

1 UNITED STATES PATENT AND TRADEMARK OFFICE

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3
4 BEFORE THE PATENT TRIAL AND APPEAL BOARD

5
6
7 THE BOEING COMPANY

8 Petitioner,

9 v.

10 THE REGENTS OF THE UNIVERSITY OF CALIFORNIA

11 Patent Owner.

12
13
14 Case IPR2024-00761

15 Patent 7,487,684

16
17
18 REMOTE DEPOSITION of

19 JUNLAN WANG, PH.D.

20 Thursday, May 29, 2025

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24 Reporter: MaryJo O'Connor, RDR, RMR

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Thursday, May 29, 2025

12:06 p.m. PST

REMOTE DEPOSITION of JUNLAN WANG,
PH.D., held in Seattle, Washington, pursuant
to notice, before before MaryJo O'Connor,
Registered Diplomat Reporter, Registered
Merit Reporter and Notary Public in and for
the Commonwealth of Massachusetts.

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19 * * * * *

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1 I N D E X

2 Deposition of: JUNLAN WANG, PH.D.

3 Examination By: Page

4 By Mr. Rachuba 7

5 * * * * *

6 E X H I B I T S

7 No. Page

8

9 Exhibit 1001 United States Patent 52

10 Number 7,487,684 B2

11 Exhibit 1004 Curriculum Vitae of Junlan 64

12 Wang

13 Exhibit 1005 Document entitled 9

14 "Thin-Film Adhesion

15 Measurement by Laser-Induced

16 Stress Waves"

17 Exhibit 1038 Document entitled 10

18 "Supplemental Declaration of

19 Junlan Wang, Ph.D. "

20 Exhibit 1056 Document entitled "High 56

21 strain-rate spallation and

22 fracture of tungsten by

23 laser-induced stress waves"

24 * * * * *

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1 P R O C E E D I N G S

2

05:30:14 3 VIDEO TECHNICIAN: We are now on
12:06:12 4 the record for the video deposition of
12:06:15 5 Dr. Junlan Wang. The time is 12:06
12:06:18 6 p.m., May 29, 2025, in the matter of The
12:06:25 7 Boeing Company versus The Regents of the
12:06:26 8 University of California, Case Number
12:06:36 9 IPR2024-00761 being held before the
12:06:37 10 United States Patent and Trademark
12:06:40 11 Office, Patent and Trial Appeal Board.

12:06:43 12 The court reporter is MaryJo
12:06:45 13 O'Connor, the videographer is Gus
12:06:48 14 Phillips, and Boston are representatives
12:06:50 15 of GregoryEdwards LLC.

12:06:52 16 Will counsel please state their
12:06:54 17 appearances for the record beginning
12:06:56 18 with the Petitioner?

12:06:57 19 MS. SHOMAKER: This is Casey
12:06:58 20 Shomaker from the law firm McKool Smith,
12:07:02 21 and online with me is my colleague
12:07:05 22 Arvind Jairam, also from McKool Smith,
12:07:05 23 representing Petitioner Boeing.

12:07:07 24 MR. RACHUBA: Good afternoon.
12:07:09 25 This is Roman Rachuba from Sughre Mion

12:07:13 1 representing Patent Owner, and in the
12:07:15 2 room with me, although not in the Zoom
12:07:18 3 link, is Raja Saliba.

12:07:26 4 MR. JAIRAM: Before we get
12:07:28 5 started, I have a logistical question.
12:07:31 6 Can we actually go off the record? I'm
12:07:32 7 sorry, can we go off the record real
12:07:34 8 quick so I can address a logistical
12:07:38 9 question?

12:07:38 10 MR. RACHUBA: Okay.

12:07:38 11 VIDEO TECHNICIAN: We are off the
12:07:45 12 record. The time is 12:07 p.m.

12:14:06 13 (Proceedings recessed at
12:14:06 14 12:07 p.m., and reconvened at 1:31 p.m.)

12:19:19 15
16 JUNLAN WANG, PH.D.,
17 having been satisfactorily duly sworn by the
18 Notary Public, was examined and testified as
19 follows:

20 EXAMINATION

13:31:39 21 BY MR. RACHUBA:

13:31:39 22 Q. Good afternoon, Dr. Wang.

13:31:45 23 A. Excuse me?

13:31:46 24 Q. Good afternoon.

13:31:47 25 A. Oh, good afternoon. Thank you.

13:31:50 1 Q. Can you hear me okay?

13:31:51 2 A. Yes.

13:31:52 3 Q. This is our second deposition in

13:31:55 4 this case. As a reminder, my name is Roman

13:32:01 5 Rachuba. I am counsel for Patent Owner, and I

13:32:04 6 will be asking you questions today.

13:32:06 7 Do you understand?

13:32:07 8 A. Yes.

13:32:08 9 Q. I know we went over this the first

13:32:10 10 time, but just so we're clear on the record, I

13:32:13 11 will ask you questions. I will ask that you

13:32:15 12 please give verbal responses so the transcript

13:32:17 13 is clear.

13:32:18 14 Do you understand?

13:32:19 15 A. Yes.

13:32:19 16 Q. Okay. I ask that you also please

13:32:22 17 give me time to finish my questions.

13:32:25 18 Do you understand?

13:32:27 19 A. Yes.

13:32:27 20 Q. And your counsel throughout the

13:32:32 21 process, throughout today, may object to some

13:32:36 22 of my questions; but unless your counsel

13:32:39 23 explicitly gives you an instruction not to

13:32:42 24 answer, you are still required to answer my

13:32:44 25 questions.

13:32:44 1 Do you understand?

13:32:45 2 A. Yes.

13:32:45 3 Q. Can you please state your full

13:32:50 4 name for the record?

13:32:51 5 A. Junlan Wang.

13:32:56 6 Q. And what is your involvement with

13:32:58 7 this proceeding?

13:33:00 8 A. Asked to act as a technical expert

13:33:07 9 to give opinions.

13:33:10 10 Q. For which party specifically?

13:33:12 11 A. For the McKool Smith and

13:33:17 12 representing Boeing side.

13:33:19 13 Q. Are you aware of any reason that

13:33:21 14 you cannot provide truthful and accurate

13:33:24 15 testimony today?

13:33:25 16 A. No.

13:33:30 17 MR. RACHUBA: Okay. I'm going to

13:33:33 18 share in the chat Exhibit 1005. And

13:33:37 19 this is your dissertation relied on in

13:33:46 20 Boeing's petition.

13:33:47 21 (Document marked for

13:33:52 22 identification as Wang Exhibit 1005)

13:33:52 23 Q. And, Dr. Wang, if you could please

13:33:55 24 open that up and let me know when you have it

13:33:58 25 open.

13:34:09 1 A. Yes, it's open.

13:34:10 2 Q. Okay. Do you recognize this

13:34:12 3 document?

13:34:12 4 A. Yes.

13:34:17 5 Q. And what is this document?

13:34:20 6 A. It's my Ph.D. dissertation.

13:34:25 7 Q. If you could please turn to page

13:34:32 8 81 of the PDF. And let me know when you're

13:34:47 9 there.

13:34:56 10 A. 81. Yes.

13:35:03 11 MR. RACHUBA: Now I'm going to

13:35:05 12 share another exhibit in the chat. This

13:35:18 13 is Exhibit 1038. If you could please

13:35:23 14 open that document as well, please,

13:35:25 15 Dr. Wang.

13:35:26 16 (Document marked for

13:35:34 17 identification as Wang Exhibit 1038)

13:35:34 18 A. Yes.

13:35:34 19 Q. And do you recognize this

13:35:36 20 document, Dr. Wang?

13:35:37 21 A. Yes.

13:35:43 22 Q. What is this document?

13:35:44 23 A. It's my supplemental declaration.

13:35:47 24 Q. In paragraph 1 of your

13:35:53 25 supplemental declaration, you write that:

13:35:57 1 "Figure 3.15(c) of
13:36:00 2 Wang-Dissertation shows a stress wave in
13:36:04 3 fused silica that is modified to have a
13:36:06 4 long linear ramp of approximately 26
13:36:09 5 nanoseconds in length and a sharp
13:36:12 6 decompression shock. "
13:36:13 7 Do you see that?
13:36:14 8 A. Yes.
13:36:14 9 Q. What do you mean by the term
13:36:18 10 "long" here?
13:36:21 11 A. "Long" means this is in
13:36:25 12 comparison. This is the leading edge of the
13:36:28 13 stress wave, and from zero stress to the
13:36:48 14 maximum value.
13:36:55 15 Q. Is there a distance or time value
13:37:04 16 minimum that you would consider to meet the
13:37:07 17 definition of the term "long" in this context?
13:37:10 18 MS. SHOMAKER: Objection to form.
13:37:12 19 A. So this is in comparison to the
13:37:17 20 stress wave in regular substrate like silicon.
13:37:25 21 So the leading edge is much shorter there than
13:37:28 22 this one.
13:37:30 23 Q. By how much?
13:37:34 24 A. I have to look at the figure in
13:37:40 25 the first exhibit you send, my dissertation. I

13:37:47 1 think technically I think -- yeah, let me
13:37:50 2 quickly take a look of the figure there.

13:37:57 3 Q. Okay. And you're taking a look at
13:38:02 4 Exhibit 1005?

13:38:02 5 A. Yes.

13:38:03 6 Q. Figure 3.14?

13:38:03 7 A. Exhibit, yeah, 1005, my
13:38:08 8 dissertation.

13:38:08 9 Q. And which figure are you looking
13:38:10 10 at specifically?

13:38:29 11 A. Let me go there. I'm looking at
13:38:30 12 Figure 3.14.

13:38:34 13 Q. Which letter of 3.14?

13:38:36 14 A. The (c). The (c). Yeah, the
13:38:38 15 subpanel (c). So I'm looking at the leading
13:38:42 16 edge there, so it's about 3 to 4 nanoseconds.

13:38:48 17 So in comparing to that, in Figure
13:38:54 18 3.15(c), so the leading edge is stretched to 26
13:38:59 19 nanoseconds. So much longer. That is what I
13:39:03 20 meant by "long."

13:39:05 21 Q. Also referring, again, to
13:39:08 22 paragraph 1 of your dissertation, you refer to
13:39:23 23 "a sharp depression shock of a few
13:39:27 24 nanoseconds."

13:39:29 25 Do you see that?

13:39:30 1 A. Which?

13:39:31 2 Q. In paragraph 1 of Exhibit --

13:39:37 3 A. Yes.

13:39:37 4 Q. -- 1038.

13:39:39 5 A. Yes, I see that.

13:39:40 6 Q. What do you mean by "a few

13:39:42 7 nanoseconds"?

13:39:43 8 A. That means, so from the maximum

13:39:47 9 compressing stress in Figure 3.15(c) to the

13:39:52 10 zero stress, so that's just a couple

13:39:55 11 nanoseconds.

13:39:58 12 Q. How many is a couple?

13:40:00 13 MS. SHOMAKER: Objection to form.

13:40:04 14 A. One, two, three, four, five.

13:40:06 15 Yeah, so a few nanoseconds. Below 5

13:40:10 16 nanoseconds I will say.

13:40:11 17 Q. Below 5 nanoseconds?

13:40:13 18 A. Approximately.

13:40:29 19 Q. Approximately how many nanoseconds

13:40:32 20 are shown in the time scale of this figure?

13:40:35 21 A. 30 nanoseconds.

13:40:47 22 Q. You're referring to 3.15(c),

13:40:56 23 correct?

13:40:56 24 A. Correct.

13:40:57 25 Q. How many nanoseconds from the

13:40:58 1 peak -- again, I'm referring to Figure 3.15(c).

13:41:04 2 How many nanoseconds for the waveform to have

13:41:06 3 peak compressive stress to zero stress?

13:41:10 4 A. So I think -- approximately, let's

13:41:20 5 see. About 1 -- about 1 nanoseconds. Yeah, 1

13:41:33 6 to 2 nanoseconds. I think below 2. About a

13:41:37 7 little bit -- around 1 nanosecond.

13:41:40 8 Q. And about how many nanoseconds go,

13:41:46 9 looking at that same waveform, from zero stress

13:41:49 10 to the peak tensile stress of .6 GPa?

13:41:51 11 A. So that's about another 1

13:41:55 12 nanosecond.

13:42:16 13 Q. How short does a waveform change

13:42:21 14 in stress need to be for there to be a shock?

13:42:25 15 MS. SHOMAKER: Objection to form

13:42:26 16 and scope.

13:42:27 17 A. I think there are no strict

13:42:31 18 definition. It's just a rapid, basically, a

13:42:38 19 rapid drop of pressure. So when comparing this

13:42:42 20 with Figure 3.14, that's absolutely, definitely

13:42:48 21 a very rapid drop.

13:42:50 22 So a theoretical shock would be

13:42:53 23 instantaneous. But experimentally, you --

13:42:57 24 yeah, so always have some, yeah. But that's

13:43:01 25 what we measured. This is already a pretty

13:43:05 1 sharp shock.

13:43:06 2 Q. Are you aware of any figures in
13:43:13 3 your dissertation where the change from peak
13:43:21 4 compressive stress to zero stress takes longer
13:43:27 5 than 2 nanoseconds?

13:43:27 6 MS. SHOMAKER: Objection to form
13:43:32 7 and scope.

13:43:33 8 A. Longer than 2 nanoseconds?

13:43:33 9 Q. Yes.

13:43:33 10 MR. RACHUBA: Can I have the court
13:43:33 11 reporter repeat my question back.

