

DEPOSITION OF
JAMES RICHARD SHEALY, PH.D.
INNOSCIENCE TECH. V. EFFICIENT POWER CONVERSION
TAKEN ON
MAY 31, 2024



1IN THE UNITED STATES PATENT AND TRADEMARK OFFICE 2BEFORE THE PATENT TRIAL AND APPEAL BOARD 3IPR-2023-01381 4U.S. PATENT NO. 8,350,294 5----- 6INNOSCIENCE (ZHUHAI) TECHNOLOGY CO., LTD. AND 7INNOSCIENCE AMERICA, INC., 8Petitioners, 9-v- 10EFFICIENT POWER CONVERSION CORPORATION 11Patent Owner. 12----- 13 14ORAL DEPOSITION OF JAMES RICHARD SHEALY, PH.D. 15 16 17Friday, May 31, 2024 18 19Reported by: Misty Klapper, CSR, CRR, RMR 20Job No.: 24-137283 21 22	1APPEARANCES: 2ON BEHALF OF PETITIONERS: 3AMEYA PARADKAR, ESQUIRE 4WALTER DAVIS, ESQUIRE 5BLANK ROME 61825 Eye Street, N.W. 7Washington, D.C. 20006 8(202) 420-2200 9E-mail: arun.paradkar@blankrome.com 10walter.davis@blankrome.com 11 12ON BEHALF OF PATENT HOLDER AND WITNESS: 13KARA SPECHT, ESQUIRE 14LIONEL LAVENUE, ESQUIRE 15CARLOS DUARTE-GUEVARA, ESQUIRE 16FINNEGAN, HENDERSON, FARABOW, GARRETT 17AND DUNNER 181875 Explorer Street, Suite 800 19Reston, VA 20190 20(571) 203-2700 21E-mail: kara.specht@finnegan.com 22lionel.lavenue@finnegan.com carlos.duarte-guevara@finnegan.com ALSO PRESENT: Caitlin Coverstone Feven Negussie
1IN THE UNITED STATES PATENT AND TRADEMARK OFFICE 2BEFORE THE PATENT TRIAL AND APPEAL BOARD 3IPR-2023-01381 4U.S. PATENT NO. 8,350,294 5----- 6INNOSCIENCE (ZHUHAI) TECHNOLOGY CO., LTD. AND 7INNOSCIENCE AMERICA, INC., 8Petitioners, 9-v- 10EFFICIENT POWER CONVERSION CORPORATION 11Patent Owner. 12----- 13 14Oral deposition of JAMES RICHARD SHEALY, PH.D., 15taken on behalf of the Petitioners, beginning at 9:23 a.m. 16on Friday, May 31, 2024, at the Law Offices of Finnegan, 17Henderson, 1875 Explorer Street, Reston, Virginia, 18before Misty Klapper, RMR, CSR, CRR and Notary Public, when 19were present: 20 21 22	1C O N T E N T S 2WITNESS: EXAMINATION BY: PAGE: 3Richard Shealy, Ph.D. Mr. Paradkar 5 4Ms. Specht 52 5 6 7E X H I B I T S 8NO.: DESCRIPTION: PAGE: 9Ex 2007 Patent Owner's Notice of Deposition 10of Dr. James Shealy 7 11Ex 2008 United States Patent Application 12Publication, Saxler, et al. 42 13PREVIOUSLY MARKED EXHIBITS: 14NUMBER: IDENTIFIED AT PAGE: 151001 13 161003 18 171005 30 181006 23 191008 20 20 21 22

Page 5

1 P R O C E E D I N G S
2 JAMES RICHARD SHEALY, PH.D.,
3 The Witness herein, called for
4 examination by counsel for the Petitioner,
5 having been duly sworn, was examined and
6 testified as follows:
7 EXAMINATION
8 BY MR. PARADKAR:
9 Q. Good morning, Dr. Shealy.
10 How are you?
11 A. Good morning.
12 Q. Have you been deposed before?
13 A. Recently, yeah.
14 Q. And how many times -- approximately
15 how many times have you been deposed?
16 A. Maybe -- I don't know, 20 or 30
17 maybe.
18 Q. Okay. Great.
19 Did you do anything -- let me -- let
20 me rephrase that.
21 Why don't we quickly go over some
22 ground rules for the deposition and then we can

Page 6

1 get started.
2 I'm going to ask you questions and
3 you can give me an answer. We'll try to not talk
4 over each other while we -- while we -- while we
5 do that. If you could answer audibly, I would
6 appreciate it.
7 And do you understand that you are
8 under oath?
9 A. Yes.
10 Q. Great.
11 Also, if you don't understand a
12 question, please ask for clarification. Please
13 let me know and I will -- I will clarify the
14 question.
15 A. Okay.
16 Q. Is that all understood?
17 A. Yes.
18 Q. Great.
19 Lastly, if you need a break, please
20 let me know. We'll try to make sure you get all
21 the breaks you need.
22 A. Okay. Thank you.

Page 7

1 MR. PARADKAR: Could we mark this
2 as Exhibit 2007.
3 (Thereupon, Deposition Exhibit
4 Number 2007 was marked for
5 identification.)
6 BY MR. PARADKAR:
7 Q. Dr. Shealy, do you recognize this
8 document?
9 A. Yes, I've seen this before.
10 Q. What is it?
11 A. It's a Notice of Deposition for me.
12 Q. And this deposition -- and this is
13 for IPR2023-01381?
14 A. Yes, that's what's on this document.
15 Q. And that relates to U.S. patent
16 number 8,350,294; is that correct?
17 A. Yes.
18 Q. Are you okay with me referring to
19 that patent as the '294 patent?
20 A. Yes.
21 Q. Great.
22 Did you review any documents filed in

Page 8

1 this IPR proceeding?
2 A. Yes. If you look in my declaration,
3 you'll find a list of documents under materials
4 considered.
5 Q. Did you review any other documents?
6 A. Yes. There was the -- what I
7 remember as the '111 patent. I briefly reviewed
8 that because, I believe, that came up since I
9 wrote the declaration.
10 And I reviewed the Institution
11 decision and the replies of each party that were
12 associated with that.
13 I think that covers it all.
14 Q. Okay. Did you -- do you understand
15 that the patent owner and petitioner are engaged
16 in a dispute regarding the '294 patent in front
17 of the International Trade Commission?
18 A. Yes.
19 Q. Did you review any documents related
20 to that dispute before the ITC?
21 A. No.
22 Q. Have you reviewed any of the other

Page 9

1 documents related to -- excuse me.
2 Do you understand that there are
3 other patents involved in this ITC proceeding
4 between patent owner and petitioner?
5 A. It hasn't been a topic of discussion,
6 but I think -- and I may be mixing these up, but
7 I think the '508 patent might be involved.
8 Q. Have you reviewed any of the filings
9 in the ITC regarding that patent?
10 A. No.
11 Q. Dr. Shealy, do you know what an
12 enhancement mode transistor is?
13 A. Yes.
14 Q. And do you know what a depleted --
15 depletion mode transistor is?
16 A. Yes, I do.
17 Q. What is an enhancement mode
18 transistor?
19 A. An enhancement mode transistor is a
20 transistor that is often referred to as a
21 normally off device, so without any potential
22 applied to the gate source there will be no

Page 10

1 current flowing in the drain circuit.
2 Q. When you say normally, do you know
3 what a 2DEG is, Dr. Shealy?
4 A. Yes.
5 Q. What is a 2DEG?
6 A. In a so-called HEMT device, which
7 stands for high electron mobility transistor, the
8 channel is the two-dimensional electron gas. I
9 would just mention that I know what it is. We --
10 my group was the first one to build a functional
11 HEMT device on silicon, which is the backbone of
12 this technology.
13 My group was also the first one to
14 build an insulated gate HEMT device in gallium
15 nitride.
16 So, yes, I know what a 2D gas is and
17 I know what HEMTs are.
18 Q. Are you still building those types of
19 devices?
20 A. I have recently in some foundry work
21 that my company does. But I was going to mention
22 we also in the early 2000s built an HEMT device

Page 11

1 with a recessed gate, which is -- shows up in
2 some of these references, and set performance
3 standards at 10 gigahertz. Even though that
4 paper is over 20 years old, nobody has touched
5 those results.
6 Q. Have you built any insulated gate
7 devices in your foundry?
8 A. The HEMTs we built were Schottky
9 gates.
10 Q. Let's go back to the 2DEG.
11 You said that that's in -- in the
12 channel, correct?
13 A. The 2D electron gas basically forms
14 the channel, the conducting channel, in an HEMT.
15 Q. And is the 2DEG present in
16 enhancement mode devices?
17 A. Yes.
18 Q. Is the 2D -- where is the 2DEG in
19 enhancement mode?
20 A. In enhancement mode and depletion
21 mode devices, the two-dimensional electron gas
22 resides below the interface between the barrier

Page 12

1 and the channel layer. And when I say below,
2 it's -- it's highly localized near that
3 interface, but it is below it.
4 Q. And at zero volt is the 2DEG present
5 below the gate enhancement mode devices?
6 A. Would you repeat the question?
7 MR. PARADKAR: Could you just read
8 back that question?
9 (The record was read as requested.)
10 THE WITNESS: In order to be
11 normally off, the two-dimensional electron
12 gas concentration would not be present, at
13 least under a portion of the gate.
14 BY MR. PARADKAR:
15 Q. And for depletion mode devices at
16 zero volts, is there 2DEG present below the gate?
17 A. Generally, yes.
18 Q. Does a depletion mode device require
19 positive or negative voltage to be applied to
20 turn the device off?
21 A. It requires negative voltage to turn
22 the device off.

