 07:23:33

18 Q. Dr. Glew, you were just testifying about 07:23:42
19 the Nishizawa reference. I want to see if your 07:23:52
20 testimony would be the same for the ONODA reference. 07:23:59
21 In Figure 11 of ONODA, if you were trying to 07:24:08
22 determine whether Figure 11 is capable of moving an 07:24:12
23 electron or a hole from the active region, would you 07:24:21
24 have to consider additional factors for the active 07:24:27
25 region than you would for other parts of the well? 07:24:32

1	MR. BOMBACH: Objection. Leading.	07:24:38
2	THE WITNESS: Similar to my last answer,	07:24:42
3	the active region is different than the substrate or	07:24:51
4	other areas. So in order to determine the net	07:24:54
5	effective electrical and other forces on a charged	07:24:57
6	carrier, one would need to know those other effects.	07:25:02
7	The active region is very complicated, much more	07:25:07
8	complicated than anywhere else on a transistor.	07:25:10
9	However, I've already testified that Figure 11 is	07:25:12
10	flat, between 0 and .5 microns. So I don't see it	07:25:17
11	generating an electric field.	07:25:39
12	Q. Same question for Kawagoe. If you were	07:25:42
13	trying to determine whether Figure 17 is capable of	07:25:59
14	moving an electron or a hole from the active region,	07:26:05
15	would you have to consider additional factors for the	07:26:09
16	active region that you would not have to consider for	07:26:14
17	other parts of the well?	07:26:18
18	MR. BOMBACH: Objection. Leading.	07:26:21
19	THE WITNESS: The answer I would give for	07:26:25
20	Figure 17 of Kawagoe would be similar to the previous	07:26:38
21	answers I just gave. In order to know whether there	07:26:40
22	was an effect in the active region, one would have to	07:26:45
23	know the net of all the electrical and other forces	07:26:48
24	acting on a charged carrier to determine if there was	07:26:51
25	motion.	07:26:58

1	Q. Thank you, Dr. Glew. I pass the witness.	07:26:59
2	MR. BOMBACH: Yeah. I only have a handful	07:27:01
3	of questions.	07:27:03
4	EXAMINATION BY MR. BOMBACH	07:27:04
5	Q. Thank you, Dr. Glew. What is a minority	07:27:04
6	carrier?	07:27:09
7	A. If for example, an MOS device, the minority	07:27:19
8	carrier is the opposite of the source and drain.	07:27:27
9	Q. Do you have any academic literature or have	07:27:33
10	you otherwise submitted any academic literature to	07:27:40
11	support your understanding of what a minority carrier	07:27:44
12	is?	07:27:47
13	A. Well, I relied upon the specification of	07:27:50
14	this patent and how it's used in this patent. I	07:27:55
15	think the specification of this patent was the most	07:27:58
16	relevant piece of information to rely on. Figure 35	07:28:01
17	of my declaration -- excuse me. Paragraph 35 of my	07:28:04
18	declaration, I believe I cited to column 3:41 of the	07:28:08
19	'195 patent which uses the language, "accelerate	07:28:21
20	majority carriers toward the drain."	07:28:25
21	Clearly, the carriers that go from source	07:28:27
22	to drain are the same as source and drain, so it	07:28:30
23	considers source and drain polarity to be the	07:28:33
24	polarity of the majority carriers in the patent.	07:28:38
25	Q. If you could turn to page 17 of your	07:28:46

1	declaration. Footnote 3 you state, and I'll give you	07:28:49
2	a second to go there.	07:28:54
3	A. Yup.	07:28:56
4	Q. "Because the channel is formed by electrons	07:28:56
5	with a negative charge, the MOS that is referred to	07:29:00
6	as N channel MOSFET, and the minority carriers are	07:29:09
7	holes. And then, above you have a figure showing	07:29:17
8	several negative balls with negative signs going from	07:29:38
9	source to drain. Do you see that?	07:29:49
10	A. Yes.	07:29:51
11	Q. This device is depicting a conductive	07:29:51
12	channel; right?	07:29:54
13	A. This is a channel that's conducting in the	07:29:57
14	on mode. Yes.	07:30:01
15	Q. When the channel is conducting, there are	07:30:02
16	more electrons than holes in the channel; right?	07:30:19
17	MR. WHITEHURST: Object to form.	07:30:23
18	Q. I will clarify, then. When the channel is	07:30:31
19	conductive between source and drain, there are more	07:30:37
20	electrons than holes in the conductive channel;	07:30:43
21	correct?	07:30:45
22	MR. WHITEHURST: Object to form.	07:30:46
23	THE WITNESS: The channel is formed to be	07:30:55
24	conductive and uses electrons for an NMOS. Yes.	07:31:01
25	Q. So there are more electrons than holes in	07:31:04

