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

LG ENERGY SOLUTION, LTD.,

Petitioner,

v.

MOLECULAR REBAR DESIGN, LLC,

Patent Owner.

Case IPR2024-01006 (US Patent No. 8,808,909)

Ref. 18768-0210IP4

VIDEOCONFERENCE DEPOSITION OF

DEBORAH D.L. CHUNG, Ph.D.

INDIVIDUALLY AND ON BEHALF OF

PATENT OWNER

JULY 1, 2025

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9:03 a.m. to 11:51 a.m. EST

REPORTED BY:

Tamara L. Houston

CA CSR No. 7244, RPR, CCRR No. 140

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.

THE SULLIVAN GROUP OF COURT REPORTERS

1 APPEARANCE OF COUNSEL:

2

3 On behalf of the Petitioner:

4 FISH & RICHARDSON
5 BY: HYUN JIN "HJ" IN, ATTORNEY
6 1000 MAINE AVENUE SW, SUITE 1000
7 WASHINGTON, D.C. 20024
8 (202) 783-5070
9 IN@FR.COM

10 FISH & RICHARDSON
11 BY: DANIEL JANG, ATTORNEY
12 BY: GRETCHEN DEVRIES
13 7 TIMES SQUARE, 20TH FLOOR
14 NEW YORK, NY 10036
15 (212) 765-5070
16 DJANG@FR.COM
17 DEVRIES@FR.COM

18 ON BEHALF OF THE PATENT OWNER AND WITNESS:

19 CABELLO HALL ZINDA, PLLC
20 BY: STEPHEN ZINDA, ESQ.
21 801 Travis Street
22 Suite 1610
23 Houston, Texas 77030
24 (832) 631-9994
25

THE SULLIVAN GROUP OF COURT REPORTERS

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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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THE SULLIVAN GROUP OF COURT REPORTERS

1 REMOTELY HELD AND REPORTED FROM THE STATE OF CALIFORNIA

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

3 ---o0o---

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

6 --o0o--

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

12 --o0o--

13 EXAMINATION BY MR. IN:

14 Q. Good morning, Dr. Chung.

15 How are you?

16 A. Good.

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

20 How are you this morning, Dr. Chung?

21 A. Good.

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

24 A. Deborah D.L. Chung.

25 Q. Okay. And we just went through two

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

4 Will that be okay with you, Dr. Chung?

5 A. Yes.

6 Q. Okay. Great.

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

9 A. No.

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

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

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

16 A. Yes.

17 Q. -- in them?

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

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

25 A. Yes.

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

4 But you can otherwise answer.

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

8 BY MR. IN:

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

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

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

15 You can otherwise answer, Dr. Chung.

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

17 BY MR. IN:

18 Q. Did you discuss with anyone else?

19 MR. ZINDA: Same objection.

20 THE WITNESS: No.

21 BY MR. IN:

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

24 MR. ZINDA: Same objection.

25 THE WITNESS: Could be four hours.

1 BY MR. IN:

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

4 MR. ZINDA: Same objections.

5 THE WITNESS: No.

6 BY MR. IN:

7 Q. Great. Thank you.

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

12 A. Yes.

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

15 A. Yes.

16 Q. Great.

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

19 Do you have that with you, Dr. Chung?

20 A. Yes.

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

24 A. Paragraph 57?

25 Q. Yes, thereabouts. Page 28.

1 A. Okay. I have it.

2 Q. Okay. So in this section, you're providing --
3 or you've provided a technology -- technological
4 background relevant to the '909 patent; is that right?

5 A. Yes.

6 Q. And in paragraph 58 there, you've provided a
7 schematic.

8 Can you tell me what that is?

9 A. Yeah.

10 MR. ZINDA: Object to form. Excuse me.

11 THE WITNESS: Okay. This schematic depicts
12 the cathode on the current collector. And, also, it
13 also provides in (b) a more -- a bigger view of the
14 system including the cathode, anode, and the separator
15 in between.