13:43:33 12 (Record read as requested)

13:44:09 13 A. Yes, of course. In 3.14, it takes
13:44:12 14 longer than 2 nanoseconds from the peak
13:44:17 15 compressive stress to the zero stress.

13:44:19 16 Q. Are you aware of any other figures
13:44:21 17 besides 3.14?

13:44:24 18 MS. SHOMAKER: Objection to form
13:44:25 19 and scope.

13:44:25 20 A. I have to -- I can go through. I
13:44:30 21 believe there are others.

13:44:34 22 Q. Please take a minute to briefly
13:44:38 23 look through and let me know if you can
13:44:41 24 identify any others.

13:44:46 25 A. Okay.

13:44:46 1 MS. SHOMAKER: I'm going to object
13:44:47 2 to form and scope to the extent that was
13:44:50 3 a question.

13:46:12 4 A. So I think most of the results
13:46:16 5 have a -- have that time scale around 1
13:46:20 6 nanoseconds from the maximum to zero stress
13:46:23 7 with the exception of 3.19. But to that one
13:46:29 8 figure, I will see -- we already discuss the
13:46:31 9 last time. And because there was severe damage
13:46:37 10 on the film, which means interferometric signal
13:46:45 11 might not be completely reliable there.

13:47:04 12 Q. Dr. Wang, so you identified two
13:47:17 13 figures as part of that discussion, 3.14 and
13:47:20 14 3.19, correct?

13:47:28 15 A. Right.

13:47:28 16 Q. In Figure 3.14, the substrate does
13:47:33 17 not use silica, but silicon, correct?

13:47:35 18 A. Correct. It's silicon.

13:47:37 19 Q. In the context of this proceeding,
13:47:45 20 do you understand what Patent Owner referred to
13:47:51 21 as tension-wave-1?

13:47:54 22 A. Tension-wave-1 I think is in -- in
13:48:06 23 the declaration of Dr. Gupta. That means the
13:48:10 24 tensile stress following the compressive
13:48:14 25 stress.

13:48:15 1 Q. And then do you have an
13:48:16 2 understanding of, again, in this proceeding,
13:48:19 3 what Patent Owner referred to as
13:48:22 4 compression-wave-1?

13:48:24 5 MS. SHOMAKER: Objection to form.

13:48:26 6 A. Can you point me to the document
13:48:34 7 where this term was used?

13:48:41 8 Q. Paragraph 5 of your declaration,
13:48:45 9 which is Exhibit 1038.

13:49:15 10 A. Yes.

13:49:16 11 Q. Okay. And what is
13:49:20 12 compression-wave-1?

13:49:22 13 A. Compression-wave-1 is compressive
13:49:27 14 stress generated at absorbing layer that's
13:49:30 15 directly propagated toward the film.

13:49:34 16 Q. In the same paragraph, you refer
13:49:40 17 to compression-wave-2. What is that?

13:49:42 18 A. That's the compressive wave that's
13:49:48 19 propagating backward toward the side of the
13:49:50 20 laser pulse toward the confining layer.

13:49:55 21 Q. Okay. Let's turn back again to
13:50:00 22 Exhibit 1005, Figure 3.15(c). And this is on
13:50:08 23 page 81 of the PDF. And let me know when you
13:50:20 24 have that figure in front of you.

13:50:26 25 A. Yes.

13:50:26 1 Q. How many waveforms are depicted in
13:50:29 2 Figure 3.15(c)?

13:50:34 3 A. So that's just -- primary, the
13:50:40 4 compressive wave. That's the
13:50:41 5 compressive-wave-1 from the -- referred to in
13:50:46 6 the declaration. And then it's followed by
13:50:51 7 tensile peak there.

13:50:54 8 Q. So there are two peaks depicted in
13:50:57 9 3.15(c)?

13:50:59 10 A. It's not a complete peak. Yeah,
13:51:01 11 but that is a tensile wave, yes.

13:51:05 12 Q. Are there any -- I asked how many
13:51:09 13 waveforms, and you responded with peaks. In
13:51:12 14 this context, is there a difference between a
13:51:14 15 waveform and a peak?

13:51:16 16 A. Okay. So it's just -- it's how
13:51:21 17 you define it. So I think you can separate
13:51:25 18 that into two, but -- yeah. Or you just
13:51:30 19 consider it as one stress wave, so it has a
13:51:35 20 compression portion and it has a tensile
13:51:39 21 portion.

13:51:39 22 Q. So is it your testimony that there
13:51:42 23 is one stress wave depicted that's composed of
13:51:47 24 two peak stresses: one compressive and one
13:51:50 25 tensile?

13:51:50 1 MS. SHOMAKER: Objection to form.

13:51:52 2 A. Okay. So it's a different ways to
13:51:55 3 understand it, but you can separate into two,
13:52:07 4 like compressive wave then follow that by a
13:52:07 5 tensile wave, or there is a continue signal
13:52:11 6 there. It shouldn't matter.

13:52:14 7 Q. Okay. One signal; two waves,
13:52:18 8 correct?

13:52:19 9 MS. SHOMAKER: Objection to form.

13:52:20 10 A. Because these two signals are
13:52:23 11 connected. So, basically, you have a
13:52:27 12 compressive portion and then you have a tensile
13:52:30 13 portion.

13:52:30 14 Q. So two different signals?

13:52:34 15 MS. SHOMAKER: Objection to form.

13:52:35 16 A. It really depends on how you
13:52:38 17 understand it.

13:52:40 18 Q. What is your understanding?

13:52:42 19 A. So, since these two waves are
13:52:45 20 immediately adjacent to each other, so it's
13:52:54 21 either you consider it as one waveform that's
13:52:57 22 compressive wave followed by a tensile, or you
13:52:58 23 can say two waves. You separate it at zero
13:53:01 24 stress, and then you have a compressive wave,
13:53:03 25 and then you have a second waveform, the

13:53:07 1 tensile wave.

13:53:07 2 Q. Okay. So we can consider that
13:53:12 3 there is two waves, but the figure is measuring
13:53:16 4 just stress in general. Would that be
13:53:19 5 accurate?

13:53:19 6 A. Right. Right. Yeah. There is a
13:53:21 7 stress in the material in general.

13:53:26 8 Q. Okay. Can you show me, or can you
13:53:28 9 identify in Figure 3.15(c), where the tension
13:53:36 10 wave starts and ends?

13:53:38 11 A. So the tension wave starts from
13:53:42 12 zero stress.

13:53:46 13 Q. Are you looking at the -- what
13:53:49 14 time?

13:53:50 15 A. So I would -- because this part is
13:53:53 16 sharp, I think it's around 29 nanoseconds to 30
13:53:58 17 nanoseconds.

13:54:01 18 Q. That's the peak of the tensile
13:54:03 19 wave?

13:54:04 20 A. Right. That's a tensile portion.
13:54:06 21 Or you can call it that's a tensile wave.

13:54:09 22 Q. Okay. The tensile wave appears at
13:54:12 23 around 29 nanoseconds.

13:54:15 24 A. Right.

13:54:16 25 Q. What about the compression wave?

13:54:19 1 A. So from the beginning, from zero
13:54:21 2 to 29, that's the compressive wave.

13:54:23 3 Q. So does the tension wave start
13:54:39 4 where the compression wave ends?

13:54:42 5 A. Right. That's a definition of
13:54:46 6 "tension"/"compression." Compression is
13:54:49 7 negative. Tension is positive.

13:55:28 8 Q. Right. I understand one is
13:55:30 9 negative and one is positive. I'm looking for
13:55:33 10 the specific waves.

13:55:34 11 Would it be accurate to say that
13:55:36 12 the -- where the tension wave starts, the
13:55:40 13 compression wave ends?

13:55:41 14 MS. SHOMAKER: Objection to form.

13:55:43 15 A. You can assume that, yes.

13:55:51 16 Q. What's the basis for that
13:55:53 17 assumption?

13:55:54 18 A. That's just based on the sign of
13:55:58 19 the stress.

13:56:02 20 Q. Okay. So if one were to take the
13:56:12 21 same experimental setup that was used to get
13:56:15 22 the results in 3.15(c) and were to change only
13:56:21 23 the thickness of the constraining layer, would
13:56:25 24 the tension wave take longer to arrive at the
13:56:28 25 test interface?

13:56:29 1 MS. SHOMAKER: Objection to form

13:56:30 2 and scope.

13:56:31 3 A. Is your question by changing the
13:56:44 4 confining layer thickness?

13:56:45 5 Q. Yes.

13:56:46 6 A. It might.

13:56:47 7 Q. Why might it?

13:56:50 8 A. Because when you change the
13:56:52 9 confining layer thickness, that means the path
13:57:00 10 traveled by the compressive wave to would
13:57:02 11 change. So that will change how long it will
13:57:06 12 come back to reach the interface. It will
13:57:11 13 change the path that's traveled by the stress
13:57:28 14 wave.

13:57:28 15 Q. I think throughout this
13:57:31 16 proceeding, I think both parties have used the
13:57:34 17 term "constraining layer" and "confining
13:57:38 18 layer." Is it your understanding that those
13:57:40 19 terms are interchangeable?

13:57:41 20 A. Correct. Yeah, they are
13:57:44 21 interchangeable.

13:57:55 22 Q. So, if we were to double the
13:57:57 23 thickness of the constraining layer in the
13:58:02 24 experimental setup shown in Figure 3.15(c) and
13:58:06 25 not change anything else, it would double the

13:58:13 1 thickness of that constraining layer, and
13:58:15 2 calculate the stress at the exact point as
13:58:17 3 shown in Figure 3.15(c), would the tension wave
13:58:22 4 start where compression wave ends?

13:58:27 5 MS. SHOMAKER: Objection to form
13:58:29 6 and scope.

13:58:29 7 A. I would expect, yeah, it would be
13:58:33 8 the same. But give me time. I want to quickly
13:58:38 9 check some information in the dissertation.

13:58:42 10 Q. Okay.

13:58:42 11 A. (Document review.) Yes. So my
14:00:36 12 answer is when you change the confining layer
14:00:39 13 thickness, so that will change the time scale,
14:00:43 14 but it will still follow. So the tensile wave
14:00:47 15 will still follow the compressive wave.

14:00:48 16 Q. Okay. But that wasn't the
14:00:51 17 question. Would the tensile wave arrive at the
14:00:55 18 same time that the compressive wave ends?

14:00:57 19 A. Yes.

14:00:59 20 Q. Why?

14:01:00 21 A. Because that's when -- that's,
14:01:12 22 again, basically the definition for a tensile
14:01:15 23 versus compressive stress.

14:01:18 24 Q. Dr. Wang, you had testified
14:01:27 25 earlier that if we change the thickness of the

14:01:30 1 constraining layer, it would take longer for
14:01:33 2 the tensile wave to arrive.

14:01:35 3 How do I connect the logic there;
14:01:41 4 that it would take longer for the tensile wave
14:01:43 5 to arrive, but it would still arrive at the
14:01:43 6 same time?

14:01:45 7 A. No. Tensile --

14:01:45 8 MS. SHOMAKER: Objection to form.

14:01:47 9 A. No, I think you are referring to
14:01:52 10 the same time. It's not the same absolute
14:01:54 11 time. It will still arrive after the
14:02:00 12 compressive wave ended, but the compressive
14:02:04 13 wave can go longer.

14:02:06 14 Q. What do you mean by that?

14:02:09 15 A. So right now, for example, the
14:02:13 16 zero -- the compressive stress lasts from zero
14:02:17 17 to 28 -- 29, and the tensile wave starts from
14:02:23 18 29 to 30. But if you change the confining
14:02:26 19 layer thickness, so that zero stress might
14:02:34 20 happen slightly earlier than 29 seconds or
14:02:37 21 later than 29 seconds. But if the confining
14:02:41 22 layer is thicker, it should arrive at a later
14:02:46 23 time.

14:02:47 24 Q. When I asked you earlier, you said
14:03:02 25 you had to check your dissertation for

14:03:06 1 something, for some information. What were you
14:03:07 2 checking on your dissertation?

14:03:08 3 A. I was checking my Table of
14:03:10 4 Content.

14:03:12 5 Q. And did you look somewhere after
14:03:14 6 you checked the Table of Contents?

14:03:16 7 A. I also look at a paragraph in my
14:03:21 8 dissertation, and there is a section on the
14:03:25 9 effect of confining layer thickness.

14:03:29 10 Q. Where specifically did you look?

14:03:31 11 A. Let's see, it's page -- if you go
14:03:34 12 to my Table of Contents, I can point you. It's
14:03:38 13 page 69.

14:03:41 14 Q. 69 of the PDF or the --

14:03:43 15 A. Page 69 of the PDF. Page 69 of
14:03:48 16 the -- they're both on page number on my
14:03:52 17 dissertation. It's -- what's the page number
14:04:04 18 for PDF? How do you see the page number for
14:04:04 19 the PDF?

14:04:06 20 MS. SHOMAKER: I believe it would
14:04:08 21 be PDF page number 86.

14:04:11 22 A. Yeah, on the bottom, it says 69
14:04:15 23 the page number. Yeah, page 86 of the PDF.

14:04:41 24 Q. Just reading this.

14:04:46 25 (Document review.) Turning, again,

14:04:56 1 to your second declaration, looking at
14:04:59 2 paragraph 2 you write:
14:05:04 3 "The existence of a tensile peak
14:05:04 4 following this decompression shock is
14:05:04 5 immaterial to whether a decompression
14:05:04 6 shock occurred."

14:05:14 7 Do you see that?

14:05:14 8 A. Yes.

