

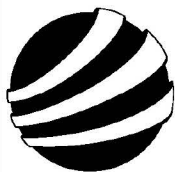
In the Matter Of:

LG ENERGY vs MOLECULAR REBAR

IPR2024-01013

YU ZHU PHD

August 11, 2025



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IPR2024-01013

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Case IPR2024-01013
U.S. Patent 10,153,483

LG ENERGY SOLUTION, LTD.,
SAMSUNG ELECTRONICS CO., LTD. AND
SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioner

VS.

MOLECULAR REBAR DESIGN, LLC,
Patent Owner

VIDEOCONFERENCED DEPOSITION OF YU ZHU, PhD

Date Edith A. Boggs, CSR

8-11-2025 HOUSTON, TEXAS

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DEPOSITION OF YU ZHU, PhD

DEPOSITION AND ANSWERS of YU ZHU, PhD, taken before
Edith A. Boggs, a certified shorthand reporter in Harris
County for the State of Texas, taken via videoconference
with the witness appearing from Akron, Ohio, on the 11th
day of August, 2025, between the hours of 9:01 a.m. and
9:38 a.m.

A P P E A R A N C E S

ATTORNEYS FOR PETITIONER:

Fish & Richardson P.C.
1000 Maine Avenue SW, Suite 1000
Washington, DC 20024

By: Hyun Jim In, Esq.
(Present via videoconference)
Gretchen DeVries, Esq.
(Present via videoconference)
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ATTORNEY FOR PATENT OWNERS:

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By: Stephen D. Zinda, Esq.
(Present via videoconference)

REPORTED REMOTELY BY:

Ms. Edith A. Boggs

EXAMINATION INDEX

QUESTIONS BY

PAGE

Mr. Zinda

5

INDEX OF EXHIBITS

NO.	MARKED	DESCRIPTION
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None		
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1 YU ZHU, PhD

2 was called as a witness and, being first duly sworn by
3 the notary, testified as follows:

4 EXAMINATION

5 Q. (BY MR. ZINDA) Good morning, Dr. Zhu. How are
6 you doing?

7 A. Very good. Good morning, Stephen.

8 Q. It's good to see you again. And I know,
9 obviously, you've been deposed multiple times in these
10 proceedings alone, but I just want to go over some
11 ground rules again just to refresh your memory. We may
12 not need to do that for the other depositions this week,
13 but if you don't understand a question, could you please
14 let me know?

15 A. Yes.

16 Q. And if you don't tell me that you misunderstand
17 or need clarification, I'm going to understand that you
18 understood the question. Does that make sense?

19 A. Yes.

20 Q. And, of course, your counsel may object to
21 certain questions I've asked, but you have to answer
22 unless they object on the basis of privilege. Do you
23 understand that?

24 A. Yes, I understand.

25 Q. And, of course, we'll take breaks. Just

1 whenever you think you need to take a break, let me
2 know. All I ask is that you don't ask for a break in
3 the middle of a question, while there's a question
4 pending. Does that make sense?

5 A. Yes, that does make sense.

6 Q. Do you have any documents with you?

7 A. Yeah, I have my declaration with me.

8 Q. And is that -- well, let me break it up.

9 Do you have any physical documents with
10 you?

11 A. Yes.

12 Q. Do they have any markings or any notes on them?

13 A. No. It's just the printed declaration
14 documents.

15 Q. And do you have any other -- other than your
16 declaration, do you have any other physical documents
17 with you?

18 A. No.

19 Q. Okay. And if you need, I can also upload
20 exhibits to the chat room if we need to, but I'm
21 assuming you probably have those available as well.