16 BY MR. IN:

17 Q. And did you create this schematic yourself,
18 Dr. Chung?

19 A. No.

20 Q. Do you recall who did?

21 A. Okay. It's in MRD-2037.

22 Q. Okay. So this schematic came from MRD-2037;
23 is that right?

24 A. As far as I can remember.

25 Q. So I think you said this before, but just to

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

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

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

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

11 MR. ZINDA: Objection. Form.

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

14 BY MR. IN:

15 Q. Great. Thank you.

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

18 MR. ZINDA: Objection. Form.

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

21 BY MR. IN:

22 Q. What are those components?

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

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

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

3 MR. ZINDA: Objection. Form.

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

8 BY MR. IN:

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

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

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

17 What is a functionality of that active
18 material?

19 MR. ZINDA: Objection. Form.

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

23 BY MR. IN:

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

1 MR. ZINDA: Objection. Form.

2 THE WITNESS: Well, in this particular
3 schematic, it is the lithium cobalt oxide.

4 BY MR. IN:

5 Q. And below that, it says, "polymer binder."

6 Can you tell me what the polymer binder is
7 used for?

8 A. The polymer binder or binder in general is to
9 hold the components together so that the electrode is
10 one piece.

11 Q. So what would happen if a binder were not
12 present in a composite electrode?

13 MR. ZINDA: Objection. Form.

14 THE WITNESS: If the binder is absent, then
15 the composite might be mechanically very flimsy.

16 BY MR. IN:

17 Q. And what are some example materials that are
18 used as binders in these types of applications,
19 Dr. Chung?

20 MR. ZINDA: Objection. Form.

21 THE WITNESS: Polymer binders. One of the
22 most common polymers is PVDF.

23 BY MR. IN:

24 Q. Are there any other commonly used polymer
25 materials for binder applications?

1 MR. ZINDA: Objection. Form.

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

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

9 MR. ZINDA: Objection. Form.

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

14 BY MR. IN:

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

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

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

20 A. Yes.

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

1 MR. ZINDA: Objection. Form.

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

7 BY MR. IN:

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

11 MR. ZINDA: Objection. Form.

12 THE WITNESS: The presence of a conductive
13 additive.

14 BY MR. IN:

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

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

20 MR. ZINDA: Objection. Form.

21 THE WITNESS: The conductive additive is to
22 enable the overall composite to exhibit conductivity
23 and, in addition, helps the overall composite electrode
24 to be electrically connected to the current collector.
25

1 BY MR. IN:

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

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

6 MR. ZINDA: Objection. Form.

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

13 BY MR. IN:

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

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

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

4 MR. ZINDA: Objection. Form.

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

16 BY MR. IN:

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

19 A. The most --

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

22 THE WITNESS: The most common is carbon black.

23 BY MR. IN:

24 Q. Are there any other commonly used additive
25 materials?

1 MR. ZINDA: Objection. Form.

2 THE WITNESS: Much less common is carbon
3 nanotube.

4 BY MR. IN:

5 Q. Are there any other materials that you could
6 think of?

7 MR. ZINDA: Objection. Form.

8 THE WITNESS: Oh, there can be other
9 materials, even graphite.

10 BY MR. IN:

11 Q. But regardless of what specific material is
12 used as the conductive additive, fair to say they all
13 function in a similar way by providing this electrical
14 path that you just talked about?

15 MR. ZINDA: Objection. Form.

16 THE WITNESS: Yes.

17 BY MR. IN:

18 Q. So in your declaration now, Dr. Chung, let me
19 go back a little bit to paragraph 52 on page 27.

20 A. Okay. I have it.

21 Q. And that is the Claim Construction paragraph;
22 is that right?

23 A. Yes. Yes.

24 Q. Have you provided a specific construction for
25 any particular claim terms in this patent, Dr. Chung?

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

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

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

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

12 A. It's paragraph 67 of my declaration.

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

15 MR. ZINDA: Objection. Form.

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

19 BY MR. IN:

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

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

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

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

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

12 A. Yes, I'm there.

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

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

16 Q. Which line do you see?

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

19 Q. Sorry about that.

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

22 A. Yes.

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

1 MR. ZINDA: Objection. Form.

2 THE WITNESS: I don't see it as a disputed
3 term because of what I said earlier about the meaning of
4 this term.

5 BY MR. IN:

6 Q. Sorry. Could you explain what you mean by
7 that, that it is not -- you don't view it as a disputed
8 term --

9 MR. ZINDA: Objection.

10 BY MR. IN:

11 Q. -- regarding what you said earlier about this
12 term?

13 MR. ZINDA: Sorry. Objection. Form.

14 THE WITNESS: As I mentioned earlier and
15 stated in paragraph 67 of my declaration, the meaning is
16 consistent from these various sources, including not
17 only the dictionary, but also the testimony of Dr. Zhu.

