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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INERGY TECHNOLOGY, INC.,
Petitioner

V.

FORCE MOS TECHNOLOGY CO. LTD.,
Patent Owner

Inter Partes Review No. IPR2024-00094

U.S. Patent No. 7,812,409

REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
DR. DAVID KUAN-YU LIU
AUGUST 23, 2024

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REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
DR. DAVID KUAN-YU LIU, produced as a witness at the
instance of the PATENT OWNER, and duly sworn, was taken
in the above-styled and -numbered cause on
August 23, 2024, from 10:03 a.m. to 7:08 p.m., via Zoom,
before MERCEDES ARELLANO, CSR in and for the State of
Texas, reported by machine shorthand, in Dallas County,
Texas, pursuant to 37 C.F.R. § 42.53.

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P R O C E E D I N G S

THE VIDEOGRAPHER: Today's date is
August 23rd, 2024. We're on the record at 10:03 a.m.

This is the videotaped deposition of
David Liu in the matter of Inergy Technology, Inc.,
versus Force Mos Technology Co., LTD, filed in the
United States Patent and Trademark office.

Coun- -- counsel will now state their
appearance and affiliation for the record.

MR. SAUNDERS: Good morning. This is
Michael Saunders, of Dickinson Wright, on behalf of the
patent owner.

MR. TIPESCU: And this is Mircea Tipescu,
from the Benesch Law Firm, on behalf of Petitioner.

THE VIDEOGRAPHER: Will the court reporter
swear in the witness, and we may proceed.

DR. DAVID KUAN-YU LIU,
having been first duly sworn, testified as follows:

EXAMINATION

BY MR. SAUNDERS:

Q. Good morning, Dr. Liu. Can you state your full
name for the record.

A. Good morning. My full name is
David Kuan-Yu Liu. L-I-U is the last name.

Q. And you're appearing today remotely via Zoom;

1 is that correct?

2 A. Yes, that's correct.

3 Q. And where are you physically located right now?

4 A. I'm sorry. I'm physically located in my home
5 office in Fremont, California.

6 Q. Is there anyone else there with you today?

7 A. No. Ag- -- again, just as yesterday, I -- all
8 my family members are out, leaving the space to -- to
9 myself.

10 Q. And do you have any papers with you today?

11 A. I have the printed copy -- a clean printed copy
12 of my declaration as well as the -- the -- I thought I
13 had the -- the '409 Patent, but apparently, not so.

14 Q. You understand we're here today to discuss the
15 declaration you submitted in IPR2024-00094 filed in the
16 patent trial and appeal board relating to U.S. Patent
17 No. 7,812,409?

18 A. Yes, I do.

19 Q. Okay. And you understand today if I refer to
20 the '409 Patent, that's the patent I'm referring to?

21 A. Yes, I do.

22 Q. Okay. And do you have access to the Exhibit
23 Share platform right now?

24 A. I logged on earlier, and I think I -- I see --
25 everything from yesterday seems to still be there.

1 Maybe I need to refresh it.

2 Q. Okay. I think you will need a new invite for
3 today, then, because we have a -- a different folder.

4 A. I see.

5 Q. So --

6 THE STENOGRAPHER: Should we go off --

7 Q. (BY MR. SAUNDERS) Is it not showing --

8 THE STENOGRAPHER: Should we go off the
9 record to send him that link?

10 MR. SAUNDERS: Let's go off the record.

11 THE VIDEOGRAPHER: Time is 10:05. We're
12 off the record.

13 (Break taken from 10:06 a.m. to 10:22 a.m.)

14 THE VIDEOGRAPHER: The time is 10:22.
15 We're back on the record.

16 Q. (BY MR. SAUNDERS) All right. Dr. Liu, do you
17 now have access to Exhibit Share for today's deposition?

18 A. Yes, I do.

19 Q. And do you see already introduced Exhibits 1001
20 and 1003?

21 A. Yes, I do.

22 Q. And 1001 is the '409 Patent?

23 A. That's correct.

24 Q. And 1003 is your declaration submitted in this
25 IPR?

1 A. That's correct.

2 Q. And you were deposed yesterday in connection
3 with a different IPR involving Force Mos and Inergy?

4 A. That's correct, yes.

5 Q. Do you understand today the same rules apply as
6 we discussed at yesterday's deposition?

7 A. Yes, I do.

8 Q. And is there any reason today why you can't
9 give truthful and complete testimony?

10 A. No, there -- there's no reason.

11 Q. All right. I'd like to go to your declaration
12 to Paragraph 58. Let me know when you're there.

13 A. Declaration Paragraph 58?

14 Q. Yeah.

15 A. I'm there.

16 Q. And in Paragraph 58, it's -- you set forth your
17 opinion that the term "rounded corners" in Claim 1 of
18 the '409 Patent should be construed as "corners that are
19 truncated by design layout and then rounded"; is that
20 correct?

21 A. Repeat your question again.

22 Q. Yeah. So in your declaration, you set forth
23 the opinion that you believe the appropriate
24 construction of the term "rounded corners" in the Claim
25 1 of the '409 Patent is "corners that are truncated by

1 design layout and then rounded"; is that correct?

2 A. I think the -- to be exact, I think my opinion
3 is that after going through the -- the filing history
4 and the Prior Art, is that it's truncated by design and
5 subsequently rounded by lithography or on the process --
6 lithography being one of the process, yes.

7 Q. And it -- it's still your opinion that that is
8 the correct claim construction?

9 A. That's the opinion I offer in the claim
10 construction. Yes, that's my opinion.

11 Q. Okay. Now, in Paragraph 56, you mention a
12 "mask layout."

13 Do you see that?

14 A. Yes, I do.

15 Q. What's -- what's the difference between a mask
16 layout and a design layout?

17 A. Can you -- can you give specific context. I
18 think this is a very open-ended question, very broad.

19 Q. Well, you -- you have an opinion about the
20 appropriate construction of rounded corners where you
21 use the phrase "design layout." So let's start with
22 there.

23 What do you mean by "design layout" in
24 your opinion of -- in Paragraph 58 of your declaration?

25 A. Well, I was referring to on the mask. If you

1 have a square on the mask -- a square shape on the mask,
2 and that's by your design, to have that square shape to
3 be on the mask.

4 Q. And what is "a mask"?

5 A. In integrated processing, a mask is -- has a
6 pattern, and we use photolithography to transfer the
7 pattern as closely -- trying to transfer the pattern as
8 closely as possible, giving the limitation of the optics
9 from whatever feature that's on the mask onto the --
10 onto the wafer.

11 Q. So there's some source of -- of light energy
12 that is used to transmit through the mask, and the parts
13 where the mask doesn't block out that light, it's
14 transferred to the wafer; is that correct?

15 MR. TIPESCU: Objection, form.

16 A. Can you repeat your question again.

17 Q. (BY MR. SAUNDERS) Yes.

18 So is -- what is getting exposed through
19 the mask that creates the features on the wafer?

20 MR. TIPESCU: Objection, form.

21 A. I think photolithography is -- is beyond the
22 scope of this -- of this declaration. There's a lot of
23 physics and intricacies involved. And just the way you
24 phrased the question, I think -- excuse me -- there --
25 there -- there's a -- there's a whole nuances involved.

1 So I -- I don't -- I don't quite understand
2 your question. I don't quite know how to -- how -- I
3 don't quite understand your question, please.

4 Q. (BY MR. SAUNDERS) Well, I just -- I'm trying
5 to unpack your opinions about the appropriate
6 construction of rounded corners. And you mention
7 lithography, and you mention design layout, and you
8 mention mask layout, and you also mention your opinion
9 that you believe it is well known in the art that
10 corners would become rounded as a natural or incidental
11 result of lithography.

12 And so I'm -- I'm trying to understand how
13 in lithography does a mask cause structures to appear on
14 the wafer that is being subject to the lithography?

15 MR. TIPESCU: Objection, form.

16 A. I -- I can quote you -- cite to you that that's
17 what '409 Patents also mention in terms of manufacturing
18 process that would involve with mask that a -- the
19 square contact, for example, become approximately
20 circular-shape contact, and the truncated corner becomes
21 smoother. So and it says truncated corners are formed
22 by design layout, not process.

23 This is the language that '409 Patent is
24 using, and -- and that's the basis of the -- of the --
25 of the '409 -- '409 alleged invention.

1 Q. (BY MR. SAUNDERS) All right. Can you look at
2 the '409 Patent, Column 2, Lines 14 through 17.

3 A. You said 14 through 17?

4 Q. Yeah. Column 2.

5 A. I'm there.

6 Q. And you see that there's a reference to
7 "exposure through the mask"?

8 A. That's correct.

9 Q. What -- what does that mean?

10 A. I -- I'm not here to define the process flow.
11 Sufficed to say, '409 Patent says clearly there's a step
12 of exposure through the mask. And as I mentioned
13 earlier, it is a step of transferring -- you're trying
14 to transfer as faithfully as possible; but due to the
15 limitation, you may not.

16 So it's just you're trying to transfer the
17 pattern that you have on the mask onto the silicon
18 wafer. So to the extent that '409 Patent mention that
19 include a step of exposure through the mask, that's --
20 that's a process step, exposure through the mask.
21 (Coughing). Excuse me.

22 Q. Well, what is going through the mask?

23 MR. TIPESCU: Objection, form.

24 A. I -- I don't understand your question, what --
25 "What is going through the mask?"

1 Q. (BY MR. SAUNDERS) You'd agree with me, it's
2 light or other forms of electromagnetic energy that are
3 going through the mask during photolithography; is that
4 correct?

5 MR. TIPESCU: Objection, form.

6 A. I'm not here to discuss the intricacy of
7 photolithography process. That's a big science by
8 itself. But suffice to say that it is going through a
9 process -- it's called photolithography -- in which the
10 pattern on the mask, you're trying to reproduce the
11 pattern on the mask onto the silicon wafer, and you're
12 trying to do it as closely as possible.

13 And given that there's limitations. So the
14 Patent '409 as we just read, the limitation such that in
15 the exposure step, the square contact becomes
16 approximately circular-shape contact; meaning --
17 meaning, you have -- you have rounding of the corner.

18 MR. SAUNDERS: I'm going to object as
19 nonresponsive.

20 Q. (BY MR. SAUNDERS) Dr. Liu, are you refusing to
21 answer my question?

22 MR. TIPESCU: Objection, argumentative.

23 A. I'm not refusing to answer your question,
24 Counsel. I'm trying to answer the question, but I'm --
25 I don't want to delve into the intricacy of

1 photolithography. I'm here to discuss the declaration I
2 presented and for '409 Patent, and -- and I'm trying to
3 answer your question as faithfully as possible.

4 Q. (BY MR. SAUNDERS) And -- and, Dr. Liu, twice
5 now you've responded to my question saying you're not
6 here today to talk about certain subject matter. I'm
7 directed you to specific portions of your declaration
8 that refer to photolithography.

9 A. Okay.

10 Q. In fact, you refer to language saying "exposure
11 during photolithography" in Paragraph 55 of your
12 declaration. And I'm asking a very basic question to
13 understand what you mean by that.

14 Can you ask my -- answer my question about
15 what is being exposed through the mask during
16 photolithography.

17 MR. TIPESCU: Objection, form.

18 A. So, Counsel, with all due respect, the reason
19 I'm not answering your question or I might -- I may seem
20 to not answering your question is because the question
21 is phrased -- I don't want to use the word
22 "incorrectly," but there's some -- some -- to me,
23 there's some difficulty for me to understand your
24 question. So I can just briefly describe the
25 photolithography process.

1 Essentially, you have a mask, and the
2 mask is trying to transfer the pattern onto the photo
3 resist. And depending on the type of the photo resist
4 you have and the -- which is why I hesitate to answer
5 your question, you ha- -- you could have positive photo
6 resist, you could have negative photo resist, and they
7 behave differently.

8 So, for example, in the case, you -- in
9 general, what happens is that the -- the mask opening,
10 the mask is either opaque or transparent, depending on
11 the polarity that you design the mask. So opaque will
12 block the light; whereas transparent -- transparent mask
13 would let -- transparency feature would let light go
14 through.

15 And when the light goes through into the --
16 onto the resist -- again, it depends on the type of the
17 resist -- either the resist will harden, or the resist
18 will soften. And after that, you put the wafer with the
19 resist on top through what we call development process.

20 And then that's where the -- the -- either
21 the region I exposed to the light, depending on the
22 polarity of the resist, either that region will get
23 washed away or remain; whereas the other region will
24 either get converse -- will either get -- either stay or
25 get removed.

1 That's how the pattern is transferred onto
2 the photo resist, which sits on top of the -- the wafer,
3 and then that's how you transfer the feature from the
4 mask onto the photo resist, which sits on top of the
5 wafer.

6 Q. (BY MR. SAUNDERS) And so in your answer, you
7 mentioned "light." Is a light source involved in
8 photolithography?

9 A. Yes, light source is involved in
10 photolithography.

11 Q. And the light source would be on one side of
12 the mask, and the wafer would be on the other side of
13 the mask?

14 A. Yes. You can say that.

15 Q. And turning to -- turning to Paragraph 56 of
16 your declaration, it's your opinion that Figure 1A of
17 the '409 Patent is a square-shaped mask layout of a
18 trench gate; is that correct?

19 A. Please repeat your question again. I'm -- I'm
20 sorry.

21 Q. Yeah, so in Paragraph 56 of your declaration,
22 you opine that Figure 1A of the '409 Patent shows a
23 square-shaped mask layout of a trench gate; is that
24 correct?

25 A. That's correct.

1 Q. And so that mask layout would create, in your
2 opinion, a square shape or a trench gate via the
3 photolithography process; is that correct?

4 MR. TIPESCU: Objection, form.

5 A. Repeat -- repeat your question again.

6 Q. (BY MR. SAUNDERS) Yeah. So that square-shaped
7 mask layout of -- that you identify in Figure 1A would
8 create a square-shaped trench gate via the result of
9 photolithography; is that correct?

10 MR. TIPESCU: Objection, form.

11 A. I think you might -- in Paragraph 56, I said it
12 is also well known in the art that the corners would be
13 rounded as a natural or incidental result of the
14 photolithography. So to answer your question, it would
15 be -- the corners will be rounded.

16 Q. (BY MR. SAUNDERS) Which corners that you see
17 in Figure 1A would be rounded as a natural or incidental
18 result of photolithography, in your opinion?

19 A. I -- I think to start out with, the corner I
20 pointed that the -- has designation of B. That's a
21 corner. And any other corner of that similar to B would
22 be rounded as well as the Feature 15, where it's a
23 contact feature. It also has four corners, and that
24 would also be rounded.

25 Q. And...

1 A. I -- I'm not -- I'm not finished. I just want
2 to caution, the outer edge, that feature, it depends on
3 the -- on the layout of the memory cells. It may -- may
4 or may not be there if I repeat a memory cell. So that
5 -- that may or may not be in the artifact. So I'm not
6 -- for the -- for the sake of not complicating the
7 issue, I'm not counting those corners for now.

8 But if the -- if, for example, you only
9 have one singular cell and you lay out exactly like
10 this, you're not repeating. Then, you know, the -- the
11 gate feature -- usually, the gate feature is not like
12 that. But if you're not repeating it, you just show me
13 this, and I will -- I will also include the outer corner
14 just to be complete.

15 But in general, as we know in the array,
16 that may -- that artifact may -- not maybe -- just
17 artifact, I was trying to show a unicell. It may not be
18 there. I just want to be complete.

19 Q. And how do corners become rounded as a natural
20 or incidental result of pho- -- of -- sorry. Withdrawn.

21 How do corners become rounded as a
22 natural or incidental result of lithography?

23 A. I'm -- I'm not --

24 MR. TIPESCU: Objection, form.

25 A. I'm not here -- it -- it -- it's -- it's beyond

1 the scope of this -- this declaration to discuss the
2 optic and optical interference that -- that lies -- that
3 lies a way feature to -- in- -- interfere.

4 And so at the corner, it -- it has -- it
5 has reflection and everything. I -- I don't think I
6 want to get into all the detail. Suffice to say that
7 the '409 Patent in the introduction background section
8 mentions rounded and post -- as oppose, and I -- I've --
9 I have done many -- have -- done for many years in
10 industrial experience, and where the feature -- I put
11 down, and there are feature that put down, and they get
12 -- get rounded.

13 For example, the contacts -- contact
14 feature, as '409 Patent clearly -- clear- -- clearly
15 says, the square contact become approximately
16 circular-shaped, because usually contact --- trench
17 contact are made with minimum feature, so those minimum
18 feature, once the corner get rounded become circular.

19 So it's -- it's sufficed to say that it's
20 due to the optical interference and then -- and a lot of
21 physics involved in the optics. And I also want to say
22 that as we get down to -- to more advanced technology,
23 this kind of rounded become obviously more problematic.

24 So -- so suffice to say that rounding
25 occurs, and it's just -- the -- the -- now it's -- I

1 always like to give is that when you bake the bread and
2 you pick -- pick a square dough into the oven, when it
3 comes out, the corners are in- -- inevitably rounded.

4 And we can go into the ther- -- thermo- --
5 thermodynamic of oven and -- and the heat and how
6 different corner will get inflated differently. But
7 that's the -- that's the case. That's the -- that's the
8 nature. And the corner gets rounded. And this is --
9 this is one of the things where we can go into the
10 detail physics involved.

11 But suffice to say that in -- in optical
12 situation and also any subsequent process step, there
13 will be round introduce simply because with a corner,
14 you have different stress, different tensor stress,
15 different shear stress.

16 So -- so corner behaves differently in
17 optics in a -- in a -- in a semiconductive process. And
18 I think that's -- that's as complete answer I can -- as
19 I can give you.

20 Q. (BY MR. SAUNDERS) All right. So the last
21 sentence of Paragraph 56 of your declaration states, "It
22 was also well known in the art that the corners would
23 become rounded as a natural or incidental result of
24 lithography."

25 What is the entire basis for that opinion,

1 Dr. Liu?

2 MR. TIPESCU: Objection, form.

3 A. The basis of the opinion is from -- from the
4 physics of optics and physics of semi-conducted
5 processing. And it's also consistent and supported by
6 the specification of '409 Patent, which says that
7 exposure through the mask, such that the square contact
8 become approximately circular-ish -- circular-shape
9 contact, and truncated corner becomes smoother, and the
10 rounding -- suffice to say, rounding occurs. It says
11 right here, "It is by nature that truncated corner in
12 layout becomes rounded after exposure."

13 So I think my opinion is -- is supported or
14 confirmed or even in agreement with -- with the
15 specification of '409 Patent.

16 Q. (BY MR. SAUNDERS) So in Paragraph 61 of your
17 declaration, you opine that the term "truncated corners"
18 in the '409 Patent should be construed as corners that
19 are "truncated by" a "design layout"; is that correct?

20 A. Can you point my -- me to which sentence. I'm
21 -- I'm just -- let me get to my 61--

22 Q. Yeah. The last sentence of Paragraph 61.

23 A. Okay. I'm there.

24 Q. So it's your opinion that truncated corners in
25 the claims of the '409 Patent should be construed as

1 corners that are truncated by design layout; is that
2 correct?

3 A. That's correct, in the sense that I base my
4 opinion on the -- again, the specification of '409
5 Patent as a reference. That's the only -- that's the --
6 that's where the inventor specified that the truncated
7 corners are formed by design layout, not by -- not
8 process.

9 Q. And just one point of clarity. I think in
10 Paragraph 61, you mention Claim 13, but it seems that
11 the '409 Patent only goes up to six claims.

12 Was that Claim 13 meant to refer to Claim
13 6?

14 A. Yes. The -- I apologize for -- for the -- the
15 typo.

16 The reason the Claim 13 was there is
17 because Claim 13 was in the original application, which
18 later was granted as Claim 6 after the modification. So
19 I'm -- I'm -- I -- I think in drafting this, I was -- I
20 didn't make that translation. So Claim 13 should be
21 Claim 6. That's correct.

22 Q. So both your constructions of rounded corners
23 and truncated corners require corners that are truncated
24 by design layout; is that correct?

25 MR. TIPESCU: Objection, form.

1 A. Repeat your question again. Do you mind --
2 Counsel, do you mind repeating your question again. I
3 didn't quite catch the beginning of your -- your
4 question.

5 Q. (BY MR. SAUNDERS) Yeah. One sec. Your -- I
6 don't -- your volume's a little bit low right now,
7 Dr. Liu. Maybe it's your position, or...

8 A. Should I put on -- I -- I didn't want to be
9 impolite. Can I -- I can put on my -- my -- my earbud.
10 Maybe that'll be better?

11 Q. It's really -- it's fine when you're sitting
12 closer. I think just when you're leaning back a little
13 bit, it was harder to hear.

14 A. I'm sorry. I'm sorry. I'll -- I'll sit
15 closer. Yeah. I'm sorry.

16 Q. Okay. So I was asking, Dr. Liu, your
17 construction of truncated corners and your construction
18 of rounded corners, both require corners that are
19 truncated by design layout; is that correct?

20 MR. TIPESCU: Objection, form.

21 A. Repeat your question again. I -- I think I'm
22 -- I'm somehow -- do you mind repeating your question
23 again.

24 Q. (BY MR. SAUNDERS) Yes. I -- I'll -- I'll ask
25 it very clearly.

1 Paragraph 58 of your declaration, you
2 have a construction of rounded corners. Paragraph 61 of
3 your declaration, you have a construction of truncated
4 corners, and both of those constructions recite the
5 phrase "corners that are truncated by design layout"; is
6 that correct?

7 MR. TIPESCU: Objection, form.

8 A. I think we're referring to the claim
9 construction. In the claim construction giving the file
10 history, giving the context of '409 Patent, I am
11 referring to the claim. Especially when it refers to
12 rounded corner in the claim limitation, that should be
13 construed as corner that are truncated -- as I mentioned
14 here, that "rounded corner" means corners that are
15 truncated by design and subsequently rounded by
16 lithography.

17 Now, that's my claim construction with a
18 context of Claim Limitation 1 when it refers to rounded
19 corner. To that extent, whether that claim -- the --
20 the claim that I construed is accepted or agreed with
21 other party or with -- with p-type, that's a separate
22 issue, but that's my opinion I offer giving the
23 limitation of Claim 1 rounded corner.

24 Now, I also need to qualify that, as I
25 mentioned earlier, and also referring to the Prior Art

1 by Pfirsch, corner that are not truncated, corner that
2 are -- are a corner will also get rounded.

3 So the -- if the question is do I believe
4 rounded corners in general has to be -- has to be
5 truncated by design and are rounded by process? No,
6 Pfirsch shows that a rounded corner without truncation,
7 a square layout, even '409 Patent mentions that in -- in
8 the picture that we just go over with Figure 2. It is a
9 square cell with -- with corner that get rounded by
10 process.

11 So -- so, again, I want to be very clear
12 that in this section where it talk about claim
13 construction, and I'm construing the claim limitation of
14 rounded corner in Claim 1 to be in the context of '409,
15 in the context of file history to be corner that are
16 truncated by design and rounded by process.

17 And that is not to say that my opinions
18 that all rounded corners are truncated by design, okay?
19 There's a di- -- there's a difference.

20 MR. SAUNDERS: I'm going to object as
21 nonresponsive.

22 Q. (BY MR. SAUNDERS) I -- I did ask a very simple
23 question, Dr. Liu. I'm trying to understand the
24 differences with regards to your proposed constructions
25 for rounded corners and truncated corners that appear in

1 your declaration.

2 So isn't it true that just looking at the
3 text of those proposed constructions, the only
4 difference is that your construction of rounded corners
5 adds the language "and then rounded" to the end of the
6 text for your construction of truncated corners,
7 correct?

8 A. Can you refer me to which part of my
9 declaration, please, which part are you referring to?

10 Q. Yes. I'm comparing the last sentence of
11 Paragraph 58 to the last sentence of Paragraph 61.

12 MR. TIPESCU: Objection, form.

13 Is there a -- a question?

14 MR. SAUNDERS: Yes. There's still the
15 question pending.

16 A. So in the context of -- of -- of claim
17 construction, I think it's very clear, and on pa- --
18 Paragraph 58, I stand by that: The rounded corners are
19 corners that are truncated by design layout and then
20 rounded.

21 And then "truncated corner" simply means
22 corner that are truncated by design layout.

23 Q. (BY MR. SAUNDERS) Now, given the fact that you
24 opine that it is well known in the art that the corners
25 would become rounded as a natural or incidental result

1 of lithography, what is the substantive difference
2 between your construction of rounded corners and your
3 construction of truncated corners?

4 MR. TIPESCU: Objection, form.

5 A. In the co- -- context of the claim limitation,
6 cons- -- claim construction of Claim Limitation 1 in
7 rounded corner, I offer the opinion that rounded corner
8 are corners that are truncated by design layout and then
9 rounded. And truncated corner are just corner that are
10 truncated.

11 Q. (BY MR. SAUNDERS) So in your construction of
12 rounded corners, when you have the phrase "and then
13 rounded," does that exclude the natural or incidental
14 rounding that's a result of lithography that you mention
15 in Paragraph 56 of your declaration?

16 A. The rounding comes from, as '409 Patent
17 specification cited, the mask-printing photolithography
18 as one of them. So the rounded is -- is -- you have a
19 design layout, and you go through the process. You go
20 through lithography, you go through etching. You go
21 through growth. You go through everything. And then
22 the corner becomes rounded.

23 So rounded corners are -- for that
24 limitation, given the context and the file history,
25 rounded corners are corners that are truncated by design

1 layout and then rounded.

2 Q. But would it be truncated corners of Claim 6 of
3 the '409 Patent also become rounded as a natural or
4 incidental result of lithography?

5 MR. TIPESCU: Objection, form.

6 A. I will say truncated corner will also -- going
7 through the process will also get rounded.

8 Q. (BY MR. SAUNDERS) And can you turn to
9 Paragraph 69 of your declaration.

10 A. Excuse me. I'm there.

11 Q. And there you show an annotated version of
12 Figure 6C of the Kobayashi reference; is that correct?

13 A. That's correct.

14 Q. And you quote the language that Kobayashi
15 referenced. It says, "The corners of each Trench 6 at
16 the bottom are rounded, and corners of each Trench 6 at
17 an opening portion may also be rounded."

18 You see that?

19 A. Yes, I do.

20 Q. Is that rounding as -- occur as a result of a
21 design layout?

22 MR. TIPESCU: Objection, form.

23 A. That rounding occurs as -- as a -- first of
24 all, that rounding -- the rounding itself -- I'm showing
25 in Figure 6C, there's different corner, and it's

1 sufficed to say that the physics doesn't really care
2 where the corners are.

3 So in the -- in -- in -- in both this cross
4 section view and the top view, if you see the corner,
5 due to the physics get rounded, on the top level, top
6 cross section of view -- top view, the corner will also
7 get rounded.

8 So it's a three-dimensional -- as -- as --
9 as both side pointed out, it's a three-dimensional
10 process. So all the corners will get rounded. Whether
11 it's in the vertical direction, X, Y, Z direction, they
12 will all get rounded.

13 Now, in thi- -- in this specific case,
14 the corners are rounded as a result of process.

15 Q. (BY MR. SAUNDERS) So the corners that are
16 rounded in Kobayashi Figure 6C are not a result of
17 truncation of corners in a design layout; is that
18 correct?

