1 UNITED STATES PATENT AND TRADEMARK OFFICE
2 BEFORE THE PATENT TRIAL AND APPEAL BOARD
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4 LG ENERGY SOLUTION, LTD.,
5
Petitioner,
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v.
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8 MOLECULAR REBAR DESIGN, LLC,
9 Patent Owner.
10
Case IPR2024-01006 (US Patent No. 8,808,909)
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Ref. 18768-0210IP4
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VIDEOCONFERENCE DEPOSITION OF
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DEBORAH D.L. CHUNG, Ph.D.
14
INDIVIDUALLY AND ON BEHALF OF
15
PATENT OWNER
16
JULY 1, 2025
17
Page 1 - 71 9:03 a.m. to 11:51 a.m. EST
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REPORTED BY:
20 Tamara L. Houston
CA CSR No. 7244, RPR, CCRR No. 140
21 Job Number J12853867
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REMOTE VIDEOCONFERENCE DEPOSITION OF DEBORAH D.L. CHUNG, Ph.D., taken on behalf of the Petitioner, commencing from 9:03 a.m. to 11:51 a.m. EST, Tuesday, July 1, 2025, before Tamara L. Houston, CSR No. 7244, CCRR, RPR.

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LG ENERGY SOLUTION, LTD. vs. MOLECULAR REBAR DESIGN, LLC

JULY 1, 2025

Tamara L. Houston, CSR No. 7244, CRR No. 140, RPR

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NO EXHIBITS MARKED

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REMOTELY HELD AND REPORTED FROM THE STATE OF CALIFORNIA

TUESDAY, JULY 1, 2025, 9:03 A.M.

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COURT REPORTER: My name is Tamara Houston, California Certified Shorthand Reporter Number 7244.

--o0o--

Whereupon, DEBORAH D.L. CHUNG, PH.D., having been called as a witness was duly sworn to tell the truth, the whole truth, and nothing but the truth testified as follows:

--o0o--

EXAMINATION BY MR. IN:

Q. Good morning, Dr. Chung.

How are you?

A. Good.

Q. It's good to see you again. My name is Hyun Jin In, representing Petitioner here. I'm joined by my colleagues, Mr. Daniel Jang and Dr. Gretchen DeVries.

How are you this morning, Dr. Chung?

A. Good.

Q. Could you please just state your full name for the record, please?

A. Deborah D.L. Chung.

Q. Okay. And we just went through two

depositions last week for the related '649 and '282 patents, so I think we'll skip through a lot of the deposition background-type questions.

Will that be okay with you, Dr. Chung?

A. Yes.

Q. Okay. Great.

Do you have any documents or applications open on your computer right now?

A. No.

Q. Do you have any notes or physical documents with you?

A. Those documents, like my declaration and all, the exhibits pertinent to this case.

Q. Okay. And those are clean copies with no notes --

A. Yes.

Q. -- in them?

And just to make things easy for the court reporter, if you could just wait until I'm completely done with my questions, and then if you could answer, that would be great. Thank you.

So since your deposition last Friday, did you do anything to prepare for today's deposition, Dr. Chung?

A. Yes.

MR. ZINDA: I'm going to object to the extent it calls for the disclosure of attorney-client or product communications or documents.

But you can otherwise answer.

THE WITNESS: Yeah, I reviewed my -- my declaration and the main exhibit. And I also discuss with the counsel.

BY MR. IN:

Q. So you discussed with counsel from -- let me strike that.

So you discussed with Mr. Zinda; is that right?

MR. ZINDA: Object -- objection to the extent it calls for disclosure of privileged information.

You can otherwise answer, Dr. Chung.

THE WITNESS: Yeah, I discuss with Mr. Zinda.

BY MR. IN:

Q. Did you discuss with anyone else?

MR. ZINDA: Same objection.

THE WITNESS: No.

BY MR. IN:

Q. How many hours would you say you spent in preparing for today's deposition?

MR. ZINDA: Same objection.

THE WITNESS: Could be four hours.

BY MR. IN:

Q. Did you speak with anyone from -- from MRD in preparing for today's deposition?

MR. ZINDA: Same objections.

THE WITNESS: No.

BY MR. IN:

Q. Great. Thank you.

So today, Dr. Chung, as you know, I will be asking you questions concerning IPR -- proceeding number IPR 2024-01006 related to U.S. patent number 8,808,909; is that right, Dr. Chung?

A. Yes.

Q. And when I say the '909 patent, you'll know that I'm referring to this patent, correct?

A. Yes.

Q. Great.

So earlier, I uploaded Exhibit 2006, your declaration, into the chat.

Do you have that with you, Dr. Chung?

A. Yes.

Q. If you could turn with me to page 28 of your declaration around paragraph 57. Let me know when you're there.

A. Paragraph 57?

Q. Yes, thereabouts. Page 28.

A. Okay. I have it.
Q. Okay. So in this section, you're providing -- or you've provided a technology -- technological background relevant to the '909 patent; is that right?
A. Yes.
Q. And in paragraph 58 there, you've provided a schematic.
Can you tell me what that is?
A. Yeah.
MR. ZINDA: Object to form. Excuse me.
THE WITNESS: Okay. This schematic depicts the cathode on the current collector. And, also, it also provides in (b) a more -- a bigger view of the system including the cathode, anode, and the separator in between.
BY MR. IN:
Q. And did you create this schematic yourself, Dr. Chung?
A. No.
Q. Do you recall who did?
A. Okay. It's in MRD-2037.
Q. Okay. So this schematic came from MRD-2037; is that right?
A. As far as I can remember.
Q. So I think you said this before, but just to

get a bit more into the details, on the left side of that schematic, next to letter (a), it says, "Composite electrode."

What is being shown there, Dr. Chung, under "Composite electrode"?

A. Okay. The composite electrode includes a few components, the active material, the conductive additive, and the polymer binder.

Q. And what is the function of the composite electrode as shown there in paragraph 58?

MR. ZINDA: Objection. Form.

THE WITNESS: Well, in this illustration, this electrode functions as a cathode.

BY MR. IN:

Q. Great. Thank you.

And why is it called a composite electrode as opposed to just a regular electrode?

MR. ZINDA: Objection. Form.

THE WITNESS: Just because it is a composite material involving several components put together.

BY MR. IN:

Q. What are those components?

A. The active material, conductive additive, and polymer binder.

Q. Is it pretty common in the industry to use a

composite electrode as -- such as what is shown here in lithium-ion battery applications?

MR. ZINDA: Objection. Form.

THE WITNESS: Yes, it is common using composite, not necessarily this particular composite; but using composites to formulate electrodes, that's very common.

BY MR. IN:

Q. Okay. And what is some benefits of using a composite material as opposed to a noncomposite material?

A. A composite material -- because it comprises a number of components, it provides the functionality of these components exhibited in that one electrode.

Q. Okay. So if we could maybe start with what you've shown here as the active material.

What is a functionality of that active material?

MR. ZINDA: Objection. Form.

THE WITNESS: The active material is the electrochemically active component that participates in the electrochemical reaction.

