

Deposition of
Dr. James R. Shealy
January 26, 2023

Lite-On Technology Corporation
vs.
Sensor Electronic Technology, Inc.



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UNITED STATES PATENT AND
TRADEMARK OFFICE

BEFORE THE PATENT AND APPEAL
BOARD

- - - - -x

LITE-ON TECHNOLOGY CORPORATION,

Petitioner,

-against-

SENSOR ELECTRONIC TECHNOLOGY,
INC.,

Job No. 10113537

Patent Owners.

IPR2022-00780

U.S. Patent 9,923,117

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VIRTUAL ZOOM

January 26, 2023
10:05 a.m.

DEPOSITION of DR. JAMES R. SHEALY, an
expert witness testifying on behalf of the
petitioner in the above-entitled action,
remotely held at the above time, taken
before SAMUEL HITTIN, a Notary Public of
the State of New York, pursuant to order
and stipulations between Counsel.

* * *

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BY: JONATHAN AUERBACH, ESQ.

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6 this examination shall be furnished to the
7 attorney for the witness being examined
8 without charge.

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D R. J A M E S R. S H E A L Y, the
Witness herein, having first been duly
sworn by the Notary Public, was examined
and testified as follows:

EXAMINATION BY
MR. AUERBACH:

Q. Good morning, Mr. Shealy.
Can you hear me okay?

A. Good morning. Yes. You're
coming through fine.

Q. Please state your name for the
record?

A. James Richard Shealy.

Q. And can you please state your
address?

A. 615 Wyckoff Road, Ithaca, New
York.

Q. As I went to Cornell for
undergraduate, my undergraduate degree?

A. And of course Radulescu did his
graduate work there.

Q. Yes. I was biological
engineering major.

A. Oh, okay.

1 DR. J. R. SHEALY

2 Q. Graduated in 2005.

3 A. Okay.

4 Q. All right. Give me one second.

5 Dr. Shealy, I think you've been
6 deposed before, but I'll just go over some
7 ground rules so we're all familiar with
8 them.

9 A. Okay.

10 Q. Give me one second, sorry. It's
11 different getting organized for these
12 depositions when they're over Zoom. Bear with
13 me one moment.

14 A. Okay.

15 Q. Let me start: Are you
16 represented by counsel here today?

17 A. Yes.

18 Q. Who is that?

19 A. Jack Ko.

20 Q. Have you been deposed before?

21 A. Yes.

22 Q. How many times have you been
23 deposed?

24 A. Probably somewhere between 20
25 and 30 times, that's a guess.

1 DR. J. R. SHEALY

2 Q. So as you're familiar with it,
3 at least, what I'm about to go through
4 probably isn't new, but I'm just going to
5 go through it so we're all clear on it.

6 Even though this appears to be
7 an informal proceeding, the oath you've
8 just taken is the same oath you would give
9 if you were testifying in court with the
10 same legal penalties; do you understand
11 that?

12 A. Yes.

13 Q. Our court reporter is recording
14 what is said while we're on the record so
15 that there will be a transcript prepared
16 that will record all of my questions and
17 all of your answers; do you understand
18 that?

19 A. Yes.

20 Q. So it's important that you give
21 audible verbal responses to my questions
22 so that the court reporter can prepare an
23 accurate transcript; do you understand
24 that?

25 A. Yes.

1 DR. J. R. SHEALY

2 Q. That means no nodding of the
3 head or other nonverbal answering. Okay?

4 A. Yes.

5 Q. Your lawyer may object from time
6 to time, but unless he instructs you not
7 to answer, due to attorney-client
8 privilege, you still need to answer my
9 question; do you understand that?

10 A. Yes.

11 Q. Because you're under oath giving
12 sworn testimony, I just want to make sure
13 that your testimony is accurate as
14 possible. To help us do that, I'll ask
15 you if there's anything about my questions
16 that is confusing to you or that you don't
17 understand that you'll tell me, and I'll
18 rephrase the question; will you do that?

19 A. Yes.

20 Q. We can take a break ever now and
21 again. If you need a break sooner, just
22 let me know. Okay?

23 A. Okay.

24 Q. However, if there is a pending
25 question, I'll ask you that answer the

1 DR. J. R. SHEALY

2 question before we take a break.

3 A. Okay.

4 Q. Is there any reason why you are
5 unable to testify truthfully today?

6 A. No.

7 Q. I think Mr. Ko mentioned that
8 you had some paper copies of things with
9 you.

10 What do you have paper copies of
11 in front of you?

12 A. I have -- all of these are clean
13 copies. I have a copy of the patent, I
14 have a copy of my declaration, and then I
15 have a binder which is filled with
16 exhibits 1001 through 1017.

17 Q. And you're copy of -- when you
18 say the "copy of the patents," you're
19 referring to the patent ending in 117?

20 A. That's correct, yes.

21 Q. Okay. And does that have -- in
22 the bottom right-hand corner, does that
23 have a marking that says Exhibit 1001?

24 A. Yes. It's in the binder and it
25 says Lite-On Exhibit 1001.

1 DR. J. R. SHEALY

2 Q. Okay. So the only copy of the
3 patent you have with you today is in that
4 binder?

5 A. I have another one which I can
6 discard, it's one that I printed out. It
7 doesn't have the exhibit on it.

8 Q. Can you confirm that there's no
9 markings or highlighting on that?

10 A. No. There's no markings on any
11 of these documents.

12 Q. Okay.

13 A. But I can use the one in the
14 binder that has the exhibit number on it,
15 if you prefer.

16 Q. I think we're okay with --
17 because I'm going to be -- when I mark an
18 exhibit, I will put it into the chat and
19 that will be the, kind of, official
20 exhibit, and so as long as you -- I just
21 wanted to establish that the copy of the
22 patent is, you know, clean, so you could
23 refer to that. It doesn't matter that it
24 has -- doesn't have the exhibit number on
25 the bottom.

1 DR. J. R. SHEALY

2 A. Yeah. Every document I have in
3 front of me is clean.

4 Q. Other than the paper copies we
5 were just talking about, did you bring
6 anything else with you today to the
7 deposition?

8 A. No.

9 Q. You're not currently in
10 communication with anyone, correct?

11 A. No.

12 Q. What did you do today to prepare
13 for today's deposition?

14 A. I had some meetings with counsel
15 and I read most of the prior art and I've
16 read the declaration a couple of times, so
17 I think that would describe it.

18 Q. How many meetings with counsel
19 did you have prior to today in preparation
20 for today's deposition?

21 A. Three.

22 Q. When did the first of those
23 meetings take place?

24 A. About a week ago.

25 Q. And who attended that meeting a

1 DR. J. R. SHEALY

2 week ago?

3 A. Jack Ko and Chris --

4 THE WITNESS: Is it Kao, Jack?

5 MR. KO: That's correct. K-A-O.

6 Q. How long did that first meeting
7 last?

8 A. Two hours.

9 Q. Was that meeting over Zoom?

10 A. I don't think it was Zoom. I
11 think it was Microsoft Teams, but
12 Zoom-like.

13 Q. Other than yourself, Mr. Ko and
14 Mr. Kao, was there anyone else on that
15 meeting?

16 A. No.

17 Q. All right. When did the second
18 meeting take place?

19 A. I don't remember exactly, I'd
20 say three or four days ago. I mean, I
21 could look it up, but I don't have this on
22 the top of my head. And that was also a
23 two-hour meeting, I think.

24 Q. Who attended that meeting?

25 A. Same attendees, myself and the

1 DR. J. R. SHEALY

2 two attorneys.

3 Q. Did that meeting also take place
4 over at Microsoft Teams?

5 A. Yes.

6 Q. And when was the third meeting?

7 A. That was yesterday.

8 Q. How long did that meeting last?

9 A. I believe it was about a half an
10 hour.

11 Q. And who attended that meeting?

12 A. I think on that one it was just
13 -- I'm pretty sure it was just me and
14 Jack Ko.

15 Q. Other than those three meetings
16 and reading the material that you -- we
17 talked about, is there anything else you
18 did to prepare for today's deposition?

19 A. I read e-mails, Jack provided
20 some materials from our meetings that I
21 read.

22 Q. Are those materials other than
23 what's in your -- in the binder in front
24 of you?

25 A. No. I'd say there's no new

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2 material that came out of these meetings.

3 We were just reviewing the opinions in the
4 declaration primarily. There were no new
5 opinions that were formed.

6 Q. You weren't asked to review
7 anything other than the 17 exhibits as a
8 result of these meetings; is that correct?

9 A. There's another patent involved
10 in the 562, which a deposition's coming up
11 pretty quick, so some of those material
12 were reviewed as well.

13 Q. Okay. But putting that
14 deposition aside, with respect to today's
15 deposition and the 117 patent, were you
16 asked to review any materials other than
17 the 17 exhibits that are in the binder?

18 A. You have to add my declaration
19 to it.

20 Q. So your declaration is Exhibit
21 1002, so I'm including that as one of
22 the --

23 A. Oh, sorry.

24 Q. Yeah. No worries.

25 A. I also looked at -- this was

1 DR. J. R. SHEALY
2 before the first meeting, I looked at the
3 response from SETI and the institution
4 response. So I've seen those, and the --
5 I'm not sure it's complete, but I've
6 looked at some file history as well.

7 Q. And by file history, you mean
8 the file history of the 117 patent?

9 A. Yes.

10 Q. Okay. So other than those
11 materials, is there anything else you
12 reviewed?

13 A. No. I think that covers it to
14 the best of my recollection.

15 Q. Your current -- do you currently
16 have a position at Cornell?

17 A. I am -- I was granted emeritus
18 status. I believe that constitutes a
19 position, it's considered a promotion, but
20 I'm not teaching there anymore. I was
21 granted emeritus status this past July.

22 Q. Prior to being granted emeritus
23 status in July of 2022, you were a member
24 of the Cornell faculty since 1987; is that
25 correct?

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2 A. That's correct.