Page 13

1 Q. And for an enhancement mode device,
2 does it require positive or negative voltage to
3 turn the device on?
4 A. It requires positive voltage to turn
5 the device on.
6 (Thereupon, Exhibit Number
7 1001, previously marked, was referred
8 to.)
9 BY MR. PARADKAR:
10 Q. I'm handing you what's been
11 previously marked as Innoscience Exhibit 1001.
12 Dr. Shealy, do you recognize this
13 document?
14 A. Yes, I do.
15 Q. What is this document?
16 A. This is what we are going to refer to
17 as the '294 patent.
18 Q. Have you previously reviewed the '294
19 patent?
20 A. Yes.
21 Q. Let's go to figure 1. This shows --
22 are you there?

Page 14

1 A. Yes.
2 Q. Great.
3 This shows an enhancement mode
4 transistor, correct?
5 A. It is the construct of an enhancement
6 mode device. Without knowing the doping and
7 thickness, the barrier thickness, you -- you
8 can't tell whether it's depletion or enhancement
9 mode without further details.
10 Q. Let's go to column 1, line 55.
11 Are you there?
12 A. Yes.
13 Q. And the first sentence reads, Figure
14 1 illustrates a conventional enhancement mode GaN
15 transistor device 100.
16 Is that what it says?
17 A. I believe you read that correctly.
18 Q. So let's go back to figure 1.
19 Given what we just read, would you
20 agree that figure 1 is an enhancement mode
21 transistor?
22 A. I'll give you the same answer. It's

Page 15

1 the construct of an enhancement mode transistor.
2 But without information about the doping and the
3 thickness of the high dope p-GaN and the
4 thickness of the barrier, without that
5 information, you cannot -- this can also be a
6 depletion mode device. You need details to
7 decide whether or not it's an enhancement mode.
8 But the patent -- the sentence you
9 read says it's an enhancement mode. I think what
10 they mean is it's the construct of an enhancement
11 mode device. That's what it would look like.
12 Q. Understood.
13 But you don't disagree with the
14 patent's specification, correct?
15 A. I'm -- I have reviewed the patent and
16 I'm trying --
17 Q. Withdraw the question.
18 A. Thank you.
19 Q. So with the understanding that figure
20 1 is a construct of an enhancement mode
21 transistor, you would agree that there's no 2DEG
22 present below the gate at zero voltage?

Page 16

1 A. Yes, the 2D gas will be interrupted
2 between the source and drain. If it had zero
3 volts applied between the gate and source, it
4 won't be continuous between the source and drain.
5 It would be interrupted under the gate.
6 Q. And you would apply positive voltage
7 to the gate to turn on the transistor of figure
8 1, correct?
9 A. Assuming it's an enhancement mode
10 device, correct.
11 Q. And if you look to figure 1, elements
12 105 and 106, they refer to low doped p-ALGaN and
13 high doped p-ALGaN; is that correct?
14 A. 105 is low doped p-ALGaN. 106 is
15 high doped p-GaN.
16 Q. And this p-type doping of the p-ALGaN
17 and p-GaN is what causes the 2DEG to be depleted
18 at zero voltage, correct?
19 A. If the -- if the acceptors, which is
20 what makes it p-type, are ionized, then what you
21 say is correct.
22 Q. And if we continue to look at

Page 17

1 elements 105 and 106, that p-ALGaN and the p-GaN,
2 that's -- it's conductive, correct?
3 A. Well, certainly the high doped p-GaN
4 is conductive. It's basically there to provide
5 an ohmic contact to the gate. The p-ALGaN could
6 be mostly depleted of -- of holes and still
7 function. So if it's depleted, it would not
8 conduct.
9 Q. Is it your opinion that that p-ALGaN
10 is depleted in figure 1?
11 A. The -- if you added extra material at
12 the same doping, it -- you could have a region
13 that's not depleted. In general, the -- it
14 doesn't -- if it's not depleted, it's not going
15 to contribute to moving the threshold to a
16 positive value. So -- but it could have a
17 nondepleted portion.
18 Q. So let me just rephrase the question.
19 I don't know if we got that answer. I just want
20 to make it clear.
21 Is it your opinion that the p-ALGaN
22 in figure 1 is depleted as shown?

Page 18

1 MS. SPECHT: Objection, asked and
2 answered, form.
3 THE WITNESS: It's not shown where
4 the depletion region is in the p-type
5 ALGaN, but there is a depletion region
6 there. It's not shown.
7 (Thereupon, Exhibit Number
8 1003, previously marked, was
9 identified.)
10 BY MR. PARADKAR:
11 Q. I'm handing you what's been
12 previously marked Innoscience Exhibit 1003.
13 Do you recognize this document,
14 Dr. Shealy?
15 A. Yes.
16 Q. What is this document?
17 A. It's the declaration I submitted in
18 this case.
19 Q. And if we go to paragraph 48, you say
20 there with -- with reference to the first
21 embodiment of the admitted prior art, which is
22 figure 1, correct?

Page 19

1 A. Yes, figure 1 is identified as prior
2 art.
3 Q. And you're comparing that to figure 2
4 of the '294 patent, correct?
5 A. Yes.
6 Q. You say that the only difference is
7 the purported use of a compensated semiconductor
8 layer under the gate labeled as element 38
9 instead of the doped p-type layers labeled as
10 elements 105 and 106. Every other element is the
11 same.
12 Is that your statement?
13 A. Yeah, but the patent has a -- states
14 what they mean by a compensated semiconductor.
15 So the -- in the patent the compensated
16 semiconductor is nonconducting. And they
17 contrast that with the prior art that has a
18 conducting layer.
19 Q. So then you would agree that the
20 prior art has a conducting layer and figure 2,
21 the patent, does not have a conducting layer?
22 A. The compensated semiconductor is a

Page 20

1 nonconductive layer in the patent. And in the
2 prior art it's conducting.
3 But that -- one skilled would know,
4 even though it's conducting, a significant
5 portion of that layer is depleted of holes.
6 (Thereupon, Exhibit Number
7 1008, previously marked, was
8 identified.)
9 BY MR. PARADKAR:
10 Q. I'm now handing you what's been
11 marked Innoscience Exhibit 1008.
12 Do you recognize this document,
13 Dr. Shealy?
14 A. Yes, I do.
15 Q. What is this document?
16 A. This is the Kigami, if I'm
17 pronouncing that correctly, prior art reference.
18 Q. And if we look at Kigami -- if you
19 look at figure 1 of Kigami -- are you there,
20 Dr. Shealy?
21 A. Yes, I'm at figure 1.
22 Q. Element 58, that's the gate

