

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

MONOLITHIC POWER SYSTEMS	) IPR 2024-00468
INC.,	) Patent No. 8,421,195
	)
Petitioner,	) IPR 2024-00469
	) Patent No. 9,190,502
V.	)
	) IPR 2024-00470
	) Patent No. 11,121,222
GREENTHREAD, LLC,	)
Patent Owner.	)
	)

REMOTE DEPOSITION OF
STEPHEN A. CAMPBELL, PH.D.

October 17, 2024
9:00 a.m. Central Daylight Time

Reported by: Lori J. Goodin, RPR, CRR, RSA,
California CSR #13959

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1 REMOTE DEPOSITION of
2 STEPHEN A. CAMPBELL, PH.D.,
3 a Witness in the above-titled action, held on
4 Thursday, October 17, 2024, commencing at
5 approximately time 9:00 a.m. before Lori J.
6 Goodin, RPR, CRR, RSA, California CSR #13959,
7 Registered Professional Reporter, Certified
8 Realtime Reporter, Realtime Systems
9 Administrator, and Certified Shorthand Reporter,
10 and Notary Public of the State of Florida, State
11 of California, State of Maryland, District of
12 Columbia, State of Delaware and Commonwealth of
13 Pennsylvania.

1 REMOTE APPEARANCES:

2

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21

22

1 INDEX TO EXAMINATION

2 WITNESS: STEPHEN A. CAMPBELL, PH.D.

3

4 EXAMINATION BY

PAGE

5 MR. MATICH

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1 INDEX TO EXHIBITS
2 STEPHEN A. CAMPBELL
3 Greenthread, LLC vs Monolithic Power Systems,
4 Inc.

5 Thursday, October 17, 2024
6 Lori J. Goodin, RPR, CRR, RSA
7 California CSR #13959

8 CAMPBELL

9	EXHIBIT	DESCRIPTION	PAGE
10	Exhibit 1	Declaration of Stephen Campbell	11
11	Exhibit 2	Figure 16 of US Patent 5,384,476	27

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1 THURSDAY, OCTOBER 17, 2024, 9:00 a.m. CDT

2 PROCEEDINGS

3 * * *

4 THE REPORTER: Unless an objection
5 is heard at this time, all parties to this
6 deposition are appearing remotely and have
7 agreed to the witness being sworn in
8 remotely.

9

10 Whereupon,

11 STEPHEN ALAN CAMPBELL

12 a witness called for examination, having been
13 first duly sworn, was examined and testified as
14 follows:

15 * * *

16 EXAMINATION

17 BY MR. MATICH:

18 Q. Good morning, Dr. Campbell.

19 A. Good morning.

20 Q. Could you please state and spell
21 your full name for the record.

22 A. My name is Stephen Alan Campbell,

1 S-T-E-P-H-E-N, A-L-A-N, C-A-M-P-B-E-L-L.

2 Q. And, you are currently --

3 What is your current occupation?

4 A. I am retired from the University of
5 Minnesota. So, I retain a status of Emeritus
6 Professor of Electrical and Computer Engineering.

7 Q. And where are you physically located
8 right now?

9 A. I am in Arden Hills, Minnesota, a
10 suburb of the twin cities.

11 Q. And what building are you located
12 in?

13 A. I am at my home which is 3248
14 Sandeen Road, Arden Hills, Minnesota, 55112.

15 Q. Is there anything that would prevent
16 you from testifying completely and truthfully
17 today?

18 A. No.

19 Q. You have no medical issues that
20 would interfere with your ability to testify
21 today?

22 A. No.

1 Q. You're not on any medications that
2 would interfere with your ability to testify
3 today?

4 A. No.

5 Q. You have no personal issues that are
6 distracting you from your testimony today?

7 A. No.

8 Q. Have you ever been deposed before?

9 A. No.

10 Q. So, I assume that the Monolithic
11 lawyers went over the rules of the deposition
12 with you, but, I'll go over them now just so we
13 have a record of it and to make sure you
14 understand; is that okay?

15 A. Yes, that's fine.

16 Q. You understand that I'll ask you a
17 series of questions and you are required to give
18 truthful answers?

19 A. Understood.

20 Q. And you understand that you, the
21 court reporter is going to be taking down
22 everything that I say and everything that you

1 say?

2 A. Yes.

3 Q. And you understand that you need to
4 wait for me to ask you a question and finish
5 asking the question before you speak, because the
6 court reporter can't take down two things at
7 once.

8 A. Yes.

9 Q. So, I'll try and avoid starting a
10 new question until you have finished your answer.

11 And if you could do the same; avoid
12 starting your answer until I have finished asking
13 the question.

14 Does that work?

15 A. Yes, that's fine.

16 Q. And you understand that the
17 statements and testimony you're giving today are
18 under oath?

19 A. Yes.

20 Q. And you understand that you're under
21 the penalty of perjury?

22 A. Yes.

1 Q. And you understand that the
2 testimony you are giving today is no different
3 than if we were in a court of law or if there
4 were officials at the Patent Office present
5 before us?

6 A. Yes.

7 Q. What's your understanding of the
8 nature of these proceedings?

9 A. My understanding of the proceedings
10 is that there are a series of patents that are
11 owned by patent owner and these patents, the
12 validity of these patents are being challenged.

