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

SAMSUNG DISPLAY CO., LTD.,	)	
	)	
Petitioner,	)	
	)	Case No.
vs.	)	IPR2024-01223
	)	
PICTIVA DISPLAY CO., LTD.,	)	Patent No.
	)	6,949,389
Patent Owner.	)	
-----	)	

Saturday, May 31, 2025
9:02 a.m.

Remote Zoom Deposition of VIVEK
SUBRAMANIAN, PH.D., held before Stacey L.
Daywalt, a Court Reporter and Notary Public of
the District of Columbia.

1 A P P E A R A N C E S:

2 (All appearances via remote Zoom)

3

4 Attorneys for Petitioner:

5 COVINGTON & BURLING LLP

6 BY: DAVID A. GARR, ESQ.

7 850 Tenth Street, NW

8 Washington, DC 20001-4956

9 (202) 662-5250

10 dgarr@cov.com

11

12 Attorneys for Patent Owner:

13 IRELL & MANELLA LLP

14 BY: HONG (ANNITA) ZHONG, ESQ.

15 1800 Avenue of the Stars

16 Los Angeles, California 90067

17 (310) 203-7183

18 hzhong@irell.com

19

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-----I N D E X-----

WITNESS	EXAMINATION BY	PAGE
VIVEK SUBRAMANIAN, PH.D.	BY MS. ZHONG	4
	BY MR. GARR	211
	BY MS. ZHONG	217

-----EXHIBITS-----

EXHIBITS	PAGE	LINE
(All exhibits were premarked and are part of the PTAB record.)		

1 (All exhibits were premarked and are part of
2 the PTAB record.)
3

4 VIVEK SUBRAMANIAN, PH.D.,
5 called as a witness, having been duly sworn by
6 a Notary Public, was examined and testified as
7 follows:
8

9 EXAMINATION BY
10 MS. ZHONG:

11 Q. Good morning, sir.

12 A. Good morning.

13 Q. Can you please restate your name for
14 the record.

15 A. Certainly. Good morning.
16 My name is Vivek Subramanian.

17 Q. So Doctor, did you submit a
18 declaration for this proceeding, IPR2024-01223?

19 A. Yes, I did.

20 Q. And is that Exhibit 1004?

21 A. Yes, it is.

22 Q. And for this proceeding, 1223
23 proceeding, you are relying primarily on a
24 reference by the name Kijima. Correct?

25 A. That's the main reference that I

1 used for my analysis in this proceeding, yes.

2 Q. And you proposed modifying Kijima in
3 view of another reference, Suzuki. Correct?

4 A. Among other things, I proposed a
5 combination in which the teachings of Kijima
6 are combined with the teachings of Suzuki.

7 Q. And what is the modification you're
8 proposing?

9 A. Well, I mean, I go through it in
10 detail on a sort of claim element by claim
11 element basis within my declaration.

12 But at a high level, Suzuki provides
13 teachings related to a two-layer stack that is
14 put on top of the device, including a smoothing
15 layer and a barrier layer. And I incorporate
16 those teachings into my analysis with respect
17 to how one of skill in the art would put those
18 teachings in conjunction with Kijima to provide
19 a basis for my opinions, resulting in my
20 opinion that the claims that I analyzed are --
21 with respect to the asserted patent are invalid
22 as obvious.

23 Q. Okay. And Kijima itself has two
24 layers, what it describes as sealing films.
25 Correct?

1 A. Yes, Kijima has two layers, which in
2 Figure -- well, I guess it's in several
3 figures.

4 But for example, in Figure 18, it
5 calls one layer the conductive sealing film,
6 and that's layer No. 7, and another layer the
7 insulating sealing film, and that's layer
8 No. 8.

9 Q. But Kijima does not include an
10 organic sealing layer. Correct?

11 A. In that stack, I agree. Yes, that's
12 true.

13 Q. Does Kijima disclose an organic
14 sealing layer anywhere in it?

15 A. (Reviewing document.)

16 I don't believe so. I believe it's
17 always using -- it uses various conductive
18 sealing layers and various insulating
19 sealing -- sorry.

20 (Reporter admonition.)

21 THE WITNESS: It uses -- it
22 discloses various conductive sealing films made
23 out of different metals, and it discloses
24 various insulating sealing films made out of
25 various dielectric materials.

1 But all of the insulating sealing
2 films and conductive sealing films disclosed
3 are inorganic, i.e., they're not organic.

4 BY MS. ZHONG:

5 Q. What is the reason that Kijima
6 incorporates a conductive sealing film?

7 A. (Reviewing document.)

8 So the conductive sealing film
9 serves various functions in Kijima.

10 To start with, the function that
11 is -- just because I have it on the last page
12 of the text, if we look at Page 7 of Kijima --
13 and this is of course the translation -- in the
14 subsection entitled Function and Effects of the
15 Invention, it says: "The electrode is formed
16 under vacuum film-forming conditions and then
17 at least a conductive" --

18 (Reporter admonition.)

19 THE WITNESS: Okay. So in the
20 section entitled Function and Effects of the
21 Invention, it says: "The electrode is formed
22 under vacuum film-forming conditions and then
23 at least a conductive sealing film is formed
24 thereon while maintaining the vacuum.
25 Therefore, the present invention prevents

1 oxidation of the electrode due to the
2 atmosphere and also prevents degradation of the
3 organic layer due to radiant heat during
4 formation of the insulating sealing film on the
5 conductive sealing film."

6 So in that section it calls out two
7 reasons to do it. One is it provides
8 essentially an oxidative barrier function
9 because it's covering the oxygen-sensitive
10 materials, and the other is it provides a
11 radiant barrier function.

12 Now, in addition, the other point is
13 it's conductive. And so therefore, it becomes
14 a part of the device because it actually
15 provides a conductive contact to the cathode
16 material, and so it's what allows the actual
17 array structure to be made where each cathode
18 is provided with electrical connection.

19 BY MS. ZHONG:

20 Q. The topmost electrode already
21 provides a conductive path. Correct?

22 A. The topmost electrode -- and I
23 assume you're talking about the cathode
24 electrode as shown, for example, in Figure 1.

25 That provides a conduction point to

1 the individual device, but it does not provide
2 a conductive -- a load resistance conductive
3 path to get in and out of the device.

4 Q. And when you say "device," what are
5 you referring to?

6 A. In this case I'm referring to an
7 individual OLED.

8 Q. When you say "an individual OLED,"
9 what do you mean?

10 A. I mean a single stack of materials
11 which will be a single light-emitting device,
12 an organic light-emitting diode.

13 Q. So you're referring to a single
14 pixel or subpixel?

15 A. Well, that's -- in a display, it's
16 true, that's how an individual OLED would be
17 used.

18 Q. So unlike yesterday for Yamazaki,
19 you are not defining a device in reference to
20 the entire display panel for Kijima. Correct?

21 A. That's fair. Yes, I agree.

22 Q. So the term "device" can be mapped
23 to different elements in different -- for
24 different references. Correct?

25 MR. GARR: Objection, form.

1 THE WITNESS: I'm not sure I
2 understand what you mean by that.

3 Q. So for example, yesterday you mapped
4 the term "device" to an entire display panel
5 that includes many numerous pixels or numerous
6 OLED devices.

7 And today you are mapping the term
8 "device" to individual OLED pixel or stack.
9 Correct?

10 A. Correct.

11 Now, the reason I did that is with
12 respect to the subject matter of yesterday,
13 that's consistent with how "device" is used in
14 the patent at issue.

15 However, I understand that the
16 patent owner in related matters has pointed to
17 individual pixels as pointing to them as
18 devices. So under the basis of using that, I
19 have provided this analysis.

20 Q. Okay. Does Kijima -- strike that.
21 If you apply the same mapping as
22 yesterday, is that device in Kijima?

23 MR. GARR: Objection, form.

24 THE WITNESS: Is there a device?
25 Sure.

1 For example, if we look at Figure 2
2 of Kijima, it is a multipixel display.

3 But that's not what I've used in my
4 claim element by claim element analysis.

5 BY MS. ZHONG:

6 Q. Understand.

7 So if you apply yesterday's mapping
8 of "device," are there multiple devices on a
9 substrate in Kijima?

10 MR. GARR: Objection. Same
11 objection.

12 THE WITNESS: I understand.

13 So with respect to my analysis here,
14 my analysis is using -- it maps an individual
15 OLED element, so an individual emissive
16 element, which you've been referring to and is
17 acceptable for me to refer to as "a pixel," as
18 a device.

19 I have not performed an analysis
20 with respect to Kijima where I looked or where
21 I mapped multiple displays to be a plurality of
22 devices.

23 BY MS. ZHONG:

24 Q. Does Kijima discloses multiple
25 displays on a substrate?

1 A. (Reviewing document.)

2 No, I don't believe so.

3 Q. Okay. And now let's go back to the
4 Figure 1 or Figure 18 that you were discussing.

5 You stated that the cathode provides
6 a conductive path for each individual emissive
7 device.

8 But it does not provide a conductive
9 path in and out of that device. Correct?

10 A. No, actually you mischaracterized
11 what I said.

12 I said the cathode provides a
13 conductive contact to the top of each OLED
14 stack or each device.

15 But I did go on to say it does not
16 provide a conductive path in and out. And the
17 reason is each OLED element has its own
18 cathode.

19 But to form a row or column of OLED
20 elements, it's necessary to have a conductive
21 paths running in rows and columns, and that is
22 provided with low resistance by the conductive
23 sealing film.

24 Q. And what is the basis for that
25 conclusion?

1 A. (Reviewing document.)

2 So I address that, for example, on
3 Page 30 of my declaration where I refer to the
4 text and disclosure associated with Figure 3 of
5 Kijima.

6 And you can see that in Figure 3 of
7 Kijima, the mask that is used for the organic
8 layer and for the electrode is a square, so it
9 does not provide rows and columns. The mask
10 that is used to provide the rows and columns is
11 provided by the conductive masks. And
12 specifically in Figure 3, the mask for the
13 conductive sealant runs top to bottom.

14 Q. Can you please take a look at
15 Figures 12 and 13.

16 A. (Complying.)

17 I see them.

18 Q. What is is Element 9, Figure 12?

19 A. (Reviewing document.)

20 So I believe -- I'm struggling to
21 find the reference to it, but that is an --
22 that's an insulating layer that is used to
23 ensure that the conductive sealing layer does
24 not short to the bottom electrode.

25 But I'm not finding the exact

1 reference to it.

2 If you give me a minute, I'll find
3 it. Oh, I got it.

4 Yes. In Paragraph 40 it says: "And
5 then SiO₂ is deposited on the entire surface,
6 which is then etched into a prescribed pixel
7 pattern to form a large number of openings
8 through which" the device is built basically.

9 So what -- the function of 9 is to
10 be an insulating region that prevents the
11 conductive stripe from shorting the OLED by
12 connecting the top electrode to the bottom
13 electrode of the OLED pixel.

14 Q. And are Figures 12 and 13
15 cross-sectional views from two different
16 viewing angles?

17 A. I'm sorry. I missed the last part
18 of your sentence.

19 Could you repeat it, please.

20 Q. Are Figures 12 and 13 depicting the
21 same structure from two different viewing
22 angles?

23 A. (Reviewing document.)

24 Yes. Specifically if we look at
25 Paragraph 53, it says that Figure 12 is a

1 cross-section along the line A-A in Figures 3
2 and 5, while Figure 13 is a cross-section along
3 the line B-B in Figures 3 and 5.

4 Q. What is the thickness of that
5 conductive sealing film 7?

6 A. (Reviewing document.)

7 So there's various discussions of
8 the thickness of the conductive sealing film
9 depending on which embodiment we are talking
10 about.

11 But for example, if we look in the
12 description of Figure 10, which is
13 Paragraph 50 --

14 Q. Okay.

15 A. -- it says specifically: "Gold was
16 deposited on the metal electrode to a thickness
17 of about 10 kilo-angstroms. As a result, gold
18 was deposited through the openings to form a
19 conductive sealing film."

20 So in that instance, for example,
21 it's 10 kilo-angstroms, which means
22 10 kilo-angstroms is 10 to the minus 6 meters,
23 so about a micrometer.

24 Q. Okay. And 10 angstrom equals
25 1 nanometer. Correct?

1 A. That's correct.

2 Q. And 1,000 nanometer is 1 micron or
3 1 micrometer?

4 A. That's correct.

5 Q. What about, what's the thickness for
6 the cathode?

7 A. So referring to the same
8 description, the cathode deposition is
9 described in the previous paragraph, which is
10 Paragraph 49, where it says: "A lithium
11 aluminum alloy," so LiAl, "was deposited to a
12 thickness of about 2 kilo-angstroms."

13 Q. And does Kijima describe the surface
14 roughness for either the cathode or the gold
15 sealing film?

16 A. (Reviewing document.)

17 No, I don't believe so.

18 Q. And on top of the gold sealing
19 film 7, there is an insulating sealing film 8.
20 Correct?

21 A. That's correct.

22 Q. And do you consider the conductive
23 sealing film 7 a planarization layer?

24 A. No, I have not offered that opinion.
25 The conductive sealing film in my

1 opinion is part of the device. It's not a
2 planarization layer in my analysis.

3 For a planarization layer, I perform
4 a combination with Suzuki.

5 Q. Okay. And in your opinion, does the
6 conductive film generally follow the contours
7 of the underlying layers or structures?

8 A. Kijima in the textual description
9 doesn't provide great detail on the specific
10 step coverage of the conductive sealing film.

11 What it does say is, for example, in
12 Paragraph 50: "To form a conductive sealing
13 film 7 so as to cover the surface of the
14 laminate body of the organic layers and
15 electrode as depicted in the figure."

16 And then if we look at the figures,
17 we see that it shows it -- it looks like the
18 way it's shown, it's -- that there's a
19 difference in thickness between the top and the
20 sides. But as shown in the figures, the
21 corners here are fairly sharp.

22 Q. And what does that inform you?

23 A. Well, for me, it's irrelevant
24 because I'm not using that as a planarization
25 layer, so I didn't perform that analysis.

1 It doesn't -- it's part of the
2 device, so it's not relevant to my analysis of
3 the claim elements related to planarization.

4 Q. Outside -- I understand your
5 position, but I would still like to know.

6 Based on the description and
7 depiction in Kijima, would you consider the
8 conductive sealing film a planarization layer?

9 A. I couldn't say.

10 As I said, there's not enough
11 information in Kijima for me to make a clear
12 determination, and I didn't need to because I'm
13 not using that for my analysis.

14 And it is very clear from Kijima
15 that the conductive sealing film is part of the
16 device.

17 Q. Does Kijima provide any information
18 on surface roughness for that conductive
19 sealing film?

20 A. I think you have asked me that
21 question.

22 And the answer is, no, it does not.

23 Q. Okay. And why does the -- strike
24 that.

25 Why does the conductive sealing

1 film 7 provide also a radiation barrier?

2 A. I think it was "a radiant barrier,"
3 but let me confirm the words. (Reviewing
4 document.)

5 Oh, actually, I have to offer a
6 correction just in -- I noticed something while
7 looking for that terminology.

8 I told you previously that there's
9 no disclosure, or I agreed you with you
10 previously that there's no disclosure of
11 organic sealing films in Kijima. That's
12 actually not true.

13 If you look at Paragraph 94, it
14 points out that: "The conductive sealing film
15 may be made of a material other than a metal
16 material. For example, a conductive organic
17 material containing polyoxadiazole may be vapor
18 deposited and then cured with ultraviolet
19 light," a light, "to perform vapor deposition
20 polymerization."

21 So that's just a side note. That is
22 a correction that I have to offer to my
23 previous answer.

24 Now, getting back to your question
25 regarding the radiant heat barrier properties,

1 I had addressed that previously in discussing
2 the section on Page 7 of the translation of
3 Kijima where it refers to the fact that it also
4 prevents degradation of the organic layer due
5 to radiant heat. So that's the radiant heat
6 barrier properties you are referring to.

7 The reason it provides that is, at
8 the wavelengths at issue, in other words,
9 during the process, metal is relatively
10 reflective. So being relatively reflective, it
11 prevents thermal radiation from penetrating the
12 device.

13 Q. What if instead of using a gold film
14 you used the conductive organic material that
15 you just referenced?

16 A. So I don't actually remember the
17 absorption properties of polyoxadiazole. I'm
18 familiar with the material, but I don't
19 remember its properties. I don't know if it
20 absorbs significantly at the wavelengths at
21 issue.

22 But in general I would expect it to
23 be a poorer radiant heat barrier than a metal
24 just because it's likely to be less reflective
25 at those wavelengths.

1 Q. And if the conductive film is
2 comprised of the -- strike that.

3 If instead of gold the conductive
4 sealing film is the conductive organic
5 material, does it form a planarization layer?

6 A. Again, I couldn't say.

7 There's no details -- there's no
8 disclosure on the details of that film within
9 Kijima, and I have not performed that analysis
10 because I'm not pointing to that as the
11 planarization layer in my claim element
12 analysis.

13 Q. Okay. And like the gold film,
14 Kijima does not describe the surface roughness
15 for that conductive organic material either.
16 Correct?

17 A. That's true. I agree with that.

18 Q. Now, if you -- so if I understand
19 your proposal correctly, you are proposing to
20 add an organic layer between the gold film and
21 the insulative sealing film 8. Correct?

22 A. Could you repeat the question,
23 please.

24 Q. Okay. The proposed modification --
25 strike that.

1 The modification you proposed is to
2 add an organic film between the conductive
3 sealing film 7 and the insulative sealing
4 film 8. Is that correct?

5 A. So I address that specifically in
6 the section of my declaration that deals with
7 the planarization and barrier layer elements of
8 the asserted claim, for example, 34.

9 So generally it starts at Page 34 of
10 my declaration and continues to Page 49 for the
11 section that I'm referring to.

12 But at a high level -- and we can
13 see this from the annotated Figure 12 that I
14 show on the top of Page 47 -- the idea is that
15 there's a planarization layer that's added
16 between the device and the inorganic sealing
17 layer.

18 And it's true that the top of the
19 device in -- or the outer part of the device in
20 Kijima is the conductive sealing film.

21 So effectively therefore in the
22 combination, the modification that is made is
23 to use Suzuki's protective double layer in a
24 way so that a planarization layer is inserted
25 between the conductive sealing film of Kijima

1 and the insulating sealing film of Kijima.

2 Q. Okay. And you did not really depict
3 the contour of that organic sealing layer that
4 you proposed to insert between films 7 and 8 of
5 Kijima's structure. Correct?

6 A. I think I understand. You're asking
7 me if I drew it in the modification.

8 No, I didn't. I just pointed an
9 arrow and indicated where it would be.

10 Q. Okay. And what will be the contour
11 that film will form?

12 A. Well, we get some teachings of that
13 from Suzuki.

14 So for example, if we look at my
15 declaration at Page 37 --

16 Q. Okay.

17 A. -- I point to an annotated version
18 of Figure 1 of Suzuki. And we see that
19 Figure 1 of Suzuki has what it calls an
20 "organic barrier layer," which is what I'm
21 pointing to as a planarization layer. And we
22 note that it is smooth and has rounded corners.

23 And specifically, Suzuki on -- as I
24 point to in Paragraph 75 of my declaration,
25 makes clear that that organic barrier layer is

1 used to make a smooth surface on the relatively
2 irregular surface of cathode 18, which happens
3 to be a layer below it. So that's what I'm
4 pointing to to get an understanding of what
5 would happen.

6 So what would happen in the
7 combination is the inserted layer would make a
8 smooth surface on the relatively irregular
9 surface of what is below it, which would be it
10 would essentially create more rounding and a
11 smoother surface, so elimination of --
12 preventing the propagation of surface defects
13 and irregularities for the layers below it in
14 the way that is described in Suzuki.

15 Q. So in the context of Kijima, can it
16 describe the shape that it will take?

17 A. Sure.

18 So as I said earlier, there's two
19 things that Suzuki is teaching us in its
20 textual description and its figures.

21 We see the textual description makes
22 clear in the section that I pointed out that it
23 makes a smooth surface on irregular surfaces,
24 so it doesn't propagate defects and it doesn't
25 replicate the underlying topology.

1 We also see that in the figure,
2 which is further proof of that because we see
3 the figure produces rounding and doesn't
4 propagate topology of underlying sharp corners.

5 So what we would have in a structure
6 that used these teachings together is defects,
7 such as asperities or other kinds of defects,
8 would not propagate up through the inserted
9 organic layer that we are adding in, the
10 organic sealing layer, and we would not get a
11 replication or a continuation of the topology.
12 So we would get the corner rounding and
13 smoothing out that is taught by Suzuki.

14 Q. So would it come down the sides as
15 in Suzuki?

16 A. Would it come down the sides of the
17 OLED pixel? Is that the question?

18 Q. Yes. Yes.

19 A. Yes, it would.

20 Q. And would it cover the entire
21 surface of sealing film 7?

22 A. If -- I think I understand. You're
23 asking me is if it will go on the sidewalls and
24 over the top.

25 And if that's the question you're

1 asking me, the answer is yes.

2 Q. But if you look at the film 7, it
3 also is continuous along the B-B line of
4 Figure 2. Correct?

5 A. Yes, I agree.

6 Q. And will the organic layer also be
7 continuous along the B-B line?

8 A. The nature of the deposition is
9 since the deposition will follow in sequence as
10 the -- since the deposition will follow in
11 sequence after the conductive sealing film and
12 before the insulating sealing film, it will
13 cover exposed surfaces at that time.

14 So in other words, it will cover the
15 exposed portions of the conductive sealing
16 film.

17 Q. Okay. And in your proposed
18 modification, will the insulating film also
19 cover the exposed surface of the organic
20 sealing film?

21 A. Yes. Sequentially in the
22 fabrication process, since the sequence is
23 conductive sealing film, organic planarization
24 layer, insulating sealing film, exposed --
25 during the deposition of the insulating sealing

1 film, it will cover exposed surfaces of the
2 polymer that was deposited previously.

3 Q. Okay. That's not your proposal in
4 your declaration. Correct?

5 You are not proposing any
6 modification of the inorganic sealing film?

7 A. I think that's what I just said.

8 You perhaps misunderstood my answer,
9 but what I said is exactly what I say in the --
10 in my declaration.

11 Q. Okay. So you're not proposing any
12 modification to the existing inorganic sealing
13 film?

14 A. I'm not sure I understand the
15 question.

16 As I've said over and over, the
17 organic sealing layer is added between the
18 device and the inorganic sealing layer.

19 Q. Sorry.

20 You are not proposing any
21 modification to the existing inorganic sealing
22 film 8. Correct?

23 A. Again, I -- you mean changing
24 the -- other than inserting this organic layer
25 in between the two?

1 Q. Correct.

2 A. That's right.

3 I think Kijima on its own provides
4 teachings on the inorganic sealing film, which
5 serves as a barrier.

6 Q. Okay. So you are not proposing to
7 change the coverage of that inorganic sealing
8 film?

9 A. I don't understand what you mean by
10 that question.

11 Q. Okay. So if you look at Figures 12
12 and 13 of Kijima.

13 A. Yes.

14 Q. And as depicted in Figures 12 and
15 13 -- and you can look at the other figures as
16 well -- inorganic -- insulating sealing film or
17 the inorganic sealing film 8 is not continuous
18 in any of the directions. Correct?

19 A. (Reviewing document.)

20 Sorry. Could you say that again,
21 please.

22 Q. If you look at Figures 12 and 13,
23 and in particular the coverage of the
24 insulating sealing film 8, it's discontinuous
25 in all directions. Correct?

1 A. Ah, I think I understand what you
2 mean.

3 You mean that there is gaps in both
4 the A-A and the B-B --

5 Q. B-B direction.

6 A. -- directions.

7 Yes, I agree.

8 Q. Okay. And that will also be the
9 case at your proposed modification. Correct?

10 A. I mean, I haven't specifically
11 addressed that, but sure, that's fine.

12 It doesn't really matter, because
13 whether that's continuous or not, it still
14 meets the required -- my modification still
15 discloses everything that is purportedly
16 inventive in the asserted claims.

