

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

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4 SAMSUNG DISPLAY CO., LTD.,
5 Petitioner,
6 v.

7 PICTIVA DISPLAYS INTERNATIONAL, LTD.,
8 Patent Owner.
9 -----

10 Case No. IPR2024-01093
11 U.S. Patent 8,723,164
12 -----

13 CORRECTED TRANSCRIPT
14 REMOTE DEPOSITION OF
15 RUSSELL HOLMES
16 Friday, September 12, 2025
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24 Reported By: Lynne M. Ledanois, CSR 6811
25 Job No. 7567678

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U.S. Patent 8,723,164

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14 Videotaped deposition of RUSSELL HOLMES,
15 Ph.D., taken in Chanhassen, Minnesota, commencing at
16 7:01 a.m. Pacific Time, on Friday, September 12,
17 2025 before Lynne Ledanois, Licensed and Certified
18 Stenographic Shorthand Reporter No. 6811
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A P P E A R A N C E S:

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I N D E X O F E X H I B I T S

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1 Friday, September 12, 2025

2 7:01 a.m. Pacific Time

3
4 RUSSELL HOLMES,

5 having been duly sworn, testified as follows:
6

7
8 EXAMINATION

9 BY MR. LINDSAY:

10 Q Dr. Holmes, would you please state your
11 full name for the record?

12 A Sure. My name is Russell Holmes.

13 Q Is it okay if I refer to you as
14 Dr. Holmes?

15 A That's fine.

16 Q Is it your understanding that this
17 deposition today is in connection with IPR
18 2024-01093?

19 A That's correct.

20 Q And that proceeding relates to U.S. Patent
21 Number 8,723,164; is that --

22 A That's correct.

23 Q If I say the '164 patent, you'll
24 understand that I refer to U.S. Patent 8,723,164?

25 A That's fine as well.

Page 6

1 Q And if I refer to this proceeding, you'll
2 know that I mean this IPR that relates to the '164
3 patent?

4 A Yes, that's also fine.

5 Q Okay. In April of 2025, you submitted a
6 declaration in connection with this proceeding, the
7 '164 IPR; is that correct?

8 A Yes, that's correct.

9 Q And that was assigned Exhibit Number 1003;
10 is that right?

11 A Yes, that looks correct, yes.

12 Q I previously introduced that exhibit.
13 Can you confirm that the exhibit that I
14 introduced as 1003 is, in fact, your declaration
15 that you submitted in April of 2025?

16 A Sure, let me just quickly scan the document
17 that you uploaded.

18 Yes, this looks like my original
19 declaration.

20 Q So it's okay if we refer to that also as
21 your original declaration?

22 A That's fine with me.

23 Q Okay. And then last month you submitted a
24 second declaration in connection with the same IPR,
25 the '164 IPR; is that right?

1 A That's correct.

2 Q And that was assigned Exhibit 1044?

3 A Yes, that's correct.

4 Q I previously introduced that as
5 Exhibit 1044, same number. Can you open that and
6 confirm that's your second declaration?

7 A Sure. Let me scan through this.

8 Yes, this looks like my reply declaration.

9 Q Okay. If we refer to that, as you just
10 said, as your reply declaration, we'll be referring
11 to Exhibit 1044; is that okay?

12 A That's fine.

13 Q Dr. Holmes, why did you submit your reply
14 declaration, Exhibit 1044?

15 A So I submitted my reply declaration to
16 respond to specific questions raised by Dr. Sims
17 regarding my original declaration.

18 Q And what do you mean by questions that
19 Dr. Sims raised?

20 A Dr. Sims presumably looked at my initial
21 declaration and had their own opinions regarding the
22 grounds that I used in my original declaration. And
23 so my reply declaration was responding to Dr. Sims's
24 opinions and outlining why I don't agree with them.

25 Q Okay. So when you say questions that he

1 raised, are you referring to the opinions that he
2 raised which you disagree with?

3 A Yes, I'm referring specifically to
4 Dr. Sims's own declaration in this proceeding.

5 Q You also introduced several new exhibits
6 with your reply declarations; right?

7 A I do. Are there any in particular that
8 you're referring to?

9 Q Well, I guess by my count, there's about
10 12 new articles and technical publications that span
11 from Exhibit 1031 to 1042.

12 A Yes, that's correct.

13 Q Were you aware of any of those exhibits
14 when you submitted your original declaration?

15 A I may have been aware of some of those
16 exhibits just from my own research when I submitted my
17 own declaration, first declaration.

18 Q You don't remember any specifically that
19 you were aware of?

20 A It would be challenging for me to -- again,
21 since I read a lot of papers obviously in my line of
22 work, it would probably be challenging for me to know
23 exactly which ones I had thought about recently at the
24 time of my own declaration, my first declaration.

25 But certainly several of these exhibits

1 are ones that I am quite familiar with from my own
2 work.

3 Q I'm going to introduce an exhibit.

4 I introduced Exhibit 1033. Let me know
5 when you see that.

6 A Yes, I see it. I'm just going to download
7 it. Okay.

8 Q Were you aware of Exhibit 1033, the Li
9 article?

10 A Again, I don't know if that's one I had read
11 before. It's not one I had thought about during my
12 initial declaration necessarily.

13 But it's quite possible I came across this
14 paper previously, given my own research.

15 Q Okay. I introduced another exhibit, 1039,
16 Chang. Let me know when you see that and have it
17 downloaded and opened.

18 A Okay. I have it ready.

19 Q Dr. Holmes, were you aware of
20 Exhibit 1039, the Chang reference, at the time you
21 submitted your original declaration?

22 A I was certainly familiar with this approach
23 to introducing emitters into polymers. Again, whether
24 it was this paper or prior papers I'd encountered, but
25 I was familiar with this approach.

1 Q So you were familiar with the work that's
2 described in Exhibit 1039?

3 MR. BYUN: Objection, form.

4 THE WITNESS: Again, I was familiar with
5 the approach of introducing dopants into a polymer
6 via this transfer process.

7 BY MR. LINDSAY:

8 Q Is Exhibit 1039 then supportive of at
9 least some of the opinions in your original
10 declaration?

11 MR. BYUN: Objection, form.

12 THE WITNESS: This exhibit certainly
13 supports the prior utilization of created emitter
14 profiles in solution-processed OLEDs.

15 BY MR. LINDSAY:

16 Q So, again, is that a yes, this is
17 supportive of at least some of your opinions in your
18 original declaration?

19 MR. BYUN: Objection, form.

20 THE WITNESS: Again, in my original
21 declaration, I took the position that it would have
22 been obvious to integrate gradients into both vapor
23 and solution-processed OLEDs, and so this would be
24 consistent with that opinion.

25 (Reporter clarification.)

1 THE WITNESS: Gradients into solution and
2 vapor-processed OLEDs I think is what I said.

3 BY MR. LINDSAY:

4 Q So, Dr. Holmes, you were aware of the
5 approach that Chang describes in Exhibit 1039 and
6 you agree it was supportive of some of your original
7 opinions.

8 Why did you not cite to Exhibit 1039 in
9 your original declaration?

10 MR. BYUN: Objection, form.

11 THE WITNESS: So I'll just first note that
12 I was familiar with the process to use thermal
13 transfer as a means to introduce emitters into a
14 polymer film, which is the process being utilized
15 here to form a gradient.

16 Again, I don't recall if I had recently
17 looked at this paper. But in my opinion, the case
18 for my initial opinion in the declaration was strong
19 enough without having to utilize this paper.

20 I reference this paper in my reply only to
21 respond to Dr. Sims's comment that
22 solution-processed devices would somehow be excluded
23 from created emitter profiles.

24 MR. LINDSAY: Let me introduce another
25 exhibit. Let me know when you have it. It's going

1 to be 1040.

2 THE WITNESS: Okay. I have it open.

3 BY MR. LINDSAY:

4 Q Dr. Holmes, were you aware of this
5 reference, Exhibit 1040, at the time you submitted
6 your original declaration?

7 A So this paper, again, is similar work and I
8 think even similar authorship to the one we just
9 discussed.

10 So as I already noted, I was familiar with
11 this approach. Whether I was specifically thinking
12 of this paper or familiar with this paper, that I
13 can't recall.

14 Q So like Exhibit 1039, is it fair to say
15 that Exhibit 1040 is supportive of at least some of
16 your original opinions?

17 MR. BYUN: Objection, form.

18 THE WITNESS: So, again, Exhibit 1040 and
19 1039 are consistent with my initial opinion, which
20 is that whether by solution processing or vapor
21 processing, a POSITA would have thought it obvious
22 to apply a gradient to the device in Choulis.

23 So certainly it's supportive of my initial
24 opinion, but it was included in response to
25 Dr. Sims.

1 BY MR. LINDSAY:

2 Q What is the difference between fluorescent
3 emission material and phosphorescent emission
4 material?

5 A So the difference between fluorescent and
6 phosphorescent emitters is based on what the actual
7 excited state is that does the light emission.

8 And so when an organic semiconductor is
9 electrically excited, there's two different types of
10 excitons formed, which are molecular excited states,
11 either singlet --

12 (Reporter clarification.)

13 THE WITNESS: Which are formed, I think.
14 They can either be a singlet exciton or a triplet
15 exciton.

16 In fluorescent materials, the light
17 emission comes from the recombination of singlet
18 excitons. In phosphorescent materials, the light
19 emission comes from the recombination of triplet
20 excitons.

21 BY MR. LINDSAY:

22 Q I'm sorry, I was looking at the realtime.
23 Can I ask you: For phosphorescent
24 emitters, is light emission from both singlet and
25 triplet excitons or only triplet excitons?

1 A Usually a phosphorescent emitter will emit
2 from the triplet state if it's been designed
3 correctly. So in, you know, a commercial OLED that
4 uses phosphorescent, the emission is from the triplet
5 state.

6 But certainly there might be instances
7 where perhaps a not yet optimized phosphorescent
8 emitter might emit predominantly from the triplet.
9 Maybe there is a little bit of singlet emission
10 left, but a good optimized phosphorescent emitter
11 will emit from the triplet state, yes.

12 Q Is one of these emitter types more
13 difficult to work with than the other?

14 MR. BYUN: Objection, form.

15 THE WITNESS: So can you just clarify
16 "difficult," what you mean specifically by that?
17 BY MR. LINDSAY:

18 Q Fluorescent or phosphorescent emitters,
19 are they more sensitive than the other?

20 MR. BYUN: Objection, form.

21 THE WITNESS: I guess the -- I just want
22 to make sure first I understand the question. So is
23 there a particular part of my reply that you're
24 pointing to with this question just to make sure I
25 can be specific in how I answer?

1 BY MR. LINDSAY:

2 Q Not yet. Just generally speaking, what
3 would be your understanding?

4 A No, I don't think necessarily there's a
5 difficulty in working with one material or the other.

6 Phosphorescent materials can realize much
7 higher efficiencies. Phosphorescent materials have
8 been widely commercialized and fluorescent materials
9 have also been commercialized to a lesser extent.

10 And so I think there's strong evidence
11 that suggests one can work with both of them. In
12 fact, frequently, there's similar aspects of
13 architecture and even similar materials used with
14 both of them.

15 So I wouldn't necessarily say one is more
16 difficult than the other.

17 Q How about sensitive, is one more sensitive
18 than the other?

19 A So, again, sensitive to what in particular?

20 Q Let's say sensitive to quenching, for
21 example.

22 A So, again, I didn't consider sensitivity to
23 quenching in my declaration or reply declaration for
24 either of these materials.

25 And just to make sure I'm answering

1 correctly, quenching by what?

2 Q Well, in your experience, what would be
3 some of the reasons why quenching would occur?

4 MR. BYUN: Objection to form.

5 THE WITNESS: So I'll just define
6 "quenching" because that's a fairly broad term.

7 In the context of OLEDs, quenching has
8 been most widely discussed when looking at the
9 efficiency of OLEDs under high current injection.
10 So organic LEDs frequently show reduced efficiency
11 under high current injection.

12 In fluorescent materials and
13 phosphorescent materials, that quenching might come
14 from different factors just because of the
15 difference in the exciton that's emitting light.

16 So in a fluorescent OLED, the quenching
17 might come from interactions between singlets and
18 triplets or singlets and charge carriers. In
19 phosphorescent devices, the quenching might come
20 from interactions of triplets with each other or
21 triplets and polarons.

22 Again, the quenching can be different in
23 terms of what governs the efficiency versus current
24 density.

25 But I wouldn't say there's any sort of

1 significant change in how one would at address the
2 materials. There's good strategies to minimize
3 efficiency loss under high injection and that's
4 evidenced by the fact that these are all widely
5 commercialized devices.

6 So clearly one can realize high efficiency
7 without worrying about things like bimolecular
8 quenching, which is what I'm describing.

9 BY MR. LINDSAY:

10 Q What would cause something like
11 bimolecular quenching?

12 MR. BYUN: Objection, form.

13 THE WITNESS: So, again, bimolecular
14 quenching is a situation where -- so let's take the
15 case of a fluorescent device. You might be
16 electrically exciting the device and creating a
17 large number of excitons.

18 And what can happen is if you have two
19 adjacent molecules that both have an exciton on
20 them, one molecule can transfer its energy to the
21 other, which basically puts now a very large amount
22 of energy on a molecule and that excess energy can
23 be just dissipated as heat.

24 So that's a bimolecular quenching process
25 in that you have two excitons that go into the

1 process but only one comes out, so you've got loss.

2 And that's why frequently when you're
3 running a OLED under high injection, you'll see
4 efficiency fall with current density because you
5 might have these sorts of bimolecular quenching
6 processes that are present.

7 The one I just described would be an
8 excitonic-excitonic bimolecular quenching process.

9 BY MR. LINDSAY:

10 Q And that would be of the singlet or
11 triplet state or both?

12 MR. BYUN: Objection to form.

13 THE WITNESS: In a fluorescent device,
14 again, as I said earlier, it could be between a
15 singlet and a polaron, it could be between a singlet
16 and a triplet.

17 There is even evidence from the
18 single-crystal literature where it might be a
19 singlet with itself, singlet-singlet interaction.
20 So it could be a variety of processes.

21 (Reporter clarification.)

22 THE WITNESS: Singlet and polaron,
23 P-O-L-A-R-O-N.

24 BY MR. LINDSAY:

25 Q Dr. Holmes, you mentioned heat a moment

1 ago.

2 Is it fair to say then that heat is one of
3 the causes or potential causes of quenching?

4 MR. BYUN: Objection, form.

5 THE WITNESS: No. So the quenching I'm
6 referring to is, again, a bimolecular quenching when
7 you have an interaction of an exciton and another
8 exciton, or an exciton and a polaron.

9 And the way to think about these quenching
10 processes is, again, if you imagine two molecules
11 that are sitting next each other and let's say they
12 both have an exciton on them, what can happen is
13 that one molecule can transfer its energy to an
14 already excited molecule.

15 So you now have basically like two
16 excitons worth of energy on a molecule. And what
17 happens is the molecule dissipates all that excess
18 energy as heat, leaving you with just one exciton.

19 And so the way to think about it is you
20 have two excitons going in, you put all of that
21 energy now in one molecule, that excess energy is
22 released just as heat in the material and you're
23 left with just one exciton.

24 So it's a quenching process because you're
25 going from two excitons to one exciton with that

1 excess energy wasted as heat and so it reduces the
2 efficiency of the device. So that's the quenching
3 process.

4 The heat is a byproduct. It's not a --
5 it's not the quenching -- the quenching is the two
6 particles interacting and then losing the energy as
7 heat. Rather than having two excitons that can emit
8 light, you now only have one.

9 BY MR. LINDSAY:

10 Q Okay. Understood.

11 So backing up a second, maybe we can
12 address the manufacturing process.

13 A Okay.

14 Q Can decomposition, for example, that
15 occurs during evaporative processing during
16 manufacturing, can that cause quenching?

17 MR. BYUN: Objection, form.

18 THE WITNESS: I haven't considered
19 questions of manufacturability and decomposition in
20 the context of my declaration or reply declaration.

21 So is there a particular place you want to
22 point me just so I make sure I understand the
23 context of your question?

24 BY MR. LINDSAY:

25 Q Yes. We'll look at your declaration. I

1 want to kind of get a baseline of what your
2 understanding is about the causes of quenching and
3 then we can be more specific.

4 What I'm referring to basically is a
5 manufacturing process, that heat created during
6 evaporation, for example, would you agree that
7 occurs?

8 MR. BYUN: Objection, form, outside the
9 scope.

10 Counsel, I think I've given you a lot of
11 leeway but we're getting away from any relevant
12 opinions that was expressed in Dr. Holmes's reply
13 declaration, which is the subject of today's
14 deposition.

15 MR. LINDSAY: Objection noted.

16 Q Dr. Holmes, can you answer the question,
17 please?

18 A So your question is, is there heat generated
19 during a typical deposition process?

20 Q Yes. Evaporative deposition process.

21 MR. BYUN: Same objection.

22 THE WITNESS: During evaporative
23 deposition, a solid powder material is heated to its
24 sublimation point and then it transfers from the
25 solid phase to the vapor phase, so there's

1 intrinsically some heating involved.

2 BY MR. LINDSAY:

3 Q Is there decomposition that may occur of,
4 say, the host film during that process?

5 MR. BYUN: Objection, same objection.

6 THE WITNESS: So I'm just going to answer
7 that in the way I think I understand the question.

8 The material itself should not decompose.
9 So the way to think about it is that you have a
10 solid powder where the granules, if you like, of the
11 powder are just basically loosely-bound collections
12 of the target molecule.

13 And when you heat it up, those granules or
14 those solid particles of the target molecule are
15 just being volatilized to now the vapor phase of the
16 molecule.

17 And so generally when you're processing an
18 OLED, you don't want decomposition. In fact, that
19 would be not typically the goal.

20 Usually you're trying to vaporize the
21 molecule as a unit and then recondense it on a
22 substrate to form a film.

23 BY MR. LINDSAY:

24 Q So is it fair to say that a person of
25 ordinary skill in the art would then seek to avoid

1 using a host material that would decompose during
2 the manufacturing process?

3 MR. BYUN: Objection, outside the scope.

4 THE WITNESS: So I want to be very careful
5 because that's not what I said.

6 What I just said is that normally the
7 process involves volatilizing the molecule from the
8 solid to the vapor phase and having the molecule be
9 intact.