1	the channel when it is conducting between a source	07:31:07
2	and drain; right?	07:31:10
3	A. The channel, as I've noted in the footnote,	07:31:18
4	is formed by electrons to conduct. The channel has	07:31:21
5	two states: On and off for a MOSFET. Other types of	07:31:26
6	transistors aren't necessarily on or off. They might	07:31:34
7	be proportional. For the MOSFET it basically has go	07:31:37
8	states: On or off. The conducting state has more	07:31:47
9	electrons.	07:31:52
10	Q. And the nonconducting state, does the	07:31:53
11	transistor have more holes than electrons?	07:31:58
12	MR. WHITEHURST: Object to form.	07:32:01
13	THE WITNESS: When you say "the	07:32:08
14	transistor," I mean, I can answer -- the source and	07:32:09
15	drain are always electrons in this NMOS device, but	07:32:12
16	the channel flips on and off based upon transacting	07:32:17
17	or repelling electrons. The source and drain are	07:32:22
18	always electrons. They're doped permanently. The	07:32:25
19	gate shown in gold with oxide underneath it, a	07:32:33
20	voltage is applied to that and that pushes the way it	07:32:36
21	holds and attracts the electrons when it's on in a	07:32:39
22	depletion mode.	07:32:45
23	Q. I'm not asking a complex question. I'm	07:32:46
24	referring to a channel of the transistor depicted in	07:32:49
25	page 17 of Exhibit 2057. You testified in an on	07:32:54

1	state the channel has more electrons than holes. I'm	07:33:01
2	asking in the opposite off state, does the channel	07:33:05
3	have more holes than electrons?	07:33:09
4	MR. WHITEHURST: Object to form.	07:33:14
5	THE WITNESS: The channel of the NMOS	07:33:16
6	transistor has more holes in the off state than in	07:33:18
7	the on state.	07:33:21
8	Q. The '195 patent, Exhibit 1001, if you could	07:33:37
9	look at column 4, line 14 that says, "a surface	07:33:42
10	layer."	07:33:49
11	A. I see that.	07:33:53
12	Q. Is the surface layer limited in size?	07:33:54
13	A. I'm a little unclear on your question.	07:34:10
14	These are very small devices. They don't have sizes.	07:34:12
15	Q. Is a specific sizing requirement included	07:34:18
16	in the limitation of a surface layer?	07:34:21
17	MR. WHITEHURST: Object to form.	07:34:24
18	THE WITNESS: The limitations describe some	07:34:32
19	of what's in the surface layer. It doesn't limit it	07:34:52
20	to a certain size beyond being inclusive of those	07:34:55
21	elements.	07:35:15
22	Q. Looking at column 4, line 23, it says,	07:35:15
23	"minority carriers." Do the claims limit the	07:35:22
24	minority carriers to electrons or holes?	07:35:33
25	A. The specification describes minority	07:35:47

1	carriers for MOSFET transistors as being electrons	07:35:49
2	and holes. I understood electrons were NMOS and	07:36:07
3	holes for PMOS. Are you asking me, is there	07:36:13
4	something other than holes and electrons?	07:36:15
5	Q. Yeah. I'm asking if the minority carriers	07:36:22
6	as claimed should be read or understood to be limited	07:36:24
7	to solely electrons or holes or, in your view, does	07:36:27
8	it encompass the possibility for both?	07:36:31
9	A. The specification describes -- and as I	07:36:41
10	mentioned recently in paragraph 35 of my report, it	07:36:46
11	describes that the majority carrier for a device, an	07:36:51
12	MOSFET device, is the same as the source drain. It	07:36:59
13	would be electrons for an NMOS or holes for a PMOS.	07:37:04
14	So there's only one majority and the minority is the	07:37:07
15	opposite polarity of that.	07:37:11
16	Q. And my question is more specific to the	07:37:14
17	claim element minority carriers. Do you read that to	07:37:17
18	be specific to an electron, a hole, or does it cover	07:37:21
19	any type of minority carrier which could be a hole or	07:37:28
20	an electron?	07:37:33
21	A. My understanding is in a CMOS device, there	07:37:35
22	are two types. C stands for complimentary. Metal	07:37:43
23	oxide semiconductor. So these two complimentary	07:37:55
24	types are NMOS and PMOS. Each has a majority and	07:38:05
25	minority carrier that are opposite of each other.	07:38:17