19 MR. TIPESCU: Objection, form.

20 A. This Kobayashi also has feature where a
21 substantially square shapes are truncated. In those
22 cases, the corner trunc- -- cor- -- corner rounded will
23 also be due to truncation. So Kobayashi includes that
24 -- that feature.

25 Q. (BY MR. SAUNDERS) What -- what are you

1 referring to as having truncation in Kobayashi?

2 A. Let's go to my declaration. In Paragraph 68,
3 Kobayashi shows a plurality of hexagon- -- hexagonal
4 cell, which can be described as square-shaped cell with
5 truncated corners in Figure 4A.

6 Q. So you're -- you're quoting from Paragraph 68
7 of your declaration; is that right?

8 A. That's correct.

9 Q. Okay. And so that's showing Figure 4 -- 4A of
10 Kobayashi; is that correct?

11 A. That's correct.

12 Q. And that's a top-view perspective of MOSFET
13 cells in Kobayashi?

14 A. That's correct.

15 Q. And the Figure 6C in Kobayashi that's in
16 Paragraph 69, that's a side view of a cross section of
17 MOSFET cells in a step of the fabrication in Kobayashi?

18 A. For the sake of not trusting my memory, I --
19 let me go to Kobayashi.

20 Q. Okay. I have -- I have uploaded Kobayashi,
21 which is Exhibit 1005.

22 A. I'm sorry. Okay.

23 Q. And I'm -- I'm correct that Figure 6C shows
24 a -- in Kobayashi shows a side-view cross section of the
25 MOSFET during a step of its manufacture, correct?

1 A. Kobayashi specifically said, to be accurate,
2 referring to Figure 6A through 6D, 7A, and 7D and 8A and
3 8C, the description will be made of a method of
4 producing the MOSFET in Figure 5A, so the MO- -- I'm --
5 I'm really sorry.

6 The MOSFET in Figure 5A shows a -- a
7 cross section of a MOSFET. So in that context, that's
8 correct.

9 Q. And looking at -- I guess, first of all, is
10 your -- let me withdraw.

11 Is your theory that's in Paragraph 68 of
12 your declaration an alternative theory to the theory
13 that's in Paragraph 69 of your declaration, with respect
14 to how Kobayashi satisfies Limitation 1[a] in your
15 opinion?

16 MR. TIPESCU: Objection, form.

17 A. Repeat your question again.

18 Q. (BY MR. SAUNDERS) Yeah. I'm trying to
19 understand your opinions regarding Limitation 1[a] with
20 regards to Kobayashi in Paragraph 67 through 69 of your
21 declaration.

22 So are the statements you have in
23 Paragraph 68 an alternative theory to what you have in
24 Paragraph 69 of your declaration?

25 A. I -- I don't know what you meant by

1 "alternative theory."

2 Here's the paragraphs -- let me explain
3 the Paragraph. 67 shows a square cell. So Kobayashi
4 definitely described a -- a substantially square cell.
5 So there's a square cell.

6 Now, in -- according to my claim
7 construction, the claim construction I offer, such
8 square cell could be truncated to be -- to be something
9 -- to be -- to be a shape that's demonstrated in Figure
10 4A.

11 So a square cell -- substantial square cell
12 could be truncated, and then in figure -- in -- in 69,
13 it says that such a cell will have rounded corner in all
14 three dimension.

15 Kobayashi showing the -- the two cross
16 section dimension, and the claim says that you have
17 rounded corners. So you have all three dimension in
18 your -- it could be from top view going down because you
19 have corner. And a- -- again, I said the physics
20 doesn't care which X, Y, Z direction orientation of
21 corners. So you have -- you have everywhere, anytime
22 there's a corner, it's rounded.

23 So going from Paragraph 68 -- 67, 68, 69,
24 it's consistent to show how Kobayashi anticipate -- or
25 discloses -- I -- I believe, antic- -- anticipates or

1 discloses all the feature of limitation of Claim 1.

2 Now, to the extent you were saying that
3 whether corners need to be truncated to be rounded, to
4 that extent, even figure -- even what I showed in 67,
5 even to be complete, even without truncation, that
6 corner is -- as disclosed by Kobayashi in -- in a -- in
7 cell, that corner -- the corner in that cell will also
8 be rounded. So it would satisfy under any claim
9 construction.

10 But the sequence I'm showing is showing
11 that it satisfied -- definitely satisfied -- Kobayashi
12 definitely disclosed and every aspect of limitation of
13 Claim 1 of '409. Under the claim construction, I
14 offered and even also discloses under claim construction
15 that -- under other -- under -- under the opposed claim
16 construction, so...

17 So I -- I don't know what you meant by
18 "alternative," but this is a sequence of -- of -- of my
19 -- my declaration to show that Kobayashi anticipates and
20 discloses all the limitations of Claim 1 of the ''409
21 Patent.

22 Q. So is it your opinion that the combination of
23 Figures 3A, 4A, and 6C of Kobayashi together disclose
24 Limitation 1[a] of the ''409 Patent?

25 MR. TIPESCU: Objection, form.

1 A. The combination? I'm presenting a supporting
2 opinion to show how Kobayashi discloses all the feature,
3 all the limitation of Claim 1. So in that sense, I -- I
4 use Paragraph 67, 68, 69 to articulate and -- and to
5 articulate my opinion as a support of my declaration.

6 Q. (BY MR. SAUNDERS) You agree that Figure 3A of
7 Kobayashi's a different embodiment than Figure 4A of
8 Kobayashi, correct?

9 A. I think the best way to answer your question is
10 that Figure 3A of Kobayashi, the corner could be
11 truncated into Figure 4A of Kobayashi.

12 Q. Does Kobayashi have a disclosure of the square
13 cells being truncated to form hexagonal cells?

14 MR. TIPESCU: Objection, form.

15 A. Let me go to Kobayashi. I -- I don't want to
16 trust my memory.

17 Okay. I'm -- I'm -- I just have a chance
18 to briefly review Kobayashi. What's your question
19 again, please.

20 Q. (BY MR. SAUNDERS) Yeah. Does Kobayashi have a
21 disclosure of truncating square cells to form hexagonal
22 cells?

23 MR. TIPESCU: Objection, form.

24 A. Effectively, yes, by showing the hexagonal --
25 hexagonal cell, and hexa- -- hexagonal cell essentially

1 is substantially square cell truncated with a corner
2 truncated. So effectively, Figure 4A is a substantial
3 -- substantial square cell truncated with corner
4 truncated.

5 Q. (BY MR. SAUNDERS) Anything else you could
6 point me to in Kobayashi?

7 A. I beg your pardon?

8 Q. Is there any other disclosure in Kobayashi of
9 square cells being truncated to form hexagonal cells?

10 A. Figure 4A, clearly, I -- I -- with -- with -- I
11 show the annotation -- a hexagon cell six sides, when
12 you truncate four corner of a substantially square cell,
13 you get six -- six sides. It just like -- just like the
14 -- the ''409 Patent is -- in -- in consistency with
15 ''409 Patent when you have -- for example, let's go to
16 Figure 2 of ''409 Patent.

17 You have -- in there, you have what's a
18 substantially square cell, and you truncate the corner.
19 You have a -- you could get a hexag- -- hexagonal. You
20 can get a -- a polygon.

21 So -- so it's -- it's just truncating the
22 corner. I think it's very effectively -- it's -- it's
23 truncated corner -- truncate a square cell with
24 truncated corner in one embodiment is a hexa- --
25 hexagon.

1 Q. Are you okay taking our first break now?

2 A. I think that's fine. Yeah. I don't mind.

3 MR. SAUNDERS: All right. Let's go off the
4 record.

5 THE VIDEOGRAPHER: The time is 11:16.
6 We're off the record.

7 (Break taken from 11:16 a.m. to 11:28 a.m.)

8 THE VIDEOGRAPHER: The time is 11:28.
9 We're back on the record.

10 Q. (BY MR. SAUNDERS) Dr. Liu, before your work on
11 this case, you previously heard hexagons and squares as
12 being different potential cell shapes for MOSFETs,
13 correct?

14 A. I'm sorry. Re- -- repeat your question.

15 Q. Yeah. Before your work on this case, you've
16 heard of both hexagons and squares as being different
17 potential cell shapes for MOSFETs, correct?

18 MR. TIPESCU: Objection, form.

19 A. I -- I think the -- in my experience working, I
20 have either directly or indirectly laid out feature,
21 either a square or a hexagon, yes.

22 Q. (BY MR. SAUNDERS) And prior to your work on
23 this case, have you ever heard of someone referring to
24 hexagonal MOSFET cells as being truncated square cells?

25 A. Repeat your question.

1 Q. Yeah. Before your work in this case, have you
2 ever heard someone refer to hexagonal MOSFET cells as
3 truncated square cells?

4 MR. TIPESCU: Objection, form.

5 A. Sitting right here, I play with many different
6 type of layout and using different way to connect lines
7 to -- to make layout and with different -- many
8 different features.

9 So to the extent that I don't recall
10 directly, someone would say, hey, you know, hexagon is
11 -- is a square cell truncated, but -- but nonetheless,
12 it doesn't change the fact that in my opinion, hexagon
13 in light of Kobayashi could be viewed as a -- a square
14 cell with -- with corner truncated.

15 Q. (BY MR. SAUNDERS) All right. Can you turn to
16 the ''409 Patent? In particular Column 1, Line 48.

17 A. You said ''409 Patent?

18 Q. Yeah. ''409 Patent, Column 1, Line 48.

19 And do you see that it says, "There are
20 weak points of the MOSFET device due to" -- let me
21 restart. Withdraw that question.

22 Do you see that it says, "There are weak
23 points of the MOSFET device due the nonuniform space
24 between the square contact and the trench in the closed
25 cell"?

1 Do you see that?

2 A. Yes. I see -- I see the line that you just
3 read, yes.

4 Q. And going to Column 2, Line 3. Let me know
5 when you're there.

6 A. Okay.

7 Q. You see it says, "The purpose of the truncated
8 corners or the rounded corners of the gate trenches is
9 to make the space between the trench gate and the metal
10 contact more uniform in the closed cell to enhance the
11 device ruggedness."

12 Do you see that?

13 A. Yes, I do.

14 Q. And then let's go to Paragraph 69 of your
15 declaration, and let me know when you're there.

16 A. I'm there.

17 Q. So the rounding you identify in Figure 6C of
18 Kobayashi, that does not make the distance between the
19 gate and the contact more uniform, correct?

20 A. Re- --repeat your question again.

21 Q. Yeah. The rounding that you identify in Figure
22 6C of Kobayashi in Paragraph 69 of your declaration,
23 that type of rounding does not make the distance between
24 the gate and the contact more uniform, correct?

25 A. I disagree.

1 Q. Can you explain why.

2 A. Again, Paragraph 69 is -- is in context with 67
3 and 68. And I think we went through this. The fact
4 that I'm using 16 -- Figure 6C to show the rounding, my
5 -- I'm trying to show that, yes, rounding exists, and
6 rounding is three-dimensional.

7 So what you see in the cross section, you
8 also are going to see the rounding in the top view. So
9 if you refer to Figure 3A and Figure 4A of Kobayashi,
10 that corner -- the corner -- for example, in -- in -- in
11 Figure 3A, the corners are rounded; therefore, the
12 distance to the contact would be shorter.

13 In addition, the truncated of a square cell
14 through hexagon, you also reduce the distance to the
15 contact, and those corners are rounded because the
16 roundings are three-dimensional. It's not just -- it's
17 not just two in the cross sections. Those are on the
18 top view.

19 The fact that you have corner that rounds,
20 the corner -- again, corner rounding doesn't know it's
21 X, Y, Z orientation. It just -- it just knows that
22 there's a corner; and due to the process, including
23 photolithography, you will get rounded.

24 Q. The rounding -- the rounding you see in Figure
25 6C of Kobayashi, that can appear in Kobayashi's square

1 topology or its hexagonal topology, correct?

2 A. Repeat your question again.

3 Q. Yeah. Let me ask it a little bit differently.

4 The rounding you identified in Figure 6C
5 of Kobayashi in Paragraph 69 of your report, that
6 rounding can appear in both the square and the hexagonal
7 cell layouts, correct?

8 A. The round -- your question is that rounding can
9 appear in both square cells and hexagon -- a hexagon
10 cell?

11 Is that your question?

12 Q. Let me withdraw and ask it a slightly different
13 way.

14 Can you tell me what cell layout is used
15 in Figure 6C of Kobayashi.

16 A. In Figure 6C is irrespective of -- of the cell
17 layout because it's referring to a cross section, and
18 it's referring to the MOSFET disclosed by Kobayashi,
19 which would include -- if you look at Figure 3A as a
20 nontruncated square cell or you look at Figure 4A as a
21 truncated square cell, the rounded corner will show up
22 in both of them, in all three dimensions -- or, I should
23 say, all three orientation, no matter how you look at.
24 It will show up from top view because the corner of the
25 top view -- again, the corner of the top vie- -- from

1 the top view looking down will be rounded, and the side
2 wall will be rounded. The bottom will be rounded. X,
3 Y, Z direction will all be rounded.

4 So -- so the rounding described in 6C with
5 all three dimensions will be occurring and bo- -- in
6 both the cell in -- in -- in 4A as -- as well as in 3A.

7 Q. Now, Figure 6C is a step in a method for
8 producing the MOSFET depicted in Figure 5A of Kobayashi,
9 correct?

10 MR. TIPESCU: Objection, form.

11 A. Correct, in the sense that in the context, the
12 4A is also a cross section of both Figure 3A and Figure
13 4A.

14 Q. (BY MR. SAUNDERS) Yeah. I think you might
15 have misheard me because I think you said Figure 4A. So
16 let me reask the question again -- actually, let --
17 let's ask it a simpler way.

18 Let me point you to column -- Column 7,
19 Line 19. Do you see there? Let me know when you're
20 there.

21 A. In which patent?

22 Q. Kobayashi Column 7, Line 19.

23 A. I'm there.

24 Q. And do you see it says, "Referring to Figure 6A
25 through 6D, 7A through 7D, and 8A through 8C,

1 description will be made of a method for producing the
2 MOSFET in Figure 5A."

3 Do you see that?

4 A. Yes, I do.

5 Q. So Figure 6C is one step in one method for
6 producing the MOSFET that's shown in Figure 5A of
7 Kobayashi, correct?

8 A. That's correct. And I -- I believe I answered
9 your question correctly, as well. I did not misunder-
10 -- -understand your question.

11 And Figure 5A is a generic cross section,
12 and that is cutting through the A-A' in both Figure 3A
13 and Figure 4A.

14 Q. Now, Figure 6C doesn't --

15 A. Or Figure 4A -- sorry. I'm sorry. Figure 5A
16 applies to both Figure 4A and Figure 3A.

17 Q. Now, Figure 6C of Kobayashi doesn't show the
18 source contact or its trench yet, correct?

19 A. Let me go to the figure and -- and take a look.

20 Which figure are you referring to again?
21 Figure...

22 Q. 6C of Kobayashi.

23 A. I believe that's correct.

24 Q. Okay. Now, in Figure 5A of Kobayashi, the
25 source -- let me get this right. I'll withdraw. One

1 second.

2 In Figure 5A of Kobayashi, the source
3 contact is present at Element 17, correct?

4 A. I think the correct answer would be that 17 is
5 part of the source contact feature. In that sense,
6 that's correct.

7 Q. And in Figure 5A, the gates are Feature Number
8 8; is that correct?

9 A. I think the polysilicon of the gate feature is
10 8. That's correct.

11 Q. And so looking at Figure 5A of Kobayashi, could
12 you explain to me how the rounding you discuss in
13 Paragraph 69 of your declaration causes the distance
14 between the contact and the gate that are visible in
15 Figure 5A to become more uniform?

16 MR. TIPESCU: Objection, form.

17 A. You're looking at a cross section. You're not
18 looking into the picture of a three- --
19 three-dimensional. Similar, you would have to take
20 different cross section along different region to show a
21 -- just like in '409 Patent, when you have to -- when
22 you have to take a cross section between Figure 2A, for
23 example, 2B, 2C.

24 So you're not -- you're not -- you're not
25 -- you -- you are taking a snapshot, and you're not

1 showing -- showing the whole -- whole picture in the --
2 in -- in -- in the dimension going to the picture. And
3 plus there's a before-and-after. Right.

4 So -- so before rounding, so you're not
5 taking the whole cross section of -- of the picture.

6 Q. (BY MR. SAUNDERS) All right. Could you go to
7 the '409 Patent and turn to Claim 1.

8 A. Okay. I'm there.

9 Q. And do you see the first limitation after the
10 "Wherein" says, "said trenched gate surrounding said
11 transistor cells as closed cells constituting
12 substantially square-shaped cells with rounded corners"?

13 Do you see that?

14 A. Yes, I do.

15 Q. What does "cells" mean?

16 MR. TIPESCU: Objection, form. Relevance.

17 A. In the context of '409, where -- when you have
18 -- when you have a power device, it is made of
19 repeatable feature, so you're trying to demarcate one
20 unit that you use to repeat to get your power MOSFET.
21 And you -- you -- you call that unit -- perhaps you --
22 you call that unit a cell.

23 So it's just a way of demarcate. And --
24 and you can demarcate repeatable feature and just
25 somehow make that, and then -- and -- and that feature

1 could -- you could be repeated as -- and -- and make it
2 into your -- into your -- into your cell -- into your
3 final device.

4 Q. (BY MR. SAUNDERS) And what is Claim 1 of the
5 '409 Patent saying? What structure -- sorry. Let me
6 withdraw.

7 What structure in Claim 1 of the '409
8 Patent is the structure that has the rounded corners?

9 MR. TIPESCU: Objection, form.

10 A. I'm not sure I understand your question. I'm
11 sorry.

12 Q. (BY MR. SAUNDERS) Well, I guess, let's -- one
13 quick thing for reference.

14 Do you see on Page 29 of your declaration,
15 you refer to that portion, the claim I just read as
16 Limitation 1[a]?

17 A. Paragraph 29 on my declaration?

18 Q. No. Page 29 right above Paragraph 67.

19 A. Right above 67? And your question again.

20 Q. Per the language I just recently read to you in
21 Claim 1 of the '409, you see that you have that listed
22 as Limitation 1[a] in your declaration, right?

23 A. Okay.

24 Q. Okay. So you see that Limitation 1[a] of Claim
25 1 of the '409 Patent ends with the phrase "with rounded

1 corners," correct?

2 A. Okay.

3 Q. And do you see 1[a] also mentions "trenched
4 gates"?

5 You see that?

6 A. Yes, I do.

7 Q. And you see Limitation 1[a] also mentions
8 "transistor cells"?

9 A. Yes, I do.

10 Q. And do you see Limitation 1[a] also mentions
11 "closed cells"?

12 A. Yes, I do.

13 Q. And do you see Limitation 1[a] also mentions
14 "substantially square-shaped cells"?

15 A. Yes. The language there.

16 Q. So the various structures that are mentioned in
17 Limitation 1[a] of Claim 1 of the '409 Patent, which of
18 those is the one that is with rounded corners?

19 A. In the context of '409 Patent, it's the --
20 again, we have laid ourselves in an array. So as I
21 mentioned earlier, you have to be very careful. So in
22 the context of '409, the corner is the inner corner;
23 meaning that its inner corner to the contact.

24 So it's the -- the -- the polysilicon, and
25 it's the inner corner. So you -- as you earlier

1 mentioned, it's -- it's -- it's the polygate that
2 surrounds the -- the contact layer -- con- -- source
3 contact.

4 Q. If Force Mos introduces expert testimony that
5 says that it is the substantially square-shaped cells in
6 Limitation 1[a] that have the rounded corners, would you
7 disagree with such opinion?

8 MR. TIPESCU: Objection, form. And
9 relevance.

10 A. I have not -- you just asking me this question,
11 and this is first time I'm hearing this. And it's
12 not -- it's not consistent with the specification of
13 '409. So I'm hearing it first time, and I do not know
14 the context of the Force Mos expert's opinion.

15 So I will have to do more analysis and also
16 understand the analysis of the Force Mos expert before I
17 can render opinion.

18 Q. (BY MR. SAUNDERS) Why do you say that it's
19 inconsistent with the specification of the '409 Patent?

20 A. Because in the '409 Patent and from the
21 specification in the -- taken at a whole context, and
22 you also mentioned earlier, it's that distance between
23 the source contact to the gate edge. And it is that
24 feature -- that inner -- inner feature -- inner poly
25 feature that is -- that is the -- the rounded.

1 So right now, the question you asked,
2 somehow -- I do not know the context of the question you
3 ask, is substantially square-shaped cell with rounded
4 corner. And I -- I -- I -- do not know the context, and
5 I do not know how the Force Mos expert is parsing the --
6 the question.

7 So what I'm -- I'm saying is that it's
8 not -- it's not quite -- has been considered by both the
9 '409 Patent. And in my analysis -- I -- my analysis is
10 simply -- my analysis already describe, and -- and is
11 consistent with the specification, is the distance
12 between the polysilicon gate to the contact -- source
13 contact.

14 Q. Can you turn to Figure 3 of the '409 Patent,
15 and let me know when you're there.

16 A. I'm there.

17 Q. Does Figure 3 of the '409 Patent depict a
18 substantially square-shape cell with rounded corners?

19 A. Let me refer to the context of Figure 3.
20 Figure 3 says that, "The doped contact region 220 is
21 formed with a substantially circular shape, and the
22 trenched gate is formed with rounded corners."

23 Q. Let me ask the question this way: Is -- in
24 your view, is Figure 3 embodiment of the '409 Patent
25 covered by Limitation 1[a] of Claim 1 of the '409?

1 A. Repeat your question again.

2 Q. Yeah. Is Figure 3 of the '409 Patent an
3 embodiment covered by Limitation 1[a] of Claim 1 of the
4 '409 Patent?

5 MR. TIPESCU: Objection, relevance.

6 A. In the context of Figure 3 is a result of
7 Figure 2, the mask layout of Figure 2 into Figure 3.
8 And so the feature of rounded corner from truncating is
9 there, and but if I -- if I were to look at Figure --
10 Figure 2, going to Figure 3, if that similarly rectangle
11 feature is considered to be substantially square, then
12 perhaps I would agree that it's embodi- -- in -- in --
13 in the -- it's embodiment of claim limitation -- at
14 least part of the -- in part of the claim limitations in
15 Figure 1 -- in -- in Claim 1.

16 Q. (BY MR. SAUNDERS) Other than Figure 3 of the
17 '409 Patent, do any of the figures -- or let me
18 withdraw.

19 Other than the embodiment of Figure 3 of
20 the '409 Patent, is there any other embodiment described
21 or depicted in the '409 Patent of rounded corners?

22 MR. TIPESCU: Objection, form.

23 A. Repeat your question again.

24 Q. (BY MR. SAUNDERS) Yeah. So other than Figure
25 3 of the '409 Patent, is there any embodiment depicted

1 or described in the '409 Patent having rounded corners?

2 MR. TIPESCU: Objection, form.

3 A. I will have to go through the -- the whole
4 specification to look through it, but it says,
5 "Referring to Figure 3 for another embodiment of this
6 invention."

7 So and in that context, there's -- there's
8 -- in the context specification figure -- figure --
9 (coughing) -- excuse me. Figure 3, at least for the
10 gafe -- gate feature is a -- is a result of -- of
11 truncating in Figure 2 with the exception of the
12 contact. So that -- that shows a rounded corner.

13 Q. (BY MR. SAUNDERS) Can you turn to figures --
14 the -- the -- the sheet that has Figures 3A through 3D
15 of the '409 Patent.

16 A. I'm there.

17 Q. And those are cross section of the MOSFET
18 depicted in Figure 3 of the ''409 Patent; is that right?

19 A. Yes. I believe so.

20 Q. And do you see any corner rounding visible in
21 the cross sections of Figure 3A through 3D of the ''409
22 Patent?

23 A. Repeat your question again.

24 Q. Yeah. In the cross sections Figure 3A through
25 Figure 3D of the ''409 Patent, do you see any rounded

1 corners?

2 MR. TIPESCU: Objection, form.

3 A. No. Figure 3A through D is just the rendition
4 trying to show the distance as you go taking different
5 cross section. I don't think you're trying to
6 faithfully produce all the features of the -- of the --
7 of the cross section, all -- al the features you will
8 see in the cross section; therefore, I don't believe --
9 even if the rounding is there, I don't believe this will
10 be faithfully reproduced in those figures because those
11 figures are only trying to convey certain feature.
12 They're not trying to convey accurately every feature.

13 Q. (BY MR. SAUNDERS) So sitting here right now,
14 you don't see rounded corners in Figures 3A through 3D
15 of the ''409 Patent, correct?

16 MR. TIPESCU: Objection, form.

17 A. Sitting here, the illustration does not -- may
18 or may not faithfully represent the corner that might be
19 rounding in all three dimensions. The figure, it just
20 -- again, it's just a -- a rendition trying to
21 illustrate a key point.

22 In this case, it's trying to illustrate the
23 distance between the two gate -- between the gate and --
24 and with the -- with -- in some certain circumstances,
25 it has contact. Some it doesn't. But it's not trying

1 to represent the feature of the trench or the feature of
2 the trench with corner in all three dimensions.

3 Q. (BY MR. SAUNDERS) All right. Can you turn to
4 the sheet of the ''409 Patent that has Figures 2A
5 through 2C.

6 A. I'm there.

7 Q. Okay. What are these figures?

8 A. Let me go to the specification. According to
9 contact -- according to the specification, these figures
10 are different location of cross section of a truncated
11 cell as shown in Figure 2.

12 Q. And in Figures 2A --

13 A. Wait. I'm sorry. I'm sorry. I should mention
14 that it's a mask layout. Figure 2 is a mask layout.

15 Q. Now, Figure 2A shows you source and body
16 regions, right?

17 A. Okay.

18 Q. You agree with that, right?

19 A. I agree there's a label that points to a region
20 that's called source and a label in the re- -- point to
21 region that's called P-body.

22 Q. And the mask itself wouldn't have source and
23 body regions on it, right?

24 MR. TIPESCU: Objection, form.

25 A. Which is why the figures are not meant to be

1 showing all the aspect -- of every aspect and -- in all
2 -- all time sequence. It clearly says right here Figure
3 2A and 2B and 2C show three cross sections, no view of
4 the semiconductive power cell along A-A', B-B', and
5 C-C'. It's not showing Figure 2.

6 Okay. So Figure 2 is a layout, so they're
7 trying to say, "if I have this layout. And this will be
8 the cross sectio."

9 Q. (BY MR. SAUNDERS) So Figure 2C corresponds to
10 the cross section in Figure 2 on the Line C to C prime;
11 is that correct?

12 A. Yes. It appears so.

13 Q. And in Figure 2, the measurement W3 has the --
14 the measurement of where the Line C to C prime
15 intersects the gate trenches; is that correct?