10 Whether there might be instances where a
11 particular device might want some sort of
12 decomposition or reaction, I'm not necessarily aware
13 of but such cases could exist.

14 But that's not something that I had to
15 consider in the context of this IPR.

16 BY MR. LINDSAY:

17 Q Fair enough. But just looking at the
18 realtime, you said a moment ago that generally when
19 you're processing an OLED, you don't want
20 decomposition?

21 A Hopefully what it says is generally when
22 you're processing an OLED, you don't want your source
23 to decompose into fragments out of the vapor phase per
24 se.

25 So when we're talking about an OLED,

1 usually your objective is to heat the solid material
2 and volatilize the molecule as a unit, right, not
3 necessarily break up the molecule. So usually you
4 would have the molecule be intact leaving the
5 source.

6 Q So you would want to avoid using a
7 material that would break down during heating, for
8 example?

9 MR. BYUN: Objection, form.

10 THE WITNESS: Again, there could be
11 instances where perhaps there might be other
12 constraints or other requirements that you're trying
13 to satisfy.

14 What I'm just saying is that usually
15 you're trying to realize a -- you're trying to
16 realize a molecule that's vaporized as the molecule.

17 BY MR. LINDSAY:

18 Q Under what conditions might you want to
19 use a molecule that does decompose during the
20 manufacturing process, during the evaporative
21 manufacturing process?

22 MR. BYUN: Objection, form, outside the
23 scope.

24 THE WITNESS: So, again, I cannot speak to
25 having complete knowledge over every process that's

1 available.

2 But, for example, if you had other
3 constraints perhaps related to the cost of
4 processing that material via other methods, maybe
5 the uniformity of processing that material via other
6 methods, availability of equipment to process the
7 material via other methods, you know, maybe there's
8 some unique chemistry that you're trying to realize.

9 I think there could be a variety of
10 reasons. What I'm just pointing out is that
11 normally when you have a small molecule source
12 material that's present as a powder, you heat it up,
13 you're generally going to have the molecule itself
14 be volatilized.

15 BY MR. LINDSAY:

16 Q You mentioned small molecule. What if you
17 were use using a large molecule host material like a
18 polymer?

19 A Mm-hmm.

20 MR. BYUN: Objection, form.

21 THE WITNESS: So that's clearly something
22 that I do discuss in my original declaration and
23 also discussed in my first deposition.

24 So an example there would be something
25 like PVK, at least in the context of these

1 proceedings.

2 And as I note in my original declaration,
3 the prior work on vaporizing a polymer like PVK
4 permits the realization of a film that still has
5 properties that resemble that of PVK while also
6 potentially unlocking some of the other advantages
7 that come with vapor processing over solution
8 processing.

9 And so this would be an example of what I
10 said earlier, which is there might be other
11 constraints that would compel someone to use vapor
12 processing where some decomposition might be --
13 might be present.

14 BY MR. LINDSAY:

15 Q So in that example, is it the case that --
16 that it's your understanding that PVK would
17 experience some decomposition during the evaporative
18 process?

19 MR. BYUN: Objection, form.

20 THE WITNESS: My understanding of what
21 happens to PVK during the evaporative process is
22 based on the work I cite by Djobo.

23 And what Djobo shows is that when they
24 evaporate PVK, they realize emission spectra from
25 the resulting film that are consistent with PVK and

1 some vinylcarbazole oligomers. And also, the film
2 retains its hole transporting properties which would
3 be also what PVK observes as well.

4 (Reporter clarification.)

5 THE WITNESS: Consistent with PVK and
6 vinylcarbazole oligomers and that the film retains
7 the properties of hole transport and light emission.

8 BY MR. LINDSAY:

9 Q So I think my question was a little
10 different. So I'll just ask, you know, again.

11 Is it your understanding that PVK would
12 experience some decomposition during the evaporative
13 process?

14 MR. BYUN: Objection to form.

15 THE WITNESS: So, again, as I noted, the
16 prior work would suggest that the spectrum is
17 consistent with a mixture of PVK and vinylcarbazole,
18 which would suggest there could be some degradation.

19 BY MR. LINDSAY:

20 Q When that decomposition or degradation
21 occurs, what is produced as a result of that
22 decomposition?

23 MR. BYUN: Objection, form.

24 THE WITNESS: So I think I answered that,
25 which is that Djobo looks at their emission spectrum

1 and the behavior of the OLED and notes that the
2 emission spectrum from the film is a combination of
3 PVK plus vinylcarbazole oligomers, which would
4 suggest that the composition of the film is PVK plus
5 vinylcarbazole oligomers.

6 Further -- they don't offer further
7 details on particular compositions beyond that
8 observation.

9 BY MR. LINDSAY:

10 Q So are you saying that there would be no
11 radicals that would be produced as a result of that
12 decomposition?

13 MR. BYUN: Objection to form.

14 THE WITNESS: That prior work doesn't
15 comment on any further details of composition.

16 And I haven't taken any further opinion on
17 the composition of that film.

18 BY MR. LINDSAY:

19 Q In your experience, when a polymer
20 decomposes into an oligomer, is there any
21 other radical that is created as a result of that
22 process?

23 MR. BYUN: Objection, form.

24 THE WITNESS: So in my experience, I
25 haven't looked at the question of radical formation

1 during heating of a polymer.

2 BY MR. LINDSAY:

3 Q Just generally speaking, you've -- what
4 would be your expectation? If a polymer was
5 decomposing into an oligomer, would there be some
6 additional we'll call it radical that would be
7 produced as a result of that?

8 MR. BYUN: Objection, form.

9 THE WITNESS: Again, as I just noted, my
10 experience is not in looking at those sorts of
11 questions and so I can't offer an opinion on what
12 the potential products would be of such a
13 hypothetical reaction.

14 BY MR. LINDSAY:

15 Q So in rendering your opinions regarding
16 Djobo and the use of PVK in an evaporative process,
17 is it fair to say that you didn't consider whether
18 any radicals would result as a result of that
19 process?

20 MR. BYUN: Objection, form.

21 THE WITNESS: So in looking at Djobo and
22 looking at Djobo from the perspective of a person
23 skilled in the art, the most important details that
24 are present in Djobo is that the emission spectrum
25 largely remains PVK and, as we've already discussed,

1 that the resulting film has hole transport
2 properties and that the layer can be used to make a
3 functioning OLED.

4 Further discussion of the specific
5 composition and whether or not there's radicals
6 formed would not impact whether or not a person
7 skilled in the art could combine what is taught in
8 Djobo -- or used and taught in Djobo as motivation
9 to apply PVK in an evaporative process.

10 BY MR. LINDSAY:

11 Q Understood. So let me just ask maybe
12 again.

13 Is it fair to say that you did not
14 consider whether any radicals would result from
15 evaporating PVK?

16 MR. BYUN: Objection, form.

17 THE WITNESS: I'll just answer in a
18 similar way, that when a person skilled in the art
19 who's building OLEDs and not looking at polymer
20 chemistry would look at Djobo and look for the
21 functional property output of the films, right, the
22 person skilled in the art would say, is this still a
23 material that emits light, does this material still
24 carry holes, can it still be applied in an OLED?

25 Whether or not radicals are formed along

1 the way is not something a person skilled in the art
2 would be concerned with in trying to make an OLED
3 that functions.

4 BY MR. LINDSAY:

5 Q Is it fair to say that a person skilled in
6 the art would not be concerned if he was building
7 Djobo's system, but he may be concerned if he was
8 building different system?

9 MR. BYUN: Objection, form.

10 THE WITNESS: I would have to know what
11 you mean by different system to be able to assess
12 the weight of these various questions.

13 BY MR. LINDSAY:

14 Q Does Djobo teach a person of ordinary
15 skill in the art that it is suitable to evaporate
16 PVK in every OLED system?

17 MR. BYUN: Objection, form.

18 THE WITNESS: So Djobo demonstrates that
19 PVK can be evaporated and applied in an OLED. I
20 don't know if I can generalize to every OLED system.

21 But a person skilled in the art would see
22 the use of PVK from an evaporative perspective in
23 Djobo and understand that this is a method that can
24 be applied to PVK to make an operational OLED.

25

1 BY MR. LINDSAY:

2 Q Does Djobo rely on a phosphorescent
3 emitter?

4 A Djobo does not rely on a phosphorescent
5 emitter.

6 Q What is the emitter that Djobo relies on?
7 MR. BYUN: Objection, form.

8 THE WITNESS: So I want to make sure I
9 answer accurately and so I'm going to go open Djobo.
10 Is it possible for you to include that in
11 the marked exhibit folder?

12 MR. LINDSAY: I just introduced
13 Exhibit 1023. It will take a moment to populate.

14 THE WITNESS: I'm going to quickly review
15 it.

16 So Djobo demonstrates electroluminescence
17 from two different devices, one that's based on an
18 emitter layer of just PVK and the other that's based
19 on an emitter layer of presumably Alq3.

20 BY MR. LINDSAY:

21 Q What type of emitter is Alq3?

22 A Alq3 is a fluorescent light-emitting
23 material.

24 Q So a moment ago we just discussed the fact
25 that fluorescent-emitting materials emit singlet

1 energy only, not triplet energy; is that right?

2 A Fluorescence comes from the recombination of
3 singlet excitons.

4 Q So Djobo would not be concerned with
5 conditions that might quench triplet energy. Is
6 that fair?

7 A I guess I'm not sure -- can you be more
8 specific about conditions that might quench triplet
9 energy? I just want to make sure I understand what
10 you're referring to there.

11 Q So the emitters that Djobo utilizes,
12 whether PVK or Alq3, do not emit light using triplet
13 energy; is that correct?

14 A That's correct, the triplets are not
15 emitting in PVK or Alq3.

16 Q So if there was a manufacturing or
17 operating condition which quenched triplet excitons,
18 that would not concern Djobo; is that fair?

19 MR. BYUN: Objection, form.

20 THE WITNESS: So certainly the triplets in
21 Djobo not being emissive would make them less of
22 a -- less of a concern.

23 BY MR. LINDSAY:

24 Q I mean, there would be a zero concern;
25 right?

1 MR. BYUN: Objection, form.

2 THE WITNESS: The only reason I hedge to
3 say zero is because there are some instances where
4 fluorescent devices can regenerate singlets from two
5 triplets interacting.

6 And so, for example, a commercial blue
7 OLED right now will often utilize the fact that when
8 two triplets interact, they can form a singlet.

9 So I am a little hesitant to say that, you
10 know, that triplets are completely written off. But
11 I agree they aren't emitting.

12 BY MR. LINDSAY:

13 Q Okay. That's fair. Maybe I'll ask it in
14 an easier fashion.

15 A person skilled in the art seeking to
16 build Djobo's OLED system would not have a material
17 concern with whether there was a manufacturing or
18 operating process that quenched triplet energy?

19 MR. BYUN: Objection, form.

20 THE WITNESS: So for PVK and for Alq3,
21 since those are the materials considered in Djobo,
22 those are materials that are fluorescent and emit
23 exclusively from the singlet, so in those systems, a
24 triplet quenching mechanism would not impact the
25 efficiency presumably.

1 BY MR. LINDSAY:

2 Q And if Djobo modified his system to
3 include a phosphorescent emitter instead, would
4 Djobo then be concerned with any manufacturing or
5 operating condition that might quench triplet
6 energy?

7 MR. BYUN: Objection, form.

8 THE WITNESS: So from the data in Djobo,
9 which is what I'm relying on, and based on the time
10 period where Djobo was published, which is still
11 very early in the development of phosphorescence,
12 it's not -- it's not possible to know what their
13 mindset was, what they might be concerned with or
14 what they wouldn't be concerned with.

15 What my perspective is and my opinion is
16 is that a person skilled in the art seeing Djobo and
17 seeing the ability to construct vapor processed
18 OLEDs using PVK in Djobo would be motivated to try a
19 similar process in the context of, say, Choulis.

20 Whether that leads to defects or loss
21 processes that somehow challenge the ability to get
22 the highest efficiency OLED would be unknown
23 a priori.

24 But that's not the kind of question that
25 would stop a person skilled in the art from trying

1 to make the combination and build the OLED.

2 So at this period in the development of
3 OLEDs, there were all kinds of new devices and
4 materials emerging and frequently people -- a person
5 skilled in the art would take those new
6 developments, try to apply them to their own work
7 and then look at what the efficiency was.

8 So it's hard to say from Djobo whether
9 there are or aren't the sorts of triplet quenching
10 sites that you're describing, but I don't see
11 anything in Djobo that would suggest to a person
12 skilled in the art that this method won't work with
13 triplet emitters.

14 I think there would be motivation to try
15 it and expect that the device would work.

16 Whether or not it's the peak efficiency,
17 that's a question of optimization and the next level
18 of device development.

19 BY MR. LINDSAY:

20 Q If a person of ordinary skill in the art
21 began with a system which used a phosphorescent
22 emitter, does Djobo inform that person of ordinary
23 skill in the art as to whether his system would work
24 with a phosphorescent emitter?

25 MR. BYUN: Objection to form.

1 THE WITNESS: So, again, I just want to
2 make sure I'm clear. When you say his system, can
3 you be specific on what aspect of Djobo? Just the
4 vapor processing of PVK or is there a particular
5 device structure?

6 BY MR. LINDSAY:

7 Q Let's start with just the evaporation of
8 PVK.

9 A So I think that looking at Djobo and the
10 fact that Djobo reports the spectrum is still a blue
11 emitting spectrum that Djobo ascribes to a combination
12 of PVK and the vinylcarbazole oligomers would be
13 important for a person skilled in the art because they
14 would understand that you haven't formed largely small
15 fragments.

16 The fact that you're still seeing that
17 blue emission means that you do have, you know,
18 essentially a wider energy gap material that's a
19 blue material like PVK in the film.

20 And I think that would give a person
21 skilled in the art confidence that they could then
22 incorporate a fluorescent or a phosphorescent
23 emitter into that material and try to build their
24 device accordingly.

25 Q Does Djobo contain any teaching that would

1 suggest that the evaporative process of PVK is not
2 producing radicals which might otherwise quench the
3 triplet excitons of a phosphorescent emitter?

4 MR. BYUN: Objection, form.

5 THE WITNESS: So, again, the question of
6 radicals, I'm actually going to go back and look at
7 Djobo because I don't think they discuss
8 specifically that point. But I'm going to take a
9 moment and just refresh my memory on Djobo.

10 So reaffirming what I said before, again,
11 Djobo does not talk about radical formation in their
12 discussion.

13 And so Djobo talks about the fact that the
14 optical spectra suggest, again, a mixture of PVK and
15 vinylcarbazole oligomers in the film and
16 specifically say there is a decrease in chain
17 length. But there is no discussion of radicals or
18 reactive species.

19 And so I don't think a person skilled in
20 the art reading Djobo would interpret it in the way
21 you're describing, that there are formation of
22 radicals that would somehow quench triplets or
23 interact with triplets and not interact with
24 singlets, for example.

25 So I don't see it that way and I don't

1 think a person skilled in the art would see it that
2 way. I think they would see the spectrum in the
3 discussion of Djobo and interpret it as it's
4 written.

5 BY MR. LINDSAY:

6 Q A moment ago we talked about the fact that
7 Djobo wouldn't be concerned with any operating or
8 manufacturing condition that would quench triplet
9 excitons because it was using a fluorescent emitter,
10 so doesn't it make sense that he wouldn't talk about
11 any radicals that would otherwise quench triplet
12 energy?

13 A So, again --

14 MR. BYUN: Objection, form.

15 THE WITNESS: I'll just first note that
16 again, the question of radicals is not discussed in
17 Djobo and is not something I've discussed in my
18 declaration or reply declaration.

19 But if there were radicals present, I
20 don't see why they would be specific to quenching
21 triplet energy. In fact, if there's radicals
22 present, they could quench all sorts of
23 luminescence, they could even just cause chemical
24 reactions in the film.

25 So, again, I don't think there is an

1 instance where one would say that if you have
2 radicals in the layer, it would be acceptable if you
3 have a fluorescent emitter but not if you have a
4 phosphorescent emitter.

5 But unless there is a certain type of
6 radical perhaps that you have in mind, but this is
7 not something that I considered in the context of
8 this proceeding.

9 BY MR. LINDSAY:

10 Q Are you aware of any manufacturing or
11 operating conditions that quench triplet excitons
12 but not singlet excitons?

13 MR. BYUN: Objection, form.

14 THE WITNESS: So again, I'll -- in terms
15 of manufacturing and operating conditions, the way I
16 normally think of quenching would be, okay, if there
17 is a molecule or another state in the system that
18 energetically can interact with the exciton in
19 question.

20 So if there is an exciton that has
21 particular energy and another molecule that might be
22 a quencher has an appropriate energy to quench it,
23 then the quenching might occur.

24 But, you know, I haven't thought
25 exhaustively about what the various species might be

1 for a given fluorescent or phosphorescent materials
2 that would quench one and not the other.

3 BY MR. LINDSAY:

4 Q I mean, it's fair to say that, as you
5 said, the presence of a certain type of molecule
6 might quench a triplet exciton but not a singlet
7 exciton?

8 MR. BYUN: Objection, form.

9 THE WITNESS: So, again, as I noted,
10 singlets and triplets have different energy. And so
11 it depends on the energetic overlap of the singlet
12 and triplet of a given molecule with a potential
13 quenching site.

14 But, again, the specifics of that all
15 depend on the specific molecules that are in
16 question and what the quenching process is.

17 And even just the term "quenching," as I
18 talked about earlier, can mean a variety of things.
19 The context in which I described it was the
20 bimolecular quenching that's most responsible for
21 efficiency roll-off.

22 But I think there needs to be more
23 specificity of what is meant by quenching in this
24 context to go much further.

25

1 BY MR. LINDSAY:

2 Q Quenching which impacts efficiency is what
3 I'm referring to. And the degree of that, you know,
4 obviously depends on the degree of quenching.

5 I don't think my question was all that
6 complicated.

7 I was just asking if the presence of
8 certain types of molecules would be -- because they
9 match the energy level, would be more inclined to
10 quench a triplet exciton and not affect or impact
11 the efficiency of a singlet exciton?