3 Q. What was the area of your
4 research at Cornell?

5 A. Compound semiconductor materials
6 growth, and device design and fabrication
7 on those materials.

8 Q. Did your research into compound
9 semiconductors have a particular
10 application?

11 A. There were a lot of different
12 applications over the years; infrared
13 invisible light emitting diodes and laser
14 diodes. I began working on nitrides in
15 the 1990s, so I'd say in the mid 1990s to
16 the late 1990s, most of the work was
17 focused on how to power microwave
18 transistors. But I -- there was research
19 funded by a variety of people in LEDs, so
20 I was doing nitride LED work of various
21 types.

22 Let's see, my group produced the
23 first monolithic millimeter wave
24 integrated circuits on gallium nitride.
25 So that's a few highlights, that doesn't

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2 cover everything, but --

3 Q. With respect to LEDs, you know,
4 what were the applications that you were
5 researching?

6 A. In the early days I developed an
7 MOCVD process for infrared LEDs that were
8 used for optocouplers, this is a device
9 that has an LED, some sort of isolation
10 material, back then it was a piece of
11 glass, not a photo transistor, it's for
12 high voltage isolation.

13 Then later, my group developed
14 some high power visible red LEDs, those
15 were used in plastic fiber communications.

16 Then I produced some prototypes
17 of a new type of gallium nitride LED which
18 involves selected area growth, which kind
19 of touches on some of the things that
20 happened in this case, and it was about
21 that period of time, the late 90s, that I
22 was doing epitaxial lateral overgrowth for
23 -- at the time we were interested in using
24 it for LEDs and transistors.

25 So those are some highlights.

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2 I'm not sure if that's everything you
3 wanted in the question.

4 Q. Did any of your research involve
5 applications for LEDs for illumination?

6 A. No. I did not produce white
7 light emitters which are really required
8 for general illumination, so I have not
9 done any phosphor work.

10 Q. What about any research for
11 using -- involving UV LEDs?

12 A. The LED I was working on was a
13 UV LED, it was a pyramidal LED, so it's
14 kind of a unique structure. The interest
15 was to make it blue, but it was easier to
16 make it UV, so it had a gallium nitride
17 active region.

18 Q. When was that? When did you do
19 that research?

20 A. That was in the late 90s, early
21 2000s.

22 Q. Other than that research, have
23 you done any additional research involving
24 UV LEDs?

25 A. No.

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2 Q. What was your research involved
3 with? What was the subject of your
4 research from like the early 2000s to
5 2010?

6 A. I had a -- in that time, a group
7 of about four or five students; had one
8 working on the -- a UV LED, the other
9 three were working -- two were working on
10 MOCVD growth of nitride materials, and
11 then there was a student who took those
12 materials and build -- and built
13 monolithic integrated circuits. So that
14 was kind of the partition of effort in my
15 group at the time.

16 Q. And then similar question from
17 like 2010 to when you were granted
18 emeritus status; what was the subject area
19 of your research?

20 A. I continued working on high
21 power microwave transistors. The LED work
22 at Cornell kind of wrapped up 2010 time
23 frame, and -- was it three years ago? -- I
24 founded a company and that company builds,
25 among other things, micro LED arrays with

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2 gallium nitride materials. So not at
3 Cornell, but in this company, I -- up till
4 last year I was providing guidance on the
5 fabrication and materials growth of those
6 LED arrays, so that would cover most of my
7 recent LED experience.

8 Q. All right. The name of that
9 company that you were just referring to is
10 Odyssey Semiconductor?

11 A. Yes.

12 Q. All right. I guess, one more
13 preliminary point: I will try my best to
14 not talk over you and ask you to do the
15 same, it's a little harder since we are
16 not in the same room together, but I will
17 do my best. Normally these things go
18 smoothly in that regard.

19 A. I will too.

20 Q. Turning back to the pyramidal UV
21 LED you were talking about; what was the
22 particular application of that LED of that
23 research?

24 A. The hope, at the time, that it
25 was going to be applied to general

1 DR. J. R. SHEALY
2 lighting, but again, my research stops at
3 the LED device. I've never added phosphor
4 coatings to the LED, but it's certainly a
5 suitable engine for general illumination,
6 if you know what I mean using the term
7 "engine." But that would represent the
8 work.

9 Q. You said earlier that the LED
10 was -- it was -- you were trying to make
11 it a blue LED, but it was easier to make
12 it a UV LED.

13 A. Yes.

14 Q. Why was that?

15 A. Because the blue LED requires a
16 gallium indium nitride active region which
17 requires low temperature growth, and it
18 also requires generally using a different
19 carrier gas in the reactor, and in which
20 my reactor wasn't, at the time, configured
21 for that, and we were doing all this at a
22 high temperature. So it would be very
23 difficult to build a gallium indium
24 nitride quantum well. This was really a
25 more a quantum box type geometry than a

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2 quantum well, it was confined in all
3 directions which made it a new type of
4 device, that's why we were pursuing it.

5 So I don't know if that answered
6 your question.

7 Q. I guess if you were looking at
8 -- trying to make an LED to apply it
9 general lighting.

10 But you manufacturing it, how
11 would you have done that with a UV LED?

12 A. Well, it's possible to use a UV
13 LED with phosphorus to produce white
14 light, you don't have to use blue.
15 Although right now blue seems to be the
16 preferred way of doing it, there are some,
17 not many, commercial lamps that use UV
18 emitters, but the vast majority are blue.

19 So it was a materials reason why
20 we didn't pursue that because we were
21 growing these things at high temperature,
22 and you can't grow gallium indium nitride
23 at those temperatures.

24 Q. So what's the different material
25 that the UV LED was made out of that you

1 DR. J. R. SHEALY

2 were working on?

3 A. It's the same material system,
4 the cladding layers were alluminum gallium
5 nitride, the quantum well or quantum dot
6 region was gallium nitride, the p-type
7 contact layer was also gallium nitride,
8 that was on the outer surface of the
9 pyramid, and the n-type contact was
10 internal to the device, these were grown
11 on silicon needles, and the silicon needle
12 provided the n-type contact.

13 Q. What's a silicon needle?

14 A. It's possible using fabrication
15 methods to form a very sharp needle
16 protruding from a planar surface of
17 silicon, and that served as a nucleation
18 site for the gallium nitride. It was also
19 compliant, so we didn't see any threading
20 dislocations in those structures.

21 So anyway, that's -- it involved
22 a lengthy process to produce the needle,
23 but it's doable.

24 Q. And then so on the needle you
25 grew an n-type contact?

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2 A. The entire LED structure was
3 growing on that needle.

4 Q. How long did you engage in the
5 research on the pyramidal LEDs in the late
6 90s?

7 A. I would guess 10 to 15 years
8 I've been working on that.

9 Q. Do you have patents directed to
10 that research?

11 A. There's a lot of patents on
12 various nitride growth technologies.
13 That, there was a docket filed at Cornell,
14 but the way their IP machinery works, if
15 you don't have somebody standing there
16 ready to take a license, they're not going
17 to go through the expense of filing the
18 patent, and that's where it -- so there's
19 a docket, but I don't believe it was ever
20 filed.

21 Q. Got it.

22 A. And for that reason we never
23 published it.

24 Q. So when you were doing your
25 research you would only be publishing for

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2 things that ended up in filed patent
3 applications?

4 A. No. We -- I saw this as very
5 valuable technology, so I didn't want to,
6 you know, take out a patent with a
7 publication. But no, that's not the way
8 it works at all.

9 Q. How do you normally manage, kind
10 of, publishing -- filing patent
11 applications versus publishing your work
12 at Cornell?

13 A. The professor decides. And the
14 vast majority of the work -- I'll give you
15 an example -- we -- my group was the first
16 one to put a gallium nitride transistor on
17 silicon, that was done in 1999. We should
18 have patented that, we didn't. That is
19 now the basis for all gallium nitride hemp
20 power devices which has turned into a
21 sizeable industry, and we were the first
22 one to do it, we didn't patent it, saw no
23 protection.

24 Q. Got it. Okay. And at Cornell
25 what courses did you teach?

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2 A. The -- I guess, later in my
3 career they seemed to box me in to
4 teaching a lot of large undergraduate
5 courses. Earlier in my career I taught --
6 I developed a course on compound
7 semiconductor materials and devices, was
8 taught for about five years.

9 I taught the senior level
10 semiconductor materials and device class,
11 I taught a senior level microwave device
12 class, I taught solid state physics
13 classes, that was graduate level.

14 Let's see, I taught
15 undergraduate quantum mechanics, and I
16 taught freshman math. And then in the
17 last many years I was stuck in
18 introduction to microelectronics, a junior
19 class; that introduces semiconductor
20 materials and semiconductor devices. And
21 then a sophomore class, introduction to
22 circuits.

23 So I guess I taught at all
24 levels in the curriculum, but in the last
25 five years or so in my career I was stuck

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2 in those undergraduate courses. There
3 weren't many of us that could effectively
4 teach them.

5 Q. That's here, teaching the first
6 -- the freshman, you know, calculus class
7 at --

8 A. I did that for three years.

9 Q. Okay.

10 A. They had -- we had so much
11 trouble with math students or with the
12 math curriculum preparing the students for
13 the classes, that the math department
14 decided to let us teach some of those
15 classes that's what happened.

16 Q. That's funny. I think I had --
17 I don't believe I had you, I had -- I just
18 remember that my first semester I had to
19 go -- I was, you know, living on the north
20 campus, and I had, you know, a 9 a.m. math
21 section.

22 A. On the other side.

23 Q. On the other side, so yeah, they
24 had -- well, that first semester we had a
25 smaller lecture.

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2 A. Yeah. They broke it into
3 sections of 25 and there were many of us
4 teaching the sections.

5 Q. Yeah. Okay. I'm going to put
6 into the chat Exhibit -- what's been
7 designated as Exhibit 1002 into the chat.

8 A. And that's my declaration.

9 Q. That's your declaration.

10 A. Okay. Can I use the paper copy
11 in front of me or would you rather --

12 Q. Yes. Let me just -- the paper
13 copy in front of you, of your declaration,
14 Exhibit 1002 does not have any markings of
15 any kind, correct?