16 A. Repeat again, please. I'm sorry.

17 Q. Well, let me ask it this way: What is W3
18 measuring in Figure 2 of the '409 Patent?

19 A. I believe measure the spacing between --
20 between the gate edge.

21 Q. At the Line C to C prime?

22 A. That's correct.

23 Q. Okay. And when you go to Figure 2C, you see
24 that same W3 measurement; is that correct?

25 A. 2C? You said 2C?

1 Q. Yeah.

2 A. Yes.

3 Q. And so does that fact that the same W3
4 measurement appears -- actually, let me withdraw.

5 In Figure 2C, W3 is also measuring the
6 distance between the gates, correct?

7 A. Re- -- repeat your question again. In figure
8 what?

9 Q. In Figure 2C, W3 is also measuring the distance
10 between the gates, correct?

11 A. Figure 2C?

12 Q. Yeah.

13 A. Figure 2C is the distance between W3 as shown
14 in figure cross section C-C' prime.

15 Q. And so does the fact that it's the same W3
16 distance in Figure 2 and Figure 2C indicate to you that
17 the cross section Figure 2C is the result of a mask
18 layout of Figure 2 without any subsequent rounding?

19 A. Repeat your question again.

20 MR. TIPESCU: Objection, form.

21 Q. (BY MR. SAUNDERS) Yeah. Does the fact that
22 you have the same W3 measurement for C to C prime in
23 Figure 2, as you have in Figure 2C, indicate to you that
24 the cross section of Figure 2C is the result of
25 implementing the mask layout of Figure 2 without any

1 subsequent rounding?

2 MR. TIPESCU: Objection, form.

3 A. Well, I -- I'm -- I'm sorry. I have -- I have
4 a hard time processing your question. I don't
5 understand your question. Figure --

6 Q. (BY MR. SAUNDERS) So --

7 A. Figure 2A to 2C -- maybe I should let you ask
8 the question. Yeah. I don't understand the question.
9 I'm sorry.

10 Q. So let me step back.

11 It's your opinion that Figure 2 depicts the
12 mask layout, correct?

13 A. I think the fact that it says "mask layout"
14 leads me to believe that it is depic- -- depicting a
15 mask lay- -- mask layout.

16 Q. And so if you implemented the mask layout of
17 Figure 2 and there was subsequent rounding of the
18 corners, the distance between the gates at C to C prime
19 would change from the distance W3 in Figure 2, correct?

20 MR. TIPESCU: Objection, form.

21 A. Can you clarify what -- what do you mean by
22 "implement"?

23 I -- I believe, based on what I just read
24 to you, that Figure 2A through 2C is a-cross section
25 taken, trying to illustrate what's in Figure 2, which is

1 a mask layout.

2 So we're looking at a cross section of a
3 mask layout. And all these other things is trying to
4 show us that -- that that's where the mask position
5 respect to each other will be, and I -- I don't -- there
6 -- there -- there -- it may not be -- I don't know --
7 understand the word "implementation" -- after
8 "implementation."

9 Q. (BY MR. SAUNDERS) Okay. So by
10 "implementation," I mean use the mask layout to
11 fabricate a MOSFET.

12 With that clarification in mind, do you
13 have further elaboration?

14 MR. TIPESCU: Objection, form.

15 A. I still -- first of all, I still don't believe
16 Figure 2 -- 2-- 2A through 2C would be what you see in
17 Figure 2 after implementation, there are indication that
18 it may not be, so -- so I cannot make that assumption
19 that -- that Figure 2A through 2C is after implementing.

20 I assume when you say "implementation," you
21 mean after processing. And I do not -- I do not have
22 the confidence that's the case.

23 Q. (BY MR. SAUNDERS) In your prior answer, you
24 referred to "a cross section of a mask layout."

25 What is "a cross section of a mask

1 layout"?

2 A. What I'm trying to say in that context is that
3 this is trying to show -- you have layout. You have
4 respective layout. You have contact. And you have
5 polysilicon gate. And based on the position of this
6 mask, you're trying to produce a rendition where the
7 location by design of each of these should be, but
8 that's not necessarily the same after -- as after
9 implementation.

10 For example -- let me give you an
11 example. There will be -- there will be process
12 variation and everything by -- by cross. So the fact
13 that you have these things and they're perfectly aligned
14 to be the same number, even in printing -- even -- even
15 in printing a dimension, you're going to have variation.
16 It's not going to be the -- the hundred percent
17 accurate.

18 So -- so the fact that you're -- you're
19 showing me this and you're saying, "Oh. W3 here is
20 saying this. The W3 there, that shows that after
21 implementation, there's no rounding," I cannot make that
22 jump as a person of ordinary skill in the art.

23 Q. Does the phrase "rounded corners" have an
24 established ordinary meaning in the field of
25 semiconductors?

1 A. I think prior to the '409 Patent, as the first
2 Prior Art reference show, a corner -- a corner after
3 going through process will be rounded, and you can call
4 that a rounded corner, and in my claim construction
5 offering that, that is the Prior Art.

6 So according to the context of '409 Patent,
7 a rounded corner should be cornered. They are truncated
8 by design and -- (coughing) -- excuse me. Let me go to
9 the -- my claim construction.

10 So "rounded corner" means corners that are
11 truncated by design and subsequently rounded by
12 lithography, so in that context, this -- the -- this
13 context of rounded corner based on the claim -- based on
14 my claim construction of '409 Patent.

15 Q. Prior to your work on Force Mos matters, have
16 you heard of the phrase "rounded corners" in connection
17 with the field of semiconductors?

18 A. Yes, I have.

19 Q. And --

20 A. The different terms -- for example, the -- the
21 "Corner are rounding" or "Corner are rounded" and --
22 and, therefore, "rounded corner" -- yes, I have.

23 Q. Do you remember in which context you've heard
24 that term?

25 A. Sitting right here, the first - the more

1 prominent case I can think of is when -- when the gate
2 is overlapping and active, and there's a special design
3 limit that needs to be made because the corner will be
4 rounded -- because the corner are rounded.

5 If you don't give enough margin of the gate
6 overlapping the -- the accurate region when it rounds,
7 you may actually cause transition to be shorted.

8 Q. Was that a particular --

9 A. It's in context of a -- of a CMOS transistor.

10 Q. Was -- you remember what particular CMOS you
11 were talking about?

12 A. I'm just giving a illustration of one of the
13 example to show that, yes, in a feature, the corner will
14 be rounded. Well, you will have rounded corners.

15 Q. Outside of the disclosures of the '409 Patent,
16 what does "rounded corners" mean in the field of
17 semiconductors?

18 MR. TIPESCU: Objection, form.

19 A. Repeat your question again.

20 Q. (BY MR. SAUNDERS) Yeah. Outside of the
21 disclosures of the '409 Patent, what does the term
22 "rounded corners" mean in the field of semiconductors?

23 MR. TIPESCU: Again, objection, form. And
24 relevance.

25 A. It just means that when you're trying to

1 reproduce a feature, that could be a -- a -- a 90-degree
2 angle or even acute angle less than 90-degree or even
3 more than 90-degree.

4 The -- there will be -- when you reproduce
5 it through the process, going through the lithography,
6 going through oxidation, going through etching, going
7 through the process, that corner will not -- the corner
8 will see rounding just like, you know, '409 Patent.

9 The contact -- it says clearly that a
10 contact feature will have rounded corner. So the -- the
11 -- the edges will get rounded. The corners will get
12 rounded.

13 Q. (BY MR. SAUNDERS) Does the degree of rounding
14 of corners in a semiconductor depend on process steps
15 after photolithography?

16 A. Repeat your question again.

17 Q. Yeah. Does the degree of rounding of a corner
18 in a semiconductor depend on process steps that occur
19 after photolithography?

20 MR. TIPESCU: Objection, form.

21 A. Typically, we -- we -- we use pho- --
22 photolithography as a module. The -- the reason you
23 have photolithography is you're trying to introduce or
24 remove selected region with different material. Okay.

25 So to that extent, when you have a feature

1 and -- just like lithography, just it's all physics.
2 When you have a feature that is not infinitely linear,
3 because infinitely linear, everything will be the same.

4 But anytime you have a -- a bending or
5 meaning the line, whether you have a -- anytime you have
6 a corner, inevitably, the physics, including oxidation,
7 including echi- -- etching, will always have a
8 preferential degree, such that the corner will behave
9 slightly different from an infinite straight -- straight
10 line.

11 So to that extent, to answer your
12 question, lithography is one that will cause the corners
13 to be rounded. The other process step that will also
14 preferentially -- will have preferential action based on
15 the shape or the feature of the corner.

16 Q. (BY MR. SAUNDERS) Is one of those aspects the
17 process step which type of etching you use to create a
18 -- a trench?

19 A. It may be, but for example, oxidation --
20 oxidation step certainly is a -- is a -- is a -- is --
21 is corner sensitive, and -- among other stuff.

22 Q. Let me mark a new exhibit.

23 (Exhibit 2011 marked.)

24 Q. (BY MR. SAUNDERS) All right. I'm introducing
25 Exhibit -- it's been marked Force Mos 2011. It's Claim

1 Construction Order from Case Number 2:22-CV-00460 in the
2 United States District Court for the Eastern District of
3 Texas, Marshall Division.

4 Do you see that document on Exhibit Share
5 now, Dr. Liu?

6 A. Yes, I do.

7 Q. (BY MR. SAUNDERS) And I -- I believe you
8 testified that you saw that document for the first time
9 yesterday during your deposition?

10 A. Yes. That's correct.

11 Q. Can you go to Page Number 28 in the Claim
12 Construction Order.

13 A. Counsel, just -- just like yesterday, when I
14 saw this for the first time, this is referring to a
15 District Court; is that correct?

16 Q. That's correct.

17 A. And I think I'm here to testify regarding the
18 IPR, and -- which is not -- I'm not involved in the
19 District Court case.

20 Q. I understand, Dr. Liu. And, you know,
21 obviously, the -- the board in this case may adopt what
22 claim construction it chooses, and I expect that it --
23 pursuant to the board's rules, it will look at this
24 District Court's claim construction.

25 So I want to understand what points that

1 you agree or disagree with the District Court's claim
2 construction.

3 You understand that?

4 MR. TIPESCU: Objection, relevance. And
5 form.

6 Q. (BY MR. SAUNDERS) Dr. Liu, are you on Page 28
7 of the Claim Construction Order?

8 A. Yes, I am.

9 Q. And do you see that there's a table with a row
10 for rounded corners, and it has "Plaintiff's Proposal"
11 and "Defendant's Proposal"?

12 A. Yes, I do.

13 Q. And do you see that Defendant's Proposal for
14 rounded corners is the same proposed construction that
15 you have in your Claim construction declaration in this
16 IPR?

17 A. By -- that appears to be the case, yes.

18 Q. And turning to Page 30, you see the first full
19 paragraph on that page?

20 A. Okay.

21 Q. You see it says, "Defendant incorrectly argues
22 that rounded corners must be truncated by design layout
23 and then rounded."

24 You see that?

25 A. I see that opinion rendered by the Court, yes.

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1 Q. And do you see the next sentence says,
2 "Contrary to Defendant's argument, all the cited
3 portions are in passages that discuss the process for
4 manufacturing or manufacturing process"?

5 Do you see that?

6 A. Again, I'm seeing that. I'm -- I'm -- I'm -- I
7 don't have time to digest that. I'm just see -- I -- I
8 just agreed to that I'm seeing that right now.

9 Q. In your IPR in this -- sorry. In your
10 declaration submitted in this IPR, you are also relying
11 on portions of the '409 Patent that discuss the process
12 for -- process for manufacturing or manufacturing
13 process to reach your conclusion that the term "rounded
14 corners" has to be corners that are truncated by design
15 layout, correct?

16 A. Repeat your question again.

17 Q. Yeah. So isn't it true that your opinions in
18 this IPR regarding the appropriate construction of
19 rounded corners are based on passages of the '409 Patent
20 that discuss a process or manufacturing or manufacturing
21 process?

22 MR. TIPESCU: Objection, form.

23 A. I believe it's more than that. I -- I -- in
24 reaching the opinion, there's a progression I go
25 through, including the Prior Art, including the

1 specification, including the filing history.

2 And given that the Prior Art reference of
3 Pfirsch already has rounded corner and to distinguish
4 it, so there- -- therefore, that's how I form my
5 opinion. But my opinion is not simply formed by just --
6 just what you cited just now.

7 Q. (BY MR. SAUNDERS) Let's go to Paragraph 57 of
8 your declaration.

9 Let me know when you're there.

10 A. Okay. 57.

11 I'm there.

12 Q. And in that -- that's the portion of your
13 declaration addressing the claim construction rounded
14 corners where you discuss the Pfirsch reference,
15 correct?

16 A. First reference? Can you -- first -- what are
17 you referring to "first reference"? Oh, Pfirsch --
18 Pfirsch reference.

19 Q. Yeah. P- -- P-F-I-R-S-H [sic].

20 A. Okay. Sorry. I thou- -- I thought you meant
21 first -- yeah, Pfirsch reference. That's correct, yes.

22 Q. Or, actually, P-F-I-R- --

23 A. -S-C-H.

24 Q. -- -S -- P-F-I-S-R-C-H [sic].

25 So let me ask the question again, to be

1 clear.

2 Paragraph fifty-sec- -- 57 of your
3 declaration's a portion of your declaration where you
4 address the Phirsch reference in connected with your
5 claim construction opinions regarding the term "rounded
6 corners," correct?

7 A. That's correct.

8 Q. And at the end of that Paragraph 57, you have a
9 quote that says, "The Phirsch has a closed cell with
10 square trench gate with rounded corner as shown in
11 Figure 2 in Phirsch."

12 Do you see that?

13 A. Yes, I do.

14 Q. And you're citing to the file history of the
15 '409 Patent; is that correct?

16 A. I believe that's correct.

17 Q. And let me just introduce that.

18 And it's your opinion that that -- that
19 sentence you have at the end of Paragraph 57
20 demonstrates that the claim term "rounded corners" was
21 added to distinguish the '409 Patent from the Phirsch
22 reference; is that correct?

23 A. Can you repeat your question again.

24 Q. Yeah. So you have two sentences in
25 Paragraph 57 of your declaration. The first sentence

1 says, "I also understand that Claim 1 was amended during
2 prosecution. I understand that the claim term 'rounded'
3 corners" was added to distinguish the '409 Patent from
4 the Pfirsch reference shown below."

5 Do you see that?

6 A. Yes.

7 Q. And then you have a second sentence that you
8 then quote from Exhibit 1002 in Paragraph 57, correct?

9 A. That's correct.

10 Q. And that second sentence is supposed to
11 demonstrate that the -- the -- that the Claim 1 was
12 amended to add rounded corners to distinguish the
13 Phirsch reference?

14 A. I -- I'm -- (audio distortion.) I'm -- hard
15 time under- -- understanding your question and -- and
16 understanding the -- the -- the history. I -- rounded
17 corner, the -- can you repeat again.

18 The patent application initially had the --
19 had rounded corner, right?

20 Q. Well, I'm just reading what you have, but I
21 guess my question -- maybe I'll ask the question this
22 way:

23 What's the connection between the first
24 sentence in Paragraph 57 of your declaration and the
25 second sentence of Paragraph 57?

1 A. At the time, and -- looking at file history,
2 the connection between the first sentence and second
3 sentence is that because Phirsch reference was cited,
4 and it was rejected. Claim 1 and Claim 13, as -- as
5 given, were rejected due to the Phirsch IR, as being
6 anticipated by Phirsch.

7 Q. Is now a good time for another break, Dr. Liu?

8 A. Sure.

9 MR. SAUNDERS: All right. Let's go off the
10 record.

11 THE VIDEOGRAPHER: The time is 12:33.
12 We're off the record.

13 (Break taken from 12:33 p.m. to 12:45 p.m.)

14 THE VIDEOGRAPHER: The time is 12:45.
15 We're back on the record.

16 Q. (BY MR. SAUNDERS) All right. Dr. Liu, can you
17 turn back to Paragraph 68 of your declaration.

18 Paragraph 68 of the -- your declaration,
19 you're citing Figure 4A of Kobayashi, correct?

20 A. Yes, that's correct.

21 Q. Is Figure 4A of Kobayashi depicting a mask
22 layout?

23 A. Let me use -- go to Kobayashi. I don't want to
24 -- according to the -- the description of the figures in
25 Kobayashi, these are layout, yes. That's correct.

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1 Q. And would Figure 3A of Kobayashi also be a
2 layout of -- sorry. Let me withdraw it -- Figure 3A of
3 Kobayashi be a mask layout?

4 A. Again, the language Kobayashi uses that Figure
5 3A and 3B are plain view, showing cell layouts in a
6 vertical MOSFET according to this invention. And with
7 respect to Figure 4A, it says, "Plain view showing
8 different cell layouts."

9 Q. So do you understand that to be the layout of a
10 mask or the layout of the device as it will look after
11 fabrication?

12 A. I will understand it as mask layout not after
13 fabrication.

14 Q. So assuming you're starting with the mask of
15 Figure 3A of Kobayashi, how would the cell layout look
16 different after fabrication?

17 A. First, I'd like to say that the -- according to
18 the -- Kobayashi, the contact itself could be round- --
19 rounded contact evening the layout, but we actually said
20 that specifically. It could be hexagon contact layout
21 or -- or -- or circular contact layout.

22 Keeping that aside, the -- supported by
23 the -- by my -- my showing in Figure 6C of Kobayashi,
24 there will be rounding -- rounding in all dimensions, X,
25 Y, Z.

1 So applying that to Kobayashi Figure 3A, if
2 I look at it, I will see that the corner of that cell
3 will be rounded, and depending on what kind of source
4 contact layout you use, you will also be rounded --
5 rounded to such -- such a degree that you will have
6 circular contact, source contact depending on the
7 dimension, also depending on the layout with the
8 contact. You will -- you'll have circular contact, and
9 you're also going to have rounded corner in -- in the --
10 in -- in the feature of the cell in...

11 Q. You'd agree with me that Kobayashi's Figure 3A
12 depicts the same layout as Figure 1[a] of the '409
13 Patent?

14 A. Let me look at the '409 Patent. I'm sorry I'm
15 coughing more. So maybe in this round, we'll go a
16 little shorter before our lunch break. Yeah.

17 Repeat your question again.

18 Q. Yeah. So Figure 3A of Kobayashi depicts the
19 same layout as Figure 1[a] of the '409 Patent, correct?

20 A. I will say similarly -- I -- I don't know the
21 word "same" connotation, the word "same," but I will say
22 that very similar layout.

23 Q. Can you observe any differences in the layout
24 between Figure 3A of Kobayashi and Figure 1[a] of the
25 '409 Patent?

1 A. Repeat your question again.

2 Q. Yeah. You mentioned the -- that they had --
3 that Figure 3A and -- of Kobayashi and Figure 1[a] of
4 the '409 Patent had similar layouts.

5 And I asked you, could you observe any
6 differences in the layout of Figure 3A of Kobayashi and
7 the layout of Figure 1[a] of the '409 Patent?

8 A. First of all, they are showing different
9 thing -- showing different -- in a different view. For
10 example, in the Figure 3A of Kobayashi, the gate feature
11 is actually anything that's not drawn that's the gate
12 feature. I don't know if you know what I mean. Okay.

13 So the gate e- -- gate feature is -- is
14 actually the -- the -- the thing that goes behind -- be-
15 -- between the big square; whereas in -- in -- in Figure
16 1[a], it's trying to demarcate a region by cutting --
17 demarcate a region to show the actual unicell.

18 So I will -- I will say that I label on --
19 in the label of Figure 3A, that unicell, you can see
20 that the polygate feature is much, much more narrow
21 because somehow the Figure 1 -- 1[a] seems to have moved
22 the polygate to be much, much wider.

23 But -- but you can see that the actual
24 unicell, the polydimension is actually relatively to the
25 -- to the contact. It's -- it should be -- it should be

1 relative to the half size of the contact, not the whole
2 size of the contact.

3 Does that make sense?

4 Q. Yeah.

5 Any other differences you observe?

6 A. They both seem to be -- and I don't -- this is
7 not a difference. They both seem to be rectangular --
8 substantially rectangular or substantially square --
9 square feature.

10 Q. Anything else?

11 A. I think that's about it.

12 I'm sorry. Can -- can you hear my
13 previous answer?

14 Q. Yes, I could. I'm -- I'm --

15 A. Sorry.

16 Q. -- contemplating my next question. Thank you.

17 A. Okay. Let's go to Paragraph 80 of your
18 declaration.

19 Paragraph 80 of your declaration. So
20 Paragraph 80 of your declaration addresses Kobayashi
21 compared to Claim 5 of the '409 Patent, which recites a
22 -- "a diameter of a top surface of said circular trench
23 contact is smaller than 1.0 micrometer."

24 Do you see that?

25 A. Yes, I do.

1 Q. Now, you don't opine that the written text of
2 Kobayashi expressly provides a measurement for the
3 diameter of the circular trench contacts in Kobayashi,
4 correct?

5 MR. TIPESCU: Objection, form.

6 A. Can you repeat your question again.

7 Q. (BY MR. SAUNDERS) Yeah. You don't opine that
8 any of the written disclosures of Kobayashi specify that
9 the top surface of Kobayashi's circular trench contact
10 is smaller than 1.0 micrometers, correct?

11 MR. TIPESCU: Objection, form.

12 A. Although -- at the time of -- although I may
13 not -- may not have an explicit number for the contact
14 trench, but I did provide a reference, and that
15 reference is that the width of the gate trench is half a
16 micron -- I mean, it's -- it's a half micron. It's not
17 greater than half a micron. Okay.

18 Given this -- this thing called "aspect
19 ratio," meaning that in order to fill a trench, you will
20 prefer that aspect ratio not to be too wide, and given
21 that the contact -- source contact is shorter in
22 vertical depth compared to the gate -- the -- the gate
23 trench, based on the aspect ratio, if the gate width,
24 the gate trench width is not greater than half a micron;
25 and given the aspect ratio, using that as the

1 calibration point and knowing the process flow of -- for
2 etching the trench and filling the trench, it is -- give
3 me one second.

4 And given the reference in -- in the
5 figure, it is disclosed by Kobayashi that that
6 limitation, that the -- the width of the trench cannot
7 be greater than 1 micron. In fact, I don't want to go
8 too much, but it's not too much to say that it cannot
9 even be greater than half a micron.

10 Kobayashi expressly shown and expressly
11 given calibration point, which is the polywidth,
12 disclose that; and there- -- therefore, Ko- -- Kobayashi
13 disclosed that based on the consideration, based on the
14 illustration, based on the, as I mentioned, aspect ratio
15 of a trench and the necessity of filling a trench and
16 given the fact Kobayashi disclosed this limitation, that
17 it's no greater than 1 micron.

18 Q. (BY MR. SAUNDERS) Now, so let me just clarify.
19 So the bottom of Figure 80, you have an annotated --
20 sorry. Let me withdraw.

21 At the bottom of Paragraph 80 of your
22 declaration, you have an annotated version of Figure 5A
23 of Kobayashi, correct?

24 A. That's correct.

25 Q. And you've annotated it with measurements from

1 the ridden -- description of Kobayashi that you cite to
2 in Paragraph 80, correct?

3 A. That's correct.

4 Q. And in Figure 5A of Kobayashi, Element 17 would
5 be the trench contact, correct?

6 A. 17 would be the -- 17 will be part of the
7 feature of a trench contact. That's correct.

8 Q. Now, is there any way to know whether Figure 5A
9 -- sorry. Withdraw.

10 Is something in Kobayashi telling you
11 that the Element 17 depicted in Figure 5A is a circular
12 trench contact, as opposed to a square-shaped trench
13 contact?

14 A. Again, Figure 5A is a cross section. So in --
15 in Figure 5A, the fact that Kobayashi in his teaching --
16 let me try to find the reference for you, the citation.

17 So Kobayashi says in his implementation,
18 referring to all the different cells, there is layout of
19 a cells that a MOSFET may have various layout of he
20 cell; specifically cited 3A and the -- and 4A.

21 He says, "The contact holes may have any
22 desired shape" -- I'm sorry -- I'm reading off Column 6,
23 starting with Line 37.

24 "The contact holes may have any desired
25 shape, such as a square shape, a hexagonal shape, an

1 octagonal shape, and a circular shape." Okay. "If
2 contact holes is sufficiently small, the contact holes
3 has a generally circular shape without any angle,
4 although, depending upon the resolution of the
5 photolithography."

6 So in the cross section shown in Figure
7 5A, it could be any of the shape, including the circular
8 shape contact, and -- and again, this is a -- a
9 cross-sectional cut. Assuming it's just cutting, we
10 don't even know. It's cutting through the diameter or
11 cutting through right in the diameter; but a --
12 sufficient to say that this -- this would include all --
13 all contact, including circular -- circular contacts.

14 Q. If Figure 5A depicted -- or withdraw.

15 If Figure 5A of Kobayashi depicted a
16 square contact, then the width of Element 17 would be
17 different if the cross section was through the corners
18 of a square contact, as opposed to the sides of the
19 square contact, correct?

20 MR. TIPESCU: Objection, form.

21 A. Repeat your question again.

22 Q. (BY MR. SAUNDERS) Yeah. So if -- if Figure 5A
23 of Kobayashi was depicting a cross section through an
24 embodiment using a square-shaped contact, then the width
25 of Element 17 would be different depending on whether

1 that cross section was passing through the corners of
2 the square contact, as opposed through the sides of the
3 square contact, correct?

4 MR. TIPESCU: Objection, form.

5 A. I think in my earlier testimony, I already
6 showed that the cross- -- where the cross section was
7 taken in both Figure 4A and -- and both Figure 4A and
8 Figure 3A. And 5A represents where the cross section is
9 taken.

10 And I'm -- I'm -- my testimony's -- is
11 taken across a diameter. I'm just only -- I'm referring
12 to that -- when you take cross section, you don't -- you
13 don't necessarily see the features, whether the circular
14 or hexagonal or rectangle. But Kobayashi made it simple
15 for us. He's taking the cross section across the
16 center, across a diam- -- a diameter, also across the --
17 the polygate and -- as shown in Figure 3A and the Figure
18 4A.

19 Q. (BY MR. SAUNDERS) Is there a disclosure in
20 Kobayashi that the length of the sides of the
21 square-shaped contacts is identical to the diameter of
22 the circular-shaped contacts of Kobayashi?

23 A. Repeat your question again.

24 Q. Is there a disclosure in Kobayashi that the
25 length of the sides of the square-shaped contacts are

1 identical to the diameter of the circular-shaped
2 contacts?

3 MR. TIPESCU: Objection, form.

4 A. When you talk about the contact in -- in -- in
5 this kind of situation, you are always talking about
6 what you need to do with respect to that contact and
7 what you need to do respect to the overall dimension as
8 calibrate to other feature. I mention aspect ratio
9 because you have to fill this contact. Right. I had
10 also mentioned that the -- the -- the cell layout --
11 unicell layout.

12 So -- so in that -- in that feature, in
13 that case, you have to disclose -- you have to show in
14 -- in our field when we do the layout, we -- we say
15 contact is .5 -- .5 micron or contact's .3 micron, we
16 meant that the -- the width of the square, the width
17 across -- across -- across that contact.

18 And even if we do a circular contact, we'd
19 refer to diameter. You're not going to refer to a
20 little slice -- little slice of a -- of a -- of a edge
21 of a circle and say, "Oh," I -- "I'm going to design a"
22 con- -- "contact .1 micron." You're going to confuse
23 people. You're going to ruin layout. That's -- you're
24 going -- you're going to cause people to do layout
25 that's going to be totally erroneous and cause waste of

1 money, waste of manufacturing, waste of time.