12 MR. BYUN: Objection to form.

13 THE WITNESS: So two answers to that. I
14 think, first, you're talking about specifically
15 radicals and what I had answered was that I'm not
16 sure I can think of a situation where having a
17 radical is going to be a negative in the device for
18 triplets but not for singlets or just the basic
19 chemistry of the molecule.

20 But regarding your question that you're
21 just asking now or clarifying now, yes, of course,
22 if I have a molecule with a particular singlet and
23 triplet levels and an adjacent molecule has a
24 triplet level that's lower in energy but a singlet
25 level that's higher in energy, then it would quench

1 the triplet but not quench the singlet.

2 What I noted earlier is that it depends on
3 the energetic alignment between the material in
4 question and the potential quencher in question.

5 BY MR. LINDSAY:

6 Q Okay. I'm asking because -- I want to go
7 back to Djobo then.

8 A Sure.

9 Q Djobo uses a fluorescent emitter, as we've
10 established; right?

11 A Yes.

12 Q So a person of ordinary skill in the art
13 looking to practice Djobo to build his system is not
14 going to be materially concerned with the presence
15 of molecules that impact only the triplet state.

16 Is that fair?

17 MR. BYUN: Objection to form.

18 THE WITNESS: So, again, Djobo doesn't
19 talk about any molecules or degradation products
20 that would materially impact only the triplet state.
21 There is no specific discussion to the level that
22 you're describing.

23 So as I've said, Alq and PVK being
24 fluorescent materials would not be impacted by
25 quenchers that would specifically act on the

1 triplet. But Djobo isn't bringing such issues to
2 bear.

3 Djobo is merely showing that PVK, when
4 evaporated, remains a hole transporter that has a
5 gap in the blue part of the spectrum.

6 And I'm pointing out that that's what a
7 person skilled in the art would look at when
8 deciding whether or not to try this in their own
9 system.

10 BY MR. LINDSAY:

11 Q I guess what I'm asking is: Djobo didn't
12 design his system with Choulis in mind; is that
13 fair?

14 A Yes, that's fair.

15 Q And Djobo is not aware of whether Choulis
16 might otherwise have molecules that would impact the
17 triplet state because it wasn't using a
18 phosphorescent emitter?

19 MR. BYUN: Objection, form.

20 THE WITNESS: Djobo is not considering a
21 phosphorescent emitter in their work and of course
22 is not aware of Choulis's materials.

23 MR. LINDSAY: We've been going about an
24 hour. Now is maybe a good time for a break.

25 (Recess taken.)

1 BY MR. LINDSAY:

2 Q Dr. Holmes, are you aware of anyone who
3 used evaporated PVK to make a phosphorescent OLED
4 prior to the '164 patent?

5 A I'm not aware of a work that uses evaporated
6 PVK in a phosphorescent OLED.

7 Q Are you aware of anyone who used
8 evaporated PVK to make a phosphorescent OLED after
9 the '164 patent?

10 MR. BYUN: Objection, form.

11 THE WITNESS: Again, not off the top of my
12 head, I'm not aware of a paper since then that have
13 applied PVK in a phosphorescent OLED.

14 BY MR. LINDSAY:

15 Q And that's even today?

16 A Yes, since then, yes.

17 Q Okay. If you could pull up your
18 declaration -- your reply declaration, 1044, please.

19 A Okay.

20 Q I want to look at Paragraph 7.

21 And the last sentence of Paragraph 7, can
22 you read that for me?

23 A Sure. I want to read the full paragraph
24 first.

25 Yes, I can read that for you.

1 "The term 'matrix' in 'matrix material'
2 signifies that the material is part of the same
3 matrix."

4 Q What do you mean by "part of the same
5 matrix"?

6 A So in considering that a functional layer in
7 the device is formed by a matrix, that matrix can
8 consist of the materials -- various matrix materials
9 and other materials in the functional layer.

10 Q So you're saying the term "matrix" in
11 "matrix material" means that the materials form part
12 of the matrix?

13 MR. BYUN: Objection, form.

14 THE WITNESS: So I just want to make sure
15 I heard that correctly. Can you just state it
16 again?

17 BY MR. LINDSAY:

18 Q Sure.

19 So are you saying that the term "matrix"
20 in the term "matrix materials" means that those
21 materials form part of the matrix?

22 A So the term "matrix" in "matrix material"
23 means that that material is a component of the matrix.

24 Q Right. So I guess that's what I'm trying
25 to figure out.

1 What do you mean by a component of the
2 matrix?

3 A That it forms part of the matrix. That it's
4 a component of the matrix, part of the matrix, yes.

5 Q Okay. Maybe we'll come back to that.
6 Let's go to Paragraph 11, if you could.

7 A Okay.

8 Q Here you say, "the term 'matrix material'
9 does not possess a consistent, widely accepted
10 definition within the OLED field."

11 Do you see that?

12 A I do.

13 Q So in your experience, when you run across
14 a claim term that doesn't have a widely accepted
15 definition, how do you typically go about figuring
16 out what that claim term means?

17 MR. BYUN: Objection, form.

18 THE WITNESS: So in this context
19 especially, what I'm informed by is what is in the
20 patent itself, what's in the '164.

21 And in the context of the '164, matrix
22 material comes with additional constraints on, say,
23 for example, the HOMO and LUMO of the various matrix
24 materials in question and so I'm informed by that,
25 by the text in the patent and the text in the

1 claims.

2 BY MR. LINDSAY:

3 So let me unpack that if we could.

4 A Mm-hmm.

5 Q So the specification talks about matrix
6 materials and the specification talks about
7 characteristics of embodiments of the matrix
8 materials; is that right?

9 MR. BYUN: Objection, form.

10 THE WITNESS: Yes, the specification talks
11 about matrix materials and some of the
12 characteristics. But then the claims are also very
13 clear in terms of what especially energetic
14 alignment is required for the various matrix
15 materials.

16 BY MR. LINDSAY:

17 Q Right. We will get to the claims.

18 So a moment ago, if I understood you
19 right, you said when you encounter a claim term that
20 doesn't have a widely accepted definition, you
21 particularly look to the specification?

22 MR. BYUN: Objection, form.

23 THE WITNESS: I think what I said is I
24 look to the patent as a whole. So, again, that
25 includes the claims as well.

1 BY MR. LINDSAY:

2 Q Okay. And what do you -- when you look at
3 the specification -- let's just start with the
4 specification.

5 When you look at the specification and you
6 encounter a term -- I want to be general here.
7 We'll come back to matrix materials.

8 When you encounter a term that doesn't
9 have a widely accepted definition, what do you look
10 for in the specification?

11 MR. BYUN: Objection, form.

12 THE WITNESS: Well, so, again, I'll answer
13 first in the context of matrix materials because I
14 think that's really where this is most relevant.

15 I look specifically at how that term is
16 being used by the inventors and what properties in
17 this case that material is being given.

18 BY MR. LINDSAY:

19 Q Do you look for consistent usage of a term
20 or if it's described in a particular way in a
21 consistent fashion?

22 MR. BYUN: Objection, form.

23 THE WITNESS: Certainly I would look for
24 consistency in how terms are applied, especially in
25 the context here of matrix material, which is the

1 term I'm noting, does not possess a widely common
2 definition in the OLED field.

3 BY MR. LINDSAY:

4 Q And if a patent used the term in a
5 consistent manner, what would that signal to you as
6 a person who's trying to figure out the meaning of
7 the term?

8 MR. BYUN: Objection, form.

9 THE WITNESS: So if the patent uses a term
10 in a consistent manner and, again -- and I can
11 interpret what the properties of that material are
12 intended to be based on the specification and the
13 claims, then I would use that to inform my own
14 assessment and my own opinion of what the intended
15 meaning of the term is.

16 BY MR. LINDSAY:

17 Q Right. I guess what I'm asking is: Would
18 it tell you something about what the inventors
19 regarded as the meaning of the term when they
20 themselves use the term in a consistent fashion
21 through the specification?

22 MR. BYUN: Objection, form.

23 THE WITNESS: Again, I just -- before I
24 answer, I just want to make sure I'm -- you know,
25 when you say what the inventors meant, I'm not sure

1 if there's sort of any kind of legal weight to that
2 terminology. So I'll just give that one disclaimer.

3 But certainly I would read the patent and
4 the specification and the claims and the consistency
5 of usage and I would think about what a person skill
6 in the art would then interpret this all to mean as
7 a whole.

8 I would -- in terms of what the inventors
9 meant, I guess I'm hesitant to say that I would know
10 what they meant. I would look at more what is
11 written in the patent I think.

12 BY MR. LINDSAY:

13 Q The inventors are presumed to have written
14 the specification; correct?

15 A Oh, of course. But my point is just to say
16 that I can only base my opinion of what particular
17 parts of the patent mean based on what is explicitly
18 written in the patent is all I'm pointing out.

19 I would hope that that would reflect the
20 inventor's intent, but, you know, I have to base my
21 opinion on what is explicitly presented in the
22 patent.

23 Q And is consistent usage of a term evidence
24 of what the inventors intended the term to mean?

25 MR. BYUN: Objection, form.

1 THE WITNESS: So, again, the consistent
2 usage of a term, so I think consistent usage of a
3 term where there's some clear, you know, consistent
4 description of what, say, in this case the
5 associated property requirements are or energetic
6 requirements are of a matrix material would
7 certainly inform a person skilled in the art's
8 opinion of what that term means.

9 Again, in terms of whether that's the
10 inventor intent or not, I guess I'm just saying that
11 I would view the patent for how it's written and
12 read it accordingly.

13 BY MR. LINDSAY:

14 Q You mentioned a couple of times now
15 associated properties.

16 A Mm-hmm.

17 Q What are you referring to?

18 A So as I noted earlier in the context of
19 matrix material, and part of the rationale for the
20 sentence that you pointed to originally in
21 Paragraph 11, is that matrix material has specific --
22 specific requirements on material HOMO and LUMO levels
23 in the '164 patent.

24 And those are not requirements that might
25 be present in other works or patents accordingly,

1 necessarily with that term.

2 So what I'm pointing out is that the term
3 "matrix material" comes with some specific defining
4 details in the '164.

5 So those are things that I am using to
6 inform my opinion of what a matrix material might
7 be.

8 Q So when the specification describes
9 certain LUMO and HOMO levels for the various matrix
10 materials, you understand those to be requirements
11 of the term "matrix material"?

12 MR. BYUN: Objection, form.

13 THE WITNESS: No, I would not rely
14 entirely on the specification in that respect,
15 because I'm really looking at, for example, in
16 Claim 1 where there is a clear energetic alignment
17 required between the various matrix materials, that
18 would tell me effectively, okay, what was the intent
19 for that particular claim as part of this invention
20 of the inventors.

21 The examples and embodiments in the '164
22 may or may not satisfy the energetic alignment in
23 perhaps Claim 1.

24 But I'm looking at Claim 1 as clearly
25 indicating, for example, that this is something a

1 matrix material has to have in terms of its
2 HOMO/LUMO level alignment to meet Claim 1, for
3 example.

4 BY MR. LINDSAY:

5 Q So I think we agree with that, but
6 respectfully, I think you're conflating
7 requirements.

8 So Claim 1 certainly describes a matrix
9 material and then requirements relating to that
10 matrix material as to relative HOMO and LUMO levels;
11 correct?

12 A Yes.

13 Q If you'll allow me to analogize.

14 If I had a claim to a widget and then the
15 widget went on to be recited as a six-sided widget,
16 the fact that it's six sided does not tell me what a
17 widget is. Is that fair?

18 A So in your example, you're just saying if
19 all that was described is that this is a six-sided
20 widget or six-sided object?

21 Q Right.

22 A No, not exclusively in isolation.

23 Q So I want to figure out what a widget
24 means. And six-sided might tell me something about
25 what's required of that widget, but I still don't

1 know what a widget is. Is it a block, is it a die?

2 I'll go to the specification and see what
3 the inventors were talking about. Is that fair?

4 A Yeah, I think that's fair, you're looking at
5 the patent as a whole.

6 Q Okay. So taking that back to our example.
7 I understand your opinion that the material matrix
8 has certain requirements related to HOMO/LUMO levels
9 that are recited in the claim.

10 What I want to do is kind of step back
11 from that and say, okay, fine, that's our six-sided
12 widget or object. I want to figure out what an
13 object or widget is, so in our case, a matrix
14 material. Okay.

15 So let's step back and go back to your
16 previous conversation about looking at the
17 specification to see what -- it doesn't have a
18 generally defined meaning, what the inventors meant
19 by matrix material. Okay?

20 In that context, if the inventors use the
21 term "matrix material" in a consistent fashion
22 throughout the specification, putting aside the
23 additional requirements of the claim, would that
24 inform you that the inventors had a particular
25 meaning in mind at least by implication?

1 A So --

2 MR. BYUN: Objection, form, calls for a
3 legal conclusion.

4 THE WITNESS: I think my -- you know, my
5 answer there is that certainly the specification
6 would help to inform the meaning of terms. I guess
7 I would have to see sort of specific examples if
8 there's particular examples here you're referring
9 to.

10 But in my opinion, the definition that I
11 have taken and the meaning I've taken for "matrix
12 material" is consistent with the specification and
13 how the inventors use it in the '164.

14 BY MR. LINDSAY:

15 Q And what aspects of your opinion about the
16 meaning of matrix material is consistent with the
17 specification's description of matrix material,
18 putting aside, again, the additional requirements of
19 the claim relating to HOMO and LUMO levels?

20 MR. BYUN: Objection, form.

21 THE WITNESS: So the fact that the matrix
22 material is a component of the matrix. And so
23 looking at the embodiments that are described in the
24 specification of the patent, my reading of matrix
25 material as a component of the matrix where the

1 matrix forms the functional layer is consistent with
2 the examples provided.

3 MR. LINDSAY: I'm going to introduce
4 Exhibit 1030.

5 BY MR. LINDSAY:

6 Q Go to Page 32.

7 A Okay.

8 Q Stepping back, are you familiar with this
9 document?

10 A I am.

11 Q What is this document?

12 A This is the decision on claim construction.

13 Q Is this from the District Court proceeding
14 between Samsung and Pictiva?

15 A Yes, that's my understanding.

16 Q And you cite to this document in your
17 supplemental or reply declaration?

18 A I do, yes.

19 Q You've reviewed this document?

20 A I've reviewed specifically the section on
21 the '164. I have not reviewed the parts of the
22 document pertaining to other patents involved in the
23 District Court.

24 Q That's fair enough.

25 On Page 32, there is a box in the middle

1 there.

2 A Yes.

3 Q And what is your understanding of what
4 that -- what the information in that box represents?

5 A So my understanding is that there's -- I
6 guess that there is disagreement between the two
7 parties involved in the District Court proceeding
8 regarding what the term "matrix" and "matrix material"
9 necessarily mean.

10 Q So is it your understanding that Samsung
11 proposed constructions for the term "matrix
12 material" and a separate construction for the term
13 "matrix"?

14 A I just want to reread this document since
15 it's been awhile since I looked at it. If you just
16 give me a moment.

17 Yes, my understanding is that Samsung is
18 providing a construction for both matrix and matrix
19 material.

20 Q Is Pictiva providing a proposed
21 construction for both matrix and matrix material?

22 A Again, based on what I see, it looks like
23 Pictiva is providing a construction for matrix
24 material.

25 Q So not providing a separate construction

1 for matrix; is that your understanding?

2 A I don't think so. I don't think there is a
3 separate construction for matrix, just for matrix
4 material.

5 Q Have you seen Samsung's proposed
6 construction for matrix before?

7 A No, just in the context of this claim
8 construction report.

9 Q Do you generally agree with Samsung's
10 construction of matrix, just the term "matrix" as
11 presented here on Page 32?

12 A Yes, I do.

13 MR. LINDSAY: Okay. I'm going to
14 introduce another exhibit. You should see
15 Exhibit 2016 shortly.

16 THE WITNESS: I have it open.

17 BY MR. LINDSAY:

18 Q Are you familiar with this document?

19 A I have not reviewed this document in detail,
20 but I think it's been referenced perhaps by Dr. Sims
21 before.

22 Q Do you know who Dr. Schubert is?

23 A I don't know Dr. Schubert.

24 Q Do you know his role in the litigation?

25 A I assume he is another expert in the

1 proceedings, but I'm not familiar with his detailed
2 role in the litigation.

3 Q You cited the District Court claim
4 construction order. Are you aware that he submitted
5 this declaration in connection with the claim
6 construction process in the District Court?

7 A Yes, I'm aware that he submitted a
8 declaration. I'm just not privy to the specifics of
9 what role he's had throughout the District Court case.

10 Q Okay. We're going back to Page 55. I'm
11 going there myself.

12 Paragraph 129, Dr. Holmes, if you could
13 familiarize yourself with that and any other
14 sections you would like to.

15 A I'm going to read this full section because
16 I have not examined this document in detail.

17 MR. BYUN: I would object to the scope on
18 any questions regarding this document.

19 THE WITNESS: Okay. I've read the
20 paragraph in question.

21 BY MR. LINDSAY:

22 Q Okay. About halfway through the paragraph
23 or so, he -- maybe we'll start with the second
24 sentence. Can you read the second sentence just
25 into the record where it says "To be effective"?

1 MR. BYUN: Same objection as to scope.

2 THE WITNESS: So you want me to read the
3 sentence starting with "To be effective"?

4 BY MR. LINDSAY:

5 Q Yes, please.

6 A So quoting from Dr. Schubert here, "To be
7 effective, a matrix needs to be in a continuous phase
8 to not only encourage the efficient transport of
9 electrons and holes through, e.g., the electron
10 transporting material and hole transporting material
11 on the matrix, but to also ensure the desired
12 distribution and stable housing of the emitter
13 material."