22 A. Yes.

23 Q. Okay. So, Dr. Zhu, can I get you to turn to
24 your declaration, which is LGES 1056. And if it's hard
25 to hear me, I've got a bad case of --

1 A. Stephen, I just want to make sure, I have two
2 declarations, so which one you are referring to?

3 Q. Sure. It should be LGES 1056, which is titled
4 Supplemental Declaration of Dr. Yu Zhu.

5 A. Okay. That's the second one. Yes.

6 Q. And if I could get you to go to Page 5. It's
7 the bottom -- there's two different page numbers on
8 these documents. I'm talking about --

9 A. Yeah, there's two different pages. Okay.

10 Q. Page 5 should have an image of LGES 1003,
11 Page 50.

12 A. Uh-huh.

13 Q. And that appears to be an image of Figure 1B
14 from Ohata; is that correct?

15 A. Yes. That's correct.

16 Q. Okay. And in this figure, you've added a red
17 arrow. Do you see that red arrow?

18 A. Yes.

19 Q. And that red arrow is pointing -- would you
20 agree that that red arrow is pointing to a fully
21 isolated carbon nanotube?

22 MR. IN: Objection, form.

23 A. Yeah, that one I have already noted on my
24 declaration. It's a discrete, nonagglomerated and
25 exfoliated carbon nanotube.

1 Q. (BY MR. ZINDA) Okay. But would you agree with
2 me that the carbon nanotube that that arrow is pointing
3 to is a fully isolated carbon nanotube?

4 MR. IN: Same objection.

5 A. Yeah, as I said, it's a discrete,
6 nonagglomerated and exfoliated carbon nanotube. I
7 didn't say the word of isolated.

8 Q. (BY MR. ZINDA) You've never described that
9 nanotube that you've identified with the red arrow as
10 fully isolated?

11 MR. IN: Objection, form.

12 A. I said exfoliated.

13 Q. (BY MR. ZINDA) So -- well, let me ask you this
14 question: Is the carbon nanotube that you've identified
15 with the red arrow, is that a fully isolated carbon
16 nanotube?

17 A. Well, I already answered your question. I said
18 it is discrete, nonagglomerated and exfoliated carbon
19 nanotubes, and this is one example of that carbon
20 nanotube. I did not make any other description on that.

21 Q. Dr. Zhu, I'm going to ask you again. Is the
22 carbon nanotube that you've identified with the red
23 arrow a fully isolated carbon nanotube?

24 MR. IN: Objection, form.

25 A. Yeah, as I just answered, what I said here is a

1 discrete, nonagglomerated and exfoliated carbon
2 nanotube.

3 Q. (BY MR. ZINDA) I'm going to ask you again,
4 Dr. Zhu. I'm not asking you what you said in your
5 declaration right here. I'm asking you can you tell me
6 whether or not the carbon nanotube that you've
7 identified with the red arrow is a fully isolated carbon
8 nanotube?

9 MR. IN: Objection, form.

10 A. Yeah, that's -- I just answered you a couple of
11 times. When I describe that nanotube, I use a red arrow
12 to point out it's discrete, nonagglomerated and
13 exfoliated carbon nanotube, with no other additional
14 description except that.

15 Q. (BY MR. ZINDA) Do you know one way or the
16 other whether or not that carbon nanotube identified by
17 the red arrow is fully isolated?

18 A. Yeah, I said it's exfoliated and
19 nonagglomerated and discrete, yeah.

20 Q. But I'm not asking you about that, Dr. Zhu.
21 You're simply not answering my question. I'm asking you
22 a simple yes or no question.

23 You've been retained as an expert, correct?

24 A. Yes, I'm an expert. So that's why I use expert
25 language to describe the situation I have described in

1 my declaration. So that is already written very clearly
2 on my description, and this is stated as a discrete,
3 nonagglomerated and exfoliated carbon nanotube, which is
4 pointed out by that red arrow from that LGES 1003, 50.
5 So that's my expert comment on what is the status of
6 that nanotube.

7 Q. But can you tell me whether or not the nanotube
8 identified with the red arrow is a fully isolated
9 nanotube?

10 MR. IN: Objection, form.

11 A. I think this nanotube is described as discrete
12 and nonagglomerated and exfoliated carbon nanotube, and
13 that is the most accurate description based on my expert
14 view.

15 MR. ZINDA: All right. I'm going to move
16 to strike as nonresponsive.

17 Q. (BY MR. ZINDA) It's clear that you're just not
18 going to answer the question, Dr. Zhu, but I'll ask you
19 one more time, though.