2 And so when we talk about layout, when we
3 talk about contact, it is always the -- the widest point
4 of a contact because that's the minimum -- that's the
5 design rule. You have to fit into the cell to calculate
6 the budget of your cell, to ca- -- calculate the cell
7 size. And in the case of 409 A, you need that
8 dimensionally to calculate the A and B point.

9 So -- so I think the question of -- of is
10 it -- when I talk about contact sizes, am I talking
11 about the width or di- -- or diameter? I think that
12 question is -- is -- is -- it's a -- it's -- I don't
13 believe that's the question posed. I -- I don't believe
14 that that's a question that will be disclosed in -- in a
15 patent.

16 The patent clearly show -- Kobayashi shows
17 that -- disclosed clearly, the trench, its width is less
18 than .5 micron. Okay. Trench width, so that means the
19 -- the dimension, the maximum dimension of the trench --
20 trench micron, the width, not -- not some rounded
21 corner, the width, as cross section A-A'' shown in
22 Figure 3A and -- and -- and the 4A.

23 And then in relations to that, use that as
24 calibration point, Kobayashi clearly disclosed that,
25 "Look, this is my trench gate with certain aspect ratio,

1 and this is my contact -- source contact with a
2 different aspect ratio."

3 If you're taking to aspect ratio, that
4 means that that -- Kobayashi clearly disclosed that the
5 dimension of the contact -- you call it a whole or
6 contact width -- cannot be greater than .5 micron, much
7 less than 1.0 micron.

8 Q. (BY MR. SAUNDERS) There's no expressed
9 disclosure in Kobayashi that the square contacts have
10 the same width as the circular-shape contacts, correct?

11 MR. TIPESCU: Objection, form.

12 A. Repeat your question again.

13 Q. (BY MR. SAUNDERS) There's no expressed
14 disclosure in Kobayashi that the square-shaped contacts
15 have the same width as the circular-shaped contacts,
16 correct?

17 MR. TIPESCU: Again, objection, form.

18 A. I disagree with that because eventually
19 Kobayashi disclosing that this contact needs to be
20 filled, and to fill the contact with a given aspect
21 ratio. So the dimension that you worry about is always
22 the dimension that's spent across the contact because
23 that's how you conformally deposit a tungsten layer by
24 layer 'til the point where the trench is filled.

25 So in -- Kobayashi effectively discloses

1 that given all these figure, given the aspect ratio,
2 given the -- the dimension using as calibration point
3 for the trench width, Kobayashi discloses the width of
4 the source contact is less than one -- 1 micron.
5 Actually, is even less than .5 micron, but definitely
6 less than 1 micron.

7 Q. (BY MR. SAUNDERS) Can you give me a citation
8 to a place in Kobayashi that you believe expressly
9 discloses that the width of the square-shaped contacts
10 is the same as the width of the circular-shaped
11 contacts?

12 MR. TIPESCU: Objection, form.

13 A. The fact that they use the same picture for
14 both 4A and 3A is an indication that they're not trying
15 to have different size of the width of square contact
16 versus the size of the circular contact.

17 Q. (BY MR. SAUNDERS) Anything else?

18 MR. TIPESCU: Object. Same objection as
19 before.

20 A. Look, I believe the -- the -- I think -- I
21 think my opinion render, and -- and -- and I think is --
22 is -- is -- it's -- it's perfect in the sense that Ko-
23 -- the way that Kobayashi describes it, the way he -- he
24 -- he calibrates it with a gate trench and the way that
25 Figure 5A is depicting both Figure 4A and the Figure 3A,

1 I think it's very clearly that Kobayashi explicitly dis-
2 -- disclosed that -- that means and limitation of Claim
3 5, which is that circular trench contact is smaller than
4 1.0 micron.

5 I -- I don't know why we're comparing
6 square contact and -- and circular contact. But respect
7 to Figure 4A and being represented by Figure 5A and
8 respect -- that's a circular contact. And in -- and in
9 -- in -- in the contacts of the gate trench depth and
10 the aspect ratio, sufficed to say that Kobayashi clearly
11 discloses that the circular trench contact is smaller
12 than 1.0 micron. And that's being conservative.

13 Q. (BY MR. SAUNDERS) You'd agree with me that the
14 gates in Kobayashi are filled with a different material
15 than the source trenches or -- or, sorry. Let me
16 withdraw.

17 You'd agree with me that the gr- -- gate
18 trenches in Kobayashi are filled with different material
19 than the source contact trenches; is that correct?

20 A. Repeat your question again.

21 Q. Yeah. The g- -- the gate -- the gate trenches
22 in Kobayashi are filled with different material than the
23 source contact trenches in Kobayashi, correct?

24 A. Let me look into the -- look at the -- the
25 specification to make sure. I -- I --

1 I'm -- I'm sorry. I'm trying to make
2 sure that I give you the correct answer.

3 Q. And if you want to refer yourself to somewhere,
4 you can look at Column 6, Lines 55 through 56 and Lines
5 64 through 65.

6 A. Are you referring to Kobayashi?

7 Q. Yeah.

8 A. What's the number you mentioned?

9 Q. Yeah. So Column 6, say, Lines 55 through 67.

10 A. I'm sorry it's taking a while. I -- I -- I'll
11 get to it.

12 Okay. I'm...

13 Q. So in Kobayashi's Figure 5A, the trenched gates
14 are filled with a different material than the source
15 contact trenches, correct?

16 A. In the embodiment described Kobayashi, that's
17 correct, yes.

18 Q. Okay. So the -- the source contact trenches
19 are filled with tungsten, correct?

20 A. That's correct.

21 Q. And the gate trenches are filled with
22 polysilicon, correct?

23 A. That's correct.

24 Q. Does polysilicon have the identical capability
25 as tungsten to conformally fill a trench?

1 MR. TIPESCU: Objection, form.

2 A. It really depends on the process. Now, as I
3 mentioned, it -- it depends on the process. The -- the
4 key feature is that in both cases, the thickness of the
5 layer you're forming cannot be greater than the width.

6 Let me get to the point.

7 So here's what I was trying to say.

8 Yeah. I -- I -- I'm glad I found the citation. So the
9 thickness of the -- of the material you're depositing to
10 fill has to be equal or greater than the aperture. When
11 I say "aperture," that means maximum. So for the case
12 circular trench, it'd be diameter.

13 So the width, the layer you -- you --
14 you're doing has to be equal to or greater than the
15 diameter. So given that, that's another way that
16 Kobayashi discloses that the width of the circular
17 trench cannot be greater than 1 micron, because you're
18 trying to fill everything conformal, whether --
19 regardless it's polysilicon or regardless it's -- it's
20 tungsten into respectively gate trench or tungsten
21 trench, you have to fill it.

22 And the filling dictates certain behavior
23 in terms of aspect ratio as well as in terms of
24 relationship to the thickness; so, again, based on the
25 calibration with polysilicon, with the gate width --

1 gate trench width and also based on -- based on the
2 thickness, that tungsten depo- -- deposition and
3 polydeposition, Kobayashi clearly discloses the
4 limitation of Claim 5, that it's less than 1 micron.

5 Q. (BY MR. SAUNDERS) In Paragraph 80 of your
6 declaration, you quote language from Kobayashi that, "It
7 is possible to obtain the trench width not greater than
8 0.5 microns"; is that correct?

9 A. Where do you see that -- yeah, it's -- it's...

10 Q. That -- that --

11 A. I --

12 Q. -- passage is not -- sorry.

13 Did you finish your answer?

14 A. Go ahead. I -- I -- I -- I'm sorry. Go ahead,
15 please.

16 Q. That -- that passage is not stating that it is
17 impossible to etch trenches greater than 0.5 microns,
18 correct?

19 A. Again, Kobayashi discloses that -- in this cell
20 layout, in giving all the criteria, Kobayashi gives --
21 and giving all the dimension re- -- and I show the --
22 the relative dimension. Kobayashi clearly discloses
23 claim limitation -- Claim 5 -- of Claim 5.

24 Q. So that passage in Column 7, Lines 49 through
25 50 of Kobayashi that you're quoting, does that passage

1 mean it is possible to obtain trench width less than 0.5
2 micron?

3 A. Repeat your question again.

4 Q. Yeah. I'm just trying -- you have this quote
5 of -- of Column 7, Lines 49 through 50 of Kobayashi. It
6 states, "It is possible to obtain the trench with not
7 greater than 0.5 micron."

8 And I'm trying to understand what you
9 believe that that passage means. And so my question to
10 you is --

11 A. The passage --

12 Q. -- does that -- does that passage mean that it
13 is possible to obtain the trench with less than 0.5
14 micron?

15 A. I'm sorry. You -- you -- I -- I think -- I --
16 I -- I'm -- always get confused by double negative.

17 Can -- can you say that again.

18 Q. Yeah. So what does Kobayashi mean when it
19 says, "not greater than 0.5-micron"?

20 MR. TIPESCU: Objection, form.

21 A. It means -- Kobayashi means that my technology
22 that's disclosed in this -- in this pattern is .5
23 micron or less.

24 Q. (BY MR. SAUNDERS) Would now be a good time to
25 take a lunch break, Dr. Liu?

1 A. I'm okay with that, yes, please.

2 MR. SAUNDERS: All right. Let's go off the
3 record.

4 THE VIDEOGRAPHER: The time is 1:25. We're
5 off the record.

6 (Break taken from 1:25 p.m. to 2:12 p.m.)

7 THE VIDEOGRAPHER: The time is 2:12. We're
8 back on the record.

9 Q. (BY MR. SAUNDERS) All right. Dr. Liu, could
10 you turn to Paragraph 81 of your declaration.

11 A. 81?

12 Q. Yeah.

13 A. Okay.

14 I'm there.

15 Q. Okay. And just so I have some nomenclature
16 with you, in that paragraph, you have a symbol that's
17 two squiggles that's I think associated with the
18 approximately equal symbol.

19 Do you see that?

20 A. Yes, I do.

21 Q. Okay. Is there a convenient name I should call
22 that symbol that you would use?

23 A. I don't have one. Maybe just...

24 Q. All right. I'll just -- for the purposes of
25 our discussion, I'll call it double squiggles.

1 And you'll understand I'm referring to that
2 symbol you have there?

3 A. Okay.

4 Q. All right. See -- see you have a sentence that
5 says, "The relevant dimensions I have considered include
6 the regions that do not include the double squiggle
7 symbol, which are indicative that those double squiggle
8 portions of the drawing are not drawn to scale"?

9 Do you see that?

10 A. Yes, I do.

11 Q. And you're talking about the Figure 5A that's
12 above Paragraph 81?

13 A. That's correct.

14 Q. Okay. And so the double squiggles you're
15 pointing to in Figure 5A are the four double squiggles
16 that kind of appear towards the upper left, upper right,
17 bottom left, and bottom right of Figure 5A?

18 A. That's correct.

19 Q. Okay. And so there's a pair of double
20 squiggles on the top that's in the source metal; is that
21 correct?

22 A. That's correct.

23 Q. And there's a pair of double squiggles at the
24 bottom that's in the substrate?

25 A. That's correct.

1 Q. And it's your opinion that the -- well,
2 actually, withdraw.

3 So for purpose of nomenclature, can I
4 call the portion of the figure there between the upper
5 and bottom sets of double squiggles the cell of the
6 MOSFET?

7 Would you understand I'm referring to that
8 area there (indicating)?

9 A. You mean excluding the -- the N+ substrate and
10 excluding the top -- top source metal?

11 Q. Well, right now I'm just focussing on the area
12 between the double squiggles, between the top set of the
13 double squiggles and the bottom set of the double
14 squiggles.

15 If I refer to the -- that as the cell of
16 the MOSFET, you understand I'm referring to that area in
17 Figure 5A?

18 A. Okay. Yes, I do.

19 Q. Okay. And so is it your understanding that the
20 cell of the MOSFET in Figure 5A is to scale?

21 MR. TIPESCU: Objection, form.

22 A. The -- my understanding, as disclosed by
23 Kobayashi, at least the -- not saying the X direction,
24 showing the dimension X direction will be consistent.
25 And the dimension in the Y direction will also be

1 consistent within itself.

2 Q. All right. Okay. I'm pointing to the last
3 sentence on Paragraph 81.

4 Do you -- do you see that it says, "The
5 remaining portions of the drawing, which do not have the
6 double squiggle symbol, appear to be drawn to relative
7 scale"?

8 Do you see that?

9 A. Yes, I do.

10 Q. So what is the basis for that opinion?

11 A. Rarely Kobayashi discloses that if the scale is
12 not to be drawn consistently relative to each other,
13 whether it's in the X direction or Y direction, the use
14 of double squiggle, just to show that that portion is
15 not relative to -- in the relative scale in that
16 dimension in that figure.

17 Q. So other than the double squiggles that appear
18 in Figure 5A, is there anything else that supports your
19 opinion that the remaining portions of the drawing,
20 which do not have the double squiggle symbol, appear to
21 be drawn to relative scale?

22 MR. TIPESCU: Objection, form.

23 A. Can you repeat your question again.

24 Q. (BY MR. SAUNDERS) Yeah.

25 So other than the double squiggles, which

1 appear in Figure 5A, is there anything else that is --
2 supports your opinion that the remaining portions of the
3 drawing, which do not have the double squiggle symbol,
4 appear to be drawn to relative scale?

5 MR. TIPESCU: Same objection. Form.

6 A. There's also, as I noted, the text in the -- in
7 the -- in the -- dis- -- as disclosed by Kobayashi with
8 the number that shows the relative scale and also show
9 the dimension of the features.

10 Q. (BY MR. SAUNDERS) Which text in Kobayashi are
11 you referring to?

12 A. Kobayashi disclosed that the width of the gate
13 trench, as we mentioned earlier -- let me try to find
14 the citation.

15 Refer to Column 8. For the -- for
16 example, in the case of the P-type base layer, it has a
17 -- a range. In the case of N+ base layer, it has a
18 range. And also the interlayer oxide film 11, it has a
19 -- it has a number. It has a range.

20 And this is in -- in conjunction to the --
21 to the other dimension he mentioned. For example, he
22 mentioned that the depth of the gate trench is 1 to 1/2
23 micron. (Couching). Excuse me.

24 And, of course, we mentioned that it is
25 possible to obtain the trench with not greater than .5

1 micron. Kobayashi disclosed that the mi- -- the -- the
2 trench gate width will be equal to or less than .5
3 micron. And taking this, Kobayashi clearly disclosed
4 that the -- the claim limitation on Claim 5.

5 Q. Sorry. What lines of Column 8 of Kobayashi
6 were you referring to in your prior answer?

7 A. It will be Column 7, Lines 48 to 55.

8 THE WITNESS: Also, do you mind if I put
9 some eyedrop in my eyes? It's very -- my eye getting
10 dry. I'm looking at a screen, so...

11 MR. SAUNDERS: Sure. Why don't we go off
12 the record.

13 THE VIDEOGRAPHER: The time is 2:24. We're
14 off the record.

15 (Break taken from 2:24 p.m. to 2:31 p.m.)

16 THE VIDEOGRAPHER: The time is 2:31. We
17 are back on the record.

18 Q. (BY MR. SAUNDERS) Welcome back, Dr. Liu.

19 Have you been able to address the issue
20 with your eyes?

21 A. Yes, I have. Thank you so much for the
22 accommodation.

23 Q. Okay. I think before the break, I was asking
24 you for portions of the Kobayashi reference that you
25 believe supported your opinion that the remaining

1 portions of the drawing, which do not have the squiggle
2 symbol, appear to be drawn to relative scale.

3 So do you have any other citations to
4 Kobayashi that you have for me?

5 MR. TIPESCU: Same objection as before.
6 Form.

7 A. I think my declaration says clearly there's --
8 Kobayashi discloses in many -- many ways explicitly, and
9 I cited in my declaration one, and as well as if -- if
10 you take other disclosure in Kobayashi, Kobayashi
11 definitely disclosed that the -- the width of the
12 contact trench is -- or meet the claim limitation of
13 Claim 5, which is less than 1 micron.

14 And the citation I provided are not
15 exclusive. Kobayashi discloses -- again, Kobayashi
16 definitely disclosed in -- in this claim limitation very
17 clearly.

18 Q. Well, just to clarify, I wasn't asking you
19 about the claim limitation. I was asking you for a very
20 specific statement you had, the last sentence of
21 Paragraph 81, which was that the remaining portions to
22 the drawing, which do not have the double squiggle
23 symbol, appear to be drawn to relative scale.

24 And I -- I believe you read out one
25 passage in Column 7. Is there anything else that you

1 can cite to me, that supports that statement?

2 A. I believe prior to reading passage Column 7, I
3 also read the passage in Column 8, as well.

4 Q. Do you have line numbers for that passage in
5 Column 8?

6 A. Yes, I do. Column 8, for example, Lines 34 and
7 35.

8 Q. Anything else?

9 A. Then, again -- and then, again, Line 42 to 4-
10 -- I guess that'll be 40- -- -1 -- -2 -- 42, 43. And
11 then Lines 47, 48. And Kobayashi discloses in other
12 location the -- the dimension, as well, so...

13 Q. You're not relying on any express statement in
14 Kobayashi that any portion of Figure 5A is drawn to
15 scale, correct?

16 MR. TIPESCU: Objection, form.

17 A. I disagree with that because when it's not
18 drawn to sca- -- scale, as we just talked about earlier,
19 Kobayashi used the double squiggle trying to give us a
20 heads-up, that itself might not be -- be -- be to
21 relative scale.

22 Q. (BY MR. SAUNDERS) You don't remember anywhere
23 in the written description at Kobayashi explaining the
24 significance of the double squiggle symbols, correct?

25 MR. TIPESCU: Objection, form.

1 A. I suppose we could -- we could -- (coughing)
2 excuse me -- we could do a search.

3 Sitting right here, unless you want me to
4 go through it, I -- I -- I -- I can- -- I -- I do not
5 have a citation for you.

6 Q. (BY MR. SAUNDERS) Okay.

7 A. However, effectively, if you look at the
8 dimension that Kobayashi disclosed in light of the
9 Figure 5A, Kobayashi is consistent -- Kobayashi, with --
10 with regard to your question, I think is consistent.

11 Q. Dr. Liu, in your experience, is it common for
12 the source metal layer of a MOSFET to be significantly
13 thicker than the cell of a MOSFET?

14 MR. TIPESCU: I'm -- I'm sorry, Michael. I
15 couldn't -- I didn't catch that question. I'm sorry.
16 Can you repeat that. My --

17 MR. SAUNDERS: Sure.

18 MR. TIPESCU: -- computer was acting up.

19 Q. (BY MR. SAUNDERS) Doc- -- Dr. Liu, in your
20 experience, it's common for the source metal layer of a
21 MOSFET to be significantly thicker than the cell of a
22 MOSFET, correct?

23 MR. TIPESCU: Objection, form.

24 A. I -- I -- can you repeat your question,
25 especially the part about "significant." I -- I'm --

1 I'm -- I'm missing -- I'm missing something. I'm sorry.

2 Q. (BY MR. SAUNDERS) Let me make sure my volume's
3 all the way up. All right.

4 Can you hear me a little bit better now?

5 MR. TIPESCU: Yes.

6 A. Yes, I can.

7 Q. (BY MR. SAUNDERS) Okay. Dr. Liu, in your
8 experience, it's common for the source metal layer of a
9 MOSFET to be significantly thicker than the cell of a
10 MOSFET, correct?

11 MR. TIPESCU: Objection, form.

12 A. I -- I don't understand what you meant by "the
13 cell" of the -- of the -- "of the MOSFET."

14 Q. (BY MR. SAUNDERS) Okay. So let's -- I'll --
15 I'll reask it to define -- to define very specifically.

16 The -- it's very common in MOSFETs for
17 the source metal layer to be significantly thicker than
18 the portion of the MOSFET between the source metal layer
19 and the substrate, correct?

20 MR. TIPESCU: Objection, form.

21 A. I disagree with that.

22 Q. (BY MR. SAUNDERS) Why do you disagree?

23 A. You're asking, is it common? Th- -- that's
24 your question, right?

25 Q. Yes. In your experience.

1 A. And you're talking about -- are you -- compare
2 relative to -- in -- in your question, are you comparing
3 to -- relative to Figure 8, are you talking about Figure
4 5?

5 Q. Well, I -- I mean, you could look at Figure
6 5 -- for example, obviously, Figure 5A is one example of
7 a MOSFET, right?

8 A. That's correct.

9 Q. Okay. And -- and Figure 5A is a -- a trench
10 MOSFET with the trench source contact, right?

11 A. That's correct.

12 Q. And Figure 5A has a -- a source metal layer
13 atop, right?

14 A. That's correct.

15 Q. And Figure 5A has a -- a substrate and a train
16 electrode at the bottom, correct?

17 A. That's correct.

18 Q. And there is a region in Figure 5A between the
19 bottom of the source metal and the top of the substrate,
20 correct?

21 A. That's correct.

22 Q. And so in your experience, it's common for,
23 let's say, trench MOSFETs with trench source contacts
24 to have a significantly thicker source metal layer than
25 the layer that is between the bottom of the source metal

1 and the top of the substrate; is that correct?

2 MR. TIPESCU: Objection, form.

3 A. Are you asking about my experience, or are you
4 asking --

5 Q. (BY MR. SAUNDERS) Yes.

6 A. -- as shown in Figure 5A implementation?

7 Q. Your experience with MOSFETs like those shown
8 in Figure 5A.

9 MR. TIPESCU: Objection, form.

10 A. And your question, a- -- again, because it's --
11 it's a long -- long question, so I'm trying to process.

12 Your question is: In my experience, is
13 it true that it's always -- the top metal is always
14 thicker compared to -- to the portion in between?

15 Is -- is that what you're asking?

16 Q. (BY MR. SAUNDERS) Well, I don't think I said
17 always, so let me rephrase.

18 In your experience, is it common in
19 MOSFETs that look like the MOSFET of Figure 5A of
20 Kobayashi to have a source metal layer that is
21 significantly thicker than the layers between the bottom
22 of the source metal layer and the top of the substrate?

23 MR. TIPESCU: Objection, form.

24 A. I would say it would be case by case. You have
25 to show me example because it will be case by case,

1 depending on what you're trying to achieve with the de-
2 -- device specification and what you're trying to a- --
3 accomplish.

4 Now so it's -- it's really case by case.

5 Q. (BY MR. SAUNDERS) And in your experience, is
6 it common for MOSFETs that look like the MOSFET of
7 Figure 5A of Kobayashi for the substrate to be
8 significantly thicker than the layers that are between
9 the top of the substrate and the bottom of the source
10 metal layer?

11 MR. TIPESCU: Objection, form.

12 A. In my experience, again, it's case by case.
13 Typically, you start off with a substrate that's going
14 to be very, very thick. But there might be cases where
15 you would need to polish, grind them to thin out for --
16 for form, fact, or reason, so again, it's case by case.

17 It's -- it's not -- there's no -- there's
18 no -- a given -- it depends on the -- again, depends on
19 the application. Depends on the usage.

20 Q. (BY MR. SAUNDERS) When I look at Figure 5A of
21 Kobayashi and I look at the double squiggles, it seems
22 to me that the double squiggles are used to indicate
23 that the source metal layer and the substrate layers can
24 be significantly thicker than the other layers in the
25 MOSFET.

1 Do you disagree with that interpretation?

2 MR. TIPESCU: Objection, form.

3 A. I think my interpretation is -- is already
4 given, which is in -- in my -- in my declaration, that
5 the reg- -- the relevant region that I have in- --
6 considered include the region that do not include a
7 double squiggle symbol, which are indicative tho- -- of
8 those double squiggle portion of the drawing are not
9 drawn to scale.

10 And I already opined or testified that
11 that's my declaration, and -- and -- and -- and to the
12 extent that's -- whether the -- the thickness could be
13 much big- -- much -- much wider, it depend on the
14 application, as I said, which is why there's -- there's
15 uncertainty about that aspect.

16 Q. (BY MR. SAUNDERS) What reasons do you have for
17 disagreeing with interpreting the double squiggles in
18 Figure 5A of Kobayashi as indicating that the source
19 metal layer and the substrate can be significantly
20 thicker than the other layers?

21 A. Repeat your question again.

22 Q. Yeah. So what reasons do you have for
23 disagreeing with the interpretation of the double
24 squiggles in Figure 5A of Kobayashi as indicating that
25 the source metal layer and substrate layer can be

1 thick- -- substantially thicker than the other layers?

2 MR. TIPESCU: Objection, form.

3 A. I -- I'm -- it -- it's a loaded question.

4 What reason do I have to disagree with
5 your comment that the source metal layer has to be much
6 thicker than -- than nonsquiggle area, is what you're
7 saying?

8 Q. (BY MR. SAUNDERS) I -- I -- that's not quite
9 what I -- what I was saying, so let me rephrase it
10 again.

11 I interpret Figure 5A and its use of
12 double squiggles to indicate that the source metal layer
13 and the substrate layer may be substantially thicker
14 than the other layers depicted in 5A of Kobayashi.

15 What reasons do you have for disagreeing
16 with that interpretation?

17 MR. TIPESCU: Objection, form.

18 A. I -- I -- I think it's depending on -- this
19 question is -- is -- is a little bit -- I -- I -- I'm
20 sorry, but I don't know how to answer. When you say
21 "substantially," are you talking about order magnitude
22 -- two order magnitude? What -- I -- what do you mean
23 by "substantially"?

24 Again, I -- my testimony is that it's not
25 drawn to scale. There are many reason it may not be

1 drawn to scale because there may be difference in -- in
2 the -- in the -- in the process design and also in the
3 form factor.

4 So there may be reason so that these two
5 are not drawn to scale; therefore, they are label with
6 double squiggle. To that extent, I am using the region
7 that, as disclosed by Kobayashi -- again, let me
8 emphasize, Kobayashi disclosed in many way, in many
9 forms that the width of the contact trench is less than
10 1 micron.

11 I'm citing some example to demonstrate that
12 this is disclosed by Kobayashi. I can have other
13 example that Kobayashi disclosed this limitation, but to
14 the extent -- to answer your question, whether
15 significantly, I -- I do not know -- know the -- the --
16 the context of your question.

17 Let's say -- let's -- let -- just for the
18 sake of argument, even if I assume looking at the --
19 let's say looking at the -- the source all the way to
20 the base to be between certain dimension. And are you
21 saying significantly that -- do you -- do you mean the
22 metal will be 10 micron, 15 micron?

23 I -- I -- I don't know that. I don't -- I
24 cannot answer significantly, but I do know Kobayashi
25 also mentioned -- give a guideline, disclose the

1 guideline, the -- the dimension -- rel- -- relative
2 dimension -- oh, relevant dimension -- I should say,
3 relevant dimension of these features.

4 Q. (BY MR. SAUNDERS) All right. Let's turn to
5 Paragraph 100 of your declaration. Let me know when
6 you're there.

7 A. I'm there.

8 Q. And this is a portion of your declaration
9 addressing the motivation to combine Kobayashi and
10 Kikkawa?

11 A. That's correct.

12 Q. Okay. And do you see in Paragraph 100, you
13 say, "The Kobayashi and Kikkawa references are both in
14 the same field of endeavor as Claims 2 and 6 of the
15 ''409 Patent"?

16 Do you see that?

17 A. Yes, I do.

18 Q. What is the field of endeavor of Claim 2 of the
19 ''409 Patent?

20 A. Let's go to my declaration in the field
21 endeavor. The ''409 Patent, Kobayashi and Kikkawa all
22 are dir- -- are all directed to semiconductive
23 structure; therefore, both Kobayashi and Kikkawa,
24 analogous, are in the same field of end- -- endeavor.