14:05:15 9 Q. Is that because there are two
14:05:17 10 independent waves, a compression wave and a
14:05:23 11 tension wave?

14:05:23 12 MS. SHOMAKER: Objection to form.

14:05:24 13 A. It's referring to the compressive
14:05:26 14 stress versus the tensile stress. So
14:05:28 15 "decompression" means a rapid drop of pressure.
14:05:33 16 So that's a rapid drop from the maximum
14:05:37 17 compressive to the zero stress. So that's a
14:05:39 18 decompression shock.

14:05:40 19 So regardless of the tensile peak,
14:05:43 20 that shock is always shown for that. That's
14:05:46 21 what I meant.

14:06:42 22 Q. So, if we were to increase the
14:06:47 23 thickness of the constraining layer, keep
14:06:51 24 everything else in your experiments the same,
14:06:54 25 it would take longer for the tension wave to

14:07:00 1 catch up with the compression wave; is that
14:07:03 2 correct?

14:07:03 3 MS. SHOMAKER: Objection to form.

14:07:05 4 A. So, that's one factor. Because
14:07:11 5 when you say you keep everything the same, but
14:07:14 6 the confining layer thickness itself will also
14:07:19 7 affect how large a stress can be generated,
14:07:23 8 because the confining layer is there to confine
14:07:26 9 the expansion of the absorbing layer once it
14:07:31 10 absorbs the energy.

14:07:32 11 When you have a higher -- when you
14:07:35 12 have a thicker confining layer, that will
14:07:39 13 typically be to a higher stress. So the higher
14:07:42 14 stress might have a different velocity than the
14:07:42 15 lower stress because of the nonlinear
14:07:46 16 elasticity. So it's just a part of the
14:07:48 17 picture.

14:07:51 18 Q. Let's focus on that part. Yes or
14:07:53 19 no, if you increase the confining layer
14:07:56 20 thickness, leave everything else the same,
14:07:58 21 would it take longer for the tension wave to
14:08:01 22 reach the compression wave?

14:08:02 23 MS. SHOMAKER: Objection to form.

14:08:03 24 A. So you are assuming --

14:08:03 25 Q. The peak. The peak.

14:08:08 1 A. So that's not valid, since the
14:08:10 2 confining layer is playing a role in the stress
14:08:12 3 generation. So you have -- because the stress
14:08:16 4 is going to be at a different amplitude when
14:08:26 5 you change the confining layer thickness. So
14:08:31 6 the generated stress will be different, so you
14:08:34 7 cannot just assume everything is the same.

14:08:36 8 Q. Well, I'm saying you input -- all
14:08:41 9 your experimental variables are the same,
14:08:43 10 except for the confining layer thickness, which
14:08:45 11 has increased. You had testified that would be
14:08:47 12 one factor in the arrival time of the tension
14:08:50 13 wave. So how would that factor impact the
14:08:53 14 arrival timing of the tension wave? Does it
14:08:57 15 change the compression wave peak?

14:08:57 16 MS. SHOMAKER: Objection to form
14:08:57 17 and scope.

14:09:00 18 A. So, as I said, so the confining
14:09:02 19 layer plays not just as a thickness extender.
14:09:08 20 So, it definitely extend the path for the
14:09:12 21 tension wave to travel, so that will lead to
14:09:15 22 longer travel time. But it also affect the
14:09:18 23 stress generated. So you're not going to
14:09:20 24 generate the same amplitude of stress when you
14:09:23 25 change the confining layer thickness. So that

14:09:26 1 factor also affect the propagation speed of the
14:09:31 2 tensile wave.

14:09:34 3 So the two factors combined will
14:09:36 4 decide when the tensile wave will arrive. So
14:09:42 5 you cannot just leave the other factor out.

14:09:45 6 Q. Well, take into account both of
14:09:54 7 those factors, then, would the tension wave
14:09:59 8 arrive later or earlier than the compression
14:10:03 9 wave peak, if you increased the confining layer
14:10:06 10 thickness?

14:10:07 11 MS. SHOMAKER: Objection to form
14:10:09 12 and scope.

14:10:10 13 A. So, from what we observed, when
14:10:40 14 the confining layer thickness is thicker, it
14:10:44 15 typically takes slightly longer time, later
14:10:47 16 time, for the tensile wave to arrive.

14:10:51 17 Q. Does the tension wave speed depend
14:10:55 18 on the compressive wave speed?

14:10:58 19 A. No. The tension wave speed
14:11:04 20 shouldn't depend on the -- it -- no.

14:11:06 21 Q. If you increase the thickness of
14:11:23 22 the confining layer, would the compressive wave
14:11:29 23 speed up or slow down?

14:11:30 24 A. So, when you increase the
14:11:33 25 compressive wave -- when you increase the

14:11:36 1 confining layer thickness, so the magnitude of
14:11:41 2 the compressive wave will change, and the
14:11:46 3 different part of the stress wave will
14:11:48 4 propagate with different speed. So the maximum
14:11:54 5 peak stress will slow down. It will slow down.

14:12:01 6 Q. So, if --

14:12:03 7 A. It will take longer.

14:12:04 8 Q. So, if the peak of the compression
14:12:08 9 wave will slow down upon increasing thickness
14:12:11 10 of the confining layer, and the speed of the
14:12:13 11 tensile wave does not change in relation to the
14:12:18 12 compressive wave --

14:12:18 13 A. It will also change. So, the
14:12:20 14 stress wave speed, because the fused silica is
14:12:26 15 a nonlinear elastic material, a different part
14:12:30 16 of the stress will propagate a different speed.
14:12:33 17 But to the zero stress part, it will propagate
14:12:39 18 at the same speed, whether it's compressive or
14:12:41 19 tension.

14:12:44 20 So that's what I see. When you
14:12:46 21 change the confining layer thickness, you
14:12:48 22 generate a higher compressive stress, so the
14:12:52 23 compressive stress wave will be elongated even
14:12:58 24 longer.

14:13:01 25 So, the tensile wave will also

14:13:04 1 come slightly later. That's why the two waves
14:13:07 2 are still approximately arriving at a similar
14:13:11 3 time.

14:13:12 4 Q. If you increase the confining
14:13:22 5 layer thickness, would the propagation speed of
14:13:25 6 the peak of the tension wave speed up or slow
14:13:28 7 down?

14:13:31 8 A. The peak.

14:13:38 9 Q. And this is for the compressive
14:13:41 10 wave.

14:13:42 11 A. For the --

14:13:42 12 MS. SHOMAKER: Objection to form
14:13:43 13 and scope.

14:13:44 14 A. So, for the compressive wave, when
14:13:49 15 you increase confining layer thickness, the
14:13:52 16 peak will slow down.

14:13:54 17 Q. Okay. Now, the peak of the
14:13:57 18 tensile wave, if you increase the confining
14:13:59 19 layer thickness, would the propagation speed of
14:14:02 20 the peak of the tension wave speed up or slow
14:14:06 21 down?

14:14:07 22 MS. SHOMAKER: Objection to scope.

14:14:08 23 A. So for this question, because the
14:14:13 24 theoretical foundation, the tensile behavior
14:14:18 25 for the fused silica is not so well understood

14:14:26 1 as for the compressive behavior, so we can only
14:14:30 2 make an assumption. So, assuming the tensile
14:14:34 3 follow the same equation as the compressive, so
14:14:40 4 the peak stress will -- the peak -- the higher
14:14:46 5 tensile peak will propagate faster than the
14:14:50 6 lower tensile peak.

14:14:54 7 Q. You said it was the same equation?

14:15:11 8 A. Right.

14:15:11 9 Q. What are you referring to?

14:15:13 10 A. I'm referring to the equation in
14:15:16 11 Chapter 2. So assuming the tensile and the
14:15:33 12 compressive stress follow the same governing
14:16:09 13 equation. I'm referring to Equation 2.53.

14:16:45 14 Q. What is your basis for assuming
14:16:47 15 that the tension wave follows that governing
14:16:50 16 equation?

14:16:51 17 A. That's my -- that's postulation,
14:16:54 18 speculation, because there is no previous paper
14:16:58 19 on this.

14:16:59 20 So this equation was established
14:17:01 21 in the 1970s by a well-established researcher
14:17:10 22 Barker and Hollenbach. That's the same --
14:17:10 23 that's one of the exhibit we cited, and I
14:17:14 24 believe Dr. Gupta also cited. So, basically,
14:17:17 25 everybody cited this work for the shock

14:17:20 1 behavior for fused silica. And this equation
14:17:25 2 was established based on compressive behavior.

14:17:27 3 Q. Right. What is your basis for
14:17:30 4 assuming that this equation would hold for
14:17:33 5 tensile behavior?

14:17:35 6 A. The same paper also refer --
14:17:37 7 mention the relief wave also followed the same
14:17:41 8 behavior. So that's unloading. You can --
14:18:26 9 yeah, based on that.

14:18:26 10 MR. RACHUBA: Let's take a
14:18:27 11 five-minute break right now. We've been
14:26:43 12 going roughly an hour.

14:26:43 13 (Proceedings recessed at
14:26:45 14 2:18 p.m., and reconvened at 2:26 p.m.)

14:26:45 15 BY MR. RACHUBA:

14:26:47 16 Q. Welcome back, Dr. Wang.

14:26:55 17 A. Thank you.

14:26:55 18 Q. Looking again at Figure 3.15 in
14:27:05 19 your dissertation. Page 81 of the PDF, page 64
14:27:21 20 on the bottom of the dissertation.

14:27:23 21 A. Okay. I'm here.

14:27:24 22 Q. Where in the substrate is the
14:27:27 23 stress measured from that's depicted in these
14:27:32 24 figures?

14:27:32 25 MS. SHOMAKER: Objection to form.

14:27:38 1 A. So the stress, or the signal, from
14:27:40 2 my dissertation is measured on the front film.

14:27:51 3 So then, you back calculate it using the wave
14:27:56 4 equation to derive the stress in the substrate.

14:27:58 5 So that means this stress is closer to the film
14:28:02 6 interface, far away from the absorbing layer.

14:28:12 7 Q. How much closer to the film than
14:28:16 8 the absorbing layer?

14:28:18 9 MS. SHOMAKER: Objection to form.

14:28:20 10 A. Oh, okay. So, how to say that?
14:28:31 11 So, this stress wave has propagated through the
14:28:34 12 whole sample stack from the absorbing layer to
14:28:38 13 the film side. So that means everything has
14:28:45 14 been propagated through. So you basically can
14:28:49 15 assume this is the substrate material just
14:28:53 16 adjacent to the interface.

14:28:55 17 Given the substrate is around 3
14:28:58 18 millimeter thick, so the special wavelengths of
14:29:06 19 the stress wave is around, as can be estimated,
14:29:12 20 60 micron. So 3,000 divided by 60, that's 50.
14:29:23 21 So you can assume you can have 50 waveforms
14:29:27 22 between the -- complete waveform between the
14:29:29 23 absorbing layer and the front film. So this is
14:29:32 24 the waveform closest to the front film. So
14:29:35 25 that's -- you can assume this is about a couple

14:29:43 1 millimeters away, or closer, to the interface.

14:29:51 2 Q. So this equation, the calculation

14:30:11 3 in 3.15(c), takes into account how many

14:30:19 4 millimeters from the test interface?

14:30:22 5 MS. SHOMAKER: Objection to form.

14:30:24 6 A. It doesn't -- it doesn't matter.

14:30:28 7 This is a stress wave you referred from the

14:30:32 8 signal mirrored on the film surface. So the

14:30:35 9 film is going through autoplain motion so that

14:30:41 10 displacement is being measured. Based on the

14:30:43 11 displacement, you can better calculate what

14:30:47 12 would be the stress wave that's generated that

14:30:51 13 displacement.

14:30:54 14 Q. So is it your testimony, then,

14:30:55 15 that the stress calculated in 3.15(c) is closer

14:31:01 16 to the test interface?

14:31:03 17 A. Right.

14:31:04 18 Q. Okay. How much closer?

14:31:09 19 MS. SHOMAKER: Objection to form.

14:31:10 20 A. The whole waveform will go through

14:31:12 21 the interface. So this whole stress wave will

14:31:16 22 go through the interface, reach the film, then

14:31:19 23 get reflected back. So that's the -- that's

14:31:22 24 the stress the interface will experience.

14:31:29 25 Q. Okay. Maybe my question isn't

14:31:31 1 clear. If we look at 3.15(c), right?

14:31:39 2 A. Yes.

14:31:40 3 Q. The graph depicts a calculated
14:31:47 4 stress at some point in the substrate, correct?

14:31:50 5 A. Correct.

14:31:51 6 Q. Where in the substrate is that
14:31:53 7 stress calculated?

14:31:56 8 A. Okay. So you can assume this
14:32:01 9 stress is entering the interface from the
14:32:04 10 substrate side at the zero time.

14:32:09 11 Q. So this assumes right -- this is
14:32:14 12 the stress right at the substrate interface?

14:32:17 13 A. Right. Yeah, it's entering the
14:32:20 14 interface. It's going to go through. As it
14:32:23 15 goes through the interface, the front part will
14:32:27 16 get reflected, which will be overlapped with
14:32:31 17 the incoming compressive part, the incoming
14:32:34 18 part. So that's why the interface stress
14:32:36 19 profile in 3.15(d) is different from (c).

14:32:41 20 Q. Okay. Let's look at Figure 3.14
14:33:15 21 in Exhibit 1005. This is on page 80 of the
14:33:27 22 PDF.

14:33:29 23 A. Okay. I'm there.