17 Q. Okay. I just want to make sure
18 that's your proposed modification.

19 MR. GARR: Objection.

20 Q. And in Kijima as disclosed -- well,
21 strike that.

22 Do you have a sense of the roughness
23 of a 1 micron thick gold film deposit using the
24 condition employed by Kijima?

25 A. (Reviewing document.)

1 So Kijima doesn't say anything about
2 it.

3 I have done a lot of gold deposition
4 within my past research, including deposition
5 at these specific rates.

6 It really can be tuned quite a bit
7 by changing the surface temperature during the
8 deposition, but it can be varied from RMS
9 roughness values in the single -- or the in
10 10 nanometer range to even hundreds of
11 nanometers, depending on how thick the film is.

12 Q. 1 micron thick film?

13 A. Right.

14 So that's why I said it can be in
15 the range of up -- you know, tens of nanometers
16 to even a hundred or a couple of hundred
17 nanometers.

18 Q. And for a 1 micron thick film?

19 A. Correct.

20 Q. Okay. So you can get that surface
21 roughness to as little as 10 nanometers?

22 A. You can, depending on the choice of
23 conditions.

24 It gets -- the more smooth you try
25 to get it, the more tricky it gets from a

1 manufacturing perspective. But you can
2 minimize it.

3 I mean, you can reduce it. You can
4 never get rid of it, but you can reduce it.

5 Q. Understood.

6 So to solve the purpose of being
7 radiant reflective, you wanted the surface to
8 be as smooth as possible. Right?

9 A. No, that doesn't follow.

10 In fact, if it is rough, it can
11 actually do a better job of scattering the
12 reflected light.

13 The relationship between smoothness
14 and radiant barrier properties is less
15 important than the relationship between
16 reflectivity, which is related to the complex
17 refractive index of the material, and the
18 radiant barrier properties.

19 Q. Okay. And when you say the
20 reflective index, that is --

21 A. I said -- sorry. I said "refractive
22 index."

23 Q. Refractive index.

24 And the refractive index is a
25 function of the material composition, for

1 example, it's gold versus silver versus
2 lithium?

3 A. Correct.

4 Q. Okay. And so if you cover that gold
5 film with an organic layer as you propose, the
6 refractive index will be much reduced.
7 Correct?

8 A. Not off the gold.

9 If you're saying that the net
10 refractive index of the stack changes, that's
11 true.

12 But the gold refractive index is
13 unchanged. It's just now a bilayer.

14 Q. Okay. So now if you cover the gold
15 surface with an organic layer and then the
16 deposit the inorganic layer, how would that
17 affect the heat dissipation during the
18 inorganic layer deposition process?

19 A. It still serves its purpose because
20 the gold still protects the OLED device
21 underneath.

22 Q. But it's not refracting or
23 reflecting a radiant -- directed the heat away?

24 A. No, that's not true. It absolutely
25 is.

1 Just because you have a bilayer on
2 top, it doesn't mean it fails to or it ceases
3 to protect the layers underneath. It still
4 serves as a radiant barrier for the layers
5 underneath.

6 Q. How can that be?

7 A. Quite simple. You can -- you now
8 have a bilayer, so you would calculate the
9 interlayer interference at each interface.

10 But the bottom interface is still a
11 highly reflective interface of gold. So
12 anything under that gold is still largely
13 protected because of the excellent radiant
14 barrier properties of the metallic gold.

15 Q. Does it matter whether it's top
16 emitting or bottom emitting OLED?

17 A. Well, in the device of Kijima,
18 because the top of the device is covered by
19 gold, you would generally use it in a bottom
20 emitting OLED.

21 A top emitting OLED would be pretty
22 inefficient if you covered the top with gold,
23 because then you're counting only on scattered
24 light, so -- but other than that, it doesn't
25 really matter.

1 I mean, I think in Kijima, if you
2 look at the devices, are really bottom emitters
3 because they put the cathode on the top and the
4 indium tin oxide on the bottom.

5 Q. And so when it's mentioned the
6 bottom surface of gold, are you referring to
7 the surface that's touching the cathode?

8 MR. GARR: Object.

9 THE WITNESS: I don't think I ever
10 said the words "bottom surface of gold," so I
11 don't know what you're talking about.

12 BY MS. ZHONG:

13 Q. When you reference "the bottom
14 interface," which interface are you referring
15 to?

16 A. That is the interface between the
17 top of the gold and the bottom of the organic
18 planarization layer.

19 Q. The top of the gold and the
20 bottom -- and the bottom of which layer?

21 A. The organic planarization layer that
22 I inserted in my combination.

23 Q. But that heat conduction pass will
24 now have to go through the organic layer,
25 doesn't it?

1 MR. GARR: Objection.

2 THE WITNESS: I think you are mixing
3 terms. We're talking about radiant heat, so
4 we're talking about radiation.

5 It is true that the radiant heat
6 will have to pass through, be transmitted
7 through, the organic planarization layer. But
8 that's not a problem because the gold still
9 acts as an excellent radiant barrier to protect
10 the OLED device that's underneath it.

11 BY MS. ZHONG:

12 Q. If the heat doesn't get transmitted
13 away efficiently, how can it still serve to
14 protect the OLED organic layers below?

15 MR. GARR: Objection.

16 THE WITNESS: But it still does get
17 transmitted efficiently.

18 As we just said, the gold is an
19 excellent reflector, so it reflects it out.

20 The organics are not significant
21 absorbers in relation to the reflection
22 properties of the gold. So the gold will still
23 act as an excellent radiant barrier to protect
24 the OLED underneath.

25

1 BY MS. ZHONG:

2 Q. Why do you say that the organic
3 layer is not a significant absorber in relation
4 to the reflection properties of gold?

5 A. Well, the reason I say that is most
6 of these organic materials are not significant
7 absorbers of visible light.

8 So they are -- and they're
9 certainly -- when they are put in a sandwich or
10 put in a stack with -- of highly reflective
11 gold underneath, they do not alter the
12 properties of the gold itself. The gold is
13 still an excellent reflector.

14 It's now an interference device. So
15 you have to account for the fact that the stack
16 you have is, in one embodiment, silicon dioxide
17 with organic below it with gold below that.

18 But because the gold is an excellent
19 reflector, anything below the gold is still
20 protected.

21 Q. Well, doesn't it also depend on the
22 reflective and refractive index of the organic
23 layer itself?

24 A. It does.

25 But in fact because gold is such an

1 excellent reflector, while it does change the
2 interference patterns and the relative light
3 intensities above the gold, the heat, or the
4 radiant heat below the gold, is still entirely
5 suppressed because gold is still an excellent
6 radiant barrier.

7 Q. Would it then degrade the organic
8 layer above gold?

9 MR. GARR: Object to the form.

10 THE WITNESS: Just so I understand,
11 by "it," you mean the radiant -- the incident
12 radiant light during the insulator deposition?

13 BY MS. ZHONG:

14 Q. Correct.

15 A. Okay.

16 No. The answer is no, because the
17 OLED materials are extremely sensitive to
18 heating.

19 But if you look at the materials
20 that are called out as relevant materials for
21 planarization layers in Suzuki, for example,
22 those in fact are designed to be terminally
23 crosslinked. So they don't degrade. They
24 handle it fine.

25 Q. What's the heat?

1 What is the temperature during the
2 inorganic material deposition?

3 A. Well, so the temperatures have to be
4 low enough to not degrade the OLED.

5 And so really we're not talking
6 about temperature. We are talking about
7 radiant heat absorption. And there will not be
8 significant radiant heat absorption because of
9 the excellent radiant barrier properties of the
10 gold.

11 Q. And what's the source of that
12 radiant heat?

13 A. Oh, it's the process.

14 So it's, for example, if you are
15 doing the process of depositing the SiO₂, which
16 is the top layer, there's -- just because SiO₂
17 is deposited, depending on the process, at an
18 elevated temperature -- certainly it's not
19 typically deposited at room temperature --
20 there's some heat radiation from the process
21 into the device.

22 But the idea is by having the gold,
23 you are protecting the OLED, which is the
24 sensitive material.

25 Q. Now, the planarization layer

1 material, for example, polyacrylates, they
2 still degrade at high temperatures. Correct?

3 A. At much higher temperatures.

4 In fact, polyacrylates are thermally
5 polymerized. So at the temperatures that will
6 seen in this device, they will not be degraded.

7 Q. What is the temperature used to
8 deposit the silicon dioxide?

9 A. (Reviewing document.)

10 Okay. So a specific temperature
11 if -- for SiO₂ deposition is not called out.

12 But there is some information given
13 about the deposition technique in Kijima,
14 specifically on Page 4 in discussing Figure 4,
15 which is used for all the depositions, it
16 says --

17 Q. Which paragraph in particular?

18 A. Page 4 -- sorry --
19 Paragraph 41 [sic].

20 It says: "Each deposition source is
21 heated by a power source 29 using a resistance
22 heating method. This heating can be performed
23 as necessary using an electron beam heating
24 method or the like."

25 So it's very clear what it's

1 referring to in Figure 4 is an evaporation
2 method, so either e-beam evaporation, so
3 electron beam evaporation, or a thermal
4 evaporation. Both are called out.

5 The temperature of those
6 evaporations are generally -- so they are in
7 fact done at room temperature, but there's a
8 little bit of heating because of the energy
9 that's transferred from radiation from the
10 source, and that's typically very low. I mean,
11 it's barely above room temperature, especially
12 if you have a reflective protector for the heat
13 sensitive OLED device itself.

14 Q. So if you use a thermal evaporator
15 to deposit silicon oxide, you say you do that
16 at room temperature?

17 A. Correct. Yeah.

18 I mean, I do that in my lab. You
19 use a thermal evaporator.

20 So the source is very hot, because
21 to sublimate silicon dioxide, the source has to
22 be very hot.

23 But the source is very far removed.
24 You can see that in Figure 4. The source is
25 very far removed. It's on the bottom of the

1 box.

2 And so the heat transfer to the
3 deposition target, which is near the top of the
4 box, is purely just radiative heat transfer,
5 so -- and that is much, much lower
6 temperatures.

7 And specifically since you see the
8 deposition rates are called out to generally be
9 quite low, so the deposition rates are in the
10 tens of angstroms per second, there's not
11 significant thermal mass; so it's almost
12 entirely radiative, which means it's very low,
13 particularly since you have the reflective gold
14 to prevent direct radiative heat absorption by
15 the OLED materials.

16 Q. And does it matter whether the
17 organic layer is transparent or opaque?

18 MR. GARR: Object to form.

19 THE WITNESS: And by "the organic
20 layer," just to be clear, you're talking about
21 the planarization layer that I'm inserting in
22 my combination?

23 BY MS. ZHONG:

24 Q. Let's say the organic sealing layer
25 that you characterize as.

1 A. I'm sorry. Now I'm confused.

2 Q. Well, if you look at your
3 declaration, your proposal is to insert an
4 organic sealing layer. Correct?

5 A. Yes, which I map to the
6 planarization layer -- the planarization
7 element of the claim.

8 Q. Okay. So does it matter?

9 Does the ability to handle radiant
10 heat vary based on whether that organic sealing
11 layer is opaque or transparent?

12 A. Yes. In general, yes.

13 If the material is opaque, that
14 means it absorbs more radiant heat. So the
15 material itself will heat up, but we still have
16 the excellent radiant barrier properties of the
17 gold which is below it.

18 Q. So less radiant heat will be
19 reflected by the gold if it's opaque?

20 A. No, the reflection coefficient will
21 not change.

22 What will change is now you will
23 have additional absorption in this purported
24 opaque material above it. But the gold still
25 does its job of protecting the OLED device

1 below it.

2 Q. So if it's opaque, the organic
3 sealing layer will absorb more radiant heat?

4 A. If the -- this organic sealing layer
5 is chosen to be opaque, it's true, the organic
6 sealing layer will absorb more radiant heat.

7 But there will not be an increase in
8 the radiant heat absorption below the gold
9 because the gold will still be an excellent
10 reflector.

11 Q. And when gold reflects the radiant
12 heat, that radiant heat will again be absorbed
13 by the opaque material. Right?

14 A. Some of it, yes, I agree.

15 But again, that's not a problem
16 because the device underneath is still
17 protected.

18 Q. But then wouldn't -- so if the
19 organic layer, the organic sealing layer,
20 absorbs more heat, it will heat up more?

21 A. Well, hold on. That's not -- your
22 earlier question was you asked me to assume I
23 was using an opaque absorber.

24 Now you're changed to just a general
25 organic. And there are plenty of organic

1 sealing layers that are not absorbers because
2 most of them are transparent or
3 semitransparent.

4 Q. Okay. So if the opaque organic
5 sealing layer -- if you have an opaque organic
6 sealing layer and it absorbs radiant heat, its
7 temperature will go up more?

8 A. That is conceptually possible.

9 In other words, first, we have to
10 assume we're using a -- for some reason we've
11 made a hypothetical where we're choosing to use
12 a heavy absorber, so something that absorbs --
13 that is very opaque and absorbs a lot of the
14 incident radiant light.

15 Assuming we do that, it will heat up
16 at least some because there is more heat
17 absorption, but it will also do a good job of
18 radiating the heat because now it will increase
19 its black-body radiation.

20 So the actual amount of heating to
21 the device underneath will not be largely
22 changed because the gold is an excellent
23 radiative barrier.

24 Q. But even though the gold is an
25 excellent -- okay.

1 Even though gold refracts the heat,
2 if it's -- the layer above it is opaque, that
3 light or whatever you call it is not going to
4 be transmitted out.

5 It's just going to be absorbed by
6 the organic material itself. Right?

7 A. No, that's an incorrect
8 understanding of how multilayer light
9 transmission works.

10 And unless the layer is a true
11 perfect optical absorber, which doesn't exist
12 in reality in thin films, it will always
13 transmit some of the light. Even an opaque
14 structure has a certain absorption distance.

15 And these organics actually are not
16 good absorbers of lights in these wavelengths.
17 That's the reason, when we want to do
18 absorption in organics, we have to choose
19 specific wavelengths that they do absorb it.

20 So it's not true that when we have
21 gold underneath and if it reflects light, all
22 of the light will be absorbed by an organic on
23 top of it. That's simply not the case.

24 Q. If the temperature of the organic
25 goes up, will the gold temperature also go up

1 accordingly since it's a pretty good heat
2 conductor?

3 A. So gold is a pretty good heat
4 conductor.

5 But remember, organics are not
6 particularly good heat conductors.

7 (Reporter admonition.)

8 THE WITNESS: So gold is a pretty
9 good heat conductor.

10 But remember, organics are not good
11 heat conductors.

12 So the organic will heat up. I've
13 already agreed that that will be the case. But
14 in fact the amount of heat it will propagate to
15 the gold will probably be pretty limited
16 because of the poor thermal conductivity of the
17 organic itself.

18 And again, remember, in these
19 systems with long throw thermal evaporation,
20 which is what's shown in Figure 4, either
21 thermal or electron beam evaporation, the
22 actual amount of heat we are talking about is
23 pretty limited.

24 BY MS. ZHONG:

25 Q. You're referring to out of the

1 substrate?

2 A. Correct. I'm referring to that at
3 the target, which is whatever we are
4 evaporating the film onto, which in this case,
5 in the case of building an OLED, will be the
6 glass with the partially fabricated OLED
7 devices on it.

8 Q. Then why would it be a concern for
9 the OLED materials in the first instance if
10 there is little heat actually reaching the
11 substrate?

12 A. And this is the point. It is a
13 concern for the OLED materials because it turns
14 out that OLED materials in terms of their
15 optoelectronic performance are quite
16 temperature sensitive. So you have to protect
17 the OLED materials, but that's what the gold
18 does.

19 The other organic layers that might
20 be on top of it, it's not really an issue,
21 given that the temperatures are not that high
22 anyway.

23 Q. But the OLED devices are designed to
24 operate at -- not only at room temperature but
25 also at high temperatures as well. Right?

1 A. Not very high, no.

2 Typically OLED devices are spec'd to
3 operate up to several tens of degrees of
4 Celsius above room temperature, not much more
5 than that.

6 Q. Okay. So the OLED material can
7 withstand heat, a temperature up to, say, 70 to
8 80 degrees?

9 A. It depends on the material, but
10 certainly in that range is reasonable.

11 I don't know how long they can
12 sustain temperatures of 70 to 80 degrees, but I
13 would say yes, that kind of temperature range
14 is okay without significant damage.

15 Q. Okay.

16 A. I mean, it depends on the material.

17 Q. So does that suggest the temperature
18 at the substrate is probably above 70 to
19 80 degrees?

20 A. No.

21 The reason to use the radiant
22 barrier is the more you can prevent temperature
23 excursions, the better the overall
24 controllability of the process.

25 So that doesn't suggest -- that

1 doesn't indicate that it's going to 70 or
2 80 degrees. It just indicates that by putting
3 the gold there, you don't have to worry about
4 it.

5 Q. But isn't it the case that there is
6 actually experiment that information that if
7 you don't have the gold there, there is
8 significant observance of dark spots?

9 A. Could you point me to what you're
10 referring to, please.

11 Q. The comparative examples in Kijima.

12 A. Again, could you point me to what
13 you're referring to.

14 Q. Page 6. And look at the Comparative
15 Examples 1, 2, and 3.

16 A. (Reviewing document.)

17 Okay. I see the examples.

18 But that's exactly my point.

19 Because you have the gold, you don't have to
20 worry about it with the device.

21 Q. But if the temperature is not that
22 high, then whether you have gold or not doesn't
23 really matter. Right?

24 A. But my answer was in relation to
25 having the gold there. That's my point.

1 The gold means the device just
2 doesn't get that hot.

3 Q. So without gold, the device is going
4 to get hot?

5 A. It may, depending on the deposition
6 conditions.

7 But that's not the device. That's
8 not the device I used in my analysis. In my
9 analysis, which is a modification of the Kijima
10 device, the gold is there.

11 Q. But that device does not have an
12 organic layer on top of it. Right?

13 A. In my combination or in the Kijima
14 device unmodified?

15 Q. Well, it's the same, right, because
16 your combination has an organic layer on top of
17 the gold?

18 A. Correct.

19 Q. Okay. So it doesn't really matter
20 whether -- so maybe you can clarify your
21 confusion.

22 A. Well, I just didn't understand your
23 question, because you said "your device," and
24 I -- or "the device."

25 And I asked you to clarify were you

1 talking about the device of Kijima unmodified
2 or the device of my combination.

3 And you said they're the same.

4 And they're not, because I've
5 already agreed that I'm making a modification.
6 So therefore, I don't know how to answer your
7 question.

8 Q. So the examples in Kijima doesn't
9 have the organic layer on top of the gold.
10 Correct?

11 A. Off my modification? Yes, I agree.

12 That is not -- in the unmodified
13 Kijima, there is no organic layer inserted
14 between the metal sealing film and the
15 inorganic sealing film.

16 Q. Okay. And we can agree that without
17 the gold layer, it appears that the temperature
18 at the substrate goes up significantly enough
19 that it's affecting the performance or the
20 longevity of the organic layer. Correct?

21 A. Just to make the -- my answer
22 clearer, you're saying "organic layer," but now
23 I think you're referring to the OLED
24 materials --

25 Q. Correct.

1 A. -- not to the organic layer itself.
2 So I'll just be very clear in my answer.

3 So it's true that if we look at the
4 comparative examples of Kijima, it does appear
5 that Kijima states, for example, in
6 Paragraph 75, that if there is no -- (reviewing
7 document) -- if the radiant heat generated
8 during deposition of the insulating sealing
9 film was allowed to affect the OLED device by
10 not taking advantage of the radiative barrier
11 properties of the conductive sealing film,
12 Paragraph 75 indicates that the device
13 degrades. I agree.

14 But remember, in my combination I'm
15 not removing the conductive sealing film. That
16 is still there because it's part of the device.
17 You need it to get electrical signals in and
18 out of the device array.

19 Q. I understand.

20 But is there any data showing the
21 change in performance with a relatively thick
22 organic layer deposited on top of gold?

23 A. Within Kijima, no, because Kijima
24 doesn't have it there.

25 But again, putting an organic layer

1 on top does not change the radiant properties
2 and the reflectivity of the gold underneath.

3 Q. Okay.

4 A. So I would not expect, and in fact
5 it would unreasonable to expect, a dramatic
6 degradation in performance in the combination.

7 Q. And you did not expect that the
8 temperature at the substrate would be high
9 enough under the evaporation conditions to
10 affect the -- strike that.

11 I think previously we -- when we
12 discussed the deposition conditions for the
13 inorganic layer, your position is that given
14 the distance between the source and the
15 substrate, the temperature at the substrate
16 will be close to room temperature. And I think
17 you mentioned that at --

18 A. Yes.

19 But that's in the presence of gold
20 as a reflector, because the gold is doing a
21 good job of acting as a radiant barrier.

22 Q. Okay.

23 A. That's my point.

24 And I'm not removing the gold in my
25 combination.

1 Q. And why would the temperature go up
2 without the gold?

3 A. The reason the temperature goes up
4 without the gold is actually that now there's
5 radiant interactions directly with the organic
6 LED materials and because those are no longer
7 protected, so therefore they will directly be
8 affected by radiative absorption from the
9 deposition source.

10 Q. Okay. And so the -- so if you have
11 an organic sealing material on top of the gold,
12 that organic sealing material will not be
13 protected by the gold itself -- by gold.

14 It will interact directly with the
15 radiant heat source. Correct?

16 A. I agree. That's true.

17 But organic sealing materials are
18 just not particularly thermally sensitive. The
19 very example you gave of polyacrylates can
20 handle much higher temperatures without
21 degradation.

22 Q. Okay. But do you know what the
23 temperature would be?

24 A. No, Kijima doesn't say the
25 temperature.

1 But these materials are designed to
2 handle higher temperatures. The polymerization
3 temperature, or the polymerization method of
4 polyacrylate to form it, is a thermal
5 polymerization. So that tells you that it can
6 handle these temperatures.

7 Q. And what is the polymerization
8 temperature if it's --

9 (Simultaneous crosstalk.)

10 Q. -- instead of UV?

11 A. Yeah, I don't know off the top of my
12 head.

13 Q. So you don't really know what the
14 temperature would be for the polymerization of
15 the polyacrylates. Right?

16 A. No.

17 It was your hypothetical. You're
18 the one who told me to think about
19 polyacrylate.

20 I don't know the temperature.

21 Q. Do you know the polymerization
22 temperature for any other suitable
23 planarization layer?

24 A. Yes.

25 For example, I have done a lot of

1 work on planarization using epoxies. And most
2 epoxies can go up to 150 to 200 degrees Celsius
3 without damage.

4 Q. Okay.

5 A. And I use them in my own personal
6 research.

7 Q. Do you know what the temperature --
8 when it's interacting directly with the radiant
9 source, would it go up to 150 to 200 degrees?

10 A. I doubt it, just because epoxies
11 don't absorb much light in these wavelengths,
12 so I just don't think it will get -- I'm
13 positive it will not get to those temperatures.

14 You remember, this whole issue of
15 the temperature was going up was because you
16 placed a hypothetical in front of me requiring
17 that we use an opaque, highly absorbing
18 organic.

19 There's nothing in my combination
20 that requires that to be true. So it's a
21 hypothetical that's been imposed by you
22 artificially.

23 If I were to use epoxies, they
24 really don't absorb much light in these
25 wavelengths.

1 Q. You did not provide any information
2 on the type of organic sealing materials.
3 Right?

4 Does your report actually provide
5 the identification of the organic sealing
6 materials used?

7 A. (Reviewing document.)

8 So actually yes, because I point
9 specifically to the language of Suzuki.

10 And Suzuki, in describing the
11 organic barrier layers on Column 6, says: "The
12 organic barrier layer may be formed from
13 several types of starting materials. Such
14 starting materials include photocurable
15 monomers or oligomers to provide a cured
16 organic layer, thermoplastic resins and
17 materials having a glass transition point, for
18 example, polymers or low molecular weight
19 materials."