BY MR. IN:

Q. What -- what are some common examples of materials that are used for that purpose?

MR. ZINDA: Objection. Form.
THE WITNESS: Well, in this particular schematic, it is the lithium cobalt oxide.
BY MR. IN:
Q. And below that, it says, "polymer binder."
Can you tell me what the polymer binder is used for?
A. The polymer binder or binder in general is to hold the components together so that the electrode is one piece.
Q. So what would happen if a binder were not present in a composite electrode?
MR. ZINDA: Objection. Form.
THE WITNESS: If the binder is absent, then the composite might be mechanically very flimsy.
BY MR. IN:
Q. And what are some example materials that are used as binders in these types of applications, Dr. Chung?
MR. ZINDA: Objection. Form.
THE WITNESS: Polymer binders. One of the most common polymers is PVDF.
BY MR. IN:
Q. Are there any other commonly used polymer materials for binder applications?

MR. ZINDA: Objection. Form.

THE WITNESS: Oh, obviously the PVDF is by far the most common. PVDF is an example of a fluorocarbon and is a whole family of fluorocarbons. It's not just one, and also there can be homopolymers and copolymers.

BY MR. IN:

Q. And what about PVDF makes it ideal for use as a binder in these composite electrodes?

MR. ZINDA: Objection. Form.

THE WITNESS: Yeah, PVDF is very good in that it is chemically resistant and is mechanically pretty strong, and it's quite processable. And it's commonly quite stable.

BY MR. IN:

Q. Is PVDF a conductive material or an insulated material?

A. It is not -- the PVDF is not conductive.

Q. Okay. So PVDF is an electrical insulator; is that right, Dr. Chung?

A. Yes.

Q. Okay. So, for instance, if I have one active particle and another active particle and those two active particles are bridged by a PVDF binder in between, is there an electrical connection between the two active particles?

MR. ZINDA: Objection. Form.

THE WITNESS: No. Unless you have something else, you know, between the two active particles; but if you only have PVDF and nothing else, then you wouldn't have electrical connection between the two active particles.

BY MR. IN:

Q. So what would be an example of this "something else" that could help achieve that electrical connection between the two active particles?

MR. ZINDA: Objection. Form.

THE WITNESS: The presence of a conductive additive.

BY MR. IN:

Q. And I think that leads me to my third question about the third constituent here in your schematic; namely, the conductive additive.

What is the function of the conductive additive in this context?

MR. ZINDA: Objection. Form.

THE WITNESS: The conductive additive is to enable the overall composite to exhibit conductivity and, in addition, helps the overall composite electrode to be electrically connected to the current collector.

BY MR. IN:

Q. And how does the active -- strike that.

Then how does the conductive additive help achieve this electrical connectivity that you just talked about?

MR. ZINDA: Objection. Form.

THE WITNESS: The conductive additive needs to be able to provide the electrical conduction linkages so that the -- so that you can have current flowing as needed in the operation of the battery. And you cannot have an open circuit inside the electrode or between the electrode and the current collector.

BY MR. IN:

Q. And what do you mean when you say "electrical conductive linkages"? Can you expand on what that means?

A. Okay. You have A and B which -- let's say they are not conductive, but then you want to electrically connect the two. Then the presence of a conductive additive between the two would provide linkage. Actually, the linkage doesn't have to be between A and B that are not conductive. Even if they are conductive, if they are not touching one another, then a conductive additive in between the A and B would provide an electrically conducting path between A and B.

Q. And in order to provide this electrically conducting path, does the conductive additive need to be in physical contact with the active material?

MR. ZINDA: Objection. Form.

THE WITNESS: Active material is very often not conductive as in this particular example, the lithium cobalt oxide. And so in order for this nonconductive species to be able to function so that when it undergoes the electrochemical reaction, whatever charges that come out of the win to this then needs to be a conduit for the charges to go in or to go out. Okay. Obvious active material. And that's why the conductive additive needs to be in physical contact with the active material so that the charges can come out or go in of this active material particle.

BY MR. IN:

Q. And what are some example materials that are commonly used for the conductive additive?

A. The most --

MR. ZINDA: Objection. Form. Sorry. Delayed.

THE WITNESS: The most common is carbon black.

BY MR. IN:

Q. Are there any other commonly used additive materials?

MR. ZINDA: Objection. Form.
THE WITNESS: Much less common is carbon nanotube.
BY MR. IN:
Q. Are there any other materials that you could think of?
MR. ZINDA: Objection. Form.
THE WITNESS: Oh, there can be other materials, even graphite.
BY MR. IN:
Q. But regardless of what specific material is used as the conductive additive, fair to say they all function in a similar way by providing this electrical path that you just talked about?
MR. ZINDA: Objection. Form.
THE WITNESS: Yes.
BY MR. IN:
Q. So in your declaration now, Dr. Chung, let me go back a little bit to paragraph 52 on page 27.
A. Okay. I have it.
Q. And that is the Claim Construction paragraph; is that right?
A. Yes. Yes.
Q. Have you provided a specific construction for any particular claim terms in this patent, Dr. Chung?

A. As this very patent '909 explains, discrete CNTs are those that are individually dispersed and separate from other CNT.

And the Webster dictionary defines "discrete" as separate and distinct, not attached to others, unrelated.

And the Petitioner's expert, Dr. Zhu, testified that CNTs are discrete because they are fully isolated from one another.

Q. Where were you reading from just now, Dr. Chung?

A. It's paragraph 67 of my declaration.

Q. So is that a construction that you're providing for the term "discrete carbon nanotubes"?

MR. ZINDA: Objection. Form.

THE WITNESS: I don't know what you mean by "providing," but this is the information available, you know, from the various sources that I mentioned.

BY MR. IN:

Q. Okay. If I could bring your attention back to paragraph 52, where we were. There, it says that you're applying the plain and ordinary meaning of the disputed terms as they would be understood by a POSITA.

What do you mean by "plain and ordinary meaning" there, Dr. Chung?

A. One example of plain and ordinary meaning is from the dictionary, like Webster dictionary. But I -- I have to know exactly which term we're talking about.

Q. Okay. I was just generally asking about what plain and ordinary meant in that context, but I think we can talk a little bit more specifically then about the term "discrete carbon nanotubes" that you just talked about.

If you could turn with me to the patent, Exhibit 1001, in the Column 7. Let me know when you're there, Dr. Chung.

A. Yes, I'm there.

Q. So for Claim 1 there in around line 4, do you see the term "discrete carbon nanotubes"?

A. I see the term, but it's not line 4.

Q. Which line do you see?

A. Oh, it's line 3 of Claim 1. I guess you count from the top of the page.

Q. Sorry about that.

So third line of Claim 1 has the term "discrete carbon nanotubes"; is that right?

A. Yes.

Q. Is that one of the disputed terms to which you apply a plain and ordinary meaning as part of your declaration?

MR. ZINDA: Objection. Form.
THE WITNESS: I don't see it as a disputed term because of what I said earlier about the meaning of this term.
BY MR. IN:
Q. Sorry. Could you explain what you mean by that, that it is not -- you don't view it as a disputed term --
MR. ZINDA: Objection.
BY MR. IN:
Q. -- regarding what you said earlier about this term?
MR. ZINDA: Sorry. Objection. Form.
THE WITNESS: As I mentioned earlier and stated in paragraph 67 of my declaration, the meaning is consistent from these various sources, including not only the dictionary, but also the testimony of Dr. Zhu.
BY MR. IN:
Q. Then looking at Claim 1 there on Column 7, are there any terms that are, in your view, disputed?
MR. ZINDA: Objection. Form.
THE WITNESS: No.
BY MR. IN:
Q. And this term, "discrete carbon nanotubes," it applies in other patents that you have provided opinions

on as well; is that right, Dr. Chung?