14:33:31 24 Q. Page 63 of the document.

14:33:51 25 How long is the post-peak delay of

14:33:54 1 the compressive stress shown in 3.14(c)?

14:34:01 2 A. What do you mean by "peak delay"?

14:34:06 3 Q. No, sorry, not peak delay. What

14:34:08 4 is the post-peak decay in nanoseconds of the

14:34:17 5 compressive stress shown in 3.14(c)?

14:34:21 6 A. So, if we count the time from the

14:34:23 7 maximum compressive peak, that's around 3 to 4

14:34:29 8 nanoseconds, then ending at around 14, around

14:34:35 9 10 nanoseconds.

14:34:48 10 Q. Okay. Now, switching back to your

14:34:51 11 second declaration, this is Exhibit 1038, could

14:35:01 12 you please read paragraph 5 to yourself and let

14:35:03 13 me know after you familiarized yourself with

14:35:05 14 it?

14:35:07 15 A. (Document review.)

14:35:44 16 Q. Actually, strike that. Let's move

14:35:46 17 on.

14:35:47 18 A. Okay.

14:35:50 19 Q. We can move on. Give me one

14:35:52 20 second.

14:36:04 21 Let's turn back again to your

14:36:07 22 dissertation, Exhibit 3.14(c).

14:36:14 23 A. Okay.

14:36:15 24 Q. Is this a modified wave profile

14:36:22 25 depicted?

14:36:23 1 MS. SHOMAKER: Objection to form.

14:36:24 2 A. So it depends on what you are
14:36:33 3 comparing to. This -- we are using this as the
14:36:36 4 base comparison. So that's just a stress wave
14:36:42 5 generated as-is in a silicon substrate.

14:36:46 6 Q. So unmodified, correct?

14:36:48 7 A. Right.

14:36:48 8 Q. While we have your dissertation
14:37:19 9 up, could you please turn to page -- the page
14:37:29 10 you were referencing earlier, page 69, the
14:37:31 11 "Effect of Confining Layer Thickness." And let
14:37:47 12 me know when you are at page 69.

14:37:49 13 A. Okay. I'm here.

14:37:50 14 Q. The last sentence on the last line
14:37:53 15 of page 69, it goes over to page 70, and it
14:37:56 16 reads:

14:37:57 17 "If the waterglass is too thin, no
14:38:00 18 shock is detected either because no
14:38:03 19 shock is developed at all or because the
14:38:08 20 shock is so weak that it attenuated
14:38:11 21 before reaching the film interface."

14:38:13 22 Do you see that?

14:38:14 23 A. Yes.

14:38:16 24 Q. What do you mean by that sentence?

14:38:20 25 MS. SHOMAKER: Objection to scope.

14:38:28 1 A. What it meant is the waterglass
14:38:33 2 affects the shock stress development. If the
14:38:36 3 waterglass is too thin, maybe there will be no
14:38:39 4 shock developed at all; or a shock is
14:38:43 5 developed, but the amplitude is so -- it's a
14:38:46 6 weak shock, and so it doesn't propagate and
14:38:50 7 reach the film interface.

14:38:53 8 Q. At what level of stress would no
14:38:56 9 shock be developed?

14:39:01 10 MS. SHOMAKER: Objection to form
14:39:03 11 and scope.

14:39:04 12 A. Let's see. (Document review.)
14:41:01 13 So it's relative. So "no shock
14:41:05 14 development" means there is no time for the
14:41:10 15 initial Gaussian stress wave to transform into
14:41:15 16 a shock wave profile.

14:41:19 17 So, basically, I would refer to
14:41:22 18 this -- to Equation 2.65 in my dissertation.
14:41:28 19 So Equation 2.65 on page 48 of the PDF. It
14:41:40 20 basically says the shock -- the time it takes
14:41:43 21 for the Gaussian distributed stress to evolve
14:41:48 22 into a shock is universally proportional to the
14:41:54 23 peak stress.

14:41:56 24 So if the peak stress is too low,
14:41:59 25 it takes too long for the shock to develop. So

14:42:04 1 even after the stress wave propagates through
14:42:07 2 the whole sample, maybe the shock is still not
14:42:10 3 fully developed.

14:42:12 4 Q. Are you looking at page 48 of your
14:42:18 5 dissertation right now?

14:42:20 6 A. Page 31 of my dissertation. Yeah,
14:42:24 7 yeah, page 48 of the PDF.

14:42:25 8 Q. I'm sorry, yes, page 48 of the
14:42:28 9 PDF, page 31 of your dissertation.

14:42:31 10 A. Yeah.

14:42:32 11 Q. Can you tell me what those
14:42:35 12 variables are in 2.65, starting with t_{sh} ?

14:42:42 13 A. T_{sh} is the time it takes for
14:42:50 14 the tail of the stress pulse to overtake the
14:42:55 15 peak.

14:42:56 16 Q. What is, I guess, capital T there
14:43:03 17 in the top?

14:43:04 18 A. Capital T is a fall time -- the
14:43:07 19 fall time of the laser pulse.

14:43:09 20 Q. And what is alpha?

14:43:13 21 A. Alpha and the beta are two
14:43:20 22 constants in the earlier equation. Elastic --
14:43:26 23 they are elastic constants. They find in
14:43:33 24 Equation 2.53.

14:43:35 25 Q. And what's omega and rho? Or

14:43:40 1 omega sub rho?

14:43:41 2 A. Okay. It's a sigma sub P.

14:43:41 3 Q. Oh, sigma sub P.

14:43:50 4 A. Peak stress. That's a peak

14:43:53 5 stress.

14:43:54 6 Q. How does this equation describe

14:44:07 7 whether stress would -- whether shock would not

14:44:13 8 develop?

14:44:14 9 MS. SHOMAKER: Objection to scope.

14:44:15 10 A. So this -- that means the time it

14:44:18 11 takes for the shock to develop is a function of

14:44:24 12 the peak stress. If the peak stress is high,

14:44:28 13 it takes very short time to develop a shock.

14:44:32 14 If the peak stress is too low, it will take a

14:44:36 15 long time to develop a shock. Maybe the whole

14:44:39 16 waveform already propagated through the sample,

14:44:41 17 the shock is not fully formed yet.

14:44:43 18 Q. I see. So what is the minimum

14:44:45 19 amount of stress necessary to form a shock?

14:44:48 20 A. It depends on the thickness. So

14:44:50 21 you want to form the shock before the stress

14:44:54 22 goes through the whole sample thickness.

14:44:57 23 Q. What sample thicknesses did you

14:45:00 24 use in Chapter 3 of your dissertation?

14:45:03 25 MS. SHOMAKER: Objection. Scope.

14:45:04 1 A. I used varying sample thickness,
14:45:12 2 from 1.5 millimeter to 6 millimeter. For
14:45:16 3 example, 3.15, I used the 3 millimeter --
14:45:19 4 around 3 millimeter thickness.

14:45:21 5 Q. Okay. Let's take 3 millimeters,
14:45:24 6 then. What is the minimum amount of stress
14:45:26 7 necessary to develop a compressive shock?

14:45:29 8 MS. SHOMAKER: Objection to form
14:45:31 9 and scope.

14:45:32 10 A. So you have to do a calculation.

14:45:41 11 Q. What would I do that calculation
14:45:44 12 with?

14:45:44 13 MS. SHOMAKER: Objection to form
14:45:45 14 and scope.

14:45:46 15 Q. How would I do that calculation,
14:45:53 16 rather?

14:45:54 17 MS. SHOMAKER: Same objections.

14:46:30 18 A. So, what's your question again?

14:46:36 19 Q. How would I calculate the minimum
14:46:38 20 amount of stress to generate a compressive
14:46:41 21 shock in a 3 millimeter substrate?

14:46:44 22 MS. SHOMAKER: Objection to form
14:46:45 23 and scope.

14:46:46 24 A. So you would -- you reverse
14:46:59 25 Equation 2.65 to calculate sigma P based on the

14:47:09 1 time of the stress wave needed to travel
14:47:16 2 three -- to travel through 3 millimeter of the
14:47:20 3 sample.

14:47:21 4 Q. So, first, I would have to
14:47:23 5 calculate the time needed?

14:47:25 6 A. Right.

14:47:26 7 Q. How would I calculate the time
14:47:28 8 needed?

14:47:29 9 A. You divide the thickness by the
14:47:32 10 wave speed.

14:47:34 11 Q. Would the wave speed be known?

14:47:38 12 A. You can estimate it, yeah, just
14:47:44 13 using the zero stress speed.

14:47:49 14 Q. Would you perform that same
14:48:31 15 calculation set for a 1.5 millimeter thick
14:48:35 16 substrate?

14:48:36 17 A. So what do you want me to do?

14:48:41 18 Q. So the series of questions I asked
14:48:42 19 earlier just now was about a 3 millimeter
14:48:45 20 substrate. Would you use the same process for
14:48:48 21 a 1.5 millimeter substrate?

14:48:50 22 MS. SHOMAKER: Objection to scope.

14:48:52 23 A. Yes, you can.

14:49:09 24 Q. So do you agree that there is a
14:49:11 25 minimum stress for which no shock would develop

14:49:15 1 in --

14:49:18 2 A. Okay. I do have that equation in

14:49:21 3 my dissertation for the minimum stress needed.

14:49:25 4 Q. Where is that?

14:49:26 5 A. Equation 2.79 on page 53 of the

14:49:38 6 PDF.

14:49:44 7 Q. And you would this equation to

14:49:46 8 calculate the minimum stress necessary to

14:49:48 9 generate a compressive shock in both 3

14:49:51 10 millimeter and 1.5 millimeter substrates?

14:49:55 11 MS. SHOMAKER: Objection to scope.

14:49:56 12 A. Correct. Estimate. Yeah.

14:49:58 13 Q. Okay. Can you walk me through

14:50:00 14 Equation 2.79 and explain what those variables

14:50:04 15 are?

14:50:04 16 MS. SHOMAKER: Objection to scope.

14:50:05 17 A. Okay. So this is sigma P-naught

14:50:12 18 has to be the greater than the -- so the left

14:50:14 19 has to be the greater. It means your stress

14:50:15 20 has to be above this one to develop a shock.

14:50:17 21 Q. Okay.

14:50:18 22 A. So on the right, on the top,

14:50:22 23 numerator, c-naught, is the zero stress speed.

14:50:27 24 And T is the fall time of the stress wave, of

14:50:32 25 the laser pulse. Alpha and the beta are the

14:50:35 1 elastic constants defined earlier in the same
14:50:39 2 equation. L is now the thickness of the
14:50:43 3 sample.

14:50:46 4 So for 3 millimeter, you just plug
14:50:47 5 in L equals 3 millimeter. If it's 1.5, you
14:50:50 6 just plug in 1.5 millimeter. So this one, you
14:50:54 7 can calculate the minimum stress needed to
14:50:57 8 develop a shock.

14:51:09 9 Q. So would you agree that there is
14:51:11 10 a minimum amount of stress necessary for a
14:51:18 11 compressive wave to develop into a shock in
14:51:20 12 both a 1.5 millimeter and a 3 millimeter
14:51:25 13 substrate?

14:51:26 14 MS. SHOMAKER: Objection to form
14:51:27 15 and scope.

14:51:27 16 A. Yes. It needs a certain amount of
14:51:29 17 stress to develop a shock.

14:51:30 18 Q. And you would calculate that
14:51:34 19 stress using this Equation 2.79.

14:51:37 20 A. Right.

14:51:52 21 Q. Would you agree that coal and --
14:51:56 22 strike that question.

14:51:57 23 Based on your experience, and in
14:52:31 24 light of your dissertation, do you expect
14:52:36 25 stress/strain propagation characteristics to be

14:52:41 1 different in a crystalline versus in an
14:52:44 2 amorphous solid?

14:52:48 3 MS. SHOMAKER: Objection to scope.

14:52:51 4 A. So it really depends. So every
14:53:00 5 material is different. So some material
14:53:06 6 between the amorphous and crystalline might be
14:53:09 7 similar, might be different. So it's all
14:53:12 8 intrinsic property of the material.

14:53:24 9 Q. A moment ago we were talking about
14:53:26 10 the minimum stress needed. I was asking you
14:53:28 11 about the 1.5 millimeter versus 3 millimeter
14:53:31 12 substrate thicknesses. Do you recall that
14:53:33 13 conversation?

14:53:33 14 A. Yeah.

14:53:34 15 Q. The equations that we were looking
14:53:36 16 at were actually referring to confining layer
14:53:39 17 thickness, not substrate layer thickness,
14:53:41 18 correct?

14:53:42 19 MS. SHOMAKER: Objection to form.

14:53:43 20 A. We are referring to substrate
14:53:45 21 thickness.

14:53:47 22 Q. What does the thickness of the
14:54:11 23 confining layer have -- strike that.

14:54:15 24 How does the confining layer
14:54:19 25 thickness have an impact on the minimum amount

14:54:20 1 of stress necessary for a shock to develop?

14:54:24 2 MS. SHOMAKER: Objection to scope.

14:54:29 3 A. Okay. So, the confining layer

14:54:31 4 will have an effect on how much stress can be

14:54:36 5 generated when a certain amount of a laser

14:54:39 6 energy is absorbed by the absorbing layer.

14:54:43 7 Q. And how will the confining layer

14:54:46 8 have an effect?

14:54:47 9 A. This is because when the laser

14:54:51 10 energy is absorbed by the absorbing layer, the

14:54:55 11 absorbing layer will go through, for example,

14:54:58 12 evaporation, volume expansion. So the

14:55:04 13 confining layer there is to limit expansion; to

14:55:09 14 confine that momentum.