14 Q This is one of the paragraphs under the
15 heading "Matrix," the term "matrix" in the '164
16 patent; correct?

17 A So you're saying this is a paragraph in
18 this -- the matrix section here, not in the '164
19 patent; right?

20 Q Yes. In the section of Dr. Schubert's
21 declaration that is addressing --

22 A It's under Section A, "Matrix," yes.

23 Q Okay. I'll clear that up on the record.
24 Paragraph 129, which you just read into
25 the record, Dr. Holmes, is from the section in

1 Dr. Schubert's declaration discussing his opinions
2 about the meaning of the term "matrix"; is that
3 right?

4 A It is from the section --

5 MR. BYUN: Objection to the scope.

6 THE WITNESS: It is from the section
7 labeled "Matrix" under the "'164 Patent Terms"
8 broader section.

9 BY MR. LINDSAY:

10 Q Okay. As you read, towards the end of
11 that sentence, Dr. Schubert says that the matrix
12 needs to be in a continuous phase to ensure the
13 desired distribution and stable housing of the
14 emitter material, one of the reasons?

15 A Dr. Schubert does say that.

16 Q So is the -- is it your understanding that
17 it's his opinion that the matrix is housing the
18 emitter material?

19 MR. BYUN: Objection, form, outside the
20 scope.

21 THE WITNESS: So I'm hesitant to draw a
22 conclusion on what Dr. Schubert's specific
23 conclusions are without having examined this whole
24 document.

25 That sentence says there is a stable

1 housing of the emitter material. I don't know if I
2 can say more about Dr. Schubert's opinion beyond
3 that.

4 BY MR. LINDSAY:

5 Q That's fair.

6 When you read that as an expert, what does
7 that mean to you?

8 MR. BYUN: Objection, form, outside the
9 scope.

10 Counsel, this is the declaration of
11 Dr. Schubert, not a declaration of Dr. Holmes.
12 Today's deposition is about Dr. Holmes's reply
13 declaration, which did not even cite this exhibit.

14 MR. LINDSAY: Okay. Objection noted.

15 Q Dr. Holmes, as an expert in this field,
16 what is your understanding of that sentence in
17 Paragraph 129?

18 MR. BYUN: Objection, outside the scope.

19 THE WITNESS: Again, I think Dr. Schubert
20 is just pointing out that the emitter would be
21 distributed in the functional layer here is the way
22 I'd interpret it.

23 I have to rely on my own interpretations
24 of the '164 and my own interpretation of terms like
25 "matrix" and "matrix materials." And so I'm not

1 entirely comfortable to speculate on what
2 Dr. Schubert's interpretation is and how that would
3 necessarily be applied in the associated way that
4 I'm using those terms.

5 So I interpret that just to mean that
6 there is an emitter that's distributed through the
7 functional layer as well.

8 BY MR. LINDSAY:

9 Q Fair enough.

10 I'm just asking you as an expert that read
11 this paragraph, how you would understand what
12 Dr. Schubert meant.

13 I'm not saying that's what you meant, but
14 what Dr. Schubert is saying about the matrix needing
15 to be in a continuous phase to provide stable
16 housing of the emitter material.

17 MR. BYUN: Objection, outside the scope.

18 THE WITNESS: So, again, I'm going to rely
19 on my own understanding having thought about the
20 '164 a great deal in this proceeding is that in my
21 understanding, the matrix essentially forms the
22 functional layer and that matrix and functional
23 layer will be a continuous phase, it's a continuous
24 film of material.

25 So obviously if it was discontinuous and

1 had holes in it, that would be unsuitable for the
2 inclusion of an emitter in that functional layer.

3 Going beyond that and further speculating
4 on what Dr. Schubert is thinking here, I think I
5 would have to think a lot more about the text in his
6 report here and ideally read the entire document to
7 make sure I'm not missing something else that's said
8 elsewhere.

9 BY MR. LINDSAY:

10 Q Okay. That's fair.

11 Does the matrix provide a medium in which
12 the emitter material is isolated?

13 MR. BYUN: Objection, form.

14 THE WITNESS: So as I've said before, the
15 matrix forms the functional layer in the OLED and
16 the emitter molecules are present within that
17 functional layer. So they would also be present
18 throughout that structure.

19 In terms of their isolation, I guess I
20 need to better understand what you're getting at
21 there.

22 BY MR. LINDSAY:

23 Q Okay. The emitter material is embedded in
24 the matrix, I guess we start there. Is that
25 correct?

1 A The emitter material is part of the matrix.

2 Q Is the emitter material in a continuous

3 phase?

4 MR. BYUN: Objection, form.

5 THE WITNESS: The emitter material, that

6 component, need not be in a continuous phase.

7 BY MR. LINDSAY:

8 Q What if the emitter material were in a

9 continuous phase, would that impact efficiency?

10 MR. BYUN: Objection, form.

11 THE WITNESS: No, one could certainly

12 construct a device where the emitter is in a

13 continuous phase. And, in fact, such an incarnation

14 may be present, for example, in Thompson, one of the

15 references that I cite.

16 BY MR. LINDSAY:

17 Q Referring back to Paragraph 129 of

18 Dr. Schubert's declaration, the second-to-last

19 sentence. I'll read it.

20 It says, "That is, the multiple matrix

21 materials would together form a mixed matrix - a

22 connected structure that holds, e.g., the emitter

23 material."

24 Do you see that?

25 A I see that sentence.

1 Q Do you agree with that sentence?

2 MR. BYUN: Objection, outside the scope.

3 THE WITNESS: So just looking at that
4 sentence at face value, I would not necessarily
5 agree with that sentence because in my opinion and
6 in my declaration, reply declaration, I've noted
7 that the emitter material is part of the matrix and
8 actually can, in some instances, be a matrix
9 material.

10 BY MR. LINDSAY:

11 Q Okay. So you understand Dr. Schubert here
12 to be saying that the emitter material is not part
13 of the matrix but that the matrix holds the emitter
14 material?

15 MR. BYUN: Objection, outside the scope.

16 THE WITNESS: So, again, I'm not
17 necessarily providing a firm description of what
18 Dr. Schubert is saying here, but I could see that as
19 being one interpretation of the sentence. And I
20 just want to make sure that my opinion is clear.

21 BY MR. LINDSAY:

22 Q So to the extent that Dr. Schubert is
23 suggesting that the emitter material is embedded in
24 the matrix and not part of the matrix, you would
25 disagree with that?

1 A I would say that the emitter material is
2 part of the matrix.

3 Q And being part of the matrix is distinct
4 from it just being embedded in the matrix?

5 MR. BYUN: Objection, form.

6 THE WITNESS: So, again, that distinction
7 is not something I have had to opine on in my
8 declaration and my reply.

9 So I would prefer to leave my opinion as
10 the emitter is part of the matrix.

11 BY MR. LINDSAY:

12 Q Okay. Well, I mean, a moment ago you
13 disagreed with Dr. Schubert to the extent he was
14 suggesting that the emitter is embedded in the
15 matrix and not part of the matrix. I think we
16 established that.

17 Right?

18 MR. BYUN: Objection, form.

19 THE WITNESS: So just to make sure it's
20 clear, I don't know the specific limitations of what
21 Dr. Schubert's opinion is. I'm just making it very
22 clear what my opinion is.

23 So it's possible that sentence could be
24 interpreted to mean that the -- that somehow
25 embedding is different than part of, and I just want

1 to make sure my opinion is clear based on what I've
2 talked about in my declaration and my reply
3 declaration.

4 BY MR. LINDSAY:

5 Q What is it that you would like to be clear
6 on?

7 A That the emitter is part of the matrix.

8 Q And you're distinguishing that from
9 something that is embedded in the matrix?

10 A I'm just making clear the terminology that I
11 have chosen to apply in my assessment of the '164 and
12 how I've written my opinion.

13 The term "embedded" versus "part of" is
14 not something I have had to opine on in detail, but
15 I want to make sure that my opinion is clear in the
16 sense that I think it's more direct to say that the
17 emitter is part of the matrix.

18 Q I understand that you haven't addressed
19 this in your declaration.

20 But sitting here today as an expert in the
21 field, do you have an opinion on whether there is a
22 distinction between embedding something in a matrix
23 versus something being part of a matrix?

24 MR. BYUN: Objection, outside the scope.

25 THE WITNESS: So, again, I have not

1 thought in detail about how I would distinguish
2 those terms.

3 I think what I'm just more trying to
4 emphasize is that I think being a part of the matrix
5 is a very clear statement of my opinion on how this
6 term should be construed and how one should think
7 about the role of the emitter.

8 Embedded I think could mean a variety of
9 things and I think I would have to better understand
10 what Dr. Schubert's limitations are or inclusions
11 are in how they are using that term.

12 BY MR. LINDSAY:

13 Q Right. I understand.

14 Putting aside Dr. Schubert's opinion for a
15 moment, I was asking you as an expert in this field,
16 do you today have an opinion on whether there is a
17 distinction between embedding something in a matrix
18 versus something being a part of that matrix?

19 MR. BYUN: Objection, outside the scope.

20 THE WITNESS: So in the context of how I
21 think about the '164, I think the role of the
22 emitter as part of the matrix is clear.

23 And I don't want to offer further
24 off-the-cuff opinions on "embed" versus "part of" as
25 a matter here because it's not something I've

1 considered in detail.

2 My reading of Dr. Schubert's sentence is
3 just one where I want to make sure that my opinion
4 is not misconstrued.

5 BY MR. LINDSAY:

6 Q Okay. So is it fair to say that you are
7 not prepared to render an opinion on whether there
8 is a distinction between embedding something in a
9 matrix versus something being part of a matrix?

10 A That is not something I'm willing to offer a
11 new opinion on right now in terms of further detail on
12 those terms.

13 MR. LINDSAY: Okay. I'm going to
14 introduce a new exhibit. Give me a second here.

15 This is a transition, if folks want to
16 take a break now, it's fine. No? Okay.

17 MR. BYUN: Up to the witness.

18 THE WITNESS: I'm fine if everyone else is
19 fine.

20 BY MR. LINDSAY:

21 Q I already introduced this one. If you can
22 pull up Exhibit 1033.

23 A Okay. I have it.

24 Q Are you familiar with this document,
25 Exhibit 1033?

1 A Yes, I reference this document in my reply
2 declaration.

3 Q If I refer to this as the Li article or Li
4 paper, you'll know which document I'm referring to?

5 A Yes.

6 Q Although there may be two of these; right?
7 I think for today, this is the only one we'll
8 discuss.

9 A It's the only new exhibit titled with a Li
10 author I think.

11 Q Okay. So I think it's Paragraph 14 of
12 your declaration, you reference the -- this Li
13 article or paper?

14 A Yes, that's true.

15 Q And why are you citing Li here?

16 A I'm trying to -- again, replying to
17 Dr. Sims's further support that the usage of the term
18 "dopant" does not imply some particular concentration
19 threshold and that here in Li, this is an example of
20 using the terminology "co-doping" to dope, for
21 example, two hosts into an OLED that each have a
22 supportive charge carrier transport function.

23 Q So you're citing Li to support your
24 opinion that host materials can be dopants; did I
25 get that right?

1 A What I said is I'm citing Li here to
2 demonstrate that there is no requirement that a dopant
3 necessarily have some particular concentration
4 threshold in the literature. And that the usage of
5 the word "doping" and "dopant" means simply to add an
6 additional species into the layer.

7 And I'm citing this as an example where
8 two hosts are actually being referred to by
9 co-doping; that the term "dopant" here is being
10 applied to a material that's actually present in a
11 significant amount of the film.

12 So that's consistent with my initial
13 opinion and this was offered as additional support
14 based on Dr. Sims's declaration.

15 Q Right. So in Paragraph 14, I don't see
16 any reference to concentrations. I just see a
17 statement, second sentence, where you say, "host
18 materials can also be dopants." Right? And then
19 you say in the next sentence, "For example, work by
20 Li."

21 So --

22 A Sure.

23 Q -- is it your opinion that Li supports the
24 opinion that host materials can be dopants?

25 A Yes, and the fact that the act of doping, in

1 this case co-doping, does not necessarily imply any
2 sort of threshold concentration.

3 But yes, I'm using this as support that a
4 host material can also be envisioned as a dopant.

5 Q So when the term "doping" or -- strike
6 that.

7 When the verb "dope," "to dope," for
8 example, or "doping" is used, is it your
9 understanding that that the subject of that verb
10 would be a dopant?

11 A So I just want to make sure I understand
12 what you're asking. So you're saying when the term
13 "doping" is used, is the subject a dopant?

14 Q Yes.

15 A Yes, when the term "doping" is used, the
16 subject would certainly would then be a dopant.

17 Q Okay. And so walk me through Li, if you
18 could, as to why Li supports the opinion that a host
19 material can be a dopant.

20 A So what I'm pointing out in Li is that the
21 use of the terminology in the community supports that
22 a host could also be doped and then be a dopant.

23 Q I mean specifically, what passages in Li
24 or an example of one -- I don't expect you to find
25 them all -- but an example of one that shows what

1 you're saying to be true.

2 A Sure. So considering first just the title
3 of the manuscript, "Pure-blue fluorescent organic
4 light-emitting diodes by co-doping a supplementary
5 host material," this is implying right away that the
6 act of doping is being applied to a host, which would
7 indicate that the host is a dopant.

8 If we look in the abstract of the
9 manuscript as well, there's similar terminology.
10 Let's see. It would be six lines in, "Compared with
11 the device without CzSi, the performances of the
12 co-doped device were improved effectively."

13 So those are just two instances, but I can
14 certainly go through the manuscript as a whole if
15 you would like others.

16 Q Okay. So this is just consistent with
17 what you were saying, which is when a reference
18 talks about doping or in this case co-doping, it
19 would be understood that it's talking about a
20 dopant?

21 A Yes.

22 Q Okay. What is the main host in Li?

23 A I'm going to review Li to me remind myself
24 of the compositions.

25 So the main host is TcTa.

1 Q Does Li tell us what the concentration is
2 of TcTa?

3 A Yes, I'm just going to go on and reread
4 passages here to get that answer for you.

5 There's several examples, but I'll start
6 with the first one I found here.

7 So above Figure 1, there is a passage here
8 that refers to -- this is a different co-host, but
9 doping DBzA into TcTa -- pardon me, you know,
10 actually that's the emitter.

11 Let me just reread specifically because I
12 didn't pull the concentrations out yet. Give me one
13 moment. I'm sorry.

14 Q Of course, take your time.

15 A So there is a variety of concentrations
16 examined, but in their co-doped, co-host device, the
17 concentration of TcTa is about 80 percent nominally.

18 Q And where are we seeing this?

19 A There is a few different places. So let's
20 see.

21 One example -- for example, the devices at
22 the top of the first column on Page 3443 are listing
23 the exact structures for hole and electron only
24 devices, those cite CzSi concentrations of
25 6 percent, DBzA concentration of 16, and basically

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1 TcTa would be the balance of that nominally.

2 There's also data shown in Figure 4 where
3 the concentration of the co-doped host is being
4 varied and in the text the concentration is provided
5 right under Figure 3. And it's -- it would be a
6 similar range for TcTa.

7 So under Figure 3, it says the structure
8 of the designed devices is IT0/HAT-CN/HAT-CN and
9 then the emissive layer of CzSi with a variable
10 concentration, DBzA at 16 percent and TcTa
11 presumably taking up the rest of the film. So,
12 again, that would be nominally 80 percent TcTa.

13 Q Okay. So the main host, on the order of
14 80 percent.

15 How about what Li refers to as the
16 supplementary host, what is the concentration of
17 that material?

18 A So that's listed in Figure 4, the
19 concentration is varied to 8 percent.

20 Q And the supplementary host is CzSi;
21 correct?

22 A Correct.

23 Q And it varies from, according to this
24 figure, 2 to 8 percent?

25 A Yes.

1 Q What is DBZA?

2 A So DBZA in this device is playing the role
3 of the emitter. So it's present in -- let me go back
4 here again.

5 DBZA is shown in Figure 1 and it's playing
6 the role of the emitter in this structure.

7 Q And what is the concentration of the
8 emitter in Li?

9 A For the structures that we had just been
10 referring to, the concentration is 16 weight percent.

11 Q So the emitter has a concentration that is
12 between two and eight times that of the
13 supplementary host; is that right?

14 A In that particular architecture, that's
15 correct.

16 Q Is there any other architecture that
17 differs from that in a material fashion? Is that
18 a -- excuse me, strike that.

19 Is that architecture representative
20 architecture for purposes of the Li publication?

21 A Yes, it is. There is an additional
22 architecture discussed towards the end of the paper
23 that adds a second dopant, but, yes, the DBZA
24 structure we're talking about is representative of the
25 Li paper.

1 Q Okay. And the other architecture towards
2 the end of the paper you mentioned, what is the
3 additional dopant?

4 A The additional dopant there is iridium
5 phosphor.

6 Q Can you point me to where you're looking?

7 A So this is, for instance, the spectra in
8 Figure 8 are collected for that additional device and
9 the discussion of architecture is above Figure 6.

10 Q And what is the concentration in that case
11 of the second emitter?

12 A So the second emitter here is it's being
13 used as a sensitizer to try and probe exciton
14 recombination in the main device. So it's being
15 included as a thin strip at 2 weight percent.

16 Q And DBzA, the original I guess we can call
17 it emitter, that's still at 16 weight percent?

18 A Let me just confirm that.

19 Yes, DBzA is still at 16 weight percent.

20 Q And looking at this same page, 3443, it
21 looks like CzSi is at 6 percent weight?

22 A Give me a moment, please.

23 If you're referring to, I assume,
24 device F, it is still at 6 weight percent.

25 Q Is 16 percent considered high for

1 concentration for an emitter?

2 MR. BYUN: Objection, form.

3 THE WITNESS: It depends, I suppose, on
4 the emitter. Certainly there are OLEDs that have
5 concentrations in that range.

6 BY MR. LINDSAY:

7 Q Are you familiar with any OLEDs before the
8 '164 patent that had emitter concentrations greater
9 than 16 percent?

10 MR. BYUN: Objection.

11 THE WITNESS: Just any paper that has
12 emitter concentration greater than 16 percent?

13 BY MR. LINDSAY:

14 Q For an OLED.

15 A It's not something I looked for, but I'm
16 fairly certain I could find some. And I might
17 actually -- I'm quite confident I can find some.

18 I'm aware of my own work where I've
19 published OLEDs with emitter concentrations having a
20 neat film.

21 So absolutely there's papers that predate
22 the '164 that have concentrations higher than that
23 number.

24 The first OLED, for example, has a
25 concentration of 100 percent for the emitter. So

1 certainly.