MR. ZINDA: Objection. Form.

THE WITNESS: Could you be clear as to what other patents you are talking about?

BY MR. IN:

Q. Sure.

So the term "discrete carbon nanotubes," as it appears here in the '909 patent, also appears in the '649 patent; is that right?

A. I really have to look at the details of the '649, if I have it here.

Q. All right. That's fine. Let me strike that.

Does the term "discrete carbon nanotubes" appear in the '924 patent?

A. '924. Okay. I have to get that.

Okay. I've gotten the '924 patent.

In that exhibit -- in the '924 patent, Claim 1, it mentions discrete carbon nanotubes.

Q. Okay. Fair to say you've applied the same plain and ordinary meaning of that term for both the '909 and '924 patents?

A. Yes.

Q. In your view, Dr. Chung, is there a difference between discrete carbon nanotubes and discrete nonagglomerated and exfoliated carbon nanotubes?

MR. ZINDA: Objection. Form.
THE WITNESS: Could you repeat, please?
BY MR. IN:
Q. Yeah. So I'm basically trying to ask if there is a difference between the meanings of these two terms. The first term is "discrete carbon nanotubes," and the second term is "discrete nonagglomerated and exfoliated carbon nanotubes."
A. No difference.
Q. So is it fair to say that if you have discrete carbon nanotubes, you necessarily have discrete nonagglomerated and exfoliated carbon nanotubes?
MR. ZINDA: Objection. Form.
THE WITNESS: Can you repeat, please?
BY MR. IN:
Q. Yeah. So based on your statement just now, is it fair to say that if you have discrete carbon nanotubes, then you necessarily have discrete nonagglomerated and exfoliated carbon nanotubes?
MR. ZINDA: Objection. Form.
THE WITNESS: Yes.
BY MR. IN:
Q. And vice versa?
MR. ZINDA: Objection. Form.
THE WITNESS: I wouldn't say vice versa.

BY MR. IN:

Q. Why not?

MR. ZINDA: Object to form.

THE WITNESS: You have to clarify what you exactly mean by "vice versa."

BY MR. IN:

Q. Fair enough.

If you have discrete nonagglomerated and exfoliated carbon nanotubes, does that necessarily require having discrete carbon nanotubes?

MR. ZINDA: Objection. Form.

THE WITNESS: Could you repeat, please?

BY MR. IN:

Q. If you have discrete nonagglomerated and exfoliated carbon nanotubes, do you also necessarily have discrete carbon nanotubes?

A. Yes.

Q. And if we could go, again, to paragraph 67 that I believe you were referring to earlier, Dr. Chung, on page 36 of your declaration...

A. Yes.

Q. And here you are providing your understanding of the term "discrete carbon nanotubes"; is that right?

A. Yes.

Q. And among the various exhibits that you cite

here in paragraph 67, you cite to Figure 1 of the '909 patent; do you see that?

A. Yes.

Q. So is it your view that Figure 1 of the '909 patent depicts individual tubes separate from any other tube; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: If one just looks at Figure 1 of the '909 patent, one of these microscope image, that is not very clear as is the case for most microscope images in patents. And just by looking at this image, one cannot pinpoint where are the nanotubes.

However, the description of Figure 1 in this same patent, patent '909, it mentions that this Figure 1 depicts lithium salt coated at a nanolayer on discrete carbon nanotubes.

So it does mention discrete carbon nanotubes in the description of this figure.

BY MR. IN:

Q. Okay. So based on your understanding of the description associated with Figure 1, as well as your observation of Figure 1, it is your view that discrete nanotubes are shown in Figure 1; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: That's not what I said, because

what I said is that the quality of the image in Figure 1 is not very high. And so I'm not saying that I'm for sure seeing carbon nanotube here, carbon nanotube there. I'm not saying that. But I have to believe what the inventor says. And the inventor says clearly about discrete carbon nanotubes in Figure 1.

BY MR. IN:

Q. And based on your reading and understanding of the description related to Figure 1, would you expect that all of the nanotubes shown in Figure 1 are discrete, or would you expect only a subset of them to be discrete?

MR. ZINDA: Objection. Form.

THE WITNESS: I would not expect all of the nanotubes to be discrete.

BY MR. IN:

Q. Okay. So some of the nanotubes depicted in Figure 1 will be discrete while some other nanotubes may not be discrete; is that right?

A. Well, actually, that is not conveyed in the patent. Okay. Because the description just said discrete carbon nanotubes. It doesn't say whether it's all of the nanotubes being discrete or some. It doesn't say that. Okay? So the patent is not clear about that -- that fact that you are trying to question.

Okay.

But from my general understanding, I would expect not all of the carbon nanotubes to be discrete because there are so many of them.

Q. So just earlier, Dr. Chung, you mentioned that Figure 1 of the '909 patent is not very clear in depicting the discrete carbon nanotubes; is that right?

A. Yeah, what I mean is that the quality of the reproduction as shown in the patent is not very high, and that's actually typical of microscope images in patents.

Q. Okay. Understood.

So if you had, let's say, the original raw image corresponding to Figure 1's SEM image here, would that allow you to discern whether there are discrete carbon nanotubes in this image?

MR. ZINDA: Objection. Form.

THE WITNESS: I cannot be sure until I see it.

BY MR. IN:

Q. But it is possible, based on the equipment used and the magnification used, the electron voltage used, that you could conceivably see discrete carbon nanotubes; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: It really depends on the

diameter of the carbon nanotube. If it's only 1 nanometer, for instance, and this scale is 300, so it's 1 over 300 of the length of that scale, you know, that's pretty tiny, tiny. And so if it's, say, 1 nanometer diameter carbon nanotube, it might be difficult to see that.

BY MR. IN:

Q. And why would it be difficult to see that, Dr. Chung?

A. Because the -- the magnification is not that high, you know, as I said. This scale marking in the image, associated with the image, the 300 nanometer, there's a line to it, okay. That's the length of 300 nanometer. So if you want to see 1 nanometer, you have to discern 1 over 300 of the length of this scale line. And that's a very, very small distance to discern.

Q. Are there other measurement techniques that would allow you to more definitively discern whether there are discrete carbon nanotubes in the sample?

MR. ZINDA: Objection. Form.

THE WITNESS: Certainly there are -- there is techniques in addition to scanning electron microscopy, or SEM. There is transmission electron microscopy, or TEM.

BY MR. IN:

Q. In your research, Dr. Chung, have you used TEM to view carbon nanotubes?

A. I have used TEM to view carbon nanofiber.

Q. So unlike the SEM where if you have an electrode, for instance, you could image the entire electrode, what additional steps do you need to take to image such nanotubes under a TEM?

MR. ZINDA: Objection. Form.

THE WITNESS: I don't know what you mean by an entire electrode.

BY MR. IN:

Q. If you have an electrode, composite electrode that contains carbon nanotubes, how would you go about imaging the nanotubes in that electrode using a TEM?

A. In general, for imaging using TEM, one needs to prepare the specimen so that it is very, very thin, so thin that the electrons can go through the specimen as required for the operation of the TEM. And this sample preparation is very tedious. But it's, in general, doable.