13 Q. And you understand that the patent
14 owner is a company called Greenthread?

15 A. Yes.

16 Q. All right. So, if I refer to
17 Greenthread or Greenthread's patents, you'll
18 understand what I mean?

19 A. Yes.

20 Q. And, you understand that the patent
21 challenger is a company called Monolithic?

22 A. Yes.

1 MR. MATICH: And, could we pull up
2 Tab 1 and mark it as Exhibit 1.

3 (Exhibit 1 marked for
4 identification.)

5 BY MR. MATICH:

6 And, Dr. Campbell, during the course
7 of this deposition, I'm going to show you some
8 documents.

9 I will primarily be showing you your
10 declaration in these proceedings.

11 But if you need to see any of the
12 documents referenced in your declaration, feel
13 free to ask and we can make that happen.

14 A. All right.

15 Q. And if I ask you a question and you
16 need to see other portions of the document, you
17 are free to direct the tech, Danny, to scroll to
18 other parts of the document.

19 A. All right.

20 Q. Dr. Campbell, is Exhibit 1 your
21 declaration in these proceedings?

22 A. From this first page, I would say

1 yes.

2 Q. If you need to look at the rest of
3 the document to confirm that it's a complete and
4 accurate copy of your declaration, please do
5 that.

6 A. All right. Are we going to go
7 through 150 pages?

8 Q. I am willing to represent to you
9 that I believe this is the full and complete
10 version.

11 But if you want to verify for
12 yourself, you're more than welcome to.

13 A. I will take you at your word that it
14 is a full copy.

15 Q. Dr. Campbell, do you see about
16 halfway up the first page of your declaration it
17 says PTAB Case Numbers.

18 And then it lists the IPR 2024-00468
19 and then a patent number and then some other
20 proceeding numbers?

21 A. Yes. I can see that.

22 Q. Is it your understanding that the

1 IPR 2024- numbers represent, identify different
2 proceedings on different patents?

3 A. Yes.

4 Q. And you understand that this
5 declaration pertains to the proceedings and the
6 patents listed here on the first page?

7 A. Yes.

8 Q. It is also -- is it your
9 understanding that for Patent Number 11,121,222
10 that today's deposition and these proceedings is
11 only about Claim 44 in that patent?

12 A. I don't, I did not know that. Okay.

13 Q. And is it your understanding that
14 there are other IPR proceedings in which you have
15 submitted a declaration?

16 A. This is the only declaration that I
17 have submitted.

18 Q. Okay. You didn't submit a
19 declaration in IPR proceedings challenging other
20 Greenthread patents?

21 A. To the best of my knowledge, this is
22 the only document that I produced.

1 Q. Okay. And you understand that
2 across all of the proceedings in which you have
3 submitted a declaration, there are some common or
4 similar issues?

5 A. Yes. Pretty much so.

6 Q. And you understand that the claims
7 in each of the patents use the same or similar
8 language in parts --

9 A. Yes. Sorry.

10 Q. And did you interpret and apply the
11 claim language consistently across all the
12 patents?

13 A. Yes.

14 Q. Dr. Campbell, on your CV it says
15 that you worked for several years as a consultant
16 for a law firm called WilmerHale?

17 A. Yes.

18 Q. What was the nature of your work for
19 WilmerHale?

20 A. It was challenging a patent that was
21 related to a process technology that the patent
22 owner claimed that the company was infringing on

1 their patent.

2 Q. Can you tell me who the accused
3 infringer was?

4 A. I don't think I'm allowed to
5 disclose that. It's a major semiconductor
6 fabrication company.

7 Q. Can you tell me who the patent owner
8 was?

9 A. University of Arizona.

10 Q. And is that the only case you worked
11 on for WilmerHale?

12 A. That's correct.

13 Q. Was your work on that case made
14 public?

15 A. Not to the best of my knowledge.

16 Q. So, you did not submit an expert
17 report in that litigation?

18 A. That is correct.

19 Q. Is that the only time you've been
20 involved in patent litigation?

21 A. Yes.

22 Q. Your CV also mentions a patent that

1 you applied for?

2 A. Yes, that is true.

3 Q. Is that the only patent you've ever
4 applied for?

5 A. Yes.

6 Q. Did that patent issue?

7 A. I was not the primary person on that
8 patent. It was one of my colleagues.

9 I don't know if it issued or not.

10 Q. About how much work -- scratch that.

11 About how many hours worth of work
12 did you do for WilmerHale?

13 A. This is, was several years ago.

14 My guess would be somewhere between
15 50 and 100 hours.

16 Q. Over the course of three years?

17 A. No, that took about a year. It
18 could have been 18 months. Something like that.

19 MR. MATICH: Could we scroll down to
20 PDF Page 112.

21 DOCUMENT TECHNICIAN: Sorry counsel,
22 which page is that?

1 MR. MATICH: The PDF Page 112. It's
2 Appendix A. Next page, please.

3 BY MR. MATICH:

4 Q. Dr. Campbell, it lists here
5 consulting 2019 to 2021 WilmerHale.

6 A. Yes.

7 Q. And that's what you were referring
8 to?

9 A. Yes. It was late '19 -- again, late
10 2019 and wound up early 2021.

11 Q. Okay. So, it wasn't, it spanned
12 three calendar years, but the work was
13 approximately a little more than a year?