20 Have you ever described that nanotube with
21 the red arrow pointing to it as a fully isolated carbon
22 nanotube?

23 A. I think I answered this question for multiple
24 times, and this a discrete and nonagglomerated and
25 exfoliated carbon nanotube based on my expert view on

1 this content.

2 Q. What is a fully isolated carbon nanotube?

3 A. The fully isolated carbon nanotube is like one
4 of the examples showing on that image, which means that
5 the nanotube is not forming any bundles or as many as
6 the carbon nanotubes.

7 Q. So does a fully isolated carbon nanotube have
8 to be separate from other nanotubes?

9 MR. IN: Objection, form.

10 A. This doesn't mean that it was completely
11 separated and not in contact with any other carbon
12 nanotube, but they are exfoliated and they are separated
13 largely.

14 Q. (BY MR. ZINDA) So it's your testimony that a
15 fully isolated carbon nanotube can be attached to
16 another nanotube?

17 A. A fully isolated nanotube is a -- it's a status
18 of the nanotube when it was compared with bundled and
19 agglomerated nanotubes. So it has largely separated
20 from other nanotubes.

21 Q. Can I get you, Dr. Zhu, to pull out LGES 1004,
22 which is the Ohata reference.

23 A. Okay. Give me a second.

24 Okay. Yeah, I opened LGES 1004.

25 Q. And then if I could get you to turn to

1 Figure 1.

2 A. Yes.

3 Q. Okay. So we'll look at Figure 1. Figure 1B,
4 you've testified that Figure 1B depicts discrete carbon
5 nanotubes, correct?

6 A. Figure 1B is -- yeah.

7 Q. But you would agree with me that Figure 1A does
8 not depict discrete carbon nanotubes, correct?

9 A. Figure 1A is an entangled carbon nanotube.

10 Q. Right. But does Figure 1A depict discrete
11 carbon nanotubes?

12 A. It's not a discrete carbon nanotube. Figure 1A
13 is not a discrete carbon nanotube.

14 Q. And would you agree with me that the nanotubes
15 in Figure 1A are capable of being separated to give
16 individual tubes?

17 A. As I just said, Figure 1A is entangled.
18 Entangled means nanotube are actually woven together and
19 they have many contact. They are typically not regarded
20 as exfoliated carbon nanotube.

21 Q. Right. I understand that. But are the
22 nanotubes in Figure 1A capable of being separated to
23 give individual tubes?

24 MR. IN: Objection, form.

25 A. The status showing in Figure 1A are nanotubes

1 that are entangled. They are not separated from each
2 another.

3 Q. (BY MR. ZINDA) But are they capable of being
4 separated from each other?

5 MR. IN: Objection, form.

6 A. Well, when you say they are capable or not
7 separated each other, I think this is depending on how
8 you treat other nanotubes and how the nanotube was
9 processed. So there is no definite answer about whether
10 entangled nanotube are capable to be separated. It
11 depends on many things, like what is preparation
12 procedure to separate those nanotubes. So --

13 Q. (BY MR. ZINDA) Right. But if you apply the --
14 if you apply the appropriate process, isn't it true that
15 any carbon nanotube is capable of being separated from
16 another carbon nanotube?

17 MR. IN: Objection, form.

18 A. The carbon nanotube -- or the entangled carbon
19 nanotube in Figure 1A, if it was under right procedure,
20 there is always a potential to be separated.

21 Q. (BY MR. ZINDA) Right. In other words, if you
22 apply the appropriate process, entangled carbon
23 nanotubes are capable of being separated to give
24 individual nanotubes, correct?

25 MR. IN: Objection, mischaracterizes.

1 A. It depends on the conditions. So there's
2 usually no universal answer for such a status. So this
3 is depending on, as I said, the processing technique
4 used and initial stages of the entanglement and you
5 possibly can achieve a separated status, you possibly
6 cannot achieve a separated status. So that condition is
7 complicated.