Q. Have you done this sample preparation before, yourself, Dr. Chung, or --

MR. ZINDA: Objection.

Q. -- your other graduate students?

MR. ZINDA: Sorry. Objection. Form.
THE WITNESS: Yes.
BY MR. IN:
Q. If you had an electrode sample that is depicted in Figure 1 of the '909 patent and if you were to create a TEM sample based on that electrode, would you expect the discreteness of the nanotubes to be affected by the sample preparation step?
MR. ZINDA: Objection. Form.
THE WITNESS: In general, in the -- this thinning procedure, as required for the preparation of the TEM specimen, it is possible to have this specimen damaged to a degree.
For instance, ion milling is very commonly used to make it very, very thin; and that involves shooting ions that have high kinetic energy, just eroded. And this erosion is possible to cause some damage, and that damage can include the possibility of making some nanotubes be shortened.
BY MR. IN:
Q. Is it possible that you could start with a sample that does not have discrete nanotubes, but by the time you've prepared that sample for TEM imaging, that it becomes discrete nanotubes? Would that be possible?
MR. ZINDA: Objection. Form.

THE WITNESS: Not likely. You know, it would be too fortuitous for this to happen.

BY MR. IN:

Q. Okay. I've uploaded Exhibit 1004, Ohata, earlier to the chat.

Could you get that reference out, Dr. Chung?

A. Yes, I have it.

Q. So that's U.S. Patent Application Number 2004/0160156 that we've been referring to as the Ohata reference; is that right?

A. Yes.

Q. Did you review this reference in your preparation for today's deposition?

A. Yes.

Q. And you've provided opinions regarding Ohata in your declaration for the '909 patent; is that right?

A. Yes.

Q. You've also provided opinions regarding Ohata in your declarations for the '924 and '483 patents; is that right?

A. I don't remember all these numbers as well as you can.

Q. Sure. And just FYI, it is the two remaining patents that we have not gone over with you during depositions.

A. Yeah. I -- I believe that Ohata is relevant to those two, but I may have to look -- look at my -- the document to be really sure.

Q. Sure. But would it be fair to say that you applied a consistent understanding of Ohata across your three declarations?

MR. ZINDA: Objection. Form.

THE WITNESS: Yes, it's consistent.

BY MR. IN:

Q. So if we could now go to paragraph 16 of Ohata, Dr. Chung.

A. Okay. I'm there.

Q. Do you see, in that paragraph where it says, "The unraveled and straightened carbon nanotubes 102 are expected to form an excellent conductive path in an electrode even if the amount thereof is small."

Do you see that?

A. Yes.

Q. What is meant by the term "conductive path" in this context?

MR. ZINDA: Objection. Form.

THE WITNESS: This conductive path refers to the conductive path within this -- this composite which it has the carbon nanotubes.

But in the absence of the active particles, it

is -- and it's also a schematic. And in the paragraph 12, it says, "Figure 1(a) is a schematic diagram showing that carbon nanotubes are tangled and twisted with one another before they are blended with a resin."

Okay. So if in Figure 1(a), it's, before, blended with a resin. But then we're talking about 1(b). Figure 1(b) is in paragraph 13. It says, "Figure 1(b) is a schematic diagram showing that the carbon nanotubes are unraveled and straightened after they have been blended with a resin."

Okay. So back to paragraph 16 of Ohata, it says, "The carbon nanotubes are unraveled and straightened by blending them with a resin, as shown in Figure 1(b)." And then, "The unraveled and straightened carbon nanotubes 102 are expected to form an excellent conductive path in an electrode."

And so the conductive path that Ohata is referring to in the context of Figure 1(b) is the conductive path within this -- the -- within the circle of Figure 1(b). You know, there's a circle. It's within that circle which has the resin and the nanotubes in it. Within the circle, you have a conductive path.

BY MR. IN:

Q. So in that sentence from paragraph 16 that you just read from, Dr. Chung, it says, and I quote, "an

excellent conductive path in an electrode."

What electrode is being referred to here?

MR. ZINDA: Objection. Form.

THE WITNESS: In here, an electrode is not just the stuff inside the circle that I mentioned.

The electrode -- as I explained earlier in this deposition, the electrode includes a few components, and these components include the active particles. Okay?

And I should refer to -- I mean, I should point out the term "expected to," okay, in paragraph 16 of Ohata in relation to Figure 1(b). It says that the raveled -- "the unraveled and straightened carbon nanotubes 102 are expected to form an excellent conductive path in an electrode even if the amount thereof is small."

Okay. So it says "expected." You know, it's not for sure because what -- what really is depicted here has no active particle in it, and the electrode has active particle in it.

BY MR. IN:

Q. Would you agree with me, Dr. Chung, that Ohata's objective in embedding carbon nanotubes into its electrode includes enhancing that electrode's conductivity?

MR. ZINDA: Objection. Form.

THE WITNESS: Because in -- in Ohata, they first incorporate the nanotubes in a resin. That's the first step of their process of making an electrode. Okay. And then after making this, then they introduce the active particles.

However, the presence of the nanotubes in this resin makes this resin more electrically conductive. And the fact that this -- this resin, which actually serves as a binder, is now more electrically conductive due to the presence of the nanotubes inside. It can only potentially help the overall electrode to become more conductive because the binder now is for sure more conductive.

BY MR. IN:

Q. And when you say, Dr. Chung, that the binder is now more electrically conductive, does that mean the binder can provide an electrical connection between two active particles?

MR. ZINDA: Objection. Form.

THE WITNESS: If that binder happens to be located between two active particles and that binder is electrically conducted, then the presence of that binder between the two active particles would enhance the electrical connectivity between those two active

particles.

BY MR. IN:

Q. Would it be fair in that instance to say that a conductive path is formed between the two active particles?

MR. ZINDA: Objection. Form.

THE WITNESS: The conductive path is very likely formed, but is not necessarily -- it depends on the quality of that binder; that is, it depends on the nanotubes inside, whether they -- they form a percolative network or not. Okay? That is the mere presence of nanotube. Doesn't necessarily mean that the productivity is high. The nanotubes need to form a percolative net -- conductive network in order for the nanotubes to enhance the conductivity of this resin substantially.

BY MR. IN:

Q. And why do the nanotubes need to form this percolative network in order to enhance conductivity?

A. The nanotubes are not very long. You know, they have limited length. Okay. But you need to have continuous electrically conductive path formed by using these nanotubes, which are not very long.

So you -- you need to have a plurality of nanotubes coming together and making electrical contact

between one another -- that is, touching one another -- in order to have the entirety of the collection of nanotubes be able to work together so as -- as a whole, the network would provide a continuous electrically conductive path.

Q. Okay. And this network of nanotubes would also need to make contact with the active particle itself, right?

MR. ZINDA: Objection. Form.

THE WITNESS: No, because we had -- Ohata is just trying to develop a more conductive form of binder. Okay? And the nanotubes are inside this resin that constitutes the binder. So the nanotubes are inside the -- they are covered by the resin.

In spite of that, the nanotubes, if they form the percolative network, is able to enhance the conductivity of this binder, this lump of binder. So the nanotubes would not be touching the active particle because they are wrapped up -- I mean, embedded inside this resin.

BY MR. IN:

Q. Is the resin itself electrically conductive?

MR. ZINDA: Objection. Form.