18 BY MR. IN:

19 Q. Then looking at Claim 1 there on Column 7, are
20 there any terms that are, in your view, disputed?

21 MR. ZINDA: Objection. Form.

22 THE WITNESS: No.

23 BY MR. IN:

24 Q. And this term, "discrete carbon nanotubes," it
25 applies in other patents that you have provided opinions

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

2 MR. ZINDA: Objection. Form.

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

5 BY MR. IN:

6 Q. Sure.

7 So the term "discrete carbon nanotubes," as it
8 appears here in the '909 patent, also appears in the
9 '649 patent; is that right?

10 A. I really have to look at the details of the
11 '649, if I have it here.

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

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

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

16 Okay. I've gotten the '924 patent.

17 In that exhibit -- in the '924 patent, Claim
18 1, it mentions discrete carbon nanotubes.

19 Q. Okay. Fair to say you've applied the same
20 plain and ordinary meaning of that term for both the
21 '909 and '924 patents?

22 A. Yes.

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

1 MR. ZINDA: Objection. Form.

2 THE WITNESS: Could you repeat, please?

3 BY MR. IN:

4 Q. Yeah. So I'm basically trying to ask if there
5 is a difference between the meanings of these two terms.
6 The first term is "discrete carbon nanotubes," and the
7 second term is "discrete nonagglomerated and exfoliated
8 carbon nanotubes."

9 A. No difference.

10 Q. So is it fair to say that if you have discrete
11 carbon nanotubes, you necessarily have discrete
12 nonagglomerated and exfoliated carbon nanotubes?

13 MR. ZINDA: Objection. Form.

14 THE WITNESS: Can you repeat, please?

15 BY MR. IN:

16 Q. Yeah. So based on your statement just now, is
17 it fair to say that if you have discrete carbon
18 nanotubes, then you necessarily have discrete
19 nonagglomerated and exfoliated carbon nanotubes?

20 MR. ZINDA: Objection. Form.

21 THE WITNESS: Yes.

22 BY MR. IN:

23 Q. And vice versa?

24 MR. ZINDA: Objection. Form.

25 THE WITNESS: I wouldn't say vice versa.

1 BY MR. IN:

2 Q. Why not?

3 MR. ZINDA: Object to form.

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

6 BY MR. IN:

7 Q. Fair enough.

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

11 MR. ZINDA: Objection. Form.

12 THE WITNESS: Could you repeat, please?

13 BY MR. IN:

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

17 A. Yes.

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

21 A. Yes.

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

24 A. Yes.

25 Q. And among the various exhibits that you cite

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

3 A. Yes.

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

7 MR. ZINDA: Objection. Form.

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

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

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

19 BY MR. IN:

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

24 MR. ZINDA: Objection. Form.

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

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

7 BY MR. IN:

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

13 MR. ZINDA: Objection. Form.

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

16 BY MR. IN:

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

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

1 Okay.

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

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

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

12 Q. Okay. Understood.

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

17 MR. ZINDA: Objection. Form.

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

19 BY MR. IN:

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

24 MR. ZINDA: Objection. Form.

25 THE WITNESS: It really depends on the

1 diameter of the carbon nanotube. If it's only 1
2 nanometer, for instance, and this scale is 300, so it's
3 1 over 300 of the length of that scale, you know, that's
4 pretty tiny, tiny. And so if it's, say, 1 nanometer
5 diameter carbon nanotube, it might be difficult to see
6 that.

7 BY MR. IN:

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

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

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

20 MR. ZINDA: Objection. Form.

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

25

1 BY MR. IN:

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

4 A. I have used TEM to view carbon nanofiber.

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

9 MR. ZINDA: Objection. Form.

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

12 BY MR. IN:

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

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

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

24 MR. ZINDA: Objection.

25 Q. -- your other graduate students?

1 MR. ZINDA: Sorry. Objection. Form.

2 THE WITNESS: Yes.

3 BY MR. IN:

4 Q. If you had an electrode sample that is
5 depicted in Figure 1 of the '909 patent and if you were
6 to create a TEM sample based on that electrode, would
7 you expect the discreteness of the nanotubes to be
8 affected by the sample preparation step?