20 So if we look at thermoplastic
21 resins, which would include some of the ones
22 that I've used, those do not absorb significant
23 light at the wavelengths that an evaporation
24 process would generate and can handle high
25 temperatures. That's why they are

1 thermoplastic.

2 Q. Did you give any particular example
3 of thermoplastics in your report?

4 A. (Reviewing document.)

5 So I specifically do cite to Suzuki,
6 including some of the sections that I've been
7 reading you on Column 6.

8 Suzuki says -- again, it does give
9 some examples. I don't think I called out
10 these examples specifically, but it calls out
11 specifically: "Examples of such monomers
12 include trimethylol acrylates" -- I won't read
13 all the chemical names because there's a whole
14 bunch of them -- "cyclohexyl acrylates and the
15 like. Examples of photocurable oligomers
16 include acrylate oligomers, epoxy acrylate
17 oligomers, urethane acrylate oligomers, ether
18 acrylate oligomers and the like."

19 So those cover the very same
20 materials that we've been discussing.

21 Q. Okay. Where in your report did you
22 cite that?

23 A. So as I said, I didn't specifically
24 cite that.

25 But I discussed Suzuki at length,

1 including specifically pointing to Column 6 at
2 various points.

3 I will agree that I never
4 specifically called out those materials.

5 Q. Okay.

6 A. But that is the teaching of
7 Kijima -- sorry -- that is the teaching of
8 Suzuki.

9 Q. And those materials can be opaque or
10 transparent. Correct?

11 A. It depends.

12 So the raw materials actually are
13 all largely transparent. You can put additives
14 in them to increase their absorption, but these
15 acrylates, the epoxy acrylates, the metal
16 acrylates, those are all intrinsically very
17 transparent. The base urethanes are, again,
18 intrinsically very transparent. That's why we
19 have to put absorbers into them to make them
20 more opaque.

21 But it is true, if you add the
22 absorbers in for some reason, you could make
23 them opaque.

24 Q. Thermoplastic resins can be opaque.
25 Correct?

1 A. If you put absorbers into them so
2 that they absorb, you can make them opaque.

3 But you can also have very, very
4 transparent thermoplastic resins that do not
5 absorb significantly in the wavelengths at
6 issue.

7 Q. Even without additives,
8 thermoplastic resins can be opaque. Correct?

9 A. I agree, there are some
10 thermoplastic resins that are opaque.

11 But there are also lots of them that
12 are not.

13 Q. Are benzophenones opaque or
14 transparent?

15 A. I don't actually know. I don't
16 remember the optical properties of all of these
17 specifically.

18 And just to be clear, benzophenones
19 are not the monomers itself. Those are the
20 photoinitiators that are added so that you can
21 thermally cure them -- sorry -- so that you can
22 optically cure them.

23 MS. ZHONG: Let's go off the record
24 and let's take a ten-minute break.

25 (Recess was taken from 10:38 a.m. to

1 10:50 a.m.)

2 BY MS. ZHONG:

3 Q. Dr. Subramanian, you said that you
4 had a lot of experience depositing gold films.
5 Correct?

6 A. Yes.

7 Q. If you control the process properly,
8 do the gold films have a lot of pinhole
9 defects?

10 A. It depends on the thickness.

11 If the films are in the thickness
12 range of a micrometer, then no.

13 If the films are in the thickness
14 range of a few nanometers, then there's a much
15 higher likelihood.

16 Q. Okay. So for a 1 micron thick gold
17 film, usually there are no pinhole defects?

18 A. I agree, the likelihood of getting
19 pinhole defects in a 1 micrometer film will be
20 basically zero or close to zero.

21 There are other types of defects,
22 but pinhole defects will be almost nonexistent.

23 Q. Okay. What kind of other defects
24 have you observed?

25 A. There are buckle defects where the

1 gold buckles up and creates an asperity.

2 That's actually a big problem with
3 gold, and it actually gets worse as the gold
4 gets thicker.

5 There can be --

6 Q. Let me stop you there.

7 What do you mean by "buckle
8 defects"?

9 A. So a buckle defect is if you look at
10 the surface of the gold, because gold is a
11 relatively soft material and can move, it can
12 sort of form a little pyramidal structure, an
13 asperity, a sharp point on the surface --

14 Q. Okay.

15 A. -- because of the nature of gold
16 being so soft.

17 Q. But I thought you said the surface
18 roughness can be as little as 10 nanometers.
19 Right?

20 A. It can.

21 But it can also be as much as
22 hundreds of nanometers. And that's my point.

23 Even 10 nanometers in a sharp point
24 can still be a problem. Right? It's not just
25 a question of the magnitude of the roughness.

1 It's also a question of the spatial frequency
2 of the roughness.

3 And gold unfortunately can form
4 asperities which are extremely sharp, and they
5 may not be very tall or they can be a hundred
6 nanometers tall. It depends on the specifics.

7 Q. Okay. Would that be an issue as far
8 as sealing is concerned, the sealing properly
9 is concerned?

10 MR. GARR: Object to form.

11 THE WITNESS: I think I need to
12 understand.

13 You mean sealing of structures below
14 it?

15 BY MS. ZHONG:

16 Q. Correct, to protect it against
17 oxygen and moisture, the two big concerns for
18 OLEDs.

19 A. It can be. It depends on the
20 specifics.

21 So what happens is when you get
22 these buckle defects, it's happening because
23 gold is moving on the surface of gold. Gold
24 being a soft, mobile material can move on
25 itself.

1 If it is moving to form a buckle
2 defect, that means it's lowering the density of
3 gold somewhere nearby, which then can increase
4 the likelihood of gaseous penetration through
5 those regions.

6 You could have expanded grain
7 boundaries. You can have stacking faults
8 through which it gets easier for oxygen and
9 particularly moisture to penetrate.

10 Q. But those problems can be addressed
11 if you deposit an inorganic barrier layer as in
12 Kijima. Correct?

13 A. Not entirely, in that -- and this is
14 actually a problem with buckle defects.

15 Because they have sharp asperities,
16 when you deposit another layer on top of it,
17 now it will tend to have a weak spot over the
18 buckle defect.

19 And this is a benefit of using a
20 smoothing layer between the sealing gold and
21 the inorganic layer that you put on top.

22 Q. How can a sealing layer prevent gold
23 moving on top of gold?

24 A. Okay. To be clear, it's not that
25 the sealing layer prevents the formation of

1 asperities.

2 But what it does is, because it's a
3 smoothing function, the asperities, the
4 defects, don't propagate up, and so then when
5 you put the organic on top of the planarization
6 layer, the -- sorry -- when you put the
7 inorganic on top of the planarization layer,
8 you don't have to worry about weak spots
9 developing over asperities because the
10 sharpness of the asperity defect has not
11 propagated up to the top of the planarization
12 layer.

13 Q. In Kijima, the use of a two-layer --
14 strike that.

15 In Kijima, the use of an inorganic
16 sealing layer coupled with a gold sealing layer
17 provides satisfactory performance of the
18 device. Correct?

19 A. In Kijima, it shows that it provides
20 some benefits.

21 It's still, as I recall, the -- it
22 talks about the devices work well for the
23 periods of months. That doesn't mean it won't
24 benefit from additional improvement to provide
25 even more stability and endurance benefits.

1 Q. And have you done any calculation or
2 experiments to see what additional benefits
3 there would be?

4 A. Not personally, no.

5 Q. And have you made OLED devices that
6 uses the protection structure that you have
7 proposed, which is a 1 micron stack gold
8 coupled with -- on top of an organic smoothing
9 layer then on top of an inorganic sealing
10 layer?

11 A. No, personally I have not.

12 Q. What about other people in the
13 field?

14 A. I don't know one way or another.

15 Q. You follow the literature. Right?

16 A. Yes.

17 Q. And have you seen any literature on
18 that?

19 A. I honestly don't know one way or
20 another.

21 You are asking for a very specific
22 arrangement of materials with very specific
23 specified thickness numbers.

24 I don't know one way or another
25 whether that exists in the literature or not.

1 Q. Have you seen the use of an organic
2 layer on top of a relatively thick gold layer
3 then an inorganic layer on top of an organic
4 layer?

5 A. I don't recall.

6 I know that I've definitely seen --
7 and personally within my group we have done
8 planarization layers on top of gold
9 specifically to deal with asperities. But in
10 our work I'm positive we did not put a third
11 layer on top of that.

12 But I don't know about other work.
13 Certainly I cannot recall it off the top of my
14 head.

15 Q. And why would you use an organic
16 layer on top of the gold layer if you are not
17 putting another layer on top of the organic
18 layer?

19 A. We were putting another layer on top
20 of the organic layer.

21 Actually, to clarify, the work that
22 I'm thinking about was not a planarizing
23 organic layer. It was a planarizing glass, so
24 it was a liquid glass that we coated for
25 planarization.

1 So it's an organo -- it's a --

2 Q. Organosilicon.

3 (Simultaneous crosstalk.)

4 THE WITNESS: Yeah, it's
5 organosilicate. Okay? We used that a lot in
6 my previous work.

7 We did put another layer on top, but
8 the layer that we put on top was another metal
9 because we were making a multilayered
10 interconnect structure.

11 BY MS. ZHONG:

12 Q. Is it for OLED, or it's for some
13 other applications?

14 A. It was for display circuits.

15 But it was actually in the area where
16 the thin film transistors are, not where the
17 OLED is.

18 Q. Oh, okay. It's for the TFT film or
19 for the TFT circuitry?

20 A. Correct.

21 And actually just to add, now I do
22 recall -- and I think we published on this --
23 we also did it with organic planarization
24 layers where we used -- it was either acrylates
25 or epoxies. I don't remember. But we have

1 published on it.

2 But again, it was not for the OLEDs
3 themselves. It was for the TFT circuitry.

4 Q. Okay. And what kind of improvement
5 did you observe?

6 A. Oh, the big improvement that we
7 observed -- now for us, our characterization
8 was looking at leakage currents through the
9 high fields that result from the asperities.

10 And we observed and actually
11 published on a dramatic reduction in leakage
12 current. I believe it was orders of magnitude
13 reduction in leakage current.

14 Q. What about in terms of the oxygen
15 permeation or the moisture permeation? Was
16 there any difference observed?

17 A. We never measured that.

18 We were focused on electrical
19 characterization of leakage through defects for
20 the work I'm referring to.

21 Q. Okay. And so you don't really know
22 whether the use of the organic layer is going
23 to help with reduction in the oxygen and the
24 moisture permeability. Correct?

25 A. No, that's not true.

1 In our work we were focused on
2 leakage current. But to be clear, the reason
3 that you get leakage current over asperities is
4 you get weak spots in the insulating film that
5 you put over the asperities, which then allows
6 increase in electrical leakage.

7 Those same weak spots can be
8 responsible for enhanced permeability, because
9 it's the same mechanism. It's dangling bonds
10 that then allow either electrons to hop through
11 or allow small molecules, particularly such as
12 moisture, to propagate.

13 Q. Did you do any measurement?

14 A. Of leakage current? Yes.

15 Of moisture permeance? No.

16 Q. And you are not aware of other
17 people using a smoothing layer over a gold film
18 then on top of it another barrier layer?

19 A. I think I answered that.

20 I don't recall specifically one way
21 or another.

22 Q. And you're pretty familiar with the
23 literature in general. Correct?

24 A. I am familiar with the literature.

25 That doesn't mean I've memorized all

1 the literature.

2 Q. Since you are working in that field
3 and using gold film, you would have recalled
4 literature that discloses similar structures.
5 Right?

6 A. No, that's not true. I wish I had
7 that kind of memory, but I don't.

8 And this is the reason literature
9 exists, so that we don't have to memorize
10 everything.

11 Q. But sitting here today, you don't
12 recall any literature for OLED structures where
13 people put a smoothing layer on top of a thick
14 gold film then another inorganic barrier layer
15 on top of the organic smoothing layer.
16 Correct?

17 A. Yes, that's fair.
18 I mean, that's the reason I did an
19 obviousness combination.

20 Q. Okay. And I just want to be clear
21 that I -- when I'm talking about the
22 literature, I'm not just talking about at the
23 time of the invention but since the invention
24 as well.

25 A. I understand.

1 I mean, my answers would be the
2 same.

3 Q. Okay. And when did you perform the
4 TFT circuitry work that you just discussed?

5 A. Would have been between 2000 and
6 2005.

7 Q. And it will be closer to 2000 or
8 closer to 2005?

9 A. Probably over that entire period.
10 Probably not before 2002, just
11 because I was a new professor at that time and
12 was still establishing my lab. But I think our
13 early publications started coming out in around
14 2002 and from there on.

15 Q. Okay. Were you involved in --
16 strike that.

17 Were you intimately involved in
18 directing the research projects in those years?

19 A. Of course.

20 Those were my Ph.D. students.

21 Q. So you gave them a lot of directions
22 as to how the research should be shaped?

23 A. Absolutely.

24 Q. What they should explore?

25 A. Yes.

1 Q. Okay. And do you consider yourself
2 at that stage to be a person with skills above
3 a POSITA?

4 A. Yes, that would follow, because by
5 then I had already had -- I already had had a
6 Ph.D. for two years and I had been involved in
7 display research, and specifically in OLEDs,
8 for -- at that point, for five years.

9 So yes.

10 Q. So you would have above average
11 skill set at the time?

12 A. That's fair.

13 Q. Do you know the skill level of
14 Kijima?

15 A. No, not specifically.

16 Q. Do you know the skill level of
17 Suzuki?

18 A. No, not specifically.

19 Q. Any of the co-inventors on the
20 Suzuki patent?

21 (Reporter clarification.)

22 Q. Do you know the skill level of any
23 of Suzuki's co-inventors?

24 A. No, I don't think so. I don't
25 recognize any of the names.

1 I have collaborated with Matsushita
2 Electric before, but I don't recognize any of
3 these people.

4 Q. And for the people that you have
5 collaborated at Matsushita, do they have the
6 skill level above what you'd define for a
7 person of ordinary skill in the art?

8 MR. GARR: Objection.

9 THE WITNESS: I don't recall.

10 The people I collaborated with from
11 Matsushita, or the person I collaborated with
12 from Matsushita, was not working on displays,
13 so I don't know if he met the POSITA
14 requirement of one year of experience with
15 display technology.

16 BY MS. ZHONG:

17 Q. Okay. Were you collaborating with
18 the display technology or some other areas?

19 A. Something else.

20 Q. Okay. What about James C. Sturm?
21 You know him well. Correct?

22 A. I know him. I've known him a long
23 time.

24 I think the first time I met him was
25 in my second year of my Ph.D., so that would

1 have been 1996.

2 I wouldn't say I know him well, but
3 I've known him a long time.

4 Q. Okay. And so by 2002, he would be
5 someone with above average skill set. Correct?

6 A. Yes, I would think so.

7 Q. And even by 1999, he would be
8 someone with above average skill set. Correct?

9 A. Yes, he was at -- by 1999, he was
10 already a well-established professor at
11 Princeton and had worked in this field for many
12 years.

13 I don't remember when he started at
14 Princeton, but definitely he was
15 well-established by 1999.

16 Q. Okay. What about Fujimori? Do you
17 know his or her skill set?

18 A. No, I don't know anything about
19 Shigeo Fujimori.

20 Q. And do you know anything about skill
21 sets of the other co-inventors on the Fujimori
22 patent?

23 A. No, I don't.

24 Q. What about the inventors on the
25 Duthaler PCT application?

1 A. I don't --

2 MR. GARR: Sorry. I didn't hear
3 that.

4 THE WITNESS: Could you repeat the
5 question, please.

6 BY MS. ZHONG:

7 Q. Do you know anything about the skill
8 levels for the inventors on the Duthaler PCT
9 application?

10 A. Could you tell me what exhibit
11 number that is.

12 I don't have a paper copy of it.

13 Q. Exhibit 1016.

14 A. No, I don't personally know Gregg
15 Duthaler, though I do know at least one -- no,
16 I know one person who's a co-inventor.

17 Q. Which person?

18 A. Paul Drzaic.

19 Q. What's his skill level?

20 A. I'm pretty sure he has a Ph.D.

21 He's definitely older than me, which
22 means he probably got his Ph.D. before me, and
23 he worked on displays for a long time.

24 Q. So he is someone with above average
25 skill set?

1 A. Yes, that's certainly true.

2 Q. Okay. What kind of tasks would you
3 assign to someone with just one year of
4 experience in display in your group?

5 A. Well, I've always given my students
6 a huge amount of freedom, so it really depends
7 on what the students' interests were.

8 But for me, I would give students
9 with one year of experience -- by that time
10 they would be doing full device fabrication,
11 they would be designing their own devices, they
12 would be developing their own processes. In
13 some cases, they would be building their own
14 equipment.

15 So I treated a first year student
16 almost the same as I treat a fifth year Ph.D.
17 student. It's just they make more mistakes and
18 they need more guidance, but that doesn't mean
19 they're not as capable.

20 Q. Do you have to give them more
21 guidance as to how to connect the dots in the
22 literature?

23 A. No. I would say no.

24 That's one thing I find is more
25 person to person dependent and less seniority

1 dependent.

2 Really I think the more junior
3 students mainly need a little more guidance
4 about sort of realities of experiments.

5 What I mean is --

6 (Simultaneous crosstalk.)

7 Q. Go ahead.

8 A. What I mean by that is younger
9 students would often propose ideas that may be
10 less likely to work just because they wouldn't
11 have become jaded by experience, so to speak.
12 I would say that's the big difference.

13 So in many ways, the best ideas come
14 from younger students.

15 Q. And when you say they propose ideas
16 that are less likely to work, can you give some
17 examples.

18 A. Yeah, sure.

19 So I'll give you a recent example
20 that I'm dealing with. I have -- this is
21 unrelated to the displays.

22 I have a student who's attempting to
23 make a robotic capsule that you would swallow.
24 And it's steered to your colon, and it grabs
25 hold of the walls of your colon and then

1 penetrates a needle through the stoma of the
2 colon and injects a colon cancer drug into a
3 tumor, a colon tumor.

4 She's an extremely smart student,
5 has proposed an excellent device concept but
6 has made it probably more complicated than it
7 needs to be. So I have been trying to work
8 with her to try to simplify the device, not
9 because her device won't work, but -- and also
10 not because her device idea is not good. It's
11 actually a really good idea. It's just
12 sometimes you don't need to make the really
13 good idea. It's okay to make the okay idea if
14 it's good enough. And that's kind of what I'm
15 working with her on.

16 Q. And in your work that you mentioned
17 earlier of adding an organic layer on top of
18 the gold film for the TFT circuitry, whose idea
19 was that?

20 A. It was -- almost all the ideas come
21 from a collaboration between my Ph.D. students
22 and me.

23 Q. Do you --

24 A. I think when we --

25 (Simultaneous crosstalk.)

1 Q. Go ahead.

2 A. I think when we launched that
3 project, I had a sort of an end goal of what I
4 wanted to do.

5 And we had a -- my lab was pretty
6 small at the time. I think I only had four
7 Ph.D. students.

8 So I guess it was me and two of my
9 Ph.D. students. I'm pretty sure that's right.

10 Q. And who proposed that idea of adding
11 the organic layer specifically? Was it you or
12 the Ph.D. student?

13 A. I honestly don't know. It was
14 20 years ago.

15 It was probably done through a
16 brainstorming session involving all of us.

17 Q. Okay. And by that time they had
18 more than one year of experience in display.
19 Correct?

20 A. Yes.

21 Q. So they had above average skill set
22 by then?

23 A. Probably just above threshold.

24 The two students I'm thinking of had
25 just completed their Bachelor's degrees in

1 approximately the year 2000 and had just been
2 working on displays for about a year or two,
3 depending on the time frame.

4 Q. Okay. And the idea was the result
5 of a brainstorm session with you, who had above
6 average skill set. Correct?

7 A. That's almost certainly true.

8 MR. GARR: Objection.

9 Q. I think you mentioned yesterday that
10 you have recommended the Sturm work. Correct?

11 A. That's what I recall.

12 I don't know that I specifically
13 found the patent, but I knew the work of Jim
14 Sturm and recommended him as a source for
15 publications on inkjet related work.

16 Q. Okay. And for Exhibit 1012 [sic],
17 which is Patent 6,087,196 to Sturm and his
18 coworkers, did that involve encapsulation layer
19 of OLEDs?

20 A. I'm sorry. What was the exhibit
21 number again, please?

22 Q. 1012.

23 No, actually 1013, looks like it.

24 Sorry. 1013.

25 A. Okay. I have the exhibit.

1 Could you repeat your question,
2 please.

3 A. So in this Exhibit 1013, which is
4 Patent No. 6,087,196, does it involve the
5 encapsulation layer?

6 A. (Reviewing document.)

7 No, it doesn't appear that there's
8 any specific discussion of encapsulation within
9 Exhibit 1013.

10 Q. And in the structures that's inkjet
11 deposited, is it correct -- why don't we do --
12 why don't we do it like embodiment by
13 embodiment in figure.

14 So let's take a look at Figure 7A
15 through 7C.

16 22 and 24 are inkjet deposit
17 structures. Correct?

18 A. (Reviewing document.)

19 Yes.

20 Q. So are 26 and 28. Correct?

21 A. (Reviewing document.)

22 No, I don't think so.

23 Let's take a look.

24 You said -- sorry. What were the
25 other structures, the numbers?

1 Q. 26 and 28.

2 A. (Reviewing document.)

3 Q. Sorry. 26 and 28 looks like they
4 are deposited by thermal evaporations through
5 shadow masks.

6 A. Correct.

7 Q. So 26 and 28 only cover a portion of
8 the inkjet deposit at structure 22 and 24.
9 Correct?

10 A. Yes.

11 Q. Okay. And let's look at Figures 8A
12 through 8C.

13 So 34, 36 and 38 are the inkjet
14 deposited materials. Correct?

15 A. Yes.

16 Q. And 40, 42 and 44 only cover a
17 portion of those inkjet deposit materials.
18 Correct?

19 MR. GARR: Do you need a printed
20 copy?

21 THE WITNESS: No, it's okay. Thank
22 you. (Reviewing document.)

23 Yes, I agree. They only cover a
24 portion of the inkjet printed islands.

25

1 BY MS. ZHONG:

2 Q. In Figures 9A through 9C, the
3 material that's deposited by inkjet is 50.
4 Correct?

5 A. (Reviewing document.)

6 Also 46.

7 So it's true that 50 is inkjet
8 printed, but so is 46 and so is 52.

9 Q. So is 50 deposited as a continuous
10 layer or only at certain -- or strike that.

11 So is 50 deposited as a continuous
12 layer or only at certain locations on the
13 substrate?

14 A. (Reviewing document.)

15 So it says that it's deposited in a
16 desired pattern, so it is -- it's spatially
17 specified.

18 It says that on Column 6, roughly at
19 Line 4.

20 Q. Is 50 a planarization layer?

21 A. (Reviewing document.)

22 So the text of Sturm does not
23 discuss the details of the material used to
24 form 50, so it's silent as to that.

25 Certainly looking at the image of

1 50, it appears to not propagate the topology of
2 46 upwards. So it seems to suggest that it
3 could be used as a planarization layer, but it
4 doesn't specifically explicitly call that out.

5 Q. What is the function of 50?

6 A. (Reviewing document.)

7 So it actually doesn't say.

8 This embodiment is related to the
9 fabrication of bottom contact, but it doesn't
10 say what device it's being used in in this
11 section nor in the figure caption.

12 It just says that the bottom contact
13 is printed, then organic materials are printed
14 and then a top contact is printed, but it
15 doesn't say specifically what the device target
16 is for Figure 9.