8 Q. (BY MR. ZINDA) Have you ever heard of a
9 concept known as electron tunneling?

10 A. Yes.

11 Q. What is electron tunneling, in your opinion?

12 A. Electron tunneling is a microscopic phenomenon
13 and, typically, the electron can transport from one
14 place to another place to create empty spaces. A lot of
15 times it's vacuum and without any conducting materials
16 between them.

17 Q. Have you ever heard of a concept known as the
18 percolation threshold?

19 A. Yes.

20 Q. What is --

21 A. I've heard.

22 Q. What is your understanding of the percolation
23 threshold?

24 A. The percolation threshold is basically a volume
25 percentage of a feeler in a composite system, and when

1 those feeler volume percentage reach a specific volume
2 out of the total volume of the composite and the feeler
3 can form a connected network, and that threshold was
4 typically called a percolation threshold.

5 Q. Can active material have a high electrical
6 conductivity?

7 MR. IN: Objection, form.

8 A. Can you repeat the question? I didn't hear.

9 Q. (BY MR. ZINDA) Can active material have high
10 electrical conductivity?

11 MR. IN: Same objection.

12 A. So are you referring to active material used in
13 the lithium-ion battery?

14 Q. (BY MR. ZINDA) Correct.

15 A. So the intrinsic conductivity of acting
16 materials in the lithium-ion battery, depending on what
17 electrode you are referring to, some of them have good
18 intrinsic conductivity, for example, the graphite
19 materials, and some materials does not have good
20 intrinsic electronic conductivity, such as some oxide
21 materials. So this question is -- it's depending on
22 which exactly electrode you are referring to.

23 Q. Okay. What is a scanning electron microscope
24 image?

25 A. A scanning electron microscope image is

1 basically a scanning microscopic technique, and this is
2 the image formed by electrons and samples under
3 generally a vacuum condition and the electrons which was
4 bounced back and was collected by the detector, and the
5 detector will generate an image of the surface of the
6 sum typically.

7 Q. And an SEM image, that is a two-dimensional
8 projection of a three-dimensional sample, correct?

9 A. That is actually exploring the surface of the
10 sample. So you've got the surface, which is the sample.
11 It's not necessary to be exactly on the same plane, but
12 it's on the surface of the sample.

13 Q. Right. But would nanotubes -- would you agree
14 that nanotubes that appear to cross in an SEM image may,
15 in fact, be present on an entirely different plane and,
16 thus, not in contact at all?

17 A. Well, for SEM, that's -- it's possible, but
18 usually it's not true because SEM may explore the
19 surface of your sample. So they are exploring the
20 surface information of your nanometers, which is pretty
21 much in a similar range of the carbon nanotube diameter.
22 So if you see the cross of a nanotube on the SEM image,
23 usually it's an indication there are physical contact
24 between those carbon nanotubes, yeah.

25 Q. But it's also possible that the carbon

1 nanotubes that appear to cross may be at different
2 depths in the image, correct?

3 A. Well, that -- that part would be difficult to
4 achieve because the materials that you observed under
5 SEM has a different capability to allow the electron to
6 explore the depths of the surface. So usually it's not
7 that high as compared with the diameter of the nanotube.
8 So I would regard for majority of the SEM pictures, if
9 there is a cross between carbon nanotube, there is
10 likely a contact between those tubes.

11 MR. ZINDA: I have no further questions.
12 I'll pass the witness.

13 MR. IN: Could we take a ten-minute --
14 sorry -- 15-minute break? Would that be okay?

15 MR. ZINDA: That's fine with me.

16 (Short recess.)

17 MR. IN: No further questions from
18 petitioner. Thank you.

19 (Whereupon at 9:38 a.m. the
20 deposition was concluded.)
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Line

1 I, YU ZHU, PhD, have read the foregoing
2 deposition and hereby affix my signature that same is
true and correct, except as noted above.