25 Q. Is Kikkawa about -- sorry. Withdraw it.

1 Is anything in Kikkawa specifically about
2 MOSFETs?

3 MR. TIPESCU: Objection, form.

4 A. I mentioned semiconductive structure. So I --
5 Kikkawa addressing semiconductor structure and ''409
6 Patent, and Kobayashi, those are semiconductive
7 structures, and -- go ahead.

8 Q. (BY MR. SAUNDERS) If I were to say that I
9 believe that the field of endeavor of the ''409 Patent
10 is directed to power MOSFETs and that Kikkawa is not
11 directed to the field of endeavor of power MOSFETs, what
12 basis would you have for disagreeing with me?

13 MR. TIPESCU: Objection, form. And
14 relevance.

15 A. The many -- I would have a -- a -- a
16 disagreement with you in this -- in -- in -- in this
17 following fashion: Kikkawa is addressing stress
18 migration and electromigration, with respect to the use
19 example of DRAM, which will answer your question
20 regarding CMOS, and but it's a semiconductive structure.

21 Now, the improvement in electromigration
22 and stress migration is important, in fact, due to the
23 high-voltage nature of vertical power MOSFET with a high
24 current and also experiencing high voltage.

25 The concern is greater for the integrity of

1 the interconnect, with respect to both electromigration
2 as well as stress migration; therefore, the learning in
3 the same field of endeavor of Kikkawa showing that
4 certain composition of structure can improve that
5 definitely -- definitely that someone in the vertical
6 power MOSFET, such as I was when I was doing --
7 developing my novel devices with high current, I would
8 definitely apply any learning that will improve the
9 electromigration and stress migration, simply because my
10 issue with electromigration and stress migration, given
11 the high current or high voltage, is much more
12 manifested compared to, for example, a -- a -- a CMOS
13 semiconductive structure that may not experience as
14 higher voltage or as higher current compared to power --
15 vertical power MOSFET.

16 Q. What is "electromigration"?

17 A. You want me to explain electromigration?

18 Q. Yes.

19 A. It's -- again, it's -- I can -- I can just do
20 it on the service for this -- for the scope of this --
21 this declaration. Electromigration essentially is when
22 interconnect -- we use -- interconnect would be -- by
23 means like the source metal layer. You use it to
24 conduct current.

25 When an inter- -- interconnect or source

1 metal layer experiencing current flow, inevitably, when
2 you have current flow, you have heat. You -- also, you
3 have electro field. You have current. And because of
4 that, the interconnect structure in the case of -- say,
5 in the case of Kikkawa, the source metal layer, the
6 grain that -- the metal is -- is form of grain.

7 In the case of aluminum silicon, copper,
8 the grain will start moving. And when the grain start
9 moving and it migrates, it changes the -- the -- the
10 stoichiometry, and the resistance will go up. And
11 that's what you -- the manifestation of
12 electromigration, the resistance will go up and then
13 eventually lead to failure.

14 So electromigration is manifested much more
15 when you are actually experiencing high current and high
16 voltage. So in this case, whatever learning you have
17 applying to semiconductive structures, even specifically
18 applying to CMOS devices, any learning that you have to
19 improve electromigration will be obvious to try and
20 obvious to apply to vertical power MOSFET to gain the
21 enhanced reliability in a vertical power MOSFET.

22 Q. And what is "stress migration"?

23 A. Stress migration, in the context -- in the
24 context of -- again, in the context of semiconductive
25 structure. When you have material forming on top of

1 each other and you have other material on top -- and
2 this other material, for example, with -- with regard to
3 interconnect, you have -- you have -- you're sitting on
4 -- on top of certain material and on top because these
5 structure, as you show with the -- with the top view
6 layout of the -- of the -- of the -- of the power
7 device, there'll be -- there'll be other material.
8 Whether it's coming from packaging the devices
9 and -- and -- or -- and making a propat [phonetic] onto
10 it, there'll be -- due to the material difference and
11 due to the stress or the force we exert on that layer,
12 you also will have what's called "stress migration."

13 Again, due to the nature of the vertical
14 and power MOSFET that you're combining many, many cells
15 together, you tend to make it into a -- one large
16 discrete cell.

17 So then the source metal layer is -- spend
18 a lot of area; and of course, the more area you have,
19 then it's -- you -- you're more -- more likely to have
20 weaker point, whether it's due to stress migration or
21 electrical -- electromigration; therefore, any learning
22 that you have of a very integra -- or of a -- a
23 interconnect structure with integrity or integra
24 interconnect structure from any semiconductor structure
25 that you learn or you a- -- you -- you -- you know.

1 Especially, in CMOS application, then you
2 would -- it will be obvious to apply that, obvious to
3 try, obvious to combine to address the same problem of
4 stress migration and electromigration.

5 And perhaps I will say that the urgency to
6 -- to improve those is higher in a vertical power MOSFET
7 simply because the nature of the device structure and
8 also the nature of the higher current and higher
9 voltage.

10 Q. So why do you believe that Kobayashi has
11 problems of electromigration or stress migration between
12 its metal plug and its source metal layer?

13 A. Repeat your question again.

14 Q. Why do you believe that Kobayashi has problems
15 of stress migration or electromigration between its
16 metal plug and its source metal layer?

17 MR. TIPESCU: Objection, form.

18 A. Can you repeat your question again.

19 Q. (BY MR. SAUNDERS) Yeah. Why do you believe
20 that Kobayashi has a problem of stress migration or
21 electromigration between its metal plug and its source
22 metal layer?

23 A. Applying the interconnect structure,
24 compositional structure of Kikkawa, there's a known
25 benefit of applying that. So when you said how do --

1 how do I know there's a problem, I know electromigration
2 issue exists. I know stress migration issue exists.
3 And I know that these are exacerbated or more -- these
4 problem are more magnified with high voltage and high
5 current in the power MOSFET.

6 Now, as a person of ordinary skill in the
7 art, knowing that, my device is going to have high
8 voltage and high current going through it. And one of
9 the problem with high voltage and high current related
10 to the interconnect structure is stress migration and
11 electromigration.

12 And I know there's a known benefit as
13 taught by Kikkawa. I would apply -- it would be obvious
14 for a person of ordinary skill in the art to apply that
15 known benefit to my -- to -- to a -- my -- when I say
16 "my," let me just -- phrased as Kobayashi.

17 I will apply it to a power MO- -- vertical
18 power MOSFET. Knowing that, that device is going to be
19 operating under high current and high voltage, and it
20 will be susceptible to stress migration and
21 electromigration, among other issues, that are common in
22 semiconductor structures.

23 So this is a -- one of case where known
24 problem and one of the case that problem
25 electromigration and stress migration always ex- --

1 exists simply when you pass through current to it. It's
2 just that higher current, higher voltage, the problem is
3 magnified tremendously. I would say even -- or magni-
4 -- magnified greatly.

5 And knowing a known method, a known
6 teaching from Kikkawa that benefits, that improves and
7 address my known problem, it will be obvious to apply --
8 to combine the teaching of Kikka- -- Kikkawa with the
9 structure of Kobayashi.

10 Q. Kikkawa doesn't specifically disclose applying
11 a titanium or titanium nitride layer between a metal
12 plug and a source metal layer, correct?

13 MR. TIPESCU: Objection, form.

14 A. I disagree with that. Kikkawa says there's a
15 benefit of a inter- -- in the interconnect structure
16 that use aluminum copper -- aluminum silicon copper. It
17 is -- it is -- it serves you well, in terms of improving
18 the electromigration and the -- and the stress migration
19 by having an underlying titanium nitride or titanium
20 barrier layer.

21 Now, so this composite layer works together
22 in situation where you need to apply -- where -- in a
23 situation where you previously only have aluminum
24 silicon copper.

25 So that's the teaching of Kikkawa, to that

1 extent that -- that aluminum silicon copper happens to
2 sit on tungsten plug, happen to sit on tungsten plug --
3 it -- the improvement is still there, is that the
4 underlying -- underlying the aluminum silicon copper
5 with a titanium -- ti- -- titanium nitride, there is
6 improvement in the stress migration and electromigration
7 of the aluminum copper -- aluminum silicon copper metal
8 layer, metal.

9 So that's -- that's the -- the -- the
10 expressed teaching of Kikkawa. And that could be
11 applied on -- on -- on a tungsten plug, and that could
12 be applying -- again, applying to -- to -- to --
13 applying on tungsten plug, rather than just have
14 aluminum silicon copper without a titanium nitride or
15 titanium underlying, yet directing on top of tungsten
16 plug.

17 Q. (BY MR. SAUNDERS) So given that Kobayashi uses
18 tungsten plugs, what's the basis for your opinion that
19 Kobayashi has issues with electromigration or stress
20 migration that would be alleviated by adding a titanium
21 layer from Kikkawa between the metal plugs and the
22 source metal layer?

23 A. Again, by summation, there's known benefit by
24 the teaching of Kikkawa to not just have aluminum
25 silicon copper single layer, rather have a composite

1 layer of aluminum silicon copper with titanium nitride
2 and titanium barrier layer underneath it. That improve
3 electromigration and stress migration.

4 To the extent that improvement will
5 actually be much more, I will use the word "appreciated"
6 or much more eager to be applied to a device structure
7 with high-current and high-voltage operation --
8 operating conditions.

9 So, again, the benefit -- I'm repeating
10 myself. That benefit of Kikkawa is known, and that
11 benefit a pos- -- a -- a POSITA, person of ordinary
12 skill or not, would apply the benefit to a vertical
13 DMOS, knowing that it is operating under the extreme --
14 much more harsh condition compared to other -- perhaps
15 other CMOS structure in a semicon- -- -conductor
16 structure field endeavor.

17 So given that it's much harsher and given
18 that there's no improvement, a person of ordinary skill
19 in the art will be motivated to combine, knowing the
20 benefit of combining.

21 Q. What's on ei- -- either side of Kikkawa's
22 electro- and stress-migration-resistant interconnection
23 structure?

24 MR. TIPESCU: Objection, form.

25 A. Again, it's comparing apple to apple. Kikkawa

1 is showing -- again, showing that if you have a single
2 layer of aluminum silicon copper, given that it has top
3 layer and underlying -- underlying layer, compared to
4 another case, a composite case of having aluminum
5 silicon copper with -- with titanium nitride and titani-
6 -- titanium barrier layer, these two structure, one is
7 single layer just aluminum silicon copper; one is
8 composite with aluminum silicon copper and -- and with
9 titanium nitride and titanium barrier layer.

10 These two, you've compare apple to apple.
11 Under certain stress condition, the composite layer
12 improve the electromigration, and the composite layer
13 improve the stress migration. This is a known benefit
14 as taught by Kikkawa.

15 So a poser knowing this known benefit and
16 knowing that there's a same problem of -- addressing
17 same problem electromigration, except perhaps
18 Kobayashi's problem is much more on a much higher scale.

19 So there is a -- again, there's a reason to
20 -- to -- to use this dome technique -- known technique
21 of composite layer to apply to a device structure --
22 similar device structure because they all in the field
23 of semiconductive structure, specifically CMOS, which
24 means they're operating under voltage, under current and
25 -- except Kobayashi's higher voltage, higher current.

1 So you -- you apply a known technique to
2 improve a similar problem and -- and improve on a
3 similar device in the same way. And it's -- (coughing.)
4 Excuse me.

5 So you know that this composite structure
6 gives you better reliability against these two
7 electromigration and stress migration. So you're simply
8 applying this known teaching from Kikkawa to get -- to
9 apply to Kobayashi, knowing that, the resulting of that
10 is regardless how severe my electromigration problem and
11 stress migration problem may be, applying this composite
12 layer, I will improve my electromigration problem, and I
13 will improve the reliability due to stress migration
14 problem.

15 MR. SAUNDERS: I -- I'm going to object as
16 nonresponsive.

17 Q. (BY MR. SAUNDERS) Dr. Liu, my question did not
18 reference Kobayashi or the ''409 Patent. I'm trying to
19 ask you a question very specifically about Kikkawa. It
20 should be available to you in Exhibit Share now if you
21 need to look at it. But I'm going to ask the question
22 very directly and very simply:

23 True or false? In Kikkawa, it only
24 provides examples of adding the titanium and titanium
25 nitride layers between aluminum silicon copper and a

1 layer of silicon dioxide?

2 MR. TIPESCU: Objection, form.

3 A. Kobayashi clearly in the conclusion --
4 regardless, I already mentioned, this is comparing apple
5 to apple. I'm comparing a -- a single layer to a
6 composite layer with the same condition, same underlying
7 layer. In the case, you mention oxide. Fine. And in a
8 case, top layer, top -- to material to apply the stress.
9 Fine.

10 Knowing that the stress -- electro- --
11 electromigration stress is applied, and this is the same
12 stress that a semiconductor device will see. Kikkawa
13 said that is a candidate for DRAM interconnect, which is
14 a semiconductor device.

15 So knowing that this is going to be the
16 case, you apply electromigration stress. You apply
17 mechanical stress, and the composite layer perform
18 better. That's a known resolve. That's a known benefit
19 of a composite layer. Apple to apple. Same condition.

20 So I know, of course, in the CMOS, as you
21 know, as -- as you know in -- in a CMOS, even in the
22 vertical MOSFET, the area that the source contact layers
23 sitting on top of the actual tungsten, it's -- it's much
24 smaller than sitting on top of oxide.

25 The current just -- doesn't just flow

1 between tungsten and -- and -- and a source metal and
2 top metal in the case. It actually goes through -- go
3 through the whole interconnect, and which are sitting on
4 the oxide.

5 I -- I use example, so Kobayashi -- if you
6 look at Kobayashi, the contact area, the source contact
7 could be only half a micron; whereas the whole device
8 area that's sitting on top of oxide is much longer, much
9 wider; area is much bigger.

10 So I'm comparing a long result or -- in
11 your case, si- -- you -- as you mention, silica oxide,
12 it gives the benefit; therefore, at least a portion that
13 silica oxide in -- in -- in a semiconductor device is
14 any other -- any semiconductor devices, whether it be
15 DRAM or would be -- will be a vertical power MOSFET,
16 will also benefit from this stress migration, whether
17 it's -- it's electrical -- electromigration or
18 mechanical stress migration.

19 So it's very clear -- it's very clear
20 when I'm comparing apple to apple, and I'm answering
21 your question. I don't -- I -- I -- this is the -- the
22 question -- this is the answer.

23 MR. SAUNDERS: I -- I'm going to object as
24 nonresponsive again.

25 Q. (BY MR. SAUNDERS) Dr. Liu, again, my question

1 made no reference to Kobayashi. It was strictly about
2 Liu -- or sorry. It's strictly Kikkawa.

3 So to simplify this --

4 A. Okay.

5 Q. -- in Paragraph 85 of your declaration, you
6 cite to Page 4 of Exhibit 1007, which is Kikkawa,
7 correct?

8 A. Which paragraph again?

9 Q. 85.

10 A. Okay.

11 Q. And can you pull up Kikkawa now, Exhibit 1007,
12 and turn to that Page 4.

13 A. Okay. Where are you referring to?

14 Q. So Page 4 of 9, I guess in the upper right, it
15 also says Page Number 297.

16 Are you on that page?

17 A. 297. Yes, I'm on that page.

18 Q. And in the upper right, do you see three cross
19 sectional diagrams?

20 A. Yes, I do.

21 Q. And those are the cross-sectional diagrams of
22 the electro- and stress-migration-resistant
23 interconnection structure disclosed in Kikkawa; is that
24 correct?

25 A. That's correct.

1 Q. And each of those diagrams has a silicon
2 dioxide layer in it; is that correct?

3 A. That's correct.

4 Q. And Kikkawa doesn't discuss having an electro-
5 and stress-migration-resistant interconnection structure
6 between an aluminum alloy and tungsten, correct?

7 MR. TIPESCU: Objection, form.

8 A. Kikkawa discloses that a structure, regardless
9 underlying layer -- the structure, a composite layer of
10 -- of aluminum silicon copper with titanium nitride and
11 titanium performs better in terms of electromigration
12 and stress migration reliability.

13 Q. (BY MR. SAUNDERS) And what in Kikkawa says
14 that that applies to an interface between an aluminum
15 alloy and tungsten?

16 Can you cite me to a specific portion?

17 A. If this interconnect is going to be used in a
18 DRAM application, a candidate for DRAM application,
19 that's the conclusion from Kikkawa. Inevitably, in that
20 case, the application of this composite layer will be
21 sitting on top of both silicon dioxide as well as in the
22 case in -- in -- in -- at the time of the -- the
23 publication, sitting on top -- will be sitting on top of
24 certain contact plug, in the case will be tungsten plug.

25 You're not going to just -- to apply to a

1 CMOS device, you're not just going to have interconnect
2 sitting on top of oxide not connecting to anything else.
3 That -- that's not a device.

4 Q. You're not aware of anywhere in Kikkawa that
5 they mention -- that they -- sorry. Withdraw.

6 You're not aware of anywhere in Kikkawa
7 where they analyze the benefits of its electro- and
8 stress-migration-resistant interconnection structure
9 between an aluminum alloy and a tungsten layer, correct?

10 MR. TIPESCU: Objection, form.

11 A. I disagree with that in -- in -- in effectively
12 by saying that the -- this is a candidate for DRAM
13 application. He means that this composite layer will be
14 used to interconnect CMOS device structure or
15 semiconductor device structure.

16 And tungsten plug definitely is one of the
17 most widely used contact structure in the field of CMOS
18 and semiconductor structure at the time of Kikkawa's
19 publication.

20 Q. (BY MR. SAUNDERS) Can you look at Figure 13 of
21 Kikkawa on Page 8 of 9, or also Page 301 in the upper
22 right corner.

23 A. Sure. I'm -- I'm -- I just want to mention,
24 be- -- we -- after we -- we finish this que- -- line of
25 questioning, I would like to request a break, a bio one.

1 Q. That's fine. Let me just finish this, and then
2 we can go ahead and break.

3 A. Yes, please.

4 I'm at Figure 13.

5 Q. The caption to Figure 13 at Kikkawa says,
6 "Electromigration cumulative failure versus stress time
7 for quarter-micrometer-wide ALSiCu single layer, as well
8 as AL-Si-Cu/TiN-Ti and TiN/AL-Si-Cu/TiN/AL-Si-Cu/TiN/Ti
9 multilayer conductors."

10 Do you see that?

11 A. Yes, I do.

12 Q. So in the actual testing performed in Kikkawa,
13 they didn't test on tungsten, correct?

14 MR. TIPESCU: Objection, form.

15 A. Again, I do not know what they test on. And
16 the -- one of the figure you had shown earlier show that
17 this composite layer and the singular layer, the silicon
18 oxide.

19 And my testimony earlier is that
20 interconnect will sit on both oxide, but it cannot only
21 sit on oxide; will also have to sit on interconnect
22 structure underneath it.

23 And the fact that the -- this is applied
24 with a quarter-micron technology, especial- --
25 specifically with DRAM technology, knowing that at the

1 time of quarter-micron technology, and it -- with a DRAM
2 and the -- and -- and then -- and the state of the art
3 of DRAM, definitely tungsten plug is part of the
4 interconnect system; therefore, to -- for Kikkawa to say
5 that it's a candidate for DRAM interconnection, I
6 believe that include not just composite layer sitting on
7 the oxide all the way without underlying plug
8 connection. And definitely tungsten is one of the main
9 underlying interconnect plug that's used at the time.

10 MR. SAUNDERS: All right. Why don't we go
11 off the record.

12 THE WITNESS: Thank you.

13 THE VIDEOGRAPHER: The time is 3:23. We're
14 off the record.

15 (Break taken from 3:23 p.m. to 3:35 p.m.)

16 THE VIDEOGRAPHER: The time is 3:35. We're
17 back on the record.

18 Q. (BY MR. SAUNDERS) All right. Dr. Liu, can you
19 turn to Page 3 of 9 of Kikkawa.

20 It's also the page that has 296 in the
21 upper left corner.

22 A. Yes. I'm there.

23 Q. And do you see there's a section titled, Roman
24 Numeral "II Experiment"?

25 A. Yes. I'm there.

1 Q. And that first paragraph under that
2 "Experiment" heading describes the structure that is
3 tested in Kikkawa, correct?

4 A. Yes, that's correct.

5 Q. And that paragraph doesn't mention tungsten,
6 correct?

7 A. It mentioned that the composite layer, later
8 on, the conclusion will be used as a candidate for
9 quarter-micron DRAM technology.

10 Q. Okay. But they didn't -- they didn't test on
11 real DRAM cells, correct?

12 MR. TIPESCU: Objection, form.

13 A. I have no information for that. I only know
14 that it's a candidate to be used for quarter-micron DRAM
15 technology, and it shows the -- the apple-to-apple
16 comparison between single layer and composite layer.

17 Q. (BY MR. SAUNDERS) All right. Let's go to
18 Paragraph 80 -- sorry. One second.

19 Let's go back to Paragraph 100 of your
20 declaration.

21 A. 100?

22 Q. Yeah.

23 A. Okay. I'm there.

24 Q. And do you see the second sentence says, "Both
25 references are pertinent to the problems addressed by

1 the inventors of the '409 Patent"?

2 Do you see that?

3 A. Yes, I do.

4 Q. What are the problems addressed by the
5 inventors of the '409 Patent that you're referring to
6 there?

7 A. Let me pull that back. '409 Patent. I believe
8 I was -- I was referring to Claim 2 for the reduction of
9 contact resistance between contact metal plug and -- and
10 said source metal.

11 Q. So what is the problem you think that's
12 addressed by Claim 2 of the '409 Patent?

13 MR. TIPESCU: Objection, form.

14 A. Claim 2 disclosed the benefit of having a
15 titanium layer -- underlying layer on top of having a --
16 having a -- let me -- let me rephrase.

17 Having a titanium layer as part of the
18 composite metal layer, that reduces contact resistance
19 between contact metal plug and -- and source metal.

20 Q. (BY MR. SAUNDERS) If I were to say that I
21 believe that the problem with the '409 Patent is
22 directed to weak points that occurred in the corners of
23 Prior Art MOSFET cells that resulted in low avalanche
24 current and reduced device ruggedness and, therefore,
25 that Kikkawa is not pertinent to that problem, what

1 basis would you have for disagreeing?

2 MR. TIPESCU: Objection, form. And
3 relevance.

4 A. Repeat your question again.

5 Q. (BY MR. SAUNDERS) Yeah. If I were to say that
6 the problem that the '409 Patent's inventors were trying
7 to address were the problems of weak points at the four
8 corners of Prior Art square layouts for MOSFET cells,
9 which resulted in low avalanche current and reduced
10 device ruggedness -- therefore, Kikkawa was not
11 reasonably pertinent to that problem -- what basis would
12 you have for disagreeing?

13 MR. TIPESCU: Objection, form. And
14 relevance.

15 A. Let me answer your question as concise as
16 possible without a -- have you said I'm not -- I'm not
17 -- I'm being unre- -- unresponsive.

18 Now, the ruggedness you mentioned is
19 overall ruggedness. We discussed this. It comes in --
20 it comes in many weak points in a vertical power MOSFET.
21 It includes a corner effect, which will cause more
22 avalanche current, or it cause the -- the current going
23 through the -- the corner have higher current;
24 therefore, more susceptible to turning out.

25 Now, all these issue are in line with a --

1 all this so-called ruggedness issue are in line with
2 getting the maximum current and with highest breakdown
3 voltage reliably.

4 To that extent, the corner may be a weak
5 point, but interconnect could also be a weak point,
6 given that there's electromigration and there's a stress
7 migration.

8 So applying a composite layer to improve
9 overall, in addition to perhaps to -- to '409 Patent,
10 which talks about in addition to improving the corner
11 issue, this is -- this is optimization. This is
12 improvement. This is to -- to -- to apply known benefit
13 to a- -- achieve the optimum device.

14 So I -- I think this is consistent, and I
15 -- I think -- I don't think there's any contradiction to
16 the '409 Patent.

17 Q. All right. Can you go to Paragraph 101 in your
18 declaration, in particular the last sentence.

19 Are you there?

20 A. Yes, I'm there.

21 Q. You -- you see that it says, "This would yield
22 a constant resistance that is more stable and lower over
23 time"?

24 Do you see that?

25 A. Yes, I do.

1 Q. What period of time are you talking about?

2 A. During the device operation time. Depends on
3 the level of stress. If the stress is very high -- for
4 example, if the device conducting very high current or
5 the device have close to avalanche current, so very high
6 current, then the -- the -- the time will be shorter.
7 It will manifest itself. Electromigration and stress
8 migration manifests itself as a increase contact
9 resistance.

10 So you want to reduce the resistance. You
11 want to ke- -- keep the resistance low, reduce
12 resistance. And one way to reduce resistance -- it's
13 not just -- in the beginning, you reduce the resistance
14 of your system. You design the system with low
15 resistance in the beginning, but also a re- -- a con- --
16 interconnect structure that has continuous low
17 resistance over the operation lifetime of the device.

18 So you don't want -- you want to continue
19 to have a reduced contact resistance in the structure.
20 You don't want resistance to be increased due to
21 electromigration or stress migration.

22 Q. Could you look at Kobayashi and tell me without
23 the benefit of Kikkawa how long it would take for
24 Kobayashi to experience the problems of stress-induced
25 electromigration?

1 MR. TIPESCU: Objection, form.

2 A. Can you repeat your question. I think it's...

3 Q. (BY MR. SAUNDERS) Yeah. Could you look at the
4 disclosures in Kobayashi and determine how long without
5 the benefit of -- of Kikkawa would it take for
6 Kobayashi's design to experience the problems of
7 stress-induced electromigration?

8 MR. TIPESCU: Objection, form.

9 A. A- -- again, I'm -- these devices, the
10 ruggedness -- the reason they use ruggedness, these
11 devices are used in -- we cannot -- in the
12 semiconductive devices you cannot control the
13 environment the device is going to be used in. Okay.

14 So to that extent, a harsher environment
15 will cause these effect to be more exaggerated or mani-
16 -- more manifested -- or "more accelerated" is --
17 probably is a better word.

18 So to that extent, we -- in -- in our
19 field, we try to guarantee a lifetime over certain
20 normal operating condition. Now, the user may not use
21 it at that operating condition; may use at a much
22 harsher condition. So any benefit -- known benefit,
23 known method that yields a benefit in terms of reduction
24 or contact resistance as functional operation.

25 A POSITA -- it would be obvious to a POSITA

1 to apply that to semiconductive devices, to CMOS
2 devices. It's particularly to a vertical power DMO- --
3 power devices such as Kobayashi's device.

4 Q. (BY MR. SAUNDERS) You're not opining that if
5 you hooked up an ohmmeter to Kobayashi's source metal
6 and its plug and compared it to an ohmmeter hooked up to
7 the source metal and plug of the combination of Kikkawa
8 and Kobayashi, that before either device is turned on,
9 that the combination of Kobayashi and Kikkawa would have
10 lower resistance, correct?

11 MR. TIPESCU: Objection, form.

12 A. There may be way to trick the composition, such
13 that the starting point of the composite layer would
14 have lower contact resistance. It just depends on the
15 -- on the -- on the chemistry, on the process.