Page 21 1 electrode, correct? 2 A. Yes, it's identified as the gate 3 electrode. 4 Q. And below that is gate insulating 5 layer 52, correct -- excuse me, gate insulating 6 film 52? 7 A. The gate insulator is identified as 8 52. 9 Q. And then below that we have local 10 region 34; is that correct? 11 A. It's shown as a layer there, 34, 12 under the insulator, directly under the 13 insulator. 14 Q. And so that gate insulating film is 15 between the gate electrode and the local region 16 34, correct? 17 A. Correct. 18 Q. If we go to paragraph 10, and in the 19 third -- the third paragraph of paragraph 10, 20 second sentence, it reads, When the semiconductor 21 device has been turned on, the hydrogen atoms 22 form a composite with the p-type impurity in the	Page 23 1 Do you see that? 2 A. Yes. You read that correctly. 3 Q. And then the second to last paragraph 4 reads, because -- excuse me, the second to last 5 sentence of paragraph 22 reads, Because the 6 concentration of the hydrogen atoms of the local 7 region 34 is higher than the concentration of the 8 magnesium contained in the local region 34, 9 substantially all of the magnesium forms a 10 composite with the hydrogen atoms. 11 Do you see that? 12 A. Yes. I think you read that 13 correctly. 14 Q. Do you agree that paragraph 22 refers 15 to figure 1? 16 A. A quick review of the figures, it 17 appears that figure 1 is the only figure that has 18 layer 34 indicated in it. So I would conclude, 19 yeah, that any discussion of region 34 must 20 relate to figure 1. 21 (Thereupon, Exhibit Number 22 1006, previously marked, was
Page 22 1 region in which the two-dimensional electron gas 2 layer is formed, and thereby the p-type impurity 3 is inactivated. 4 Do you see that? 5 A. I guess we started looking at figure 6 1. And this paragraph does not relate to figure 7 1, but -- so that's the first thing I noticed. 8 And now I'm going to need to re-hear 9 the question. 10 Q. Sure. 11 (The record was read as requested.) 12 THE WITNESS: Yes. 13 BY MR. PARADKAR: 14 Q. Do you agree that this sentence 15 refers to the local region 34 in figure 1? 16 A. No. 17 Q. Let's go to paragraph 22. First 18 sentence of paragraph 22 reads, The concentration 19 of the hydrogen atoms existing in the local 20 region 34, uneven hydrogen-distribution region, 21 is higher than the concentration of the magnesium 22 contained in the semiconductor layer 32.	Page 24 1 identified.) 2 BY MR. PARADKAR: 3 Q. I'm now handing you Innoscience 4 Exhibit 1006. 5 Dr. Shealy, do you recognize this 6 document? 7 A. Yes, this is the Uemoto -- again, if 8 I'm pronouncing that correctly -- prior art 9 reference. 10 Q. Let's go to figure 7 of Uemoto. 11 Are you there? 12 A. Yes. 13 Q. You rely on figure 7 of Uemoto in 14 your declaration, correct? 15 A. Yes. 16 Q. And if we look at figure 7, Uemoto 17 discloses conductive p-GaN or control region 15A 18 below the gate contact, correct? 19 A. Yes, 15A is -- region 15A is -- 20 appears directly below the gate electrode, as 21 does region -- a portion of region 15B also is 22 shown to be directly below the gate contact.

Page 25

1 Q. Control region 15A is conductive,
2 right?
3 A. 15A, yes, it could have a conductive
4 region in it.
5 Q. I just want to be clear on the
6 record.
7 Are you saying that 15A could be
8 conductive or is conductive?
9 A. It is conductive; but if you look at
10 the band diagram in figure 2 -- there's a couple
11 of band diagrams -- and that shows that in both
12 cases the significant portion of the layer is
13 depleted, as I said earlier. That's the way
14 these work.
15 Q. Let's go to paragraph 33.
16 Are you there?
17 A. Yes.
18 Q. You agree that paragraph 33 refers --
19 is a discussion about figure 1, correct?
20 A. Yes, it appears to be a discussion in
21 the first embodiment, which -- which figure 1 is
22 attached to.

Page 26

1 Q. And if you look at the second
2 sentence of paragraph 33, it reads, The third
3 nitride semiconductor layer doped with magnesium
4 is composed of, a control region 15A in which
5 magnesium is activated to exhibit a p-type
6 conductivity.
7 A. Yes.
8 Q. That's what it says, correct?
9 A. Yes.
10 Q. Now let's go to paragraph 63.
11 Are you there?
12 A. Yes.
13 Q. And you agree that this paragraph
14 refers to figure 7, correct?
15 A. Yes, it appears that it refers to
16 figure 7.
17 Q. And then in the last -- last sentence
18 of that paragraph it says, On the other hand, in
19 the portion thereof exposed from the opening of
20 the third nitride semiconductor layer 15, the
21 impurities contained are activated, whereby the
22 control region 15A having p-type conductivity can

Page 27

1 be selectively formed, correct?
2 A. I believe you read that correctly.
3 Q. So control region 15A -- actually,
4 let me rephrase.
5 Figure 7 of Uemoto describes an
6 enhancement mode device, correct?
7 A. Figure 7 you said?
8 Q. Correct.
9 A. It has the construct of an
10 enhancement mode device; but, again, as I was
11 saying earlier, there are details in the
12 structure that need to be known to conclusively
13 conclude it's enhancement mode, like the doping
14 and thickness of that P layer and the thickness
15 of the barrier. These are all things that play
16 into that moving the threshold around.
17 Q. Okay.
18 A. So it could be an enhancement mode
19 device.
20 Q. Let's go to --
21 A. And I think that's the intent.
22 Q. Let's go to Innoscience Exhibit 1003.

Page 28

1 Let's go to paragraph 96.
2 A. This is my declaration?
3 Q. Your declaration, yes. It's
4 paragraph 96 of Exhibit 1003.
5 Are you there?
6 A. Yes.
7 Q. And the first sentence of that
8 paragraph reads, Uemoto, like the '294 patent,
9 relates normally-off, also known as enhancement
10 mode, III-nitride semiconductor transistors.
11 Are you there, Dr. Shealy?
12 A. Yes.
13 (reporter clarification)
14 BY MR. PARADKAR:
15 Q. And in paragraph 96 you state,
16 Uemoto, like the '294 patent, relates
17 normally-off, also known as enhancement mode,
18 III-nitride semiconductor transistors.
19 Is that what you said in your
20 declaration?
21 A. Yes.
22 Q. And do you stand by that?

Page 29

1 A. Yes.

2 Q. Let's go back to Exhibit 1006.

3 Are you there?

4 A. Yes.

5 Q. So if we look at figure 7, do you

6 agree that Uemoto discloses that the 2DEG is

7 depleted below control region 15A at zero volts?

8 A. Yes. If this is an enhancement mode

9 device at zero volts applied between the source

10 and the gate, there would be a region under the

11 gate where there's no 2D gas.

12 Q. Uemoto discloses that the 2DEG gas is

13 present below transistor region 15B at zero

14 volts, correct?

15 MS. SPECHT: Objection, foundation.

16 THE WITNESS: Under at least

17 portions of 15B there will be a 2D gas

18 underneath it at zero volts.

19 You said at zero volts?

20 BY MR. PARADKAR:

21 Q. Correct.

22 A. Okay.

Page 30

1 Q. Go to paragraph 38.

2 Are you there?

3 A. Yes.

4 Q. And if you look at the second

5 sentence of paragraph 38, it says, In the region

6 other than the control region, as shown in figure

7 2B at the heterointerface the conduction band is

8 located at a lower level than the Fermi level,

9 and thus 2DEG is created.

10 Do you see that?

11 A. Yes.

12 Q. That sentence says that in the region

13 other than the control region, 2DEG is present,

14 correct?

15 A. It says other than the control region

16 a 2D gas is created in that sentence.

17 (Thereupon, Exhibit Number

18 1005, previously marked, was

19 identified.)

20 BY MR. PARADKAR:

21 Q. I'm handing you what's been marked

22 Innoscience Exhibit 1005.

Page 31

1 Do you recognize this document?

2 A. Yes, I do.

3 Q. What is it?

4 A. This is the Smith prior art

5 reference.

6 Q. And you rely on figure 2A of Smith in

7 your declaration, correct?

8 A. Figure 2A does appear in my

9 declaration.

10 Q. And you also rely on figure 1B of

11 Smith, correct? Actually, let me strike that.

12 Let's just look at figure 2A.

13 Are you there?

14 A. Figure 2A, yes.

15 Q. Element 32 in figure 2A represents

16 the gate contact, correct?

17 A. 32 is the gate contact.

18 Q. And then element 40 represents doped

19 region, correct?

20 A. It represents a -- what they call a

21 doped region, but that doesn't necessarily mean

22 there's not doping elsewhere in that layer.

Page 32

1 Q. And then below that we have cap layer

2 34, correct?

3 A. Below the gate electrode, yes.

4 Q. And then below the cap layer, we have

5 the barrier layer, correct, 22?

6 A. The barrier layer is identified as

7 22.

8 Q. And then channel layer 20 below

9 barrier layer, correct?

10 A. Immediately below, yes.

11 Q. And the 2DEG region in figure 2A

12 would be present between -- at the interface

13 between the barrier layer and the channel layer,

14 correct?

15 A. The 2D electron gas is located below

16 that interface, but it's very close.

17 Q. Below what interface?

18 A. The interface between the barrier

19 layer and the channel layer.

20 Q. As shown in figure 2A, the cap layer

21 runs from one ohmic contact to the other ohmic

22 contact, correct?