THE WITNESS: The resin that is typically used, such as PVDF, is not conductive.

BY MR. IN:

Q. Then if the network of nanotubes that you just mentioned were inside this resin, and the only thing making contact with the two active particles is the resin itself and not the nanotubes, how does that improve electrical conductivity between the two active particles?

MR. ZINDA: Objection. Form.

THE WITNESS: You have to consider the binder to be one unit, and that is a composite material with the resin as the matrix and the nanotubes as the filler. Okay? That composite material's electrical conductivity is much increased because of the presence of the nanotube. Okay.

And as a result, the binder now is a better binder because it doesn't only do the binding function, it provides electrical conductivity so that it can enhance the possibility of forming continuous conductive path in the overall electrode.

So there's no need, you know, for the nanotubes to stick out of this improved binder to touch the nanotube -- to touch the active particles. In fact, they would not stick out because you are just dealing with a lump, and that lump is an improved lump; improved in the sense that the conductivity is enhanced.

BY MR. IN:

Q. So when you talk about an improved lump here, Dr. Chung, are you saying that an active particle that is in contact with this improved lump can conduct electricity through that lump?

MR. ZINDA: Objection. Form.

THE WITNESS: I am talking about the overall electrode which comprises the active material particles as well as the binder, which we are calling lumps. Okay. And with the binder being conductive, then the possibility of the overall electrode exhibiting a continuous conductive path would be much higher than the situation where the -- these lumps or binder is not conductive.

That's what I mean. I'm looking at the overall electrode, which -- which is what needs to have an overall continuous electrically conductive path.

BY MR. IN:

Q. So in that description that you just gave, Dr. Chung, would there be a continuous electrical conductive path between active particles that are not in direct contact with each other?

MR. ZINDA: Objection. Form.

THE WITNESS: Could you rephrase, please?

BY MR. IN:

Q. So in the description that you just gave where there is a continuous electrical conductive path within the electrode, how would that electrically conductive path be defined between two active particles that are not touching each other?

MR. ZINDA: Objection. Form.

THE WITNESS: Between two conduc- -- active particles that are not touching one another and there's no conductive medium, such as the conductive binder connecting the two, then the two would not be electrically connected.

However, when you deal with the overall electrode, you are not just counting on those two active particles. You have many active particles that constitute that electrode.

So it could be that some of those particles are not electrically connected, but some others are. And the totality would provide an overall conductive path that is continuous.

BY MR. IN:

Q. But if there was this improved lump or improved binder with enhanced conductivity that spans two active particles, there would be a conductive path between those two particles; is that your view?

MR. ZINDA: Objection. Form.

THE WITNESS: I -- I don't quite agree with how you phrase it because what's needed is not really a conductive path between two active particles.

What's needed is that each active particle has a means of directing -- let's say electrons, whatever charge is involved -- letting the electrons go in or go out of the -- this particular active particle and such that this active particle is allowing this electron to go in -- to be connected to the current collector. Okay.

So the bottom line is whether the electrical particle is electrically connected to the current collector, okay? It's not so much, one active particle being connected electrically to another active particle.

MR. IN: I think we've been going for about an hour.

Would this be a good time for a quick break, Dr. Chung?

THE WITNESS: Sure.

MR. IN: Okay. Could we go off the record.

(Recess: 10:13 a.m. to 10:24 a.m.)

BY MR. IN:

Q. Dr. Chung, did you speak with anyone during the break just now?

A. No. I always talk to my graduate students about their research.

That doesn't count, right?

Q. That's impressive that you did that in the ten minutes.

So before moving on to a totally different topic, I just wanted to follow up on one thing you said earlier, which is that the bottom line of creating a conductive electrode is that an electrical connection needs to be made between the active particle and the current collector; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: I mean, that is what I mean by the conductive path. And you need to have the charges be able to get to the current collector. That is what I mean by the bottom line.

BY MR. IN:

Q. Yes. So to form this electrically conductive path, does there need to be a direct contact between the active particles and the current collector?

MR. ZINDA: Objection. Form.

THE WITNESS: No, no, that it -- there's so many active particles all over the electrode, so you -- it wouldn't be possible for all of these active particles to physically contact the current collector.

And so you need to have other -- other entities like the conductive binder or this conductive additive in general to enable the conductive path to be established.

BY MR. IN:

Q. Okay. But you do need to have a conductive medium between the current collector and the active particles to enable this conductive path; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: Yeah, you need to have a conductive path formed and the use of certain -- one or more conductive medium would be -- would be a way to do it.

BY MR. IN:

Q. Is it fair to say that a conductive path cannot be formed through an insulating material?

MR. ZINDA: Objection. Form.

THE WITNESS: If the path is an open circuit because of an insulator actually making the path not continuous, just open circuit, then obviously you wouldn't have that conductive path messed up.

BY MR. IN:

Q. So an open circuit obviously would not form a conductive path between two conductive materials; is that fair?

MR. ZINDA: Objection. Form.

THE WITNESS: Yes. If the overall conductive path is open-circuited, then it wouldn't work.

But, you know, in general, you can have a number of paths, electrically and parallel, you know; so if one of the paths go open-circuited, you still have the other path.

BY MR. IN:

Q. Okay. Sticking with Dr. Ohata for now, Dr. Chung, if I could direct your attention to paragraph 30. Let me know when you're there.

A. Yes, I'm there.

Q. Here, Ohata is talking about making a masterbatch.

Do you see that?

Sorry. Did you answer, Dr. Chung? I didn't hear you.

A. What was the question?

Q. I was just asking you to confirm that you see the formation of the masterbatch in that paragraph 30 of Ohata.

A. Yes, I do.

Q. And what is in that masterbatch, according to Ohata?

A. He has 15 parts by weight of carbon nanotubes

and 85 parts by weight of polyvinylidene fluoride as a resin component.

Q. What is meant by the term "masterbatch"?

A. Masterbatch -- in the context of this particular patent, the masterbatch refers to this particular composite which has the carbon nanotubes and the PVDF resin.

Q. And is that a final product of Ohata or is a masterbatch sort of just an intervening product?

MR. ZINDA: Objection. Form.

THE WITNESS: Oh, it is not the final product. It's just the first step of his overall procedure.

BY MR. IN:

Q. And what else does Ohata do then to the masterbatch to form the final product?

A. Well, after forming this masterbatch, then he has to add the active particles.

Q. Does he add anything else?

A. Well, he can add certain chemicals to help disperse the constituents, particularly this masterbatch.

Q. And what sorts of chemicals would be used to help this first -- these types of materials?

MR. ZINDA: Objection. Form.

THE WITNESS: Well, he used NMP.

BY MR. IN:

Q. And what is NMP?

A. It is n-Methyl-3-pyrrolidone [sic].

Q. And why do -- why does Ohata add NMP into the masterbatch along with the active materials?

A. Would you repeat? I'm sorry.

Q. Yeah.

Why does Ohata add NMP into the masterbatch along with the active materials?

A. Okay. The NMP functions to disperse the -- these lumps, the masterbatch, so that they are spread consistently throughout the electrode.

Q. And how does NMP physically disperse these materials?

MR. ZINDA: Objection. Form.

THE WITNESS: The NMP can dissolve the PVDF to a degree, and -- and in so doing, it breaks up these lumps into smaller particles often called domains. And that is a mechanism for making these -- these lumps be spread out consistently.