16 I'm simply saying that given whatever
17 starting point is, which you could trick it to be lower
18 starting point with a composite layer. Over time, that
19 starting resistance, it's not going to run away,
20 increase to the point of failure with the composite
21 layer composition simply because it has better immunity
22 against electromigration and against stress migration.

23 Therefore, whatever starting contact
24 resistance you have, it could be lower for the composite
25 layer compared to the single layer, depending on how you

1 treat the process again. And you could be -- starting
2 point could be lower, but then that lower starting point
3 -- that starting point, that lower starting point will
4 be maintained -- continue to be maintained as a low
5 resistance over time with a composite layer simply
6 because it's more immune from electromigration and
7 stress migration.

8 Q. All right. Can you turn to Paragraph 111 of
9 your declaration. Let me know when you're there.

10 A. I'm there.

11 Q. This is a portion of your declaration
12 addressing an argument that Claim 5 is obvious over
13 Kobayashi and the knowledge of a POSITA; is that
14 correct?

15 A. That's correct.

16 Q. And do you see in Paragraph 111, at the end
17 there, you mention, "The given technology capability at
18 the time of invention (which is no greater than 0.5
19 microns as stated by Kobayashi)"?

20 Do you see that?

21 A. Yes, I do.

22 Q. What technology capability are you referring
23 to?

24 A. Let me refer to Kobayashi.

25 I believe it's in Column 11 of Kobayashi.

1 Column 11, line -- I guess you would call it -- 43, 44
2 -- starting at 40- -- 41. "For example, a series of
3 silicide-forming steps can be implemented by a common
4 technique used in an LSI process, having a design with
5 .35 micron."

6 So at the time, Kobayashi apparently
7 already know what will be a common technique using a
8 technology with the design with a .35 micron; therefore,
9 I'm trying to be conservative. I'm trying to say that
10 at the time of Kobayashi invention, the technology of
11 the design rule will be no greater than .5-micron.

12 Q. When Kobayashi is mentioning a "design role of
13 0.35 microns," what is that measuring?

14 A. For this question, I need to give a little bit
15 of lengthy answer. Please bear with me. The way we
16 define "technology," each generation, the technology, we
17 define -- for example, some people -- we go an -- we
18 went from 1 micron, 7-micron, .5-micron, .35 micron.

19 In each generation, the technology -- as
20 the technology advances, the idea is that we strengthen
21 the feature size so that we compact more device onto a
22 given real estate.

23 So the nomenclature typically used for
24 each technology is that to -- to -- in order to compare
25 apple to apple to see how events or technology, we use a

1 number. For example, we -- when we set the design of
2 .35-micron technology, that means my mask, when I draw
3 it on the mask, the mi- -- minimum feature size my
4 technology can provide is .35 micron.

5 That include -- I can -- my lithography
6 could resolve a .35-micron contact feature. That
7 include my lithog- -- my -- my -- my etching capability
8 or my spacing capability could be at the .35-micron
9 rule. Okay.

10 So when Kobayashi says, "I have your design
11 rule at .35 micron," the nomenclature, it just means
12 that it's a -- it's a indication of the technology. And
13 typically, that .35 micron always referred to, as I
14 mentioned earlier, the minimum feature size that you can
15 resolve in a given technology.

16 And inevitably, only -- al- -- always refer
17 to two features -- that will be the minimum, either the
18 gate feature or the contact feature.

19 So some- -- sometimes you -- you -- you see
20 in the industry, they -- they have what's called
21 half-pitch or a technology pitch; meaning that I --
22 instead of defining .35 to show how advanced my
23 technology is, I define half the contact size along with
24 half the poly size as my minimum feature.

25 So to that extent, typically, the contact

1 feature and the poly feature will be using the minimum
2 design rule afforded by the technology.

3 Q. And so you don't know when Kobayashi mentions a
4 design rule of 0.35 microns whether that's referring to
5 contacts or gates, correct?

6 MR. TIPESCU: Objection, form.

7 A. As I mentioned, only two dimension used minimum
8 design rule. One is contact, and one is metal -- one --
9 one is poly.

10 Q. (BY MR. SAUNDERS) And you're not sure which of
11 those is the 0.35 micron in Kobayashi, right?

12 MR. TIPESCU: Objection, form.

13 A. As I also testified, that one of the feature --
14 one of the bragging rights -- or one of the feature is
15 half contact, half micron; meaning that contact and mic-
16 -- cont- -- half -- half contact and half poly and half
17 gate, half con- -- start over.

18 The -- some of the bragging right -- or
19 some of the figure merit is half contact adding half
20 gate width; so therefore, it's an indication both of
21 them are either at the minimum contact, minimum feature
22 size or very close to a minimum feature size. It's not
23 going to deviate very much from it.

24 Q. (BY MR. SAUNDERS) Now, you can have a process
25 with a design rule of 0.35 microns and still have

1 contacts with a diameter larger than 1.0 micrometers,
2 correct?

3 A. I disagree. This is one of the technology I
4 believe that -- that -- this is one of the technology
5 feature I don't want to -- I don't want to -- I don't
6 want to -- to be personalized. This is one of the
7 technology feature that contact size is always the same
8 and always the minimum feature size.

9 The reason for that is these contacts will
10 need to be filled, regardless whether you have a
11 vertical power MOSFET or vertical -- vertical -- a
12 source contact.

13 A contact size is always minimum feature,
14 because whether it is a vertical contact or -- or just
15 regular contact, the contact always has to be filled by
16 tungsten -- in the case of .35 micron will be tungsten.

17 And you cannot have different contact size
18 across the die be- -- in that case, because some of the
19 -- the wider one, like you say, with more micron, the
20 contact will not be filled. You will have a contact
21 only lining the -- the -- the -- the big contact,
22 so-called alleged white contact, hypothetical white
23 contact.

24 And that's going to be cause of problem
25 later on in terms of topography, in terms of

1 planarization, in terms of having upper metal coming
2 down to contact; and for example, in the case of
3 aluminum silicon, copper with titanium lining that
4 coming down the contact.

5 So therefore, in the technology, unless it
6 is a specific -- a requirement where use for test
7 structure, the contact size always is the uniform across
8 the diagonal metaquad, and it's always the same size,
9 minimu- -- close to minimum size, feature size.

10 Q. So you could have a design rule of 0.35 microns
11 for the gate dimension and have uniform dimensions for
12 the context of greater than 1.0 micrometers, correct?

13 A. Repeat your question again.

14 Q. You could use a design rule of 0.35 microns for
15 the size of the gates but still have contacts throughout
16 the device that are all greater than 1.0 micrometers in
17 diameter, correct?

18 A. I disagree. Now, let me just for the sake of
19 -- shorten my answer, let me just apply it to a -- a
20 vertical DMOS situation. Let's say this vertical DMOS
21 situation in the case of Kobayashi fabricate under
22 .35-micron design rule.

23 Now, both the trench gate as well as the
24 source contact needs to be filled with a given layer.
25 And we'd al- -- already mentioned that that layer, that

1 -- that -- the thickness of that layer has to be greater
2 than the opening of the trench, in the case of trench
3 gate or in the case of trench contact.

4 As I mentioned, if the dimension of the
5 trench gate is much wider or the dimension of the
6 contact size is much wider, then the thickness of the
7 layer you are trying to conformally deposit to fill,
8 it's not going to completely fill that hole. And that's
9 going to be problematic, as I testified earlier.

10 Therefore, I would disagree that you would
11 have a .35-micron design rule and yet have a 1 micron --
12 greater than 1-micron feature size for the contact
13 layer.

14 Q. Now, when Kobayashi mentions a zero -- a design
15 -- sorry. Withdraw.

16 When Kobayashi mentions a design rule of
17 0.35 microns, it's part of the sentence, "For example,
18 "a series of silicide-forming steps can be implemented
19 by a common technique used in an LSI process, having a
20 design rule of 0.35 microns"; is that correct?

21 A. It's correct what you just read. It's -- it's
22 -- it's described as a -- it's in Kobayashi.

23 Q. And -- and that's a portion of Kobayashi that's
24 talking about steps for creating a silicide, correct?

25 A. What Kobayashi is saying that in the .35-micron

1 process technology, the feature of a silicide forming
2 step is available. This is indication that Kobayashi's
3 technology at the time of -- of the -- the state of
4 technology -- the state of the art of technology at
5 Kobayashi's time, .35 micron alone with its saving
6 feature, such as silicide-forming steps, are well known
7 already.

8 Kobayashi already known that .35-micron
9 technology has the silicide-forming steps, which mean
10 it's a -- a knowledge at a time already for the state of
11 the art. This is why I try to be conservative. I said
12 the technology capability at a time of invention is no
13 greater than .5 micron. I'm trying to give a little bit
14 of a gap.

15 Maybe Kobayashi is not using the most
16 advanced one, but he cannot be too far from it. And the
17 previous generation technology is .5, but kobayashi
18 already know all of the detail. It's already a
19 hindsight now of all the detail of the saving feature of
20 a .35-micron technology.

21 Q. You're not sure if the LSI process having a
22 design rule of 0.35 microns that's referred to in
23 Kobayashi was a process that was actually being used to
24 create power MOSFETs, correct?

25 MR. TIPESCU: Objection, form.

1 A. Again, repeat your question, please.

2 Q. (BY MR. SAUNDERS) Yeah. You -- you're not
3 actually sure that the LSI process having a design rule
4 of 0.35 microns that's referred to in Kobayashi was
5 actually being used to manufacture power MOSFETs,
6 correct?

7 MR. TIPESCU: Objection, form.

8 A. I disagree, because in -- as we mention in
9 Column 8 of Kobayashi, he mentioned that -- he described
10 an aperture of a trench -- the aperture width of a
11 trench of .35 micron -- for the gate -- gate trench of
12 .35 micron; meaning that, in fact, Kobayashi is
13 discussing the feature of a .35-micron technology.

14 And I'm simply trying to step back and
15 saying that there's no greater than -- because .35
16 micron is no greater than .5-micron. So my statement is
17 that given what Kobayashi's disclosed explicitly, the
18 aperture sides is .35 micron; meaning that he can
19 resolve a printing of .35 micron opening, and the fact
20 that he knows the saving feature of a .35-micron
21 technology. (Coughing.) Excuse me.

22 Kobayashi is discussing his technology or
23 his power MOSFET very much close to a .35-micron
24 technology no greater than .5. In fact, it should be
25 .35 micron technology because the aperture is .35

1 micron. (Coughing.) Excuse me.

2 Q. So that .35-micron aperture measurement, would
3 you mea- -- would that be something that would be
4 measured in the mask, or would that be something that
5 would be measured in the actual fabricated device?

6 A. Again, to answer your question, I need to go
7 back to a -- a -- a -- give you background, little bit.
8 The .35 micron ti- -- .35 micron, in art when we -- when
9 we set a design rule -- when we set a design rule, we
10 try to make sure what is shown, what is laid out in the
11 design rule is as faithfully reproduced as possible onto
12 the silicon itself, onto the semiconductor wafer.

13 It could be -- it could be -- when I say,
14 "silicon," I mean it may be overlying -- overlaying
15 layer from the starting substrate such as that P-layer
16 and -- and all this.

17 So we're trying to reproduce as faithfully
18 as possible. So when I say "aperture of .35 micron,"
19 even if it's drawn at .35 micron, at the time a --
20 technology -- the process technology has to deliver, has
21 to reliably print that aperture at .35-micron as
22 accurate as possible.

23 Granted for square -- square feature or for
24 rectangle feature, you may have rounding, but you're
25 trying to reproduce, given with the rounding, and you

1 can address it with truncating. You're trying to
2 reproduce as -- at least in the aperture case, you're
3 trying to reproduce that features -- feature size as
4 much as possible.

5 Q. In your experience with
6 semiconductor-manufacturing technology at the time of
7 Kobayashi, in general, you'd expect that the opening of
8 a trench top would be wider than the -- actually, let me
9 withdraw.

10 All right.

11 A. Counsel, before your next -- after your next
12 question, can we take a break -- another bio break?

13 MR. SAUNDERS: Yeah. Let's -- let's go off
14 the record.

15 THE WITNESS: All right. Thank you.

16 THE VIDEOGRAPHER: The time is 4:07. We're
17 off the record.

18 (Break taken from 4:07 p.m. to 4:18 p.m.)

19 THE VIDEOGRAPHER: The time is 4:18. We're
20 back on the record.

21 Q. (BY MR. SAUNDERS) All right. Dr. Kim [sic],
22 can you turn now to Paragraph 133 in the your
23 declaration?

24 A. Dr. Liu, you mean. Sorry.

25 Q. Oh, I'm sorry. It's late -- late in the

1 afternoon.

2 Dr. Liu, can you please turn to
3 Paragraph 133 in your declaration.

4 A. (Audio distortion.) It -- it -- it doesn't
5 bother me. I just want to make sure I'm in the right
6 deposition. That's all.

7 Q. You there?

8 A. I -- I'm there.

9 Q. Okay. So this is part of your declaration
10 related to the motivation to combine Kobayashi and the
11 Hshieh reference, correct?

12 A. That's correct.

13 Q. Okay. And in Paragraph 133, you cite the Kim
14 reference; is that correct?

15 A. That's correct.

16 Q. You say that, "The Kim reference discusses the
17 benefits of trench corner rounding leading to higher
18 breakdown voltage and lower leakage current"; is that
19 correct?

20 A. You -- that's correct.

21 Q. You'd agree with me that the trench corner
22 rounding discussed in Kim relates to that rounding you
23 see in trench bottoms and trench openings in the
24 side-view cross section, correct?

25 MR. TIPESCU: Objection, form.

1 A. (Coughing.) Excuse me. As I mentioned, the --
2 in the -- in the side view -- or cross section view --
3 side view, the -- the fact that corner rounded is a
4 three-dimensional issue, meaning that the trench corner
5 in the -- going from the top view or the plain- --
6 plainer view X horizontal cross section will also be an
7 issue as well if you look from the top.

8 It's a -- it's a three-dimensional problem,
9 and it's -- it's not -- I don't think -- I -- as I
10 testified earlier, the exist- -- the stress or the --
11 the rounding does not know which corner. Whether it's
12 -- it's lying down or it's standing up, there's a --
13 there's a corner, and rounding will occur.

14 Q. Okay. But you don't dispute that Kim is only
15 depicting rounding that's visible in the side-view cross
16 section, correct?

17 MR. TIPESCU: Objection, form.

18 A. I think better way to say is that Kim described
19 the issue rounding corner using -- using the -- the
20 rounding in the -- in the bottom and the corner in the
21 cross-sectional view as a -- as a -- as a illustration
22 to -- to -- for discussion.

23 Q. (BY MR. SAUNDERS) Oh. Okay. Thank you.

24 And then in paragraph -- in
25 Paragraph 133, you state towards the end of that

1 paragraph, "Hshieh also discloses vulnerable
2 punch-through weak points in the corners of square cell.
3 Again, this is due to an undesirable higher peak
4 electric field being reached due to the same corner
5 effect."

6 Do you see that?

7 A. Yes, I do. It's similar -- analogous to -- to
8 -- to Kim and also to Kobayashi. Again, as I -- we
9 discussed earlier, even if you look at the cross
10 section, you see the rounding. That rounding -- or the
11 -- before the rounding with a sharp corner, that's going
12 to be an issue, and that issue is mitigated by having --
13 have -- have -- having a rounding; and that rounding,
14 although is shown in the cross section -- vertical cross
15 section, it exists also, again, in the -- in the top
16 view in -- in terms of looking at a top view, that
17 corner also be rounded in top view.

18 Q. And after the portion of Paragraph 133 of your
19 declaration that I just read, you have a citation to
20 Column 2, Lines 19 through 39 of Hshieh, correct?

21 A. Yes. That's cited there, 29 -- 19 through 39.

22 Q. All right. And you should have the Hshieh
23 reference available, Exhibit 1006, in Exhibit Share.

24 Can you pull it up and go there to Column 2
25 for me.

1 A. I'm on Column 2 now.

2 Q. And do you see that the portion of Hshieh that
3 you cited to has a discussion of the three-dimensional
4 diffusion effect?

5 A. Which line? So --

6 Q. So for example, Column 2, lines -- I -- I
7 believe it's 24 through 26?

8 A. Yes. I do see that.

9 Q. And so Hshieh identifies the three-dimensional
10 diffusion effect as what is causing high electric fields
11 in the corners, correct?

12 MR. TIPESCU: Objection, form.

13 A. I think better way to say is that corner issue
14 -- an issue, corner crosses the avalanche breakdown to
15 be compromised. And there are many reason that corner
16 is an issue. It could be -- in terms of your layout --
17 in terms of where you have a layout with a -- such as
18 the case of square layout, you may have distance issue,
19 which exacerbate the current flowing nonuniformity
20 because the corner there that cause current
21 nonuniformity, in which results in bipolar transistors
22 being turned on.

23 Now, you could -- at a corner, it is also
24 known that you could have a three-dimensional diffusion
25 effect, which will make the -- the doping profile in the

1 corner much sharper, much steeper; therefore, you also
2 have issue to cause punch-through effect.

3 These are all interrelated, and they are
4 many facet of an issue with a corner, and many facet
5 with a issue that you're trying to address in -- in a
6 power -- vertical power MOSFET.

7 Q. Just focussing specifically on that portion of
8 Hshieh at Column 2, Lines 19 through 39, the only
9 problem related to corners discussed in that passage is
10 the three-dimension diffusion phenomenon, correct?

11 MR. TIPESCU: Objection, form.

12 A. He cites Yilmaz reference as indication of an
13 issue that -- that makes a power device compromise
14 because of a sharp corner of a square cell.

15 Q. (BY MR. SAUNDERS) And that name of that issue
16 is the three-dimension diffusion phenomenon, correct?

17 A. Another way it was say that a sharp corner has
18 issue, and the cited issue in the '914 Hshieh Patent in
19 a specification cites a three-dimensional diffusion
20 phenomenon, and that leads to a vulnerable punch-through
21 weakness due to a corner of a square cell.

22 Q. Now, you mentioned the Yilmaz reference there.
23 Did you review the Yilmaz reference in connection with
24 rendering the opinions in your declaration?

25 A. Yes. I believe I did.

1 (Exhibit 2012 marked.)

2 Q. (BY MR. SAUNDERS) I'm going to -- actually, I
3 believe it's already been marked as Force Mos Exhibit
4 2012, U.S. Patent Number 5,304,831 to Yilmaz et al.

5 Do you see that in Exhibit Share?

6 A. Let me try to get to it. (Reading exhibit).
7 2012? Yilmaz. Yes, I have it now.

8 Q. Okay. And is that the Yilmaz reference that's
9 discussed in -- let me withdraw.

10 Does that appear to be the Yilmaz
11 reference that's discussed in the Hshieh reference at
12 Column 2, Lines 19 through 39?

13 A. I believe so.

14 Q. Okay. And if you'll turn in Yilmaz to Column
15 3, Line 52, and let me know when you're there.

16 A. Column 3, Line 52?

17 Q. Yep. Actually, let's do Column 3, Line 42.

18 A. Okay. I'm there.

19 Q. And do you see that's a beginning of a section
20 of Yilmaz explaining "an effect known as the
21 three-dimensional diffusion phenomenon"?

22 A. That's correct.

23 Q. And Yilmaz mentions that in that phenomenon,
24 the "P-type dopant diffuses horizontally at a rate of
25 about 80 percent of vertical diffusion."

1 Do you see that?

2 A. Yes, I do.

3 Q. And do you see that it says, "In the corners,
4 the effective rate of horizontal diffusion" of P-type
5 dopant is "on the order of merely 50 percent"?

6 A. Yes, I do.

7 Q. And do you see that later on in the same
8 passage, it says, "While the effect also occurs with the
9 N-type dopant, it is much less severe than the effect
10 seen with the P-type dopant. The reason is because the
11 N-diffusion, the second diffusion in the double
12 diffusion process is a rather heavy N+ plus type
13 diffusion to a comparatively shallow depth on the order"
14 of -- "from 0.5 to 1 micron. Moreover N-type dopant
15 tends to ditch fuse to about the same extent
16 horizontally as vertically"?

17 Do you see that?

18 A. Yes, I do. I also want to point out that in
19 Line 52, the basis of my -- of my analysis, he also has
20 common that the result is that diffusion does not
21 advance as far at the corner of the square cell as it
22 does along the linear segment.

23 Again, this is referring to the distance
24 of a corner cell, which is what '409 Patent is -- is
25 discussing also. The distance with a corner, unless

1 it's truncated distance farther, and -- and because the
2 distance farther, these kind of problems gets
3 exacerbated.

4 Q. So in Yilmaz at Column 3, Line 65 through
5 Column 4, Line 2, it's stating that because in the
6 corners the P-type dopant is not advanced as far as the
7 N-type dopant, the result is a shorter channel link,
8 correct?

9 MR. TIPESCU: Objection, form.

10 A. I want to point out that -- where do you see
11 the channel length issue?

12 Q. Column 4, Lines 1 through 2.

13 A. See, so the -- it's not the channel length. I
14 was going to say that it's not the channel length per se
15 that's an issue. It's that because the doping is not as
16 much; therefore, that doping compared to a linear -- a
17 diffusion to a linear edge doping, that doping is not
18 sufficient to sustain the voltage; therefore, you will
19 have more of a leakage occurring, which will lead to
20 punch-through.

21 Again, this is due to the corner is
22 distance longer, so the dopant -- P-type dopant cannot
23 diffuse as much; whereas, N-type dopant being high --
24 highly dopant is called the dopant-enhanced diffusion;
25 meaning the higher concentration diffuse faster; so

1 therefore, you have this issue of not being able to
2 sustain the voltage due to premature punch-through
3 -- punch-through breakdown.

4 Q. You see in Column 4, Lines 9 through 11, it
5 says, "Punch-Through would occur because the
6 three-dimensional diffuse effect would cause the channel
7 44 to be excessively short at the corners"?

8 Do you see that?

9 A. Yes, I do.

10 Q. "Short" there is talking about the length of
11 the channel, correct?

12 A. That's correct. But in the -- the -- the
13 context is that the -- the channel 44 does tend to be
14 shorter at the corner. The cell is still useful.

15 So that's -- that's what I was trying to
16 emphasize, highlight. It is not channel length, per se.
17 It's -- is a causal effect. It's not channel length per
18 se that is the problem. It's the fact that the dopant
19 diffused less so that the buffer region or the -- the
20 region that need to sustain the voltage; and of course,
21 one manifestation is the shorter channel length. But
22 that channel length can give you higher current. By
23 itself, it's not the problem.

24 It's doing the off stay when that region no
25 longer can have enough dopant or enough distance to

1 support the breakdown voltage; therefore, the premature
2 punch-through would occur, which would compromise your
3 device reliability.

4 Q. And if you go to Column 3 of Yilmaz, Lines 42
5 through 45, it's talking -- it says that, "The
6 three-dimensional diffusion phenomenon generally does
7 not cause too much of a problem in the cells of Figures
8 3 and 4, although it is evident in the plan view of
9 Figure 3."

10 Do you see that?

11 A. Again, column -- column -- I'm sorry. I -- I
12 lost -- somehow I lost the -- yeah. The -- the --

13 (Simultaneous conversation.)

14 Q. (BY MR. SAUNDERS) Yeah. Let -- let me just
15 tell you again. So Column 3, Lines 42 through 45, you
16 see it's referring to Figures 3 and 4 of Yilmaz in
17 connection with the three-dimensional diffusion
18 phenomenon?

19 Do you see that?

20 A. Yes, I do.

21 Q. Okay. And can you turn to Figure 4 of Yilmaz.

22 A. Okay.

23 Q. Figure 4 of Yilmaz is not depicting a trench
24 MOSFET, correct?

25 A. Figure 4 is depicting a -- a -- a power MOSFET.

1 And the evolution of power MOSFET, as someone who work
2 in the field many years, is that the first -- the gate
3 is become trenched; and then later on, the source
4 contact become trenched. This is evolution.

5 So this would be a earlier generation of
6 power MOSFET, without that has not adopted the vertical
7 gate -- gate trench -- trench gate and has not adopted
8 trench source contact. Yes.

9 Q. And so would you call the MOSFET design in
10 Figure 4 of Yilmaz a lateral MOSFET?

11 MR. TIPESCU: Objection, form.

12 A. No. It's still a vertical power MOSFET. But
13 that vertical referred to the way the current flows. It
14 doesn't refer to the -- how should I say? It doesn't
15 refer to having a -- a trench contact or a trench gate
16 being vertical.

17 But the current still flow vertically, I
18 believe. Yeah. I -- I -- I'm -- I -- I shouldn't say
19 "I believe." I -- I -- it is -- it is the case, yeah.
20 So it's still a vertical DMOS. "Vertical DMOS" simply
21 means where the source is respect to the drain. It
22 doesn't tell you where the -- the -- the gate is
23 oriented or the source contact's oriented.

24 Q. (BY MR. SAUNDERS) And in Figure 4 of Yilmaz,
25 the channel is located at where it's pointing at with

1 the Number 44, correct?

2 A. To be exactly accurate, that's one part of the
3 channel. So the current would go from 50 -- 52 through
4 44, and then at 54, that's where there's -- they -- they
5 going to get diverted to go down vertically.

6 So 54 technically is also a gate. It's a
7 -- it's a -- it's a -- there's a combination. And then,
8 of course, the -- the -- the that's how the vertical
9 DMOS work. It -- it -- it flows through 44, and once
10 you get to 54, the current just start making a turn to
11 go -- go vertically into the drain region, which is on
12 the bottom of the -- of the -- of the substrate.

13 Q. So 44 in Figure 4 of Yilmaz is where the
14 inversion layer can be created when the gate sends the
15 appropriate signal to the MOSFET; is that correct?

16 MR. TIPESCU: Objection, form.

17 A. I think in the context, we -- I just mentioned,
18 where the current from -- flow from 54 through 44 to 54
19 going down to -- to 46. In that context, 44 is one --
20 one of the gating path of the current flow.

21 Q. (BY MR. SAUNDERS) So in Figure 4 of Yilmaz, 52
22 is the source region, correct?

23 A. I believe that's the case. That's correct.

24 Q. And Figure 4 of Yilmaz, 50 is the P-body
25 region; is that correct?

1 A. Yes. I believe that's correct.

2 Q. And in Yilmaz, 54 is the drain region; is that
3 correct?

4 A. 54 percent is not a drain region. 54 percent
5 is where there's a -- what's known as JFET region where
6 the current a- -- di- -- diverted current will -- will
7 be accumulating along 54 and then get diverted and go
8 down vertically. So that's not --

9 (Simultaneous conversation.)

10 Q. (BY MR. SAUNDERS) Go ahead.

11 A. I'm just saying that's not a drain.

12 Q. In Figure 4 of Yilmaz, you'd expect that Region
13 52 would have opposite type doping of Region 50; is that
14 correct?

15 A. For a transistor to -- to happen, yes, 52 will
16 be first connectivity type, and the 50 will be another
17 connectivity type, the second connectivity type.

18 Q. And you'd expect Region 50 to have opposite
19 type doping of Region 54?

20 A. Say that again?

21 Q. In Yilmaz Figure 4, you'd expect Region 50 to
22 have the opposite type of doping as Region 54, correct?

23 A. Yes, that's correct.

24 Q. And so that means that you'd expect Region 52
25 and Region 54 in Yilmaz to have the same type doping,

1 correct?