2 Q So Li uses the term "supplementary host."
3 Did you come across that term in any other
4 reference?

5 A I've come across the terms "co-host" and
6 "mixed host." I'm not sure I've come across the term
7 "supplementary host." I might have.

8 So there's definitely a lot of literature
9 on the use of multiple hosts in the emissive layer
10 of an OLED.

11 Q Let me ask it maybe differently.

12 Is the term "supplementary host" a term
13 you were familiar with before you found Li?

14 A Again, I'm not sure I've seen supplementary
15 host. I might have looked at this more in the context
16 of like a mixed host. Co-host certainly is something
17 I would have immediately recognized.

18 So I can't say if I had seen supplementary
19 hosts before or not.

20 Q What is the date of invention of the '164
21 patent that you used in your analysis?

22 A Sure, I just want to go back to my
23 declaration to make sure I get the priority date
24 correct. I have that here.

25 Again, the priority date I was asked to

1 assume was May 30, 2008.

2 Q And what is the date of the Li reference?

3 A The Li reference is from -- it was received,
4 it looks like, based on the masthead information,
5 December 7, 2019. And it looks like it was accepted
6 on January 20th, 2020.

7 Q So the Li publication postdates the '164
8 patent by 11 or 12 years; is that fair?

9 A The Li reference would not be prior art
10 based on that priority date. However, I just want to
11 note back to my original declaration that mixed
12 emissive layers and co-host emissive layers certainly
13 were prior art and I do describe that in my original
14 declaration under the heading of mixed emissive
15 layers.

16 Q Fair enough.

17 But you can't say that Li represents what
18 was known in the art in 2008; right?

19 MR. BYUN: Objection, form.

20 THE WITNESS: No, Li -- so, again, Li
21 being a mixed host emissive layer certainly was in
22 the prior art, like that concept, and that had
23 already been applied prior to the priority date.
24 But, yes, Li, of course, is not prior art.

25

1 BY MR. LINDSAY:

2 Q So, again, I'll just ask -- I think we're
3 on the same page here, but you can't say Li
4 represents what was known in the art in 2008; right?

5 MR. BYUN: Objection, form.

6 THE WITNESS: So, again, the specific
7 content of Li and the exact, you know, text and
8 results of Li clearly was not known at that point.

9 However, what I'm pointing to is that the
10 novelty is the idea of mixing multiple hosts in a
11 common emissive layer which was known as prior art.

12 And, in fact, I reference I believe it's
13 Kim that extensively describes how multiple hosts
14 can be applied to realize effective performance in
15 an OLED.

16 BY MR. LINDSAY:

17 Q You can't say that the use of the term
18 "supplemental host" was known in the art in 2008 at
19 the time of the invention; right?

20 A I don't have any exhibits that point to the
21 use of the term "supplemental host." Again, what I
22 point to is the use of mixtures of hosts in the
23 emissive layer.

24 Q You've used the term a few times "a
25 co-host" here in our discussion.

1 Do you find any references that use the
2 term "co-host" and that describe the co-host as
3 being doped into an emissive layer?

4 A So I just want to reconsult one of my
5 exhibits before I answer your question, which is 1015.
6 Is it possible for you to include that in the marked
7 exhibit folder?

8 Q Yes, I'll grab it and put it in there, I
9 just need a moment.

10 A Thank you.

11 Q I introduced Exhibit 1015. You should see
12 it in a moment.

13 A I'm downloading it. I want to have a quick
14 look at it.

15 To answer your question, I don't have an
16 exhibit prior to the priority date that uses
17 supplemental host or a co-doped host.

18 Q Okay. Let me ask it a different way
19 because you said co-doped host.

20 So prior to the '164 patent, you are not
21 aware of any publication that describes a host or
22 co-host as being doped into an emissive layer?

23 MR. BYUN: Objection, form.

24 THE WITNESS: So, again, what I can answer
25 with certainty is that my exhibits that are prior

1 art do not use that terminology.

2 In terms of whether there are other
3 papers, again, I'm not aware of one off the top of
4 my head. But certainly at the time there was
5 extensive use of co-hosts in OLEDs to make mixed
6 emissive layer devices as I show in this exhibit.

7 BY MR. LINDSAY:

8 Q Right. I understand co-hosts were
9 described in the literature in your opinion.

10 But none of those co-host systems were
11 describing a host or co-host as being a dopant;
12 right?

13 A So, again, what I can say with certainty is
14 that the exhibits I have here that are prior art do
15 not describe them as a dopant.

16 But whether there's other prior work that
17 might use that terminology in the context of a mixed
18 host OLED, I can't say with certainty that there is
19 not.

20 MR. LINDSAY: Okay. Can we take a
21 ten-minute break or longer if Dr. Holmes likes?

22 THE WITNESS: Ten is okay for me.

23 MR. LINDSAY: Okay.

24 (Recess taken.)

25 MR. LINDSAY: I'm going to introduce

1 another exhibit, 1004.

2 Q Dr. Holmes, are you familiar with this
3 exhibit, 1004?

4 A Yes, I am. This is the Choulis patent.

5 Q If I could get you to focus on
6 Paragraph 31 for now. I'll give you a moment to
7 kind of refamiliarize yourself with that paragraph.

8 A I'll reread it.

9 Okay. I've read 31.

10 Q About halfway down or so, there is a
11 sentence that starts, "The PBD is used."

12 Do you see that?

13 A I see it.

14 Q Could you just read that so we're all on
15 the same page, that sentence?

16 A Sure. So, "The PBD is used as a moiety in
17 the light emitting layer rather than as a thin
18 matching layer, as above."

19 Do you want me to continue?

20 Q No, that's fine.

21 What does Choulis mean by a moiety?

22 A I interpret moiety simply to mean another
23 molecular component in the film.

24 Q He's contrasting that with a thin matching
25 layer it seems; right?

1 A Right. So what -- well, what they are
2 saying is the PBD is used as a moiety and so, again,
3 I'm interpreting that to mean a component, for
4 example, that has a moiety in the light-emitting
5 layer, meaning that it's actually present in that
6 multicomponent light-emitting layer rather than as a
7 neat layer when it's a thin matching layer.

8 So I think Choulis is just noting that
9 here PBD is actually a component of light-emitting
10 layer rather than a standalone layer that's adjacent
11 to light-emitting layer.

12 Q Okay. And in Paragraph 32, below that,
13 first sentence, I guess I'll read it.

14 He then goes on to add that "the
15 light-emitting layer can be co-doped with organic
16 moieties, that is, matching material."

17 A Yes, I see that sentence.

18 Q So is it fair to say that at least in this
19 context, he's describing the moieties as dopants in
20 the light-emitting layer?

21 A Certainly he's saying that they are being
22 co-doped into the light-emitting layer.

23 Q So, I mean, I think we talked about this
24 earlier.

25 So in this case it would be fair to refer

1 to the organic moieties as dopants?

2 A That would be one interpretation of the
3 sentence. I guess I think it's important to note as
4 well that the organic moieties have hole and electron
5 transporting functionality as well, as is described
6 earlier in the text of the patent.

7 Q Right. But you've already taken the
8 position that dopants can have electron and hole
9 transporting properties. So that's nothing new.
10 But I'm just asking about the sentence
11 here, is it fair to say that Choulis is using the
12 moieties as a dopant in the light-emitting layer?

13 A So, again --

14 MR. BYUN: Objection.

15 THE WITNESS: -- the moieties are being
16 co-doped into the light-emitting layer, but I just
17 want to make it clear that they have a specific
18 function that's also described in Choulis to be the
19 electron and hole transporting material in the layer
20 as well.

21 BY MR. LINDSAY:

22 Q You seem resistant to use the term
23 "dopant" in connection with materials that have hole
24 and electron transport properties. But I think
25 you've already said that they can in your

1 declaration?

2 MR. BYUN: Objection to form.

3 THE WITNESS: It's not that I'm resistant,
4 it's just that the term "dopant" can be a fairly
5 broad term.

6 And so I'm making sure to be clear that
7 when it's applied in this context, it's referring to
8 the molecular species in the layer that would also
9 transport charge.

10 BY MR. LINDSAY:

11 Q Okay. So maybe I'm misunderstanding.

12 Are you saying that dopants can refer to
13 materials that do not impact electron or hole
14 transport properties and so you're trying to
15 distinguish that category of dopants from what is
16 being described here?

17 MR. BYUN: Objection to form.

18 THE WITNESS: No, that's not what I'm
19 saying.

20 What I'm just saying is that as I said
21 earlier, a dopant is a material that you're adding
22 into the system, into the film. So that on its own
23 doesn't really provide the additional context in
24 terms of the function of those components.

25 And I'm trying to make clear here that

1 Choulis's organic moieties being doped into that
2 light-emitting layer have a broader role and
3 identity in the device.

4 Just like in other instances, a dopant
5 might predominantly be designed to emit light. In
6 other instances a dopant might be designed to do
7 some other function in an OLED.

8 So I'm just trying to make sure that my
9 answer is clear in outlining what Choulis's intent
10 is for these materials.

11 BY MR. LINDSAY:

12 Q Okay. So I don't think there's
13 disagreement here.

14 The term -- I'll ask it this way just so
15 we're clear: The term "dopant" can refer to
16 materials that participate in transport properties
17 of a functional layer or not; is that fair?

18 MR. BYUN: Objection to form.

19 THE WITNESS: Yes, that's fair. But in
20 this case I would say that they go beyond just
21 participate because that almost sounds like it might
22 be secondary or a passive secondary result of the
23 material being there.

24 Here, Choulis's moieties are designed to
25 be the primary sources of charge transport in the

1 layer.

2 BY MR. LINDSAY:

3 Q Okay. Fair enough.

4 So in Choulis's example, he's using, in
5 your opinion, dopants which are performing the
6 primary transport properties for the light-emitting
7 layer?

8 A Choulis is selecting those dopants for their
9 charge transporting properties is maybe the way I'd
10 rephrase that.

11 Q Okay. I think that's fair, clear.

12 Going back to Paragraph 31, Choulis also
13 says that the -- I'm not sure where this is, it's --
14 it's about halfway down -- no, it's the next
15 sentence from the one we read last time.

16 "PBD is also used as a LUMO matching layer
17 (or interfacial layer) between the light emitting
18 layer 305 and a cathode 350."

19 Did I read that correctly?

20 A Yes, you read that correctly.

21 Q Okay. Can you -- what does that mean to
22 you?

23 A So what Choulis is saying there is that in
24 addition to PBD being present as a moiety that carries
25 electrons in the light-emitting layer of the device,

1 there is an additional neat layer of PBD adjacent to
2 the light-emitting layer with matched LUMO levels in
3 this case to the PBD in the light-emitting layer.

4 Q So when he described the thin matching
5 layer in the preceding paragraphs, I guess, maybe
6 sentences, how is that different than the
7 interfacial layer that he's describing in the
8 sentence we just read?

9 A So I would have to go back and look at what
10 you're referring to as the description of the
11 interfacial layer in prior paragraphs. I just want to
12 make sure I would know exactly what we're pointing to.

13 But the PBD layer being used here is
14 effectively an interfacial layer, but it's matched
15 in the sense that it's using the same material as
16 one of the moieties in the light-emitting layer.

17 Q Okay.

18 A So it's by default matched to PBD in the
19 light-emitting layer by virtue of the fact you're
20 using PBD as the matching layer as well.

21 Q Okay. No, I understand that.

22 I guess what I'm asking is: How is PBD,
23 when it's used as a thin matching layer, different
24 than when Choulis uses PBD as the interfacial
25 matching layer?

1 A When you say how is it different, can you be
2 more specific as to what -- do you mean functionally
3 or chemically? What do you mean "different"?

4 Q Well, I read Choulis to be saying that PBD
5 can be used as a moiety rather than a thin matching
6 layer and also as an interfacial matching layer.

7 And I guess what I'm trying to understand
8 is how is -- when Choulis uses PBD as a thin
9 matching layer, how is that different than when he
10 uses it as the interfacial layer?

11 MR. BYUN: Objection to form, outside the
12 scope.

13 THE WITNESS: So I'm not sure I've drawn a
14 distinction in the opinions I have presented between
15 interfacial layer and thin matching layer.

16 Can you point me to where in Choulis the
17 definition of interfacial layer is that you want me
18 to consider? I just want to remind myself of the
19 distinction or whether it's purely a semantic one.

20 BY MR. LINDSAY:

21 Q I don't know that there is a definition.
22 But I read the sentence, after he mentions the
23 matching layer as above, right, so that sentence we
24 read, he said, "PBD is used as a moiety in the light
25 emitting layer rather than as a thin matching layer,

1 as above."

2 And then he goes on to say, "PBD is also
3 used," that tells me that it's a different use.

4 Would you agree with that?

5 MR. BYUN: Objection to form, outside the
6 scope.

7 THE WITNESS: So just so that I can
8 comment on this, I actually do want to search
9 elsewhere in Choulis to make sure any distinction is
10 clear because I don't think I have had to draw a
11 distinction in the context of my declaration or
12 reply declaration. But just let me search for a
13 moment earlier in Choulis.

14 I guess I'll point to maybe Paragraph 29
15 which, again, forms some of the preamble to the
16 discussion in 31. Looking at the end of 29, it's
17 talking about the role of PBD and saying that the
18 cathode layer's work function is different from that
19 of Ir(mppy)3, but can inject electrons into the PBD
20 which forms a matching or interfacial layer on top
21 of the light-emitting layer.

22 So, again, I can certainly look further,
23 but my read of that is that these are synonymous
24 terms.

25 So I would have to go further to see if

1 there is a distinction that perhaps I've forgotten
2 about. But I think that would be my initial read on
3 interfacial versus matching.

4 BY MR. LINDSAY:

5 Q So are you saying that you believe Choulis
6 is using thin matching layer and interfacial layer
7 synonymously?

8 MR. BYUN: Objection, form, outside the
9 scope.

10 THE WITNESS: Again, I haven't had to take
11 a position on the role of interfacial versus
12 matching. The passage I just pointed to would
13 suggest that at least in the context of PBD, they
14 are being used interchangeably.

15 But I would have to go back through
16 Choulis thinking about this particular issue to be
17 able to draw a more general conclusion.

18 BY MR. LINDSAY:

19 Q Okay. No, that's fair.

20 But the passage you just read doesn't
21 mention thin matching layers at all, does it?

22 MR. BYUN: Objection, form.

23 THE WITNESS: The passage I read mentions
24 a matching layer. So is your distinction that it
25 doesn't have the word "thin"?

1 BY MR. LINDSAY:

2 Q Well, that's Choulis's apparent
3 distinction in Paragraph 31, no?

4 MR. BYUN: Objection, form, outside the
5 scope.

6 THE WITNESS: So I think to answer
7 further, I'm going to reread part of Choulis to make
8 sure there is not a distinction that I have
9 forgotten about here.

10 I was rereading a few of the paragraphs.
11 I think in the context of the example that's being
12 described in 29 and 30 and 31, I think the matching
13 and interfacial layer are synonymous.

14 If there is a distinction based on
15 thickness, I don't think it's impactful to how the
16 device would be designed or understood. Because
17 there is a range of thicknesses, many that are thin
18 even for the matching layer, as discussed in prior
19 paragraphs.

20 BY MR. LINDSAY:

21 Q Are Choulis's matching layers neat layers?

22 MR. BYUN: Objection, form, outside the
23 scope.

24 THE WITNESS: So it does describe that
25 some of these layers can be mixed.

1 BY MR. LINDSAY:

2 Q How about specifically in the context of
3 PBD, can it be in a mixed matching layer?

4 MR. BYUN: Objection, form, outside the
5 scope.

6 THE WITNESS: I did not consider any
7 embodiments where the matching layer, interfacial
8 layer would be mixed.

9 In fact, the embodiment I considered is
10 one where, as described here, the matching or
11 interfacial layer is the same as the electron
12 transporting moiety.

13 So any further iteration or engineering of
14 the matching or interfacial layer is not something I
15 considered in detail in drawing my opinions based on
16 Choulis.

17 BY MR. LINDSAY:

18 Q That's fair. I understand that.

19 I'm just asking you: Does Choulis
20 describe using PBD in a mixed matching layer?

21 MR. BYUN: Objection, form, outside the
22 scope.

23 THE WITNESS: I would have to go back and
24 read Choulis in detail to make sure I answer that
25 consistently with what's in Choulis.

1 BY MR. LINDSAY:

2 Q You mentioned a moment ago that Choulis
3 describes mixed matching layers.

4 Where are you seeing that?

5 A Let me go back to the paragraphs I was
6 reading and see if I can find that call-out.

7 I don't see it immediately, but I'll keep
8 looking.

9 Yes, so Paragraph 26 is what I see just on
10 rereading, "In some embodiments, the matching layers
11 include a mixture of materials with different work
12 functions."

13 Q So in the case of PBD, Choulis envisions
14 that it can be part of a mixture when used in a
15 matching layer?

16 A No, that's not --

17 MR. BYUN: Objection, form.

18 THE WITNESS: -- what I'm saying. I don't
19 know of an instance in Choulis where PBD is cited as
20 a component in a mixed matching layer.

21 The paragraph I point to is just generally
22 saying that matching layers could include a mixture
23 of materials.

24 BY MR. LINDSAY:

25 Q Okay. And when a matching layer includes

1 a mixture of materials with different work functions
2 or different HOMO or LUMO levels, would those
3 materials be in a matrix form?

4 MR. BYUN: Objection, form, outside the
5 scope.

6 THE WITNESS: So I did not consider
7 mixtures of materials in a matching layer, nor the
8 application of matrix materials or any other
9 terminology to such a hypothetical layer.

10 So that's not something I considered in my
11 analysis.

12 BY MR. LINDSAY:

13 Q Have you worked with matching layers in
14 your work, in OLED work?

15 A I haven't used that terminology before.

16 Q Are you familiar with the concept of a
17 matching layer?

18 A In reading Choulis, I think Choulis is
19 echoing the fact that there is some benefit to having
20 aligned energy levels for injection and transport.

21 Q I guess what I'm asking is: In your work,
22 have you used or researched or studied the use of
23 layers at the interface -- at the interfacial layer,
24 what Choulis calls I guess a matching layer, is that
25 something that you've worked with in your

1 experience?