BY MR. IN:

Q. And how big are these domains?

MR. ZINDA: Objection. Form.

THE WITNESS: Well, the size of the domain is not described in -- in this patent. This '9 -- this

Ohata patent. The size of the domains is not indicated, though the function as for dispersing the lumps or the masterbatch is conveyed.

However, in a dequarious [phonetic] document that I cited in my declaration, I have included references that support not only the presence of these domains, but there are microscope pictures that provide some information on the size of the domains.

BY MR. IN:

Q. So in that paragraph 32 of Ohata that we were just looking at, I do see in the middle of that paragraph where it says, "The masterbatch was easily dissolved in NMP [as read]."

Do you see that, Dr. Chung?

A. Yes.

Q. So your understanding of this easy dissolution of the NMP is that the PVDF resin breaks up into domains; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: One of the aftermaths of the interaction between the NMP and the masterbatch is the breaking -- breaking up of the masterbatch pellets into domains.

The NMP can do a little more than this dispersing because of its ability to dissolve NMP.

But the -- there is strong -- pretty strong bonding between the nanotubes and -- and the PVDF inside this lump. Okay? As a result, that dissolution of the PVDF by the NMP cannot possibly be so much that the CNT becomes naked. Not even a monolayer of PVDF remaining on -- on the CNT. That's not possible.

BY MR. IN:

Q. And what is your basis for saying that, Dr. Chung, that it is not possible?

A. Yeah, I have explained that in some detail in my declaration. It really has to do with the PVDF being a fluorocarbon, and it has these carbon flourine bonds, and these bonds are polar. Okay. And -- and the polar nature of -- of the bonds inside the PVDF enables the PVDF to interact with the nanotube. And that interaction enhances the bond between the PVDF and the carbon nanotube.

Q. So this bond somehow prevents the PVDF from being dissolved by NMP?

MR. ZINDA: Objection. Form.

THE WITNESS: No. This bond makes it not possible for the dissolution by the NMP on the PVDF to go to a level that the nanotubes become totally naked, not even a monolayer of the PVDF remaining on the nanotube.

BY MR. IN:

Q. You mentioned citing some references in your declaration. Do you cite to a reference that says that not even a monolayer of PVDF -- strike that.

Is there a reference that you're aware of that describes that phenomenon whereby it is impossible to fully remove PVDF from the surface of a carbon nanotube?

MR. ZINDA: Objection. Form.

THE WITNESS: My declaration is very clear that this dissolution -- the main effect is the dispersing of these lumps into small domains. And I have plenty of microscope photos showing that, even with a large proportion of NMP around the PVDF.

The PVDF remains as particles. You can call them domains. They remain as particles even when the NMP is present in very big proportion compared to PVDF, and I have plenty of microscope photos to show that. Okay? And these photos mean that the NMP cannot just simply dissolve away, make the PVDF go away. It doesn't happen.

Q. But you do agree with me, Dr. Chung, that NMP will dissolve away -- dissolve away at least some of the PVDF; is that right?

MR. ZINDA: Objection. Form.

BY MR. IN:

A. The NMP has ability to dissolve a part of the PVDF. But based on the microscope photos, that phenomenon is very minor compared to the phenomenon of the NMP causing the dispersing of those lumps into domains.

Q. And while you agree that NMP does have the ability to dissolve at least some of the PVDF, it is your view that it is impossible for NMP to dissolve away PVDF that is on the surface of a nanotube, carbon nanotube; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: I'm saying that this dissolution, so that the PVDF is just dissolved away, is a very minor effect. Okay. And it is a very minor effect compared to the -- to the dispersing effect. Then obviously the NMP is not able to remove the PVDF totally away from the CNT.

BY MR. IN:

Q. My question was slightly different than that, Dr. Chung, so let me try again.

Is it your view, Dr. Chung, that it is impossible to remove PVDF from the surface of a carbon nanotube using NMP?

MR. ZINDA: Objection. Form.

THE WITNESS: I think that anything is possible. Anything in this world is possible, but whether it's likely, based on evidence or not, that is what's relevant. And based on the evidence that I have cited in my declaration, the chance of that happening is very small because, as I said, the removal of the PVDF from the CNT is a very minor effect compared to the dispersing effect of the masterbatch.

BY MR. IN:

Q. I'm going to add to the chat Exhibit 2017.

A. What --

Q. Sorry. And that is the -- is the Nicolas '429 reference.

A. Is this an MRD or LG document?

Q. Yeah. So it's MRD-2017, and you cite to it in, for instance, paragraph 123 of your declaration.

A. MRD what --

Q. 2017.

A. I have it.

Q. Great. And then if you could also turn to paragraph 123 of your declaration as well where you referred to it, Dr. Chung.

A. Yes.

Q. So I think just earlier, you were saying that you've provided several references to support your

position that NMP does not fully dissolve PVDF.

Is this one of those references that you mentioned, Dr. Chung?

A. Yes.

Q. And if we look at paragraph 123 of your declaration, you provide a reproduction of Figure 2 of MRD-2017; namely, the Nicolas reference.

Do you see that?

A. Yes.

Q. Can you explain what is being shown here in Figure 2 of Nicolas?

A. Nicolas '429 proposed its own masterbatch process. And in example 3 of his, the process uses 5 percent by weight of CNT, 1 percent by weight of PVP, at .8 percent by weight of PVDF, and 93.2 percent by weight of NMP to form a paste, which is then mixed with lithium-ion phosphate.

And his Figure 2, which is shown on page 67 of my declaration, shows domains of PVDF. This -- and those domains exist despite the use of the NMP to disperse the PVDF.

Q. So are you saying, Dr. Chung, that Figure 2 of Nicolas shows these domains of PVDF after being dissolved in NMP?

A. Yeah, after -- well, obviously after the

adding of the NMP to the nanotubes and the PVDF and the PVP, so obviously after adding the NMP.

Q. And where are you seeing these domains of PVDF in Figure 2 of Nicolas?

A. You see all those little lumps. Those little lumps are the domains.

Q. So besides what you've identified here as domains of -- or lumps of PVDF, are there other materials present in this image that you can identify?

A. Okay. I was looking for the description of Figure 2 of Nicolas. I just found it. It's in this paragraph 97. It says, "Figure 2 is an SEM image [as read] (magnification: 50,000 times) showing the dispersion of the CNTs, obtained from the paste according to the invention, around lithium-ion phosphate/carbon particles."

So this image shows the -- shows the masterbatch, his masterbatch, which has the NMP applied to it, and -- and it -- and it shows the lithium-ion phosphate carbon -- /carbon particles.

Okay. And he further described it in --

Q. Before you do that, Dr. Chung, I just wanted to go back to what you just said earlier.

Where were you reading from just now in Nicolas?

A. It's paragraph 97.

Q. Okay. So paragraph 97 where it says Figure 2 shows the dispersion of CNTs... and the LFP/carbon particle; is that right?

A. Yes.

Q. Okay. If I could just direct you to Figure 2, briefly, again.

Where are the LFP/carbon particles in this image?

MR. ZINDA: Objection. Form.

THE WITNESS: The carbon nanotubes are inside the PVDF, and you see all these PVDF domains. And these domains include in them the CNTs. And the -- and these domains are dispersed around the lithium-ion phosphate.