2 A. Same polarity as doping. But the type, I want
3 to be cautious. It -- it may not -- it may not have the
4 same concentration, but same polarity -- connectivity
5 type, I would say, yeah.

6 Q. And the MOSFET illustrated in Figure 4 of
7 Yilmaz has horizontal PN junctions between 52 and 50 and
8 50 and 54, correct?

9 A. I disagree. It has junction in all direction,
10 including as your -- your language is what -- what's
11 your language?

12 Q. Let -- let me withdraw and -- and ask it this
13 way.

14 So in the channel region of Yilmaz Figure
15 4, the junction between 52 and 50 is a horizontal PN
16 junction, correct?

17 A. I disagree. It's both -- it -- it's a -- it's
18 a -- it's a two-dimensional. 52 to 50, the way the
19 breakdown works, it's just -- it's -- it's -- it's both.
20 It's 50. The junction between 52 and 50 is all around
21 52, and the junction between 50 and 54 is all around 50.

22 Q. So it had -- in your opinion, it has both
23 vertical and horizontal and in-between junctions between
24 52 and 50; is that correct?

25 A. That's how a junction's defined. That's

1 correct.

2 Q. And the same answer be- -- between 50 and 54;
3 is that correct?

4 A. Yes, that's correct.

5 Q. Now, could you turn to Figure 5A of Kobayashi.

6 A. Figure 5A, you said?

7 Q. Yeah.

8 A. I'm there.

9 Q. And in Kobayashi's Figure 5A, the source region
10 12 and the body region -- sorry. Let me withdraw. I
11 want to make sure I get my numbers right here.

12 In Figure 5A of Kobayashi, the source
13 region and the P-body region only have a vertical PN
14 junction, correct?

15 A. Can you repeat your question again because it
16 -- it's a -- it's a -- there's a little bit of a --
17 there's a little bit of subtlety, I believe, about...

18 Q. Yeah. In Figure 5A of Kobayashi, the source
19 layer and the P-body layer only have a vertical PN
20 junction, correct?

21 A. As shown in Figure -- in Figure 5A, I -- I
22 think the N+ interface with a P, although I -- I need to
23 caution that P-base -- of course, within that P-base
24 region, there's also the source contact layer. That's
25 also P-type. So that will also contribute to a

1 junction. But -- but mostly -- I think the answer to
2 your question is mostly yes.

3 Q. Okay. I heard "yes." Can you get a little
4 closer to the screen again, Dr. Kim [sic]. You're
5 getting a little soft.

6 A. It's Liu.

7 Q. And, Dr. Kim [sic], in Figure 5A of Kobayashi,
8 the only -- let me withdraw it.

9 (Simultaneous conversation.)

10 MR. TIPESCU: Before you go on, just
11 interject. Just for -- to clear up the record, I don't
12 know -- I heard almo- -- "mostly yes" on the -- as the
13 answer to the last question. So I heard the word
14 "mostly" before, so I -- I don't think it was "yes," but
15 that's -- that's what I heard.

16 MR. SAUNDERS: Okay. Actually, can the
17 court reporter re- -- read back the last answer.

18 (Requested portion was read.)

19 Q. (BY MR. SAUNDERS) All right. Dr. Liu, what do
20 you mean by "mostly"?

21 A. I just want to be -- be cautious that to the
22 extent how far does that P-base layer go and how far it
23 forms on the -- so as you can see that -- that -- that
24 junction and -- and where there -- where there's
25 curvature.

1 So I just want to be cautious that there --
2 there might be aspect where due to the curvature, that
3 it's not a plane and flat vertical junction. That's
4 all.

5 Q. I'm sorry. Which element's curvature in Figure
6 5A of Kobayashi are you referring to?

7 A. I'm referring to 14 -- P-base 14.

8 Q. Okay. So in Figure 5A of Kobayashi, it's not
9 showing Element 14 contact, the source layer, correct?

10 A. I beg your pardon?

11 Q. In Figure 5A in Kobayashi, there's -- it's not
12 showing Element 14 contact Element 10, correct?

13 A. That's correct.

14 Q. And in Figure 5A of Kobayashi, the only
15 junctions between the N- layer 2 and the P-body layer
16 are vertical PN junctions, correct?

17 A. Yes. I think I answered that question already.
18 Yes.

19 Q. Okay. And because of the vertical -- actually,
20 let me withdraw one more.

21 I -- I believe we talked about this
22 yesterday, but I just want to make sure it's on the
23 record today. The channel in Kobayashi Figure 5A is in
24 the vertical direction adjacent to the gates, correct?

25 MR. TIPESCU: Objection, form.

1 A. Repeat the question again.

2 Q. (BY MR. SAUNDERS) Maybe -- maybe I'll ask it
3 this way.

4 So in Figure 5A of Kobayashi, the channel
5 region is adjacent to the gates approximately where that
6 X to X prime line is, but obviously in the P-body layer;
7 is that correct?

8 MR. TIPESCU: Objection, form.

9 A. I guess fair to say -- say -- way to say is
10 that current flow -- flow ver- -- vertically along
11 the -- the sidewalk of the gate trench going down into
12 the N- region.

13 Q. (BY MR. SAUNDERS) And so because of the
14 vertical arrangement of the source/body and drain
15 regions in Kobayashi Figure 5A and the vertical
16 direction of its channel, Kobayashi Figure 5A would not
17 experience the three-dimensional diffusion problem as
18 explained in Yilmaz, correct?

19 MR. TIPESCU: Objection, form.

20 A. Not necessarily correct. There's going to be
21 corner in Kobayashi with respect to the gate just like
22 there's going to be corner respect to the gate in
23 Yilmaz.

24 Now, although the current flows vertically,
25 we need to remember that at this gate interface,

1 especially in the corner, there are -- there are other
2 effect. And I -- suffice to say that there are other
3 effect that contribute to doping concentration and due
4 co- -- co- -- also cont- -- contributing to electro
5 field; therefore, it's contributing to punch-through
6 current phenomenon.

7 Q. (BY MR. SAUNDERS) In Kobayashi's Figure 5A, it
8 would not have shorter channels in the corners that are
9 visible in, for example, Figure 3A of Kobayashi,
10 correct?

11 MR. TIPESCU: Objection, form.

12 A. I think, as I testified earlier, channel is one
13 thing. It's really -- and Yilmaz specifically mentioned
14 very clearly that shorter channel is fine. The device
15 still functional. It is because the -- the -- the
16 corner, along with the -- you can say either due to
17 doping effect or due to corners -- corner due to high
18 electric field or due to longer distance, it introduces
19 an onset of breakdown in a form of punch-through, also
20 in the form of degraded, avalanche breakdown.

21 Q. Okay. But you're not disputing that in
22 Kobayashi, the channels are not shorter in the corners,
23 correct?

24 MR. TIPESCU: Objection, form.

25 A. I think perhaps a better way to answer is that

1 because of the corner and because the way that implant
2 is done to form the P region and N+ region and given the
3 fact that with that corner you have this trench corner,
4 and there's a issue with a dopant behavior with respect
5 to the corner. I think there may be some -- there will
6 be -- the corner will cause effect, which will be the
7 greater breakdown voltage.

8 So when you say "channel," it is -- is
9 really depends on the profile of the doping right next
10 to the gate trench due to the two-dimensional -- due
11 to -- sorry -- the three-dimensional wall, in the case,
12 top down two-dimensional quality at the -- at the top
13 service.

14 So there may be -- there may be -- there
15 may be some variation going on there.

16 Q. Okay. So Figure 5B of Kobayashi depicts the
17 doping concentration on the line of X to X prime in
18 Figure 5A of Kobayashi, correct?

19 A. That's correct.

20 Q. Okay. And it's not telling you whether that
21 line of X to X prime in Figure 5A of Kobayashi is in a
22 corner or away from a corner, correct?

23 MR. TIPESCU: Objection, form.

24 A. I think showing there is a way from the edge,
25 from both edges, both source contact edge, and also the

1 gate -- trench gate edge.

2 Q. (BY MR. SAUNDERS) Figure 5A is -- is showing X
3 to X prime much closer to the trench gate than the
4 source trench, correct?

5 A. I would say that's fair, yes.

6 Q. So sitting here today, can you point me to any
7 disclosure in Kobayashi that indicates to you that
8 Kobayashi's embodiment of Figure 5A would have a shorter
9 channel length in the corners?

10 MR. TIPESCU: Objection, form.

11 A. Can you repeat your question. I'm sorry. I --
12 I was trying to think, and I lost my train of thought.

13 Q. (BY MR. SAUNDERS) Yeah. So sitting here
14 today, can you point me to some disclosure in Kobayashi
15 that indicates to you that Kobayashi has a shorter
16 channel length in the corners?

17 MR. TIPESCU: Objection, form.

18 A. Again, you're looking at Figure 5A. If you
19 just compare the N+ -- the extent of the N+ region, and
20 to the extent of the P-region, it's shown to be -- to be
21 constant across; however, as I mentioned, there's a
22 corner in Kobayashi, and that corner could be a cause of
23 variation, whether it's in peak electro field or whether
24 it's the doping concentration.

25 It's not shown in Figure 5A, but we know

1 that in the -- in the case where there's a -- there's a
2 corner with the -- with the poly with a trench. And the
3 way the corner works, the rounding, there may be -- and
4 given that you are implanting through with a gate
5 transform already, there may be variation in the doping
6 going into the -- going to the -- the silicon,
7 especially with the trench corner at the corner due to
8 the implant shadowing whatnot.

9 Q. (BY MR. SAUNDERS) In Figure 7A of Kobayashi,
10 that's showing a step where the source and body regions
11 are created, correct?

12 A. That's correct.

13 Q. And those regions -- like, let me withdraw.

14 So in Figure 7A of Kobayashi, you'd first
15 implant the P-body layer across the entire surface of
16 the wafer, correct?

17 MR. TIPESCU: Objection, form.

18 A. Sufficed to say that the implant is done, and I
19 don't believe it's show- -- showing all the mask,
20 sufficed to say that the implant is done after the --
21 the -- the formation of the gate trench.

22 Q. (BY MR. SAUNDERS) And the...

23 A. I -- I should caution in terms of the actual
24 process flow. As I mentioned earlier in my testimony
25 also in my declaration, in six -- the basis of my

1 testimony is that in 6C, as I nano- -- annotated 6C, I
2 just want to qualify my earlier answer that because
3 there's going to be rounding of the corner at all
4 dimension and you're implanting through that as you want
5 to discuss Figure 7 in terms of the implant, that's my
6 -- the basis of my -- my point that the implant and the
7 doping along the sidewall may be impacted by the corner
8 of the trench as shown in 6C -- as shown in my annotated
9 6C. And I -- and I -- I wasn't able to -- to answer the
10 question in time before you jumped to next question.

11 Q. Yeah. I'm sorry that -- you're a little soft
12 again.

13 MR. SAUNDERS: Can the court reporter
14 please read back the last answer for me.

15 (Requested portion was read.)

16 MR. TIPESCU: Michael, can we -- is this a
17 good time to take a break?

18 MR. SAUNDERS: I -- I'm fine. Yeah. Let's
19 go off the record.

20 THE VIDEOGRAPHER: The time is 5:06. We're
21 off the record.

22 (Break taken from 5:06 p.m. to 5:18 p.m.)

23 THE VIDEOGRAPHER: The time is 5:18. We're
24 back on the record.

25 THE WITNESS: I have the earbud just --

1 just in case, but I'll try to speak louder.

2 MR. SAUNDERS: Okay. Thanks.

3 Q. (BY MR. SAUNDERS) Dr. Liu, can you turn back
4 to the Yilmaz reference.

5 A. Okay. I'm there.

6 Q. And can you point me to where in Yilmaz you
7 believe it discusses problems associated with corners
8 other than in connection with shortening of the channel?

9 MR. TIPESCU: Objection, form.

10 A. Can you repeat your question again.

11 Q. (BY MR. SAUNDERS) Yeah. So where in Yilmaz
12 does it discuss problems associated with corners, other
13 than in connection with shortening of the channel?

14 MR. TIPESCU: Same objection, form.

15 A. Okay. I think that the -- I'll answer the
16 question this way: Yilmaz said that channel tend to be
17 shorter, and the cell is still useful. Okay. But
18 Yilmaz says that at the corner, there's going to be
19 tendency for punch-through.

20 Now, this is due to three-dimensional
21 diffusion effects, so it's not just -- not all
22 diffusion. It's also si- -- side diffusion, all lateral
23 -- all diffusion at the corner of the trench to cause
24 the punch-through voltage. Okay. So I am not combining
25 Yilmaz with Kobayashi.

1 Hshieh, looking at this three-dimensional
2 diffusion issue with the corner punch-through, is
3 applying this knowledge to a vertical gate DMOS, which
4 is same as Kobayashi. So I'm trying to -- based on what
5 Hshieh is learning from Yilmaz in terms of
6 three-dimensional diffusion causing premature
7 punch-through at a corner of the gate.

8 And this two-di- -- two-dimensional
9 punch-through -- two-dimensional gate or lateral gate,
10 as you call it, the gate that's being -- the thing --
11 la- -- these phenomena also is observed by Hshieh in a
12 vertical DMOS, and that's why Hshieh refers to Yilmaz.

13 That's the basis of my -- my opinion. And
14 the -- the di- -- the -- the key thing -- the reason I
15 keep on saying that it's not a channel, because the
16 issue here is the punch-through due to three-dimensional
17 diffusion effect, which is disclosed by Yilmaz, which is
18 also observed by Hshieh, and which is why Hshieh rounded
19 his corner and which is the motivation to combine with
20 Kobayashi.

21 Q. Can you provide me a citation to where in
22 Yilmaz you believe it discusses the problem of
23 punch-through at the corners, which is unrelated to the
24 channel length?

25 MR. TIPESCU: Objection, form.

1 A. If you look at Figure 4 -- I mean -- sorry --
2 Column 4, Line 3, while the channel to be made -- 44 to
3 be made generally short, the three-dimensional diffusion
4 effect likely will result in a punch-through at the
5 corner.

6 So it's at a corner -- or the corner in
7 this contrast is the corner of the poly layout. It
8 doesn't say at the -- at -- it doesn't say anything
9 about the channel. It's talking about the corner of the
10 poly layout, the three-dimensional diffusion effect
11 likely resulting in the punch-through at the corners;
12 meaning that because the corners has -- has the -- the
13 -- the -- the issue with the three- -- three-dimensional
14 diffusion. And this is picked up by Hshieh, and also in
15 his issue with punch-through. In his vertical gate,
16 DMOS, that he's trying to blunt the corner with.

17 So that's -- that's the basis. I'm talking
18 about punch-through will occur because of
19 three-dimensional diffusion effect will cause the
20 channel to be excessively short at the corners. But the
21 corners -- the -- the -- the corner -- the -- the
22 channel's short. It's not so much the reflection where
23 the breakdown would occur.

24 The channel "short," meaning that the whole
25 three-dimensional diffusion of the P-profile is -- at

1 the corner is short compared to where the N+ could
2 diffuse; therefore, you have an issue, and the issues
3 observed with a shorter channel length, but also lower
4 punch-through voltage.

5 Q. And why do you believe that Yilmaz is saying
6 that the punch-through can occur independently of the
7 issue of shortening of the channel?

8 A. The discussion is with respect to the diffusion
9 at the corner of one type of dopant versus another type
10 of dopant. And you -- as -- you mentioned that, as
11 well. So there's going to be, for lack of a better
12 word, retardation of the diffusion compared to the N+
13 not getting retarded.

14 And one feature is that the distance
15 between -- when you mention "junction," the distance
16 between P-base surrounding the N+ region, we can use
17 figure that you -- you were using earlier, Figure 4.

18 The -- the -- all the Region 50 that goes
19 around, with respect to 52 at the corner, the -- the --
20 (coughing.) I'm really sorry -- there's going to be
21 retardation of diffusion for the 50.

22 And, of course, 50, in the middle between
23 the 2- -- 52 in Figure 4 is aided by a -- a P+, which we
24 will call the -- which should be equivalent to the base
25 contact layer of the vertical DMOS in -- in -- in -- in

1 both Hshieh or Kobayashi.

2 However, so -- so the distance between 52
3 and 50 is in general shortened. And one manifestation,
4 one -- when we observe that is, lo and behold, the
5 channel length is shorter, so we have more dry current,
6 and that gives indication that the distance between 52
7 to 50 is shorter.

8 But given hat this is a three-dimensional
9 phenomenon, all I'm saying is that the punch-through
10 occurred due to the fact that 50 is retarded in
11 three-dimension compared to 52 not being as retarded;
12 therefore, you have a lower punch-through voltage. And
13 this is stemming from the corner effect.

14 And that's why Yilmaz is dis- --
15 disclosing, and that's why it's being -- being picked up
16 by Hshieh in his citation of Yilmaz, in his observation
17 when he applies it, the blunt corner to the trench gate.

18 Q. Turning back to Hshieh -- let me know when
19 you're back to Hshieh.

20 A. (Coughing.) I'm sorry. I'm back to Hshieh.

21 Q. Where in Hshieh does it discuss problems
22 associated with corners, other than in connection with
23 the three-dimensional diffusion phenomenon?

24 MR. TIPESCU: Objection, form.

25 A. It discuss the -- due to the corner -- due to

1 the corner in a vertical DMOS in Hshieh's structure, and
2 he is saying that one explanation is the
3 three-dimensional diffusion at the corner of a vertical
4 trench MOSFET that crosses the av- -- the punch-through
5 breakdown voltage to be compromised.

6 Hshieh is saying that; therefore, the sharp
7 corner of the polysilicon opening can be either blunted
8 or rounded as shown in Figure 6A, 6B, respectively, to
9 avoid -- in order to a- -- prevent the corner vuln- --
10 vulnerability where punch-through, weak point may be
11 formed at the sharp corner due to a three-dimensional
12 diffusion effect.

13 So it is the sharp corner. And one way
14 to attribute the lower punch-through voltage, Hshieh
15 attributed to what Yil- - Yilmaz observed due to being a
16 three-dimensional diffusion effect. But the issue is
17 that Hshieh is observing this on a vertical DMOS with a
18 corner.

19 Q. Do you have a column and line number in Hshieh
20 where it discusses punch-through at sharp corners
21 unrelated to the three-dimensional diffusion effect?

22 MR. TIPESCU: Objection, form.

23 A. I think the way to answer the question is that
24 Hshieh cite -- Hshieh discloses that sharp corner has an
25 issue in terms of punch-through breakdown voltage. And

1 one of the previous observation and Hshieh is citing to
2 is that one of the contributing factors is a -- a
3 three-dimensional diffusion effect that cause a weak
4 point in a punch-through, but the issue -- the key of
5 the problem is that it's a sharp corner that has a
6 punch-through effect.

7 Now, Hshieh may a- -- attribute to
8 certain phenomenon that he observed cited from Yilmaz.
9 Regardless, that's the only one -- or not the only one.
10 The fact is that a -- a sharp corner in a vertical DMOS
11 caused an issue

12 Q. (BY MR. SAUNDERS) If the board were to
13 conclude that Kobayashi does not suffer from the
14 three-dimensional diffusion phenomenon, is there
15 anywhere in Hshieh that you could point the board for a
16 reason to, nonetheless, combine Hshieh's rounded corners
17 with Kobayashi?

18 A. I'm really sorry. It's getting late for that,
19 such a long question. Can you pause so that I can -- I
20 can try to take one part at a time. I'm -- I'm sorry.

21 Q. Yeah. So if the board has conclu- -- well,
22 let's ass- -- let me withdraw.

23 Assume the board is going to conclude that
24 Kobayashi does not suffer from the three-dimensional
25 diffusion phenomenon.

1 Do you und- -- understand that assumption?

2 A. If the board assumes that Kobayashi does not
3 suffer from three-dimensional diffusion phenomenon?
4 Hypothetically?

5 Q. Well -- yes, hypothetically.

6 Is there anywhere in Hshieh that you could
7 point me to as an expressed motivation to nonetheless
8 combine Hsheih's rounded corners with Kobayashi?

9 MR. TIPESCU: Objection, form. And
10 relevance.

11 A. We know Hshieh observed blunting the sharp
12 corner or rounding the sharp corner improves
13 punch-through breakdown voltage. Now, Hshieh cited one
14 of the reason or one of the -- the -- the reason for
15 this lower punch-through voltage is a three-dimensional
16 diffusion effect.

17 But we also know that a rounded corner,
18 especially given the light of the profile I've shown
19 you, and rounded corner tend to either concentrate the
20 electro field -- sharp corner concentrated -- either
21 concentrated electro field, which may result in
22 punch-through breakdown -- premature punch-through
23 breakdown, as well.

24 As long as the sharp corner process
25 immature breakdown voltage, you would apply the teaching

1 of rounding the corner that improve your breakdown
2 voltage from punch-through. And you will apply that
3 because you know that whatever reason three-dimensional
4 diffusion or enhanced electro field or due to longer
5 distance, it has to traverse. All these things can
6 contribute to degradation of punch-through. And a known
7 technique of blunting improves the punch-through
8 breakdown voltage.

9 You would apply it because you -- you will
10 have a known results. You will apply a known method
11 because you know that blunting improves the
12 punch-through breakdown voltage regardless what
13 predominant mechanism is there.

14 Maybe Hshieh attribute to three-dimensional
15 diffusion. There may -- there -- there are other
16 problem we know that the sharp corner introduces. So
17 blunting the corner -- regardless blunting the corner in
18 a structure that Kobayashi is applying and trying to
19 maximize the breakdown voltage, it will be obvious to
20 combine something that produce known result and
21 something that -- that works.

22 Q. Can you point me to any of the references that
23 you discuss in your declaration, that say that sharp
24 corners tend to have a concentrated electric field,
25 which may result in punch-through breakdown independent

1 of the three-dimensional diffusion effect?

2 MR. TIPESCU: Objection to form.

3 A. Give me a second.

4 I'm -- I'm -- I just finished looking
5 through Kobayashi. Can you repeat your question again.
6 I'm sorry.

7 Q. (BY MR. SAUNDERS) Yeah.

8 MR. SAUNDERS: Actually, can the court
9 reporter read back the question.

10 THE WITNESS: Thank you.

11 (Requested portion was read.)

12 A. I -- I'm sorry. Because the -- the question is
13 very long-winded. Can you repeat again. I'm really
14 sorry.

15 MR. SAUNDERS: Could the court reporter
16 read it back again.

17 THE WITNESS: I'm sorry. Please.

18 THE STENOGRAPHER: It's okay. Oh, sorry.
19 It's okay. It just takes me a minute to unmute.

20 (Requested portion was read.)

21 (Discussion off the record.)

22 A. I believe that's in my Paragraph 133, where I
23 discuss all the known problems -- all the problems.
24 Kobayashi and Hshieh are all directed to solution to
25 similar problem with semiconductive devices in

1 Paragraph 1- -- 133.

2 In fact, the 10- -- '409 Patent further
3 acknowledge as square cell configuration with sharp
4 conner in the Prior Art causes low avalanche current and
5 reduce device ruggedness due to the parasitic N-P-N
6 latches near the corner.

7 And Kobayashi cite Kim's paper that -- the
8 paper cites this as the benefit or trench corner
9 rounding leading to a higher breakdown voltage and lower
10 leakage current. And Hshieh also discussed vulnerable
11 punch-through weak point in the corners of square cell.

12 Again, this is due to an undesirable
13 high-peak electric field being breached due to same
14 corner effect.

15 Q. All right. Can you turn back to the Hshieh
16 reference, Dr. Liu.

17 A. Sure. Hshieh reference, you said?

18 Q. Yeah.

19 A. Yes. I'm there.

20 Q. And I want you to look at the description of
21 the drawings that's in Column 3, Line 57 through Column
22 4, Line 28.

23 A. You said 57 to where?

24 Q. Column 3, Line 57 through Column 4, Line 28.

25 A. I briefly glanced through them.

1 Q. So Figures 4 through 10 are identified as
2 embodiments of Hsheih's invention; is that correct?

3 MR. TIPESCU: Objection, form.

4 A. Okay. Now I'm ready for your question.

5 Q. (BY MR. SAUNDERS) Yeah. So Figures 4 through
6 10 of Hshieh are described as -- let me withdraw.

7 Figures 4 through 10 of Hshieh are
8 identified as various embodiments of Hsheih's invention,
9 correct?

10 MR. TIPESCU: Objection, form.

11 A. It's showing -- it's showing one layout
12 embodiment in the invention.

13 Q. (BY MR. SAUNDERS) We see back in Column 3,
14 Figures 1 through 3 are talking about Prior Art, right?

15 A. That's correct.

16 Q. And by contrast, Figures 4 through 10 in
17 Columns 4 of Hshieh are talking about the invention,
18 correct?

19 A. To be fair, the -- the word "invention" only
20 show up in Figure 4A and 4B.

21 Q. Well, is it your understanding that Figures 4
22 through 10 show different embodiments of Hsheih's
23 invention?

24 MR. TIPESCU: Objection, form.

25 A. What was your question, again?

1 Q. (BY MR. SAUNDERS) Let me -- you know what?
2 Let me -- let me go and skip to another question because
3 I think this will be more direct.

4 There's no embodiment depicted in Hshieh
5 of a trench MOSFET other than Figures 10A and 10B,
6 correct?

7 A. Did you say something a- -- about MOSFET? I'm
8 -- I'm sorry. I -- I missed the -- I missed the -- the
9 entire -- entire question.

10 Q. Yeah. So there are no embodiments depicted in
11 Hshieh of a trench MOSFET, other than Figures 10A and
12 10B, correct?

13 A. Based on the figure, 10A and 10B are discussed
14 in conjunction with the vertical DMOS, vertical --
15 vertical trench gate DMOS.

16 Q. So, for example, figures -- why don't you go up
17 to Figure 7A and 7B.

18 A. Yes. I'm there.

19 Q. And so actually that -- that one sheet has
20 Figures 6A, 6B, 7A, and 7B on it, right?

21 A. That's correct.

22 Q. Those -- none of those figures on that sheet
23 with Figures 6A, 6B, 7A, 7B are trench MOSFETs,
24 correct?

25 A. I disagree. 6A, 6B, 7A, 7B may not have a- --

1 associated cross section showing a vertical -- showing a
2 trench gate. It doesn't mean that they are not -- they
3 cannot be implemented with a vertical gate.

4 Q. Is there some portion of Hsheih's written
5 description that tells you that any of the MOSFETs in
6 Figure 6A, 6B, 7A, or 7B could be implemented using a
7 trenched MOSFET?

8 MR. TIPESCU: Objection, form.

9 A. The fact that it shows that, for example, based
10 on your pointing out of Figure 10 -- 10A is done with a
11 trench gate. And then similar figure in Figure 4A is
12 showing also similar cell done with nontrench gate.
13 This indicates that this invention of rounding the
14 blunted corner is applicable to both trench gate as well
15 as nontrench gate.

16 Q. (BY MR. SAUNDERS) Why do you believe that
17 rounding of sharp corners, as disclosed in Hshieh, is
18 applicable to a trench gate MOSFET?

19 MR. TIPESCU: Objection, form.

20 A. Give me one second. Let me go through that
21 reference. Yeah.

22 I -- I'm ready. Please repeat your
23 question again.

24 Q. (BY MR. SAUNDERS) Yeah.

25 MR. SAUNDERS: Can the court reporter

1 please repeat the question.