Page 33

1 A. No, there's a gap between the ohmic
2 contacts and the cap layer.
3 Q. As shown on figure 2A you see a gap
4 between the cap layer and --
5 A. Oh, I was looking at figure 2B. In
6 figure 2A it shows that the cap layer runs
7 between the two ohmic contacts.
8 Q. And figure 2A shows the cap layer is
9 in contact with ohmic contact 30 on the left and
10 the right, correct?
11 A. Figure 2A shows that the ohmic
12 contact is adjacent to cap layer 34.
13 Q. And you would agree that the cap
14 layer 34 is in direct contact with the ohmic
15 contact as shown in figure 2A, correct?
16 MS. SPECHT: Objection, asked and
17 answered.
18 THE WITNESS: Would you mind
19 pointing me to the description of that
20 before I answer?
21 BY MR. PARADKAR:
22 Q. Sure. I'll point you to the

Page 34

1 description. I will state the question is
2 directed to as the figure appears as shown in
3 figure 2A.
4 Would you agree that the cap layer is
5 in contact with the ohmic contact on the left and
6 the right?
7 MS. SPECHT: Objection, asked and
8 answered.
9 THE WITNESS: That's what the
10 figure appears to illustrate, but these
11 are often schematic. So that's why I was
12 looking for the description. But the
13 figure seems to indicate that.
14 BY MR. PARADKAR:
15 Q. You agree that -- or, rather, let me
16 rephrase that.
17 If we go to your declaration at
18 paragraph 169 -- that's Exhibit 1003.
19 Are you there?
20 A. Yes.
21 Q. In that second sentence you state
22 that Smith discloses that cap layer 34 can be

Page 35

1 doped with p-type dopants, including magnesium,
2 beryllium, zinc, calcium and/or carbon; is that
3 correct?
4 A. The sentence lists those five
5 elements as possibilities for the p-type dopants.
6 Q. And you agree that the cap layer in
7 Smith can be doped with p-type dopants?
8 A. Yes.
9 Q. And when you apply a voltage to
10 figure 2A of Smith, you induce 2DEG under the
11 gate, correct?
12 MS. SPECHT: Objection, form.
13 MR. PARADKAR: Withdrawn.
14 Let's take a break.
15 (Thereupon, a brief recess was taken.)
16 BY MR. PARADKAR:
17 Q. Welcome back, Dr. Shealy.
18 A. Thank you.
19 Q. Let's go back to figure 2A of Smith.
20 Do you agree that figure 2A depicts a
21 depletion mode transistor?
22 A. This embodiment, if the cap layer is

Page 36

1 doped sufficiently p-type and with the required
2 thickness, then it could be an enhancement mode
3 transistor. And, in fact, I believe if you look
4 in Smith, he talks about moving the threshold
5 around when you dope this layer.
6 So it's -- it's quite obvious that it
7 could cover enhancement mode devices.
8 Q. If that cap layer is p-type doped,
9 and figure 2A is an enhancement mode device, then
10 the 2DEG is depleted under the cap layer from the
11 source to the drain, correct?
12 A. That's not correct.
13 Q. In figure 2A you agree that the cap
14 layer is shown as being in contact with ohmic
15 contact 30 on the left and ohmic 30 on the right,
16 correct?
17 MS. SPECHT: Objection, asked and
18 answered.
19 THE WITNESS: Figure 2A shows the
20 ohmic contact to be adjacent to either
21 side of the cap layer.
22 BY MR. PARADKAR:

Page 37 1 Q. And in contact with the ohmic 2 contacts? 3 MS. SPECHT: Same objection. 4 THE WITNESS: I believe the figure 5 indicates that there is contact. 6 BY MR. PARADKAR: 7 Q. And you would agree, then, if the cap 8 layer was p-type doped, that it would deplete the 9 2DEG region from -- from -- let me rephrase. 10 You agree if the cap layer was p-type 11 doped, it would deplete the 2DEG along its entire 12 length, correct? 13 A. Along what entire length? 14 Q. I can rephrase the question. 15 If the cap layer is p-type doped, do 16 you agree that it would deplete the 2DEG along 17 the entire length of the cap layer? 18 A. No. 19 Q. Why not? 20 A. Because the -- if it were to do what 21 you said, the -- basically what -- the way you 22 described it is nonphysical. There's significant	Page 39 1 Q. And that paragraph says 2 conventional passivation -- let me reread that. 3 Paragraph 83, first sentence says, A 4 conventional passivation layer or a BN 5 passivation layer as described below may also be 6 provided on the structures of figures 1A and 1B. 7 Do you see that? 8 A. Yes, I do. 9 Q. So this paragraph, you would agree, 10 is talking about passivation layers or BN 11 passivation layer? 12 A. The sentence you read refers to a 13 boron nitride passivation layer; but as you can 14 see, there are other embodiments discussed. 15 Q. Those are all passivation layers, 16 correct? 17 A. The magnesium nitride and boron 18 nitride are described as passivation layers. The 19 silicon nitride, that label is not attached to 20 it. 21 Q. Let's go to paragraph 90. This is -- 22 A. You said 90?
Page 38 1 diffusion of electrons out of each ohmic contact 2 feeding the 2D gas. So there's a transition 3 between the region under the gate electrode where 4 there's no 2D gas and to the ohmic contact where 5 the 2D gas is almost in full strength. 6 There's also a significant effect of 7 the drain bias that we haven't even talked about. 8 This is not a one-dimensional device. It's a 9 two-dimensional device. 10 Q. So if figure 2A is an enhancement 11 mode device, when you apply -- you would apply 12 positive voltage to it to turn it on, correct? 13 A. Yes. 14 Q. And you would induce 2DEG under the 15 gate when you apply that positive voltage, 16 correct? 17 A. Assuming the positive voltage is 18 greater than the threshold voltage, the answer to 19 that would be yes. 20 Q. Let's go to paragraph 83. 21 Are you there? 22 A. Yes.	Page 40 1 Q. 90, yes. 2 Do you agree that paragraph 90 refers 3 to figures 3A and 3B? 4 A. Yes, it also incorporates features 5 from 1A and 1B and 2A and 2B. 6 Q. Okay. Great. Referring to figures 7 3A and 3B, do you see BN layer 100 and BN layer 8 100 prime in figures 3A and 3B? 9 A. Yes. 10 Q. And that's referring to the graphitic 11 and/or amorphous BN passivation layer, correct? 12 A. Layer 100 is a boron nitride 13 passivation layer. 14 Q. And that BN layer is separate from 15 cap layer 34, correct? 16 A. The cap layer and the boron nitride 17 layer are separate elements, yes. 18 Q. Let's go to paragraph 92. 19 Are you there? 20 A. Yes. 21 Q. And that refers to figures 4A and 4B, 22 correct?

Page 41

1 A. They are importing features from 2A
2 and 2B and 1A and 1B into figures 4A and 4B.
3 Q. Now, looking at figures 4A and 4B,
4 figure 4A shows a SIC layer 110, correct?
5 A. In figure 4A and 4B the silicon
6 carbide layer 110 is identified as a passivation
7 layer.
8 Q. And as shown -- strike that.
9 The SIC layer in figures 4A and 4B is
10 separate from the cap layer in figures 4A and 4B,
11 correct?
12 A. The silicon carbide layer is a
13 passivation layer labeled 110. The cap layer, a
14 different element, is identified as layer 24 or
15 element 24.
16 Q. Dr. Shealy, you're also testifying as
17 an expert in IPR2023-01382 with regard to U.S.
18 patent number 9,748,347, correct?
19 A. I participated in the IPR associated
20 with a '347 patent. I cannot confirm the rest of
21 the numbers that you -- I don't have that in
22 front of me, so I don't know if that's the

Page 42

1 right --
2 Q. Understood.
3 A. -- IPR number or the rest of the
4 patent number. But I did do an IPR on a '347
5 patent.
6 Q. Okay. Are you testifying as an
7 expert in IPR related to U.S. patent number
8 10,312,335?
9 A. I participated in an IPR on a patent
10 identified as '335; but as I sit here now, I
11 don't recall the rest of the numbers on the
12 patent or the IPR number.
13 MR. PARADKAR: Let's mark this
14 Exhibit 2008.
15 (Thereupon, Exhibit Number 2008
16 was marked for identification.)
17 BY MR. PARADKAR:
18 Q. Do you recognize this document,
19 Dr. Shealy?
20 A. There are many Cree patents that look
21 very similar. And -- and so Saxler, Sheppard,
22 Smith, they're all -- I've seen patents from all

Page 43

1 three of these characters, so I -- I can't
2 positively say this is the one that I've looked
3 at. They're very similar.
4 As you can see -- I mean, look at the
5 cover figure on Smith and look at the cover
6 figure on Saxler. So you can see why --
7 Q. I'll represent to you that this is --
8 this exhibit was Exhibit 1007 in IPR2023-01384
9 regarding U.S. patent number 10,312,335.
10 Let's take a look at figure 2A. And,
11 if you would, take a look at figure 2A of Smith.
12 For the record, I've asked the witness to look at
13 figure 2A of Smith and figure 2A of Saxler.
14 Are you there?
15 A. Yes.
16 Q. Do you agree that, as depicted,
17 figure 2A of Smith and figure 2A of Saxler are
18 identical?
19 MS. SPECHT: Objection. This
20 entire line of questioning goes beyond the
21 scope of Dr. Shealy's declaration, as you
22 acknowledged yourself on the record,

Page 44

1 counsel.
2 Dr. Shealy considered the Saxler
3 reference with relation to the '335
4 patent, which is not related whatsoever to
5 the '294 patent. Unless you're going to
6 give him time to analyze and form opinions
7 about this Saxler reference related to the
8 '294 patent, having him simply compare
9 figures is not something he should opine
10 on in this deposition today.
11 You still have to answer,
12 Dr. Shealy.
13 THE WITNESS: I'm not really
14 prepared to provide opinions on references
15 that are outside this case, unless I'm
16 given time to do it.
17 BY MR. PARADKAR:
18 Q. I just asked you whether the figures
19 are identical as drawn, Dr. Shealy, not -- not
20 whether -- not anything more than that.
21 MS. SPECHT: Same objection, unless
22 you're simply asking him to confirm the

Page 45

1 lines and numbering on two figures from
2 unrelated references are identical. It's
3 beyond the scope of his declaration.
4 BY MR. PARADKAR:
5 Q. Can you please confirm, Dr. Shealy.
6 A. These two figures appear to be the
7 same.
8 Q. Let's look at figures 1B of Smith and
9 1B of Saxler.
10 As drawn, would you agree that those
11 figures are identical?
12 MS. SPECHT: Same objection. And
13 if you're going to walk through every
14 figure, we'll make it a standing
15 objection.
16 MR. PARADKAR: Understood.
17 THE WITNESS: Well, on the copy I
18 have they're not identical.
19 BY MR. PARADKAR:
20 Q. What's the difference?
21 A. The copy I have of Smith shows some
22 extra marks there.