17 Q. Do you think that's for an OLED
18 structure or more for like TFT circuitry?

19 A. So TFTs are not built that way where
20 you put a bottom contact directly under a top
21 contact.

22 That could be for an OLED structure
23 because structurally it's closer to a simple
24 OLED.

25 But that's not the only structure it

1 could be for. I mean, it could also be a
2 capacitor. Right? I mean, that is what a
3 capacitor structure looks like.

4 But certainly structurally that
5 organization of two contacts vertically
6 separated from each other by a polymer is
7 exactly the structure that an OLED has.

8 Q. For the capacitor --

9 (Simultaneous crosstalk.)

10 THE WITNESS: Sorry. Let me
11 rephrase that.

12 Two contacts that are separated by
13 an organic layer is the structure that an OLED
14 has.

15 BY MS. ZHONG:

16 Q. Okay. In the sense that the OLED
17 also has a capacitor, right -- or are you
18 referring to the light-emitting region of the
19 OLEDs?

20 A. I'm referring to the light-emitting
21 region of the OLEDs.

22 So this is not what -- Sturm doesn't
23 specify what the material properties
24 necessarily are for 42 -- 46 and 52.

25 In discussing the materials --

1 Q. Well, it says -- actually, if you
2 look at Column 6, Lines 13 to 16, it says:
3 "The contacts may be formed of a precursor of
4 the final metal, metal particles suspended in a
5 solvent."

6 A. Right. You just interrupted me.
7 That's about what I was about to
8 say.

9 Q. Okay.

10 A. So it specifies that they can be
11 made of metal nanoparticles.

12 But to be clear -- and my lab has
13 done this and it was doable at this time -- you
14 can make metal nanoparticles of a range of
15 materials, including indium tin oxide,
16 including gold, including silver.

17 So that structure could be used for
18 a capacitor, but it could also be the optically
19 correct structure for an OLED, because you'd
20 have one contact being transparent and the
21 other contact being nontransparent with an
22 emissive organic layer between them.

23 It just doesn't say. It's silent as
24 to the specific application.

25 But structurally, it very much could

1 be an OLED.

2 Q. Okay. What about the structures in
3 Figures 10A through 10C?

4 A. (Reviewing document.)

5 Q. Is that an OLED structure or
6 something else?

7 A. So here it just calls them top
8 contacts, so they could be either.

9 In other words, it could be for a
10 TFT where these are contacts to the
11 semiconductor channel, but it could also be
12 used for an OLED.

13 And actually if we look at the next
14 section, which is Column 6 starting at Line 19,
15 it tells us specifically that these teachings
16 of Figure 9 and 10 can be used to make OLEDs,
17 because it says: "The techniques of Figures 9
18 and 10" -- sorry -- "9 and/or 10 may be
19 combined with the steps described in Figures 6
20 through 8. Figures 11(a)-(c) illustrates the
21 fabrication of three color OLEDs with
22 individual top contacts made by inkjet
23 printing."

24 Q. Okay. And for Figures 11(a)
25 through 11(c), again, the islands 68, 70 and 72

1 are formed by inkjets. Correct?

2 A. (Reviewing document.)

3 Sorry. 68, 70 and 72? Yes, they
4 are called out as being formed by inkjet at
5 Column 6, Line 25.

6 Q. So are the top contacts 74, 76 and
7 78. Correct?

8 A. Yes.

9 Q. And again, 74, 76 and 78 cover only
10 a portion of 68, 70 and 72. Correct?

11 A. That's right.

12 Q. And in the Figures 12(a)
13 through 12(d), the layer 88 is put -- 88 and 90
14 are printed by inkjets. Correct?

15 A. (Reviewing document.)

16 So Sturm does not specifically say
17 that those layers in Figure 12 are printed by
18 inkjet.

19 But certainly based on the teachings
20 above, it's reasonable to assume that they are
21 probably printed by inkjet.

22 In the discussion of those polymer
23 islands, which is at Column 6, Line 33, it just
24 says: "The polymer islands 88 and 90 are
25 applied on top of the bottom electrodes," but

1 it doesn't say how they are applied.

2 But I think based on the teachings,
3 they certainly look to be inkjet printed.

4 Q. Okay. And the layer 92, even though
5 it's shown as a continuous layer in the
6 cross-section in 12(c), if you look at 12(d),
7 it is only continuous in one direction.

8 But it only covers a portion of the
9 islands 88 and 90. Is that correct?

10 A. I think I understand what you're
11 saying.

12 And you're talking about 92.
13 Correct?

14 Q. Correct.

15 A. Yes.

16 If we look at Figure 12(d), 92 runs
17 from left to right. So if you meant that -- if
18 that's what you meant when you said it was
19 continuous, I agree with that.

20 I also agree that if we look at the
21 islands 88 which are, roughly speaking,
22 circular, 92 does not cover the entire exposed
23 surface of 88 for each island of 88.

24 Q. Is it a problem that only a portion
25 of the organic layer or the polymer layer is

1 covered by a top layer?

2 A. No.

3 In Figure 12(d), the organic is used
4 to ensure -- besides providing its own internal
5 functionality, it ensures in this case that the
6 vertical lines 84 do not directly short to the
7 horizontal lines 92. And that is achieved
8 here.

9 So the fact that it does not cover
10 the entirety is not a problem.

11 Q. And in the structures in
12 Figures 13(a) through 13(c), which structure's
13 deposited by inkjet?

14 A. (Reviewing document.)

15 So if we look at the discussion of
16 Figures 13(a) through (c) which is in Column 6,
17 starting roughly at Line 39, it doesn't
18 explicitly call out how the bottom electrodes
19 are formed.

20 They could have been printed,
21 because in the previous section it talks about
22 printing bottom electrodes, but it doesn't say
23 that here.

24 The only section it definitively
25 calls out as being printed are the organic

1 islands 108, 110 and 112.

2 Q. Okay. And what about in
3 Figures 14(a) and 14(b)?

4 A. (Reviewing document.)

5 Q. Which of the structures are printed
6 by inkjet?

7 A. So this is discussed at the bottom
8 of Column 6 starting at Line 52.

9 It doesn't say how the gate
10 electrode 118 is formed. Of course because it
11 is a bottom electrode, based on the teachings
12 above, it could have been printed, but it
13 doesn't say that explicitly here.

14 Then it says: "A gate insulator 120
15 is formed."

16 It does say at the bottom of that
17 paragraph that the gate insulator may be
18 printed.

19 Q. Okay.

20 A. Then it talks about the organic
21 semiconductor layer 122, and it says that that
22 is printed.

23 Then it talks about the source/drain
24 contacts, and it says those are formed by
25 conventional means, which I assume in this case

1 means that they are not printed because he's
2 contrasting inkjet printing to other
3 techniques, but I don't know for sure.

4 He does say -- he does go on to say
5 that the source/drain contacts 124 and 126 may
6 also be formed -- oh, no, I take back the last
7 sentence.

8 I think that's it. That's his
9 discussion with regard to the printing
10 techniques used.

11 Q. Is 14(a) and 14(b) an OLED structure
12 or something else?

13 A. 14(a) and (b) are referring to thin
14 film transistors, so TFTs.

15 Q. Okay. What about 13(a) through
16 13(c)?

17 A. So 13(a) through 13(c) is referring
18 to an active matrix structure. This is just
19 showing how you can create an array to form an
20 active matrix structure.

21 But it does specifically call out in
22 the bottom that: "These islands may be of
23 different emitting colors for a 1S color
24 matrix."

25 So that would indicate that it does

1 include within it OLEDs.

2 Q. Okay. And 12(a) through (d), that's
3 for a passive matrix OLED structure. Correct?

4 A. Correct.

5 Q. Or it can be used for a passive
6 matrix OLED structure?

7 A. Correct.

8 And it calls that out specifically
9 at Line 35 where it talks about different
10 emitting colors. And this is in Column 6
11 still.

12 Q. Okay. What about Figure 15?

13 A. Well, Figure 15, it calls it out as
14 being "a modified method of fabricating OLED
15 devices."

16 Q. And which structures in Figure 15
17 are deposited by inkjet printing?

18 A. It does not call out explicitly how
19 the bottom and top contacts are formed.

20 It just says the bottom contact are
21 formed thereon and may be patterned.

22 It does explicitly call out that the
23 organic material 136 is inkjet printed. And
24 then it does say that the insulator may
25 adjust -- or no, that's it. I think the only

1 thing it explicitly calls out as being inkjet
2 printed is 136.

3 On the others, it just says they are
4 deposited. They may be patterned, but it
5 doesn't explicitly say how they are done.

6 Of course the teachings above which
7 do talk about printing of bottom and top
8 contacts and printing of the insulator islands
9 suggests that put together they could be
10 printed. But it doesn't say that explicitly
11 for Figure 15.

12 Q. Okay. And any of the inkjet-printed
13 layers serve as a passivating layer or a
14 protective layer or an encapsulation layer?

15 A. So -- well, that's a compound
16 question.

17 So as far as a protective layer, the
18 answer is yes, because if we look at
19 Figure 12(d), the islands prevent the shorting
20 of 92 to 80.

21 Q. So --

22 A. Sorry. The shorting of 92 to 84.

23 Q. Okay.

24 A. But that's to prevent electrical
25 shorting.

1 Q. Okay. I was talking about the
2 protective layer in the sense of protecting
3 against oxygen and moisture permeation.

4 A. No, I think Sturm doesn't mention
5 moisture or oxygen permeation in relation to
6 any of its layers.

7 Q. Okay. And can you also take a look
8 at Columns 4, Line -- starting from Line 53,
9 through Column 5 through the end of Line 16, so
10 4-53 to 5-15.

11 A. (Complying.)
12 Yeah, I've read it.

13 Q. Okay. So in that -- in those two
14 paragraphs, they are discussing an
15 implementation where the inkjetted layer is put
16 down continuously. Is that correct?

17 A. Well, to be clear, it's as opposed
18 to discrete dots.

19 So what they do is they print a
20 continuous sheet, so a large area pattern
21 rather than individual dots, because the dots
22 are so small in their experimental apparatus
23 they were unable to align the shadow mask to
24 the individual dots.

25 Q. Okay. And for -- so when they have

1 the polymer dots printed as a continuous sheets
2 rather than discrete islands, the performance
3 was actually worse than a screen printed
4 reference device. Is that correct?

5 A. (Reviewing document.)

6 I'm sorry. What is the comparison
7 device that you're referring to? Could you
8 point me to what you're referring to.

9 Q. Read Column 5, Lines 4 through 16
10 and Figure 4.

11 A. (Complying.)

12 Q. Figures 4 and 5.

13 A. I understand.

14 You said "screen printed."

15 I think you meant "spin-coated."

16 Q. Sorry. Spin-coated.

17 A. Okay. Yeah, so I agree in general
18 what -- in terms of efficiency, it's true that
19 what Sturm says at Column 5, roughly at
20 Line 15, is the efficiency of the inkjet
21 printed device is about a factor of 2 less than
22 the spin-coated device.

23 Q. And is Sturm stating here that it's
24 unable to properly align the shadow mask,
25 whereas the polymer -- like the isolated

1 polymer dots?

2 A. Not in this section, but he says
3 that higher up at Column 4, Line --

4 Q. 53.

5 A. -- 53.

6 He says: "It was difficult to
7 fabricate devices directly on top of the
8 polymer dots fabricated by inkjet printing
9 because of the difficulty in aligning a shadow
10 mask for metal cathode formation directly over
11 a polymer dot."

12 So but to be clear, what he's saying
13 is, if I put down a single drop, a single dot,
14 by inkjet printing, the dot is so small that I
15 cannot align to it.

16 He's still able to align to inkjet
17 printing, but the way he does it is he prints a
18 larger sheet, so a big square pattern, which
19 gives him just a larger area for the alignment
20 in his system.

21 Q. But all those dots are now
22 continuous rather than discrete?

23 A. The dot -- so you print a pattern.

24 So it's a 2-D array of dots which
25 connects to each other to form a square. I

1 mean, that's the standard way of making inkjet
2 printed patterns. All inkjet printed patterns
3 are built out of individual dots that connect
4 to each other to form a larger shape.

5 Q. So those dots basically merge into a
6 continuous sheet. Is that correct?

7 A. Yes.

8 But again, to be clear, because it's
9 printed, it still has a boundary, but within
10 the limits of that boundary, the dots will
11 merge together.

12 In fact, we counted on that. We
13 sort of account for that when we do our
14 printing to create, for example, a square or a
15 rectangle or some shape like that that is big
16 enough that he's now able to do the alignment
17 that he needs.

18 Q. Okay. So in Figures 6A through 15,
19 are those inkjet printed islands composed of
20 multiple droplets merged into a larger
21 structure?

22 A. Sorry. Which -- in Figures --

23 Q. Figures 6 through 15 that we
24 discussed earlier.

25 A. Yes, anytime you are talking about

1 an inkjet printed island, it is going to be
2 composed of more than one drop. That's how we
3 build shapes with inkjet.

4 Inkjet pushes out individual dots,
5 but the dots themselves are really small. The
6 volume of a typical droplet in an inkjet
7 printer is in the range of picoliters.

8 So then you print it, you print
9 another drop next to it, you print another drop
10 next to that and so on to construct a larger
11 shape.

12 And so these islands are the larger
13 shapes that are formed through the merging of
14 individual drops.

15 Q. Now, in Kijima, were both layers --
16 were both the inorganic layer and the gold
17 sealing layers deposited by thermal evaporation
18 in the vacuum?

19 A. Yes.

20 Though he does say it doesn't have
21 to be thermal evaporation, it can also also be
22 e-beam evaporation.

23 But yes, it's true that they are
24 evaporated under vacuum.

25 Q. Okay. And so in order for you to --

1 and how do you propose to deposit the organic
2 sealing layer between the two -- the inorganic
3 and gold sealing layers?

4 A. (Reviewing document.)

5 MR. GARR: Object to form.

6 THE WITNESS: So with respect to the
7 combination that I proposed, namely -- as I
8 show in Page 41 of my declaration, namely
9 adding an organic sealing layer that I map to
10 the planarization layer of the claims at issue,
11 I address how that could be done in various
12 places.

13 Specifically in one embodiment in
14 the case where I'm not specifically addressing
15 a claim that requires inkjet printing or
16 something along those lines, I point out in
17 Paragraph 83 that this could be done -- and
18 this is from the bottom of Paragraph 83: "In
19 my opinion, a POSITA would have appreciated
20 that the additional organic sealing layers, as
21 I have shown them in the above modification of
22 Figure 12, can be readily deposited using the
23 same selective deposition methods already used
24 in Kijima, that is, masks arranged in a vacuum
25 deposition device as depicted in Figure 4 using

1 an additional mask with openings sized
2 appropriately for the desired area of the
3 organic layer."

4 BY MS. ZHONG:

5 Q. So you are suggesting using the same
6 evaporation techniques on the vacuum as for the
7 other two layers. Is that correct?

8 A. Yes, with appropriate choice of
9 source materials and process conditions.

10 But yes, evaporation of organics is
11 routinely done.

12 Q. And then what would be the reason a
13 POSITA would use inkjet printing or screen
14 printing instead of the evaporative process
15 that you have proposed here?

16 What would be the advantage?

17 A. (Reviewing document.)

18 So I provide numerous advantages in
19 Paragraph 105 of my declaration specifically.

20 "Further, in my opinion, as a POSITA
21 would have recognized that using inkjet
22 printing in the modified method of Kijima would
23 have been advantageous as it entails selective
24 deposition of fine elements for which precision
25 dispensing inkjet printing would be

1 advantageous."

2 Specifically I go on to say: "A
3 POSITA would have appreciated that there were
4 other advantages for using inkjet to
5 selectively deposit an organic layer. For
6 example, inkjet printing is a noncontact
7 deposition technique, and thus minimizes risk
8 of contamination."

9 It's "also a directed deposition
10 technique which is very material efficient and
11 limits the amount of waste generated compared
12 to other deposition techniques. Likewise, the
13 technique is conducive to depositing multiple
14 coats, allowing for the deposition of thicker
15 layers."

16 And finally: "The technique is
17 scalable, since large numbers of inkjet heads
18 can be ganged together to rapidly print over
19 large areas."

20 Q. Okay. Is the evaporative process we
21 discussed earlier, can that be done as a
22 noncontacted deposition?

23 A. Yes.

24 Q. Okay. And is the evaporative
25 process a directed deposition technique?

1 A. Yes.

2 But there is some material wastage,
3 because material is of course deposited on the
4 shadow mask. So it's not as material efficient
5 as inkjet.

6 Q. But it has the advantage of being
7 able to use the same vacuum deposition chamber?

8 A. I agree, there's advantages and
9 disadvantages to both techniques.

10 Q. Okay. And can the evaporative
11 process to obtain a thick layer of organic
12 materials?

13 A. It can.

14 It's much slower than inkjet, so
15 inkjet has a speed advantage or a throughput
16 advantage in that respect.

17 But by evaporating long enough, you
18 can get thicker layers.

19 Q. And is evaporative process scalable?

20 A. Not like inkjet.

21 The point sources used in
22 evaporation it's very difficult to gang over
23 large areas.

24 Inkjet can be ganged over large
25 areas because it's possible, and has been

1 possible for decades, to have hundreds of
2 inkjet heads running in parallel.

3 Q. Well, instead of point sources, you
4 can have linear source of evaporation. Right?

5 A. Well, that's true.

6 But you still do not achieve the
7 ganging that you can get out of inkjet.

8 Inkjet -- there's a reason that we
9 use inkjet, for example, to print huge poster
10 boards, because it can do large areas very
11 efficiently.

12 Q. But you have to use a completely
13 different set of deposition -- you have to use
14 completely different equipment?

15 MR. GARR: Objection.

16 THE WITNESS: I'm sorry. You said
17 "different," but I don't know what you --
18 that's a comparative word, so I need to know
19 what you're comparing against.

20 BY MS. ZHONG:

21 Q. Instead of using the evaporative
22 process, you are using inkjet, and for the
23 other two layers you are still using the
24 evaporative process. Right?

25 MR. GARR: Objection.

1 THE WITNESS: I think I understand.

2 If you're saying that if I want to
3 use inkjet but I still want to use -- or I
4 still need to use evaporation for other layers,
5 it's true, you're using one more tool, but now
6 the tool becomes very efficient.

7 BY MS. ZHONG:

8 Q. And do you apply the inkjet in a
9 vacuum?

10 A. No.

11 But you can apply it under nitrogen.
12 And in fact, it has routinely been used under
13 nitrogen.

14 Q. So you take the device out of the
15 vacuum chamber and into the nitrogen chamber?

16 A. In fact, the standard way that this
17 is done -- and this has been done this way for
18 decades in the OLED business, for example, by
19 some of the -- you know, my lab does it this
20 way, the labs at Princeton do it this way, the
21 labs at MIT do it this way.

22 You have an evaporator that is
23 connected to a glove box. That's pretty much
24 standard tooling in the industry. And then you
25 have an inkjet printer inside the glove box.

1 So there is no exposure to air in
2 that process. You come out of the evaporator
3 straight into the glove box, which is under
4 nitrogen, and then the inkjet printer is under
5 nitrogen.

6 It's very standard. Has been used
7 this way for decades.

8 Q. Is there anything in Kijima itself
9 that suggests the incorporation of an
10 additional sealing layer?

11 A. (Reviewing document.)

12 MR. GARR: Object to form.

13 THE WITNESS: So Kijima itself only
14 uses the structure that has the conductive
15 sealing layer followed by the inorganic sealing
16 layer.

17 But of course one of skill in the
18 art at that time, including based on the
19 disclosures of the patent at issue, would know
20 that there's benefits to the polymer multilayer
21 structure or the use of a protective double
22 layer structure. And looking at what Kijima is
23 trying to accomplish along with that knowledge,
24 one wouldn't be motivated to do it.

25 And I addressed this within my --

1 for example, within my detailed discussion in
2 addressing element 34[b] starting on Page 34 of
3 my declaration.

4 BY MS. ZHONG:

5 Q. And in fact, Kijima itself has
6 contemplated that the conductive sealing layer
7 can be a polymer layer. Correct?

8 A. I agree.

9 That's what I pointed out to you
10 previously.

11 Q. And -- but it does not say that that
12 particular layer will constitute a smoothing
13 layer. Correct?

14 A. Could you repeat the question.
15 I didn't hear it.

16 Q. Kijima does not say that that
17 particular -- when it is -- strike that.

18 Kijima does not say that when the
19 conductive sealing layer is a polymer layer,
20 that polymer layer should also serve as a
21 smoothing layer. Correct?

22 A. I believe that's right, those words
23 don't appear in Kijima.

24 Q. But not only those words, those
25 concepts also don't appear in Kijima. Correct?

1 A. (Reviewing document.)

2 In general, it doesn't.

3 In the context of talking about the
4 use of something other than a metal as the
5 conductive sealing layer, it doesn't address
6 the issue of smoothing at all.

7 Q. Okay. And now let's take a look at
8 Suzuki, in particular Suzuki Figure 1.

9 A. Okay.

10 Q. Layer 18 is a cathode. Correct?

11 A. Yes.

12 Q. And does that one have a protective
13 layer on top of it, a metal -- strike that.

14 Does 18 have a conductive sealing
15 layer or conductive protective layer on top of
16 that?

17 A. On top of 18? No.

18 Q. And is 18 continuous in at least one
19 direction?

20 A. (Reviewing document.)

21 So Suzuki is silent as to the top
22 view structure of the OLED device. And in
23 fact, its disclosure is only talking about a
24 singular device, so it doesn't specifically
25 address what happens in and out of the plane of

1 said device.

2 Q. How is the protective layer 20 of
3 Suzuki applied or deposited?

4 A. (Reviewing document.)

5 MR. GARR: We've been going about an
6 hour and a half.

7 I suggest taking a break at the next
8 opportunity.

9 THE WITNESS: So it discusses this
10 in Column 6.

11 So at the top of Column 6, it talks
12 about how the organic barrier layer 20 is made
13 of a cured resin that should be preferably
14 resistant to moisture to an extent and then
15 talks about how it starts from monomers.

16 In relation to the monomers, still
17 at Column 6, at Line 26, it says: "The monomer
18 or oligomer is applied to the anode layer 18 by
19 spin coating, casting or vacuum deposition."

20 BY MS. ZHONG:

21 Q. What is casting?

22 A. Oh, casting is essentially you put a
23 liquid source of the material directly onto the
24 target area held in place by walls of some
25 sort. So you can almost think of casting as

1 the liquid based version of shadow masking.

2 Or another type of casting is what's
3 called drop casting, where you just put a big
4 drop, a big puddle of material, where you want
5 it.

6 Q. So similar to spraying?

7 A. No, because it's not sprayed.

8 It's almost like pouring rather than
9 spraying.

10 Q. Is spin coating a selective --
11 strike that.

12 Is spin coating a selective
13 deposition process?

14 A. (Reviewing document.)

15 So on its own, spin coating is not
16 selective. It's blanket deposition technique.

17 There are ways to make spin coating
18 selective by using dewetting agents in certain
19 part of the spin-coated surface, but on its
20 own, spin coating is generally not selective.

21 Q. What about vacuum deposition?

22 A. Vacuum deposition can be selective.
23 It can be made selective when using a shadow
24 mask.

25 And a good example of that, which is

1 of course taught by Kijima, is exactly that.

2 Q. What about casting?

3 A. Casting is generally selective.

4 It's limited to the area over which
5 you cast. So any areas over which you don't
6 cast do not get material deposited.

7 Q. And how does Kijima perform the
8 deposition of the inorganic layer 22?

9 A. Sorry. Kijima or --

10 Q. Sorry.

11 How does Suzuki deposit the
12 inorganic barrier layer 22?

13 A. (Reviewing document.)

14 So Suzuki addresses this on Column 7
15 at Line 20 where it's -- and this is in
16 referring to the inorganic barrier layer 22 --
17 where it says: "For the film formation, these
18 materials are subjected to vapor phase
19 techniques such as vacuum deposition,
20 sputtering and the like under conditions
21 ordinarily used for these oxides, nitrides or
22 metals."