3 _____
4 YU ZHU, PhD

5 THE STATE OF _____
6 COUNTY OF _____

7 Before me, _____, on this day personally
8 appeared YU ZHU, PhD, known to me (or proved to me under
9 oath or through _____) (description of identity
card or other document) to be the person whose name is
subscribed to the foregoing instrument and acknowledged
to me that they executed the same for the purposes and
consideration therein expressed.

10 Given under my hand and seal of office this _____ day
11 of _____, _____.

12 _____
13 NOTARY PUBLIC IN AND FOR
14 THE STATE OF _____
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1 STATE OF TEXAS *

2 COUNTY OF HARRIS *

3 I, the undersigned certified shorthand
4 reporter and notary public in and for the State of
5 Texas, certify that the facts stated in the foregoing
6 pages are true and correct.

7 I further certify that I am neither attorney
8 or counsel for, nor related to or employed by, any of
9 the parties to the action in which this deposition is
10 taken and, further, that I am not a relative or employee
11 of any counsel employed by the parties hereto, or
12 financially interested in the action.

13 SUBSCRIBED AND SWORN TO under my hand and seal
14 of office on this the 11th day of August, 2025.

15 *Edith A. Boggs*

16 EDITH A. BOGGS, CSR
17 Certified Shorthand Reporter and
18 Notary Public in and for
19 the State of Texas

20 Notary Expires: 7-21-2028
21 Certificate No. 3022
22 Expiration date: 7-31-2026
23 Esquire Deposition Solutions, LLC
24 Registration No. 3
25

Reference No.: 13276853

Case: LG ENERGY vs MOLECULAR REBAR

DECLARATION UNDER PENALTY OF PERJURY

I declare under penalty of perjury that I have read the entire transcript of my Deposition taken in the captioned matter or the same has been read to me, and the same is true and accurate, save and except for changes and/or corrections, if any, as indicated by me on the DEPOSITION ERRATA SHEET hereof, with the understanding that I offer these changes as if still under oath.

Yu Zhu PhD

NOTARIZATION OF CHANGES

(If Required)

Subscribed and sworn to on the _____ day of

_____, 20____ before me,

(Notary Sign)_____

(Print Name) _____ Notary Public,

in and for the State of _____

Reference No.: 13276853
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Reason for change: _____

Page No. _____ Line No. _____ Change to: _____

Reason for change: _____

Page No. _____ Line No. _____ Change to: _____

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Page No. _____ Line No. _____ Change to: _____

Reason for change: _____

Page No. _____ Line No. _____ Change to: _____

Reason for change: _____

SIGNATURE: _____ DATE: _____
Yu Zhu PhD

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1	14:5, 6	6:25	13, 16	14:1
<hr/>	17:4	based	10:3, 12,	conducting
1	acting	10:13, 25	21, 25	14:15
12:1, 3	15:15	basically	11:2, 3, 6,	conductivit
1003	active	14:24	7, 11, 15	y
7:10 10:4	15:5, 9, 12	16:1	12:4, 8, 9,	15:6, 10,
1004	added	basis	11, 12, 13,	15, 18, 20
11:21, 24	7:16	5:22	20 13:15,	connected
1056	additional	battery	16, 18, 22	15:3
6:24 7:3	9:13	15:13, 16	16:21, 24,	contact
15-minute	agglomerate	bottom	25 17:9	11:11
17:14	d	7:7	case	12:19
1A	11:19	bounced	6:25	chat
12:7, 9,	agree	16:4	6:20	16:16, 23
10, 12, 15,	7:20 8:1	break	clarificati	17:10
17, 22, 25	12:7, 14	6:1, 2, 8	on	content
13:19	16:13	17:14	5:17	11:1
1B	answering	breaks	clear	correct
7:13	9:21	5:25	10:17	7:14, 15
12:3, 4, 6	appears	bundled	collected	9:23
<hr/>	7:13	11:18	16:4	12:5, 8
5	apply	bundles	comment	13:24
<hr/>	13:13, 14,	11:5	10:5	15:14
5	22	<hr/>	compared	16:8 17:2
7:6, 10	arrow	c	11:18	counsel
50	7:17, 19,	called	17:7	5:20
7:11 10:4	20 8:2, 9,	5:2 15:4	completely	couple
<hr/>	15, 23	capability	11:10	9:10
9	9:7, 11, 17	17:5	complicated	create
<hr/>	10:4, 8, 21	capable	14:7	14:14
9:38	assuming	12:15, 22	composite	cross
17:19	6:21	13:3, 6,	14:25	16:14, 22
<hr/>	attached	10, 15, 23	15:2	17:1, 9
A	11:15	carbon	concept	<hr/>
<hr/>	B	7:21, 25	14:9, 17	D
a.m.	back	8:2, 3, 6,	concluded	declaration
17:19	16:4	14, 15, 18,	17:20	6:7, 13,
accurate		19, 22, 23	condition	16, 24
10:13			14:6 16:3	7:4, 24
				9:5 10:1