Page 46

1 Q. Okay. Let's go through the figure
2 then.
3 Would you agree that both figure 1B
4 of Smith and 1B of Saxler have a block labeled 32
5 at the top?
6 A. There is a block 32 that appears in
7 both of these references that is resting on the
8 cap layer.
9 Q. And both of these references have a
10 cap layer 24 prime below block 32, correct?
11 A. I would say the gate electrode 32 is
12 above the cap layer 24.
13 Q. In both figures, correct?
14 A. Yes.
15 Q. And then both figures have ohmic
16 contact 30 on the left and right of cap layer 24
17 prime, correct?
18 A. The ohmic contacts appear as element
19 30 on either side of the cap layer.
20 Q. And then below the cap layer and
21 ohmic contacts in both figures is barrier layer
22 22, correct?

Page 47

1 A. Layer 22 is labeled barrier layer in
2 each figure.
3 Q. And that barrier layer is below the
4 cap layer and ohmic contact in both figures,
5 correct?
6 A. The ohmic contacts and cap layer are
7 shown to be immediately above the barrier layer
8 in both figures.
9 Q. And then below barrier layer 22 in
10 both figures is channel layer 20, correct?
11 A. Channel layer 20 is immediately below
12 the barrier layer in each figure. And this is
13 the copy I have, which has the extra feature on
14 it, which -- which I don't know what it is.
15 Q. Would you agree that that extra
16 feature appears to be some sort of smudge?
17 A. Without -- this is -- I don't know if
18 I'd call it a smudge. I don't know what smudge
19 is. I -- it appears that somebody drew on this
20 drawing before -- before it was handed to me.
21 Q. I see. And below channel layer 20 on
22 both figures is substrate 10, correct?

Page 48

1 A. The substrate appears below layer 20,
2 immediately below layer 20, in each figure.
3 Q. And then both figures have an arrow
4 or a line to cap layer 24 prime labeled 25 prime,
5 correct?
6 A. I -- there's a line extending from 25
7 prime, but I'm not sure what -- without reading
8 the reference -- what that is referring to.
9 Q. Understood.
10 So other than that difference you
11 identified between the figures, would you agree
12 that everything else between figures 1B of Smith
13 and figure 1B of Saxler is identical?
14 MS. SPECHT: Objection, beyond the
15 scope; mischaracterizing his prior
16 testimony. He explained he had to read
17 the reference before he could opine on
18 whether the identified items were
19 identical.
20 BY MR. PARADKAR:
21 Q. Let me rephrase the question.
22 Other than the difference you

Page 49

1 identified between the figures, would you agree
2 that the figures 1B of Smith and 1B of Saxler, as
3 drawn, are identical?
4 MS. SPECHT: Same objection.
5 THE WITNESS: They could very well
6 mean to convey something different.
7 Without identifying each element in this
8 reference I haven't looked at in quite a
9 while, you know, so they may not be
10 conveying the same information.
11 BY MR. PARADKAR:
12 Q. But you agree that they're drawn
13 identically?
14 MS. SPECHT: Same objection, and
15 asked and answered.
16 THE WITNESS: Aside from this
17 additional feature that is in this copy of
18 the Smith reference, these diagrams appear
19 to be drawn the same.
20 MR. PARADKAR: Let's take a
21 five-minute break.
22 (Thereupon, a brief recess was

Page 50

1 taken.)
2 BY MR. PARADKAR:
3 Q. Dr. Shealy, could we go to figure 2A
4 of Smith, please.
5 If you recall, we were talking
6 earlier about the cap layer being p-type doped.
7 And you disagreed with me that p-type doping of
8 that cap layer would deplete 2DEG along the
9 entire length of the cap layer.
10 Do you recall that conversation?
11 A. Yes.
12 Q. And you said, So there's a transition
13 between the region under the gate electrode where
14 there's no 2D gas and to the ohmic contact where
15 the 2D gas is almost in full strength.
16 Where -- where is that transition?
17 A. The transition changes depending on
18 the bias applied to the device. So it's not
19 going to be -- the transition occurs somewhere
20 between where 32 is to the ohmic contact.
21 Q. Where is that transition at zero gate
22 voltage?

Page 51

1 A. It depends on the drain bias.
2 Q. Would you say that the transition is
3 closer to the ohmic contact or to the gate
4 electrode?
5 A. It depends on the drain bias.
6 Q. When would the transition be closer
7 to the ohmic contact?
8 A. When the transistor enters into
9 saturation with drain bias, that would be the
10 case.
11 Q. So at a higher drain bias?
12 A. Higher than zero, yes.
13 Q. What do you mean by saturation with
14 drain bias?
15 A. There's something known as a drain
16 saturation voltage. So when you approach that,
17 it will move that transition.
18 Q. What is drain saturation voltage?
19 A. Drain saturation voltage is
20 approximately where the drain current saturates.
21 Q. How is that calculated?
22 A. It is -- it depends on a lot of

Page 52

1 things. So I guess you should repeat the
2 question. How is what calculated?
3 Q. How is the drain saturation voltage
4 calculated?
5 A. It involves the electron mobility in
6 the channel. It involves the aspect ratio of the
7 device. And it also involves the gate bias, and
8 the threshold voltage.
9 Q. When would the transition of 2DEG be
10 closer to the gate electrode?
11 A. As you lower the drain bias, it would
12 affect the transition.
13 Q. Affect the transition by moving it
14 closer to the gate electrode?
15 A. I would say away from the drain
16 contact.
17 MR. PARADKAR: We'll pass the
18 witness.
19 EXAMINATION
20 BY MS. SPECHT:
21 Q. Dr. Shealy, do you remember being
22 asked questions about Innoscience Exhibit 1006,

Page 53 1 which is the Uemoto reference? 2 A. Yes. 3 Q. And do you recall being asked 4 questions about paragraph 38 of the Uemoto 5 reference? 6 A. Yes. This is the paragraph that 7 refers to figures 2A and 2B. 8 Q. Okay. So let's take a look, then, at 9 figure 2B of Uemoto. 10 What, if anything, does figure 2B 11 tell you about the doping characteristics of 12 region 15B? 13 A. The -- 15B is -- is meant to 14 represent a p-type of material that was p-doped 15 that's heavily compensated with hydrogen. 16 Q. And based on your review of figure 17 2B, would region 15B have an effect on the 2D 18 gas? 19 A. If you look at the right-hand side of 20 figure 15B, it's clear that you can see curvature 21 in the bands. In other words, it's not a 22 straight line. That curvature arises from a	Page 54 1 fixed negative charge. 2 So the fixed negative charge is an 3 unpassivated acceptor impurity. And any fixed 4 negative charge in close proximity as it would be 5 to the two-dimensional electron gas will cause a 6 depletion of the 2D gas to occur, a partial 7 depletion. 8 Q. Thank you. 9 MS. SPECHT: Can we take a 10 five-minute break off the record? 11 MR. PARADKAR: Sure. 12 (Thereupon, a brief recess was taken.) 13 MS. SPECHT: No further questions 14 and pass the witness. 15 MR. PARADKAR: We have no further 16 questions. 17 (Thereupon, signature having not been 18 waived, at 11:34 a.m. the deposition 19 concluded.) 20 21 22
Page 55 1 CERTIFICATE OF DEPONENT 2 I, James Richard Shealy, Ph.D., do 3 hereby certify that I have read the foregoing 4 pages, ____ through ____, inclusive, which 5 contain a correct transcript of the answers 6 given by me to the questions propounded to me 7 herein, except for changes, if any, duly 8 noted on the enclosed errata sheet. 9 10 11 12 13 14 15 16 17 18 19 20 21 22	Page 56 1 CASE: INNOSCIENCE TECHNOLOGY V EFFICIENT POWER 2 DEPOSITION OF: JAMES RICHARD SHEALY, PH.D. 3 TAKEN: May 31, 2024 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Page 57 1CASE: INNOSCIENCE TECHNOLOGY V EFFICIENT POWER 2DEPOSITION OF: JAMES RICHARD SHEALY, PH.D. 3TAKEN: May 31, 2024 4 5PAGE LINE ERRORCORRECTIONREASON 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 Witness	
Page 58 1CERTIFICATE OF NOTARY 2I, MISTY KLAPPER, the officer 3before whom the foregoing deposition was 4taken, do hereby certify that the witness 5whose testimony appears in the foregoing 6deposition was duly sworn by me; that the 7testimony of said witness was taken by me 8in shorthand and thereafter reduced to 9typewriting by me; that said deposition is 10a true record of the testimony given by 11said witness; that I am neither counsel 12for, related to, nor employed by any of 13the parties to the action in which this 14deposition was taken; and, further, that I 15am not a relative or employee of any 16attorney or counsel employed by the 17parties hereto, nor financially or 18otherwise interested in the outcome of 19this action. 20 21 22 Misty Klapper, RMR, CRR Notary Public in and for the Commonwealth of Virginia	