23 Q. And what are some of the vacuum
24 deposition techniques?

25 A. Well, I mean, the most common ones

1 that -- well, the ones we've been discussing so
2 far are evaporation.

3 There could be thermal evaporation,
4 electron beam evaporation.

5 There's also sublimation techniques.

6 There's sputtering, which is
7 explicitly called out.

8 Those are all vacuum based
9 deposition techniques.

10 Q. So for the inorganic barrier layers,
11 can you do sublimation, or would that be --
12 would [e the temperature be too hot?

13 A. For the materials called out in the
14 list of materials on Column 7 of Suzuki, well,
15 other than Germanium oxide, which it turns out
16 it has a metastable sublimation temperature
17 that's quite low.

18 But other than those, yeah, most of
19 those would require too high a temperature to
20 sublimate.

21 But thermal evaporation, electron
22 beam evaporation, sputtering, techniques like
23 that are fine.

24 Q. And is sputtering a selective
25 deposition technique?

1 A. It can be if you use it with a
2 shadow mask, absolutely.

3 Q. And a shadow mask is needed for
4 the -- strike that.

5 For the vacuum deposition technique,
6 in order for that deposition to be selective,
7 you also need to have a shadow mask. Correct?

8 A. Well, you don't absolute -- there
9 are vacuum deposition techniques that are
10 selective without a shadow mask.

11 But on its own, I agree sort of
12 standard evaporation, sputtering, et cetera,
13 must be used with a shadow mask to make sure
14 you only get material where you want it if you
15 want to make them selective.

16 Q. And we agree that neither Kijima nor
17 Suzuki hint using inkjetting to apply organic
18 materials. Correct?

19 A. Yes, I think that's right.

20 That's why I do the combination with
21 Sturm for the claims that require inkjetting.

22 MR. GARR: Is now an okay time to
23 take our lunch break?

24 MS. ZHONG: That's fine.

25 Let's go off the record.

1 (Recess was taken from 12:17 p.m. to
2 1:05 p.m.)

3 BY MS. ZHONG:

4 Q. Before the break we were discussing
5 the deposition method mentioned by Suzuki.

6 So for the organic layer, Suzuki
7 specifically mentions spin coating, thermal
8 deposition of the casting as well as vacuum
9 deposition. Correct?

10 A. Yes.

11 Q. And how is casting related to
12 inkjetting or screen printing?

13 A. I'm sorry. I missed the second part
14 of the question.

15 Q. Okay. How is casting related to
16 inkjetting or screen printing?

17 A. It's -- I mean, the similarity is
18 that casting is done out of a liquid.

19 But other than that, they're
20 different techniques.

21 Q. And the advantages you mentioned --
22 strike that.

23 And the advantages for inkjet
24 printing that you mentioned includes it's a
25 noncontact deposition technique. Correct?

1 A. That's one of the advantages I
2 mentioned, yes.

3 Q. And is casting a noncontact
4 deposition technique?

5 A. It depends on how it's done.

6 If casting makes use of a bank to
7 confine the cast liquid, then the bank is in
8 contact with the target substrate, so that
9 would not be noncontact.

10 On the other hand, if the puddle
11 technique is used where the cast liquid is just
12 dispensed as a puddle, then it can be
13 noncontact.

14 Q. Okay. Is casting a direct
15 deposition technique?

16 A. Again, the answer is yes.

17 It's -- whether you use a bank or
18 you use a puddle, the deposition is directed to
19 the regions that are spatially determined by
20 the bank or by the perimeter of the puddle.

21 Q. And is a casting technique conducive
22 to depositing multiple coats?

23 A. Yes, but not quite as conveniently,
24 just because the -- between -- casting
25 typically involves longer drying steps, so to

1 build up multiple coats takes a lot of time;
2 whereas, inkjet dries very quickly.

3 Q. And is casting scalable?

4 A. Well, in some ways yes, in other
5 ways no.

6 So it's scalable in that you can
7 create a very large puddle, for example.

8 But on the other hand, when you
9 create a very large puddle, the control on
10 uniformity of the cast puddle tends to get
11 worse.

12 So it is scalable, but it tends to
13 suffer in terms of the quality of the structure
14 created in terms of uniformity, for example.

15 Q. When you mentioned "bank," are those
16 structures created on substrate or they're more
17 like masks?

18 A. They're more like masks.

19 Q. So they're removable structure,
20 structural features?

21 A. Yes.

22 I interrupted you. I apologize.

23 But yes, they are more like masks.

24 And typically in casting, the
25 casting bank is placed onto the substrate, the

1 puddle is dispensed, it reaches to the end of
2 the bank, it dries, then you remove the bank.

3 Q. Okay. Was inkjetting a known
4 technique in 1998?

5 A. Yes.

6 Q. Was inkjetting a known technique in
7 connection with OLED devices in 1998?

8 A. Yes.

9 Q. What about in 1997?

10 A. It was definitely already an area of
11 active research.

12 I don't know when the first
13 publications on inkjetted OLEDs came out, but
14 it was a technique that was actively being
15 pursued in the community and was being
16 discussed openly in the community.

17 Q. Can screen printing be performed on
18 pure liquids, or it needs to be more or less a
19 paste?

20 A. And to be clear, you're referring to
21 the ink that you're trying to screen print.
22 Correct?

23 Q. I don't know what you referred to.
24 Whatever the organic material that
25 you want to screen print onto.

1 A. Right.

2 So the clarification I need is your
3 question was: Can screen printing be performed
4 on liquids?

5 I want to make sure you don't mean
6 depositing on top of a liquid in your question
7 because your question sounded weird to me.

8 Q. Okay. I'm referring to: Can you
9 screen print a liquid or you need to use a
10 paste?

11 A. I understand.

12 So in general -- so firstly, the
13 distinction between a liquid and a paste is not
14 sharp. It's better to -- the more correct way
15 to talk about that discussion is in terms of
16 viscosity, because technically a paste is still
17 a liquid, it's just a highly non-Newtonian
18 liquid.

19 Screen printing generally benefits
20 from higher viscosities in the range of
21 thousands to tens of thousands of millipascal
22 seconds.

23 As your screen size gets smaller, in
24 other words, the size of the hole -- of each
25 hole in the screen gets smaller, you can

1 actually start using lower and lower
2 viscosities.

3 But in general I would say screen
4 printing is done with the viscosities in the
5 range that I mentioned. Those are not
6 necessarily pastes as you would colloquially
7 describe them, but they are certainly very
8 viscous liquids as you would colloquially
9 describe them.

10 Q. So were the monomers -- were the
11 monomers referenced by Suzuki within that
12 suitable viscosity range?

13 A. Through appropriate formulation,
14 yes.

15 What determines the viscosity is not
16 just the monomer itself but the solvent that it
17 is formulated in to form the ink and also --
18 and any binders that are added to the ink to
19 facilitate viscosity modification.

20 It is certainly possible to
21 formulate inks with some of the monomers that
22 are mentioned. It is indeed commonly done to
23 screen print certain monomers, and specifically
24 through appropriate formulation that is
25 possible.

1 Q. So which of the monomers are
2 suitable for screen printing?

3 A. So acrylates have been screen
4 printed, including acrylate monomers.

5 I mean, I've personally done that.

6 Q. Which acrylate in particular?

7 A. I don't remember which ones we've
8 done.

9 They're metal acrylates for sure,
10 but I don't remember the specific monomer that
11 we used.

12 Q. Can those acrylates also be used
13 with casting or spin coating?

14 A. Yes.

15 Q. What about for inkjet printing?

16 A. Yes.

17 Q. We mentioned earlier that the gold
18 sealing film in Kijima, one of its function is
19 to act as a radiant barrier.

20 What kind of a radiation is present
21 due to the deposition process of the inorganic
22 layer? For example, is it a gamma radiation?
23 Thermal radiation? Like what range of the
24 wavelength?

25 A. It's -- depending on the evaporation

1 conditions, it's generally in the range of
2 infrared to low visible, so no higher than long
3 wavelength reds, generally more in the infrared
4 range.

5 Q. Okay. So do the OLED organics
6 absorb in the infrared range?

7 A. Typically not directly.

8 The energy gap, the separation
9 between the HOMO and LUMO levels in most OLED
10 materials, is larger.

11 But there are vibrational modes that
12 will result in heating because of the infrared,
13 and that is what causes the degradation of the
14 OLED materials.

15 Q. And would there be vibration for
16 acrylates in the infrared range as well?

17 A. To some degree.

18 They're less sensitive to it, just
19 because the acrylates themselves, being
20 thermally polymerized, for example, even if
21 they do absorb and heat up, it's not a big
22 problem.

23 Q. Are there radicals generated in the
24 thermal deposition of the inorganic layers?

25 A. Generally, no.

1 Q. Because it's a vacuum process?

2 A. Correct, it's an atomic deposition
3 process or a molecular deposition process.

4 For the -- depending on the material
5 that we're depositing and the source, there's
6 almost no -- in fact, there's no ionization
7 that happens, particularly with thermal
8 evaporation.

9 Q. What about for the e-beam
10 evaporation?

11 A. My answer's the same.

12 The e-beam is used to locally heat
13 the source, but it's still primarily heat for
14 generation of the vapor, and there's -- the
15 energies are far too low to cause significant
16 ionization.

17 Q. Can you please take a look at
18 Figure 12 of Kijima.

19 A. (Complying.)

20 Q. So in Figure 12 of Kijima, does
21 Kijima's electrode 5 follow the topology or
22 topography of the substrate below it?

23 A. (Reviewing document.)

24 So the text of Kijima does not
25 address that at all.

1 Kijima does say that the materials
2 are all deposited using this evaporation scheme
3 or the vacuum deposition scheme, but other than
4 that, it doesn't address it.

5 Looking at the figures, it
6 doesn't -- it does seem to go up over the step,
7 but I don't think there's enough precision to
8 say exactly what it does on the step, if we
9 assume the step over the oxide 9 is abrupt as
10 drawn. It doesn't follow it exactly, but I
11 think this is just a sketch.

12 Q. Okay. What about the electron
13 transport layer 3? Does it follow the topology
14 below it?

15 A. My answer would be the same as with
16 respect to the ITO layer.

17 In other words -- sorry. You're
18 saying the electron transport layer now?

19 Q. Yes.

20 (Simultaneous crosstalk.)

21 THE WITNESS: Okay. Yeah.

22 So with respect to the electron
23 transport layer, Kijima itself doesn't say --
24 doesn't provide any details on the nature of
25 the topology of the surface.

1 It does indicate that it's deposited
2 using the vacuum deposition scheme that we've
3 been discussing.

4 Looking at the figure, it largely
5 seems to follow the structure of the surface
6 below it.

7 BY MS. ZHONG:

8 Q. So layer 3 as depicted in Figure 12
9 seems to be -- generally follow the topography
10 of layer 4 below it. Is that correct?

11 A. That's a fair characterization. I
12 agree with that, in the figure.

13 Q. Okay. And as depicted in the
14 Figure 12, the electrode layer 1 generally
15 follow the topology or topography of layer 3
16 below it. Is that correct?

17 A. Yes, that's fair. I agree with
18 that.

19 Q. And the topography of layer 7
20 generally follow the topography of layer 1,
21 except that it runs down the sides of the OLED
22 stack. Is that correct?

23 A. That's true.

24 But I don't -- I wouldn't call that
25 except.

1 I mean, I would say that it is
2 following it. Right? It runs down the side.

3 Q. Okay. And the topography of layer 8
4 generally follows that of layer 7, except that
5 it doesn't extend all the way out?

6 A. If we're talking about Figure 12,
7 Figure 12 doesn't talk about -- oh, I see what
8 you mean.

9 I think you mean it doesn't extend
10 over the region 9.

11 Q. Yes.

12 A. Yes, I agree.

13 It's deposited through a mask to
14 ensure that it stops where it stops.

15 But within the region where it's
16 deposited, it seems to largely, in the figure,
17 follow the shape of the structure below it.

18 Q. Okay. And if we move to Figure 13,
19 then layer 7 appears to follow the topography
20 of layer 1, but it extends out in order to form
21 a continuous layer. Is that correct?

22 A. No, I would not describe it that
23 way. It's not that it's following the topology
24 or topography of layer 1.

25 It's in fact following the

1 preexisting shape of everything that's below
2 it, which means it follows 1, then it drops
3 down along the edge, and then it goes along the
4 surface at the bottom 6 and then goes back up
5 and so on.

6 Q. So it follows the topography of the
7 OLED stack?

8 A. Well, because as shown in Figure 13
9 it's not limited -- we're talking about
10 layer 7. Correct?

11 Q. That's correct.

12 A. So because layer 7 is not -- is
13 continuous across the entire cross-section
14 shown in Figure 13, it's not just the OLED
15 stack. It's everything.

16 It also traverses across 8.

17 Sorry. It traverses across 6. The
18 numbers are a little hard to read.

19 Q. Okay. And for the section of film 7
20 that traverses across the exposed region of 6,
21 does it follow the topography or topology of
22 substrate 6 in that region as depicted in
23 Figure 13?

24 MR. GARR: Objection.

25 THE WITNESS: Again, this is -- the

1 text of Kijima doesn't -- is really silent
2 about this.

3 But certainly looking at the figure,
4 it generally seems to follow all the way all
5 the preexisting structures below it, including
6 layer 6 along the cross-section of Figure 13.

7 BY MS. ZHONG:

8 Q. And when it extends downward across
9 the layer 1, 3 and 4 and follows the general
10 shape or contours of those stacks on the
11 vertical side. Correct?

12 A. If you're referring to it largely
13 following the sidewall of those, then I agree
14 with that.

15 Q. Okay. And the section of film 7
16 that sits on top of the electrode 1, it
17 generally follows the contours or the shape of
18 electrode 1, its top surface. Correct?

19 A. Again, as I've already -- I think
20 you already asked me that.

21 But in relation to layer 7, Kijima
22 is silent as to the details of the topology
23 following of said layer.

24 But looking at Figure 13, if we look
25 at the region that is directly over the

1 layer 1, it largely seems to mimic that
2 structure in terms of its topographical
3 positioning.

4 Q. And do we know whether there are any
5 defects in the electrode layer 1?

6 A. (Reviewing document.)

7 Q. Well, let me withdraw and ask it
8 this way.

9 Does Kijima make any reference to
10 defects in electrode 1?

11 A. So with respect to the discussion of
12 electrode 1, Kijima gives us information about
13 the deposition method, including deposition
14 rates, et cetera, but doesn't specifically call
15 out the existence or absence of defects.

16 Q. Okay. And that's the same for the
17 conductive sealing layer 7. Correct?

18 A. Yes, for the same reasons that I
19 just provided you with respect to 1.

20 Q. Okay. And Kijima also says nothing
21 about defects, the presence or absence of
22 defects, in the insulating sealing layer 8.
23 Correct?

24 A. (Reviewing document.)

25 Yes, I guess that's true, there's no

1 specific discussion of defects in relation to
2 that layer 8.

3 Q. Does Kijima's insulating layer 8
4 have a smooth surface?

5 A. I think Kijima is silent as to the
6 smoothness. It doesn't say.

7 Again, as I said, it just tells us
8 about the deposition conditions and the
9 deposition methodology but does not provide
10 information regarding the actual roughness or
11 smoothness.

12 Q. But as depicted in Figure 12, does
13 Kijima's insulating 8 is shown as having an
14 even surface, an uneven surface -- or an uneven
15 surface?

16 MR. GARR: Objection.

17 THE WITNESS: I'm not sure I
18 understand what you mean by "an uneven surface"
19 in your question.

20 BY MS. ZHONG:

21 Q. Does -- do you have an understanding
22 as to what "an uneven surface" means in the
23 context of Kijima?

24 MR. GARR: Objection.

25 THE WITNESS: But again, if you can

1 point me to where the words "uneven surface"
2 appear in Kijima, I'm happy to answer that
3 question.

4 That's why I'm asking you for the
5 clarification.

6 BY MS. ZHONG:

7 Q. Do you have an understanding of that
8 concept?

9 MR. GARR: Objection.

10 THE WITNESS: That word doesn't
11 appear in Kijima.

12 So you must mean something, so I'm
13 asking you to clarify.

14 BY MS. ZHONG:

15 Q. Well, did you use the term "uneven
16 surface" in your declaration?

17 A. I don't remember.

18 It's possible. I don't remember
19 specifically. I have not memorized my
20 declaration.

21 Q. Okay. Is your opinion that
22 conductive film 7 has a visibly uneven surface,
23 as illustrated in Figure 12?

24 MR. GARR: Objection.

25 THE WITNESS: Again, I'm asking you

1 for clarification on what you mean by "uneven
2 surface" in your question.

3 That's what I don't understand.

4 BY MS. ZHONG:

5 Q. I am applying the same understanding
6 as you do in your declaration.

7 A. Could you point me to where I use
8 the word "uneven surface" in my declaration and
9 then I'll apply that understanding?

10 I don't know what exactly you're
11 referring to.

12 Q. Paragraph 80, the end of
13 Paragraph 80.

14 A. (Reviewing document.)

15 Okay. So the way I use "uneven
16 surface" in Paragraph 80 is referring to the
17 fact that if we look at the conductive sealing
18 film 7 in Figure 12, the surface of -- the
19 position relative to a level plane changes as
20 we walk from the left side of the image to the
21 right side of the image.

22 So --

23 Q. Are you referring to the dip in the
24 middle?

25 A. No.

1 I'm referring to all the surface
2 position variations going from left to right.

3 So you will notice that if it starts
4 at a certain -- if we define our zero position
5 on our vertical axis as the bottom of layer 6,
6 when we start at left, we are a certain
7 distance above it.

8 As we walk to the right, it goes a
9 little higher, then it dips, then it stays flat
10 for a while, then it rises up, then it dips,
11 then it stays flat for a while, then it has a
12 slight hump, then it dips, then it stays flat
13 for a while, then it rises up, then it dips,
14 then it stays flat for a while.

15 That's what I'm referring to as a
16 visibly uneven surface.

17 Q. And that precludes both the
18 insulating sealing film 8 and the conductive
19 sealing film 7 from being a planarization
20 layer. Is that correct?

21 MR. GARR: Objection.

22 THE WITNESS: No, that doesn't --
23 that doesn't follow.

24 Just because you don't have perfect
25 flatness, it doesn't mean it cannot be a

1 planarization layer.

2 But to be clear, I'm not applying --
3 I have not offered an opinion that on its own,
4 Kijima discloses the planarization layer. I'm
5 bringing that in through a combination with
6 Suzuki.

7 BY MS. ZHONG:

8 Q. So in Suzuki the organic layer
9 generally follows the same topography of the
10 underlying layer except that it -- except that
11 where the corners are it's a little bit more
12 rounded. Is that correct?

13 A. No, I would not characterize it that
14 way and I don't think that's a correct way to
15 characterize it. It's not perfectly flat nor
16 does it need to be to be a planarizing layer.

17 It does offer smoothness. That's
18 what Suzuki tells us.

19 Further looking at the figure, if we
20 look at Figure 1, we see that indeed, backing
21 up what it says within the text, there is
22 rounding that happens. So the sharp corners
23 that are in the underlying structure are not
24 reflected in the -- at the top of what I
25 identify as the planarizing layer. And that's

1 what's shown in Figure 1.

2 Q. So a planarization layer need not be
3 a layer that provides a flat surface. Is that
4 correct?

5 A. I agree.

6 And I'm not sure I fully understand
7 what you mean by that, but I certainly agree
8 that it doesn't have to be perfectly flat.

9 Q. Does a planarization layer -- strike
10 that.

11 Can a planarization layer have an
12 uneven surface?

13 MR. GARR: Objection.

14 THE WITNESS: It may or may not.
15 It depends on the context.

16 Q. And would you consider the -- strike
17 that.

18 Is layer 20 in Suzuki -- strike
19 that.

20 Does layer 20 in Suzuki have an even
21 surface?

22 MR. GARR: Objection.

23 THE WITNESS: If I use "even" in an
24 analogous way to the way I used "uneven" in my
25 discussion of Figure 12 of Kijima as provided

1 in Paragraph 80 of my declaration, then no, it
2 does not have an even surface.

3 It is uneven, but it still provides
4 a planarizing function.

5 BY MS. ZHONG:

6 Q. Okay. So the -- strike that.

7 So Suzuki's layer 20, similar to the
8 conductive sealing film 7 in Kijima, has an
9 uneven surface as you use it in Paragraph 80 of
10 your declaration. Correct?

11 MR. GARR: Objection.

12 THE WITNESS: So it's not -- it is
13 true that it has an uneven surface.

14 But it's not similar to the layer in
15 Kijima. It's -- because Suzuki tells us
16 explicitly that it provides smoothing.

17 BY MS. ZHONG:

18 Q. So layer 20 of Suzuki has an uneven
19 surface in the same manner as uneven surfaces
20 are used in Paragraph 80 of your declaration.
21 Correct?

22 MR. GARR: Objection.

23 THE WITNESS: With respect to the
24 way I've used the term "uneven surface" in my
25 description in Paragraph 80, if we were to

1 apply that same understanding of the
2 terminology to layer 20 of Suzuki in Figure 1,
3 I agree that it has an uneven surface.

4 But Suzuki tells us explicitly that
5 it has a smoothing function.

6 BY MS. ZHONG:

7 Q. And just because a layer has an
8 "uneven surface," as that term is used in
9 Paragraph 80 of your declaration, doesn't mean
10 that there would be a reason to add a
11 planarization layer or smoothing layer on top
12 of it. Is that correct?

13 A. Yes, I agree that just based on the
14 fact that it's uneven on its own is not
15 sufficient.

16 But of course as I pointed out in my
17 declaration, specifically in the case of
18 encapsulation of OLEDs, it was well-known, as
19 called out within the admitted prior art of the
20 patent at issue and in numerous other places
21 that I have cited to in my declaration, the
22 benefits of using the combination of this
23 multilayer system with a planarizing function
24 followed by a barrier on top.

25 Q. Okay. What is the cathode of

1 materials used in Suzuki?

2 A. Sorry. Could you repeat the
3 question.

4 Q. What is the -- strike that.
5 What is the electrode 18 -- strike.
6 What is the material for
7 electrode 18 Suzuki?

8 A. (Reviewing document.)

9 So there's several examples given
10 for the cathode material it's in -- of Suzuki.

11 So this is Column 5 of Suzuki at
12 Line 8 where it says: "The cathode 18 should
13 charge electrons into the organic layer
14 structure and should have good environmental
15 stability. The metals or alloys meeting the
16 above requirement include, for example, metals
17 such as aluminum, magnesium, indium, tin, zinc,
18 silver and the like, alloys such as aluminum,
19 lithium, magnesium and silver alloys, silver
20 and lithium alloys and the like."

21 Q. And do the films formed from those
22 materials have similar structural properties as
23 gold films?

24 MR. GARR: Objection.

25 THE WITNESS: I'm not sure I

1 understand what you mean.

2 Q. Which aspect?

3 A. I didn't understand your question.

4 Q. So the cast of the films formed from
5 those listed materials, do they have the same
6 properties as the gold films?

7 MR. GARR: Object to the form.

8 THE WITNESS: It depends on the
9 specifics.

10 They are conductors. They have
11 different work functions. They have
12 different -- well, they may have different
13 crystalline structures in some cases. They
14 have different inertness or chemical
15 reactivity. They have different bond
16 strengths. They have different electronic
17 configurations. They'll have different
18 conductivities. They'll have different melting
19 points.