14 A. Yes.

15 Q. Okay. What did do you to prepare
16 for your deposition today?

17 A. I re-read the patents that are
18 subject to this process.

19 And I re-read my declaration. And I
20 looked at a few of the patents that we reference
21 in the declaration.

22 Q. Did you speak to anyone to prepare

1 for today's deposition?

2 A. I had a session with lawyers from
3 Perkins Coie to, since this is my first time
4 going through a deposition, to tell me what to
5 expect.

6 Q. Which Perkins Coie lawyers did you
7 talk to?

8 A. Miguel Bombach, Justin Jiang, and
9 Brianna, I'm sorry, I don't remember Brianna's
10 last name off the top of my head.

11 Q. And about how many hours did you
12 spend talking to them?

13 A. Six hours, I believe. Six hours,
14 yes.

15 Q. Was that all in one day?

16 A. No, it was spread across three days.

17 Q. And which three days?

18 A. Monday, Tuesday, and Wednesday of
19 this week.

20 Q. Other than the prior art references,
21 the Greenthread patents and your declaration, did
22 you look at any documents in preparation for

1 today's deposition?

2 A. Briefly. There was a couple of
3 calculations that I wanted to do.

4 And so, I looked up some things from
5 books.

6 But that whole process was probably
7 less than 20 minutes.

8 Q. And what calculations did you do?

9 A. One was electric field calculations
10 and dopant gradient, yes. That was the primary
11 thing.

12 Q. And, could you, what electric -- you
13 were calculating the strength of an electric
14 field?

15 A. That's correct.

16 Q. Which, what, where did you get the
17 data for the electric field?

18 A. Well, the proper question is where
19 did I get the data for the doping profile,
20 because once you have the doping profile, it's a
21 straightforward calculation to get the electric
22 field.

1 I just assumed that a reasonable
2 doping profile -- yeah, I will just put a period
3 at that point.

4 It was a reasonable doping profile
5 for the types of technology that are under
6 discussion here.

7 Q. Okay. So, you didn't calculate the
8 electric field for any of the prior art cited in
9 your declaration?

10 A. That's correct.

11 Q. And, at any point in the past had
12 you calculated the electric field for the doping
13 profiles in the prior art cited in your
14 declaration?

15 A. Yes, I'm glad you asked that,
16 because as you were phrasing your question, I
17 realized that when I was writing the declaration,
18 I did do the calculation of one of the profiles.

19 And the reason that I was checking
20 my numbers yesterday, was because I couldn't find
21 my notes as to what the field was.

22 So, I just wanted to get an order of

1 magnitude estimate.

2 Q. Okay. And you couldn't find your
3 notes from that prior calculation?

4 A. That's correct.

5 Q. Is there a reason you didn't look it
6 up in your report?

7 A. I don't think I wrote it in my
8 report. That was just something from I -- I was
9 curious.

10 It wasn't something that I presented
11 to the -- for the declaration.

12 Q. Dr. Campbell, are you familiar with
13 ways to measure the doping concentration?

14 A. Yes.

15 Q. Are you familiar with a technique
16 called SRP?

17 A. Yes. I have used it quite a bit.

18 Q. What does SRP stand for?

19 A. Spreading Resistance Profiling.

20 Q. Okay. And could you describe for me
21 how SRP works?

22 A. Yes. If you want to measure the

1 concentration of a dopant as a function of depth,
2 you take a sample of a semiconductor wafer, you
3 grind it at a very shallow angle and then you
4 apply two probes that move across the top of the
5 wafer and then down the bevel. You measure the
6 resistance between the two probes.

7 The resistance -- well, is dominated
8 by current crowding near the tips of the probes
9 and it's very sensitive to the local carrier
10 concentration.

11 So, when you measure resistance as a
12 function of position and you know the bevel
13 angle, you can then extract the doping
14 concentration -- well, the active carrier
15 concentration, to put it more accurately, as a
16 function of depth.

17 Q. Are you familiar with a technique
18 called SCM?

19 A. SCM. If you tell me what it stands
20 for, I'll let you know if I've heard of it.

21 Q. Scanning Capacitance Microscopy?

22 A. I -- yes, I have heard it. I

1 haven't used that technique.

2 Q. What do you know about SCM?

3 A. Very, very little. I will plead
4 ignorance on that one.

5 Q. Are you familiar with a technique
6 called SMIN?

7 A. No, I have not.

8 Q. Are you familiar with a technique
9 called Simms?

10 A. Yes, of course.

11 Q. What is Simms?

12 A. Simms is secondary IMS spectroscopy.
13 This involves taking, again, a silicon wafer that
14 has dopant in it, using a beam of argon or cesium
15 or, I don't remember the third one.

16 It blasts into the surface of a
17 semiconductor and you have a mass spectrometer
18 inside the vacuum system with the beam and the
19 wafer, and you collect some fragment of the
20 materials that are coming off.

21 And by knowing -- you are measuring
22 the chemical composition as a function of depth

1 rather than the carrier concentration. Usually
2 those two are about the same.