Exhibits Shealy Ph.D. Exhibit 2007 4:9 7:2,3,4 Shealy Ph.D. Exhibit 2008 4:11 42:14, 15 1 1 13:21 14:10,14,18,20 15:20 16:8,11 17:10,22 18:22 19:1 20:19,21 22:6,7, 15 23:15,17,20 25:19,21 10 11:3 21:18,19 47:22 10,312,335 42:8 43:9 100 14:15 40:7,8,12 1001 13:7,11 1003 18:8,12 27:22 28:4 34:18 1005 30:18,22 1006 23:22 24:4 29:2 52:22 1007 43:8 1008 20:7,11 105 16:12,14 17:1 19:10 106 16:12,14 17:1 19:10 110 41:4,6,13 111 8:7 11:34 54:18 15 26:20 15A 24:17,19 25:1,3,7 26:4, 22 27:3 29:7 15B 24:21 29:13,17 53:12, 13,17,20 169 34:18 1A 39:6 40:5 41:2 1B 31:10 39:6 40:5 41:2 45:8,9 46:3,4 48:12,13 49:2 2 2 19:3,20 25:10	20 5:16 11:4 32:8 47:10,11, 21 48:1,2 2000s 10:22 2007 7:2,4 2008 42:14,15 22 22:17,18 23:5,14 32:5,7 46:22 47:1,9 24 41:14,15 46:10,12,16 48:4 25 48:4,6 294 7:19 8:16 13:17,18 19:4 28:8,16 44:5,8 2A 31:6,8,12,14,15 32:11,20 33:3,6,8,11,15 34:3 35:10, 19,20 36:9,13,19 38:10 40:5 41:1 43:10,11,13,17 50:3 53:7 2B 30:7 33:5 40:5 41:2 53:7, 9,10,17 2D 10:16 11:13,18 16:1 29:11,17 30:16 32:15 38:2, 4,5 50:14,15 53:17 54:6 2DEG 10:3,5 11:10,15,18 12:4,16 15:21 16:17 29:6,12 30:9,13 32:11 35:10 36:10 37:9,11,16 38:14 50:8 52:9 3 30 5:16 33:9 36:15 46:16,19 32 22:22 31:15,17 46:4,6,10, 11 50:20 33 25:15,18 26:2 335 42:10 44:3 34 21:10,11,16 22:15,20 23:7,8,18,19 32:2 33:12,14 34:22 40:15 347 41:20 42:4 38 19:8 30:1,5 53:4 3A 40:3,7,8 3B 40:3,7,8	4 40 31:18 48 18:19 4A 40:21 41:2,3,4,5,9,10 4B 40:21 41:2,3,5,9,10 5 508 9:7 52 21:5,6,8 55 14:10 58 20:22 6 63 26:10 7 7 24:10,13,16 26:14,16 27:5, 7 29:5 8 8,350,294 7:16 83 38:20 39:3 9 9,748,347 41:18 90 39:21,22 40:1,2 92 40:18 96 28:1,4,15 A a.m. 54:18 acceptor 54:3 acceptors 16:19 acknowledged 43:22 activated 26:5,21	added 17:11 additional 49:17 adjacent 33:12 36:20 admitted 18:21 affect 52:12,13 agree 14:20 15:21 19:19 22:14 23:14 25:18 26:13 29:6 33:13 34:4,15 35:6,20 36:13 37:7,10,16 39:9 40:2 43:16 45:10 46:3 47:15 48:11 49:1,12 ALGAN 18:5 amorphous 40:11 analyze 44:6 and/or 35:2 40:11 appears 23:17 24:20 25:20 26:15 34:2,10 46:6 47:16,19 48:1 applied 9:22 12:19 16:3 29:9 50:18 apply 16:6 35:9 38:11,15 approach 51:16 approximately 5:14 51:20 arises 53:22 arrow 48:3 art 18:21 19:2,17,20 20:2,17 24:8 31:4 aspect 52:6 Assuming 16:9 38:17 atoms 21:21 22:19 23:6,10 attached 25:22 39:19 audibly 6:5 B back 11:10 12:8 14:18 29:2 35:17,19 backbone 10:11 band 25:10,11 30:7 bands 53:21 barrier 11:22 14:7 15:4
--	---	--	---

27:15 32:5,6,9,13,18 46:21 47:1,3,7,9,12 based 53:16 basically 11:13 17:4 37:21 beryllium 35:2 bias 38:7 50:18 51:1,5,9,11, 14 52:7,11 block 46:4,6,10 BN 39:4,10 40:7,11,14 boron 39:13,17 40:12,16 break 6:19 35:14 49:21 54:10 breaks 6:21 briefly 8:7 build 10:10,14 building 10:18 built 10:22 11:6,8 C calcium 35:2 calculated 51:21 52:2,4 call 31:20 47:18 called 5:3 cap 32:1,4,20 33:2,4,6,8,12, 13 34:4,22 35:6,22 36:8,10, 13,21 37:7,10,15,17 40:15, 16 41:10,13 46:8,10,12,16, 19,20 47:4,6 48:4 50:6,8,9 carbide 41:6,12 carbon 35:2 case 18:18 44:15 51:10 cases 25:12 channel 10:8 11:12,14 12:1 32:8,13,19 47:10,11,21 52:6 characteristics 53:11 characters 43:1 charge 54:1,2,4 circuit 10:1 clarification 6:12 28:13	clarify 6:13 clear 17:20 25:5 53:20 close 32:16 54:4 closer 51:3,6 52:10,14 column 14:10 Commission 8:17 company 10:21 compare 44:8 comparing 19:3 compensated 19:7,14,15, 22 53:15 composed 26:4 composite 21:22 23:10 concentration 12:12 22:18,21 23:6,7 conclude 23:18 27:13 concluded 54:19 conclusively 27:12 conduct 17:8 conducting 11:14 19:18, 20,21 20:2,4 conduction 30:7 conductive 17:2,4 24:17 25:1,3,8,9 conductivity 26:6,22 confirm 41:20 44:22 45:5 considered 8:4 44:2 construct 14:5 15:1,10,20 27:9 contact 17:5 24:18,22 31:16,17 32:21,22 33:9,12, 14,15 34:5 36:14,15,20 37:1,5 38:1,4 46:16 47:4 50:14,20 51:3,7 52:16 contacts 33:2,7 37:2 46:18, 21 47:6 contained 22:22 23:8 26:21 continue 16:22 continuous 16:4 contrast 19:17	contribute 17:15 control 24:17 25:1 26:4,22 27:3 29:7 30:6,13,15 conventional 14:14 39:2,4 conversation 50:10 convey 49:6 conveying 49:10 copy 45:17,21 47:13 49:17 correct 7:16 11:12 14:4 15:14 16:8,10,13,18,21 17:2 18:22 19:4 21:1,5,10,16,17 24:14,18 25:19 26:8,14 27:1,6,8 29:14,21 30:14 31:7,11,16,19 32:2,5,9,14, 22 33:10,15 35:3,11 36:11, 12,16 37:12 38:12,16 39:16 40:11,15,22 41:4,11,18 46:10,13,17,22 47:5,10,22 48:5 correctly 14:17 20:17 23:2, 13 24:8 27:2 counsel 5:4 44:1 couple 25:10 cover 36:7 43:5 covers 8:13 created 30:9,16 Cree 42:20 current 10:1 51:20 curvature 53:20,22 D decide 15:7 decision 8:11 declaration 8:2,9 18:17 24:14 28:2,3,20 31:7,9 34:17 43:21 45:3 depending 50:17 depends 51:1,5,22 depicted 43:16 depicts 35:20 deplete 37:8,11,16 50:8	depleted 9:14 16:17 17:6,7, 10,13,14,22 20:5 25:13 29:7 36:10 depletion 9:15 11:20 12:15, 18 14:8 15:6 18:4,5 35:21 54:6,7 deposed 5:12,15 deposition 5:22 7:3,11,12 44:10 54:18 describes 27:5 description 33:19 34:1,12 details 14:9 15:6 27:11 device 9:21 10:6,11,14,22 12:18,20,22 13:1,3,5 14:6, 15 15:6,11 16:10 21:21 27:6,10,19 29:9 36:9 38:8,9, 11 50:18 52:7 devices 10:19 11:7,16,21 12:5,15 36:7 diagram 25:10 diagrams 25:11 49:18 difference 19:6 45:20 48:10,22 diffusion 38:1 direct 33:14 directed 34:2 directly 21:12 24:20,22 disagree 15:13 disagreed 50:7 discloses 24:17 29:6,12 34:22 discussed 39:14 discussion 9:5 23:19 25:19,20 dispute 8:16,20 document 7:8,14 13:13,15 18:13,16 20:12,15 24:6 31:1 42:18 documents 7:22 8:3,5,19 9:1 dopants 35:1,5,7 dope 15:3 36:5
--	---	---	---