16 A. Correct.

17 Q. Okay.

18 MR. AUERBACH: Jack, I don't
19 remember what's been happening at the
20 other depositions. Have we been
21 marking the exhibits with a different
22 number if it's, you know, an already
23 filed exhibit or just using that, you
24 know, the 1002 number?

25 MR. KO: Yeah. We can just use

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2 the exhibits numbers as we are in that
3 deposition.

4 MR. AUERBACK: Okay.

5 Q. Well, let me put the exhibit up.

6 So Dr. Shealy, I have your
7 declaration up on the Zoom; can you see
8 it?

9 A. Yes.

10 Q. And you also have the paper copy
11 in front you, correct?

12 A. Correct.

13 Q. Feel free to -- I'm going to be
14 moving the declaration to the part I'm
15 talking about, but, you know, feel free to
16 follow along either on the screen or on
17 paper.

18 A. Okay.

19 Q. Did you draft your declaration
20 in its entirety?

21 A. Yes. It was a collaborative
22 effort with the attorneys, but yes, these
23 reflect my opinions.

24 Q. Are you aware of -- since this
25 declaration was filed, are you aware of

1 DR. J. R. SHEALY
2 anything in the declaration that is
3 inaccurate?

4 A. I don't recall finding any --
5 wait a minute. No. I don't recall
6 finding any on this particular
7 declaration. There was some on the other
8 one, but that's a different case.

9 Q. Okay. Can you turn to page six,
10 paragraph 20?

11 A. Okay.

12 Q. See, it says -- sorry, I'm going
13 to go up to paragraph 19.

14 "In forming my opinions, I read
15 and considered the 117 patent and its
16 prosecution history, the exhibits listed
17 in the exhibit list filed with the
18 petition for inter partes review of the
19 117 patent, as well as any other material
20 referenced herein." See that?

21 A. Yes.

22 Q. Than paragraph 20 says:
23 "Additionally, in performing my analysis,
24 I have relied upon my own personal
25 knowledge and experience, as well as

1 DR. J. R. SHEALY
2 information generally available to, and
3 relied upon by, persons of ordinary skill
4 in the art at the time of the alleged
5 invention, including technical
6 dictionaries, technical standards,
7 technical reference materials, catalogues,
8 and well-known engineering principles
9 practiced in the industry." See that?

10 A. Yes.

11 Q. Other than the exhibits in the
12 exhibit lists, did you rely on any
13 specific technical dictionaries in forming
14 your opinions that are in the declaration?

15 A. I don't recall as I sit here
16 whether or not I used a technical
17 dictionary. The -- I mean, the technical
18 dictionary should reflect what one skilled
19 in the art would ascribe to a certain
20 term. But I don't recall if I used a
21 technical dictionary in this particular
22 declaration.

23 Q. Same question regarding the
24 technical standards mentioned in paragraph
25 20 of your declaration?

1 DR. J. R. SHEALY

2 A. I don't recall any technical
3 standards that were specified somewhere in
4 the declaration.

5 Q. Okay. Same question with
6 respect to the technical reference
7 materials mentioned in paragraph 20?

8 A. Well, I certainly relied on a
9 variety of sources in the literature in
10 forming these opinions.

11 Q. Other than the -- whatever
12 sources of -- in the literature are part
13 of the exhibit list; are there any other
14 sources that you relied on?

15 A. No. It would be just, you know,
16 what knowledge one skilled in the art
17 would have at the time of the invention in
18 addition to this, and that would represent
19 all of them.

20 Q. Same question with respect to
21 the catalogs mentioned in paragraph 20 of
22 your declaration?

23 A. Again, I don't recall a specific
24 cite to a catalog. That doesn't mean it's
25 not there, I just don't recall it as I'm

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2 sitting here.

3 Q. Let's turn to page -- sorry, one
4 second.

5 Please turn to page 16 of your
6 declaration.

7 Okay. So in paragraph 44 --
8 starting at paragraph 44 you're giving
9 some background on a -- what an LED is,
10 correct?

11 A. Correct.

12 Q. "The LED is comprised of a p-n
13 junction diode." You see that?

14 A. Yes.

15 Q. What does that mean?

16 A. It means there has to be a
17 p-layer and an n-layer to form the LED.
18 Now, there's additional layers in a modern
19 LED, but all LEDs have to have a p-n
20 junction. So meaning there's going to be
21 a p-layer and an n-layer.

22 Q. And so further down in paragraph
23 44 you say, it says: "When voltage is
24 applied across the terminals of the LED,
25 the electrons... recombine with holes to

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2 release photons." Do you see that?

3 A. Yes.

4 Q. The hole -- the p-type
5 semiconductor has the -- is the source of
6 the holes that you mention here?

7 A. Yes. Remember, a hole is a
8 empty valence band state, it's -- we
9 invent the hole for convenience, it's a
10 missing electron. But what happens is you
11 -- when you apply a forward bias to the
12 LED you reduce the internal electric
13 field, which allows electrons and holes to
14 defuse into the active region, and where
15 they overlap in space, they'll find each
16 other and annihilate each other, in doing
17 that, energy is lost, and if it's a direct
18 bandgap semiconductor that energy will be
19 given to a photon and they undergo this
20 process called recombination, also
21 sometimes referred to as annihilation and
22 that -- there's an energy lost during the
23 recombination process, and that energy is
24 given to a photon that, you know, escapes
25 the device, hopefully.

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2 Q. In the case of where it's a --
3 the photon is, you know, in the visible
4 light spectrum, the LED will give off
5 light; is that right?

6 A. Well, the LED will give off
7 radiation regardless, but if you want to
8 see it with your eye, yeah, it would have
9 to be in the visible spectrum, so the most
10 common gallium nitride LED, because of its
11 use in lighting, is a blue emitter. So
12 yes, you would see that light.

13 Q. And the region where the holes
14 and the electrons combined is, you said
15 it's either the active region; is that
16 right?

17 A. You don't have to have an active
18 region, but the LED operates more
19 efficiently if you use wider bandgap
20 materials surrounding a lower bandgap
21 active region, so that is the general
22 structure of a modern LED.

23 But the original LEDs just had
24 p-n junctions, no separate active region.
25 So the recombination was occurring in the

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2 p- and the n-layers, in a modern LED it
3 occurs in the active region which is
4 separate from the n- and p-layers.

5 Q. Turning down to -- there's a
6 diagram on page 17 of Exhibit 1002 in
7 between paragraphs 44 and 45; do you see
8 that?

9 A. Yes.

10 Q. Did you create this diagram?

11 A. No.

12 Q. Where did you get it from?

13 A. It should say. It's kind of a
14 generic diagram. I don't recall. I don't
15 recall where that diagram came from, but
16 it accurately represents the structure of
17 a -- pretty much a modern gallium nitride
18 LED; both contacts on the top surface, as
19 you can see. The red layers, the n-type
20 layer, the green layers, the p-type layer,
21 the purple layer is the active layer.

22 So I don't recall where it came
23 from, but it's a very generic depiction of
24 an LED.

25 Q. You said that the contacts are

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2 on the top in this figure?

3 A. They're on the -- they're both
4 on the same surface, the same side of the
5 substrate, and that's the way the vast
6 majority of gallium nitride LEDs, that's
7 the configuration they take. So you could
8 see the green material and the blue
9 material had to be etched away to provide
10 a surface to put the n-type contact on the
11 red material. That's what I meant by both
12 contacts on the same side.

13 Q. You said the blue material was
14 etched away?

15 A. If you want to -- you have to
16 create a surface to put the n-type contact
17 on, so that's metal that goes on that red
18 layer there, and the way you do that is
19 you etch through the green and the purple
20 layers to expose the red layer so that you
21 could put a contact on it.

22 Q. Got it.

23 A. And the reason both are on the
24 same side is the substrate which is --
25 it's also labeled the foundation, in most

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2 LEDs used for lighting, that substrate's
3 sapphire so it's insulating so you can't
4 pass current through the substrate, that's
5 why both contacts have to be on the same
6 side.

7 Q. Got it. The red layer which is
8 the n-type layer would be grown on the
9 sapphire substrate?

10 A. Yes. There's other layers
11 required to make it happen, but
12 functionally, that's the layer that --
13 that's the first layer in the stack that
14 is an integral part of the light emitting
15 diode. There can be layers underneath
16 that just to help manage the defect
17 density that exists in these mismatched
18 material systems, but what's shown here is
19 the functional part of the structure as
20 far as LED operation goes.

21 Q. And then still looking at this
22 diagram on page 17 of Exhibit 1002, the
23 purple layer is then grown on top of the
24 red layer?

25 A. Yes.

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2 Q. And then the green layer in the
3 diagram would be grown on top of the
4 purple layer?

5 A. That's correct.

6 Q. And then in order to deposit the
7 contacts, one on the green layer and one
8 on the red layer, you would need to etch
9 away through the green and the purple and
10 red; is that right?

11 A. Yeah. They show on this diagram
12 that they've actually penetrated into the
13 red layer a significant amount, and that
14 would be typical, there's no reason to try
15 to finesse it when it doesn't have to be
16 finessed; in other words, that contact
17 could be anywhere in that red layer, it
18 doesn't have to be very close to the blue
19 layer.

20 Q. Got it.

21 MR. AUERBACH: We've been going
22 for an hour. Let's take a five-minute
23 break.

24 [Whereupon, a short break was
25 taken.]

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2 MR. AUERBACH: I'm ready to go
3 back on record if everyone else is.

4 Q. Welcome back, Dr. Shealy.

5 A. Thank you.

6 Q. Did you speak to anyone during
7 that break?

8 A. No.

9 Q. Turn back to your declaration.
10 If you could turn to page 21, paragraph
11 53. Let me know when you're there.

12 A. I'm there.

13 Q. And I see in paragraph 53 you
14 state: "In conducting my analysis of the
15 claims of the 117 patent, I have applied
16 the claim language consistent with the
17 customary and ordinary meaning standard
18 described above." See that?

19 A. Yes.

20 Q. In paragraph 54 you state: "The
21 claim terms in the 117 patent should be
22 given their plain and ordinary meaning
23 because they are commonly used terms in
24 the English language and/or are common in
25 the relevant fields of semiconductor

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2 devices and LEDs." Do you see that?