3 But, in this case, it's a chemical
4 analysis.

5 MR. MATICH: Let's go to Page 27 of
6 your report. Turn to Page 27, not 127.

7 And actually, let's go up one page
8 to Page 26.

9 BY MR. MATICH:

10 Q. Dr. Campbell, do you see in this
11 section of your report, beginning on Page 26
12 going to Page 27, you're discussing the
13 background standard for determining whether or
14 not something is obvious?

15 A. Could we go out to the next page?
16 Yes.

17 Q. And you see the second bullet point
18 there where you talk about any relevant factors,
19 the secondary indicia indicating nonobviousness?

20 A. Yes.

21 Q. And you see the fourth line from the
22 bottom where it says, "the taking of licenses

1 under the patent by others and the nature of
2 those licenses"?

3 A. Yes.

4 Q. What about the nature of other, of
5 licenses to the patents is relevant to
6 determining, determining obviousness?

7 A. Your question is more of a legal
8 question than a technical question.

9 So, I'm sorry, I can't answer that.

10 Q. Okay. So, if I told you that
11 someone had taken a license to a patent, how
12 would that bear on your analysis of whether or
13 not it was obvious?

14 A. My understanding -- again, I am not
15 a lawyer, I don't pretend to be a lawyer.

16 But when you take out the license
17 that means that you are able to use information
18 in the patent in exchange for a fee. That's my
19 understanding.

20 It is not clear to me how that would
21 affect obviousness.

22 Q. Do you know if Greenthread has

1 granted any licenses to the challenged patent?

2 A. I was told that somebody, Intel, had
3 a license.

4 This is very early on. And so, I
5 think that's what they told me.

6 Q. And did you take that into
7 consideration in your analysis?

8 A. No.

9 MR. MATICH: Could we go to Page 56
10 of your report?

11 BY MR. MATICH:

12 Q. Dr. Campbell, do you see Page 56 of
13 your report here?

14 A. Yes.

15 Q. Do you see it has got Figure 16 from
16 the Nishizawa reference?

17 A. Yes.

18 Q. And the Nishizawa reference is one
19 of the prior art references that you analyzed in
20 your report?

21 A. Yes.

22 MR. MATICH: And actually, just so

1 we're on the same page, could we pull up Tab 4

2 and mark it as Exhibit 2?

3 (Exhibit 2 marked for

4 identification.)

5 BY MR. MATICH:

6 Q. Dr. Campbell, this Exhibit 2, which
7 is Patent Number 5,384,476 is the Nishizawa
8 reference?

9 A. Yes.

10 MR. MATICH: Okay. We can go back
11 to the -- your report, please. Page 56, please.

12 BY MR. MATICH:

13 Q. And Dr. Campbell, this -- is it
14 correct that Figure 16 of Nishizawa is on page,
15 is reproduced on Page 56 of your report?

16 A. I know that we used that figure. I
17 don't recall the page number.

18 But, yes, we used this figure.

19 Q. Okay. But --

20 A. So, I'm sorry. I'm sorry, this is
21 my declaration. Yes, I'm sorry. Yes, we used
22 the Nishizawa figure.

1 Q. So, I'm going to ask the question
2 again just to make sure we have a clear
3 understanding.

4 On page, Figure 16 from Nishizawa,
5 is reproduced on Page 56 of your report?

6 A. Again, it's not showing the page
7 number, but you told the tech to put up 56.

8 So, I will assume that is 56.

9 Yes, copied from Nishizawa.

10 Q. All right. The -- I'll direct you
11 to the bottom right-hand corner of the, your
12 report. And it says MPS EX1003-56/152?

13 A. Unfortunately, that does not show up
14 on my screen.

15 Q. Oh, okay. We will -- is there a way
16 you can adjust your screen to be able to see the
17 rest?

18 A. Okay, yes. Somebody put it up for
19 me. Yes, I can see that now.

20 MR. MATICH: Thank you, Danny.

21 Danny is the tech.

22 BY MR. MATICH:

1 Q. If you need to see something else,
2 you can ask him to scroll or move things around
3 or zoom in on something.

4 A. Okay.

5 Q. Okay. So, having looked at the page
6 numbers, do we agree that Figure 16 of Nishizawa
7 is what's on the screen right now, on Page 56 of
8 your report?

9 A. That's correct.

10 Q. And Figure 16 depicts a transistor?

11 A. It actually depicts a DRAM, of which
12 there is a transistor inside this picture.

13 But, this -- the total picture is a
14 DRAM.

15 Q. Okay. But, the, you see what's
16 marked as 12 and 13, the N plus regions, those
17 are the source and drain of a transistor?

18 A. That is correct.

19 Q. Okay. Where is the active region of
20 this transistor?

21 A. The active region is the region
22 depicted in blue, the source and drain and

1 channel.

2 Now, I have a little bit of a caveat
3 here, is that I would normally include the active
4 area only to the junction of the source and
5 drain.