declaration s 7:2	24 12:4, 8,10,12, 13	9:1,13,18 10:3,12, 25 11:12 12:20	forming 11:5	<hr/> I <hr/>
definite 13:9	documents 6:6,9,14, 16 7:8	exhibits 6:20	fully 7:20 8:3, 10,15,23 9:7,17 10:8,21 11:2,3,7, 15,17	identified 8:9,14,22 9:7,16 10:8
depending 13:7 14:3 15:16,21	duly 5:2	expert 9:23,24 10:5,13, 25	<hr/> G <hr/>	image 7:10,13 11:4 15:24,25 16:2,5,7, 14,22 17:2
depends 13:11 14:1	<hr/> E <hr/>	explore 16:18 17:6	generally 16:3	indication 16:23
depict 12:8,10	electrical 15:5,10	exploring 16:9,19	generate 16:5	individual 12:16,23 13:24
depicts 12:4	electrode 15:17,22	<hr/> F <hr/>	give 11:23 12:15,23 13:23	information 16:20
deposed 5:9	electron 14:9,11, 12,13 15:23,25 17:5	fact 16:15	good 5:5,7,8 15:17,19	initial 14:4
deposition 17:20	electronic 15:20	feeler 14:25 15:1,2	graphite 15:18	intrinsic 15:15,18, 20
depositions 5:12	electrons 16:2,3	figure 7:13,16 12:1,3,4, 6,7,9,10, 12,15,17, 22,25 13:19	ground 5:11	isolated 7:21 8:3, 7,10,15, 23 9:7,17 10:8,21 11:2,3,7, 15,17
depths 17:2,6	empty 14:14	fine 17:15	<hr/> H <hr/>	language 9:25
describe 9:11,25	entangled 12:9,17, 18 13:1, 10,18,22	form 7:22 8:11,24 9:9 10:10 11:9 12:24 13:5,17 15:3,7	hard 6:24	largely 11:13,19
description 8:20 9:14 10:2,13	entanglemen t 14:4	formed 16:2	hear 6:25 15:8	<hr/> L <hr/>
detector 16:4,5	EXAMINATION 5:4		heard 14:8,17, 21	
diameter 16:21 17:7	examples 11:4		high 15:5,9 17:7	
difficult 17:3	exfoliated 7:25 8:6, 12,18			LGES
discrete 7:24 8:5, 18 9:1, 12,19 10:2,11,				