3 A. Yes.

4 Q. And then in paragraph 55 you
5 say: "It is my opinion that there are no
6 claim terms that require a construction."
7 See that?

8 A. Yes.

9 Q. You don't offer any claim
10 constructions in your declaration,
11 correct?

12 MR. KO: Objection, form.

13 A. That -- other than the plain and
14 ordinary meaning, no.

15 Q. I'm going to mark -- I'm going
16 to put into the chat another exhibit. Let
17 me share this. So I put into the chat
18 what was previously designated as Exhibit
19 1004 by Lite-on. Do you have a copy? Do
20 you see Exhibit 1004 up on the screen?

21 A. Yes, I do.

22 Q. Let me know if you -- and you
23 have Exhibit 1004 in your binder, correct?

24 A. Yes, I have in front of me.

25 Q. And just to confirm, the copy of

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2 Exhibit 1004 in front of you has no
3 markings or annotations, correct?

4 A. Correct.

5 Q. Do you see Exhibit -- I'm going
6 to refer to Exhibit 1004 as Ohmae; you see
7 that?

8 A. Yes.

9 Q. So if I -- I'm going to try to
10 refer to the exhibit number because it
11 makes it easier on the transcript, but if
12 I talk about Ohmae, you'll know what I'm
13 talking about, right?

14 A. Yes.

15 Q. So Exhibit 1004 is a published
16 patent application from 2007, correct?

17 A. Correct.

18 Q. And you discuss this -- you
19 discuss Exhibit 1004 in your declaration,
20 correct?

21 A. Correct.

22 Q. Okay. So I'm going to turn to
23 paragraph 247 which is on page 94 of the
24 document if you're going by the page
25 number on the bottom right corner.

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2 Let me know when you're there?

3 A. You said paragraph 247?

4 Q. Yes.

5 A. Yeah, I'm there.

6 Q. Okay. And let me just zoom in.

7 Paragraph 247 of Exhibit 1004
8 begins, it says: "In the sixteenth
9 embodiment, as shown in figure 39." See
10 that?

11 A. Yes.

12 Q. "The step of forming protruded
13 portions 12 and growing the nitride-based
14 III-V group compound semiconductor layer
15 15 like the first embodiment starts from
16 forming protruded portions 12 on the
17 substrate 11, followed by repeating the
18 step plural times." See that?

19 A. Yes.

20 Q. So paragraph 247 is describing
21 figure 39, correct?

22 A. Correct.

23 Q. And you rely on figure 39 in
24 your declaration, correct?

25 A. Yes. Figure 39 is in the

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2 declaration.

3 Q. May I ask you to flip up to
4 figure 39 which is on page 36 of Exhibit
5 1004 that's shown up on the screen? Are
6 you -- let me know when you're there, if
7 you're looking at the paper copy.

8 A. I'm looking at the screen and
9 the paper copy.

10 Q. Okay. So figure 39 depicts a
11 layer marked 11; do you see that?

12 A. Yes.

13 Q. That's the substrate?

14 A. Yes. 11 is described as a
15 substrate.

16 Q. Okay. Then on top of substrate
17 11, there are triangle structures that are
18 labeled as 12; do you see those?

19 A. Yes.

20 Q. Those are what the -- what
21 Exhibit 1004 is calling the protruded
22 portions?

23 A. That's correct.

24 Q. And then on top of the protruded
25 portions is something designated as 15; do

1 DR. J. R. SHEALY

2 you see that?

3 A. Yes.

4 Q. That's described in paragraph
5 247 as a nitride-based III-V group
6 compound semiconductor layer, right?

7 A. Yes. I guess they labeled that
8 twice in that paragraph.

9 Q. And then above the layer 15 on
10 top of that, there are four more
11 triangles; do you see that?

12 A. Yes.

13 Q. And those are additional
14 protruded portions?

15 A. Yes.

16 Q. And above that second set of
17 protruded portions is another layer that's
18 called 15?

19 A. 15 is the layer on top of all of
20 the protruded portions, and of course, you
21 could see where the various pieces of
22 layer 15 actually contact each other in
23 between the protruded portions.

24 Q. When you say that, you're
25 talking about -- what do you mean by that?

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2 A. Layer 15, it's shown in figure
3 39, the planarize. So you start with a
4 protruded portions 12, then layer 15 has
5 grown to the point where it planarizes.
6 And under the proper growth conditions
7 that is easily achievable with gallium
8 nitride and certain compositions of
9 aluminum gallium nitride. So then the
10 growth presumably, or at least one way to
11 realize this, is another set of protruding
12 portions are placed on that planar
13 surface, then the growth is initiated
14 again, and layer 15 in between the
15 protruded portions comes in contact with
16 the previous layer 15, and you can see
17 that in figure 39, and then it's repeated
18 a third time, and each time these are
19 shifted a half wave length. So the net
20 effect is, you have a series of protruded
21 portions, the triangles imbedded in a
22 layer of 15 which would be gallium nitride
23 or aluminum gallium nitride.

24 So the method to get there was
25 to do it three times, but the end result

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2 of the structure is you have a series of
3 protruded regions imbedded in layer 15 at
4 different levels. That is pretty much the
5 way I described this figure in the
6 declaration.

7 Q. Let's go back to paragraph 247.
8 Let me know when you're there.

9 A. I'm there.

10 Q. Okay. It says -- when we were
11 looking at this a little while ago I ended
12 -- I read the first sentence.

13 The next sentence is: "In this
14 case, the protruded portions in the
15 respective layers are formed at positions
16 that are mutually shifted by a half cycle
17 within planes parallel to the main surface
18 of the substrate 11." See that?

19 A. Yes.

20 Q. This is saying that the sets of
21 protruded portions grown in the respective
22 layers plural 15 are formed at positions
23 that are mutually shifted by a half cycle?

24 A. Yes. That feature is common in
25 the literature for epitaxial lateral

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2 overgrowth. I mean, this feature of
3 shifting a half a period away, it's an
4 attempt to block dislocations. And so
5 you'll see this same arrangement in the
6 prior art.

7 Q. Okay. So then following
8 sentence says: "Like the first
9 embodiment." -- then there's a period,
10 right? I think it meant to be a comma.

11 So it says: "Like the first
12 embodiment first embodiment. The
13 uppermost nitride-based III-V group
14 compound semiconductor layer 15 is
15 successively grown thereon, for example,
16 with an nitride-based III-V group compound
17 semiconductor layer 16, an active layer 17
18 and a p-type nitride-based III-V group
19 compound semiconductor layer 18." Do you
20 see that?

21 A. I see that, but could you tell
22 me which figure that's referring to?

23 Q. So in figure 39 you agree
24 there's an uppermost layer 15, correct?

25 A. Yes.

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2 Q. Right. In figure 39 there are
3 three layer 15s that it shows, right?

4 A. Yes.

5 Q. Okay. So there's nothing
6 depicted in figure 39 above it, correct?

7 MR. AUERBACH: Sorry, let me
8 reask the question.

9 Q. In figure 39 there's nothing
10 depicted above the uppermost layer 15,
11 correct?

12 A. Correct. I guess it says in
13 paragraph 247 you can add a group or a
14 nitride-based III-V compound semiconductor
15 layer on top of it. I guess that's -- and
16 then an active layer. What they're saying
17 in that paragraph at the end of 247 is
18 they're kind of starting off a device with
19 this structure and then completing the
20 device with -- by adding a, you know,
21 another nitride semiconductor layer, an
22 active layer and a p-type layer. So all
23 of this was done presumably on the n-side
24 of the diode.

25 Q. What do you mean by the n-side

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2 of the diode?

3 A. Well, there's two sides to a p-n
4 junction on either side of the active
5 region; one side is the n-side and the
6 other side is the p-side, and they're
7 saying, here they're putting the p-side --
8 nitride semiconductor layer of 18 is going
9 on top of layer 16. So the n-type layer
10 would have to be on the bottom side of the
11 active layer the way they're describing
12 this.

13 Q. So the layer 16 that would be an
14 n-type layer?

15 A. Yes. And layer 15 presumably
16 would have to be a -- no. I guess layer
17 15 doesn't necessarily have to be doped,
18 it could be doped n-type, but it could be
19 un-doped. And then an n-type layer 16 is
20 placed on top of it, that would work just
21 fine. This structure shown in figure 39,
22 the reason people do this is to reduce the
23 number of dislocations that penetrate the
24 active region which would be placed on top
25 of this structure. And it looks like some

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2 of that's in figure 40, although we
3 haven't -- I guess the description of that
4 comes later in paragraph 251.

5 Q. What do you mean by un-doped
6 layer?

7 A. When you say un-doped, what it
8 means is it's unintentionally doped. In
9 any crystal growth process there's always
10 unintentional impurities floating around.
11 So when you call a layer un-doped it means
12 it's unintentionally doped, that doesn't
13 mean it's impurity free. If it's a good
14 crystal growth process it could be almost
15 impurity free, but that's what I meant by
16 un-doped.

17 Q. Okay. You see in paragraph
18 248 --

19 A. Yes.

20 Q. -- it says: "The sixteenth
21 embodiment other than those described
22 above is similar to the first embodiment."

23 A. Yes.

24 Q. And you agree that in figure 39
25 there are no contacts depicted, correct?

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2 A. No. What it's depicting and as
3 it's described in that paragraph 247, it's
4 a portion of a device structure, it's not
5 the whole thing.

6 Q. Okay. So I will -- let's move
7 up to paragraph 148 --

8 A. Okay.

9 Q. -- which is on page 85 of
10 Exhibit 1004.

11 A. Yep.

12 Q. In paragraph 148 it says: "In
13 figures 1A to 3, a method of manufacturing
14 a light-emitting diode according to a
15 first embodiment of the invention is shown
16 in sequence." See that?

17 A. Yes.

18 Q. So you would agree that here
19 they're talking about the first embodiment
20 that was referenced in paragraph 248,
21 correct?

22 A. Could you just point to me where
23 it says -- it says "In the first
24 embodiment" -- yeah, in figure 1A. I
25 guess it's paragraph 149. It describes

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2 all of this first embodiment.