6 And this particular figure shows
7 that it goes slightly below the source and drain
8 junction.

9 Q. Okay.

10 A. Otherwise, it's fine.

11 Q. And by "slightly below," you mean
12 that small blue sliver below the source and
13 drain?

14 A. Correct.

15 Q. Okay. And the P plus 33 structure,
16 that's below the active region?

17 A. That is correct.

18 MR. MATICH: Thank you. We can --
19 could we go to Page 56 -- oh, we are already on
20 Page 56, okay.

21 BY MR. MATICH:

22 Q. You see in the text it says,

1 "Nishizawa discloses that if the electrons were
2 allowed to flow to the circuit rather than down
3 to the substrate, the circuit would not function
4 correctly"?

5 A. Yes.

6 Q. What, could you expand on what you
7 mean by that sentence?

8 A. If you read that in the context that
9 Nishizawa wrote it, it refers to the formation of
10 excess minority carriers that might diffuse from
11 the substrate and then be collected by the source
12 and drain.

13 Q. So, the electrons are coming,
14 Nishizawa is concerned with electrons coming up
15 from the substrate?

16 A. That is correct.

17 Q. Were there any other problems
18 Nishizawa was trying to solve?

19 A. So, this was causing error. I'm
20 trying to remember if they also talked about
21 latch up.

22 Their primary focus in Nishizawa was

1 the retention time for the DRAM, which is a
2 matter of, primarily of, collecting these
3 minority carriers.

4 Q. Or avoiding the collection of the
5 minority carriers?

6 A. Yes. That's a better way of saying
7 it. Preventing them from getting to the drain.

8 MR. MATICH: Could we go to Page 15.
9 I've got a question on this page. But, actually
10 one other question.

11 BY MR. MATICH:

12 Q. What is the typical depth of an
13 active region in a CMOS?

14 A. It depends on the generation of the
15 technology. It gets thinner as the dates get
16 smaller for the technologies that are discussed
17 in Greenthread patents. The junction depth is
18 roughly half a micron.

19 So, that would be the depth of an
20 active region.

21 Q. Okay. And is the, is that also true
22 for the prior art references?

1 A. Yes. They are from similar, or,
2 they are, they predate the Greenthread patents
3 but they are roughly similar. They are a little
4 bit bigger than the Greenthread, but, the
5 technology hadn't changed very much in that
6 period.

7 Q. So similarly, the active region
8 depth is roughly half a micron?

9 A. It could be as much as a micron.
10 But, it's not orders of magnitude different.

11 MR. MATICH: Okay. And so, we're on
12 Page 15. If we go to the next page, Page 16.

13 BY MR. MATICH:

14 Q. So, about the middle of the page
15 there's a sentence that you say, "As will be
16 discussed these charged species move in response
17 to an electric field, and so, an electric field
18 that is properly constructed will push the
19 minority carriers away from the surface, making
20 their collection much less probable."

21 Do you see that sentence?

22 A. Yes, I do.

1 Q. What did you mean by
2 "properly constructed"?

3 A. You would have to construct an
4 electric field that moves the carriers away, and
5 that means the electric field has to be, the
6 direction has to be correct.

7 If you're moving poles, then you
8 have to have the electric field that points
9 downward.

10 If you're moving electrons, the
11 electric field has to be pointing upward and you
12 have to have a sufficient electric field
13 intensity to prevent most of the carriers from
14 being collected by the drain.

15 Q. Okay. Can, does temperature affect
16 the carrier motion?

17 A. In general? Yes. General, the
18 mobility of carriers decreases as the temperature
19 increases.

20 The number of minority carriers, you
21 know, this is not excess minority carriers, this
22 is just the number of minority carriers in an

1 undisturbed sector, increases with temperature.

2 And since the fusion coefficient is
3 proportional to the mobility, as the temperature
4 goes up, both mobility and the diffusion
5 coefficient goes down.

6 Q. Do capacitants affect impact carrier
7 movement?

8 A. Could you explain what you mean by
9 capacitance effects?

10 Q. What -- what's is your understanding
11 of the term capacitance effects?

12 A. It is s too broad for me to say.

13 I would say you're talking about a
14 capacitor, and where I have two plates and an
15 insulator of some kind between, and we create an
16 electric field and put the voltage across those
17 two points.

18 But, as to this, I don't know.

19 Q. What -- so, what about the
20 capacitant created a PN junction?

21 A. Okay. Now we're talking.

22 Q. Okay. Does the capacitance created

1 at a PN junction affect carrier motion?

2 A. Yes. It creates a fairly
3 substantial electric field in the depletion
4 region.

5 There's a region near the junction
6 where the carriers are, annihilate each other.
7 They come across the boundary and recombine them
8 creating a region where there are a few carriers.

9 This is called the depletion region.
10 And you're left with positive and
11 negatively-charged ions on the two sides of the
12 junction.

13 And, that creates a capacitance.
14 Thus, and that also creates an electric field.

15 Q. And, is that electric field that's
16 on top of the electric field created by the
17 dopant ingredients?

18 A. Yes. The electric field -- yes.
19 I'll just say yes.

20 Q. Does it matter -- well, let me back
21 up a second.

22 So, is it correct that boron,

1 aluminum and gallium are all P-type dopants?

2 A. I have never seen anybody use
3 aluminum as a dopant.

4 Boron is by far the most commonly
5 used, and occasionally gallium.

6 Q. Okay.

7 A. These three.

8 Q. Is the electric field of a dopant
9 gradient affected by whether or not the dopant is
10 boron or gallium?

11 A. No. As long as it is fully
12 activated, which means that the impurities are on
13 the silicon lattice and, therefore, giving up a
14 hole.