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Conducted on February 5, 2025

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1	Q. Yes. And my question is, is the claim	07:38:25
2	limitation minority carrier on column 4, line 24,	07:38:28
3	limited to a specific type of minority carrier, a	07:38:36
4	hole, or an electron, or does it encompass either?	07:38:40
5	A. It is limited to minority carriers.	07:38:49
6	There's only one type of minority carrier for each	07:38:52
7	type of transistor.	07:38:54
8	Q. If I understand your testimony correctly,	07:38:56
9	the minority carrier as claimed in claim 1 can be	07:39:01
10	either an electron or a hole?	07:39:06
11	A. Not precisely. It can be a hole for an	07:39:11
12	NMOS device or an electron for a PMOS device, as I	07:39:15
13	understand it. It must be the minority carrier for	07:39:20
14	that specific transistor in the CMOS structure.	07:39:22
15	Q. Okay. I think that is all the questions I	07:39:27
16	have. Thank you for your time, Dr. Glew. Thank you	07:39:41
17	for everybody else's time. Sorry today went late.	07:39:46
18	MR. WHITEHURST: That concludes the	07:39:52
19	deposition then. We can go off the record.	07:39:54
20	VIDEOGRAPHER: This concludes the	07:39:56
21	deposition of Dr. Alexander Glew. The time is 19:40.	07:39:57
22	We're going off the record now.	07:40:03
23	MR. WHITEHURST: Give us the same rough	07:45:12
24	order.	07:45:16
25	(Proceedings concluded at 7:40 P.M.)	07:40:07

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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DECLARATION UNDER PENALTY OF PERJURY

I, DR. ALEXANDER GLEW, do hereby certify
under penalty of perjury that I have read the
foregoing transcript of my deposition taken February
5, 2025; that I have made such corrections as appear
noted on the Deposition Errata Page attached hereto
and signed by me; that my testimony as contained
herein, as corrected, is true and correct.

Dated this ____ day of _____,
2025, at _____,
California.

DR. ALEXANDER GLEW

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1 STATE OF CALIFORNIA)
2)
3 COUNTY OF LOS ANGELES)

4 I, Michael Cagliata, Certified
5 Shorthand Reporter No. 14491, do hereby
6 Certify:

7 That prior to being examined, the witness
8 named in the foregoing deposition was by me duly
9 sworn to testify the truth, the whole truth, and
10 nothing but the truth;

11 That said deposition was taken down by me
12 in shorthand and thereafter reduced to print by
13 means of computer-aided transcription; and the same
14 is a true, correct, and complete transcript of said
15 proceedings.

16 I further certify that I am not
17 interested In the outcome of the action.

18 Witness my hand this 5th day of February, 2025.

19
20 
21 _____

22 Michael Cagliata, CSR #14491, RPR
23 Certified Shorthand Reporter
24 In and for the State of California
25

Transcript of Dr. Alexander Glew
Conducted on February 5, 2025

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1 CERTIFICATE OF SHORTHAND REPORTER - NOTARY PUBLIC

2
3 I, Michael Cagliata, Certified
4 Shorthand Reporter No. 14491, and
5 Notary Public within and for the State of California
6 do hereby certify:

7 That DR. ALEXANDER GLEW, the
8 witness whose deposition is hereinbefore set forth,
9 was duly sworn by me before the commencement of such
10 deposition and that such deposition was taken before
11 me and is a true record of the testimony given by such
12 witness.

13 I further certify that the adverse party,
14 was represented by counsel at the
15 deposition.

16 I further certify that the deposition of
17 DR. ALEXANDER GLEW, occurred REMOTELY
18 on WEDNESDAY, FEBRUARY 5, 2025, commencing at
19 10:20 AM to 7:40 PM.

20 I further certify that I am not related to
21 any of the parties to this action by blood or
22 marriage, I am not employed by or an attorney to any
23 of the parties to this action, and that I am in no way
24 interested, financially or otherwise, in the outcome
25 of this matter.

1
2 IN WITNESS WHEREOF, I have hereunto set my
3 hand this 10th day of February, 2025.
4

5
6 
7

8 Michael Cagliata, CSR #14491, RPR
9 Certified Shorthand Reporter
10 In and for the State of California
11 NOTARY PUBLIC IN AND FOR THE
12 CALIFORNIA
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A			
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