2 (Requested portion was read.)

3 A. It's disclosed --

4 MR. TIPESCU: Objection.

5 MR. SAUNDERS: Okay.

6 A. For one thing, Hshieh discloses in his claim
7 limitation of a trench gate with blunter corner and
8 rounded corners.

9 Q. (BY MR. SAUNDERS) Anything else?

10 A. I believe that answers your question.

11 Q. Okay. Now, the trench MOSFET that's depicted
12 in Figure 10B of Hshieh, that lacks trenched source
13 contacts, correct?

14 A. In the context of the problem being addressed
15 by '409 and -- and being addressed by Hshieh and
16 applying to Kobayashi, the source contact location,
17 whether is trenched source contact or nontrenched source
18 contact doesn't change.

19 I -- what I meant is that that distance is
20 fixed. What changes is that with the trench gate with
21 sharp corner, you have issues with premature
22 punch-through. And that could be due to
23 three-dimensional diffusion. It could be due to
24 three-dimensional as applied to a trench gate, as I
25 testified earlier. It could also be due to the distance

1 it has to traverse from the source contact to the corner
2 of the trench gate.

3 So regardless what type of source you use
4 -- contact you use, it only contribute to the distance
5 of that source to the trench gate corner. And it
6 doesn't change the fact that trench gate corner has weak
7 point as disclosed by Hshieh and -- (coughing.) Excuse
8 me -- as disclosed in the Prior Art of '409 Patent that
9 we went through. That corner with trench gate,
10 especially sharp corner, introduces issue that undermine
11 your goal of achieving the maximum breakdown voltage.

12 MR. SAUNDERS: All right. I'll object as
13 nonresponsive.

14 Q. (BY MR. SAUNDERS) I -- I was trying to ask a
15 very simple "yes" or "no" question about Figure 10B of
16 Hshieh, and so I'll ask it again.

17 Figure 10B of Hshieh does not depict a
18 MOSFET with trenched source contacts, correct?

19 MR. TIPESCU: Objection, form.

20 A. There's no dis- -- a figure that illustrate
21 that; but effectively, if you have a trench gate, you
22 could also have a trench source. Also the fact that in
23 -- Hshieh is trying to address the corner of trench
24 gate, and it's not the corner of trench gate. And it's
25 not addressing -- so -- so the issue Hshieh is

1 addressing is the corner of trench gate; therefore, it
2 is silent on the implementation of the source contact.

3 Q. (BY MR. SAUNDERS) The MOSFET depicted in
4 Figure 10B of Hshieh depicts at least some horizontal PN
5 junctions, correct?

6 MR. TIPESCU: Objection, form.

7 A. Can you point out -- point out to me what --
8 what you meant by "horizontal PN junction"?

9 Q. (BY MR. SAUNDERS) So for example, do you see
10 the P-body Regions 230 in Figure 10B of Hshieh?

11 A. Yes, I do.

12 Q. And do you see the N+ Source Regions 240 in
13 Figure 10B of Hshieh?

14 A. Yes, I do.

15 Q. And do you see where the N+ source regions and
16 the P-body regions of Hshieh in Figure 10B touch
17 adjacent to the Source Contact 270?

18 A. In Figure 10B, to be accurate, there's no -- I
19 assume you're referring to 270 as the source contact?

20 Q. Yes.

21 A. That source contact effectively shorts the N+
22 and the P between the two adjacent N+, that P-Region 230
23 between adjacent N+.

24 Q. Okay. I understand that. But at the location
25 of the bottom of the Source Contact 270, the N+ source

1 regions and the P-body regions have a horizontal PN
2 junction, correct?

3 MR. TIPESCU: Objection, form.

4 A. It has a horizontal interface, and that's at
5 the top where 270 -- 270's shorting the tube. Again,
6 whether it's trenched or trenched source contact or the
7 lateral source contact issue was or say it -- or it ---
8 horizontal source contact, it is a distance of that
9 contact to the gate -- corner of the gate trench.
10 That's critical, not so much what the contact
11 methodology is.

12 MR. SAUNDERS: Why don't we go off the
13 record.

14 THE VIDEOGRAPHER: The time is 6:02. We're
15 off the record.

16 (Break taken from 6:02 p.m. to 6:13 p.m.)

17 THE VIDEOGRAPHER: The time is 6:13. We're
18 back on the record.

19 Q. (BY MR. SAUNDERS) All right. Dr. Liu, you'd
20 agree with me that the corners of a hexagon are less
21 sharp than the corners of a square, correct?

22 MR. TIPESCU: Objection, from -- objection,
23 form.

24 A. If the sharpness defined by the angle that --
25 that the -- of the interfacing side, I would agree that

1 the hexagon has a different angle compared to -- which
2 one are you comparing? I -- I'm sorry.

3 Q. (BY MR. SAUNDERS) A -- a square.

4 A. Whereas a square will have 90-degree, or
5 hexagon may -- may be -- may have a -- a angle larger
6 than 90 degree. So in that sense, it's -- it's -- it's
7 more -- it's -- it's less sharp.

8 Q. If a POSITA was going to modify Kobayashi based
9 on Hshieh to have rounded corners, would it starting
10 with Kobayashi's hexagon result in even less sharp
11 corners?

12 A. Counsel, I -- I don't want to get a
13 nonresponsive reply from you because I have been trying
14 not only to -- to testify truthfully but also to provide
15 context.

16 So in that spirit, first of all, your
17 question is when Kobayashi start off with hexagon versus
18 -- versus -- versus square, you said?

19 Q. Yeah. If -- if a POSITA was going to modify
20 Kobayashi based on Hshieh to have rounded corners, would
21 in starting with the hexagon, as opposed to a square,
22 result in a combination that has even less sharp
23 corners?

24 MR. TIPESCU: Objection, form.

25 A. (Coughing.) Excuse me. There are many way to

1 -- there -- there are many different aspect to answer
2 this question. So to address a rounding corner, you
3 address which one is the sharpest, which one will give
4 you the most problem.

5 Square is sharper than hexagon, as we
6 mentioned earlier in the definition of -- of the angle.
7 So square cell will have more motivation in a -- in --
8 in a way to apply the teaching of Hshieh to round the
9 corner.

10 Now, Hshieh also say blunting could be
11 almost like truncation, so that's already hexagon shape
12 already. Now, that's not to say that you cannot round a
13 hexagon. In fact, when you do the process, the hexagon
14 will get rounded anyway.

15 So in addition, just -- just -- just like
16 you can apply the rounding to -- just -- even if you
17 said that you want to apply rounding to a hexagon, that
18 doesn't prevent you having a square set layout to apply
19 rounding to a square cell, assuming everything be equal.

20 But inevitably, hexagon cell and -- and --
21 and a square cell, assuming the square cell -- a hexagon
22 cell is not coming from a -- truncating a square cell.
23 And if you have the hexagon cell already, I think being
24 -- you're already truncating a square cell. So you're
25 already trying to address the problem.

1 Now, the square cell or even the -- the
2 Hshieh's sharp cell, that's where rounding gives you the
3 bang for your bucks, if you would.

4 Q. Okay. So in combining Kobayashi and Hshieh,
5 why would a POSITA be motivated to select a square as
6 the starting point instead of a hexagon?

7 A. Can you point me to a context where applying a
8 square over hexagon.

9 Q. Well, I'm trying to understand your conclusion
10 that one as skilled in the art would be motivated to
11 combine Kobayashi with Hshieh in the manner recited by
12 Claim 1 of the ''409 Patent, which recites having a --
13 substantially square-shaped cells with rounded corners.

14 So in that context, I'm trying to
15 understand why would you reach the conclusion that the
16 POSITA would be motivated to combine Kobayashi with
17 Hshieh in a manner that results in a substantially
18 square-shaped cell with rounded corners instead of a
19 hexagonal-shaped cell?

20 MR. TIPESCU: Objection, form.

21 A. Let me -- let me think how to answer the
22 question. So -- so --

23 MR. TIPESCU: Dr. Liu --

24 (Simultaneous conversation.)

25 MR. TIPESCU: Dr. Liu, closer to the

1 microphone, please, so we can hear you.

2 THE WITNESS: Sorry about that.

3 Yeah.

4 A. So can you point me to my -- to -- to my
5 declaration where I state that applying to square cell
6 over hexagonal cell.

7 Q. (BY MR. SAUNDERS) I think the conclusion, that
8 you believe that Kobayashi will be combined with Hshieh
9 to have a substantially square-shaped cell, is reflected
10 in at least Paragraphs 118 through 122 of your
11 declaration.

12 A. Let me answer the question this way --

13 MR. TIPESCU: Doc- -- Doctor, hold on a
14 second. There's no question pending at the moment. So
15 please listen for a question before you provide an
16 answer.

17 Q. (BY MR. SAUNDERS) Dr. Liu, now that I've
18 identified for you the relevant portions of your
19 declaration, do you have a opinion as to why a POSITA
20 would be motivated to combine Kobayashi with Hshieh to
21 result in a -- substantially square-shaped cells with
22 rounded corners, as opposed to hexagonal cells?

23 MR. TIPESCU: Objection, form.

24 A. If I look on my declaration, I don't understand
25 the basis or context of your question. I show 118 where

1 it says a square cell, and I show that -- that the
2 rounding of the corner of the square cell could be
3 combined with -- with Hshieh -- in teaching with Hshieh
4 to round the corner square cell.

5 And I also disclo- -- say that Kobayashi
6 disclosed closed cell in a substantially square shape
7 with corner that are truncated by design layout. And
8 Hshieh shows that the truncated corner of closed cell
9 can be -- can be rounded and the benefit of doing so.

10 So in the context of hexagon being a square
11 cell with truncated corner, I am also applying -- I -- I
12 also believe that it's obvious for Kobayashi to apply
13 the teaching of Hshieh. The truncated cell could be
14 rounded and as well as applying to a square -- square
15 cell.

16 Q. (BY MR. SAUNDERS) Do you have an opinion that
17 a POSITA combining Kobayashi with Hshieh would be
18 motivated to start with the embodiment of Figure 3A of
19 Kobayashi over the embodiment of Figure 4A of Kobayashi?

20 MR. TIPESCU: Objection, relevance.

21 A. Figure 4A or Figure 3 -- Figure 3 -- Figure 3A
22 shows a square cell. And Figure 4A shows a square cell
23 with truncated corner, which become a hexagonal cell.
24 And so Kobayashi disclosed -- the way I look at it is
25 you have a square cell. You can truncate it to make

1 hexagonal cell.

2 And Hshieh show that a truncated corner of
3 a closed cell could be rounded, so I'm applying that
4 teaching irrespective whether I start out with Figure 3A
5 or I truncate Figure 3A into a Figure 4A.

6 And in those cases, applying Hshieh, I
7 would -- these corner will also be rounded to gain the
8 benefit of having rounded corner against premature
9 breakdown.

10 Q. (BY MR. SAUNDERS) All right. Dr. Liu, can you
11 turn to Paragraph 89 in your declaration.

12 A. I'm there.

13 Q. And that's part of the section where you're
14 addressing Limitation 6[a] under the combination of
15 Kobayashi and Kikkawa?

16 A. Okay.

17 Q. And you see it says, "Element 6[a] is disclosed
18 by Kobayashi."

19 And then there's a citation in
20 Paragraph 89.

21 Do you see that?

22 A. Yes, I do.

23 Q. Okay. And is that pointing back to your
24 analysis that's in Paragraphs 67 through 70 of your
25 declaration?

1 A. Let me see. Which paragraph are you
2 mentioning, please.

3 Q. Well, I'm starting with -- with 89.

4 And I was asking you if -- if Paragraph 89
5 was citing back to your analysis in Paragraph 67 through
6 70?

7 A. I'm trying to get the proper reference.
8 XI.A.1.c. (Reading exhibit.)

9 I'm sorry. I'm having a little bit --
10 yeah. Here we go. Going through this right now, I -- I
11 apologize. I didn't have the table of content, but I
12 was referring to the C for Paragraph 90.

13 You're -- you're referring to Paragraph 90,
14 right?

15 Correct?

16 Q. No. Paragraph 89. My question is: Is
17 Paragraph 89 of your declaration citing to your analysis
18 in Paragraph 67 through 70 of your declaration?

19 A. Sorry about that.

20 Yes. I believe so.

21 Q. Okay. And in Paragraph 67 through 70, you're
22 addressing Limitation 1[a], which mentions rounded
23 corners, correct?

24 A. In the context of the claim construction, that
25 rounded corner are corner that are truncated by design

1 and rounded.

2 Q. And Limitation 6[a] is the limitation that
3 recites truncated corners, correct?

4 A. That's correct.

5 Q. Do you have an opinion that the portions of
6 Kobayashi that you cite in Paragraph 69 of your
7 declaration are applicable to the truncated corners of
8 Limitation 6[a]?

9 A. And do you mind repeating your question. It's
10 -- it's getting late in the day. I'm -- I'm -- I'm
11 trying to...

12 Q. Yeah. I mean, I'm just trying to understand
13 because Paragraph 89 is about Limitation 6[a], and it
14 points back up to Paragraph 67 through 70.

15 And I'm trying to understand -- about
16 Paragraph 69, you have a quotation there about rounded
17 corners. So I'm trying to understand, is what you cite
18 to in Paragraph 69 of your declaration applicable to
19 truncated corners in Limitation 6[a]?

20 A. Look, corner is going to be rounded as I denote
21 in Figure 6C in all three-dimensions. Top view, the
22 corner of the poly -- of the gate trench layout is going
23 to get rounded. And the corner of the trench gate --
24 gate trench on the -- on the -- when you look at cross
25 section, all going to get rounded. That rounding is

1 going to occur even with a truncated corner.

2 Granted that truncated corner may have
3 wider angle -- as you said, wider angle; but
4 nonetheless, as long as you have an angle, not a
5 straight line. If you have an angle, you're going to
6 have rounding. It just matter of degree.

7 And matter of -- of -- in the case of -- of
8 -- for example, in the case of the -- Kobayashi or in
9 the case of we saw in Hshieh, it's just -- it's going to
10 be the distance from the gate corner to the source
11 contact that -- that is dictated by the -- the degree of
12 rounding, not distance.

13 Q. Can you look at the annotated version of Figure
14 6C that you have underneath Paragraph 69 of your
15 declaration.

16 A. I see it.

17 Q. And do you see that you have an annotation
18 where you're putting circles around certain portions of
19 that figure?

20 A. Yes, I do.

21 Q. And are those circles meant to identify where
22 you're opining there are rounded corners in Figure 6C of
23 Kobayashi?

24 A. Keep in mind that this is a -- a cross section,
25 and there's also going to be another dimension going to

1 the page by rounding that I'm not showing. The fact
2 that you have rounding in a trench corner, whether it's
3 -- is -- in -- in all the rounded corner, whether it's
4 top of the trench or bottom of the trench, at the
5 surface when you have corner, you're going to have
6 analogous rounding of the corner, as well.

7 So I -- I'm showing that not only in this
8 cross section, but at the top of the trench and the
9 bottom of the trench, again, into the -- into the -- the
10 picture, into the -- the page, where the corner of the
11 -- the gate poly actually form a corner on the top
12 service view, there's also -- al- -- also going to be
13 rounding.

14 Q. Is it your opinion that those red circles that
15 you have in your annotated version of Figure 6C under
16 Paragraph 69 of your declaration -- do those also
17 identify the location of truncated corners?

18 A. Again, this is a cross section. And a
19 truncated corner will be showing up going into the page.
20 It could be at the truncated corner. It could be at a
21 square corner, or it could be along the edge of the --
22 of -- of the -- of the -- of the cell.

23 The indication is that anytime you have a
24 trench corner -- gate trench corner, whether it's in the
25 cross section -- the two-dimension top and bottom in the

1 cross section or it's in the top view, in which case,
2 you'll be going into the page.

3 You are going to have rounding occurring,
4 and especially at the corner of the -- of the feature
5 when you're going to the -- going to the page from the
6 top view point of view.

7 Q. Do you see in Paragraph 69, you have a
8 quotation to Kobayashi that states, "Corners of each
9 Trench 6 at the bottom are rounded, and corners of each
10 Trench 6 at an opening portion may also be rounded"?

11 Do you see that?

12 A. Yes, I do.

13 Q. Is it your opinion that that passage also
14 discloses truncated corners?

15 A. Again, as I mentioned, the truncated corner or
16 -- or square -- whether you have a truncated corner
17 coming from a substantially square cell, in that case,
18 it will be hexagon or a square itself going into the
19 page. At the corner, you're going to have two type of
20 rounding.

21 One is the corner that is similar to the
22 bottom of the -- of the bottom corner showing -- showing
23 the figure as well as the top because you're going in.
24 You have rounding. And then you're going to the corner,
25 and now you have a -- you have feature, which -- which

1 is a corner, and that also forms a -- a trench corner.

2 In that case, you're going to have -- have
3 another -- another contributing factor to the rounding.
4 So you're going to have rounding, even you look at top
5 view, at the corner whether it's a truncated cell or the
6 corner of a square cell.

7 Q. So what is the basis for your opinion that
8 Kobayashi at Column 7, Line 57 through Column 8, Line 4
9 discloses the truncated corners of Limitation 6[a] of
10 the ''409 Patent?

11 MR. TIPESCU: Objection, form.

12 A. So we're talking about 67 -- Paragraph 67 in
13 light?

14 Q. (BY MR. SAUNDERS) No. I was asking about --
15 there's a -- a citation in Paragraph 69 to Column 7,
16 Line 57 through Column 8, Line 4 of Kobayashi. And it's
17 asking for the basis of your opinion, that that passage
18 in Kobayashi discloses truncated corners as were cited
19 in Limitation 6[a] of the ''409 Patent.

20 MR. TIPESCU: Again, objection to form.

21 A. I -- I -- I want to make sure -- first of all,
22 I -- I want to -- I -- I need to step back a little bit
23 because we're talking about creating 1, 3, and 5.

24 Paragraph 67 -- or Paragraph 69 is under
25 the -- the context of Claim 1, 3, and 5. Being

1 anticipated by Kobayashi --

2 Q. (BY MR. SAUNDERS) Yeah.

3 A. -- so in -- I'm -- opinion I'm offering is that
4 the -- around the corner of a substantially square cell
5 with rounded corner, and the opinion I'm offering is
6 that the substantially square cell with -- that a hex-
7 -- hexagon is also a substantially square cell that
8 could have rounded corner.

9 Q. I think you might be a little confused because
10 the places I'm talking about don't mention hexagons at
11 all. So let me kind of step back to just frame the
12 issue again.

13 I was -- we first started looking at
14 Paragraph 89 of your declaration, which is in Limitation
15 6[a], and we established that that portion of your
16 declaration points back up to your analysis of
17 Limitation 1[a] in Paragraphs 67, 68, 69, and 70.

18 And what I was trying to do was focus
19 specifically on Paragraph 69 of your declaration and
20 determine if you had any opinion that what you're citing
21 in Paragraph 69 of your declaration in Kobayashi has any
22 relevance to your conclusion that Limitation 6[a] is
23 disclosed by Kobayashi.

24 Do you understand that?

25 A. I do now. Thank you for the clarification.

1 Now, as I mentioned, Kobayashi with this
2 -- is -- in -- in his showing of the rounding, that
3 rounding is just a cross section. We -- we -- we -- I
4 testified this many times already. That cross section
5 showing that there's rounding at the corner, and that
6 cross section also goes into the page regardless what
7 shape of the -- of the layout. It could be -- it could
8 be a square cell with truncated as in -- as in Figure 6
9 -- as in elements -- Limitation 6[a]. Trench gate
10 surrounding said transistor cell -- as a closed cell
11 constituting substantially square cell with truncated
12 corner.

13 So you have a substantially square cell
14 with truncated corner. That is in line with what
15 Kobayashi's teaching. We -- we drew the cross section
16 this morning already. That cross section go through
17 both Figure 4A and Figure 3A.

18 And it shows one cross section, but that
19 cross section will go into the page; therefore, it will
20 go to the corner where the cells -- the substantially
21 square cell are truncated.

22 MR. SAUNDERS: All right. I have no
23 further questions at this time. And I pass the witness.

24 MR. TIPESCU: All right. Let's -- let's go
25 off the record so I can have some time to consider here

1 what we want to do next on -- on redirect.

2 MR. SAUNDERS: Okay. How much time do you
3 think you need? Let's go off the record first.

4 THE VIDEOGRAPHER: The time is 6:47. We're
5 off the record.

6 (Break taken from 6:47 p.m. to 7:04 p.m.)

7 THE VIDEOGRAPHER: The time is 7:04. We're
8 back on the record.

9 EXAMINATION

10 BY MR. TIPESCU:

11 Q. All right. Dr. Liu, just a few questions for
12 you here on -- on redirect.

13 Earlier in the day, Mr. Saunders, I
14 believe, asked you if you still believe that your
15 construction for rounded corners was the correct
16 construction.

17 Do you recall that?

18 A. Yes, I do.

19 Q. Okay. And -- and do you still stand by your
20 construction for -- for rounded corners?

21 A. Yes, I do.

22 Q. Okay. Now, do you know if the PTAB construed
23 the term "rounded corners" in this IPR?

24 A. I believe I do. After the -- the declaration
25 was submitted, I think PTAB preliminary decision is that

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1 the rounded corner, which is the ordinary meaning.

2 Q. Okay. And does the board's decision to
3 construe this term as having the ordinary meaning change
4 your opinion regarding the validity of Claims 1 through
5 6 with regard to any of the grounds of invalidity stated
6 in your declaration?

7 A. No, it doesn't change my -- my opinion
8 regarding the validity. I don't think it also change my
9 -- it also doesn't change my opinion regarding the
10 appli- -- application of the -- of my -- of my analysis
11 regard to the Prior Art.

12 Q. Okay. Now, you also proposed the construction
13 for truncated corners that -- that -- that you talked
14 about in your deposition today.

15 Do you recall that?

16 A. Yes. I believe that the truncated corner, we
17 discussed that is just corner that are truncated by
18 design. That's the claim construction we offer in this
19 declaration.

20 Q. Okay. And do you know if the board had
21 construed the term round -- I'm sorry -- construed the
22 term "truncated corners" in this IPR?

23 A. Yes, I do now, after the declaration was
24 submitted, yeah.

25 Q. And -- and do you know what the board -- how

1 the board construed the term "rounded corners"?

2 A. Do you mean "truncated corner"?

3 Q. I'm sorry. No -- "truncated corner," yes.

4 A. Yeah. The -- the board, again, is ordinary
5 meaning.

6 Q. Okay. And does the board's decision to
7 construe the term "truncated corers" as having an
8 ordinary meaning change your opinion regarding the
9 validity of Claims 1 through 6 with regard to any of the
10 grounds of invalidity stated in your declaration?

11 A. No. It -- it doesn't change my opinion
12 regarding the validity of the opinion I offer with --
13 with respect to all the grounds.

14 Q. Okay. All right.

15 MR. TIPESCU: Well, that -- that's all the
16 questions I have for you, Dr. Liu. Thank you.

17 THE WITNESS: Thank you.

18 MR. TIPESCU: I pass the witness.

19 MR. SAUNDERS: Nothing further from me.

20 THE STENOGRAPHER: Mr. Tipescu, do you need
21 a copy of the transcript?

22 MR. TIPESCU: Yes, please. And we'll
23 reserve signature.

24 THE STENOGRAPHER: Okay.

25 THE VIDEOGRAPHER: The time is 7:08. We're

1 off the record.

2 (Remote deposition concluded at 7:08 p.m.)

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DATE: AUGUST 23, 2024

[illegible]

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1 I, DR. DAVID KUAN-YU LIU, have read the
2 foregoing deposition and hereby affix my signature that
3 same is true and correct, except as noted above.
4
5

6 _____
7 DR. DAVID KUAN-YU LIU
8

9 THE STATE OF _____)
10 COUNTY OF _____)
11

12 Before me, _____, on
13 this day personally appeared DR. DAVID KUAN-YU LIU,
14 known to me (or proved to me under oath or through
15 _____) (description of identity
16 card or other document)) to be the person whose name is
17 subscribed to the foregoing instrument and acknowledged
18 to me that they executed the same for the purposes and
19 consideration therein expressed.

20 Given under my hand and seal of office this
21 _____ day of _____, _____.
22
23

24 _____
25 NOTARY PUBLIC IN AND FOR
THE STATE OF _____
COMMISSION EXPIRES: _____

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1 UNITED STATES PATENT AND TRADEMARK OFFICE

2
3
4 BEFORE THE PATENT TRIAL AND APPEAL BOARD

5
6 INERGY TECHNOLOGY, INC.,
7 Petitioner

8 V.

9 FORCE MOS TECHNOLOGY CO. LTD.,
10 Patent Owner
11

12 Inter Partes Review No. IPR2024-00094

13 U.S. Patent No. 7,812,409
14

15 -----
16 REMOTE ORAL AND VIDEOTAPED DEPOSITION OF
17 DR. DAVID KUAN-YU LIU
18 AUGUST 23, 2024
19 -----
20

21 CERTIFIED STENOGRAPHIC

22 COURT REPORTER'S CERTIFICATE

23 I, Mercedes Arellano, Certified Shorthand Reporter
24 in and for the State of Texas, hereby certify to the
25 following:

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1 That the witness, DR. DAVID KUAN-YU LIU, was duly
2 sworn by the officer and that the transcript of the oral
3 deposition is a true record of the testimony given by
4 the witness;

5
6 That the deposition transcript was submitted on
7 _____ to the witness or to the attorney
8 for the witness for examination, signature and return to
9 me by _____;

10
11 That pursuant to information given to the
12 deposition officer at the time said testimony was taken,
13 the following includes counsel for all parties of
14 record:

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1 That \$_____ is the deposition officer's
2 charges to the Patent Owner, FORCE MOS TECHNOLOGY CO.
3 LTD., for preparing the original deposition transcript
4 and any copies of exhibits;

5
6 I further certify that I am neither counsel for,
7 related to, nor employed by any of the parties or
8 attorneys in the action in which this proceeding was
9 taken, and further that I am not financially or
10 otherwise interested in the outcome of the action.

11
12 Certified to by me this 10th day of September,
13 2024.

14
15
16 
17

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September 10, 2024

Inergy Technology Inc v. Force Mos Technology Co LTD
DEPOSITION OF: Dr. David Kuan-Yu Liu (# 6863245)

The above-referenced witness transcript is
available for read and sign.

Within the applicable timeframe, the witness
should read the testimony to verify its accuracy. If
there are any changes, the witness should note those
on the attached Errata Sheet.

The witness should sign and notarize the
attached Errata pages and return to Veritext at
errata-tx@veritext.com.

According to applicable rules or agreements, if
the witness fails to do so within the time allotted,
a certified copy of the transcript may be used as if
signed.

Yours,

Veritext Legal Solutions

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

DISCLAIMER: THE FOREGOING FEDERAL PROCEDURE RULES ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY.

THE ABOVE RULES ARE CURRENT AS OF APRIL 1, 2019. PLEASE REFER TO THE APPLICABLE FEDERAL RULES OF CIVIL PROCEDURE FOR UP-TO-DATE INFORMATION.

VERITEXT LEGAL SOLUTIONS

COMPANY CERTIFICATE AND DISCLOSURE STATEMENT

Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the court reporter. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the court reporter and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

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