9 MR. ZINDA: Objection. Form.

10 THE WITNESS: In general, in the -- this
11 thinning procedure, as required for the preparation of
12 the TEM specimen, it is possible to have this specimen
13 damaged to a degree.

14 For instance, ion milling is very commonly
15 used to make it very, very thin; and that involves
16 shooting ions that have high kinetic energy, just
17 eroded. And this erosion is possible to cause some
18 damage, and that damage can include the possibility of
19 making some nanotubes be shortened.

20 BY MR. IN:

21 Q. Is it possible that you could start with a
22 sample that does not have discrete nanotubes, but by the
23 time you've prepared that sample for TEM imaging, that
24 it becomes discrete nanotubes? Would that be possible?

25 MR. ZINDA: Objection. Form.

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

3 BY MR. IN:

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

6 Could you get that reference out, Dr. Chung?

7 A. Yes, I have it.

8 Q. So that's U.S. Patent Application Number
9 2004/0160156 that we've been referring to as the Ohata
10 reference; is that right?

11 A. Yes.

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

14 A. Yes.

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

17 A. Yes.

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

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

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

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

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

7 MR. ZINDA: Objection. Form.

8 THE WITNESS: Yes, it's consistent.

9 BY MR. IN:

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

12 A. Okay. I'm there.

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

17 Do you see that?

18 A. Yes.

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

21 MR. ZINDA: Objection. Form.

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

25 But in the absence of the active particles, it

1 is -- and it's also a schematic. And in the paragraph
2 12, it says, "Figure 1(a) is a schematic diagram showing
3 that carbon nanotubes are tangled and twisted with one
4 another before they are blended with a resin."

5 Okay. So if in Figure 1(a), it's, before,
6 blended with a resin. But then we're talking about
7 1(b). Figure 1(b) is in paragraph 13. It says, "Figure
8 1(b) is a schematic diagram showing that the carbon
9 nanotubes are unraveled and straightened after they have
10 been blended with a resin."

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

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

23 BY MR. IN:

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

1 excellent conductive path in an electrode."

2 What electrode is being referred to here?

3 MR. ZINDA: Objection. Form.

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

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

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

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

21 BY MR. IN:

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

1 MR. ZINDA: Objection. Form.

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

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

15 BY MR. IN:

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

20 MR. ZINDA: Objection. Form.

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

1 particles.