14:55:12 15 So that means if the confining --

14:55:14 16 for example, if you have no confining layer,

14:55:19 17 the volume is free. It can be freely expand.

14:55:22 18 So that means the stress generation is not as

14:55:25 19 effective. So you would generate lower stress.

14:55:29 20 You can still generate stress with the laser

14:55:34 21 energy just absorbed by the free surface of the

14:55:36 22 absorbing layer. But now you add the confining

14:55:41 23 layer. But to effectively confine that

14:55:43 24 expansion, you need a certain thickness.

14:55:46 25 Q. So would it be accurate to say

14:55:49 1 that the thicker the confining layer --

14:55:51 2 A. At least in the range I started,
14:55:56 3 the thicker layer, for example the 30 micron,
14:55:59 4 generate higher stress than the 8 micron.

14:56:04 5 So, yeah -- of course, I only
14:56:07 6 tested a limited range. But within the range I
14:56:12 7 studied, yes, the thicker layer, the higher
14:56:15 8 stress. But it might become irrelevant after a
14:56:19 9 certain critical thickness.

14:56:20 10 Q. With respect to your studies, when
14:56:22 11 you say "the higher stress," you mean that a
14:56:28 12 smaller initial stress would be easier to
14:56:35 13 develop into a shock? Strike that.

14:56:40 14 You would need a smaller input
14:56:43 15 stress to develop a shock, provided you have a
14:56:45 16 thicker confining layer. Would that be
14:56:48 17 accurate?

14:56:48 18 MS. SHOMAKER: Objection to form
14:56:50 19 and scope.

14:56:50 20 A. The stress is a direct -- the
14:56:55 21 stress is directly produced by the collective
14:57:03 22 motion of the absorbing layer and the confining
14:57:09 23 layer.

14:57:09 24 So if you input the same amount of
14:57:12 25 laser energy, assuming the same absorption, a

14:57:16 1 thicker layer will give you a higher stress. A
14:57:19 2 shock will be more easily developed.

14:57:20 3 Q. Okay. Understood.

14:57:31 4 Can we turn back to your
14:57:32 5 declaration, Exhibit 1038. Would you turn to
14:57:41 6 paragraph 9, please?

14:57:42 7 A. Yes.

14:57:54 8 Q. What do you mean by your statement
14:57:58 9 in paragraph 9?

14:57:59 10 A. So, it means fused silica would
14:58:09 11 act similarly to quartz, Pyrex, soda lime, and
14:58:14 12 borosilicate, that it will, of course,
14:58:18 13 propagate a stress wave, because the stress
14:58:21 14 wave can go from one end and propagate to the
14:58:24 15 other end. And it also modifies a stress wave,
14:58:28 16 because it has a nonlinear elastic property.

14:58:35 17 Q. What's the basis for your
14:58:37 18 statement in paragraph 9?

14:58:40 19 A. It's based on my work. It is
14:58:45 20 based on literature and also based on, I think,
14:58:51 21 Dr. Gupta's work, the stress wave, the waveform
14:58:55 22 he showed in his work. But in order to modify
14:59:05 23 initial Gaussian stress wave, we need a shock
14:59:06 24 wave.

14:59:13 25 Q. By "[your] work," do you mean your

14:59:15 1 dissertation?

14:59:16 2 A. Right. My dissertation.

14:59:18 3 Q. Any other work of yours?

14:59:20 4 A. What do you mean?

14:59:22 5 Q. What about Exhibit 1056, your 2009
14:59:27 6 paper?

14:59:28 7 A. 2009 paper, it also propagate and
14:59:34 8 modify a stress wave.

14:59:36 9 Q. So your 2009 paper also formed the
14:59:38 10 basis of your statement in paragraph 9?

14:59:43 11 MS. SHOMAKER: Objection to form.

14:59:45 12 A. So, it's in my -- yeah, it's also
14:59:52 13 there. It also propagates and modifies. But I
14:59:56 14 think when I put down this sentence, it's
15:00:01 15 more -- I was more thinking about my

15:00:05 16 dissertation work. But certainly the 2009
15:00:10 17 paper also propagate and modify a stress wave.

15:00:15 18 Q. Did your dissertation test fused
15:00:18 19 silica in the same arrangement as shown in the
15:00:25 20 '684 patent?

15:00:26 21 A. '684 patent, the same
15:00:32 22 configuration. So, I propose a similar
15:00:37 23 configuration as in '684. But in my
15:00:41 24 dissertation, I didn't -- I tested only fused
15:00:45 25 silica with the film. In that work, fused

15:00:48 1 silica is acting both as a stress -- glass
15:00:51 2 element and the substrate. So if you think --
15:00:55 3 if you -- if you think that way, yeah, you can
15:01:01 4 think it's the same. But, of course, I didn't
15:01:05 5 test with a different substrate material
15:01:10 6 inserted there, but I propose that in my
15:01:14 7 "Future Work" in the dissertation.

15:01:15 8 Q. So, just to be clear, you
15:01:17 9 didn't -- your dissertation did not test fused
15:01:21 10 silica as a glass element as arranged in the
15:01:25 11 '684 patent, but you discussed it in your
15:01:28 12 "Future Work" section of your dissertation?

15:01:29 13 MS. SHOMAKER: Objection to form.

15:01:30 14 A. So my -- the fused silica is
15:01:35 15 acting as a glass element. So it's modifying
15:01:39 16 and propagating the stress wave. And it's also
15:01:42 17 acting as a substrate, because the film is
15:01:45 18 directly deposited on fused silica. That's in
15:01:48 19 my experimental work.

15:01:49 20 But in the proposed work, I
15:01:51 21 proposed to insert another substrate material
15:01:57 22 between fused silica and the test film. Then
15:01:59 23 that's the same configuration as in patent
15:02:15 24 '684.

15:02:15 25 MR. RACHUBA: I'm going to place

15:02:17 1 another exhibit in the chat right now.

15:02:19 2 This is Exhibit 1001.

15:02:22 3 (Document marked for

15:02:26 4 identification as Wang Exhibit 1001)

15:02:26 5 MR. RACHUBA: And this is the '684

15:02:28 6 patent.

15:02:40 7 A. Okay.

15:02:40 8 Q. Do you recognize this document,

15:02:42 9 Dr. Wang?

15:02:43 10 A. Yes.

15:02:43 11 Q. And what is this document?

15:02:44 12 A. It's the patent that's being

15:02:48 13 disputed on, I think.

15:02:50 14 Q. If you could please turn to

15:03:00 15 Figure 4 of the '684 patent.

15:03:15 16 A. Figure 4? I don't see Figure 4.

15:03:17 17 Q. It's on page 4 -- they go out of

15:03:20 18 order a little bit.

15:03:21 19 A. Okay.

15:03:22 20 Q. It's on page 4 of the patent.

15:03:29 21 A. Okay. Yeah, I see it.

15:03:31 22 Q. Do you have an understanding of

15:03:37 23 the arrangement depicted in Figure 4?

15:03:40 24 A. I do.

15:03:41 25 Q. And what is that understanding?

15:03:45 1 MS. SHOMAKER: Objection to scope.

15:03:47 2 A. So, that's a sample configuration.

15:03:51 3 Starting from the left, that's a confining

15:03:57 4 layer, absorbing layer, glass element, the

15:04:04 5 substrate and the film.

15:04:06 6 Q. Is this a test arrangement used in

15:04:08 7 your dissertation experiments?

15:04:10 8 MS. SHOMAKER: Objection to form

15:04:12 9 and scope.

15:04:13 10 A. So, in my dissertation, 106 and

15:04:18 11 108 is the same material. That's fused silica.

15:04:22 12 And in the proposed work, I proposed to insert

15:04:27 13 a new material, the substrate. And so that

15:04:33 14 would be exactly the same configuration as this

15:04:35 15 one.

15:04:37 16 Q. So will you agree that your

15:04:39 17 dissertation experiments did not include a

15:04:42 18 separate glass element from the substrate?

15:04:46 19 MS. SHOMAKER: Objection to form.

15:04:47 20 A. So, in my dissertation, the fused

15:04:50 21 silica is the glass element.

15:04:51 22 Q. That wasn't my question. My

15:04:53 23 question was: In the experiments performed in

15:04:57 24 your dissertation, was there a separate glass

15:05:00 25 element and substrate?

15:05:05 1 MS. SHOMAKER: Objection to form.

15:05:06 2 A. There is no second, because fused
15:05:08 3 silica itself is the glass element.

15:05:11 4 Q. So, if you do not run experiments
15:05:14 5 in the manner arranged as per the '684 patent,
15:05:19 6 what is the basis for your statement in
15:05:21 7 paragraph 9 of your second declaration?

15:05:27 8 MS. SHOMAKER: Objection to form.

15:05:28 9 A. Okay. The basis is based on the
15:05:35 10 demonstrated -- the shock behavior, the stress
15:05:39 11 wave measured from my experiments. So you
15:05:45 12 would expect it will continue to propagate when
15:05:47 13 you insert a second -- a new material between
15:05:53 14 the fused silica and the film. That's why I
15:05:56 15 propose it in my future work.

15:06:00 16 I think for people with similar
15:06:03 17 knowledge in the similar field, you would
15:06:06 18 expect it would have that behavior.

15:06:09 19 Q. Are you aware of any work where
15:06:38 20 fused silica was used as a separate glass
15:06:43 21 element as per the arrangement depicted in
15:06:46 22 Figure 4 of the '684 patent?

15:06:48 23 MS. SHOMAKER: Objection to form
15:06:50 24 and scope.

15:06:50 25 A. Am I aware?

15:06:52 1 Q. Yes.
15:06:54 2 A. So if it's not limited to the --
15:07:01 3 Q. I'm talking about the specific
15:07:03 4 arrangement, not an arrangement where fused
15:07:07 5 silica was used as a single element that you
15:07:10 6 believed to be the glass element and the
15:07:11 7 substrate. I'm speaking a separate substrate
15:07:15 8 and glass element arrangement as shown in
15:07:17 9 Figure 4 of the '684 patent.

15:07:19 10 MS. SHOMAKER: Objection to form
15:07:20 11 and scope.

15:07:21 12 A. Yes, I believe so, including my
15:07:28 13 own work.

15:07:32 14 Q. "[Your] own work," what do you
15:07:35 15 mean by that?

15:07:39 16 A. Well, the 2009 paper has a fused
15:07:42 17 silica between the absorbing layer and a
15:07:45 18 constant substrate. And I also have a 2006
15:07:48 19 paper that's exactly the same as in this
15:07:51 20 Figure 4. So fused silica as a glass element,
15:07:55 21 then a silicon substrate, then another film.

15:07:59 22 Q. Let's talk about your 2009 paper.
15:08:07 23 Is this Exhibit 1056 referred to in
15:08:11 24 paragraph 11 of your second declaration?

15:08:16 25 MS. SHOMAKER: Objection to form.

15:08:17 1 A. Yes.

15:08:39 2 MR. RACHUBA: I am placing

15:08:40 3 Exhibit 1056 in the chat.

15:08:48 4 (Document marked for

15:08:48 5 identification as Wang Exhibit 1056)

15:08:44 6 Q. Dr. Wang, when you have a moment,

15:08:46 7 please open that up.

15:08:49 8 A. Yes.

15:08:59 9 Q. Dr. Wang, what is this exhibit?

15:09:01 10 A. This is my paper from 2009.

15:09:10 11 Q. When did you write this paper?

15:09:14 12 A. When? It was published in 2009.

15:09:18 13 The paper was submitted in 2008. So it was

15:09:32 14 written before then.

15:09:34 15 Q. Was this paper peer-reviewed?

15:09:46 16 MS. SHOMAKER: Sorry. Dr. Wang

15:09:51 17 got a call from her son. Really fast.

15:09:54 18 Apologies.

15:09:55 19 THE WITNESS: I'm sorry. I just

15:09:57 20 had to return a phone call from my son

15:10:00 21 because he needs a ride.

15:10:02 22 MR. RACHUBA: No problem. Do you

15:10:04 23 need to take a minute?

15:10:05 24 THE WITNESS: I told him to find

15:10:07 25 somebody. Thank you.

15:10:19 1 BY MR. RACHUBA:

15:10:19 2 Q. Dr. Wang, was this paper, your
15:10:21 3 2009 paper, was that peer-reviewed?

15:10:23 4 A. Of course.

15:10:25 5 Q. By who? Do you know?

15:10:30 6 A. Oh, I don't know. This is -- all
15:10:35 7 journal papers you submit and editorial -- the
15:10:35 8 editors handle.

15:10:35 9 (Court reporter clarification)

15:10:47 10 A. So, it follows the general
15:10:50 11 practice of all journal papers in my field;
15:10:53 12 authors submit paper, is blind reviewed by
15:11:00 13 reviewers you don't know.

15:11:03 14 Yeah. It's just like any other
15:11:05 15 paper I publish, I believe, like any other
15:11:08 16 paper Dr. Gupta published. So, yeah, it's
15:11:11 17 peer-reviewed.

15:11:12 18 Q. Was your dissertation also
15:11:14 19 peer-reviewed?

15:11:16 20 A. Dissertation is reviewed by a
15:11:20 21 committee.

15:11:22 22 Q. I guess, a doctoral committee?

15:11:25 23 A. Yeah, the doctoral committee.

15:11:28 24 Q. Turning to the second page of your
15:11:41 25 paper, page 74, do you see Figure 1 at the

15:11:55 1 bottom there?