BY MR. IN:

Q. Okay. That wasn't quite my question, Dr. Chung. So let me try again.

Where do you see the LFP particles in Figure 2 of Nicolas?

MR. ZINDA: Objection. Form.

THE WITNESS: As I mentioned earlier in testimony, the image -- this image, as well as many other images, are not very clear. And it's often not totally sure as to the meaning of the individual features or the overall features in the image, that they

are not very clear-cut.

And this image, it has that problem too. Okay. So just looking at the image, it's hard to see where is the lithium-ion phosphate particles.

BY MR. IN:

Q. Okay. These -- sorry. Go ahead.

A. One can look at the specification of the patent application, this Nicolas document, look at the specifications to get some information even though the image itself is not as clear as we would like.

Q. Okay. So sticking with Figure 2 there, it is your view that based on the lack of clarity of this image, you are not able to identify LFP particles; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: What I mean is that I cannot pinpoint where is the lithium-ion phosphate particle.

BY MR. IN:

Q. Are you able to pinpoint to any of the carbon nanotubes that are described as being shown in Figure 2?

A. I am not able to pinpoint that either because the nanotubes are inside these domains.

Q. Are you looking at a paper copy of Nicolas, Dr. Chung?

A. Yes.

Q. Do you have an electronic copy available to you as well that you can zoom in?

A. Maybe you can share it.

Q. I can share it as well, Dr. Chung, if you are able to download it from the chat window. MRD-2017.

A. Okay. I have downloaded it, and I have Figure 2. Yes.

Q. And if you zoom in a little bit closer into Figure 2, are you able to pinpoint any instances of carbon nanotubes in that image?

A. No. I cannot observe any feature that looks even like a carbon nanotube because these are all little domains that are shown.

Q. Okay. So it is your opinion then that, looking at Figure 2 of Nicolas here, you are not able to identify any instances of LFP particles; you are not able to identify any instances of carbon nanotubes that are visible, but the only thing you are able to identify in this image are domains of PVDF; is that your position?

MR. ZINDA: Objection. Form.

THE WITNESS: This material contains CNT. That is clear. We not -- they don't show up in the picture. Doesn't mean that the CNTs are absent. They have to be there. And as a result, it's quite clear

that the CNT is hidden and they are hidden inside these domains.

BY MR. IN:

Q. And I am just asking about this SEM image as you are seeing on the page right now. And it is your view that, one, LFP particles are not visible in this particular image; and, two, carbon nanotubes are also not -- not visible in this particular image; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: I wouldn't say that -- that lithium-ion phosphate particles on -- on -- are not visible in the sense that they are absent. Just because of the nature of this photo, it's got some dark regions, you know. Like right part is kind of dark, a patch that's dark and several patches that are kind of dark, you know. And it's not clear what these dark patches are.

On the other hand, the nanotubes, I don't see any feature that resemble the shape of a nanotube in this photo. And that means the nanotubes don't show -- are not visible, even though they have -- they have to be there. And so this implies that the nanotubes are hidden somewhere.

BY MR. IN:

Q. And the only materials that you are able to positively identify in Figure 2 are the domains of PVDF; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: It's the domains of the PVDF that show up clearly. And it's interesting to see that the appearance of these domains, as shown in this figure, is quite similar to the appearance of the PVF -- PVDF domains that are in the images of other -- other references. The consistencies of the appearance of the PVF -- PVDF domain in a number of references support the notion that these -- these little nodules, or whatever you call it, are the PVDF domains.

BY MR. IN:

Q. Does Nicolas say anything about the sizes of those alleged PVDF domains?

A. I don't find any sentence in this Nicolas document that talks about the size of the domains.

Q. But could one potentially figure it out based on the information given about the SEM image?

MR. ZINDA: Objection. Form.

THE WITNESS: If there's a scale in this Figure 2, then one can estimate the size of these domains.

BY MR. IN:

Q. Okay. I'm going to put up another exhibit into the chat, and hopefully hit "send" this time, and it is Exhibit 1006, the Lee reference.

Let me know when you have that, Dr. Chung.

A. Yes, I have it.

Q. Okay. If I could direct your attention to Figure 6 of the Lee reference.

A. Yes, I have that.

Q. And it may also be helpful to have your declaration open as well at paragraph 180, which is page 102.

A. Yes.

Q. Okay. So looking at Figure 6 of Lee, what is being shown there in that SEM image?

A. Okay. This image, again, is not very high quality. You see it's very grainy. But -- okay. As I have it in my declaration, paragraph 180 concerning this figure, Figure 6, Figure 6 shows fibrous-looking material associated with several clusters of silicon particles.

Yeah, so -- so apparently there are silicon particles here and some fibrous-looking material. There are two. But that's really unclear. I mean, the image is not very high quality at all.

Q. But, as you just stated, based on the related description from Lee as well, you would agree with the -- agree with me that what is being shown here are the silicon particle, carbon nanotube assemblies that are agglomerated into a larger secondary particle?

Does that sound right?

MR. ZINDA: Objection. Form.

THE WITNESS: I don't want to read that far based on Figure 6 because Figure 6 just shows one snapshot of one little area. It's very different from the schematic of Lee, which is Figure 1 of Lee.

No, it's just a snapshot of a certain local region, which is the secondary particle. You know, how big is this -- the entirety of the secondary particle that's shown? I don't think so. How much of a secondary particle is showing is not clear.

So I don't want to read that far into Figure 6. It's just showing a local region.

BY MR. IN:

Q. Okay. And let me also point you to or direct you to paragraph 84 of Lee as well.

Let me know when you've read it.

A. Yes, I have it.

Q. So looking at Figure 6 and in conjunction with what is described in Figure -- paragraph 84, would you

agree with me that what is shown here are the agglomeration of primary nanoparticles that has silicon particles bound to the carbon nanotubes that are agglomerated into a larger secondary particle?

MR. ZINDA: Objection. Form.

THE WITNESS: Again, I -- I hesitate to read that far into the meaning of Figure 6.

BY MR. IN:

Q. Let me also point you to figure -- or paragraph 95 of Lee, Dr. Chung.

A. Okay.

Q. What does paragraph 95 say about what is depicted in Figure 6?

A. Well, it says Figure 6 is an SEM, scanning --

(Court reporter requested clarification.)

THE WITNESS: Okay. Paragraph 95 of Lee, it says, "Figure 6 is a scanning electron microscope (SEM) image (60,000 times magnification) of the anode active material prepared according to Example 1. As shown in Figure 6, silicon primary nanoparticles were agglomerated into secondary particles."

BY MR. IN:

Q. Okay. So based so what you just read there from Lee, is it accurate to say that Figure 6 of Lee shows primary particles that are agglomerated into

secondary particles?

MR. ZINDA: Objection. Form.

THE WITNESS: As I said, there appears to be primary particles that are agglomerated in Figure 6, but this might be just a small part of the secondary particle, let apart saying that is a plurality of secondary particles as mentioned in paragraph 95.

BY MR. IN:

Q. So would you agree with me then, Dr. Chung, that what is included in the image that you see there on Figure 6 of Lee -- whether or not you can see it in the particular image -- but according to the specification, does it include, one, silicon particles and, two, carbon nanotubes?

MR. ZINDA: Objection. Form.

THE WITNESS: According to the description of Figure 6 in the specification of Lee reference, the particles shown in Figure 6 seem to be the silicon nanoparticles, the primary silicon nanoparticles. It appears to be that.