2 A Not exactly how it's being described in
3 Choulis. I don't generally make OLEDs that have this
4 specific architecture.

5 The devices I make generally have more
6 layers and so I don't know that I would identify one
7 as a matching layer per se.

8 Q How about interfacial layers, is that
9 something that you've worked with in your past?

10 A So the types of devices I tend to work with
11 are generally multilayer architectures where the
12 emissive layer, so something like Choulis's
13 light-emitting layer, may have perhaps blocking layers
14 on either side of the emissive layer.

15 And as a result, I would not generally
16 think of those as matching or interfacial layers
17 because Choulis's matching and interfacial layers
18 are, at least in these embodiments, directly in
19 contact with the cathode. That's not a device I
20 would necessarily make in the same way.

21 So I don't think I would use those terms
22 the same way in Choulis's and my work because my
23 structures are a little different usually.

24 Q Are the blocking layers that you're
25 referring to, are those neat layers?

1 MR. BYUN: Objection, form, outside the
2 scope.

3 THE WITNESS: Generally, yes. I think we
4 could certainly agree that a lot of the time those
5 are neat layers, yes. I'm not sure I have an
6 instance where they are going to be mixed in my
7 usual work.

8 So, yes, they would generally be neat
9 layers.

10 BY MR. LINDSAY:

11 Q In work by others, have you seen blocking
12 layers be mixed?

13 MR. BYUN: Objection, form, outside the
14 scope.

15 THE WITNESS: I would say that that's
16 uncommon. But I'm sure there's instances where
17 someone has published an OLED with a blocking layer
18 that's mixed.

19 BY MR. LINDSAY:

20 Q Have you seen any papers or publications
21 describing a mixed blocking layer that you recall?

22 MR. BYUN: Objection, form, outside the
23 scope.

24 THE WITNESS: I don't recall off the top
25 of my head, but I suspect there's probably papers in

1 the literature that might show such an architecture.

2 Normally, though, the devices that I tend
3 to build have a neat blocking layer.

4 BY MR. LINDSAY:

5 Q From what you would expect for mixed
6 blocking layers, what would the structure be? Would
7 it be a host guest situation?

8 MR. BYUN: Objection, form, outside the
9 scope.

10 THE WITNESS: Again, not having applied
11 such like mixed blocking layer structure in my own
12 research extensively, I'm not sure how I would
13 quantify it in terms of those terminologies.

14 I guess I would just say it's a mixed
15 blocking layer with multiple components probably.

16 BY MR. LINDSAY:

17 Q Would there inherently have to be a host
18 material in the mixed blocking layer?

19 MR. BYUN: Objection, form, outside the
20 scope.

21 THE WITNESS: So, again, I haven't thought
22 about how I would port the host terminology to a
23 blocking layer. So I don't think I have an opinion
24 that I can offer right now on how I consider that
25 hypothetical architecture.

1 BY MR. LINDSAY:

2 Q Okay. Maybe more generically, when you --
3 in an OLED -- in the OLED context, where there is
4 any layer that's a mixture, wouldn't there
5 inherently have to be some component that's acting
6 as the host and maybe there's co-hosts, maybe
7 there's dopants but at least one host?

8 A No, I don't think that's necessarily true.

9 In the literature, frequently there's
10 layers that are deposited as mixtures, a mixture of
11 A and B, an A/B mixture. So I don't think there
12 there is necessarily a delineation of what a host
13 might mean in that context.

14 And I don't think the community tends to,
15 you know, worry as much about how to apply that
16 terminology to a mixed blocking layer, for example.

17 Q So a mixed blocking layer with A/B, how is
18 that any different than a co-host layer?

19 MR. BYUN: Objection, form, outside the
20 scope.

21 THE WITNESS: So you're asking me to
22 consider a hypothetical blocking layer that I have
23 not considered and have said I don't work
24 extensively on and my generic description of such a
25 layer would be that if it's a mixture of A and B,

1 then without any additional trappings, you would
2 call it a mixture of A and B.

3 So your question about how is that
4 different than a host, I haven't considered that
5 question for a blocking layer versus an emissive
6 layer.

7 BY MR. LINDSAY:

8 Q Okay. That's fair. Maybe in the context
9 of Choulis, maybe it's easier to talk about.

10 In the context of Choulis having a
11 matching layer of a mixture of materials, would you
12 expect there to be a host material?

13 MR. BYUN: Objection, form, outside the
14 scope.

15 THE WITNESS: So I don't think my analysis
16 or my opinion is any different there. The
17 nomenclature of host does not -- it doesn't tell a
18 person skilled in the art anything more about
19 someone saying, okay, this is a mixed blocking
20 layer, right.

21 The details are what are those materials
22 and how do they work as a blocking layer. So the
23 idea of saying, well, does there have to be a host
24 or not a host, it's not something I've considered in
25 the context of the generic case or, frankly, in the

1 context of a matching layer that might be mixed in
2 Choulis.

3 What you would worry about is what is the
4 function of the material as a blocking layer.

5 BY MR. LINDSAY:

6 Q Okay.

7 A I think most prior art would just describe
8 it as a mixture.

9 Q Okay. Well, maybe I'll ask a different
10 question then.

11 So in the context of Paragraph 26 in
12 Choulis describing matching layers that include a
13 mixture of materials, would it be your expectation
14 that those materials form a matrix?

15 MR. BYUN: Objection, form, outside the
16 scope.

17 THE WITNESS: Again, I haven't considered
18 that question. What I've thought about the term
19 "matrix" and "matrix materials" which are, of
20 course, important terminology to this discussion, I
21 thought about them in the context of an emissive
22 layer.

23 And that's where I've done my thinking on
24 those terms and so I haven't considered what those
25 terms would mean in a different functional layer,

1 whether it's blocking, transporting or otherwise.

2 And so I'm not comfortable offering an
3 opinion on the fly about how one might use matrix
4 and matrix materials and other hypothetical
5 functional layers of the device.

6 BY MR. LINDSAY:

7 Q I'm not, you know, asking you to opine
8 about whether materials in a mixed matching layer of
9 Choulis would be matrix materials. So I just want
10 to be clear on that.

11 I'm asking a simpler question, which is:
12 When Choulis describes this mixture of materials
13 having different work functions, for example, would
14 it be your expectation that those materials would
15 have some sort of matrix structure?

16 MR. BYUN: Objection, form, outside the
17 scope.

18 THE WITNESS: So, again, what I've said
19 previously today about a matrix is that the matrix
20 forms the film and that the matrix and that
21 functional film layer would be continuous.

22 And so, you know, I don't know the
23 specifics of the film we're describing here in the
24 context of the blocking layer, so it's possible that
25 matrix and the functional layer could have a similar

1 meaning.

2 But it's not something that, again, I've
3 thought enough about that I am comfortable offering
4 a general opinion.

5 BY MR. LINDSAY:

6 Q And I understand your hesitancy to offer a
7 general opinion. I guess I was asking more in the
8 context of Choulis specifically.

9 And would your expectation reading
10 Choulis, which is, you know, one of the primary
11 references that you rely on, what would be your
12 expectation as to the structure of a matching layer
13 that's formed by a mixture?

14 Would that matching layer be a matrix?

15 MR. BYUN: Objection, form, outside the
16 scope.

17 THE WITNESS: So I think to go any
18 further, I would want to be able to analyze the
19 components of the matching layer and understand
20 exactly what the embodiment is. Just as I've done
21 with the other exhibits, I do discuss in detail in
22 my declaration, reply declaration before offering an
23 opinion even on Choulis.

24 Because even in Paragraph 26 here, Choulis
25 is not being specific, this is a very broad

1 discussion of mixtures even in a matching layer.

2 And I think to be effective, I would need
3 to have some additional details on what are the
4 materials, what are we talking about, what is the
5 functional aspect here to be able to offer a deeper
6 perspective on how that terminology might apply to
7 the blocking layer.

8 BY MR. LINDSAY:

9 Q What would you need to know specifically
10 about the materials?

11 MR. BYUN: Objection, form, outside the
12 scope.

13 THE WITNESS: So to make any assessment as
14 I've done in this process, I would like to see a
15 specific embodiment, I would like to know, okay,
16 what are the material components, what is the film's
17 function, just I would like to better understand
18 exactly what I'm pointing to when I'm making an
19 assessment here.

20 BY MR. LINDSAY:

21 Q To determine whether the matching layer
22 would form a matrix, would you need to know what the
23 specific materials were?

24 MR. BYUN: Objection, form, outside the
25 scope.

1 THE WITNESS: Again, I think ideally when
2 I'm drawing an opinion on a particular part of a
3 device, I like to understand what the layer actually
4 looks like.

5 And so understanding and knowing what the
6 materials are is certainly a helpful part of being
7 able to better understand what the layer does and
8 how to think about its function and even how to
9 think about these terms.

10 BY MR. LINDSAY:

11 Q Would you also want to know the
12 concentration of those materials to determine
13 whether they form a matrix?

14 MR. BYUN: Objection, form, outside the
15 scope.

16 THE WITNESS: I don't think I'd need to
17 know what the concentration is of the various
18 components of the hypothetical blocking layer
19 because there's nothing in the '164 that speaks to
20 particular concentration thresholds for the
21 components of a matrix.

22 BY MR. LINDSAY:

23 Q Going back to our previous discussion
24 about matrix where the materials would be in a
25 continuous phase, that's the part I'm trying to

1 figure out what you need to know.

2 You said you would need to know or it'd be
3 helpful to know the materials, the compound. And
4 what else would you need to know to know whether
5 those materials were in a continuous phase?

6 MR. BYUN: Objection, form, misstates
7 previous testimony.

8 THE WITNESS: I think in thinking about
9 the film, knowing what the molecules are, having
10 certainty, in fact, even that they are molecules
11 because, for example, Choulis lists a mixture of
12 materials with different work functions or HOMO or
13 LUMO energy levels, I don't know if that could
14 potentially include metals then.

15 I would like to better understand the
16 composition of the materials involved. I think
17 that's the primary detail I would be interested in
18 knowing about.

19 BY MR. LINDSAY:

20 Q What would the presence of metals do to
21 your analysis?

22 MR. BYUN: Objection, form, outside the
23 scope.

24 THE WITNESS: I think it's more just
25 understanding would the film be a continuous film,

1 you know, is there some issue where perhaps
2 something else is being intended by Choulis by
3 including some sort of metal in there.

4 I think it's more just making sure that
5 whatever hypothetical embodiment you're asking me to
6 consider is consistent with my understanding of what
7 a functional layer would look like in an OLED that
8 has multiple components.

9 BY MR. LINDSAY:

10 Q Would the presence of a metal suggest a
11 discontinuity in the layer?

12 MR. BYUN: Objection, form, outside the
13 scope.

14 THE WITNESS: So I wouldn't go that far.
15 I guess it's challenging for me to articulate the
16 various, I guess, issues that I could see by having
17 a metal in there perhaps.

18 But I think where I'm coming from more is
19 that in drawing an opinion, I like to have a sense
20 of what the bounds are of the material being
21 considered, you know, what is the material we're
22 looking at.

23 So I'm having -- I'm challenged to sort of
24 draw opinions on hypotheticals without having the
25 chance to think about the hypotheticals.

1 And so the point regarding the metal I'm
2 bringing up just because Paragraph 26 is reasonably
3 broad in what it could include. And so I think I
4 would want to see additional certainty before I
5 start thinking about how I would analyze such a
6 layer in the context of these terms.

7 BY MR. LINDSAY:

8 Q So to properly analyze whether a mixed
9 matching layer is a matrix, you would want to know
10 all of the materials that are in the layer; is that
11 correct?

12 A Yes, I would like to have --

13 MR. BYUN: Objection, form, outside the
14 scope.

15 THE WITNESS: I'd like to have an example.

16 BY MR. LINDSAY:

17 Q And what other piece of information
18 besides the composition of the layer would you need
19 to know?

20 MR. BYUN: Objection, form, outside the
21 scope.

22 THE WITNESS: Again, I think at first
23 glance, that would be the primary thing I'd want to
24 know.

25 But I'd have to think more about -- I

1 guess I'd have to think more just in general as I
2 develop my opinion on this hypothetical layer if
3 there's other information I need.

4 I'm not sure what else I might need, but
5 certainly an actual embodiment with material
6 composition of the various components would be an
7 important starting point.

8 BY MR. LINDSAY:

9 Q So Choulis uses PBD in the light-emitting
10 layer and it's your opinion that the light-emitting
11 layer is a matrix; is that right?

12 A Yes, the light-emitting layer is a
13 functional layer and, yes, it is a matrix.

14 Q How are you able to determine that the
15 light-emitting layer is a matrix but you're not able
16 to determine if a mixed matching layer is a matrix?

17 MR. BYUN: Objection, form.

18 THE WITNESS: So in the context of
19 Choulis's light-emitting layer, I have greater
20 confidence in drawing opinions on, you know, how
21 that layer can be considered and what these
22 different components may or may not be, because I
23 actually know what the components are.

24 The hypothetical you're asking me about, I
25 don't know anything about the system. And so as a

1 result, I'm not comfortable drawing a general
2 opinion.

3 What I'm drawing my opinion on is in the
4 embodiment of Choulis where all of the details are
5 provided, is it a matrix and what are the matrix
6 materials.

7 BY MR. LINDSAY:

8 Q So Choulis identifies the materials that
9 are in the light-emitting layer; right? And that's
10 the basis for your opinion that the light-emitting
11 layer in Choulis forms a matrix?

12 A My opinion is that the matrix -- so in the
13 usage in the '164 and my opinion is that the matrix
14 forms a film and -- a functional layer. And that the
15 matrix in that functional layer are continuous.

16 And based on the materials I'm seeing
17 utilized in Choulis and my understanding of how that
18 layer would be constructed and behave, I'm
19 concluding then that that is a matrix and a
20 functional layer and then I define the matrix
21 material components accordingly.

22 Q Right. But you're given four
23 components -- I'm looking at Figure 4 of Choulis on
24 my other screen here, it's TPD, the emitter, PBD and
25 PVK.

1 If I give you those four compounds and I
2 say, these are mixed in a layer, is it the case that
3 there would be a matrix 100 percent of the time
4 regardless of how those compounds were mixed?

5 MR. BYUN: Objection, form.

6 THE WITNESS: Are you asking me if that
7 was mixed elsewhere, is it a matrix? I guess I just
8 want to make sure I understand --

9 BY MR. LINDSAY:

10 Q Yeah, so let's --

11 A 100 percent of the time is what's giving me
12 pause. So I want to make sure I understand what
13 you're asking.

14 Q Right, yes. So what if Choulis said, I'm
15 going to take those four compounds and use those in
16 my mixed matching layer, TPD, the same emitter, PBD
17 and PVK, and he has now made a mixed matching layer,
18 does that mixed matching layer form a matrix?

19 MR. BYUN: Objection, form, outside the
20 scope.

21 THE WITNESS: So, again, I didn't consider
22 that combination of --

23 BY MR. LINDSAY:

24 Q But it's the same materials you did
25 consider?

1 A Yes. What I was going to say was I didn't
2 consider that combination in a mixed matching layer.
3 So in the context of a matrix forming a film and a
4 matrix consisting of components at that high level,
5 then those are -- the matrix aspect -- provided this
6 is a functional layer, a matrix aspect is still
7 preserved.

8 So, again, I didn't consider that
9 question, but it's possible, I suppose, that such a
10 combination could be a matrix in another layer as
11 well.

12 BY MR. LINDSAY:

13 Q Is it possible that it does not form a
14 matrix?

15 MR. BYUN: Objection, form, outside the
16 scope.

17 THE WITNESS: So I think my only
18 hesitation is that the context in which I've
19 considered matrix is specific to the follow-on usage
20 of the term "matrix materials" in the '164.

21 And so in principle, I think that these
22 four materials might form a matrix outside of the
23 device or outside of the emissive layer, I'm just
24 not sure what -- how that would extend to the rest
25 of the considerations I've made because I haven't

1 thought about the terminology of matrix outside the
2 emissive layer.

3 So, again, it could be a matrix in another
4 layer, but I haven't thought about when it wouldn't
5 and when it would be. So I don't think I can offer
6 more detail on that.

7 BY MR. LINDSAY:

8 Q Right. I guess I'm just asking for the
9 universe of possibilities if these materials were
10 used in a matching layer, in Choulis's mixed
11 matching layer, it's possible that they form a
12 matrix but it's also possible that they would not;
13 is that fair?

14 MR. BYUN: Objection, form, outside the
15 scope.

16 THE WITNESS: So I think it's more just
17 that I haven't considered that. And so I don't know
18 if there's instances where they necessarily
19 wouldn't.

20 I've considered the question of matrix and
21 matrix materials as it pertains to the emissive
22 layer and so that's where I can say with certainty
23 that I have thought about this in detail, I've
24 considered the exhibits and I can provide testimony
25 that I think I can really be confident in the use

1 of, say, those four materials in an alternate layer
2 of a device, again, I can see how that might also be
3 construed as a matrix in a functional layer if that
4 layer also has a function that might be disclosed in
5 the '164 patent.

6 But beyond that, I don't think I can give
7 additional details, I just haven't thought about it
8 enough.

9 BY MR. LINDSAY:

10 Q But a matrix, generally speaking, doesn't
11 need to be in a functional layer; right?

12 MR. BYUN: Objection, form.

13 BY MR. LINDSAY:

14 Q It's used in many areas -- even outside
15 OLED, the term "matrix" is not unique to functional
16 layers; is that correct?

17 A So I am using the term "matrix" and by
18 association "matrix materials" specifically in the
19 context of how I interpret those terms being used in
20 the '164.

21 And so while I agree the term "matrix" has
22 a variety of definitions, I am really focusing my
23 attention to how those are being applied in the
24 '164.

25 So I would be careful to not use

1 definitions that might not have anything to do with
2 the invention.

3 Q So I guess I want to come back then to you
4 concluded that Choulis's light-emitting layer forms
5 a matrix and even with those same compounds used in
6 a mixed matching layer, you can't conclude for sure
7 that it forms a matrix.

8 Can you help me understand why there is a
9 distinction there?

10 MR. BYUN: Objection, form, outside the
11 scope.

12 THE WITNESS: So I want to make sure I'm
13 being clear here.

14 What I'm saying is that I can see how it
15 could be a matrix in a different layer. However, I
16 have not considered the full -- I haven't considered
17 the full porting of the definition to say it must
18 always be a matrix.