15:11:56 2 A. Yes.

15:11:56 3 Q. Is this arrangement the same

15:12:05 4 arrangement as shown in the '684 patent?

15:12:07 5 A. Yes.

15:12:09 6 Q. Do you stand by the positions you

15:12:15 7 took in this paper?

15:12:17 8 A. Yeah.

15:12:19 9 Q. Are you aware of any errors in

15:12:21 10 this paper?

15:12:23 11 A. Say that again?

15:12:27 12 Q. Strike that question.

15:12:27 13 Do you stand by the positions you

15:12:29 14 took in your dissertation?

15:12:30 15 A. Yes.

15:12:30 16 Q. Could you please scroll to --

15:12:47 17 sorry, my screen is very slow right now.

15:12:53 18 Do you stand by the positions you

15:12:56 19 took in your first declaration?

15:12:58 20 A. Yes.

15:13:00 21 Q. Do you stand by the positions you

15:13:03 22 took in your second declaration?

15:13:04 23 A. Yes.

15:13:06 24 Q. If you could scroll to page 76 of

15:13:26 25 your 2009 paper. I'm looking at Figure 5. Do

15:13:36 1 you see that?

15:13:38 2 A. Yes.

15:13:43 3 Q. Is the data accurate in your 2009
15:13:48 4 paper?

15:13:49 5 A. I believe so.

15:13:52 6 Q. Can you show me what -- can you
15:13:55 7 explain to me what Figure 5 depicts?

15:13:58 8 A. Figure 5 shows the substrate
15:14:01 9 stress profiles obtained on the constant
15:14:06 10 substrate using three different thicknesses, .4
15:14:12 11 millimeter, .8 millimeter, and 1.4 millimeter.
15:14:17 12 So that's a compressive stress profile.

15:14:21 13 Q. And this is a -- these are
15:14:25 14 resulting stresses performed using the
15:14:27 15 experiment as shown and depicted in the '684
15:14:32 16 patent; is that correct?

15:14:32 17 A. There is no film for Figure 5.
15:14:37 18 This is the stress and the substrate only, and
15:14:41 19 no film deposited.

15:15:03 20 Q. Did you use this data to calculate
15:15:16 21 interface stress?

15:15:19 22 MS. SHOMAKER: Objection to scope.

15:15:26 23 A. So, I think we used a different
15:15:31 24 data. So in the interface stress where it's
15:15:34 25 calculated, we used the stress we directly

15:15:37 1 measured on the film. But I believe the data

15:15:41 2 is similar. The stress wave is similar.

15:15:46 3 Q. Okay.

15:17:30 4 MR. RACHUBA: Do you mind if we

15:17:32 5 take a ten-minute break right now?

15:17:35 6 MS. SHOMAKER: Sure.

15:17:36 7 (Proceedings recessed at

15:30:15 8 3:17 p.m., and reconvened at 3:30 p.m.)

15:30:15 9 BY MR. RACHUBA:

15:30:16 10 Q. Dr. Wang, welcome back.

15:30:26 11 A. My pleasure. Thanks.

15:30:31 12 Q. Could you please pull up

15:30:33 13 Exhibit 1056, your 2009 paper again, and open

15:30:39 14 up to page 75, Figure 3.

15:30:55 15 A. Okay.

15:30:55 16 Q. Can you please identify which

15:31:17 17 waveform in Figure 3 has the longest post-peak

15:31:24 18 decay?

15:31:29 19 A. So, if we just look at the peak

15:31:48 20 stress to the -- let me see -- 5 to 15, about

15:31:59 21 10, 8, 20. It's only in the range of 10 to 15

15:32:13 22 nanoseconds I would say.

15:32:16 23 Q. Are they all the same, or does one

15:32:20 24 have a longer decay than the others?

15:32:22 25 A. It's all similar. I would say

15:32:25 1 similar. There is this noise from experiments.
15:32:32 2 So, for example, the .4, it's the peak stress
15:32:39 3 is earlier, but then it also finish the
15:32:42 4 earlier. So all around, 10 nanoseconds I would
15:32:48 5 say. Yeah. The 10 to 15 nanoseconds -- 10 to
15:32:53 6 15 nanoseconds.

15:32:57 7 Q. Can you show me how you calculated
15:32:59 8 the 15 nanoseconds?

15:33:02 9 A. Okay. It would go, for example,
15:33:12 10 the .4 millimeter starts from 5. I think
15:33:21 11 actually I will say around 10. Basically, the
15:33:26 12 whole thing after the peak ends at 20
15:33:28 13 nanoseconds. But then you start from 5 or --
15:33:35 14 for example, for the 1.8 millimeter, the peak
15:33:39 15 stress is around 10 nanoseconds. So if you
15:33:45 16 start from there, ends at 20, that's 10
15:33:49 17 nanoseconds.

15:33:50 18 So the blue peak -- the blue peak
15:33:51 19 is also around 10 or 11. The red peak is
15:33:56 20 around 9 or 8. It ends at 20. So that's about
15:34:03 21 11. And the black peak starts from 5 or 6.
15:34:11 22 But because there is more noise in the last
15:34:14 23 part, so it's hard to tell the exact ending
15:34:17 24 time, but it's around -- it ends around 15
15:34:23 25 nanoseconds. I would say around 10

15:34:25 1 nanoseconds, no more than 15 nanoseconds.

15:34:29 2 Q. Okay. Do any of these waveforms
15:34:35 3 depict a shock?

15:34:37 4 A. No.

15:34:40 5 Q. Let's go to Figure 5, then.

15:34:58 6 A. Yes.

15:34:59 7 Q. One second. My computer is going
15:35:14 8 very slow right now.

15:35:21 9 So Figure 5 is on page 76. What
15:35:28 10 is the longest post-peak decay -- actually,
15:35:33 11 strike that question.

15:35:34 12 Is there a shock depicted in this
15:35:39 13 figure?

15:35:40 14 A. So the shock was not expected
15:35:46 15 here. In other words, not as sharp as
15:35:53 16 expected. The thing is not fully developed in
15:35:58 17 this figure here, or not fully shown.

15:36:02 18 Q. What do you mean?

15:36:04 19 A. So there is a reason for the -- so
15:36:09 20 the shock here, it definitely -- so the decay
15:36:14 21 time is longer than in my dissertation.

15:36:26 22 Q. Longer by how much?

15:36:31 23 A. Oh, by quite a lot. So here is
15:36:42 24 about 10 nanoseconds I will see the -- almost
15:36:47 25 around 10 nanoseconds. Yeah.

15:36:49 1 Q. Did you --

15:36:51 2 A. It's showing a linear on both
15:36:54 3 sides. Yeah, but there is a scientific reason
15:36:59 4 for this behavior, so it's expected.

15:37:03 5 Q. Did you inform Boeing of this
15:37:08 6 paper prior to when you submitted your first
15:37:13 7 declaration?

15:37:15 8 MS. SHOMAKER: Dr. Wang, I'm going
15:37:17 9 to let you answer "yes" or "no." But to
15:37:20 10 the extent that your answer would
15:37:24 11 require disclosure of communications
15:37:27 12 with counsel, I'm going to instruct you
15:37:29 13 not to reveal the substance of those
15:37:31 14 communications.

15:37:33 15 A. Okay. Roman, what's your question
15:37:40 16 again?

15:37:43 17 Q. Did you inform Boeing of the
15:37:46 18 existence of your 2009 paper?

15:37:52 19 A. So all my paper are in my CV and
15:37:56 20 on my website is on the public domain.

15:38:01 21 Q. Did you specifically -- this is a
15:38:04 22 "yes" or "no" question. I'm not asking for any
15:38:06 23 confidential privileged information.

15:38:07 24 A. Okay.

15:38:07 25 Q. Did you specifically identify this

15:38:10 1 paper to Boeing?

15:38:11 2 A. No, I didn't. So I did -- I was
15:38:17 3 instructed -- my -- I got the impression we
15:38:22 4 would only -- they were only looking for prior
15:38:25 5 art. I should only discuss prior arts. So
15:38:32 6 that's before the priority date of the '684
15:38:35 7 patent.

15:38:36 8 Yeah, but all my papers are in
15:38:39 9 public domain, and they are available there.
15:38:43 10 I'm sure Boeing is aware, and they have my CV.
15:38:46 11 So, yeah.

15:39:07 12 MR. RACHUBA: Okay. I'm going to
15:39:09 13 put another exhibit in the chat. This
15:39:13 14 is Exhibit 1004.

15:39:17 15 (Document marked for
15:39:20 16 identification as Wang Exhibit 1004)

15:39:20 17 MR. RACHUBA: And, Dr. Wang, this
15:39:25 18 is your CV.

15:39:26 19 A. Yeah.

15:39:28 20 Q. I'm sorry, one more question on
15:39:33 21 the 2009 paper before we move on. Is it fair
15:39:37 22 to say that the 2009 paper are experimental
15:39:42 23 results of the future work contemplated in your
15:39:44 24 dissertation?

15:39:45 25 MS. SHOMAKER: Objection to scope

15:39:49 1 and form.

15:39:50 2 A. So, it's an experimental result
15:39:53 3 using the configuration proposed in my future
15:39:57 4 work. Yeah, similar to that proposed in my
15:40:02 5 future work.

15:40:03 6 Q. Okay.

15:40:04 7 A. But the stress here is much higher
15:40:06 8 than the range explored in my experimental work
15:40:12 9 in the dissertation, and that's why the shock
15:40:14 10 is not as sharp. But this is expected from the
15:40:17 11 behavior I predicted theoretically.

15:40:23 12 Q. Where were you working when the
15:40:27 13 2009 paper was written?

15:40:29 14 A. I was at UC Riverside. University
15:40:40 15 of California in Riverside.

15:40:40 16 Q. Was any of your work at UC
15:40:48 17 Riverside funded by any defense or aerospace
15:40:51 18 contractors?

15:40:51 19 A. So this work was funded by
15:40:54 20 defense. This is actually already outside the
15:41:05 21 funding period, but it was initiated.

15:41:07 22 Q. What funding was initiated?

15:41:13 23 A. So, this is in the
15:41:15 24 "Acknowledgment." So this is the funding
15:41:18 25 supported by the Army Research Office, and that

15:41:23 1 the Department of Defense DURIP awards.

15:41:42 2 Q. Was any of your work funded by any
15:41:44 3 private defense or aerospace contractors, not
15:41:47 4 the government?

15:41:48 5 MS. SHOMAKER: Objection to form
15:41:49 6 and scope.

15:41:50 7 A. No.

15:41:52 8 Q. When did you first receive funding
15:42:01 9 from Boeing?

15:42:06 10 A. First receive funding from Boeing.
15:42:09 11 So I think it's also in my CV. It's around
15:42:12 12 2022 or 2021. 2022 I think.

15:42:20 13 Q. How much funding did you receive
15:42:24 14 from Boeing?

15:42:25 15 A. So, it's a multi-PI awards, so I'm
15:42:32 16 a co-PI on both projects. My colleague is the
15:42:38 17 lead PI. I think the actual amount is also in
15:42:44 18 my CV. I don't remember the actual amount.

15:42:49 19 Q. What is PI?

15:42:50 20 A. Principal investigator. So that's
15:42:55 21 the lead person who propose the project to
15:42:58 22 funding agency. I'm a co-PI basically. So I'm
15:43:06 23 the second. It's several professors work on
15:43:13 24 the same project, so I'm one of them.

15:43:16 25 Q. I don't see the funding

15:43:48 1 disclosure.

15:43:48 2 A. Okay. Yeah. So it's not there,
15:43:50 3 but I think -- yeah, but I can tell it's March
15:43:53 4 2022.

15:43:57 5 Q. So we have the month nailed down.
15:44:00 6 And do you still receive the monthly award from
15:44:03 7 Boeing? So starting from 2022 to present?

15:44:06 8 MS. SHOMAKER: Objection to form.

15:44:13 9 A. So the funding on two project, one
15:44:26 10 was ended as of last December. But the one
15:44:31 11 project we are still doing some work, but the
15:44:38 12 no more funding. It's a no-cost extension
15:44:44 13 ending September of this year.

15:44:46 14 Q. So the funding went to December --
15:44:54 15 wait. Sorry. Strike.

15:44:54 16 A. The funding ended December -- one
15:45:05 17 funding -- actually both ended December of
15:45:09 18 2024.

15:45:17 19 Q. You mentioned two projects with
15:45:19 20 Boeing. Were those the only two projects
15:45:21 21 Boeing has provided funding for?

15:45:26 22 MS. SHOMAKER: Objection to form.

15:45:27 23 A. Yeah.

15:45:28 24 Q. Are you aware of any projects
15:45:31 25 where Boeing may have provided indirect

15:45:33 1 funding?

15:45:34 2 A. Indirect fund. Oh, yes, we do.

15:45:43 3 We do have funding from Washington State with

15:45:46 4 Boeing as an industry collaborator.

15:45:50 5 Q. What is industry collaborator at

15:45:59 6 Washington State?

15:46:00 7 A. So this is a funding opportunity

15:46:03 8 called the JCATI, G-C-A-T-I [sic]. So it's a

15:46:10 9 Joint Center of Aerospace Technology

15:46:16 10 Innovation, JCATI. So the funding is provided

15:46:22 11 by Washington State, but university professor

15:46:28 12 collaborate with industry. So industry

15:46:32 13 provides in-kind support.

15:46:39 14 Q. University of Washington, that's

15:46:45 15 the same as Washington State?