BY MR. IN:

Q. Do you see a scale bar there for Figure 6, Dr. Chung, on the bottom right side?

A. Yes. It is 500 nanometer.

Q. Okay. And it starts sort of at the middle

right part of the image after like .0K, and then sort of extends rightward to the right edge of the image. Is that the scale bar?

A. Yes, although it's not very clear. Yes.

Q. Okay. And if we could go back to paragraphs 83 and 84 of Lee, you will see that it mentions some sizes associated with its silicon particles as well as its carbon nanotubes.

Do you see that?

A. Yes.

Q. And would you agree with me that the average particle size of the silicon particles in Lee is 14 nanometers?

A. Yes.

MR. ZINDA: Objection. Form.

THE WITNESS: That's what Lee says in his paragraph 84 based on x-ray defraction.

BY MR. IN:

Q. Okay. Now if we could go back to Figure 6, and based on the size of that scale bar, would you expect to be able to discern those 14-nanometer diameter silicon particles in that particular image?

MR. ZINDA: Objection. Form.

THE WITNESS: Yeah, the scale bar length is not very clear, but the 14 nanometer out of 500 is -- I

don't want to calculate it. That is 3 percent of the length of this scale bar. That's maybe just manage to see, you know. It's 3 percent of the scale bar. It's very tiny.

BY MR. IN:

Q. Okay. Then if we look at paragraph 83 where it talks about the 1 nanometer carbon nanotubes, would -- fair to say that you wouldn't be able to see that in Figure 6?

MR. ZINDA: Objection. Form.

THE WITNESS: Yeah. For a single carbon nanotube with average diameter of 1 nanometer, that is even tinier. That would -- in this scale, it would be really, really hard to see 1 nanometer diameter carbon nanotube.

BY MR. IN:

Q. And if we look at your declaration again at paragraph 180 where you included a -- sort of an orange arrow on the bottom right side of that image, what is -- what do you think is being shown there by that orange arrow?

A. Well, that is a feature that -- that has the shape of a nanotube or a nanotube bundle.

Q. What do you mean by having a shape of a nanotube or a nanotube bundle?

A. That is kind of long and thin. That's what I mean by shape.

Q. So it is your view that the elongated material there that is -- that you've indicated with the arrow is a bundle of nanotubes?

A. That's what it looks like.

Q. And this image allows you to make that conclusion?

A. Well, this image provides some evidence toward that. I don't -- I don't want to base a conclusion on just one image. It's the collection of evidences from various sources that together, one can say something. But I hate to draw one conclusion based on one image. And after all, the image is not very clear.

Q. So you are not making any conclusions about what is being shown next to that orange arrow in Figure 6; is that right?

MR. ZINDA: Objection. Form.

THE WITNESS: No, we -- I -- I don't mean that. I mean this is a part of the collection of evidence.

BY MR. IN:

Q. And what is that collection of evidence that you are referring to?

MR. ZINDA: Objection. Form.

THE WITNESS: Well, the collection of evidence is described in detail in my declaration, paragraphs 176 all the way to -- to paragraph 195.

BY MR. IN:

Q. But if we look at just Figure 6 for now, recognizing that it is just a piece of the evidence that you refer to, what is it about this image that leads you to think that a bundle of nanotubes are being shown there next to the orange arrow?

A. What's clear from Figure 6 is that we are not seeing any individual CNT. And we're just not seeing it. Okay? And that's what's clear. And this feature looks like a bundle. And for sure we are not seeing a single CNT in this image.

Q. How -- how many nanotubes do you think form that bundle that you've identified in Figure 6?

MR. ZINDA: Objection. Form.

THE WITNESS: It can be a lot. Depends on the diameter of one nanotube. If the diameter is 1 nanometer, then it will be a lot of nanotubes in that bundle.

BY MR. IN:

Q. Are there any other portions of that image where you believe a bundle of nanotubes are being shown?

A. As I said, the image is really low in quality.

Very grainy. And it's hard to see the features there.

MR. IN: Could we go off the record real quick?

MR. ZINDA: Sure.

(Recess: 11:23 a.m. to 11:38 a.m.)

MR. IN: We have no further questions for Dr. Chung and pass the witness.

MR. ZINDA: Okay. Can we go back off the record for about ten minutes and come back at 10:50? And we may or may not have redirect.

Thank you.

MR. IN: Okay. Sounds good. Thank you.

(Recess: 11:38 a.m. to 11:48 a.m.)

EXAMINATION BY MR. ZINDA:

Q. Hi, Dr. Chung. I just wanted to ask a few follow-up questions.

If I could get you to turn to -- or pull out MRD-2017 and turn to Figure 2.

And just to make it easier on everybody, I'm going to share the screen. I always find that a little more useful, if you want to see it on my screen.

Do you see that, Dr. Chung?

A. Yes.

Q. Do you recall testifying earlier that you could not identify CNTs in this image?

A. Right.

Q. If you could see CNTs in this image, would that mean that the CNTs were naked?

A. No. It doesn't imply that at all. They -- they could be still covered by the resin.

MR. ZINDA: I have no further questions.

Pass the witness.

MR. IN: No further questions from Petitioner as well.

(Off-the-record discussion.)

COURT REPORTER: Mr. Zinda, would you like a copy, sir?

MR. ZINDA: No, we don't need a copy of the rough or the final.

MR. IN: Same deal with us as with the other ones. So, yeah, rough and final, please.

COURT REPORTER: Thank you.

(Whereupon the proceedings concluded at 11:51 a.m.)

ERRATA SHEET

NAME OF CASE: LG ENERGY v. MOLECULAR REBAR DESIGN
DATE OF DEPOSITION: JULY 1, 2025
NAME OF WITNESS: DEBORAH CHUNG, Ph.D.

Reason Codes:

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

Page _____ Line _____ Reason _____

From _____ to _____

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Page _____ Line _____ Reason _____

From _____ to _____

Page _____ Line _____ Reason _____

From _____ to _____

Deponent's Signature _____

Date_____

DECLARATION UNDER PENALTY OF PERJURY

I, DEBORAH CHUNG, Ph.D., do hereby certify under penalty of perjury that I have read the foregoing transcript of my deposition taken on July 1, 2025; that I have made such corrections as appear noted on the Deposition Errata Page(s), attached hereto, signed by me; that my testimony as contained herein, as corrected, is true and correct.

This Declaration is executed this _____ day of _____, 20___, at _____, California.

_____

DEBORAH CHUNG, Ph.D.

STATE OF CALIFORNIA))) ss.

I, Tamara Houston, RPR, CCRR, CSR No. 7244, a Certified Shorthand Reporter in the State of California, duly empowered to administer oaths, do hereby certify:

That, prior to being examined, the witness named in the foregoing deposition was by me duly sworn to testify to the truth, the whole truth, and nothing but the truth;

That said deposition was taken down by me in shorthand at the time and place therein named, and thereafter reduced to typewriting by computer-aided transcription under my direction;

That the dismantling, unsealing, or unbinding of the original transcript will render the reporter's certification null and void.

I further certify that I am not interested in the event of the action.

In witness whereof, I have hereunto subscribed my name.

Dated: 8th of July, 2025.

Tamara L. Houston

TAMARA L. HOUSTON
CSR 7244, RPR, CCRR 140

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