3 Q. Right. So paragraph 248 is
4 referencing the first embodiment, correct?

5 A. Yes. That's what -- yes.
6 That's what it appears to be, yeah.

7 Q. We previously were looking at
8 248 which said -- 248 says -- and I've
9 shown it up on the screen if you don't
10 want to flip back and forth.

11 "The sixteenth embodiment other
12 than those described above is similar to
13 the first embodiment." See that in
14 paragraph 248?

15 A. Yes.

16 Q. Okay. And so then we flip back
17 to paragraph 148 which is saying that the
18 first embodiment is being discussed and
19 depicted in reference to figures 1A to 3.

20 A. That's correct.

21 Q. Do you agree with me on that?

22 A. Yes.

23 Q. Okay. If we go down to
24 paragraph 157, we see that it says:
25 "Next, as shown in figure 3, the

1 DR. J. R. SHEALY
2 nitride-based III-V group compound
3 semiconductor layer is formed thereon" --
4 sorry. In the reading -- let's move up to
5 the figures for a second.

6 So I'm on page -- I'm on figure
7 1A.

8 A. Mm-hmm. Yes.

9 Q. So figure 1A has a substrate and
10 the protruded portions, correct?

11 A. Correct.

12 Q. And then as we progress through
13 figures 1A, 1B, 1C, 2A through 2C, we see
14 that the layer 15 is from being grown,
15 correct?

16 A. Yes. When you get to figure 2C
17 you can see that it achieved a planar
18 surface which was what I was talking about
19 a little earlier.

20 Q. Right.

21 A. And you can also see
22 schematically they're -- it looks like
23 they're indicating in those dotted lines
24 what it would look like before it
25 planarizes, that's what all dotted lines

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2 are.

3 Q. Okay. So then turning back to
4 paragraph 157, you see it says: "Next, as
5 shown in figure 3, the nitride-based III-V
6 group compound semiconductor layer 15 is
7 formed thereon successively with an n-type
8 nitride-based III-V group compound
9 semiconductor layer 16, an active layer 17
10 using a nitride-based III-V group compound
11 semiconductor, and a p-type nitride-based
12 III-V group compound semiconductor layer
13 18, for example, by a MOCVD method." See
14 that?

15 A. Yes.

16 Q. So this is -- paragraph 157 is
17 describing the successive layers that are
18 grown on semiconductor layer 15, correct?

19 A. That's correct.

20 Q. Okay. And then finally --

21 A. There's does seem to be one
22 small error in figure 3, but I guess
23 contact 21 needs to contact layer 16
24 because layer 15 was un-doped, so that
25 wouldn't make a very good device the way

1 DR. J. R. SHEALY
2 it's drawn. So in other words, contact 21
3 should have landed on layer 16 not layer
4 15.

5 Q. Well, if we look at the next
6 sentence it says: "In this case, the
7 nitride-based III-V group compound
8 semiconductor layer 15 is of an n-type."

9 A. Yes. So when they discuss it
10 earlier they refer to layer as form and
11 successively with an n-type layer 16. As
12 you read that, it suggests that 15 is
13 something other than an n-type layer. But
14 if it's n-type at least it would fit the
15 figure.

16 Q. Got it. So let's go up to
17 figure -- I'm up at figure 3.

18 A. Yes.

19 Q. All right. So we have layer 15,
20 which is an n-type layer, correct?

21 A. Yes. It's described as an
22 n-type layer.

23 Q. Right. And then we have an
24 n-type layer 16, correct, on top of 15?

25 A. Yes.

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2 Q. And then an active layer 17 on
3 top of 16?

4 A. That's correct.

5 Q. And then a p-type layer 18 on
6 top of 17?

7 A. Yes.

8 Q. So then we have an n-type
9 contact 21 that's on top of layer 15,
10 correct?

11 A. Correct.

12 Q. And then we have a p-type
13 contact on top of layer 18?

14 A. That's correct.

15 Q. So this LED has the electrodes
16 on the same -- I guess on the -- sorry.
17 The LED depicted in figure 3 has the LEDs
18 on the top side, correct?

19 A. Yes. And just to make you more
20 comfortable with that, the typical etch
21 depth between -- in other words, the
22 height difference between 19 and 21 is on
23 the order of microns. The thickness of
24 the substrate is on the order of a hundred
25 microns, so it is a pretty small step if

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2 you're actually looking at one of these.

3 So they're both on the same surface more
4 or less.

5 Q. Okay.

6 A. So if we go back to the -- what
7 was it? -- figure 39, what they're saying
8 is, you could take 39 and substitute
9 everything that's below the line where the
10 contact 21 sits, if you could take that
11 out of figure 3 and substitute 39 in its
12 place and that becomes the, what they
13 refer to as -- whatever it was, was it the
14 17th embodiment or it was 16?

15 Q. The sixteenth embodiment.

16 A. Yeah. That's what they're
17 instructing you to do.

18 Q. And so then in doing that the
19 layer 15 in figure 39, those are all
20 n-type then, correct?

21 A. Yes. To be consistent with the
22 construct of layer 3 they would all be
23 n-type, yeah, or at least upper one. But
24 no, I mean, they're all labeled the same,
25 so they're all going to be n-type.

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2 Q. Put that aside.

3 A. Okay.

4 Q. All right. So I am putting into
5 the chat Exhibit 1005. I will put that up
6 on the screen.

7 So I put up on the screen and I
8 put into the chat Exhibit 1005.

9 Dr. Shealy, you have a paper
10 copy of Exhibit 1005; is that correct?

11 A. Yes. And an English
12 translation.

13 Q. Right. So Exhibit 1005 at the
14 beginning is a -- the original Japanese
15 reference through page 10, and then
16 followed by an English translation that
17 starts on page 11.

18 A. Yup.

19 Q. Okay. So I'll be referring to
20 the English translation.

21 A. It would be hard to get any
22 answers otherwise.

23 Q. Yes, I don't speak Japanese.

24 One second.

25 Okay. So if we look at the

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2 figures -- where are they? It was here.

3 The figures are up on page 9, some of
4 them; see that?

5 A. Yes.

6 Q. And you relied on figure 3 in
7 your declaration, correct?

8 A. Correct.

9 Q. And you see figure 3 here on
10 page nine, like the lower left?

11 A. Yes.

12 Q. Okay. I'm going to turn down to
13 -- turning down to paragraph 42, Ban.

14 A. Okay.

15 Q. You see paragraph 42 is
16 referencing figure 3?

17 A. Yes.

18 Q. And paragraph 42, it is saying
19 that element 33 is an n-type GaN layer,
20 right?

21 A. Yes.

22 Q. Okay. And so then it says 34 is
23 a SiO₂ mask layer; see that?

24 A. Yes.

25 Q. And SiO₂ is silicon dioxide?

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2 A. Correct.

3 Q. So let me put up, bring up your
4 declaration. Can see you Exhibit 1002 on
5 the screen?

6 A. Yes.

7 Q. Okay. So in paragraph 90 of
8 your declaration, above it it says element
9 1C, paragraph 90, it says: "Ban teaches
10 that '33 is an n-type GaN layer' which is
11 a 'group III-V compound semiconductor
12 layer.'"

13 A. Yes.

14 Q. See that?

15 A. Yes.

16 Q. Then moving down to paragraph
17 92, above that is plain limitation 1D, it
18 says "Ban uses a 'SiO₂ mask layer' which
19 'is embedded in a stripe shape in the
20 group III-V compound semiconductor layer
21 on the substrate.'" Do you see that, it's
22 the sentence I'm reading?

23 A. Yeah. I -- we're quoting
24 something. If I -- I would have said that
25 the stripe is on the, not in. It's

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2 actually fabricated on top of the
3 semiconductor layer, but I'm in the
4 sequence of realizing these things, that's
5 how it's done. The net effect is it's
6 imbedded in that layer when it's all said
7 and done. But when the stripe is formed,
8 it's placed on the semiconductor layer.
9 You're describing the whole structure
10 which is that light blue layer which has
11 all the imbedded SiO₂. This is another
12 example of epitaxial lateral overgrowth
13 just like Ohmae was or at least a portion
14 of Ohmae was.

15 Q. Okay. You see that next
16 sentence in paragraph 92?

17 A. Regarding the SiO₂ mask layer?

18 Q. Yeah. So following the quoted
19 sentence from Ban, it says: "In my
20 opinion, the SiO₂ mask layer constitutes
21 an inhomogeneous region." Do you see
22 that?

23 A. Yes.

24 Q. It's your opinion that the mask
25 layer is an inhomogeneous region because

1 DR. J. R. SHEALY
2 it's not made of an n-type GaN material
3 that layer 33 is made out of?

4 MR. KO: Objection, form.

5 A. Well, we have haven't really
6 discussed, in the deposition anyway, what
7 I think -- it's in the declaration what I
8 believe inhomogeneous region is, but I
9 stand by that sentence, yes. The --
10 anything that is imbedded in the
11 semiconductor that is not the same
12 semiconductor of identical crystal
13 orientation would be an inhomogeneous
14 layer. So if it had a different crystal
15 orientation, it had a different
16 composition, if it had a defect running
17 through it because that changes the
18 attributes of a layer, all of these would
19 represent inhomogeneous regions within a
20 layer, it's not just composition is what
21 I'm trying to say, because if you were to
22 take just a composition argument then
23 you're neglecting the fact that these
24 semiconductor materials are crystalizing,
25 they're not amorphous materials, so

1 DR. J. R. SHEALY
2 composition alone does not describe the
3 state of the material. We need the
4 crystal orientation and it also has to be
5 free of defects because the defects alter
6 the properties of the materials, so that
7 changes the attribute of the material. So
8 that, in short, is -- you know, I stand
9 behind that sentence and I stand behind
10 what I believe one skilled in the art
11 would include is a inhomogeneous region,
12 it's not just composition because we are
13 in single crystal semiconductors. Its
14 composition, orientation, anything that's
15 different about it that changes its
16 semiconductor properties would be
17 considered inhomogeneous.

18 Q. With respect to the SiO₂ mask
19 layer, it's your opinion that that mask
20 layer is inhomogeneous region because it
21 does have a different composition than the
22 n-type GaN layer, correct?