19 But what I'm saying is that that blend of
20 four materials in a matrix in a functional layer in
21 a different layer in the device could be a matrix.
22 I could see that being classified as a matrix.

23 In terms of the question of when is it not
24 a matrix, is it 100 percent always a matrix, again,
25 I would want to think a little more about that, but

1 I could see how it could be construed as a matrix in
2 a different layer as well.

3 BY MR. LINDSAY:

4 Q Then in the context of Choulis's emission
5 layer, what piece of information does Choulis
6 disclose that tells you that those materials form a
7 matrix?

8 A So when I'm looking at Choulis's emissive
9 layer and considering the question of matrix
10 specifically in the context of the '164, it's not only
11 the fact that you're forming what is a functional
12 layer, you're forming a matrix, it's also the fact
13 that that matrix also consists of matrix materials
14 that are akin to the matrix materials in the '164.

15 So at that point, because the '164 focuses
16 attention in its examples to an emissive layer, you
17 can do a very clear mapping and understanding of how
18 Choulis discloses the same items in their invention
19 as well.

20 So this comes back to what I was saying
21 before, which is just the fact that when it comes to
22 the emissive layer, there is so much description in
23 the '164 about a matrix and the matrix materials
24 that are components of that matrix that it makes it
25 much more straightforward to then map Choulis's

1 invention to the '164.

2 Q Okay. Let me ask it a different way then.

3 What piece of information does Choulis
4 disclose that tells you that the materials in the
5 light-emitting layer are in a continuous phase?

6 A So Choulis -- I'm going to have to look back
7 at Choulis, give me one moment.

8 So Choulis is describing a light-emitting
9 layer that in their embodiment is being processed
10 out of solution with these multiple components in
11 it. They are clear that this is a layer, it has
12 some measurable thickness, has these multiple
13 components present in the layer.

14 So I am then inferring from that that this
15 is indeed a matrix forming a functional layer, that
16 this is a contiguous layer that has been produced
17 from Choulis's materials.

18 Q Are all contiguous layers in a continuous
19 phase?

20 A The way I'm describing a matrix and the
21 matrix being a continuous phase, continuous as applied
22 to the functional layer itself, to the film itself.

23 And so that film is in a continuous phase.

24 Q Can you help me understand why would that
25 be the case? Is it any functional layer is a

1 mixture of materials that are in a continuous phase;
2 is that what you're saying?

3 A So the --

4 MR. BYUN: Objection, form.

5 THE WITNESS: So the continuous phase
6 aspect is referring to the continuity of the film
7 itself, of the layer itself rather than any
8 individual components.

9 And so my understanding of how Choulis is
10 processing their films is informing my opinion that,
11 yes, this is actually going to lead to a film that
12 could be integrated into the device and actually
13 give a functioning OLED rather than perhaps
14 something that, you know, might be a broken film or
15 something else that may not be as continuous
16 perhaps.

17 BY MR. LINDSAY:

18 Q So when you use the term "continuous
19 phase" to refer to a film, are you saying there's
20 continuity across -- horizontally with no breaks or
21 gaps? Is that what you're saying?

22 MR. BYUN: Objection, form.

23 THE WITNESS: Yes, I'm referring to the
24 film itself as being a continuous film so that the
25 film itself is a -- I guess a uniform perhaps --

1 "uniform" is not the right word. Maybe "continuous"
2 probably is the right word, a continuous film
3 without holes, gaps, breaks, yes.

4 BY MR. LINDSAY:

5 Q Okay. So if there is a film without
6 holes, gaps, breaks, is it your opinion that the
7 materials in that film are necessarily in a
8 continuous phase?

9 MR. BYUN: Objection, form.

10 THE WITNESS: The definition I'm using
11 would suggest that if the film -- the functional
12 layer itself, the film, is continuous in the sense
13 that it wouldn't have gaps and breaks and holes,
14 that, yes, that it is in a continuous phase.

15 BY MR. LINDSAY:

16 Q So you're not looking at the properties of
17 the individual materials in the film to determine if
18 they are in a continuous phase, you're looking at
19 the overall film?

20 A That's correct, yes, I'm looking at the
21 continuous aspect of the matrix and the functional
22 layer rather than the components of the matrix.

23 Q And that's the basis for your opinions --
24 that's the assumption for your opinion regarding
25 Choulis and the other prior art references?

1 MR. BYUN: Objection, form.

2 THE WITNESS: Certainly the basis for
3 Choulis. If by "other prior art" you're referring
4 to Sugiura, then yes.

5 BY MR. LINDSAY:

6 Q And Thompson?

7 A Correct.

8 MR. LINDSAY: Can we go off the record.

9 (Recess taken.)

10 BY MR. LINDSAY:

11 Q Dr. Holmes, still discussing Choulis for a
12 moment, what is the hole transport material that
13 Choulis uses?

14 MR. BYUN: Objection, form.

15 THE WITNESS: So I'm assuming you're
16 referring to the embodiment discussed in
17 Paragraphs 29, 30, 31, that area of the patent?

18 BY MR. LINDSAY:

19 Q No, I'm sorry. I'm referring to the area
20 of the patent that you rely on, you cite in your
21 declaration.

22 A Sure. Yes. So TPD is the hole transport
23 material I'm relying on in my declaration.

24 Q And then how about the electron transport,
25 what is the material that -- in Choulis that you

1 relied on?

2 A PBD.

3 Q What are the concentration gradients for
4 Choulis's hole transport and electron transport
5 materials?

6 MR. BYUN: Objection, form.

7 THE WITNESS: So Choulis doesn't
8 explicitly have a concentration gradient for their
9 hole and electron transport materials in the
10 embodiment I'm looking at.

11 BY MR. LINDSAY:

12 Q Is it that Choulis's hole and transport
13 materials don't have concentration gradients or that
14 Choulis does not disclose what they are?

15 A I think a person reading Choulis would get
16 the impression Choulis isn't inclined to have them not
17 have a gradient.

18 Q If Choulis were to modify its system to
19 have concentration gradients for its hole and
20 transport materials, what -- how would you determine
21 what those gradients were?

22 MR. BYUN: Objection, form.

23 THE WITNESS: So I just want to make sure
24 first I'm clear that we're talking about gradients
25 for the hole and electron transfer material, not the

1 emitter; is that correct?

2 BY MR. LINDSAY:

3 Q That's correct.

4 A So there's -- again, I didn't consider this
5 question for TPD and PBD explicitly, but one can do
6 some depth profile composition measurements on a
7 device to try and probe composition of the emissive
8 layer.

9 Q So physical testing?

10 A Physical testing, yes.

11 So we've done some of this before in
12 collaboration with partners where you literally take
13 the active layer and I think in the work we did, we
14 used -- I think it was x-ray photoelectron
15 spectroscopy which allows you to determine the
16 chemical environment of different atoms. And from
17 that, you can assess which molecules are present.

18 And then what you can do is etch the film
19 away and measure the XPS as you go through the film,
20 which gives you effectively a measure of composition
21 versus depth.

22 MR. LINDSAY: Okay. I'm going to put
23 another reference in the Exhibit Share. It should
24 be Exhibit 1017.

25 (Discussion off the record.)

1 THE WITNESS: I have the exhibit in front
2 of me.

3 BY MR. LINDSAY:

4 Q Are you familiar with the authors of this
5 publication?

6 A I'm not familiar. I don't know these
7 authors, I'm not familiar with them.

8 Q So you don't know who D. Neher is, the
9 second named author?

10 A I don't.

11 Q I'm going to introduce -- this will be a
12 new exhibit, so I'll stamp it Exhibit 2105.

13 (Whereupon, Exhibit 2105 was marked for
14 identification.)

15 BY MR. LINDSAY:

16 Q Let me know when you see that.

17 A Just downloading it.

18 Okay. Yes, I see the exhibit.

19 Q This exhibit is a page from the University
20 of Potsdam describing Professor Dr. Dieter Neher.
21 Is that what we're looking at together?

22 A So I haven't seen this exhibit before or
23 separately checked that this is, in fact, at this URL,
24 but I see that this looks from a group website most
25 likely.

1 Q And does this appear to be the author of
2 Exhibit 1017, the D. Neher, does this appear to be
3 Dr. Dieter Neher?

4 A Let me take a closer look here.

5 MR. BYUN: Objection, form, outside the
6 scope.

7 THE WITNESS: What I was hoping to see was
8 the same email address, it looks like it's not.
9 It's similar.

10 So, again, I can't be certain, but it
11 seems like a logical conclusion perhaps that this
12 would be the same D. Neher.

13 BY MR. LINDSAY:

14 Q The paper identifies the authors as being
15 from the University of Potsdam, which is the same
16 university that Dr. Dieter Neher is at described
17 here?

18 A Yes.

19 Q Okay. And just to further confirm, I'm
20 going to introduce a second exhibit. This will be
21 Exhibit 2106.

22 (Whereupon, Exhibit 2106 was marked for
23 identification.)

24 THE WITNESS: Just downloading it.

25 Okay, I have it open.

1 BY MR. LINDSAY:

2 Q Is this a LinkedIn page for a Dieter
3 Neher?

4 A It looks like a --

5 MR. BYUN: Objection, form, outside the
6 scope.

7 THE WITNESS: It looks like a LinkedIn
8 page for Dieter Neher. I haven't seen this before,
9 though.

10 BY MR. LINDSAY:

11 Q Right.

12 And scrolling down, does it identify this
13 Dieter Neher as a professor at the University of
14 Potsdam since October 1998 through the present?

15 MR. BYUN: Objection, form, outside the
16 scope.

17 THE WITNESS: There is a section that
18 lists experience, professor, University of Potsdam,
19 27 years, since 1998.

20 BY MR. LINDSAY:

21 Q Would you agree then that the D. Neher
22 that is a coauthor on Exhibit 1017 appears to be
23 this Dieter Neher that's at the same university
24 since October 1998?

25 MR. BYUN: Objection, form, outside the

1 scope.

2 THE WITNESS: So, again, based on what
3 you're telling me, that seems consistent.

4 BY MR. LINDSAY:

5 Q Okay. So Exhibit 2105 describes
6 Dr. Neher's experience in two or three paragraphs;
7 correct?

8 MR. BYUN: Objection to form, outside the
9 scope.

10 THE WITNESS: I'll just read the
11 paragraphs quickly.

12 BY MR. LINDSAY:

13 Q Sure.

14 A Yes, that describes his experience.

15 Q And it says that he obtained his Ph.D. in
16 1990 and he became a professor at the University of
17 Potsdam in 1998.

18 Do you see that part, first paragraph?

19 A Yes, I see that part.

20 Q That's consistent with his LinkedIn
21 profile that describes being a professor, off by a
22 month, but since 1998?

23 MR. BYUN: Objection, form, outside the
24 scope.

25 THE WITNESS: Yes, it's consistent.

1 BY MR. LINDSAY:

2 Q So the Exhibit 1017, what is the date that
3 that exhibit was authored?

4 A Looking at the masthead of the article, it
5 looks like it was received on the 10th of November
6 2003, accepted on the 3rd of February 2004. And it
7 looks like it appeared in the April 5th issue of
8 Applied Physics Letters, 2004.

9 Q Okay. So about 13, 14 years after
10 Dr. Neher obtained his Ph.D. and about five or six
11 years after he became a professor at the University
12 of Potsdam did he author or coauthor the Yang and
13 Neher reference; is that right?

14 A I would agree.

15 Q So when he authored the Yang reference, he
16 would have been an expert in the relevant field that
17 he was discussing there. Is that a fair assumption?

18 MR. BYUN: Objection, form, outside the
19 scope.

20 THE WITNESS: I'm just going back to the
21 biographical information you sent me. I'm going to
22 read it again quickly.

23 I suspect that is a reasonable conclusion,
24 that he would be an expert at that point in time.

25 MR. LINDSAY: Let me introduce another

1 exhibit for a moment here, if you give me a second.

2 So this is previously marked Exhibit 1006.

3 This would be the Sugiura reference.

4 THE WITNESS: Okay. I have it open.

5 BY MR. LINDSAY:

6 Q I guess just generally -- let me step
7 back.

8 What is the difference between the molar
9 ratio and the weight ratio of a mixture of
10 materials?

11 A So one is based exclusively on the mass of
12 each component of the blend, if you like, while the
13 other one is based on the number of moles and it
14 accounts for the molecular weight as well.

15 Q So if a person were interested in
16 determining whether a material was in a continuous
17 phase or not, would knowing the molar ratio of those
18 materials be useful?

19 A I'm sorry, you're talking about
20 understanding whether a component material in a blend
21 or a film might be in a continuous phase?

22 Q Right. Let's take both situations.

23 So if a person in the art were interested
24 in determining whether a mixture of materials were
25 in a continuous phase, would knowing the molar ratio

1 of those materials be useful?

2 A So if you're -- again, if you're talking
3 about a film, the aggregate of all of the components
4 potentially, I don't think the molecular rate and the
5 molar ratio is essential because as I discussed
6 earlier, the film itself is what is considered as
7 continuous or not continuous.

8 So whether individual components have
9 certain molar concentrations or not, I don't think
10 that becomes essential for determining whether the
11 film itself is continuous.

12 Q Okay. So then now I guess we can look at
13 Sugiura. And in particular, if we want to look
14 at -- sorry, my screen is acting up.

15 Paragraph 62, this relates to Example 8;
16 correct?

17 A I'm at 62.

18 Q This is describing the configuration, the
19 Example 8 is what -- so is that what it's referred
20 to as?

21 A Yes.

22 Q How does this relate to Figure 4 in
23 Sugiura?

24 A I'm just going to look at Figure 4 in that
25 paragraph.

1 So just in general, Figure 4 is the
2 schematic representation of Example 8's
3 architecture.

4 Q Okay. And Figure 4 is what you cited in
5 your original declaration to show that Sugiura
6 discloses first, second and third matrix material in
7 your opinion; right?

8 A That's correct.

9 Q Did -- you strike that.

10 In your reply declaration, you mention the
11 weight ratio that's described in Paragraph 62.

12 A Can you point to a specific paragraph just
13 to make sure -- I'm in my reply declaration.

14 Q Yes, one second.

15 So Paragraph 59.

16 A Yes, I reference that ratio.

17 Q Why did you reference that ratio exactly?
18 What was the point of that?

19 A Let me reread 59.

20 I think I'm just being complete in my
21 representation of what's described in Sugiura in
22 Paragraph 62, just offering context with the
23 compositions as well that Sugiura uses.

24 Q I guess what is the citation of that
25 weight ratio supporting, which opinion of yours?

1 A I don't think that ratio is necessarily
2 supporting -- needed to support the opinion.

3 I'm just demonstrating or calling out the
4 fact that Sugiura is using a mixture in this ratio
5 and I'm pointing to the components of that mixture
6 as the matrix materials.

7 Q Okay. But the first sentence of your
8 Paragraph 59 is drawing a conclusion about Sugiura's
9 hole and electron transport materials as not being
10 dispersed agglomerations; right?

11 A Yes.

12 Q Is that opinion what you're supporting
13 with a citation to Sugiura's weight ratio for
14 Example 8?

15 A No, because the -- again, the concentration
16 is not -- or the weight ratio is not something that I
17 need to invoke to define what the matrix materials are
18 in the blend.

19 So I think what I'm doing there is just
20 setting up the follow-on discussion of how I
21 disagree with Dr. Sims's assessment that these
22 materials are dispersed agglomerations.

23 And I think I listed the ratio just in
24 order to give context in the sense that this is
25 indeed a blend and these are the ratios in which the

1 materials blended together.

2 Q Okay. So you determined that Sugiura's
3 hole and electron transport materials are not
4 dispersed agglomerations using what information in
5 Sugiura?

6 A So there is a few different pieces of
7 information I utilize. I note first that Sugiura is
8 clear that the TPD and Alq materials are the hole and
9 electron transport materials.

10 And if they were truly dispersed
11 agglomerations in the way Dr. Sims describes, that
12 would make hole and electron transport much more
13 difficult and compromise device performance.

14 And then second of all, I point to the
15 data that's explicitly described in Sugiura and show
16 that the addition of, say, Alq as an electron
17 transporting material actually does improve device
18 efficiency, which one would not expect if it was
19 just going into the film as a dispersed
20 agglomeration.

21 So I'm supporting my conclusion that
22 that's not what is present in Sugiura by Sugiura's
23 description of their device functionality and their
24 device data.

25 Q So you're drawing an inference about

1 Sugiura's device and how it would be expected to
2 operate in forming your opinion that Sugiura's hole
3 and electron transport materials are not dispersed
4 agglomerations; is that right?

5 MR. BYUN: Objection, form.

6 THE WITNESS: That's part of what I said.
7 And so, again, in Paragraph 60 of my reply
8 declaration, I note that Sugiura is explicit in
9 noting that both holes and electrons have to readily
10 flow through their active layer or functional
11 emissive layer.

12 And that if the hole and electron
13 transporting materials were present only as
14 dispersed agglomerations as Dr. Sims is proposing,
15 that functionality would not be possible and would
16 not be what Sugiura or another inventor would be
17 trying to realize.

18 But second of all, the data in Sugiura, as
19 I show in Paragraph 61, also supports that when
20 those hole and electron transporting materials are
21 included in the mixture, that they can carry
22 electrons and holes which, again, would be counter
23 to what one would expect with a dispersed
24 agglomeration, with islands, so to speak, as
25 Dr. Sims proposes.

1 So I would say it's stronger than an
2 inference because I think Sugiura's data also
3 confirms this reading of their work.

4 BY MR. LINDSAY:

5 Q But Sugiura doesn't expressly disclose
6 that the hole and transport materials are not
7 dispersed agglomerations?

8 A Sugiura does not expressly disclose that
9 they are not dispersed agglomerations. However, I
10 think it's clear based on what I've said and further
11 supported by Sugiura's processing method that that
12 would not be expected in their device.

13 MR. LINDSAY: Let me introduce a couple
14 more exhibits.

15 I just introduced Exhibit 2107.

16 (Whereupon, Exhibit 2107 was marked for
17 identification.)