20 They have some similarities in that
21 they're all metals, but they are different in
22 other ways.

23 BY MS. ZHONG:

24 Q. What about the surface roughness or
25 the tendency to form defects?

1 A. So in some ways they will be the
2 same. In other ways, they will be different.

3 For example, aluminum and silver are
4 both known to form buckle defects, so they form
5 helix on their surface. That's a known problem
6 with both of them.

7 I know tin also does that as well.
8 Tin also forms whiskers.

9 On the other hand, indium, zinc,
10 tin, magnesium and lithium can all oxidize; and
11 when they oxidize, they will tend to form
12 oxidation induced surface roughness where,
13 since the oxide has a larger volume than the
14 unoxidized metal, it causes an expansion and a
15 different type of buckling defect.

16 So there's some things that are
17 similar. There are other things that are
18 different. They do form some of the same types
19 of defects, but also others that are different.

20 Q. Do they have a high tendency to form
21 pinhole defects?

22 MR. GARR: Object to form.

23 THE WITNESS: That depends on the
24 thickness, and that depends on the deposition
25 scheme.

1 For the same reasons that I gave
2 with respect to gold, it's dependent on how
3 thick the films are, on the surface mobility
4 during deposition, et cetera.

5 BY MS. ZHONG:

6 Q. How thick are the cathodes in
7 Suzuki?

8 A. So with respect to the cathode, on
9 Column 5, Suzuki tells us that it's usually --
10 this at Line 25 -- it's usually in the range of
11 0.05 to 1 micrometer, so that means in the
12 range of 50 nanometers to 1 micrometer.

13 Q. In OLED structure, can the cathode
14 operate efficiently at 1 micrometer thick when
15 it's 1 micron thick?

16 A. I'm sorry. I didn't understand your
17 question.

18 Q. So the cathodes are for injecting
19 the electrons into the EIL, the electron
20 injection layer, and the electron transport
21 layers. Correct?

22 A. Well, it depends on the specific
23 structure of an OLED.

24 But yes, in general that's true.

25 Q. And if the cathode gets too thick,

1 would that affect its ability to inject the
2 electrons --

3 A. No.

4 Q. -- into...

5 And does its thickness depends on
6 whether light is emitted from the top or from
7 the bottom?

8 A. No, not in -- certainly not in the
9 system of Suzuki, because in the system of
10 Suzuki just based on the fact that we know
11 based on the disclosure of Suzuki that the
12 anode is formed -- and this is from Column 3 --
13 the anode is formed usually using an optically
14 transparent layer, for example, of a conductive
15 transparent material such as indium tin oxide,
16 zinc aluminum oxide or the like. And that's
17 the top of Column 3.

18 So this is clearly a bottom emitter,
19 so the top emitter thickness really doesn't --
20 sorry -- the top electrode thickness really
21 doesn't matter in terms of optical emission.

22 Q. And so when do you use the -- strike
23 that.

24 When would you use a cathode that's
25 50 nanometers thick versus 1 micron thick?

1 A. It's entirely based on the choices
2 made in the process.

3 So there's advantages and
4 disadvantages to both.

5 If you use a thicker cathode, you'll
6 get better lateral conductivity -- or sorry --
7 lateral sheet resistance. But on the other
8 hand, it makes your stack taller, which makes
9 step coverage more challenging. So it's just a
10 tradeoff.

11 In general in OLED, films are often
12 made thin to keep the stack height manageable.

13 Q. And would you consider Kijima's
14 insulating 8 as having a smooth surface?

15 MR. GARR: Objection.

16 THE WITNESS: I think, as I've
17 already told you, Kijima is really silent as to
18 the details of the layers other than indicating
19 possible material choices and deposition
20 techniques and conditions.

21 So it doesn't really address whether
22 the layers are rough or not.

23 BY MS. ZHONG:

24 Q. So Kijima is kind of agnostic to the
25 surface smoothness of each of its layers.

1 Correct?

2 MR. GARR: Objection.

3 THE WITNESS: No.

4 I would say Kijima -- it's not that
5 it's agnostic. It doesn't specifically address
6 it. That doesn't mean it's agnostic.

7 BY MS. ZHONG:

8 Q. So Kijima says nothing about the
9 surface roughness of each of its layers.
10 Correct?

11 MR. GARR: Objection.

12 THE WITNESS: That -- I agree that
13 there's no explicit discussion in the text of
14 the roughness. There's no provision of
15 roughness measurement values, et cetera, within
16 the text of Kijima.

17 BY MS. ZHONG:

18 Q. And Kijima says nothing about
19 roughness or smoothness is good or bad for the
20 performance of its OLED stacks. Correct?

21 A. I agree that Kijima does not use any
22 verbiage stating one way or another whether
23 roughness or smoothness is good for its OLED
24 stacks.

25 I don't believe those descriptions

1 or words appear in Kijima.

2 Q. Okay. And in Kijima, the insulating
3 film 8 is optional. Correct?

4 A. (Reviewing document.)

5 Q. So take a look at, for example,
6 Paragraph 30.

7 A. (Complying.)

8 I see.

9 If by "optional" you mean that is
10 indicated as a preference but is not mandatory,
11 I agree that's what it says.

12 And certainly in some of the
13 comparative devices, that layer was not there.

14 Q. Okay. And so Kijima envisions a
15 device of its invention that includes the
16 sealing film 7 as the outmost barrier.
17 Correct?

18 MR. GARR: Objection.

19 THE WITNESS: (Reviewing document.)

20 Q. So take a look at, for example,
21 Claim No. 1 of Kijima.

22 A. (Complying.)

23 I'm sorry. I'm going to have to
24 open Kijima. I don't seem to have -- oh, I
25 have it. Yes. (Reviewing document.)

1 So Claim 1 in its language indicates
2 that it comprises at least a conductive sealing
3 film. Given that, the scope of Claim 1 could
4 cover a device that did not have an insulating
5 sealing film over said conductive sealing film.

6 Q. Okay. And I believe you have
7 confirmed multiple times that for this IPR, for
8 all grounds, you rely on Suzuki's organic
9 sealing layer to be the recited planarization
10 layer. Correct?

11 A. That's not quite right.

12 I rely on the teachings of Suzuki
13 with respect to its organic seal- -- or to what
14 what I point to as layer 20, which we've been
15 discussing as the organic sealing layer, and as
16 I identify as such in my modification to
17 Kijima.

18 And I use that teaching through the
19 eyes of one of skill in the art to apply that
20 modification in an obviousness combination with
21 Kijima.

22 Q. So basically you don't contend that
23 Kijima discloses any planarization layer.
24 Correct?

25 A. I'm not pointing to Kijima on its

1 own for providing the planarization layer.

2 In my opinion with respect to that
3 claim element, I bring in Suzuki.

4 Q. Okay. And what is the construction
5 of planarization layer you applied in this
6 proceeding?

7 MR. GARR: Objection.

8 THE WITNESS: Well, as I said, I
9 was -- I did not -- I assumed plain meaning.

10 These pieces of part were so clear
11 in their falling within the scope of the plain
12 meaning that I did not need to go further.

13 But as I told you yesterday, in
14 general what we would expect to see is
15 something that provides a smoothing function
16 similar to our discussion yesterday, and these
17 clearly fall within the scope of that.

18 BY MS. ZHONG:

19 Q. Okay. And in each of Kijima and
20 Suzuki, they have only two barrier layers.
21 Correct?

22 MR. GARR: Object to form.

23 THE WITNESS: Yeah, I'm not sure
24 what you mean by that.

25 But just to be clear, if we look at

1 Kijima, Kijima calls out two sealing layers, a
2 conductive sealing layer and an insulating
3 sealing layer.

4 If we look at Suzuki, Suzuki calls
5 out an organic barrier layer and an inorganic
6 barrier layer.

7 BY MS. ZHONG:

8 Q. Okay. What I mean is -- so in
9 Kijima, what would be the layers that you would
10 characterize as part of the encapsulation
11 layer?

12 MR. GARR: Objection.

13 THE WITNESS: So in my mapping, as I
14 already pointed out to you, I point to -- I
15 modify Kijima by adding an organic sealing
16 layer between the device and the inorganic
17 sealing layer.

18 So the inorganic sealing layer of
19 Kijima would be mapped to the barrier layer in
20 my claim element by claim element analysis, and
21 the Figures --

22 BY MS. ZHONG:

23 Q. Okay. I think you have
24 misunderstood my question.

25 So in Kijima, in that by itself, not

1 in your modified Kijima, but Kijima itself,
2 original Kijima, which are the layers that
3 serve the function of protecting the OLED from
4 oxygen and moisture?

5 MR. GARR: Objection.

6 THE WITNESS: So in Kijima, Kijima
7 actually uses a structure where part of the
8 device itself, specifically the electrical
9 connectivity of the device, provides some
10 moisture and exclusion function, and that is
11 provided by what it calls the "conductive
12 sealing film," which as I've pointed out, is
13 actually a part of the device because it
14 provides the electrical connection and in fact
15 is necessary for the device.

16 And then on top of that, it provides
17 another layer, which is the insulating sealing
18 film, which provides further moisture and
19 oxygen exclusion properties.

20 BY MS. ZHONG:

21 Q. What about in Suzuki?

22 MR. GARR: Can you repeat that.

23 I didn't hear it.

24 THE WITNESS: So she said: "What
25 about in Suzuki?"

1 MR. GARR: Oh, okay.

2 THE WITNESS: So in Suzuki, Suzuki
3 talks about different barrier layers in its
4 discussion. For example, when it talks about
5 the device structure, when it compares the
6 relative performance and it talks about two
7 layers therewith. One is an organic barrier
8 layer and the other is an inorganic barrier
9 layer.

10 BY MS. ZHONG:

11 Q. Okay. So Suzuki teaches the
12 benefits of a double barrier layer. Correct?

13 A. Yes, I agree with that.

14 Q. Does Suzuki suggest the use of
15 triple barrier layers?

16 A. No, I don't think Suzuki addresses
17 that.

18 Q. Okay.

19 MR. GARR: Objection to the last
20 question.

21 Q. Does Kijima suggest use of triple
22 barrier layers?

23 MR. GARR: Same objection, or object
24 to form.

25 THE WITNESS: So on its own, Kijima

1 uses two sealing layers.

2 But again, one of skill in the art
3 looking at Kijima would understand the benefits
4 of replacing -- of inserting this additional
5 planarization layer because that was
6 acknowledged by people of skill in the art, as
7 is evidenced, for example, by the background
8 section of the patent at issue.

9 BY MS. ZHONG:

10 Q. Does Kijima itself suggest the use
11 of three sealing layers?

12 A. Yeah, if you're asking me does it
13 explicitly call out for three sealing layers,
14 the answer is no.

15 It identifies two sealing layers,
16 which are layers 7 and 8.

17 Q. Okay. Does Kijima suggest there
18 would be benefits of using three sealing
19 layers?

20 A. So given the answer to my previous
21 question, again, if you're asking me about
22 explicit disclosure, since it doesn't talk
23 about using three sealing layers, it wouldn't
24 identify benefits therewith because it's not
25 even talking about three layers. It only

1 identifies the two, namely layers 7 and 8.

2 Q. Kijima describes conductive sealing
3 layer as providing -- as protecting -- strike
4 that.

5 So Kijima describes the function of
6 its conductive sealing film as for protecting
7 the underlying organic layer and electrode and
8 preventing oxidation of the electrode 1. Is
9 that correct?

10 A. Could you point me to what you're
11 referring to.

12 Q. Paragraph 55, for example.

13 A. (Reviewing document.)

14 In Paragraph 55 in relation to the
15 conductive sealing film, it says: "In addition
16 to protecting the underlying organic layer and
17 electrode and preventing oxidation of the
18 electrode 1," and then goes on.

19 So I agree that functions or
20 benefits that are called out with respect to
21 the conductive sealing film are inclusive of
22 protecting the underlying organic layer and
23 electrode and preventing oxidation of the
24 electrode.

25 Q. And why does the insulating sealing

1 film 8 must be thickly formed as a buffer
2 layer?

3 A. I'm sorry. I didn't understand your
4 question.

5 Could you repeat it, please. I just
6 didn't hear it properly.

7 Q. Why does the conductive sealing
8 film 7 must be thickly formed as a buffer layer
9 during deposition?

10 A. So this is in relation to
11 Paragraph 56, where it says -- and I think this
12 is a translation issue, but where it's -- this
13 is relating to the radiant heat buffer benefits
14 of the conductive sealing film.

15 So it says: "Furthermore, since the
16 conductive sealing film 7 made of gold is
17 interposed under the insulating sealing film 8,
18 degradation of the organic layer due to radiant
19 heat during vapor deposition of the insulating
20 sealing film 8 is prevented. Therefore, the
21 conductive sealing 7 must be thickly formed as
22 a buffer layer during deposition," and goes on
23 to tell you how thick it is.

24 The language is awkward. It's
25 related to the translation. But what it seems

1 to be indicating based on the previous sentence
2 is that because you have the radiant buffer,
3 it's possible to make it that thick, in other
4 words, 10 kilo-angstroms thick to get a
5 sufficient layer of thickness without having
6 problems with radiant heat during deposition.

7 Q. And is -- okay. Strike that.

8 I interpret the statement as saying
9 that the sealing layer 7 has to be of certain
10 thickness in order for it to perform the
11 radiant heat barrier function.

12 That's not your interpretation?

13 A. Well, that's exactly what I was
14 indicating. That's the interpretation.

15 It provides a radiant heat function,
16 so it has to be thick enough to be a good
17 reflective barrier.

18 Q. Why does it have to be thick enough
19 to be a reflective barrier?

20 I thought you said that's just a
21 function of the material itself.

22 A. It is.

23 But as I pointed out earlier, it
24 depends -- you are calculating the reflection
25 by dealing with the complex refractive index.

1 That depends on the material, and it goes into
2 the calculation of the stack thickness.

3 Q. So the stack thickness has to be
4 sufficiently thick for it to take on the bulk
5 property?

6 A. No, it doesn't have to take on bulk
7 properties. It's still in film properties.

8 This sentence seems to say that they
9 recommend or they target having a film
10 thickness of about 10 kilo-angstroms. It
11 doesn't say exactly why, but it uses the word
12 "therefore," which seems to be linking it to
13 its use as a radiant heat barrier.

14 Q. And is that your understanding as
15 well, based upon your technical knowledge of
16 how radiant heat barriers work?

17 A. So the thickness, what matters most
18 is the reflectivity of the surface.

19 Obviously -- I mean, it's certainly
20 true the thicker you make any layer, the more
21 of a buffer it provides.

22 But actually that buffer is not a
23 radiant buffer. It's more of a conductive
24 buffer.

25 Q. Mm-hmm, that's my understanding as

1 well. It feels like it's more a conductive
2 buffer, the way they're describing it, than
3 reflecting the radiation heat.

4 A. But that's not the language it uses.
5 It very specifically -- reading it
6 directly, it says it's related to radiant heat,
7 and then it uses the word "therefore."

8 So it's very clearly -- it's
9 probably a translation issue, but it's very
10 clearly about radiant heat.

11 Q. But the radiant heat should not
12 really be hugely dependent on the thickness of
13 the film. Correct?

14 A. To a first order, I agree. The
15 determining factor is the reflectivity. But
16 that's what they've written here.

17 From a physics perspective, I agree
18 that the reflectivity is a more important
19 parameter.

20 Q. Okay. And when you started to talk
21 about thickness of the film, that is -- that
22 suggests more a conductive path than a radiant
23 path. Is that correct?

24 A. No, that's not true.

25 I said, all else being equal, a

1 thicker film will have less overall conduction
2 through it.

3 But that's not what this is about.
4 This is very clearly about radiant heat, and
5 that's what it says.

6 Q. Do you have an understanding why
7 Kijima requires there to be certain thickness
8 for the --

9 A. Kijima doesn't say it. It
10 doesn't --

11 (Simultaneous crosstalk.)

12 Q. Strike that.

13 Do you have an understanding as to
14 why Kijima believes that there needs to be a
15 certain thickness for the conductive sealing
16 film 7 to work?

17 A. It's what I just pointed to.

18 Since it uses the word "therefore,"
19 its reasoning is based on the sentence before.
20 And the sentence before makes it very clear
21 that it's talking about dealing with the
22 radiant heat during the vapor deposition of the
23 insulating sealing film, which means it's
24 referring to radiant heating.

25 Q. I understand that's your position.

1 From physics, why is that the case?

2 A. I mean, I can tell you the
3 physics -- so there's two things.

4 First, radiant heat barrier
5 properties are largely determined by
6 reflection. So that is the most important
7 factor.

8 Having said that, all else being
9 equal, if you maintain the reflection, a
10 thicker film means you have a larger conductive
11 buffer.

12 But radiant heat is all about
13 reflection.

14 Q. So the conductive buffer has no
15 effect on the radiant heat or how to modulate
16 it. Correct?

17 MR. GARR: Objection.

18 THE WITNESS: The thickness of a
19 conductive buffer, assuming the surface
20 properties are unchanged with thickness, will
21 generally not have a strong impact.

22 It will have some impact because
23 reflection is never perfect, but that will not
24 have as strong an impact on radiant heat
25 properties as the reflectivity.

1 But given what I just said, in other
2 words, reflection is never perfect, all else
3 being equal, a thicker layer will always be
4 better because it's a bigger buffer. But it's
5 not the main factor.

6 BY MS. ZHONG:

7 Q. When you say "a bigger buffer,"
8 buffer for what?

9 A. It's a space. It's a spacing
10 between the surface upon which radiant heat is
11 impinging and the sensitive layers that you're
12 trying to protect, which in the case of Kijima
13 are the OLED stack.

14 Q. Okay. Then take a look at 57.
15 It is referencing good thermal
16 conductivity rather than reflectivity with
17 respect to dissipating radiant heat.

18 Why is that?

19 A. That is in fact exactly consistent
20 with what I just said.

21 So it's all about radiant heat,
22 which means reflection is the important
23 parameter. But all else being equal, the
24 thicker it is, the better it protects the
25 device inside.

1 So it's still about radiant heat,
2 but having a thicker film gives you a better
3 buffer.

4 Q. Okay. So Kijima mentions nothing
5 about a good reflective index.

6 The only thing the property mentions
7 regarding the conductive sealing film is its
8 thermal conductivity. Correct?

9 A. That's not true.

10 It does mention its thermal
11 conductivity, but it makes it clear that it's
12 talking about dissipation of radiant heat.

13 And radiant heat is about absorption
14 of incident optical waves because it's
15 radiation.

16 Q. Okay. I understand that. But
17 neither of us can read Japanese and we don't
18 know what the original text says.

19 Does Kijima anywhere mentions
20 reflective index?

21 A. Not that I recall.

22 Q. Okay. So the only thermal
23 property -- strike that.

24 So the property relates to heat
25 dissipation.

1 The parameter, the only parameter it
2 mentions, is thermal conductivity of that film.
3 Correct?

4 A. No, that's not true, because when
5 it's talking about heat dissipation, it's
6 making it very clear that it's not just heat
7 dissipation, it's dissipation off the radiant
8 heat.

9 Those words appear explicitly in
10 Paragraph 57.

11 Q. You're not answering my question.
12 Radiant heat is not part of the
13 thermal property of the conductive film.
14 Correct?

15 A. That's not true, because it's
16 specifically telling us the thermal
17 conductivity it's talking about is in terms of
18 dissipation of the radiant heat.

19 That's why I -- I did answer your
20 question, by starting -- the very first words
21 out of my mouth were "no, that's not true," and
22 then I told you why.

23 Q. Radiant heat is not dissipated
24 through conduction. Is that correct?

25 A. Heat dissipation occurs through

1 three processes, conduction, convection and
2 radiation.

3 But here, this is specifically
4 dealing with radiant heat.

5 Q. And the only pathway it mentions
6 here is the conductivity path.

7 It doesn't mention the convective
8 dissipation path or the reflective -- the
9 dissipation through reflection of that heat.
10 Correct?

11 A. Well, that's not entirely true.

12 So it's true that when it's talking
13 about protecting the interior, in other words,
14 the organic layers, it's mentioning thermal
15 conductivity. That's true because that's on
16 the inside.

17 And so because it's on the inside,
18 given that the gold is a reflective layer, the
19 only path for heat to get to the inside is by
20 conduction. There's no significant convection
21 inside these solid materials.

22 Q. Well, in fact, if I want to protect
23 the organic layer from the radiant heat, I
24 actually want it to have poor conduction from
25 the conductive sealing layer to the organic

1 layer, correct, so the heat that's impinged on
2 the conductive sealing layer would not be
3 transmitted or conducted to the organic layer
4 that efficiently? Correct?

5 A. That would be true if you had a
6 material that was highly reflective but not
7 thermally conductive.

8 The reality is if we want materials
9 that are highly reflective and are used in
10 these types of processes, they will tend to be
11 metals. And for better or worse, metals are
12 thermally conductive.

13 Q. Or I can have an anisotropic
14 conductive materials that it doesn't really
15 conduct well in the vertical direction but it
16 can conduct well in the horizontal direction.
17 Right?

18 A. Sure.

19 But none of those are engineering
20 materials used in OLEDs in this way.

21 Q. Okay. And when it says "efficient
22 dissipation of the radiant heat can be expected
23 with thermal conductivity," where are those
24 heat dissipated to?

25 MR. GARR: Object to the form.

1 THE WITNESS: It doesn't say in this
2 paragraph where it's dissipated to.

3 (Simultaneous crosstalk.)

4 THE WITNESS: The main thing is it
5 does say that it's advantageous in preventing
6 degradation of the organic layer, which is
7 referring to the organic material on the inside
8 of the OLED.

9 BY MS. ZHONG:

10 Q. Okay. And based on your expertise,
11 where would the heat be conducted to?

12 MR. GARR: Same objection.

13 THE WITNESS: So it's the same
14 thing. It's not just conducted. It's also
15 reflected.

16 So heat that is reflected will be
17 reflected outwards. The small amount of heat
18 that is not reflected outwards will be spread
19 throughout the entirety of the device, so it
20 will be dissipated, meaning spread, so it
21 doesn't generate a locally very high
22 temperature.

23 Given that it's a solid state
24 device, that will be primarily through thermal
25 conduction, basically no convection to speak of

1 and no radiation within the confines interior
2 to the gold.

3 BY MS. ZHONG:

4 Q. And in Kijima it wants to use vacuum
5 deposition to form the organic layer and above.
6 Correct?

7 A. I'm sorry. I didn't hear the last
8 part of that question.

9 Q. So in Kijima -- strike that.
10 Kijima wants to use vacuum
11 deposition to deposit all the layers from
12 organic layer upward. Correct?

13 A. If you're referring to the series of
14 layers that are called out in relation to using
15 the techniques shown in Figure 4, yes, I agree,
16 that's true.

17 Q. Okay. So Kijima wants to use vacuum
18 deposition techniques for the OLED stack for
19 the electrode 1, for the conductive sealing
20 layer 7 and the inorganic sealing layer 8.
21 Correct?

22 A. Those are what are disclosed within
23 the discussion in the specification of Kijima,
24 including in the embodiments.

25 Q. Does Kijima state anywhere that the

1 function of the conductive sealing layer 7 is
2 also for conducting electrons or electricity in
3 and out of the OLED devices?

4 A. (Reviewing document.)

5 Yes. Specifically in Paragraph 22
6 in discussing Figure 24, it says: "These
7 electrodes are arranged in a matrix of
8 intersecting stripes." So it's specifically
9 calling out the need for stripes.

10 And as we've discussed previously,
11 what provides the stripes in particularly the
12 top stripe in Kijima is the conducting sealing
13 layer.

14 And it says in relation to that:
15 "Signal voltages are applied in time series by
16 a luminance signal," and so on and so forth.

17 So to apply the voltages to the
18 device, it happens through the stripes shown in
19 Figure 24.

20 If we look at Figure 24 and we match
21 it up with the disclosure, for example, related
22 to Figure 3 where we discussed the arrangements
23 of the masks, we see that it corresponds
24 exactly to the conductive -- or at least one of
25 the stripes corresponds exactly to the

1 conductive sealing layer.