15 And as long as that new condition is
16 met, then it doesn't really matter which one it
17 is.

18 Q. And what do you mean "On the silicon
19 lattice"?

20 A. Means the rezone, I'm sorry, the
21 process by which these impurities change the
22 conductivity of the summit is that the impurity

1 replaces a silicon atom, and silicon atoms have
2 the valence of four which means they need to make
3 four bonds to their nearest neighbors.

4 Boron, gallium, and aluminum have
5 only three electrons in the valence.

6 And so, another electron has to come
7 in to satisfy, you know, the fourth bond, and
8 that creates a hole in the absence of an
9 electron.

10 If the boron atom is just sitting in
11 interstitial spaces between silicon atoms, it
12 doesn't act as a dopant.

13 Q. And what determines whether or not
14 the dopant is integrated into the lattice
15 structure?

16 A. After the impurity is introduced,
17 usually by implantation, you have to do a high
18 temperature anneal to create enough silicon
19 vacancies that the boron will occupy one of those
20 silicon vacancies.

21 Typically this is 1,000 or it could
22 be as much as 1,100 centigrade to activate these

1 impurities.

2 There is a limit to how many you can
3 put in and that depends on the impurity that's
4 called a solid solubility.

5 For boron, it is quite high in
6 silicon. And, so that's one of the reasons why
7 it's used heavily.

8 Q. Do imperfections in a silicon
9 crystal affect carrier motion?

10 A. Yes, that's one of the scatter
11 mechanisms. So, it reduces mobility or it
12 reduces diffusivity.

13 Q. Are you familiar with the difference
14 between obviousness and anticipation in patent
15 law?

16 A. Again, I am not a lawyer. I don't
17 intend to.

18 Q. Did you receive instruction or
19 guidance on the legal standard for obviousness
20 from Monolithic's lawyers?

21 A. I think I did. But, I mean sitting
22 here right now, I can't reproduce it.

1 MR. MATICH: Did you receive --

2 so -- could we go to Page 26, again.

3 BY MR. MATICH:

4 Q. Dr. Campbell, do you see here it
5 says Standard For Invalidity, Obviousness. "I am
6 informed and understand that a patent cannot be
7 properly granted for subject matter that would
8 have been obvious to a person of ordinary skill
9 in the art"?

10 A. Yes.

11 Q. Is, this is the instruction you
12 received from Monolithic's lawyers regarding
13 obviousness?

14 A. Yes.

15 Q. Did you receive a similar
16 instruction regarding anticipation?

17 A. I don't recall that.

18 MR. MATICH: Okay. If we could go
19 to Page 15.

20 DOCUMENT TECHNICIAN: You said 15?

21 MR. MATICH: 15, please.

22 BY MR. MATICH:

1 Q. Dr. Campbell, I would like to start
2 on the run over sentence that goes to Page 16,
3 all three, and if we flip to Page 16.

4 DOCUMENT TECHNICIAN: Sorry counsel,
5 say that again?

6 MR. MATICH: Could you go to the
7 next page, please?

8 BY MR. MATICH:

9 Q. So it says, "All three prior art
10 patents deal with the same technical challenge as
11 the patents being challenged: How to protect
12 electronic circuits from impacts of high energy
13 photons such as x-rays or high energy particles
14 such as alpha particles."

15 A. Yes.

16 Q. Do you see that sentence?

17 A. Yes.

18 Q. So, it's your understanding that the
19 Greenthread patents were focused on solving the
20 problem of high energy particles and high energy
21 photons and x-rays in semiconductor devices?

22 A. My understanding is the Greenthread

1 patents, this is fairly one of the things that it
2 would be concerned about.

3 I'm not sure that it was everything.

4 Q. What, and the, and earlier you said
5 that's what the Nishizawa reference was focused
6 on, that problem?

7 A. Yes.

8 Q. And is the Kawagoe reference focused
9 on the same problem of high energy particles?

10 A. The Kawagoe patent dealt with the
11 application of dopant heavy layers and it also,
12 let's see, I remember Page 28 on that one, it
13 talked about preventing carriers, techniques for
14 preventing carriers, particularly the use of this
15 epi layer to decrease the flow of the carriers to
16 the drain.

17 So, very similar kinds of things.

18 I don't recall if that was, off the
19 top of my head, if that was about particles or if
20 it was gamma rays.

21 But, yes.

22 Q. Okay. So --

1 A. -- very much in line with this.

2 Q. Okay. But, either way, the purpose,
3 or so the focus of, or, let me rephrase that.

4 There is a variety of things that
5 can cause electrons to bubble up from the
6 substrate in a semiconductor device, correct?

7 A. Yes.

8 Q. And the focus of Kawagoe and
9 Nishizawa and Onoda, was to solve that problem
10 and block the carriers from coming up into the
11 substrate, or into the transistor?

12 A. I would put it just slightly
13 differently. They are not saying that they are
14 totally blocking all of the carriers. They are
15 reducing the carrier flow to an acceptable level.