23 MR. KO: Objection, form.

24 A. Not only does it have a
25 different composition, it -- SiO₂

1 DR. J. R. SHEALY
2 deposited in this way is amorphous, it
3 has no crystal structure, so that also
4 qualifies it to be inhomogeneous,
5 different composition and different
6 crystal structure. And of course the
7 gallium nitride that grows on top of it is
8 different, the material that grows between
9 those stripes and the material that is
10 found on top of those stripes have
11 radically different properties. So
12 there's inhomogeneous regions in the
13 gallium nitride that forms on top of these
14 structures in addition to the
15 inhomogeneity of the SiO₂ where it's a
16 different crystal structure and a
17 different composition.

18 Q. All right. You said that
19 there's inhomogeneities in the layer 33.
20 There's GaN inhomogeneities; is that what
21 you're saying?

22 A. Yes. When you look at the GaN
23 on top of these mask layers, the GaN that
24 grows on top of the oxide and the GaN that
25 grows in between the oxide have two

1 DR. J. R. SHEALY
2 different properties. The one that's
3 grown in between the oxide is generally
4 loaded with dislocations, where as the
5 dislocation density is significantly
6 reduced in the region that grows on top of
7 these oxides, and that's why they stagger
8 them, they're trying to block them all,
9 and of course that isn't a hundred percent
10 effective, but it can lower the
11 dislocations that penetrate the device
12 layer on top by at least a factor of a
13 hundred, maybe a factor of a thousand if
14 it's done carefully. So that's what's
15 going on here.

16 Q. But you don't offer an opinion
17 in section limitation 1D that the GaN
18 itself is inhomogeneous, correct?

19 MR. KO: Objection, form.

20 A. Gallium nitride is a binary
21 compound, and I would consider that
22 compound to be inhomogeneous. Aluminum
23 gallium nitride or gallium indium nitride
24 is a mixed crystal, a ternary compound;
25 and that has alloy fluctuations,

1 DR. J. R. SHEALY
2 composition fluctuations, as all mixed
3 crystals do. The binary compound doesn't
4 suffer from this. Mixed crystals; the
5 ternary or quaternary compounds do suffer
6 from this. So this structure is if the
7 layer shaded in blue here is gallium
8 nitride then it -- I'm saying it is
9 inhomogeneous, it is not going to have
10 compositional fluctuations, that's gallium
11 nitride in general.

12 Now, this is depicting epitaxial
13 lateral overgrowth gallium nitride, that
14 is a different story, that does have
15 inhomogeneities present in it because it
16 affects the dislocation density relative
17 to the position of the mask, the
18 dislocation density is changed wildly for
19 the gallium nitride grown on top of it, so
20 but if you were growing just an isolated
21 gallium nitride layer without the
22 staggered mask here, they're -- presumably
23 that layer would be homogeneous.

24 Q. You're not offering an opinion
25 in paragraph 92 or 93 that the different

1 DR. J. R. SHEALY
2 dislocation densities of the GaN in figure
3 3 are an inhomogeneous region, correct?

4 A. I know it's in the report, it
5 may not be -- well, I do quote the
6 sentence from the patent which basically
7 states that the semiconductor structure
8 can have inhomogeneous regions by patting
9 and masking an epitaxial growth or
10 overgrowth, that is what is going on here.

11 Q. That sentence in paragraph 92
12 discussing the 117 patent is in reference
13 to your prior sentence where you say that
14 the SiO₂ mask layer constitutes an
15 inhomogeneous region, correct?

16 A. Yes. But I can't put my finger
17 on it right now, I'd have to look at it,
18 but I know it's in the declaration that
19 the GaN grown on top of these structures
20 is also inhomogeneous, I just don't -- I
21 don't know, as I sit here, exactly where
22 it is.

23 Q. In paragraph 93, if you look at
24 the third sentence says: "The result is
25 the blue-colored n-type GaN layer 33

1 DR. J. R. SHEALY
2 ('semiconductor layer') including a
3 plurality of yellow-colored SiO2 mask
4 layers 34 ('inhomogeneous regions')." See
5 that?

6 A. Yes.

7 Q. Here you are saying that the
8 plurality of -- the inhomogeneous regions
9 you are identifying are the plurality of
10 yellow-colored SiO2 mask layers 34,
11 correct?

12 A. That certainly fits the
13 definition of inhomogeneous layers, yes.

14 Q. But that wasn't my question. My
15 question was: In paragraph 93 you're
16 identifying the, in quote, inhomogeneous
17 regions as the yellow-colored SiO2 mask
18 layers 34, correct?

19 A. Correct.

20 Q. You're not identifying the
21 different -- the -- whatever
22 inhomogeneities may be present in the GaN
23 as the alleged claimed inhomogeneous
24 regions, correct?

25 A. Not in this paragraph, but it is

1 DR. J. R. SHEALY

2 found in the declaration.

3 MR. AUERBACK: We're coming up
4 on the top of the hour, let's take a
5 15-minute break.

6 MR. KO: Okay. Sounds good.

7 [Whereupon, a break was taken.]

8 MR. AUERBACH: Is everyone
9 ready?

10 MR. KO: Yes.

11 Q. Okay. Dr. Shealy, we were
12 talking about Ban before the break.

13 A. Yes.

14 Q. Let me pull up the -- okay. Can
15 you see -- no. No.

16 How's that?

17 A. Okay. I can see that.

18 Q. See the reference?

19 A. Yes.

20 Q. So we were talking about -- so
21 34, it says -- you see at paragraph at
22 Ban, it says 34 is a SiO₂ mask layer.

23 A. Yes.

24 Q. So how is the mass layer
25 deposited in this structure of figure 3?

1 DR. J. R. SHEALY

2 MR. KO: Objection, form.

3 A. Could you -- which layer was the
4 question regarding?

5 Q. We're talking about -- so we're
6 talking about 34.

7 A. All right.

8 Q. If you go down to paragraph 43
9 on the next page of Ban, it says: "SiO₂
10 is embedded in a stripe shape in the group
11 III-V compound semiconductor layer."

12 A. Yes.

13 Q. So you were saying something
14 about it's not imbedded, it's grown on the
15 semiconductor?

16 A. That's how it's fabricated, but
17 in that result is, you have a layer of
18 gallium nitride with imbedded regions of
19 SiO₂ as the reference describes, they
20 don't go into the detail of how to make
21 it.

22 Q. Okay. And you were saying that
23 the bulk GaN material, if you didn't put
24 any SiO₂, it would be a homogeneous
25 material; is that right?

1 DR. J. R. SHEALY

2 MR. KO: Objection, form.

3 A. It would be considered more or
4 less uniform, so yeah. These are -- you
5 know, these are foreign substrates, so the
6 dislocation density is pretty high, but
7 it's pretty uniform, so you would consider
8 it homogeneous. That -- the
9 non-homogeneous nature of the GaN is when
10 you use the ELO and there's a clustering
11 of the defects, and we talked about that.
12 You're right, in the discussion of Ban I
13 did not go into that, that was in the
14 discussion of Ohmae that it was discussed,
15 but they're describing the same process
16 even though the diagrams look a little
17 different.

18 Q. Got it. So the mask layer is
19 just made of SiO₂, correct?

20 A. Yes.

21 Q. So the SiO₂ is homogeneous,
22 right?

23 A. The SiO₂ within itself would be
24 considered a homogeneous material; in
25 other words, there's not any composition

1 DR. J. R. SHEALY

2 or any other attributes that would vary,
3 you know, within that stripe.

4 Q. Got it. And SiO₂ is not a
5 group-III semiconductor compound, correct?

6 A. No. It's a dielectric material.

7 Q. And it's not a group-III nitride
8 semiconductor alloy?

9 A. No, it's not.

10 Q. Okay. All right. Let's put
11 aside Ban.

12 A. Okay.

13 Q. I'm going to put in -- let's
14 make sure I don't mess this up. Okay.
15 I'm putting in Shur.

16 Okay. Can you see this?

17 A. Yes.

18 Q. Okay. And you have an unmarked
19 paper copy of Exhibit 1006 also?

20 A. Yes, I do.

21 Q. Okay. I'm going to turn to --
22 do you see figure 5 of Exhibit 1006?

23 A. I see it, yeah. I've got it. I
24 got figure 5 on paper and I see it on the
25 screen.

1 DR. J. R. SHEALY

2 Q. Okay. What is that dark -- what
3 are the dark material signifying?

4 A. In figure 5?

5 Q. Yeah.

6 A. Shur indicates it's a region of
7 higher conductivity.

8 Q. There's no -- all right. So
9 this figure 5 is in your declaration,
10 correct?

11 A. Figure 5 is in the declaration,
12 page 46.

13 Q. Okay. I'm going to put that up.
14 Sorry, one second.

15 Okay. So we see -- on page 46
16 we see the un-annotated version of figure
17 5, correct?

18 A. That's correct.

19 Q. Okay. If we go to -- we're at
20 page 52 above paragraph 116.

21 A. Yes.

22 Q. And in paragraph 115 it says:
23 "Annotated figure 5 below," see that?

24 A. Yes.

25 Q. Paragraph 115?

1 DR. J. R. SHEALY

2 A. Mm-hmm.

3 Q. If you look down at annotated
4 figure 5 we see that some annotations have
5 been added. Do you see there's a red
6 highlighted area that's labeled first
7 level and a blue highlighted area that's
8 labeled second level?

9 A. Yes.

10 Q. Who added those annotations; you
11 or the attorneys?

12 A. I think we discussed it and we
13 did it kind of jointly. I wouldn't say it
14 was one or the other.

15 Q. Okay. Do you see similarly
16 there's red -- two red circles and two
17 blue circles in the annotated figure 5?

18 A. Yes.

19 Q. Who determined where those
20 circles should be; you or the attorneys?

21 A. I don't recall, but they were --
22 they were placed there to indicate the
23 region where there was both lateral and
24 vertical inhomogeneities, that's why
25 they're placed there. But I don't recall

1 DR. J. R. SHEALY

2 who placed them. We discussed, you know,
3 where they would go and there they are.