18 BY MR. LINDSAY:

19 Q I'll let you pull that up.

20 A I have it up.

21 Q Are you familiar with the company
22 Sigma-Aldrich?

23 A Yes, I'm familiar with the company
24 Sigma-Aldrich.

25 Q What do you know about the company

1 Sigma-Aldrich?

2 MR. BYUN: Objection, outside the scope.

3 THE WITNESS: They are a chemical company.

4 BY MR. LINDSAY:

5 Q Do they sell chemical compounds?

6 A Yes.

7 Q This page that I introduced as
8 Exhibit 2107, is this one of the chemicals that
9 Sigma-Aldrich sells, namely PVK?

10 MR. BYUN: Objection, outside the scope.

11 THE WITNESS: So first, I haven't seen
12 this exhibit before and I haven't looked at it.
13 But, no, it does not describe PVK.

14 BY MR. LINDSAY:

15 Q What is it describing?

16 MR. BYUN: Objection, outside the scope.

17 THE WITNESS: Under product name, it says
18 9-vinylcarbazole.

19 BY MR. LINDSAY:

20 Q Is this a monomer for PVK?

21 MR. BYUN: Objection, outside the scope.

22 THE WITNESS: This could be considered the
23 monomer for PVK. This would be part of the repeat
24 unit.

25

1 BY MR. LINDSAY:

2 Q The molecular weight for PVK monomer is
3 about 193 grams per mol it says?

4 A That's what it says.

5 MR. BYUN: Objection, outside the scope.

6 BY MR. LINDSAY:

7 Q Does that comport with your understanding
8 of the molecular weight of PVK?

9 MR. BYUN: Same objection.

10 THE WITNESS: I haven't previously
11 calculated the molecular weight of the
12 vinylcarbazole monomer that you're showing here.

13 BY MR. LINDSAY:

14 Q Do you have any reason to believe this
15 information is incorrect?

16 MR. BYUN: Objection, outside the scope.

17 THE WITNESS: Again, I don't have any
18 reason to believe it's incorrect. But I have not
19 looked into detail as to whether it is or isn't.

20 I haven't this before, nor have I thought
21 about the mass of this particular molecule.

22 BY MR. LINDSAY:

23 Q As a company that you know that sells
24 chemical compounds, would you expect that they would
25 list the correct molecular weight on their website?

1 MR. BYUN: Objection, outside the scope.

2 THE WITNESS: I would assume that
3 Sigma-Aldrich is listing the correct molecular
4 weight on their website.

5 MR. LINDSAY: Let me introduce another
6 exhibit. This will be 2108.

7 (Whereupon, Exhibit 2108 was marked for
8 identification.)

9 THE WITNESS: I'm going to view it in
10 Veritext because it's giving me an error when I try
11 to download it.

12 MR. BYUN: Same for me.

13 THE WITNESS: There must be something
14 wrong with it, but I can see the exhibit in
15 Veritext.

16 BY MR. LINDSAY:

17 Q Are you familiar with the company Lumtec?

18 A I'm familiar with the company Lumtec.

19 Q What does Lumtec do?

20 MR. BYUN: Objection, outside the scope.

21 THE WITNESS: Lumtec is also a chemical
22 company.

23 BY MR. LINDSAY:

24 Q And is this a page that's describing the
25 chemical aluminum Q3?

1 MR. BYUN: Objection, outside the scope.

2 THE WITNESS: Again, can you just -- you
3 are asking is there their web page for Alq3?

4 BY MR. LINDSAY:

5 Q Yes.

6 A It looks like it could be.

7 Again, I'm not familiar with the web page
8 for Alq3 specifically, but this looks like a web
9 page that might be on their site.

10 Q And as a person of ordinary skill in the
11 art, you would agree that consulting Lumtec website
12 for chemical properties would be reasonable?

13 MR. BYUN: Objection, outside the scope.

14 THE WITNESS: So I would not quite agree
15 with that. Can you be specific about chemical
16 properties?

17 BY MR. LINDSAY:

18 Q Let's focus on the molecular weight.

19 A You're asking is the molecular weight
20 something I consider reliable on this web page?

21 Q Yes.

22 MR. BYUN: Objection, outside the scope.

23 THE WITNESS: So molecular weight I would
24 say is probably the one I would trust the most out
25 of the various things listed.

1 BY MR. LINDSAY:

2 Q Okay. And you cited to this -- you've
3 cited to Lumtec web pages before in support of your
4 declaration in other IPRs; right?

5 A Can you be specific to what other IPR
6 proceeding you're referring to?

7 Q Do you remember citing to Lumtec web
8 pages?

9 A Just in another IPR?

10 Q In another IPR that's related to this one.

11 A I don't have my declaration or reply
12 declaration in front of me for the '425 IPR I'm also
13 involved with, but, yes, I think I recall citing to a
14 Lumtec web page. But I would have to have my
15 declaration to be certain.

16 Q I'm not -- sorry. I'm not trying to play
17 gotcha with you.

18 In the '425 IPR, you cite to an exhibit
19 that is a page from the Lumtec website. So I picked
20 this one because I would assume that you had some
21 confidence that the information was accurate.

22 A Yes, and that's why I said the molecular
23 weight would be the property I would trust the most.

24 Q Okay. And the molecular weight that
25 Lumtec lists for aluminum Q3 is about 459 grams per

1 mol?

2 MR. BYUN: Objection, outside the scope.

3 THE WITNESS: Yes, it lists 459.43 grams
4 per mol.

5 MR. LINDSAY: Okay. One last one on this.
6 This will be Exhibit 2109. You may want to open it
7 in Veritext because it's also from Lumtec.

8 THE WITNESS: Same error. I can see it in
9 Veritext.

10 (Whereupon, Exhibit 2109 was marked for
11 identification.)

12 BY MR. LINDSAY:

13 Q What is Exhibit 2109?

14 MR. BYUN: Objection, form, outside the
15 scope.

16 THE WITNESS: So I haven't seen
17 Exhibit 2109 before.

18 BY MR. LINDSAY:

19 Q What does Exhibit 2109 appear to be to
20 you?

21 MR. BYUN: Objection, outside the scope.

22 THE WITNESS: It looks similar to the
23 document you just showed me for Alq, so I assume
24 this is a product page for TPD on Lumtec's web page.

25

1 BY MR. LINDSAY:

2 Q All right. And there is a molecular
3 weight for TPD that's listed on the second page;
4 correct?

5 A That's correct.

6 Q And that molecular weight is about
7 516 grams per MOL; is that what you're seeing?

8 A Yes, I see 516.67 grams per mol.

9 Q Would you expect that information to be
10 accurate?

11 MR. BYUN: Objection, outside the scope.

12 THE WITNESS: So as I said for the case of
13 Alq, I don't have any reason to believe that's not
14 accurate.

15 BY MR. LINDSAY:

16 Q We've looked at the molecular weight for
17 PVK, Alq3 and TPD. Are those the materials that --
18 along with the emitter, are those the materials that
19 Sugiura uses in Example 8 and shows in Figure 4,
20 same materials?

21 A So I just want to correct one thing. We
22 didn't look at the molecular weight of PVK, just the
23 vinylcarbazole.

24 Q The PVK -- okay. Let's talk about that
25 for a second.

1 So the PVK that Sugiura uses in its
2 composition of Example 8, that would not be the
3 monomer version that we just looked at?

4 A No, because Sugiura is using PVK, which
5 means it's polymerized, which means it would be
6 heavier than the monomer. The monomer is just one
7 repeat unit, PVK as a polymer would have many.

8 Q Would the molar ratio or the chemical
9 composition of Example 8 be the same or different
10 than its weight ratio?

11 MR. BYUN: Objection, form.

12 THE WITNESS: The molar ratio would be
13 different.

14 BY MR. LINDSAY:

15 Q In fact, it would be significantly
16 different; right?

17 MR. BYUN: Objection, form.

18 THE WITNESS: It could be depending on
19 what molecular weight is used for PVK.

20 BY MR. LINDSAY:

21 Q If we use the polymer molecular weight,
22 that would be several times greater than the monomer
23 molecular weight; right?

24 A Yes, that's why I'm saying it depends on the
25 molecular weight of PVK because that one is so

1 different from the small molecules.

2 Q Right. So whether you use the monomer or
3 the polymer, you get a different ratio but it would
4 be significantly different than the weight ratio?

5 MR. BYUN: Objection, form, outside the
6 scope.

7 THE WITNESS: So I want to make sure I'm
8 clear. It will depend on whether you use the
9 polymer or the monomer.

10 If you use the monomer, the mol ratios
11 will be much more similar to the weight ratios than
12 if you use the polymer. Because the monomer has a
13 molecular weight that is approximately closer to the
14 other molecules in the blend while the polymer has a
15 molecular weight much, much heavier than the
16 molecules in the blend.

17 BY MR. LINDSAY:

18 Q All right. So let's take them I guess
19 separately then.

20 For the monomer, the molecular weight of
21 PVK is less than half or more than the molecular
22 weight of TBD and Alq3?

23 A I just want to make sure we're using the
24 right terms here. So this is the monomer, not PVK;
25 correct?

1 Q Right. We'll start with the monomer PVK
2 and then we'll talk about the polymer. But you said
3 of the two, the monomer would be closest?

4 A Closer, yes.

5 Q Closer. So I'm trying to figure out how
6 close.

7 So for the monomer at 193, that's less
8 than half, if not more, than the molecular weights
9 for the other compounds, Alq3 and TPD; right? So
10 that would have a significant impact, even that
11 would have a significant impact --

12 MR. BYUN: Objection, form.

13 BY MR. LINDSAY:

14 Q -- on the ratio when you compare the molar
15 ratio to the weight ratio?

16 MR. BYUN: Objection, form, outside the
17 scope.

18 THE WITNESS: So, again, I haven't
19 calculated the mole ratio per se, but it would be
20 different than the weight ratio given that
21 difference in molecular weight.

22 BY MR. LINDSAY:

23 Q I mean, it would be -- again, when you're
24 talking about the fact that it's half -- more than
25 half the molecular weights of the other compounds,

1 you would expect the ratio to also be on that order
2 different?

3 MR. BYUN: Objection, form, outside the
4 scope.

5 THE WITNESS: Again, that depends on the
6 molecular weights of the other components as well.
7 BY MR. LINDSAY:

8 Q In our example here, we're talking about
9 the monomer PVK, it's less than half of the
10 molecular weights of the other compounds, so the mol
11 ratio would be on the order of at least 2X
12 different; right, than the weight ratio?

13 MR. BYUN: Objection, form, outside the
14 scope.

15 THE WITNESS: I can certainly grant that
16 the difference in molecular weight between
17 vinylcarbazole and at least Alq and TBD, I don't
18 know the molecular weight of Nile Red, would mean
19 that the mol ratio would change.

20 I would have to do the calculation to
21 double check by exactly how much, but I agree it
22 would change.

23 BY MR. LINDSAY:

24 Q Okay. So the Nile Red is .2 percent, so
25 I'm excluding that for purposes of our

1 generalizations.

2 A Yes.

3 Q And I'm just trying to understand when you
4 say different, I mean we're talking about order --
5 at least an order of two different; right?

6 MR. BYUN: Objection, form, outside the
7 scope.

8 THE WITNESS: So, again, I would want to
9 do the calculation, but I would agree it will be
10 different.

11 BY MR. LINDSAY:

12 Q If we use the polymer, do you happen to
13 know the molecular weight for PVK polymer?

14 MR. BYUN: Objection, form, outside the
15 scope.

16 THE WITNESS: Sugiura actually lists their
17 molecular weight.

18 BY MR. LINDSAY:

19 Q And what is that?

20 A Paragraph 52.

21 Q What is the -- I'm just asking you for the
22 record, if you can --

23 A Sure. So in Paragraph 52, Sugiura notes
24 that "For the light-emitting layer 3,
25 poly-N-vinylcarbazole (PVK) (molecular weight of

1 approximately 28,000) was used for polymer 3A," and
2 then the sentence continues.

3 So 28,000 grams per mol would be the
4 molecular weight of PVK.

5 Q So again, the mol ratio would be
6 substantially different than the weight ratio that
7 Sugiura lists; right?

8 MR. BYUN: Objection, form, outside the
9 scope.

10 THE WITNESS: I don't disagree. The
11 molecular weight difference is significant.

12 MR. LINDSAY: I have no further questions
13 for now. I pass the witness.

14 MR. BYUN: Let me take a break.

15 MR. LINDSAY: Okay.

16 (Recess taken.)

17 EXAMINATION

18 BY MR. BYUN:

19 Q Dr. Holmes, earlier today you testified
20 that Djobo is not considering a phosphorescent
21 emitter in its work. Do you recall that?

22 A Yes, I recall that.

23 Q Would a person of ordinary skill in the
24 art looking at Djobo not consider using Djobo's
25 method with phosphorescent emitter?

1 A No.

2 MR. LINDSAY: Objection to form.

3 THE WITNESS: I think I testified earlier
4 that there's nothing in my opinion in Djobo that
5 would teach against using a phosphorescent emitter.
6 BY MR. BYUN:

7 Q Dr. Holmes, earlier today you also
8 testified that you're not aware of a work that uses
9 evaporated PVK in a phosphorescent OLED.

10 Do you recall that testimony?

11 A I recall that testimony.

12 Q Does that impact your opinion as to
13 whether it would have been obvious to use evaporated
14 PVK in a phosphorescent OLED?

15 A No, it does not.

16 And as I described in my original
17 declaration, I think it would have been obvious to a
18 person skilled in the art to look at the results of
19 Djobo, see that the resulting film actually still
20 emits blue light, transports holes connected in OLED
21 and, hence, apply PVK using vapor processing in a
22 phosphorescent LED.

23 Q Can you turn to your reply declaration,
24 please.

25 A Sure, just give me a minute.

1 What page?

2 Q Paragraph 14, please.

3 A Okay. I'm there.

4 Q Do you remember discussing Paragraph 14
5 earlier today?

6 A Yes, in the context of the Li paper.

7 Q Right. You cite the Li paper, which is
8 Exhibit 1033?

9 A Correct.

10 Q And Exhibit 1033 is not prior art;
11 correct?

12 A No, Exhibit 1033 is not prior art.

13 Q What is the reason you cited Exhibit 1033
14 in Paragraph 14 even though it is not prior art?

15 A So as I noted earlier in that Paragraph 14,
16 I cited that paper in response to Dr. Sims's argument
17 that matrix material would exclude a dopant.

18 MR. BYUN: Pass the witness.

19 FURTHER EXAMINATION

20 BY MR. LINDSAY:

21 Q Dr. Holmes, did you discuss your testimony
22 today with counsel during the last break?

23 A No, I did not.

24 Q Did you discuss your testimony with
25 counsel during any of our breaks today?

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A No, I did not.

MR. LINDSAY: No further questions.

(Proceedings concluded at 12:16 p.m.)

1 I, LYNNE M. LEDANOIS, a Certified
2 Shorthand Reporter of the State of California, do
3 hereby certify:

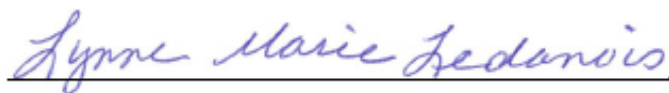
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17 IN WITNESS WHEREOF, I have this date
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21
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LYNNE MARIE LEDANOIS

25 CSR No. 6811

1 NAME OF CASE: Samsung Display vs Pictivia
2 DATE OF DEPOSITION: 9/12/25
3 NAME OF WITNESS: Russell Holmes
4 Reason codes:
5 1. To clarify the record.
6 2. To conform to the facts.
7 3. To correct transcription errors.
8
9 Page ____ Line ____ Reason____
10 From _____ to_____
11
12 Page ____ Line ____ Reason____
13 From _____ to_____
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18 Page ____ Line ____ Reason____
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Signature of Deponent

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1 JONATHAN LINDSAY, ESQ.

2 jlindsay@irell.com

3 September 14, 2025

4 RE: Samsung Display Co., LTD. v. Pictiva Displays International
5 LTD.

6 9/12/2025, Russell Holmes, (#7567678).

7 The above-referenced transcript has been
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3 make any necessary corrections on the errata pages included
4 below, notating the page and line number of the corrections.
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6 of perjury pages and return the completed pages to all
7 appearing counsel within the period of time determined at
8 the deposition or provided by the Federal Rules.
9 _x_ Federal R&S Not Requested - Reading & Signature was not
10 requested before the completion of the deposition.

[& - 4]

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Federal Rules of Civil Procedure

Rule 30

(e) Review By the Witness; Changes.

(1) Review; Statement of Changes. On request by the deponent or a party before the deposition is completed, the deponent must be allowed 30 days after being notified by the officer that the transcript or recording is available in which:

(A) to review the transcript or recording; and

(B) if there are changes in form or substance, to sign a statement listing the changes and the reasons for making them.

(2) Changes Indicated in the Officer's Certificate. The officer must note in the certificate prescribed by Rule 30(f)(1) whether a review was requested and, if so, must attach any changes the deponent makes during the 30-day period.

DISCLAIMER: THE FOREGOING FEDERAL PROCEDURE RULES ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY.

THE ABOVE RULES ARE CURRENT AS OF APRIL 1, 2019. PLEASE REFER TO THE APPLICABLE FEDERAL RULES OF CIVIL PROCEDURE FOR UP-TO-DATE INFORMATION.

VERITEXT LEGAL SOLUTIONS

COMPANY CERTIFICATE AND DISCLOSURE STATEMENT

Veritext Legal Solutions represents that the foregoing transcript is a true, correct and complete transcript of the colloquies, questions and answers as submitted by the court reporter. Veritext Legal Solutions further represents that the attached exhibits, if any, are true, correct and complete documents as submitted by the court reporter and/or attorneys in relation to this deposition and that the documents were processed in accordance with our litigation support and production standards.

Veritext Legal Solutions is committed to maintaining the confidentiality of client and witness information, in accordance with the regulations promulgated under the Health Insurance Portability and Accountability Act (HIPAA), as amended with respect to protected health information and the Gramm-Leach-Bliley Act, as amended, with respect to Personally Identifiable Information (PII). Physical transcripts and exhibits are managed under strict facility and personnel access controls. Electronic files of documents are stored in encrypted form and are transmitted in an encrypted

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