16 Q. Okay. But they are reducing the
17 carrier flow in an upwards direction?

18 A. Yes, that's correct.

19 Q. Upwards from the substrate?

20 A. Yes, that's correct.

21 Q. And, the, you thought it was
22 appropriate to modify the prior art references to

1 render the Greenthread patents obvious because
2 the Greenthread patent was also focused on that
3 same problem?

4 A. That was my reading of the
5 Greenthread patents, yes.

6 Q. Okay. Was there any other reason to
7 combine the Greenthread patents with the, or to
8 modify the prior art references to meet the claim
9 limitations of the Greenthread patents?

10 A. I'm sorry, could you repeat that?

11 Q. So, I was asking, so, you just said
12 that the reason to modify Kawagoe, Onoda, and
13 Nishizawa, was because they were focused on the
14 same problem of electrons bubbling up from the
15 substrate.

16 And I was asking if there was any
17 other reason that you would combine or modify
18 those references to come up with the claims of
19 the Greenthread patents?

20 A. Not meaning to be obtuse here, but,
21 yes, I, we use those three patents because in my
22 reading on their description -- well, the idea

1 that they were patenting is very close to what
2 was in the Greenthread patents.

3 Q. Okay.

4 A. Essentially identical, but...

5 Q. Yes.

6 A. Certainly very close.

7 Q. So, the, let me rephrase it this way
8 because I, I think I understand what you are
9 saying but I just want to make sure we are on the
10 same page.

11 Was there any other, the problem
12 that, in your view, the problem that all of the
13 prior art patents and the Greenthread patents
14 were trying to solve was electrons bubbling up
15 from the substrate.

16 Was there any other problem that all
17 of the patents were trying to solve?

18 A. Well, first of all, it is not
19 electrons, it is minority carriers.

20 Q. Okay.

21 A. So, electrons pull holes depending
22 on the polarity. I believe that that was the

1 focus, yes.

2 Q. Okay. But you can't identify
3 another problem that was in the minds of the
4 people who wrote the prior art and that -- and
5 wrote the Greenthread patent?

6 A. Well, I mean, they talked about
7 latch up and they talked about these logic
8 upsets.

9 So, both are caused by the flow of
10 these minority carriers to the surface.

11 Q. Okay. But, sort of whatever the
12 cause of the carriers moving up -- scratch that?

13 MR. MATICH: So, we have been going
14 for about an hour. Would you like to take a
15 break?

16 THE WITNESS: That would be great.

17 BY MR. MATICH:

18 Q. Actually, before we go off the
19 record, I meant to ask this at the beginning; is
20 there anybody else in the room with you?

21 A. No, just me.

22 Q. Okay. And at any point during the

1 deposition today, has anyone else been in the
2 room with you?

3 A. No.

4 Q. Okay. And, you'll -- do you have
5 any programs open up on your computer besides
6 Zoom?

7 A. Yes. Do you want me to cancel them?

8 Q. Yes, please. And what programs did
9 you have open?

10 A. Oh, I have PowerPoint and I have a
11 folder open and I have Excel, and I have a
12 browser, a web browser.

13 Q. And were you, during the course of
14 the deposition, were you looking at any, any
15 materials relevant to the topic of the
16 deposition?

17 A. No, I didn't look at anything
18 besides what was shown to me.

19 Q. Okay. Thank you.

20 If you could close all of those and
21 just go with the Zoom, thank you?

22 And, you will let me know if anyone

1 tries to communicate with you on text or via
2 phone during the course of today's deposition?

3 A. Certainly.

4 Q. Including during breaks?

5 A. Yes.

6 MR. MATICH: Okay. Thank you very
7 much. We can go off the record.

8 (Recess taken -- 10:01 a.m.)

9 (After recess -- 10:17 a.m.)

10 BY MR. MATICH:

11 Q. Good morning again, Dr. Campbell.

12 A. Good morning.

13 MR. MATICH: And just so we have a
14 record of it, I am Nick Matich from the law
15 firm of McKool Smith and with me is my
16 partner, Arvind Jairam.

17 And Miguel, I'd ask you to introduce
18 all the folks who are with Monolithic.

19 MR. BOMBACH: Yes. Miguel Bombach
20 from Perkins Coie for Monolithic Power
21 Systems.

22 Also with me is Justin Jiang, also

1 from Perkins Coie.

2 MR. MATICH: Great.

3 BY MR. MATICH:

4 Q. Dr. Campbell, when you were
5 preparing your declaration, did you read the
6 whole file history of the Greenthread patents?

7 A. Of course I read the patents. The
8 file history I don't recall reading that. I may
9 have.

10 But it was close to a year ago and I
11 don't recall.

12 Q. Okay. Do you understand what I am
13 referring to when I say "file history"?

14 A. It would be best if you were to
15 explain it to me.

16 Q. Okay. So the, I'm referring to the
17 back and forth between the patent examiner and
18 the inventor or patent owner during patent
19 prosecution.

20 A. Yes. I remember getting that
21 document. I glanced at it, but that wasn't my
22 objective or my job.

1 My job was to read the patents and
2 provide the technical comments.

3 Q. Okay. So, when you read the, your
4 declaration refers to various statements by the
5 patent owner during patent prosecution, do you
6 recall that?