2 Q. Isn't it true that Figure 24 is to
3 be paired with Figure 23, which describes a
4 conventional organic EL element and not that of
5 the Kijima specific structure?

6 A. That's true.

7 But what it's describing
8 specifically is how the signals are provided.

9 Q. So Figure 24 is describing a prior
10 art OLED structure. Correct?

11 A. (Reviewing document.)

12 Well, that's true.

13 But again, the same structure is
14 present in Figure 5, which is in relation to an
15 embodiment where we see that we have the matrix
16 arrangement of electrodes.

17 And Figure 5 is showing sort of a
18 partially completed structure, but the key is
19 we still have to have horizontal and vertical
20 stripes.

21 If we want to make a structure such
22 as Figure 2 or Figure 5, in other words, a
23 matrix arrangement of rows and columns, put
24 quite simply, we must have vertical and
25 horizontal conductive stripes.

1 And in particular to get connections
2 to the type of the OLED, given that the cathode
3 is shown as being a square and not a stripe, we
4 must have a strapped conductive material to
5 make the -- in the case of Figure 3, the
6 vertical connections; and hence, it must be
7 provided by the conductive sealing layer.

8 Q. Does the conductive sealing film 7
9 impact the charge flow within the device,
10 namely between the cathode and the anodes?

11 A. Yes, in that the -- in the following
12 sense.

13 I'm not sure I fully understand your
14 question.

15 But it is what provides electrons to
16 the cathode, and therefore, when electrons are
17 injected from the cathode into the device, the
18 only way that can happen is if they are
19 provided to it, which has to happen through the
20 conductive sealing film.

21 Q. But for -- to get in and out of
22 device, it is for connection to the control
23 circuit and the driving circuit. Correct?

24 A. You said "it," and I don't know what
25 you're talking about, ma'am.

1 Q. Well, you're referring to Figures 5
2 and 24.

3 For Figures 24, for example, those
4 stripes are connected to control circuit and
5 not to some electron source or hole sources.
6 Correct?

7 A. In fact, control circuits are
8 electron and hole sources.

9 I mean it's basic electrical
10 engineering. That's what control circuits do,
11 is they provide electrons or they provide a
12 ground bath so you generate holes within the
13 device.

14 And that's true in Figure 24.
15 That's true in Figure 5. That's true in
16 Figure 2. And given that each of the squares
17 in Figure 2 is shown through the structure of
18 Figure 3, that's true in Figure 3.

19 MR. GARR: We've been going about an
20 hour and a half.

21 Is now a good time for a break?

22 Q. And you believe that conductive
23 sealing film 7 carries charge by electron in
24 particular to electrode 1 because conductive
25 sealing film 7 is in contact with electrode 1.

1 Is that correct?

2 A. That's -- well, so it is true it's
3 in electrical contact with electrode 1, and
4 it's also true it's the only path that is
5 provided to get electrons to the cathode since
6 it is what provides the strike.

7 Q. But isn't it also true that the
8 conductive sealing film 7 is in contact with
9 all the other layers through the sidewalls?

10 A. Yes, but not -- well, to be clear,
11 other than the ITO.

12 As I pointed out in my declaration
13 and in our discussion of Figure 12, Figure 1
14 doesn't show the oxide. So there's an
15 inaccuracy in the drawing of Figure 1, since as
16 drawn the conductive sealing film would short
17 out the device. This would not be a functional
18 OLED. But in the discussion of Figure 12, it
19 makes clear that in fact the oxide layer 8
20 prevents the shorting.

21 So having said that, it is true that
22 as drawn the conductive sealing film, other
23 than the bottom ITO layer, makes contacts with
24 the sidewalls of every other layer.

25 But remember, the nature of the work

1 functions of these materials are such that the
2 low barrier for injection is to the cathode.
3 And the fact that there happens to be physical
4 contact and electrical contact between the
5 conductive sealing films and the sidewall of
6 the other layers doesn't affect the fact that
7 injection will predominantly still happen from
8 the cathode.

9 Q. Where does it say that there is an
10 insulating film between the sidewalls of the
11 OLED stack and the conductive film 7?

12 A. It doesn't say that. You
13 misunderstood my previous answer.

14 It's not that there's an insulating
15 film between the sidewalls of the OLED stack.
16 There is an insulating film between the ITO and
17 where the conductive sealing film comes down.

18 That's shown in Figure 12.

19 Q. And where's that description?

20 A. Well, it's shown. You can see it in
21 Figure 12, for example.

22 In Figure 12, if you look at what is
23 the ITO layer, you'll notice that the
24 conductive sealing film never touches the ITO.

25 Q. You're referring to like the --

1 you're referring to the element 9. Is that
2 correct?

3 A. Correct.

4 And that's how it's described in the
5 text.

6 Q. But doesn't the conductive sealing
7 film 7 touches the sidewall of the electron
8 transport layers and the light-emitting layers
9 and the whole transport material layers?

10 A. Yes, it does.

11 And that's not a problem because
12 they have different work functions. So you get
13 a large barrier and, a Schottky barrier, that
14 prevents significant electron interactions at
15 those interfaces.

16 Where you get a good work function
17 match is between the conductive sealing film
18 and the cathode, and so that's where injection
19 happens.

20 I mean, essentially this device as
21 structured with the conductive sealing film
22 wrapping around the OLED stack takes advantage
23 of the fact that actually injecting electrons
24 into organic materials requires a very low work
25 function material. Otherwise, you get a large

1 Schottky barrier.

2 So the fact that it's touching the
3 sidewalls in this design doesn't cause
4 significant injection from the sidewalls.

5 Q. So your position is that because of
6 the energy -- the molecular -- the energy level
7 difference, there would not be efficient
8 electron injection into the organic layers?

9 A. So just to be clear, there will be
10 efficient electron injection from the cathode
11 into the organic layers because the cathode
12 will be work function matched -- I mean, this
13 is sort of standard OLED design -- the cathode
14 will be work function matched to enable good
15 injection into the top of the OLED stack.

16 However, in the regions of the
17 sidewalls of the OLED stack where the
18 conductive sealing film is in contact with
19 those sidewalls, there's not a good work
20 function match, so there will be a large
21 barrier and there will not be significant
22 injection directly from the conductive sealing
23 film into those organic layers.

24 Q. Okay.

25 MS. ZHONG: We can take a ten-minute

1 break.

2 MR. GARR: Okay. Thanks.

3 (Recess was taken from 2:39 p.m. to
4 2:52 p.m.)

5 BY MS. ZHONG:

6 Q. Was the use of PML structures known
7 in 1997?

8 A. (No response.)

9 Q. Actually, sorry.

10 Was the use of polymer multilayer
11 structures known in 1996?

12 A. (Reviewing document.)

13 You said in 1996. Correct?

14 Q. Correct.

15 A. I don't recall specifically.

16 Looking at the art that I've cited
17 in relation to the use of the multilayer
18 structures, none of the art that I'm
19 specifically citing for the multilayer
20 structure goes back to 1996.

21 I don't remember if any of the other
22 art that we haven't discussed today goes back
23 to there, but as I sit here I don't remember
24 specifically.

25 Q. How much of an improvement would

1 there be by adding the organic sealing layer
2 between the conductive sealing layer and the
3 inorganic sealing layer in Kijima?

4 A. I couldn't give you -- I don't have
5 an exact number.

6 However, based on the abundant
7 disclosure attesting to the importance of the
8 planarization followed by inorganic bilayer
9 structure that we've already discussed, it's
10 clear that one of skill would expect there to
11 be an improvement.

12 But I couldn't give you an exact
13 number.

14 Q. Now, the organic sealing layer can
15 be applied in a planar fashion and then removed
16 from the undesired positions. Correct?

17 MR. GARR: Objection.

18 THE WITNESS: You said "planar."

19 I think you mean sort of blanket.

20 Right?

21 BY MS. ZHONG:

22 Q. Blanket, yeah, which is also planar.
23 Right?

24 A. No, those two are not the same
25 words. "Blanket" does not necessarily mean

1 "planar."

2 Q. Okay. My understanding, they are
3 the same.

4 But if you don't believe they're
5 same, let's just use the term "blanket."

6 A. Okay. So then could I have the
7 question again, please.

8 Q. Okay. The organic sealing layer can
9 be applied in a blanket fashion and then
10 structured subsequently after deposition.
11 Correct?

12 MR. GARR: Object to form,
13 foundation.

14 THE WITNESS: So in a hypothetical
15 situation, it is true that -- it is possible to
16 put down an organic sealing layer in a blanket
17 deposition scheme and then subsequently etch it
18 from other areas.

19 I agree. That is conceptually
20 possible.

21 BY MS. ZHONG:

22 Q. Okay. And Suzuki itself does not
23 require there to be selective deposition of the
24 organic layers. Correct?

25 A. (Reviewing document.)

1 Could I have the question again,
2 please.

3 Q. Suzuki itself does not require there
4 to be selective deposition of the organic
5 layer. Is that correct?

6 A. I agree with that.

7 There is disclosure in Suzuki of at
8 least one embodiment where spin coating is
9 used.

10 Q. Sturm itself does not suggest using
11 inkjetting for putting down sealing layers or
12 encapsulation layers. Correct?

13 A. I think we discussed this already.

14 As long as -- within the scope of
15 the way you are using the term "sealing," and
16 more particularly "encapsulation layers," we're
17 not referring to layers -- we're using it in
18 the way we've been using it in relation to the
19 patent at issue.

20 Sturm is silent. The devices and
21 embodiments shown in Sturm do not have sealing
22 and encapsulation layers of the type that we
23 have been talking about in relation to the
24 patent at issue.

25 Q. Okay. And in Duthaler the screen

1 printing is not done in the vacuum conditions.

2 Is that correct?

3 A. Could you give me the exhibit
4 number, please.

5 Q. Duthaler, I believe it's
6 Exhibit 1016.

7 A. Yes, I have it. (Reviewing
8 document.)

9 I agree that the discussion of
10 screen printing in the relevant sections in
11 Duthaler do not call out the ambient that is
12 used. They certainly don't call out that it's
13 performed in vacuum. I'm not aware of any
14 specific examples of screen printing being
15 performed in vacuum.

16 But of course screen printing is
17 routinely performed under nitrogen, similar to
18 my previous discussion with respect to inkjet.

19 Q. Okay.

20 A. But it's true that there's no
21 disclosure of that in Duthaler.

22 Q. And were you using inkjetting at the
23 time of the invention in 2001/2002?

24 A. Me personally?

25 Q. Yes.

1 A. Yes.

2 Q. And you were performing those under
3 nitrogen?

4 A. Yes.

5 Q. What are the advantages and
6 disadvantages of the inkjet printing compared
7 to vacuum deposition?

8 A. Well, it's what we talked about
9 previously.

10 So inkjet printing has various -- it
11 has various characteristics that in some cases
12 have analogous characteristics in vacuum
13 deposition and some are quite different.

14 Inkjet is a noncontact technique.
15 It's very material efficient. It can be used
16 to build up thick layers because you can do
17 multiple passes of printing in a very efficient
18 and scalable way. It can be ganged to be
19 scalable by putting multiple heads in parallel.

20 Those are some of the examples that
21 we've previously discussed and are disclosed as
22 advantages or characteristics in my report.

23 Now, when we compare it to vacuum
24 deposition techniques, vacuum deposition on its
25 own is noncontact. But when you use a shadow

1 mask, the shadow mask may come in contact, so
2 in that case there is some contact.

3 Vacuum deposition is not as
4 efficient as -- in terms of material as inkjet,
5 because in vacuum deposition, material is
6 deposited on the shadow mask, and so that is
7 wasted material.

8 Vacuum deposition is much more
9 extensive to build up thick layers just because
10 it tends to be quite a bit slower than inkjet,
11 and it doesn't have the benefits of the ability
12 to gang together large number of arrays of
13 heads that inkjet offers.

14 Q. What are the advantages of that --
15 sorry.

16 What are the advantages of vacuum
17 deposition compare to the inkjetting technique?

18 A. Well, particularly if we look at it
19 in specific relation to OLEDs, vacuum
20 deposition techniques are technologically more
21 mature. That's certainly true.

22 In terms of materials, there are
23 some materials that cannot be printed because
24 there are no ink forms available of those
25 materials.

1 That's not true for the materials
2 we've been talking about as, for example,
3 planarization materials, but there are
4 materials that cannot be printed just because
5 they're not available in an ink form.

6 In vacuum deposition, generally it's
7 easier to achieve high purity because you don't
8 have to deal with the formulation of the ink.

9 Vacuum deposition is capable of
10 depositing very thin layers, which is not
11 needed for -- or the thicknesses on the lower
12 end are not needed, or in fact not desirable.
13 Like single nanometer thicknesses may not be
14 desirable for some applications, but if you
15 need that, that is easier to achieve in vacuum
16 deposition than in inkjet printing.

17 I think those are some examples of
18 differences.

19 Q. How about -- so what are the
20 differences between -- strike that.

21 What are the advantages of vacuum
22 deposition compared to screen printing?

23 A. I think a lot of the statements that
24 I made earlier with respect to inkjet printing
25 would apply equally to screen printing, with

1 the additional difference being that in screen
2 printing, two other advantages of vacuum
3 deposition would be in screen printing, the
4 screen typically gets either in contact or in
5 close contact to regions over -- even in
6 regions where ink will be deposited or material
7 will be deposited. So it's easier to avoid
8 contact related contamination in vacuum
9 deposition than in screen printing, more so
10 than even compared to inkjet printing.

11 And then as we discussed previously,
12 generally screen printing requires higher
13 viscosity inks, which may be difficult to
14 formulate with the materials that we want to
15 use, which means that certain materials are
16 more accessible for vacuum deposition than for
17 screen printing.

18 Q. Can you -- strike that.

19 How easily can you obtain an organic
20 sealing layer that is 1 micron thick?

21 A. I mean, it's not difficult to do.
22 It's not difficult to do by evaporation. It's
23 not difficult to do by inkjet. It is not
24 difficult to do with screen printing.

25 With all of them, it's possible.

1 Q. So how thick an organic layer do you
2 need there to -- strike that.

3 So in your modified Kijima, how
4 thick an organic layer does it have to be?

5 A. There is actually not a specific
6 requirement in terms of thickness.

7 Remember that Suzuki teaches us that
8 the organic layer that we are taking the
9 teachings of and applying to Kijima provide
10 smoothness. So essentially we take advantage
11 of the smoothness to overcome features like
12 asperities, to produce rounder corners,
13 et cetera, and that benefit happens even in
14 relatively thin films.

15 For example, if we take surface
16 roughness on the top surfaces of the OLED
17 stack, even if those roughnesses are only in
18 the range of tens of nanometers, then having an
19 organic layer and a thickness of tens of
20 nanometers that provides smoothness will still
21 provide substantial benefits.

22 Q. Okay. And at that thickness, which
23 is tens of nanometers, the -- some of the
24 disadvantages that you mentioned for a vacuum
25 deposition would be much less significant.

1 Correct?

2 A. You mean as compared to --

3 Q. Inkjetting, for example.

4 A. Well, inkjetting still benefits from
5 the ability to gang large numbers of heads, so
6 I don't think that advantage of inkjet goes
7 away.

8 But it's true for other things like
9 the ability to build up thicker layers more
10 quickly, et cetera, then there's not a -- when
11 you're doing very thin films, that advantage
12 doesn't matter as much.

13 There is still the advantage of not
14 having to deal with material wastage by
15 depositing on a shadow mask.

16 Q. But if you build up a much thinner
17 layer, then there is less material to waste
18 than --

19 A. I agree with that. I agree with
20 that.

21 Q. And you don't -- the shadow mask
22 doesn't have to be in contact with the
23 substrate. Correct?

24 A. I agree. That's true.

25 Q. And you have found that in your own

1 research. Correct?

2 A. That's right.

3 Q. Now, for Ground No. IV, which is for
4 Claims 41, independent claims, the mapping of
5 the planarization layer and the barrier layer
6 are the same as for Claim 34. Is that correct?

7 A. (Reviewing document.)

8 Yes, that's true.

9 Q. And for Ground No. IV, you also
10 specifically rely on Fujimori. Correct?

11 A. That's correct.

12 Q. And what is the invention of
13 Fujimori directed to?

14 MR. GARR: Objection.

15 THE WITNESS: (Reviewing document.)

16 The invention of Fujimori as called
17 out or as specified in its claims, starting
18 from Claim 1 and running through Claim 17, are
19 related to an organic electroluminescent
20 element with certain characteristics and then
21 methods of manufacturing it, including the use
22 of what we've been referring to previously as a
23 magnetic shadow mask.

24 BY MS. ZHONG:

25 Q. Understood.

1 And the use of that magnetic shadow
2 mask is to avoid short in elements of
3 crosstalk. Is that correct?

4 A. So in -- so in terms of a ben- --
5 Fujimori, in terms of a benefit of a magnetic
6 shadow mask with respect to its identification
7 of a problem -- of a problem to be solved by
8 the invention, is related to the fact that when
9 masks are made thin to accommodate fine
10 patterns, sufficient strength cannot be
11 obtained. The adhesion between the substrate
12 and mask deteriorates due to warping and other
13 factors.

14 It then goes on to say that because
15 of that, one of the problems that can happen --
16 and in fact, it's a major problem that can
17 happen -- is a short in the elements and
18 crosstalk due to increased leakage current.

19 So that's a consequence of the
20 problem. That's not the problem itself.

21 Q. And the problem is the mask is too
22 thin and it's going to be warping?

23 A. No, the problem is not that the mask
24 is too thin.

25 The problem is that, as a

1 consequence of the mask being made thin to
2 the -- excuse me.

3 As a consequence of the mask being
4 made thin, you don't have sufficient strength,
5 and the adhesion between the substrate and mask
6 deteriorates due to warping and other factors.

7 Q. And again, in Fujimori, the
8 deposition does not involve encapsulation
9 layers. Correct?

10 A. (Reviewing document.)

11 With -- I'd assume with respect to
12 your question you're asking me about the
13 deposition steps disclosed in Fujimori.

14 And I agree, if we look at the
15 disclosures in Fujimori with respect to the
16 various embodiments and disclosures of the
17 specification, none of those steps are
18 specifically related to encapsulation; rather,
19 they are about layers within the intrinsic
20 device itself.

21 Q. In fact, in Fujimori it does not
22 mention encapsulation layers or barrier layers.
23 Correct?

24 A. In all honesty, I don't remember
25 every single word in Fujimori.

1 But I think that's true. I don't
2 recall there being discussion or use of the
3 word "encapsulation," but I don't remember for
4 sure.

5 Q. Can we go to Kijima Figure 12 again.

6 A. (Complying.)

7 Okay.

8 Q. Is 9 -- element 9 part of the
9 substrate?

10 A. I'm sorry. You said Figure 4?

11 Q. No, Figure 12.

12 A. (Reviewing document.)

13 So in the discussion related to
14 element 9, it refers back -- the discussion
15 refers back to -- well, the first time I
16 believe it appears is in reference to the
17 discussion on Figure 5, where it's first --
18 where it says in Paragraph 45: "First, as
19 depicted in Figure 5, SiO₂ 9 was deposited onto
20 an ITO transparent electrode."

21 So it tells us that it's deposited
22 on top of the ITO in specific regions.

23 Q. Okay. And so when the Fujimori mask
24 was deposited onto a Kijima device, would that
25 mask be in direct contact with the substrate?

1 A. (Reviewing document.)

2 Q. Or let me put it this way.

3 Would you consider the ITO to be
4 part of the substrate or it's part of the
5 device?

6 A. (Reviewing document.)

7 So if -- and your question is in
8 relation to Kijima.

9 I actually address that in -- on
10 Page 62 of my declaration where I show a figure
11 which shows -- generally speaking, I've
12 highlighted the substrate in yellow and I've
13 highlighted the device in blue.

14 And so you will see that the ITO is
15 part of the device.

16 Q. Okay. And 9 is on top of the ITO.
17 Correct?

18 A. Physically, yes, I agree.

19 Q. Okay. So it would not be part of
20 the substrate you colored in yellow. Right?

21 A. (Reviewing document.)

22 So could I have the question again,
23 please.

24 Q. So region 9 would not be part of the
25 substrate you colored in yellow. Is that

1 correct?

2 A. Region 9 is not part of substrate 6.

3 I agree with that, because what I
4 have colored in yellow is substrate 6.

5 Q. Okay. Can you please turn to your
6 report Page 64.

7 A. (Complying.)

8 Q. So on top of Page 64 you've
9 annotated Figs 3 and 11 of Kijima. Correct?

10 A. Yes.

11 Q. And in Figure 11, is that mask in
12 direct contact with the substrate?

13 A. In direct contact with the
14 substrate?

15 So again, if we are talking about
16 substrate 6, based on what we've been talking
17 about before, no, we can see in this picture as
18 shown that there's a separation in that figure
19 as shown.

20 Q. And in this figure is the mask
21 deposited on the substrate?

22 A. So if we look at this figure,
23 there's further description, remember, in the
24 text.

25 So specifically I addressed this

1 in -- so Figure 11 is the figure of Kijima as
2 shown.

3 Q. Mm-hmm.

4 A. And I say in Paragraph 125 that that
5 doesn't explain in detail how its masks are in
6 position.

7 And so then I go to Fujimori, which
8 uses the magnetic masking technique, which then
9 brings it into -- which adheres it against the
10 structure.

11 And so that's what I show on
12 Page 68, for example, where I do a modification
13 of Figure 12 to show how the mask would be
14 applied.

15 Q. Okay. So the mask will be in
16 contact with region 9. Is that correct?

17 A. Yes, that's fair.

18 And through that, it is in contact
19 with substrate 6.

20 Q. But it is not in contact with --
21 it's not in direct contact with substrate 6?

22 A. If "direct contact" means there's no
23 intervening layers, I agree with that.

24 It's in contract with substrate 6
25 through the layers that we've been discussing.

1 I specifically point that out, by
2 the way, in Paragraph 150 of my declaration
3 where I say: "The mask is in contact with the
4 Kijima substrate in a manner consistent with
5 the '389 patent's disclosure, even if it is not
6 in immediate contact with Fujimori's bottommost
7 substrate 6."

8 Q. What's the difference between "in
9 contact with" and "on top of the substrate"?

10 Well, let me withdraw it and re-ask.

11 What is the difference between
12 depositing a mask on top of the substrate
13 versus depositing a mask in contact with the
14 substrate?

15 MR. GARR: Objection.

16 THE WITNESS: So I couldn't provide
17 the -- so with respect to the combination that
18 I have identified, for the specific combination
19 that I have identified, it meets them both.

20 In other words, it is in contact
21 with the substrate, as I provided in my
22 reasoning, for example, that we just discussed
23 in relation to Paragraph 150.

24 And then it is deposited as a mask
25 on top of said substrate such that the mask

1 openings are placed on top of said devices, as
2 I discuss in the section that we pointed to
3 starting on Paragraph 121 and continuing to
4 136, and specifically the discussion related to
5 how it is deposited on top of is what we
6 discussed in relation to the figure on Page 68.

7 BY MS. ZHONG:

8 Q. When would the mask be deposited on
9 top of the substrate but not in contact with
10 the substrate?

11 MR. GARR: Objection, form,
12 foundation.

13 THE WITNESS: I couldn't -- that's a
14 hypothetical that I haven't thought of, because
15 with respect to the specific combination I'm
16 using, it clearly means both.

17 BY MS. ZHONG:

18 Q. Can you think of a situation under
19 your interpretation when a mask is on top of a
20 substrate but is not in contact with a
21 substrate?

22 MR. GARR: Can I have that question
23 reread by somebody?

24 I didn't hear it.

25 (The record was read as follows:

1 "Question: Can you think of a
2 situation under your interpretation when a mask
3 is on top of a substrate but is not in contact
4 with a substrate?")