2 BY MR. IN:

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

6 MR. ZINDA: Objection. Form.

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

17 BY MR. IN:

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

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

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

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

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

9 MR. ZINDA: Objection. Form.

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

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

21 BY MR. IN:

22 Q. Is the resin itself electrically conductive?

23 MR. ZINDA: Objection. Form.

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

1 BY MR. IN:

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

8 MR. ZINDA: Objection. Form.

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

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

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

1 BY MR. IN:

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

6 MR. ZINDA: Objection. Form.

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

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

18 BY MR. IN:

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

23 MR. ZINDA: Objection. Form.

24 THE WITNESS: Could you rephrase, please?
25

1 BY MR. IN:

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

7 MR. ZINDA: Objection. Form.

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

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

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

21 BY MR. IN:

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

1 MR. ZINDA: Objection. Form.

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

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

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

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

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

20 THE WITNESS: Sure.

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

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

23 BY MR. IN:

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

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

3 That doesn't count, right?

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

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

12 MR. ZINDA: Objection. Form.

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

17 BY MR. IN:

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

21 MR. ZINDA: Objection. Form.

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

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

5 BY MR. IN:

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

9 MR. ZINDA: Objection. Form.

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

14 BY MR. IN:

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

17 MR. ZINDA: Objection. Form.

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

22 BY MR. IN:

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

1 MR. ZINDA: Objection. Form.

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

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

8 BY MR. IN:

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

12 A. Yes, I'm there.

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

15 Do you see that?

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

18 A. What was the question?

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

22 A. Yes, I do.

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

25 A. He has 15 parts by weight of carbon nanotubes

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

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

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

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

10 MR. ZINDA: Objection. Form.

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

13 BY MR. IN:

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

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

18 Q. Does he add anything else?

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

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

24 MR. ZINDA: Objection. Form.

25 THE WITNESS: Well, he used NMP.

1 BY MR. IN:

2 Q. And what is NMP?

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

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

6 A. Would you repeat? I'm sorry.

7 Q. Yeah.

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

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

13 Q. And how does NMP physically disperse these
14 materials?

15 MR. ZINDA: Objection. Form.

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

21 BY MR. IN:

22 Q. And how big are these domains?

23 MR. ZINDA: Objection. Form.

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

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

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

9 BY MR. IN:

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

14 Do you see that, Dr. Chung?

15 A. Yes.

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

19 MR. ZINDA: Objection. Form.

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

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

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

7 BY MR. IN:

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

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

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

20 MR. ZINDA: Objection. Form.

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

1 BY MR. IN:

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

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

8 MR. ZINDA: Objection. Form.

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

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

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

24 MR. ZINDA: Objection. Form.

25

1 BY MR. IN:

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

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

12 MR. ZINDA: Objection. Form.

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

19 BY MR. IN:

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

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

25 MR. ZINDA: Objection. Form.

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

9 BY MR. IN:

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

11 A. What --

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

14 A. Is this an MRD or LG document?

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

17 A. MRD what --

18 Q. 2017.

19 A. I have it.

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

23 A. Yes.

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

1 position that NMP does not fully dissolve PVDF.

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

4 A. Yes.

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

8 Do you see that?

9 A. Yes.

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

12 A. Nicolas '429 proposed its own masterbatch
13 process. And in example 3 of his, the process uses 5
14 percent by weight of CNT, 1 percent by weight of PVP, at
15 .8 percent by weight of PVDF, and 93.2 percent by weight
16 of NMP to form a paste, which is then mixed with
17 lithium-ion phosphate.

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

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

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

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

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

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

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

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

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

21 Okay. And he further described it in --

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

24 Where were you reading from just now in
25 Nicolas?

1 A. It's paragraph 97.

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

5 A. Yes.

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

8 Where are the LFP/carbon particles in this
9 image?

10 MR. ZINDA: Objection. Form.

11 THE WITNESS: The carbon nanotubes are inside
12 the PVDF, and you see all these PVDF domains. And these
13 domains include in them the CNTs. And the -- and these
14 domains are dispersed around the lithium-ion phosphate.
15 BY MR. IN:

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

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

20 MR. ZINDA: Objection. Form.

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

1 are not very clear-cut.

2 And this image, it has that problem too.

3 Okay. So just looking at the image, it's hard to see
4 where is the lithium-ion phosphate particles.

5 BY MR. IN:

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

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

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

15 MR. ZINDA: Objection. Form.

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

18 BY MR. IN:

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

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

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

25 A. Yes.

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

3 A. Maybe you can share it.

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

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

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

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

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

21 MR. ZINDA: Objection. Form.

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

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

3 BY MR. IN:

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

10 MR. ZINDA: Objection. Form.

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

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

25

1 BY MR. IN:

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

5 MR. ZINDA: Objection. Form.

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

15 BY MR. IN:

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

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

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

22 MR. ZINDA: Objection. Form.

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

1 BY MR. IN:

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

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

6 A. Yes, I have it.

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

9 A. Yes, I have that.

10 Q. And it may also be helpful to have your
11 declaration open as well at paragraph 180, which is page
12 102.

13 A. Yes.

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

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

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

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

6 Does that sound right?

7 MR. ZINDA: Objection. Form.

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

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

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

19 BY MR. IN:

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

22 Let me know when you've read it.

23 A. Yes, I have it.

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

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

5 MR. ZINDA: Objection. Form.

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

8 BY MR. IN:

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

11 A. Okay.

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

14 A. Well, it says Figure 6 is an SEM, scanning --
15 (Court reporter requested clarification.)

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

22 BY MR. IN:

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

1 secondary particles?

2 MR. ZINDA: Objection. Form.

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

8 BY MR. IN:

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

15 MR. ZINDA: Objection. Form.

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

21 BY MR. IN:

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

24 A. Yes. It is 500 nanometer.

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

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

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

5 Q. Okay. And if we could go back to paragraphs
6 83 and 84 of Lee, you will see that it mentions some
7 sizes associated with its silicon particles as well as
8 its carbon nanotubes.

9 Do you see that?

10 A. Yes.

11 Q. And would you agree with me that the average
12 particle size of the silicon particles in Lee is
13 14 nanometers?

14 A. Yes.

15 MR. ZINDA: Objection. Form.

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

18 BY MR. IN:

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

23 MR. ZINDA: Objection. Form.

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

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

5 BY MR. IN:

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

10 MR. ZINDA: Objection. Form.

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

16 BY MR. IN:

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

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

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

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

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

6 A. That's what it looks like.

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

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

15 Q. So you are not making any conclusions about
16 what is being shown next to that orange arrow in Figure
17 6; is that right?