4 Q. The dark region where the
5 circles are, that's one continuous region,
6 correct?

7 MR. KO: Objection, form.

8 A. Where the circles are, yes.
9 That's what it appears to me when I looked
10 at it, yes.

11 Q. Okay. Let's -- give me one
12 second.

13 A. Okay.

14 Q. Okay. I'm going to put up Ohmae
15 again.

16 A. Okay.

17 Q. Okay. Can you see Ohmae?

18 A. Yes.

19 Q. So in Ohmae we were talking
20 about the protruded portions earlier,
21 correct?

22 A. Yes.

23 Q. And in paragraph 126 -- sorry.
24 In paragraph 26 of Ohmae it says: "The
25 materials for the protruded portion may be

1 DR. J. R. SHEALY

2 of various types and may be electrically
3 conductive or nonconductive." Do you see
4 that?

5 A. Yes.

6 Q. And then it says: "Mention is
7 made, for example, dielectric materials
8 such as oxides, nitrides, carbides and the
9 like and conductors such as of metals,
10 alloys and the like."

11 A. Yes.

12 Q. This list doesn't mention a
13 group III-V semiconductor material,
14 correct?

15 A. I think boron nitride would --
16 is a III-V compound.

17 Q. Okay. Where do you see boron
18 nitride?

19 A. On the last line of the page.

20 Q. Got it. There's no mention of
21 GaN in the list of nitrides, right?

22 A. I do not see GaN in that
23 paragraph.

24 Q. Okay. Is boron nitride a
25 semiconductor?

1 DR. J. R. SHEALY

2 A. Yes. It's a wide bandgap
3 semiconductor, yes.

4 Q. Okay. There's no reference to
5 aluminum gallium nitride in this list of
6 nitrides, correct?

7 A. I'm just scanning it briefly
8 again, yes. I do not see alluminum
9 gallium nitride in this list.

10 Q. And there's no -- okay. I'll
11 put that aside.

12 A. Well, they are suggesting -- do
13 you see the last sentence in paragraph 26?

14 Q. Yeah.

15 A. If you use gallium as the metel
16 and nitridize it, you can certainly form
17 gallium nitride as a protruded portion,
18 they're including that as a possibility.
19 It looks like a pretty exhaustive list,
20 but you see alluminum, gallium and indium
21 are a list of metals, if you nitridize
22 those you'll form a III-V compound.

23 Q. Well, there they're talking
24 about metals or alloys, and it's just --
25 there's no reference to those particular

1 DR. J. R. SHEALY

2 -- those specific compounds, correct?

3 It's just alluminum on its own, gallium on
4 its own, indium on its own, correct?

5 A. Yes. But if you nitridize
6 those, you will convert those metals into
7 a nitride semiconductor, that's what
8 they're describing in the last sentence.

9 Q. It doesn't explicitly say
10 anything about nitridizing those metals,
11 correct?

12 MR. KO: Objection, form.

13 A. Well, to me it looks like a
14 laundry list. You would apply
15 nitridation, oxidation or carbonization to
16 that full list of metals that was listed
17 as the possibilities for the protruded
18 portions. So it's listing a lot of
19 materials and among those materials could
20 be gallium nitride, alluminum nitride or
21 indium nitride. If you nitridize those
22 metals that's what you'll end up with.

23 Q. The nitrides that it mentions
24 above include metals, correct?

25 A. The nitride it mentions above --

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2 Q. Right. You said boron nitride.

3 A. Yeah. There's silicon nitride,
4 titanium nitride, and then boron nitride's
5 on the list. It's an exhaustive list of
6 materials.

7 Q. Right. And in that list of
8 nitrides examples, as we said, there's no
9 gallium nitride, correct?

10 A. In the list of nitrides, but
11 again, they're describing in the last
12 sentence a process which modifies the
13 metals. So I'm just -- I was just
14 pointing out that it's possible to end up
15 with gallium nitride as the protruded
16 portion if you choose gallium as the metal
17 and you nitridize it, and a similar
18 argument for aluminum and indium. That's
19 -- I was just pointing that out, that's
20 what you would end up with.

21 Q. Got it. Sorry, give me one
22 second, bear with me.

23 Okay. Sorry, let's put Ohmae
24 back up.

25 A. Okay.

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2 Q. Sorry, let's go back to --
3 sorry, I meant Ban, my apologies. Okay.
4 Yeah, Ban.

5 Okay. Sorry, let's go to
6 Saxler. I need to put this into the chat,
7 my apologies.

8 Okay. Can you see, let me turn
9 to page one, we have Saxler, correct?

10 A. Yes.

11 Q. Okay. In your declaration you
12 talk about figure 3 of Saxler, correct?

13 A. I think figure 3 and figure 4
14 were used in the -- yeah. Figures 3 and
15 figure 4 were used in the declaration.

16 Q. Right. And figure 3 shows
17 regions 22, correct?

18 A. Yes. It shows an array of
19 regions 22 imbedded in layer 20.

20 Q. Okay. And then in paragraph 19
21 of Exhibit 1007 it says the regions 22 may
22 be alluminum indium gallium nitride?

23 A. Yes.

24 Q. And then the different values
25 that could be for those compounds,

1 DR. J. R. SHEALY

2 correct?

3 A. Yes. But I think they generally
4 -- region 22 for this -- for what is
5 described in here would be a larger
6 bandgap material which is doped, and then
7 this has the affect of improving the
8 activation of acceptor impurities. So
9 it's a -- it was something discovered I
10 think, you know, in the early 2000s I
11 guess, this is the first patent that this
12 appeared in, but it's well-known and it is
13 practiced in some commercial LEDs in a
14 certain form. But so the idea is to
15 locally enhance the conductivity by
16 imbedding dope wide bandgap materials in
17 the structure, that's what figure 3 is.

18 And of course Saxler's careful
19 to describe when you build the structure
20 shown in figure 3, you want to enhance the
21 conductivity, but you don't want regions
22 22 to interfere with vertical conduction
23 because if you're going to place this in
24 an operating device then the operating
25 device shown in figures 4, vertical

1 DR. J. R. SHEALY
2 conduction is required to use this as a
3 component of a device. So when it's
4 described in Saxler they give a language,
5 you know, these are arranged as to not
6 interfere with vertical conduction, so
7 they're trying to enhance it actually.

8 Q. What do you mean by "they are
9 arranged to not interfere with vertical
10 conduction"?

11 A. Well, when you put this in a
12 device you want current to flow from top
13 to bottom.

14 Q. Okay.

15 A. And so the wide bandgap regions
16 are going to interfere with that
17 conduction, so they're spaced in -- in
18 around the wide bandgap regions you can
19 get regions of enhanced conductivity. So
20 you want to arrange these things so the
21 regions of enhanced conductivity
22 effectively lower the resistance of this
23 structure, but if you don't space the wide
24 bandgap regions appropriately then they
25 can actually interfere with the vertical

1 DR. J. R. SHEALY
2 conduction. So that's what the patent's
3 trying to describe, a careful process of
4 laying these out, they don't give you the
5 answer they just tell you, you lay it out
6 as to not interfere with the vertical
7 conduction because they're clearly
8 envisioning placing this in a device, a
9 vertical conduction device.

10 Q. Right. So there's different
11 columns of 22 in figure 3, right?

12 A. Yes. There's a two-dimensional
13 array shown.

14 Q. And so they're putting the
15 different columns offset so that, you
16 know, region 22, that's in the first row,
17 none of those 22s are overlapping with the
18 22s in the second row because to help with
19 this vertical conductivity; is that what
20 you're saying?

21 A. Yes. That would be a first step
22 of looking at the problem because around
23 22s is where the regions of higher
24 conductivity occur and you want those to
25 actually merge together and that will give

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2 you the best end result.

3 So but what you just said, I
4 agree with. You wouldn't stagger them so
5 that they would interfere with vertical
6 conduction, so they can't -- they
7 shouldn't overlap each other.

8 Q. Okay. And going back to
9 paragraph 19. Paragraph 19 is teaching
10 that the material for 22 is basically pick
11 the composition and it's just going to be
12 the same Al InGaN in each of these 22s,
13 whatever numbers you end up picking?

14 A. Yes.

15 Q. You know, 122 is not going to
16 have a different Al InGaN, you know,
17 composition of the other, you're going to
18 pick the same number from that, you know,
19 the ranges it gives you?

20 A. That's the way I read it, yes.
21 Now, you could see it says layer 20 has a
22 narrower bandgap than layer 22, and that's
23 what's going to result in regions of
24 higher conductivity. Of course where this
25 will benefit the device the most is on the

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2 p-layer that's above the active layer,
3 that's where you would place this.

4 MR. AUERBACH: It's 1:13, let's
5 take a 15-minute break. If we need to
6 take a longer lunch break, I'll come
7 on in a little bit.

8 [Whereupon, a short break was
9 taken at this time.]

10 MR. AUERBACH: I was going to
11 say I have no further questions.

12 EXAMINATION BY

13 MR. KO:

14 Q. Dr. Shealy, earlier today you
15 were asked questions regarding various
16 types of semiconductor layers; do you
17 recall that?

18 A. Vaguely, yes.

19 Q. What is the plain meaning of the
20 term "semiconductor layer" in the context
21 of the 117 patent?

22 A. Well, a semiconductor layer can
23 refer to, I think, and I believe in the
24 117 they talk about sublayers. But a
25 semiconductor layer can refer to a

1 DR. J. R. SHEALY
2 collection of layers performing a
3 function; for example, some LEDs use short
4 period superlattices in their p-type
5 regions to improve the whole ionization
6 energy. And so that collection of layers
7 that's in that superlattice, it has
8 individual layers that are repeated, but
9 the whole structure can be referred to as
10 a layer according to its function. So a
11 cladding layer for an LED can be a
12 superlattice that has many layers that
13 make it up. So, you know, the use of word
14 "layer" can refer to a single layer or
15 many layers collectively performing a
16 function. So that terminology is used
17 both ways.

18 Q. And Dr. Shealy, earlier today
19 you were asked questions regarding figure
20 39 of Ohmae which is Exhibit 1004; do you
21 recall that?