15:46:46 16 A. No. University of Washington is

15:46:51 17 in Washington state, but Washington state have

15:46:55 18 two university, two flagship -- two state

15:46:59 19 university: One is University of Washington,

15:47:01 20 the other is called the Washington State

15:47:05 21 University.

15:47:05 22 Q. Okay. What is Boeing's role as a

15:47:08 23 collaborator?

15:47:09 24 MS. SHOMAKER: Objection to scope.

15:47:13 25 A. They provide some support on

15:47:15 1 materials and equipment.

15:47:16 2 Q. And what is your role in the

15:47:22 3 JCATI?

15:47:24 4 A. So for that, I'm the PI.

15:47:29 5 Q. So you're the primary

15:47:31 6 investigator?

15:47:32 7 A. I'm the primary, yeah.

15:47:33 8 Q. You're the primary. So is it

15:47:36 9 accurate to say that you're the primary

15:47:38 10 investigator --

15:47:38 11 A. Right. Right. Yeah, I'm the

15:47:41 12 principal investigator.

15:47:42 13 Q. Principal, I'm sorry.

15:47:44 14 And is Boeing the principal

15:47:50 15 investor --

15:47:50 16 A. No.

15:47:51 17 Q. -- of the JCATI lab?

15:47:52 18 A. No.

15:47:53 19 Q. What is Boeing's level of

15:47:56 20 investment in the JCATI lab?

15:47:58 21 MS. SHOMAKER: Objection to scope.

15:48:00 22 A. So they provide samples, some

15:48:03 23 materials.

15:48:05 24 Q. Do they provide --

15:48:07 25 A. Yeah, provide them with materials

15:48:08 1 and the drawing -- technical discussions. So,
15:48:14 2 yeah.

15:48:14 3 Q. You are employed by the University
15:48:19 4 of Washington, not Washington State, correct?

15:48:22 5 A. Correct.

15:48:23 6 Q. So your role as a PI at Washington
15:48:25 7 State in addition to your --

15:48:27 8 A. No, PI is a role for me as a
15:48:32 9 University of Washington professor. So when Yu
15:48:41 10 Sung [phonetics] made this proposal to fund the
15:48:44 11 agency -- my role is prin- -- so the lead
15:48:47 12 proposer is called the principal investigator.

15:48:50 13 So the funding is from the State
15:48:51 14 of Washington, so it's from Washington State.
15:48:54 15 So that's why it has nothing to do with the
15:48:56 16 other Washington State University. JCATI is in
15:48:59 17 the State of Washington.

15:49:00 18 Q. I see. So the State of Washington
15:49:02 19 provides funding for the JCATI lab --

15:49:06 20 A. For the JCATI project, yeah, to
15:49:09 21 support the university and the industry
15:49:10 22 collaborations. Yeah.

15:49:13 23 Q. I see. And Boeing provides --
15:49:17 24 does Boeing provide funding to the state of
15:49:20 25 Washington --

15:49:21 1 A. No. No. Boeing doesn't provide
15:49:23 2 any funding. They just act as a technical
15:49:27 3 partner, industry partner. Yeah, they provide
15:49:32 4 some in-kind support through giving us some
15:49:40 5 samples and materials and the drawing -- and
15:49:42 6 engineer time to drawing biweekly or monthly
15:49:45 7 technical discussions.

15:49:47 8 Q. Okay. What is the Boeing Advanced
15:49:53 9 Research Collaboration Lab?

15:49:53 10 A. So that's -- that's Boeing's
15:49:59 11 advanced research -- yes. That's a high-level
15:50:02 12 collaboration between the University of
15:50:05 13 Washington and Boeing. So for that, Boeing
15:50:09 14 provides funding to the University of
15:50:14 15 Washington to support all the research, I
15:50:17 16 think -- that's a high-level collaboration.
15:50:21 17 All the research funding by Boeing fall into
15:50:25 18 that -- that collaboration. Yeah.

15:50:29 19 Q. How much funding does Boeing
15:50:34 20 provide?

15:50:35 21 A. I don't know, because I'm not
15:50:37 22 involved much.

15:50:38 23 Q. What is your involvement with the
15:50:41 24 Boeing Advanced Research Collaboration Lab?

15:50:44 25 A. Okay. So, how to say that? So,

15:50:54 1 UW has a lot of Boeing-supported research.
15:50:59 2 Used to be, like, every faculty member would
15:51:02 3 seek our own funding. So maybe half of the UW
15:51:07 4 faculty, engineering faculty, ME faculty, have
15:51:19 5 funding from Boeing, used to be like an
15:51:21 6 individual -- individual funding and all come
15:51:24 7 from different parts of Boeing.

15:51:27 8 Now Boeing and UW basically
15:51:31 9 created this BARC, Boeing Advanced Research
15:51:39 10 Collaboration model. So, basically, all the
15:51:42 11 Boeing support the project and it's funneled
15:51:46 12 through BARC. But still -- yeah. They
15:52:08 13 basically want to create one place to oversee
15:52:10 14 all the UW-Boeing collaborations or funding --
15:52:13 15 not collaboration. It's a funding. So BARC
15:52:16 16 actually has direct funding from Boeing. And
15:52:22 17 then that's used to support university faculty
15:52:25 18 and the students.

15:52:28 19 So I don't have any right now.
15:52:31 20 And previously our proposal wasn't through
15:52:34 21 BARC. But now if we were going to continue,
15:52:38 22 that's also part of. That would be considered
15:52:43 23 part of BARC. It's part of the administration
15:52:45 24 for oversight. How to say that? Say
15:52:47 25 provision. Yeah, it's a high-level UW-Boeing

15:52:54 1 collaboration.

15:52:54 2 Q. While you were employed at UC
15:52:57 3 Riverside, did you perform any laser spallation
15:53:04 4 work on behalf of any company?

15:53:06 5 A. Yes. Intel. I had funding from
15:53:17 6 Intel. Yeah, we did laser spallation work.

15:53:21 7 Q. Any other company?

15:53:23 8 A. Let me think. Not while at UC
15:53:31 9 Riverside.

15:53:31 10 Q. What companies have you performed
15:53:34 11 laser spallation work on behalf of?

15:53:37 12 A. So we did Intel. Boeing. We had
15:53:49 13 Blue Origin. We also did some work for
15:53:53 14 Microsoft. And we are currently doing a little
15:53:59 15 bit of work for some local company. It's
15:54:06 16 called NFR, NoiseFigure Research. And we
15:54:14 17 also -- yeah, I think that's about...

15:54:26 18 Yeah, we would funding from
15:54:31 19 Packer, the big semi-truck company,
15:54:36 20 P-a-c-k-e-r. Yeah, that's about -- let me
15:54:44 21 think who else. Yeah.

15:54:46 22 Q. Any others?

15:54:47 23 A. I don't remember - recall. So we
15:54:57 24 collaborated with Army Research Office -- Army
15:55:01 25 Research Lab, but that's a while -- that's

15:55:05 1 basically this paper, the 2009 paper. Yeah. I
15:55:13 2 think that's about.

15:55:15 3 Q. Okay. When did you perform laser
15:55:19 4 spallation work for Boeing?

15:55:22 5 A. So 2022. That's the -- yeah, what
15:55:31 6 the funding is about.

15:55:38 7 Q. Any earlier than 2022?

15:55:42 8 A. No.

15:55:43 9 Q. You were at the University of
15:55:49 10 Washington at the time?

15:55:50 11 A. Yeah.

15:55:51 12 Q. Have you ever done any laser
15:55:53 13 spallation work with Northrop Grumman.

15:56:05 14 A. No.

15:56:05 15 Q. Have you ever trained any employee
15:56:20 16 of Boeing on any laser spallation techniques?

15:56:24 17 MS. SHOMAKER: Objection to form
15:56:24 18 to scope.

15:56:25 19 A. No.

15:56:26 20 Q. Have you ever given a presentation
15:56:33 21 or seminar to anyone from Boeing?

15:56:38 22 MS. SHOMAKER: Objection to scope.

15:56:40 23 A. Yes. So we, for a Boeing project,
15:56:48 24 we have biweekly meetings. Of course, that's
15:56:51 25 my student who report. I did give a seminar at

15:56:55 1 Boeing in -- I forgot. I think it's on my CV.

15:57:00 2 It's 2021 or 2019. I forgot.

15:57:04 3 Q. What was --

15:57:06 4 A. 2021.

15:57:07 5 Q. What was the topic of that

15:57:10 6 seminar?

15:57:11 7 A. It's about thin films. Part is --

15:57:17 8 there are two sections. One is on laser

15:57:20 9 spallation -- yeah, laser spallation part of

15:57:23 10 that. And I also presented my other metallic

15:57:27 11 multi-layer thin films. It's about thin film

15:57:32 12 work in my group.

15:57:38 13 Q. Were you compensated by Boeing for
15:57:40 14 that?

15:57:40 15 A. No.

15:57:40 16 Q. About how many people attended
15:57:42 17 that seminar?

15:57:48 18 A. I don't remember. It was during
15:57:51 19 COVID I think. It was an online seminar.

15:57:53 20 Q. Do you know if any Boeing
15:57:55 21 engineers attended that seminar?

15:57:57 22 A. I don't know who are engineer or
15:58:01 23 not an engineer, but there are people. I think
15:58:04 24 it's advertised within Boeing. Yeah, I think
15:58:06 25 there should be.

15:58:08 1 Q. Have any Boeing engineers visited
15:58:13 2 your lab at Washington, at the University of
15:58:16 3 Washington?

15:58:16 4 A. Yes.

15:58:18 5 Q. When?

15:58:19 6 A. When?

15:58:22 7 MS. SHOMAKER: Objection to scope.

15:58:24 8 A. So that's when we just started my
15:58:27 9 project with Boeing. It's 2022 I think.

15:58:31 10 Q. This was on the topic of laser
15:58:34 11 spallation?

15:58:35 12 A. They just came -- oh, they just
15:58:39 13 came to see my lab to deliver the samples,
15:58:42 14 yeah. Yeah, for the laser spallation
15:58:46 15 experiment project.

15:58:49 16 Q. Have you done any paint adhesion
15:58:59 17 work with Boeing?

15:59:00 18 A. The what?

15:59:02 19 Q. Paint adhesion.

15:59:04 20 A. Yes. Yeah, that's basically what
15:59:07 21 we were working on.

15:59:10 22 Q. Can you explain your work in that
15:59:13 23 regard?

15:59:14 24 A. Explain? We use laser spallation
15:59:20 25 to measure the adhesion between the paint and

15:59:20 1 the --

15:59:20 2 (Court reporter clarification)

15:59:25 3 A. Interface of adhesion. We use

16:00:13 4 laser spallation to measure the interface of

16:00:16 5 adhesion between the different layers of paint.

16:00:22 6 Q. Can you explain the experimental

16:00:24 7 setup that you used to measure that adhesion?

16:00:28 8 A. It's similar to what I used in my

16:00:32 9 dissertation.

16:00:33 10 Q. Is it similar to your setup in the

16:00:38 11 2009 paper?

16:00:40 12 A. In my dissertation, some of -- for

16:00:43 13 example, similar to 3.14, for that -- for the

16:00:50 14 results in my dissertation. So, yeah. Some

16:00:54 15 work is similar to 2009. So you have fused

16:01:01 16 silica, and then you have another substrate,

16:01:03 17 and then you have the paint layers. Yeah, we

16:01:07 18 use all different kinds of configurations.

16:01:10 19 Q. This experimental setup was it in

16:01:13 20 Washington State?

16:01:14 21 A. Yeah. It's in my lab at the

16:01:19 22 University of Washington.

16:01:19 23 Q. And this research is ongoing

16:01:21 24 currently?

16:01:21 25 A. So the funding has ended.

16:01:23 1 Q. The funding has ended, but the
16:01:25 2 research is still ongoing?
16:01:27 3 A. No, the research is over for that.
16:01:29 4 The research is over.
16:01:34 5 Q. Okay. I understand you still
16:01:35 6 do --
16:01:35 7 A. I still do -- I still do laser
16:01:38 8 spallation work for different coatings for my
16:01:41 9 own research but no longer connected. Yeah.
16:01:44 10 No longer sponsored by Boeing.
16:01:48 11 Q. Did you use -- have you used laser
16:01:55 12 spallation techniques to depaint aircraft parts
16:02:00 13 for Boeing?
16:02:01 14 MS. SHOMAKER: Objection to form
16:02:03 15 and scope.
16:02:03 16 Q. Aircraft paints.
16:02:05 17 MS. SHOMAKER: Objection to form
16:02:06 18 and scope.
16:02:07 19 A. So we do laser depaint. Yeah, but
16:02:20 20 we are directly shining laser on the paint.
16:02:23 21 Yeah.
16:02:23 22 Q. Okay. Was this paint on aircraft
16:02:27 23 parts?
16:02:28 24 A. So this paint is on -- not on
16:02:32 25 aircraft. It's on coupon samples.

16:02:50 1 Q. What do you mean by "coupon
16:02:52 2 samples"?

16:02:52 3 A. Basically, a small piece of
16:02:55 4 sample, a coupon size. A smaller size.

16:02:59 5 Q. I see. You're referring to size.

16:03:02 6 A. Size, yeah.

16:03:02 7 Q. I see.

16:03:03 8 A. Not the big aircraft.

16:03:05 9 Q. I see.

16:03:06 10 A. Not directly doing laser
16:03:09 11 depainting on the aircraft body.

16:03:11 12 And so actually, the BARC center
16:03:14 13 has laser depainting work, by not me. By my
16:03:19 14 colleague for a long time.