doped 16:12,13,14,15 17:3 19:9 26:3 31:18,21 35:1,7 36:1,8 37:8,11,15 50:6 doping 14:6 15:2 16:16 17:12 27:13 31:22 50:7 53:11 drain 10:1 16:2,4 36:11 38:7 51:1,5,9,11,14,15,18,19,20 52:3,11,15 drawing 47:20 drawn 44:19 45:10 49:3,12, 19 drew 47:19 duly 5:5 E earlier 25:13 27:11 50:6 early 10:22 effect 38:6 53:17 electrode 21:1,3,15 24:20 32:3 38:3 46:11 50:13 51:4 52:10,14 electron 10:7,8 11:13,21 12:11 22:1 32:15 52:5 54:5 electrons 38:1 element 19:8,10 20:22 31:15,18 41:14,15 46:18 49:7 elements 16:11 17:1 19:10 35:5 40:17 embodiment 18:21 25:21 35:22 embodiments 39:14 engaged 8:15 enhancement 9:12,17,19 11:16,19,20 12:5 13:1 14:3, 5,8,14,20 15:1,7,9,10,20 16:9 27:6,10,13,18 28:9,17 29:8 36:2,7,9 38:10 enters 51:8 entire 37:11,13,17 43:20 50:9 examination 5:4,7 52:19	examined 5:5 excuse 9:1 21:5 23:4 exhibit 7:2,3 13:6,11 18:7, 12 20:6,11 23:21 24:4 26:5 27:22 28:4 29:2 30:17,22 34:18 42:14,15 43:8 52:22 existing 22:19 expert 41:17 42:7 explained 48:16 exposed 26:19 extending 48:6 extra 17:11 45:22 47:13,15 F fact 36:3 feature 47:13,16 49:17 features 40:4 41:1 feeding 38:2 Fermi 30:8 figure 13:21 14:13,18,20 15:19 16:7,11 17:10,22 18:22 19:1,3,20 20:19,21 22:5,6,15 23:15,17,20 24:10,13,16 25:10,19,21 26:14,16 27:5,7 29:5 30:6 31:6,8,10,12,14,15 32:11,20 33:3,5,6,8,11,15 34:2,3,10, 13 35:10,19,20 36:9,13,19 37:4 38:10 41:4,5 43:5,6,10, 11,13,17 45:14 46:1,3 47:2, 12 48:2,13 50:3 53:9,10,16, 20 figures 23:16 39:6 40:3,6,8, 21 41:2,3,9,10 44:9,18 45:1, 6,8,11 46:13,15,21 47:4,8, 10,22 48:3,11,12 49:1,2 53:7 filed 7:22 filings 9:8 film 21:6,14 find 8:3 five-minute 49:21 54:10 fixed 54:1,2,3	flowing 10:1 form 18:2 21:22 35:12 44:6 formed 22:2 27:1 forms 11:13 23:9 foundation 29:15 foundry 10:20 11:7 front 8:16 41:22 full 38:5 50:15 function 17:7 functional 10:10 G gallium 10:14 Gan 14:14 gap 33:1,3 gas 10:8,16 11:13,21 12:12 16:1 22:1 29:11,12,17 30:16 32:15 38:2,4,5 50:14,15 53:18 54:5,6 gate 9:22 10:14 11:1,6 12:5, 13,16 15:22 16:3,5,7 17:5 19:8 20:22 21:2,4,5,7,14,15 24:18,20,22 29:10,11 31:16, 17 32:3 35:11 38:3,15 46:11 50:13,21 51:3 52:7,10,14 gates 11:9 general 17:13 Generally 12:17 get all 6:20 gigahertz 11:3 give 6:3 14:22 44:6 Good 5:9,11 graphitic 40:10 Great 5:18 6:10,18 7:21 14:2 40:6 greater 38:18 ground 5:22 group 10:10,13 guess 22:5 52:1	H hand 26:18 handed 47:20 handing 13:10 18:11 20:10 24:3 30:21 heavily 53:15 HEMT 10:6,11,14,22 11:14 HEMTS 10:17 11:8 heterointerface 30:7 high 10:7 15:3 16:13,15 17:3 higher 22:21 23:7 51:11,12 highly 12:2 holes 17:6 20:5 hydrogen 21:21 22:19 23:6,10 53:15 hydrogen-distribution 22:20 I identical 43:18 44:19 45:2, 11,18 48:13,19 49:3 identically 49:13 identification 7:5 42:16 identified 18:9 19:1 20:8 21:2,7 24:1 30:19 32:6 41:6, 14 42:10 48:11,18 49:1 identifying 49:7 III-NITRIDE 28:10,18 illustrate 34:10 illustrates 14:14 immediately 32:10 47:7,11 48:2 importing 41:1 impurities 26:21 impurity 21:22 22:2 54:3 inactivated 22:3 including 35:1
--	---	--	--

incorporates 40:4 induce 35:10 38:14 information 15:2,5 49:10 Innoscience 13:11 18:12 20:11 24:3 27:22 30:22 52:22 Institution 8:10 insulated 10:14 11:6 insulating 21:4,5,14 insulator 21:7,12,13 intent 27:21 interface 11:22 12:3 32:12, 16,17,18 International 8:17 interrupted 16:1,5 involved 9:3,7 involves 52:5,6,7 ionized 16:20 IPR 8:1 41:19 42:3,4,7,9,12 IPR2023-01381 7:13 IPR2023-01382 41:17 IPR2023-01384 43:8 ITC 8:20 9:3,9 items 48:18	layer 12:1 19:8,18,20,21 20:1,5 21:5,11 22:2,22 23:18 25:12 26:3,20 27:14 31:22 32:1,4,5,6,8,9,13,19, 20 33:2,4,6,8,12,14 34:4,22 35:6,22 36:5,8,10,14,21 37:8,10,15,17 39:4,5,11,13 40:7,11,12,13,14,15,16,17 41:4,6,7,9,10,12,13,14 46:8, 10,12,16,19,20,21 47:1,3,4, 6,7,9,10,11,12,21 48:1,2,4 50:6,8,9 layers 19:9 39:10,15,18 left 33:9 34:5 36:15 46:16 length 37:12,13,17 50:9 level 30:8 lines 45:1 list 8:3 lists 35:4 local 21:9,15 22:15,19 23:6, 8 localized 12:2 located 30:8 32:15 looked 43:2 49:8 lot 51:22 low 16:12,14 lower 30:8 52:11	mention 10:9,21 mind 33:18 mischaracterizing 48:15 mixing 9:6 mobility 10:7 52:5 mode 9:12,15,17,19 11:16, 19,20,21 12:5,15,18 13:1 14:3,6,9,14,20 15:1,6,7,9, 11,20 16:9 27:6,10,13,18 28:10,17 29:8 35:21 36:2,7, 9 38:11 morning 5:9,11 move 51:17 moving 17:15 27:16 36:4 52:13	obvious 36:6 occur 54:6 occurs 50:19 ohmic 17:5 32:21 33:1,7,9, 11,14 34:5 36:14,15,20 37:1 38:1,4 46:15,18,21 47:4,6 50:14,20 51:3,7 one-dimensional 38:8 opening 26:19 opine 44:9 48:17 opinion 17:9,21 opinions 44:6,14 order 12:10 owner 8:15 9:4
J	M	N	P
JAMES 5:2	magnesium 22:21 23:8,9 26:3,5 35:1 39:17 make 6:20 17:20 45:14 makes 16:20 mark 7:1 42:13 marked 7:4 13:7,11 18:8,12 20:7,11 23:22 30:18,21 42:16 marks 45:22 material 17:11 53:14 materials 8:3 meant 53:13	necessarily 31:21 negative 12:19,21 13:2 54:1,2,4 nitride 10:15 26:3,20 39:13, 17,18,19 40:12,16 nonconducting 19:16 nonconductive 20:1 nondepleted 17:17 nonphysical 37:22 normally-off 28:9,17 Notice 7:11 noticed 22:7 number 7:4,16 13:6 18:7 20:6 23:21 30:17 41:18 42:3,4,7,12,15 43:9 numbering 45:1 numbers 41:21 42:11	p-algan 16:12,13,14,16 17:1,5,9,21 p-doped 53:14 p-gan 15:3 16:15,17 17:1,3 24:17 p-type 16:16,20 18:4 19:9 21:22 22:2 26:5,22 35:1,5,7 36:1,8 37:8,10,15 50:6,7 53:14 paper 11:4 PARADKAR 5:8 7:1,6 12:7, 14 13:9 18:10 20:9 22:13 24:2 28:14 29:20 30:20 33:21 34:14 35:13,16 36:22 37:6 42:13,17 44:17 45:4, 16,19 48:20 49:11,20 50:2 52:17 54:11,15 paragraph 18:19 21:18,19 22:6,17,18 23:3,5,14 25:15, 18 26:2,10,13,18 28:1,4,8, 15 30:1,5 34:18 38:20 39:1, 3,9,21 40:2,18 53:4,6 partial 54:6 participated 41:19 42:9 party 8:11 pass 52:17 54:14
K		O	
Kigami 20:16,18,19 knowing 14:6		oath 6:8 objection 18:1 29:15 33:16 34:7 35:12 36:17 37:3 43:19 44:21 45:12,15 48:14 49:4, 14	
L			
label 39:19 labeled 19:8,9 41:13 46:4 47:1 48:4 Lastly 6:19			