22 A. Yes.

23 Q. Let me know when you're there at
24 figure 39 of Ohmae.

25 A. Okay.

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2 Q. What does figure 39 of Ohmae
3 show in terms of the protruded regions and
4 the semiconductor layer 15?

5 MR. AUERBACH: Objection, form.

6 A. The figure shows a repetition of
7 sequences that result in regions -- the
8 protruded regions which are identified as
9 number 12 being imbedded in layer 15, that
10 is the end result of what's shown in that
11 figure.

12 Q. And do you consider figure 39 as
13 showing three different semiconductor
14 layers 15?

15 MR. AUERBACH: Objection,
16 leading.

17 A. No. One skilled in the art
18 could refer to that entire structure as
19 one layer on the substrate, but again, you
20 can you use the term "layer" to refer to
21 components of another layer, but there's
22 nothing wrong with considering what's
23 shown in figure 39 as a substrate number
24 11 with a layer 15 on top of it performing
25 a function.

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2 Q. And Dr. Shealy, earlier today
3 you were asked questions about paragraph
4 248 of Ohmae; do you recall that?

5 A. Yes.

6 Q. And paragraph 248 says: "The
7 sixteenth embodiment other than those
8 described above is similar to the first
9 embodiment." Do you see that?

10 A. Yes.

11 Q. Does paragraph 248 of Ohmae mean
12 that figure 39 is only applicable to the
13 planar LED structures shown in the first
14 embodiment which is figure 3?

15 A. No. This is separate --

16 MR. AUERBACH: Objection,
17 leading.

18 A. Well, to me what the sixteenth
19 embodiment that is described is in effect
20 taking the structure that is figure -- the
21 structure that's figure 39 and placing it
22 in a LED structure. I mean that's the
23 whole point of this.

24 Q. And can figure 39 of Ohmae be
25 applied to the LED structure shown in

1 DR. J. R. SHEALY

2 figure 39 --

3 MR. KO: Sorry, let me start
4 over again.

5 Q. Can figure 39 of Ohmae be
6 applied to the LED structure shown in
7 figure 35 of Ohmae?

8 MR. AUERBACH: Objection,
9 leading.

10 A. Yes, it can. That is the
11 separate embodiment that's being
12 discussed.

13 Q. And why is that?

14 A. Well, that's what's described in
15 the text, there's a separate embodiment to
16 take the contents of figure 39 and put it
17 in a device structure.

18 Q. Thank you. And Dr. Shealy,
19 earlier today you were asked questions
20 about figure 3 of Ban, which is Exhibit
21 1005; Do you recall that?

22 A. Yes.

23 Q. In figure 3 of Ban can you
24 identify and explain what you consider as
25 the inhomogeneous regions?

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2 A. As it's pointed out in the
3 declaration, the inhomogeneous regions are
4 the SiO₂ stripes, they differ in
5 composition and crystal structure, so they
6 certainly qualify as being inhomogeneous
7 because they're imbedded in the layer 33.

8 Q. And in addition to the SiO₂
9 layers, are there any inhomogeneous
10 regions that, in your opinion, is in the
11 device of figure 3 of Ban?

12 MR. AUERBACH: Objection,
13 outside the scope.

14 A. The -- there are inhomogeneities
15 in the layer 33 as a result of the lateral
16 overgrowth processes used. There was
17 discussion in the declaration on this, but
18 not with this reference, with the Ohmae
19 reference, but they're both doing --
20 they're both describing epitaxial lateral
21 overgrowth, they both end up with the same
22 inhomogeneities that result. And in fact,
23 Ohmae diagrams those inhomogeneities in
24 one of his figures, I don't recall which
25 one it is, but there's a diagram of the

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2 inhomogeneities that exist in the
3 epitaxial lateral overgrowth, and this --
4 that's -- Ohmae figure 21 shows the
5 inhomogeneities that exist above an
6 epitaxial lateral overgrown mask.

7 Q. And back to figure 3 of Ban; can
8 you identify where you consider as
9 inhomogeneous region that's shown in
10 figure 3 of Ban?

11 MR. AUERBACH: Objection,
12 outside the scope, leading.

13 A. If you take any plain of those
14 stripes and you compare the gallium
15 nitride that's above the stripe and in
16 between the stripe, there will be
17 differences in the defect density, and one
18 skilled would, in my opinion, consider
19 that an inhomogeneity.

20 Q. Thank you. And Dr. Shealy,
21 earlier today you were asked questions
22 about figure 3 of Saxler; do you recall
23 that?

24 A. Yes.

25 Q. In figure 3 of Saxler, what, if

1 DR. J. R. SHEALY

2 any, affect does alloy scattering have
3 regarding the regions 22 that are shown on
4 the same row in that figure?

5 MR. AUERBACH: Objection,
6 leading.

7 A. The ternary or quaternary alloy
8 that's in region 22 would have -- you
9 cannot eliminate compositional
10 fluctuations in a mixed compound
11 semiconductor layer of any kind, at least
12 it's been synthesized thus far. So
13 they'll local inhomogeneities in -- within
14 layer 22 and they'll also -- if layer 20
15 is gallium nitride, then it would have
16 local inhomogeneities because of the
17 presence at 22, because regions near 22,
18 if it's designed the way Saxler's
19 describing, are going to be regions of
20 higher conductivity, and those regions are
21 localized very close to the wide bandgap
22 regions 22.

23 So even though that in this case
24 the crystal of the gallium nitride --
25 let's say layer 20 is gallium nitride, the

1 DR. J. R. SHEALY
2 crystal is uniform, but the conductivity
3 is not uniform because of an increased
4 carrier density caused by the presence of
5 22, it's a the highly localized
6 phenomenon, but it causes an
7 inhomogeneity. As described in the 117
8 patent, the inhomogeneity in this case is
9 caused by a large change in the
10 conductivity.

11 Q. Thank you, Dr. Shealy.

12 A. If region 20 was made of a
13 ternary or a quaternary alloy then there
14 would be local fluctuations within layer
15 20 even if 22 wasn't present.

16 I don't know if that answered
17 your question.

18 [Continued on the next page to
19 allow for signature line and jurat.]
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Q. Yes, you did.

MR. KO: And thank you,
Dr. Shealy, that's all of my questions
for now.

THE WITNESS: Okay.

MR. AUERBACH: I don't have
anything further.

[TIME NOTED: 1:34 p.m.]

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I N D E X

WITNESS

DR. JAMES R. SHEALY

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CERTIFICATION

I, Samuel Hittin, a Notary Public for
and within the State of New York, do
hereby certify:

That the witness whose testimony as
herein set forth, was duly sworn by me;
and that the within transcript is a true
record of the testimony given by said
witness.

I further certify that I am not
related to any of the parties to this
action by blood or marriage, and that I am
in no way interested in the outcome of
this matter.

IN WITNESS WHEREOF, I have hereunto
set my hand this 27th day of January,
2023.

Samuel Hittin

SAMUEL HITTIN

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DECLARATION UNDER PENALTY OF PERJURY

Case Name: Lite-On Technology Corporation vs.
Sensor Electronic Technology, Inc.

Date of Deposition: 01/26/2023

Job No.: 10113537

I, DR. JAMES R. SHEALY, hereby certify
under penalty of perjury under the laws of the State of
_____ that the foregoing is true and correct.

Executed this _____ day of
_____, 2023, at _____.

DR. JAMES R. SHEALY

NOTARIZATION (If Required)

State of _____

County of _____

Subscribed and sworn to (or affirmed) before me on
this _____ day of _____, 20__,
by _____, proved to me on the
basis of satisfactory evidence to be the person
who appeared before me.

Signature: _____ (Seal)

1	DEPOSITION ERRATA SHEET
2	Case Name: Lite-On Technology Corporation vs.
	Sensor Electronic Technology, Inc.
	Name of Witness: Dr. James R. Shealy
3	Date of Deposition: 01/26/2023
	Job No.: 10113537
4	Reason Codes: 1. To clarify the record.
	2. To conform to the facts.
5	3. To correct transcription errors.
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DEPOSITION ERRATA SHEET

Lite-On Technology Corporation v. Sensor Electronic Technology, Inc.
IPR2022-00780

Deponent: **James R. Shealy, Ph.D.**
Date of Deposition: **January 26, 2023**

Reason Codes:

1. To clarify the record
2. To conform to the facts
3. To correct transcription errors

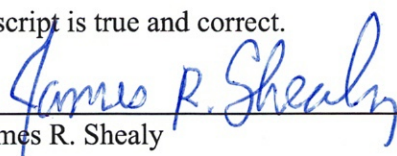
I hereby make the following changes in my deposition testimony:

Page No.	Line No.	Reason	CORRECTION	
			FROM	TO
16	7	3	"on those materials"	"of those materials"
16	13	3	"invisible"	"and visible"
17	11	3	"not a photo transistor"	"and a photo transistor"
17	18	3	"selected area growth"	"selective area growth"
19	22	3	"2010"	"in 2010"
24	3	3	"growing on that needle"	"grown on that needle"
25	19	3	"gallium nitride hemp"	"gallium nitride HEMT"
25	22	3	"saw"	"sought"
29	2	3	"we are in that"	"they are in the"
34	14	3	"defuse into"	"diffuse into"
46	3	3	"the planarize"	"it planarizes"
56	10	3	"form and"	"formed"
63	15	3	"it had"	"if it had"
63	24	3	"crystaling"	"crystalline"
65	2	3	"this was way"	"this way"
65	3	3	"crystaling"	"crystalline"
66	22	3	"inhomogeneous"	"homogeneous"
67	9	3	"inhomogeneous"	"homogeneous"
70	24	3	"mass layer"	"mask layer"
82	7	3	"affect"	"effect"
82	16	3	"dope"	"doped"
85	12	3	"A1 InGaN"	"AlInGaN"
85	16	3	"A1 InGaN"	"AlInGaN"
87	5	3	"whole"	"hole"
92	13	3	"plain"	"plane"

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Page No.	Line No.	Reason	CORRECTION	
			FROM	TO
93	13	3	"they'll"	"there're"

Subject to the above changes, I certify that the transcript is true and correct.


James R. Shealy