7 A. I do recall that, yes.

8 Q. Did you look at the other parts of
9 the prosecution history or just the excerpts that
10 are in your report?

11 A. Just the excerpts in the report.

12 Q. Okay. And I assume that when you
13 read the patents, you read all of the claim
14 terms?

15 A. Yes.

16 Q. Were there any parts of the claims
17 that you found that you were not able to
18 understand?

19 A. I don't recall any that I did not
20 understand.

21 Q. Okay. So, the, to put it
22 differently, you understood the scope of the

1 claims?

2 A. Yes.

3 Q. And you understood -- scratch that?

4 MR. MATICH: Can we pull up

5 Dr. Campbell's report again and go to Page 51

6 here.

7 DOCUMENT TECHNICIAN: That is Tab 1,

8 correct?

9 MR. MATICH: 5-1, yes.

10 DOCUMENT TECHNICIAN: And which page

11 again?

12 MR. MATICH: 5-1.

13 BY MR. MATICH:

14 Q. Dr. Campbell do you see Page 51 of

15 your report on the screen?

16 A. Yes.

17 Q. And do you see Figure 11 from Onoda

18 reproduced there?

19 A. Yes.

20 MR. MATICH: Could we zoom in on

21 Figure 11, please. No, zoom in on the figure,

22 please. Thank you.

1 BY MR. MATICH:

2 Q. Dr. Campbell, can you tell me where
3 the active region would be on this graph?

4 A. The active region, as I mentioned
5 before, is coincident with the depth of the
6 source of drain.

7 This profile is showing the channel
8 doping and below. So, we don't see the source or
9 drain here.

10 So, I can't say exactly where the
11 active area would end.

12 But consistent with my previous
13 remarks, I believe the source drain depth was
14 about a half a micron.

15 So, with that, assertion, the active
16 area would go from 0 to 0.5 on this spot.

17 Q. Okay. But you can't be sure because
18 you are not sure of the depth of source and
19 drain?

20 A. That is correct.

21 Q. Thank you. And Dr. Campbell, just
22 as another preliminary matter, is there anything

1 in your report that is inaccurate?

2 A. That's a difficult thing to answer.

3 To the best of my knowledge, there's
4 nothing inaccurate.

5 Q. Okay. And is there, is there
6 anything in your report that you think is
7 unclear?

8 A. No, not that I know of.

9 Q. And this is, the report that's on
10 the screen right now, this is the only report
11 that you have submitted to the Patent Office?

12 A. That's my understanding.

13 Q. And you have not been involved in
14 any other patent litigation or IPR proceedings
15 besides the ones you are being deposed on today?

16 A. As we discussed earlier, I was
17 involved in a patent case. We discussed it
18 earlier.

19 Q. Okay. So, and that you are
20 referring to -- let me rephrase.

21 Other than the work you did with
22 WilmerHale, the proceedings discussed in this

1 report are the only time you have been involved
2 in this patent litigation?

3 A. That is correct.

4 MR. MATICH: I think I may be done,
5 but if we could just take a short break and,
6 to let me double-check my outline, and then
7 we'll see if we could end things a little bit
8 early today.

9 THE WITNESS: Great.

10 (Discussion off the record.)

11 MR. MATICH: Dr. Campbell, or could
12 we please pull up Page 73 of Dr. Campbell's
13 declaration?

14 I'm sorry, actually, could we pull
15 up Page 78. Could we zoom in on the figures?

16 BY MR. MATICH:

17 Q. Dr. Campbell, do you see on the
18 screen is Page 78 of your report and
19 reproductions of Figures 16 and 17 from the
20 Kawagoe reference?

21 A. Yes.

22 Q. And do you see there on the right,

1 Figure 17 is the doping concentration?

2 A. Yes.

3 Q. And do you see on the left Figure 16
4 it shows the, where the doping concentration was
5 taken?

6 A. Yes.

7 Q. Down the middle of the channel?

8 A. Yes.

9 Q. And so, the, I guess the same
10 question as I asked with respect to Onoda, can
11 you tell me where on this graph the active region
12 is?

13 A. Let's see, unlike the previous plot,
14 this doesn't have any numbers on it.

15 Certainly it's not as deep as WE, W
16 sub E.

17 If we assume the drawing on the left
18 is to scale, it would look like the active area
19 is maybe a third or a fourth of the way to WE.
20 So, smaller than that first pink dash on the
21 right.

22 Q. Okay. But you can't tell for sure

1 because it's the, you don't know the depth of the
2 source and drain?

3 A. That's true. And there is no
4 numbers. It's just, hard to deal -- it's hard
5 for me to give you numbers when there is no
6 numbers in the plot.

7 MR. MATICH: Okay. Thank you very
8 much. No further questions.

9 MR. BOMBACH: And one second. No
10 questions on our end.

11 Thank you for your time,
12 Dr. Campbell.

13 (Whereupon, signature not having
14 been waived, the deposition
15 suspended at 10:34 a.m.)

16 * * *

17

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1

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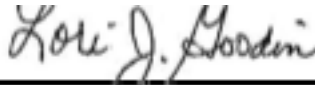
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3
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4 Date of deposition: October 17, 2024

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