5 MR. GARR: Object, form, incomplete
6 hypo.

7 THE WITNESS: Again, I haven't
8 thought about that, nor do I have to, because
9 for the combination I've identified, it clearly
10 means both.

11 BY MS. ZHONG:

12 Q. Claim 43 has to have a narrow scope
13 than Claim 41. Correct?

14 A. (Reviewing document.)

15 MR. GARR: Counsel, you got a lot
16 quieter in the last like 30 seconds.

17 If you just make sure we're -- there
18 might be an issue with the microphone position.

19 Thank you.

20 THE WITNESS: So Claim 43 depends on
21 Claim 41.

22 So to that extent, Claim 43 would be
23 used to narrow the scope of Claim 41.

24 BY MS. ZHONG:

25 Q. Okay. So it's important that for us

1 to identify -- so to -- strike that.

2 So one way to evaluate whether your
3 interpretation of the term is correct or not is
4 to find a situation where the mask is deposited
5 in such a way that it meets Claim 41 but does
6 not meet Claim 43. Right?

7 A. No, I don't think that that's what I
8 have to do.

9 To evaluate whether I fall under the
10 to claim -- to evaluate or to perform my
11 analysis, all I have to do is to offer an
12 opinion on invalidity of Claim 41 or an
13 invalidity of Claim 43 or both.

14 It can be the same structure that
15 invalidates both, and in my view, that's what
16 I've done.

17 Q. Well, if under your interpretation
18 every time when the mask is deposited on top of
19 the substrate it is also deposited in contact
20 with substrate, then Claim 43 won't be narrower
21 than 41. Correct?

22 MR. GARR: Object to form,
23 mischaracterizes.

24 THE WITNESS: So that's not true,
25 and I haven't done that analysis.

1 Just to be clear, I'm not -- to
2 establish invalidity, which is what I'm doing
3 in my declaration, I do not have to identify a
4 counter-case. I just have to show that the
5 structure that I have identified invalidates
6 the claim at issue.

7 And I believe I have shown that it
8 invalidates Claim 41 and it invalidates
9 Claim 43.

10 BY MS. ZHONG:

11 Q. So it's under what you believe to be
12 the correct interpretation. Correct?

13 A. It's under plain meaning.

14 As I said, I haven't offered
15 constructions on those terms.

16 Q. And in your interpretation of "in
17 contact with substrate," means it can be
18 through intervening layers that's not part of
19 the substrate. Correct?

20 A. So with respect to "in contact," I
21 believe that follow -- similar to how the 38 --
22 through the '389 patent's disclosure, it is in
23 contact even if it is not in immediate contact
24 with substrate 6 of Fujimori.

25 Q. Even if there are intervening layers

1 that are not part of the substrate. Is that
2 correct?

3 A. My answer accounts for the fact that
4 if we look at the structure that I've
5 identified and that's shown, for example, on
6 Page 77 of my declaration, substrate 6 which is
7 shown in yellow, is separated from -- is
8 physically separated from the mask by
9 additional layers, specifically layer 5 and
10 layer 9, but specifically they are all in
11 contact with each other sequentially.

12 Q. And you don't contend layers 5 or 9
13 are part of the substrate. Correct?

14 A. With respect to substrate 6 which
15 I've highlighted in yellow, 5 and 9 are not
16 shown as part of substrate 6.

17 Q. And what's your interpretation of
18 selectively depositing at least one barrier
19 layer over said planarization layer?

20 What's the difference between the
21 term "over" versus "on"?

22 MR. GARR: Objection.

23 THE WITNESS: Again, I -- all I have
24 to do is find -- sorry.

25 Which claim element are you on now?

1 BY MS. ZHONG:

2 Q. The last element.

3 "Over said planarization layer"
4 versus "on said planarization layer," is there
5 a difference?

6 A. I'm sorry. So I see the "over said
7 planarization layer."

8 Which claim element are you
9 referring to the "on said planarization layer"?

10 Q. I'm asking you is "over
11 planarization layer" means the same as "on
12 planarization layer."

13 MR. GARR: Objection, scope.

14 THE WITNESS: I don't -- so given
15 that you're asking me about a claim -- a claim
16 limitation that is not in Claim
17 Limitation 41[e], I don't know how to do that
18 comparison. I haven't done it.

19 I have evaluated whether the
20 combination that I have proposed would make
21 obvious Claim Element 41[e], and in my opinion
22 it does.

23 Claim 41[e] uses the word "over,"
24 so that's what I've evaluated.

25

1 BY MS. ZHONG:

2 Q. And what's your interpretation of
3 the term "over"?

4 A. So that's met.

5 So as shown -- so with respect to
6 41[e], I show that the barrier layer in
7 yellow -- you can see it as shown in the
8 figure -- is over the planarization layer,
9 which would be where the arrow shown in purple
10 would be.

11 So it meets that.

12 Q. And you don't really show the shape
13 of the planarization layer. Correct?

14 A. I think you asked me that at least
15 twice already.

16 But I'll say the same thing, which
17 is, correct. Here, I just indicated with an
18 arrow to indicate where it would be. I don't
19 explicitly draw it in this annotation that I
20 provide on Figure 12.

21 Q. And would the planarization layer
22 extend across region 9?

23 A. Oh, you mean laterally across
24 region 9?

25 Q. Yes.

1 A. (Reviewing document.)

2 So I show my analysis on -- with
3 respect to that on Page 73 of my declaration
4 where you see that I show the mask in the green
5 boxes.

6 And because of the presence of that
7 mask, the planarization layer would be blocked
8 by the shadow mask from extending laterally
9 across region 9.

10 Q. But it would cover a portion of
11 region 9, correct, because where the mask is,
12 there's still a gap between --

13 A. This --

14 (Simultaneous crosstalk.)

15 Q. Go ahead.

16 A. Yeah, I understand your question.

17 But I apologize. I interrupted you.
18 I'll stop and let you finish your question.

19 Q. Go ahead, since you started talking.

20 A. Okay. I think I understand your
21 question.

22 Your question is: Is there a small
23 gap as drawn?

24 And I agree there is. And usually
25 that's done to ensure manufacturing robustness.

1 So right at the corner there will be
2 some deposition of material.

3 Q. And then what about if you -- in
4 reference to Figure 13, would the organic layer
5 cover the lower lateral region of layer 7?

6 A. (Reviewing document.)

7 So with respect to the cross-section
8 of Figure 13, actually it doesn't matter for
9 the purposes of my analysis. It could or it
10 could not.

11 But specifically in my discussion of
12 the mask for the planarization layer, I provide
13 an annotated version of Figure 3 and Figure 11
14 on Page 71 of my declaration, and I say that a
15 similar or the same method could be used for
16 this combination.

17 So in other words, in Paragraph 140
18 I say depositing the added organic sealing
19 layer in this manner would follow this. So in
20 other words, we would use the mask and then do
21 it that way.

22 So given that disclosure, if we went
23 with a square mask opening as shown in Figure 3
24 for this structure, we would not have material
25 continuously across the cross-section of

1 Figure 13.

2 Q. So would the inorganic layer wrap
3 all the way around the organic layer?

4 A. I don't understand your question.

5 Q. So when the inorganic layer is
6 deposited on top the organic layer, would it
7 cover all of the organic layer, including
8 around the edges?

9 A. Yes.

10 So that's -- I mean, it depends on
11 the relative dimensioning of the mask.
12 Certainly both are possible.

13 If you use a mask where the
14 inorganic layer mask has a bigger opening than
15 the organic layer mask, it will wrap all the
16 way around the edges.

17 If you use, for example, a mask that
18 has the same size, it will go to approximately
19 exactly the same point.

20 In both cases it meets the
21 requirement of the claim, and in both cases
22 it's still selective.

23 Q. So if the inorganic layer covers
24 only a portion of -- strike that.

25 So if the inorganic barrier layer

1 covers only a portion of the organic layer, is
2 that depositing the barrier layer over the
3 organic layer?

4 A. I don't understand your
5 hypothetical.

6 So you'll have to explain what you
7 mean by "covers a portion."

8 Q. Maybe we can take a look at the
9 Sturm Figure 11c, for example.

10 A. I'm sorry? Sturm?

11 Q. Yes, Exhibit 1013.

12 A. One second.

13 What is the exhibit number, please?

14 Q. 1013.

15 A. (Reviewing document.)

16 Okay. I have it.

17 Q. Go to Figure 11c.

18 A. (Complying.)

19 Okay. I see that.

20 Q. And do you see that 74 is on the top
21 of 68?

22 A. Yes.

23 Q. But it's covering only a portion of
24 68.

25 A. I understand what you mean by your

1 description of it, yes.

2 Q. Okay. So is 74 over 68?

3 MR. GARR: Objection.

4 THE WITNESS: I haven't done that
5 analysis.

6 I have not used Sturm for the
7 purposes of this limitation, so I haven't
8 thought about that. That's not the structure
9 that -- or that's not the combination that I
10 proposed.

11 BY MS. ZHONG:

12 Q. I understand.

13 I just want to ask you: Do you
14 consider 74 is deposited over 68?

15 MR. GARR: Objection, scope.

16 THE WITNESS: Again, that's not an
17 issue I've considered, because this
18 combination -- or this reference I quite simply
19 have not considered in relation to this
20 limitation.

21 BY MS. ZHONG:

22 Q. Does the plain and ordinary meaning
23 of the term "over" include a configuration as
24 shown in Figure 11 of Sturm, 74 over --

25 MR. GARR: Objection, scope.

1 Q. -- 74 over 68?

2 A. Again, I haven't considered that.

3 I don't need to look to that to
4 answer that, because as I've pointed out, my
5 combination that I'm using does not depend on
6 the structure of Sturm.

7 And I've explained how my
8 combination that I've provided makes
9 Element 41[c] obvious.

10 Q. And if we look at Suzuki, is
11 layer 22 over layer 20?

12 A. (Reviewing document.)

13 MR. GARR: Layer what?

14 THE WITNESS: Sorry. Is layer 22
15 over layer 24?

16 Q. 20.

17 A. (Reviewing document.)

18 And this is with respect to
19 Figure 1?

20 Q. Sure.

21 A. Okay. I understand your question.

22 So first, to be clear, with respect
23 to Suzuki, I'm using the teaching of using the
24 planarization layer and I'm putting it into the
25 structure of Kijima.

1 But having said that, given that the
2 final structure with respect to the arrangement
3 of the organic layer and the inorganic layer
4 will be fairly similar between what's shown in
5 Figure 1 and what I propose in my combination
6 and assuming it is done selectively, which of
7 course is a requirement of Claim 41[e], I
8 believe that a structure that looks like this
9 would meet the limitation "selectively
10 depositing at least one barrier layer over said
11 planarization layer."

12 MS. ZHONG: Can we go off the
13 record?

14 MR. GARR: Sure.

15 (Recess was taken from 3:54 p.m. to
16 4:07 p.m.)

17 BY MS. ZHONG:

18 Q. Was the concept of using a smoothing
19 layer known in 1996?

20 A. Do you mean generally or in the
21 specific context of the encapsulation of OLEDs?

22 Q. In the case of encapsulation of
23 OLEDs.

24 A. I don't know specifically.

25 None of the art that we've been

1 discussing today goes back to that priority
2 date.

3 I don't know if there's other art
4 that I've cited that does, but I don't remember
5 offhand. So without looking at specific art, I
6 couldn't say for sure.

7 Q. What about generally?

8 A. I don't know exactly.

9 I don't have a -- off the top of my
10 head, without looking at the literature, I
11 couldn't say for sure.

12 Q. Okay. In Kijima why are they using
13 a separate cathode electrode 1 instead of just
14 using film 7 as a cathode?

15 A. Sorry. Say that again, please.

16 I didn't understand the question.

17 Q. So in Kijima there is an electrode 1
18 as well as conductive sealing film 7 on top of
19 the cathode 1. Correct?

20 A. Yes.

21 Q. So why do you need that separate
22 electrode 1 instead of using just the
23 conductive sealing film 7?

24 A. I understand.

25 So the answer is the reasoning I

1 gave you previously.

2 To inject electrons into the
3 emissive layers of the device, you need a
4 material with the appropriate work function so
5 that it matches up well with the energy levels,
6 specifically with the LUMO level off the top
7 layer of the organic stack.

8 And for that, you need a low work
9 function metal, such as, for example, in
10 Figure 1, lithium aluminum.

11 Q. It's for the purpose of -- to make
12 sure that there is a work function match
13 between the organic layer and the cathode
14 layer. Is that right?

15 A. With respect to electron injection,
16 yes --

17 (Simultaneous crosstalk.)

18 THE WITNESS: -- because the cathode
19 is being used to inject electrons.

20 Q. And also to make sure that for the
21 conductive sealing layer, when it goes down the
22 sidewall of the OLED stack, there's not going
23 to be significant hole or electron injections.
24 Is that right?

25 A. Well, that's not the reason you use

1 the cathode. The cathode is used to ensure
2 good injection into the organic stack.

3 But it's true that as a consequence
4 of having good injection there and having large
5 barriers to injection of electrons along the
6 sidewalls of the device in contact between the
7 gold and the organic stack, there will not be
8 significant injection from the edges.

9 Q. Okay. What about in -- and I
10 believe we discussed this earlier.

11 In Suzuki's top layer 18, that one
12 needs to run -- there needs to be a conductive
13 path for that cathode out of that device
14 itself. Correct?

15 A. Actually, as I already told you, so
16 Suzuki doesn't show connections between
17 multiple individual OLEDs. It's only about a
18 single OLED in its figures and explicit
19 disclosure.

20 So arguably it's possible to just
21 have vertical connection touching down, for
22 example, a probe touching down through the
23 insulating material to make contact from the
24 top onto cathode 18.

25 But it's true that if you wanted to

1 bring a contact to the outside, you would have
2 to run that cathode outside somehow.

3 Q. So --

4 A. But that's not shown in Suzuki.

5 Q. So if 18 is running down the side of
6 the organic conducting layers, would there be a
7 danger of it injecting electrons into the wrong
8 layers?

9 A. So if 18 -- so firstly, that's not
10 what I said. I said it would have to out to
11 the side. I didn't say it has to run down the
12 sidewall. It could run laterally out with a
13 spacer or something like that. It just doesn't
14 show it.

15 This is only -- Suzuki is silent as
16 to what's happening in and out of the plane of
17 the page of Figure 1.

18 But having said that, let's assume
19 we take your hypothetical and we were to run
20 18, which is work function matched to inject
21 into 16 down the sidewalls. That means there
22 would also be decent work function match to the
23 sidewalls of 16, and there would be a risk of
24 an injection into that.

25 With respect to 14, less so because

1 there's always -- in the design of OLEDs
2 there's always a stairstep in the LUMO level
3 between the injection layers and the emissive
4 layers, so it would be less of a problem, and
5 even less so for 12.

6 MS. ZHONG: I don't have any further
7 questions. I will pass the witness.

8 MR. GARR: Okay. Thanks.

9 I need to go off the record for
10 about five or ten minutes. I may have a few.
11 I'm not sure.

12 (Recess was taken from 4:17 p.m. to
13 4:24 p.m.)

14

15 EXAMINATION BY

16 MR. GARR:

17 Q. So Dr. Subramanian, you were asked
18 questions about ground 2 in your declaration
19 for this matter in which you proposed a
20 modification based on Sturm relating to inkjet
21 printing?

22 A. Yes.

23 Q. And this modification is directed to
24 Claim 35 which recites inkjet printing
25 vis-à-vis the planarization layer?

1 A. That's correct.

2 Q. Okay. And your modification entails
3 using inkjet printing to deposit an organic
4 layer that serves as a planarization layer?

5 A. That's correct.

6 And I specifically addressed that in
7 Paragraphs 100 through 107 of my declaration.

8 Q. Okay. And you were asked questions
9 about -- or I believe you testified that this
10 inkjet printing differs from the selective
11 deposition methods that are specifically
12 recited in the Kijima disclosure?

13 A. Yes, that's true.

14 (Simultaneous crosstalk.)

15 MS. ZHONG: Objection.

16 Q. Okay. And counsel asked you about
17 your modification.

18 The question was: "But then you
19 have to use a completely different set of
20 deposition -- you have to use completely
21 different equipment?"

22 Did you understand that question?

23 A. Generally, yes.

24 I remember the question she asked
25 me.

1 Q. Okay. And what was your
2 understanding of what that meant?

3 A. So I mean, the idea was if you were
4 only -- so I think that the series of questions
5 was if we were to look at Kijima, Kijima calls
6 out using this evaporative deposition scheme
7 shown in Figure 4 for all the layers.

8 And I said in my modification at
9 least with respect to the claimed limitation of
10 Claim 35, which is the step for selectively
11 depositing in at least one planarization layer
12 further comprises depositing by inkjet of an
13 organic layer, I said yes, what we would do is
14 for that we would replace a vacuum based
15 deposition with an inkjet based deposition.

16 And so on that basis, if that's the
17 only thing you are replacing, what you would
18 have is you would have vacuum based deposition
19 steps as originally discussed in Kijima and you
20 would have inkjet printing for the claimed
21 layer of claim 35, which is the planarization
22 layer.

23 I should note, however, that just
24 because that's what's claimed, that doesn't
25 mean that's what you're limited to doing.

1 Q. Okay. So in your modification, or
2 at least in that modification that you just
3 discussed of changing the process for the
4 planarization layer, does that lead to a
5 situation where you're using inkjet for some
6 layers and evaporative process for other
7 layers?

8 A. It could.

9 But just to be clear, as I point out
10 in my declaration, specifically if we look at
11 Paragraph 107 of my declaration right at the
12 bottom, I point out that while the Claim 35
13 requires you use it for the planarization
14 layer, you could use it for other layers as
15 well.

16 Specifically the last sentence of
17 Paragraph 107 of my declaration states:
18 "Accordingly, in my opinion, a POSITA would
19 have appreciated that it could similarly be
20 used for selectively depositing an added
21 organic sealing layer since, like the organic
22 EL layers discussed in Sturm, it is made from
23 an organic polymer material, as well as the
24 other patterned elements in Kijima's organic EL
25 element 31."

1 And so in other words, while the
2 claim is only about the planarization layer,
3 you could use inkjet for other layers as well.

4 Q. And the other layers, which layers
5 are those?

6 A. So it's the patterned layers of
7 Kijima's organic EL element 31, which we see on
8 Figure 1 is all the other layers called out
9 that are patterned including specifically the
10 organic layer that we've discussed and, for
11 example, the insulating sealing film.

12 Q. So does your modification for this
13 ground require the use of two separate
14 deposition processes?

15 A. No.

16 If you used inkjet for all the
17 patterned layers, you would just be using
18 inkjet.

19 Q. Okay. And do those patterned layers
20 include the layer 8 in Kijima, the inorganic --
21 I forget what it's called -- the layer 8 in
22 Kijima?

23 A. Yeah, layer 8 in Kijima is the
24 insulating sealing film, which is inorganic.

25 And yes, that would be one of the

1 layers that could be inkjet printed.

2 Q. Okay. You were also asked questions
3 about protection from radiant heat in the
4 Kijima grounds?

5 A. Yes.

6 Q. Okay. And what are the potential
7 concerns that could arise due to radiant heat
8 in the case where there's insufficient
9 protection?

10 A. So the specific issue that is
11 brought up by Kijima is during the evaporative
12 deposition of the insulating sealing film,
13 which is the last step in the process, the
14 radiant heat of that step could damage the OLED
15 stack.

16 And the conductive sealing film
17 provides a barrier to protect the OLED stack.

18 Q. Okay. Would that potential be --
19 would that concern be present in a scenario in
20 which inkjet were used to deposit the insulated
21 sealing film 8 in Kijima?

22 A. No, it would not, because the
23 specific issue regarding radiant heat exposure
24 is due to the use of evaporation, so the
25 apparatus of Figure 4.

1 If on the other hand we were to use
2 inkjet for the insulating sealing film, then
3 you don't have the issue with the radiant heat
4 from the evaporation source. So that would be
5 a nonissue.

6 MR. GARR: Okay. That completes my
7 questions at this time.

8

9 EXAMINATION BY

10 MS. ZHONG:

11 Q. Dr. Subramanian, for element 34[c],
12 you are not suggesting replacing Kijima's
13 evaporative process with inkjetting. Correct?

14 A. Sorry. I'm lost now.
15 For claim 34.

16 Q. 34[c], for example.
17 You only mentioned the evaporative
18 process and you didn't mention inkjetting in
19 that analysis. Correct?

20 A. (Reviewing document.)
21 So with respect to my analysis for
22 element 34[c] with respect to Ground I, that is
23 based on Kijima in view of Suzuki, so I'm not
24 referring to inkjet there.

25 Q. Okay. And for Ground No. II, I

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1 think we have agreed that Sturm does not
2 mention using inkjet for encapsulation layers
3 or barrier layers. Correct?

4 A. Putting aside the -- but if you're
5 referring to inkjet -- to encapsulation layers
6 that go over the device as an OLED, yes, I
7 agree.

8 Q. Okay. And you are not suggesting
9 using inkjetting for putting down the gold
10 sealing layer, are you?

11 A. Well, actually, I mean, inkjetted
12 gold exists. It has existed for decades. It
13 could be used for that.

14 That's unrelated to Claim 35 of
15 Ground II, because Claim 35 of Ground II is
16 specifically about the planarization layer.

17 But having said that, as I pointed
18 out in Paragraph 107 of my declaration, you
19 could just as well use it for other layers as
20 well. And that does include the conductive
21 sealing film.

22 Inkjet printed gold has existed for
23 decades.

24 Q. Okay. You did not specifically
25 state using inkjetting for conductive sealing

1 film in Paragraph 107. Correct?

2 A. Those words didn't appear.

3 But I did say very clearly: "As
4 well as the other patterned elements in
5 Kijima's organic EL element 31."

6 And that does include the conductive
7 sealing film because that is very much a
8 patterned element in Kijima's organic EL
9 element 31.

10 Q. Did you speak with counsel during
11 the break?

12 A. Yes.

13 Q. Did you speak with counsel
14 specifically about the redirect questions?

15 A. At a high level, yes.

16 Q. Did you speak with counsel regarding
17 the substance of your deposition in general?

18 A. No.

19 MR. GARR: Could I just -- oh,
20 sorry.

21 Yeah, I just wanted to know what
22 break you're referring to.

23 MS. ZHONG: Any of the breaks.

24 THE WITNESS: Oh, no.

25 So the only break -- in my previous

1 answers, my answers were specifically in
2 relation to this last break after the end of
3 your questioning and before the start of
4 redirect.

5 MS. ZHONG: Okay.

6 I don't have any further questions,
7 and I think this concludes today's deposition.

8 MR. GARR: Thank you.

9 THE WITNESS: Thank you.

10 (Deposition adjourned at 4:37 p.m.)

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CERTIFICATE

I, Stacey L. Daywalt, a Notary Public of the District of Columbia, do hereby certify that the within-named witness remotely appeared before me at the time and place herein set out, and after having been duly sworn by me, according to law, was examined by Counsel.

I further certify that the examination was recorded stenographically by me and this transcript is a true record of the proceedings.

I further certify that I am not of counsel to any of the parties, nor an employee of counsel, nor related to any of the parties, nor in any way interested in the outcome of this action.

As witness my hand and Notarial Seal this 6th day of June, 2025.



Stacey L. Daywalt, Notary Public
My Commission Expires: 4/14/2026

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ACKNOWLEDGMENT OF DEPONENT

I, VIVEK SUBRAMANIAN, PH.D., do hereby
certify that I have read the foregoing pages 1
to 224 and that the same is a correct
transcription of the answers given by me to the
questions therein propounded, except for the
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SIGNATURE

Subscribed and sworn to before me
this _____ day of _____, 2025.

My commission expires:

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[affect - apply]

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[apply - barrier]

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[barrier - buckles]

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