6:24 7:3, 10 10:4 11:21,24	misundersta nd 5:16	network 15:3	opinion 14:11	10:4
lithium-ion 15:13,16	morning 5:5,7	nonagglomer ated 7:24 8:6, 18 9:1, 12,19 10:3,12, 24	oxide 15:20	pointing 7:19,20 8:2 10:21
lot 14:14	move 10:15		P	possibly 14:5
M	multiple 5:9 10:23	nonresponsi ve 10:16	pages 7:9	potential 13:20
majority 17:8	N	notary 5:3	part 17:3	preparation 13:11
make 5:18 6:4, 5 7:1 8:20	nanometers 16:20	noted 7:23	pass 17:12	present 16:15
markings 6:12	nanotube 7:21,25 8:2,3,6, 9,14,16, 20,22,23 9:2,6,8, 11,13,16 10:3,6,7, 9,11,12, 20,22,25 11:2,3,5, 7,12,15, 16,17,18 12:9,12, 13,18,20 13:8,10, 15,16,18, 19 16:21, 22 17:7,9	notes 6:12	pending 6:4	pretty 16:20
material 15:5,9,12		numbers 7:7	percentage 14:25 15:1	printed 6:13
materials 14:15 15:16,19, 21 17:4		0	percolation 14:18,22, 24 15:4	privilege 5:22
means 11:4 12:18		object 5:20,22	petitioner 17:18	procedure 13:12,19
memory 5:11		objection 7:22 8:4, 11,24 9:9 10:10 11:9 12:24 13:5,17, 25 15:7, 11	Phd 5:1	proceedings 5:10
microscope 15:23,25		observed 17:4	phenomenon 14:12	process 13:14,22
microscopic 14:12 16:1	nanotubes 8:19 11:6,8, 19,20 12:5,8, 11,14,22, 25 13:8, 12,23,24 16:13,14, 24 17:1	Ohata 7:14 11:22	physical 6:9,16 16:23	processed 13:9
middle 6:3		opened 11:24	pictures 17:8	processing 14:3
mischaracte rizes 13:25			place 14:14	projection 16:8
			plane 16:11,15	pull 11:21
			point 9:12	Q
			pointed	question 5:13,18 6:3 8:14, 17 9:21,

22 10:18, 23 15:8, 21	5:11	situation 9:25	ten-minute 17:13	two- dimensional 16:7
questions 5:21 17:11, 17	<hr/> s <hr/>	spaces 14:14	testified 5:3 12:4	typically 12:19 14:13 15:4 16:6
<hr/> R <hr/>	sample 16:8, 10, 12, 19	specific 15:1	testimony 11:14	<hr/>
range 16:21	samples 16:2	stages 14:4	things 13:11	U <hr/>
reach 15:1	scanning 15:23, 25 16:1	stated 10:2	three- dimensional 16:8	Uh-huh 7:12
recess 17:16	SEM 16:7, 14, 17, 18, 22 17:5, 8	status 10:5 11:17 12:25 14:2, 5, 6	threshold 14:18, 23, 24 15:3, 4	understand 5:13, 17, 23, 24 12:21
red 7:16, 17, 19, 20 8:9, 15, 22 9:7, 11, 17 10:4, 8, 21	sense 5:18 6:4, 5	Stephen 5:7 7:1	time 10:19	understandi ng
reference 11:22	separate 11:8 13:12	strike 10:16	times 5:9 9:11 10:24 14:15	understood 5:18
referring 7:2 15:12, 17, 22	separated 11:11, 12, 19 12:15, 22 13:1, 4, 7, 10, 15, 20, 23 14:5, 6	sum 16:6	titled 7:3	universal 14:2
refresh 5:11		Supplementa l 7:4	total 15:2	upload 6:19
regard 17:8	short 17:16	surface 16:5, 9, 10, 12, 19, 20 17:6	transport 14:13	<hr/> V <hr/>
regarded 12:19	showing 11:4 12:25	sworn 5:2	treat 13:8	vacuum 14:15 16:3
repeat 15:8	similar 16:21	system 14:25	true 13:14 16:18	view 10:14, 25
retained 9:23	simple 9:22	<hr/> T <hr/>	tubes 12:16, 23 17:10	volume 14:24 15:1, 2
room 6:20	simply 9:21	talking 7:8	tunneling 14:9, 11, 12	<hr/> W <hr/>
rules		technique 14:3 16:1	turn 6:23 11:25	week

5:12

word

8:7

words

13:21

woven

12:18

written

10:1

Y

Yu

5:1 7:4

Z

Zhu

5:1, 5

6:23 7:4

8:21 9:4,

20 10:18

11:21

ZINDA

5:5 8:1,

8, 13 9:3,

15 10:15,

17 11:14

13:3, 13,

21 14:8

15:9, 14

17:11, 15