passivation 39:2,4,5,10,11, 13,15,18 40:11,13 41:6,13 patent 7:15,19 8:7,15,16 9:4,7,9 13:17,19 15:8,15 19:4,13,15,21 20:1 28:8,16 41:18,20 42:4,5,7,9,12 43:9 44:4,5,8 patent's 15:14 patents 9:3 42:20,22 performance 11:2 petitioner 5:4 8:15 9:4 PH.D. 5:2 play 27:15 point 33:22 pointing 33:19 portion 12:13 17:17 20:5 24:21 25:12 26:19 portions 29:17 positive 12:19 13:2,4 16:6 17:16 38:12,15,17 positively 43:2 possibilities 35:5 potential 9:21 prepared 44:14 present 11:15 12:4,12,16 15:22 29:13 30:13 32:12 previously 13:7,11,18 18:8, 12 20:7 23:22 30:18 prime 40:8 46:10,17 48:4,7 prior 18:21 19:1,17,20 20:2, 17 24:8 31:4 48:15 proceeding 8:1 9:3 pronouncing 20:17 24:8 provide 17:4 44:14 provided 39:6 proximity 54:4 purported 19:7 Q question 6:12,14 12:6,8	15:17 17:18 22:9 34:1 37:14 48:21 52:2 questioning 43:20 questions 6:2 52:22 53:4 54:13,16 quick 23:16 quickly 5:21 R ratio 52:6 re-hear 22:8 read 12:7,9 14:17,19 15:9 22:11 23:2,12 27:2 39:12 48:16 reading 48:7 reads 14:13 21:20 22:18 23:4,5 26:2 28:8 recall 42:11 50:5,10 53:3 recently 5:13 10:20 recess 35:15 49:22 54:12 recessed 11:1 recognize 7:7 13:12 18:13 20:12 24:5 31:1 42:18 record 12:9 22:11 25:6 43:12,22 54:10 refer 13:16 16:12 reference 18:20 20:17 24:9 31:5 44:3,7 48:8,17 49:8,18 53:1,5 references 11:2 44:14 45:2 46:7,9 referred 9:20 13:7 referring 7:18 40:6,10 48:8 refers 22:15 23:14 25:18 26:14,15 39:12 40:2,21 53:7 regard 41:17 region 17:12 18:4,5 21:10, 15 22:1,15,20 23:7,8,19 24:17,19,21 25:1,4 26:4,22 27:3 29:7,10,13 30:5,6,12, 13,15 31:19,21 32:11 37:9 38:3 50:13 53:12,17	relate 22:6 23:20 related 8:19 9:1 42:7 44:4,7 relates 7:15 28:9,16 relation 44:3 rely 24:13 31:6,10 remember 8:7 52:21 repeat 12:6 52:1 rephrase 5:20 17:18 27:4 34:16 37:9,14 48:21 replies 8:11 reporter 28:13 represent 43:7 53:14 represents 31:15,18,20 requested 12:9 22:11 require 12:18 13:2 required 36:1 requires 12:21 13:4 reread 39:2 resides 11:22 rest 41:20 42:3,11 resting 46:7 results 11:5 review 7:22 8:5,19 23:16 53:16 reviewed 8:7,10,22 9:8 13:18 15:15 RICHARD 5:2 right-hand 53:19 rules 5:22 runs 32:21 33:6 S saturates 51:20 saturation 51:9,13,16,18, 19 52:3 Saxler 42:21 43:6,13,17 44:2,7 45:9 46:4 48:13 49:2 schematic 34:11	Schottky 11:8 scope 43:21 45:3 48:15 selectively 27:1 semiconductor 19:7,14, 16,22 21:20 22:22 26:3,20 28:10,18 sentence 14:13 15:8 21:20 22:14,18 23:5 26:2,17 28:7 30:5,12,16 34:21 35:4 39:3, 12 separate 40:14,17 41:10 set 11:2 Shealy 5:2,9 7:7 9:11 10:3 13:12 18:14 20:13,20 24:5 28:11 35:17 41:16 42:19 44:2,12,19 45:5 50:3 52:21 Shealy's 43:21 Sheppard 42:21 shown 17:22 18:3,6 21:11 24:22 30:6 32:20 33:3,15 34:2 36:14 41:8 47:7 shows 11:1 13:21 14:3 25:11 33:6,8,11 36:19 41:4 45:21 SIC 41:4,9 side 36:21 46:19 53:19 signature 54:17 significant 20:4 25:12 37:22 38:6 silicon 10:11 39:19 41:5,12 similar 42:21 43:3 simply 44:8,22 sit 42:10 skilled 20:3 Smith 31:4,6,11 34:22 35:7, 10,19 36:4 42:22 43:5,11, 13,17 45:8,21 46:4 48:12 49:2,18 50:4 smudge 47:16,18 so-called 10:6 sort 47:16 source 9:22 16:2,3,4 29:9 36:11
---	--	--	---

SPECHT 18:1 29:15 33:16 34:7 35:12 36:17 37:3 43:19 44:21 45:12 48:14 49:4,14 52:20 54:9,13 specification 15:14 stand 28:22 standards 11:3 standing 45:14 stands 10:7 started 6:1 22:5 state 28:15 34:1,21 statement 19:12 states 19:13 straight 53:22 strength 38:5 50:15 strike 31:11 41:8 structure 27:12 structures 39:6 submitted 18:17 substantially 23:9 substrate 47:22 48:1 sufficiently 36:1 sworn 5:5 T talk 6:3 talked 38:7 talking 39:10 50:5 talks 36:4 technology 10:12 testified 5:6 testifying 41:16 42:6 testimony 48:16 thereof 26:19 thickness 14:7 15:3,4 27:14 36:2 thing 22:7 things 27:15 52:1	threshold 17:15 27:16 36:4 38:18 52:8 time 44:6,16 times 5:14,15 today 44:10 top 46:5 topic 9:5 touched 11:4 Trade 8:17 transistor 9:12,15,18,19,20 10:7 14:4,15,21 15:1,21 16:7 29:13 35:21 36:3 51:8 transistors 28:10,18 transition 38:2 50:12,16, 17,19,21 51:2,6,17 52:9,12, 13 turn 12:20,21 13:3,4 16:7 38:12 turned 21:21 two-dimensional 10:8 11:21 12:11 22:1 38:9 54:5 types 10:18 U U.S. 7:15 41:17 42:7 43:9 Uemoto 24:7,10,13,16 27:5 28:8,16 29:6,12 53:1,4,9 underneath 29:18 understand 6:7,11 8:14 9:2 understanding 15:19 understood 6:16 15:12 42:2 45:16 48:9 uneven 22:20 unpassivated 54:3 unrelated 45:2 V volt 12:4 voltage 12:19,21 13:2,4 15:22 16:6,18 35:9 38:12,	15,17,18 50:22 51:16,18,19 52:3,8 volts 12:16 16:3 29:7,9,14, 18,19 W waived 54:18 walk 45:13 whatsoever 44:4 Withdraw 15:17 Withdrawn 35:13 words 53:21 work 10:20 25:14 wrote 8:9 Y years 11:4 Z zinc 35:2	
--	--	---	--