18 MR. ZINDA: Objection. Form.

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

22 BY MR. IN:

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

25 MR. ZINDA: Objection. Form.

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

4 BY MR. IN:

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

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

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

17 MR. ZINDA: Objection. Form.

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

22 BY MR. IN:

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

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

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

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

4 MR. ZINDA: Sure.

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

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

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

11 Thank you.

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

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

14 EXAMINATION BY MR. ZINDA:

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

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

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

22 Do you see that, Dr. Chung?

23 A. Yes.

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

1 A. Right.

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

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

6 MR. ZINDA: I have no further questions.

7 Pass the witness.

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

10 (Off-the-record discussion.)

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

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

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

17 COURT REPORTER: Thank you.

18 (Whereupon the proceedings concluded at
19 11:51 a.m.)

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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	_____
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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.

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**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 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;

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

Dated: 8th of July, 2025.

TAMARA L. HOUSTON
CSR 7244, RPR, CCRR 140

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95 61:10,12,16 62:7 97 53:12 54:1,2 9:03 6:2 <hr/> <p style="text-align: center;">A</p> a.m. 6:2 41:22 67:5,13 68:19 ability 47:25 50:2,8 absence 32:25 absent 13:14 56:24 57:13 accurate 61:24 achieve 15:9 16:4 active 11:7,23 12:16,17,20,21 14:21,22,23,25 15:3,5, 10 16:2 17:3,5,12,14,15 32:25 34:8,19,20 35:6, 19,22,24,25 36:4 37:7, 18 38:4,6,22 39:3,8,21 40:5,8,14,15,24 41:4,5, 8,9,14,15 42:10,20,23, 24 43:7 45:17 46:5,9 61:18 add 45:17,18,19 46:4,8 51:10 adding 53:1,2 addition 15:23 28:22 additional 29:7 additive 11:8,23 15:13,17,19,21 16:3,7,20,24 17:2,13, 18,24 18:12 43:3 affected 30:8	aftermaths 47:20 agglomerated 60:5 61:4,21,25 62:4 agglomeration 61:2 agree 34:22 41:2 49:21 50:7 60:2,3 61:1 62:9 63:11 ahead 55:6 alleged 58:17 allowing 41:9 amount 32:16 34:15 anode 10:14 61:18 apparently 59:22 appearance 58:8,9,11 appears 22:8 62:3,20 application 31:8 55:8 applications 7:7 12:2 13:18,25 applied 22:19 32:5 53:18 applies 21:25 apply 20:24 applying 19:22 area 60:10 arrow 64:19,21 65:4,16 66:9 assemblies 60:4 attached	19:5 attention 19:20 44:10 59:7 attorney-client 8:2 average 63:11 64:12 aware 49:5 <hr/> <p style="text-align: center;">B</p> back 18:19 19:20 33:11 53:23 63:5,19 67:8,9 background 10:4 background-type 7:3 bar 62:22 63:3,20,24 64:2,3 base 65:10 based 23:16 25:20 26:8 27:20 30:6 50:3 51:3,4 55:12 58:20 60:1,9 61:23 63:17,20 65:13 basically 23:4 basis 48:8 battery 12:2 16:10 benefits 12:9 big 46:22 49:16 60:14 bigger 10:13 binder 11:8,24 13:5,6,8,11,14, 25 14:8,23 35:10,13,16, 18,21,22,23 36:9 37:11, 13,17 38:9,15,16,21 39:9,10,13 40:10,23 43:2	binders 13:18,21 binding 38:16 bit 11:1 18:19 20:6 56:8 black 17:22 blended 33:4,6,10 blending 33:13 bond 48:16,18,21 bonding 48:2 bonds 48:12,13,14 bottom 41:12 42:8,16 62:23 64:19 bound 61:3 break 41:18,25 breaking 47:22 breaks 46:17 47:17 bridged 14:23 briefly 54:7 bring 19:20 bundle 64:23,25 65:5 66:8,13, 16,21,24 <hr/> <p style="text-align: center;">C</p> calculate 64:1 California 6:1,5
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