16:03:21 15 Q. For aircraft parts?

16:03:22 16 A. For aircraft parts. So, yeah, so
16:03:25 17 that's the BARC project led by other professors
16:03:29 18 at UW. They have been doing this laser
16:03:33 19 depainting.

16:03:35 20 Q. Can you identify those other
16:03:37 21 professors?

16:03:38 22 A. I think -- I do actually -- I
16:03:47 23 know -- I don't know who is leading the actual
16:03:52 24 project, but the BARC director, Xu Chen, should
16:03:57 25 know who is doing the actual work. His name is

16:04:00 1 on the website. He oversees all the BARC
16:04:02 2 project.

16:04:02 3 Q. Do you mind spelling his name for
16:04:05 4 me, please?

16:04:05 5 A. Last name C-h-e-n. First name
16:04:09 6 X-u. You can find his name at the BARC
16:04:13 7 website.

16:04:20 8 Q. Are the coupon samples -- strike
16:04:27 9 that question.

16:04:28 10 The laser spallation work that
16:04:42 11 you've done for Boeing have used fused silica
16:04:47 12 as a glass element?

16:04:48 13 A. Yes.

16:04:48 14 Q. What other materials have you used
16:04:51 15 besides fused silica as glass elements in your
16:04:53 16 experimental setups for Boeing?

16:04:55 17 A. So I think the glass element that
16:04:57 18 we just used fused silica.

16:04:58 19 Q. Why is that?

16:04:59 20 A. Because we have a lot of
16:05:02 21 experiments. Yeah.

16:05:04 22 Q. Did you find that fused silica
16:05:10 23 works better than other materials for the glass
16:05:13 24 element in that regard?

16:05:14 25 A. We never started other glass

16:05:16 1 element. We only started fused silica --
16:05:20 2 whether it's fused silica or fused quartz,
16:05:22 3 basically, yeah, just this kind. We didn't
16:05:24 4 start any other. Since we started fused silica
16:05:27 5 very well, we understood its behavior. So,
16:05:30 6 yeah, if needed to modify the stress wave, we
16:05:34 7 just add fused silica. We have been just,
16:05:37 8 yeah, using fused silica.

16:05:38 9 MS. SHOMAKER: Can I ask a
16:05:40 10 clarifying question really quick?
16:05:43 11 Dr. Wang, is any of your work with
16:05:46 12 Boeing confidential --

16:05:46 13 MR. RACHUBA: Wait. Wait. I
16:05:46 14 object to this question. This is my
16:05:48 15 line of questioning. After I pass the
16:05:49 16 witness, you can ask your own questions,
16:05:51 17 Casey.

16:05:51 18 MS. SHOMAKER: Well, I'm asking
16:05:53 19 because Dr. Gupta is attending this
16:05:56 20 deposition, and he may need to step off
16:05:58 21 if these are confidential Boeing
16:06:01 22 questions, questions that are
16:06:03 23 confidential about Boeing. This is
16:06:04 24 exactly what we did during Dr. Gupta's
16:06:07 25 deposition.

16:06:07 1 MR. RACHUBA: Okay.

16:06:07 2 MS. SHOMAKER: Is any of this work

16:06:09 3 confidential to Boeing in the sense that

16:06:11 4 it hasn't been published outside of your

16:06:14 5 work with Boeing?

16:06:16 6 THE WITNESS: Actually, it's not

16:06:19 7 published yet.

16:06:26 8 MS. SHOMAKER: Could we just go

16:06:27 9 off the record shortly?

16:06:29 10 MR. RACHUBA: Yes.

16:06:30 11 (Proceedings recessed at

16:12:54 12 4:06 p.m., and reconvened at 4:13 p.m.)

16:12:54 13 BY MR. RACHUBA:

16:13:00 14 Q. Have you ever -- Dr. Wang, have

16:13:10 15 you ever done any laser spallation work in

16:13:12 16 relation to peening?

16:13:26 17 MS. SHOMAKER: Objection to form.

16:13:26 18 A. No, I have not.

16:13:39 19 Q. Do you understand what I mean by

16:13:44 20 peening?

16:13:45 21 A. Can you explain?

16:13:47 22 Q. I was hoping you could. We can

16:13:53 23 come back to that one. How about laser

16:13:57 24 spallation in relation to bonding?

16:13:59 25 MS. SHOMAKER: Objection to form.

16:14:05 1 A. So basically adhesion is a kind of
16:14:10 2 bonding.

16:14:15 3 Q. Yes. So you --

16:14:16 4 A. Bonding strength. That is what we
16:14:21 5 are testing.

16:14:22 6 Q. Okay. Have you used laser
16:14:45 7 spallation in the context of
16:14:48 8 composite-to-composite testing -- or, sorry,
16:14:51 9 composite-to-composite bonding?

16:14:53 10 A. We are doing some work.

16:14:53 11 Q. With Boeing?

16:14:53 12 (Court reporter clarification)

16:15:06 13 A. It's just work out of our own
16:15:08 14 scientific curiosity. It's not sponsored by
16:15:14 15 anybody.

16:15:19 16 Q. Is it work performed in relation
16:15:22 17 to the BARC lab?

16:15:24 18 A. No. It's just in my lab. I have
16:15:29 19 a student who wanted to study composites, so we
16:15:33 20 are doing that.

16:15:33 21 Q. I see.

16:15:33 22 A. Yeah.

16:15:35 23 Q. Who gave the samples that were
16:15:37 24 tested for the composites?

16:15:39 25 A. Those samples, actually, it's a

16:15:42 1 donation from Boeing.

16:15:44 2 Q. When were those samples provided?

16:15:51 3 A. When? It was a few months ago.

16:15:54 4 This year.

16:15:56 5 Q. Are you aware if Boeing does

16:16:04 6 composite testing with regard to spallation?

16:16:08 7 MS. SHOMAKER: Objection to form

16:16:09 8 and scope.

16:16:10 9 A. I'm not aware.

16:16:11 10 Q. Are you aware if any of your

16:16:19 11 colleagues do composite testing, laser

16:16:23 12 spallation work?

16:16:24 13 A. No.

16:16:25 14 Q. Are you familiar with a laser bond

16:16:35 15 inspection tool?

16:16:39 16 MS. SHOMAKER: Objection to scope.

16:16:41 17 A. No.

16:16:42 18 Q. Have you ever seen a laser bond

16:17:02 19 inspection tool?

16:17:03 20 A. No.

16:17:20 21 Q. Let's turn back to Exhibit 1056,

16:17:30 22 your 2009 paper.

16:17:33 23 A. Okay.

16:17:34 24 Q. Turn to page 76, Figure 5.

16:17:50 25 A. Okay.

16:17:51 1 Q. What are the maximum stresses for
16:17:54 2 each of those waveforms, blue, red and black?

16:18:00 3 A. So for the black is around 5 to 6
16:18:07 4 GPa, 5 to 5.5, that range.

16:18:14 5 Q. Okay.

16:18:15 6 A. For the red is around 3.4 --
16:18:21 7 around 3 GPa. Blue around 1.8.

16:18:38 8 Q. Okay. We can put that exhibit
16:18:40 9 down. Can you please pull up Exhibit 1005,
16:18:44 10 your dissertation.

16:18:46 11 A. Okay.

16:18:51 12 Q. If you go to page 49 of the PDF,
16:19:18 13 page 32 of the document.

16:19:31 14 A. Okay.

16:19:32 15 Q. In each of Figures (a), (b), and
16:19:44 16 (c), what is the peak stress level?

16:19:47 17 MS. SHOMAKER: Objection to scope.

16:19:54 18 A. (a) peak stress is 1 GPa, (b) peak
16:20:04 19 stress 2 GPa, (c) peak stress 3 GPa.

16:20:04 20 Q. Dr. Wang, did you write your
16:20:07 21 supplemental declaration yourself?

16:20:09 22 A. Yes. Yes, I worked together with
16:20:17 23 Casey. I gave her the statements, and she
16:20:27 24 formatted. She put it into the right format.

16:20:45 25 MR. RACHUBA: I'm going to take a

16:20:46 1 five-minute break, just to make sure
16:20:48 2 that I covered all of my questions. But
16:20:51 3 I think I'll be able to finish up soon.
16:20:55 4 Just take a five-minute break.

16:20:58 5 THE WITNESS: Okay. Thank you.

16:20:58 6 (Proceedings recessed at
16:27:26 7 4:20 p.m., and reconvened at 4:27 p.m.)

16:27:26 8 BY MR. RACHUBA:

16:27:33 9 Q. Dr. Wang, have you performed any
16:27:45 10 laser spallation work with or for any defense
16:27:50 11 contractor while you were at UC Riverside?

16:27:55 12 A. Defense con- -- Army Research Lab.
16:28:14 13 That's the only one.

16:28:15 14 Q. Was that work aerospace related?

16:28:19 15 A. No.

16:28:20 16 Q. Have you performed any laser
16:28:24 17 spallation work -- have you performed any laser
16:28:30 18 spallation work with or for any aerospace
16:28:32 19 company while you were at UC Riverside?

16:28:36 20 A. I don't recall any. I don't think
16:28:49 21 so. I don't recall any sitting here. Yeah, I
16:28:55 22 don't think Intel is a defense company. So,
16:28:59 23 yeah, no.

16:29:00 24 Q. Have you done any laser spallation
16:29:02 25 work in relation to paint adhesion while were

16:29:05 1 you at UC Riverside?

16:29:07 2 MS. SHOMAKER: Objection to form.

16:29:07 3 A. No.

16:29:14 4 Q. Have you read any of Boeing's

16:29:16 5 patents on laser spallation?

16:29:19 6 A. No.

16:29:19 7 Q. Where did you obtain your

16:29:24 8 doctorate from?

16:29:25 9 A. Excuse me?

16:29:26 10 Q. What university did you obtain

16:29:28 11 your doctorate from?

16:29:32 12 A. Sorry. Did you...

16:29:34 13 Q. Sorry. What university did you

16:29:36 14 obtain your doctorate from?

16:29:42 15 A. University of Illinois,

16:29:47 16 Urbana-Champaign.

16:29:47 17 Q. And that was from your

16:29:47 18 dissertation test?

16:29:49 19 A. Yeah, I over there from 1997 to

16:29:52 20 2002. So that's the work published in my

16:29:56 21 dissertation.

16:29:59 22 Q. If the University of Illinois

16:30:01 23 became aware of a material error in your

16:30:04 24 dissertation, are you aware of what the

16:30:08 25 consequences at the University of Illinois

16:30:10 1 would be regarding your doctorate degree?

16:30:13 2 MS. SHOMAKER: Objection. Form

16:30:15 3 and scope.

16:30:15 4 A. I don't believe there is any

16:30:17 5 material error.

16:30:18 6 Q. That wasn't the question.

16:30:19 7 A. Oh, okay. So what's your

16:30:21 8 question?

16:30:23 9 Q. If the University of Illinois

16:30:25 10 became aware of a material error in your

16:30:27 11 doctorate dissertation, what would the

16:30:30 12 implications be at the University of Illinois?

16:30:32 13 MS. SHOMAKER: Objection to form

16:30:33 14 and scope.

16:30:34 15 A. I don't know.

16:30:35 16 Q. What would the implications be at

16:30:39 17 the University of Washington where you're

16:30:41 18 employed?

16:30:41 19 MS. SHOMAKER: Objection to form

16:30:42 20 and scope.

16:30:49 21 A. So, I'm not familiar either. I

16:30:53 22 guess if you have an error, you have to correct

16:30:55 23 it, make a public statement to correct the

16:31:00 24 error. But I haven't seen any of those cases.

16:31:05 25 Q. Have you read the faculty handbook

16:31:09 1 at the University of Washington?

16:31:10 2 MS. SHOMAKER: Objection to form
16:31:11 3 and scope.

16:31:12 4 A. I have to see. I haven't read it
16:31:17 5 in detail. Yeah, sometimes I might look at
16:31:21 6 certain sections. But, yeah.

16:31:24 7 Q. Are you aware of any mechanism for
16:31:33 8 a third party to submit a notice of material
16:31:40 9 error to the University of Illinois?

16:31:49 10 A. Yeah, so people comment. If
16:31:52 11 people don't agree with you, they can comment
16:31:55 12 and you can have a scientific interaction.

16:32:00 13 I believe Dr. Gupta was commented
16:32:03 14 before by other people, and Dr. Gupta
16:32:05 15 responded. So that's a way of scientific
16:32:09 16 interaction. If you make a mistake and people
16:32:13 17 criticize, and you either, if it's a true
16:32:17 18 mistake, you acknowledge. If they are
16:32:19 19 mistaken, then you respond. So that's a way to
16:32:23 20 advance science.

16:32:29 21 MR. RACHUBA: Okay. I have no
16:32:30 22 further questions.

16:32:31 23 MS. SHOMAKER: We'll just take a
16:32:34 24 short five-minute break, and then come
16:32:36 25 back on if we have any redirect.

16:32:38 1 MR. RACHUBA: Okay.
16:32:39 2 (Proceedings recessed at
16:43:28 3 4:32 p.m., and reconvened at 4:43 p.m.)
16:43:28 4 MS. SHOMAKER: I have no further
16:43:33 5 questions today, so we can close the
16:43:36 6 deposition.
16:43:40 7 (Time Noted: 4:43 p.m.)

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1 C E R T I F I C A T E

2 I, JUNLAN WANG, PH.D., do hereby
3 certify that I have read the foregoing
4 transcript of my testimony, and further
5 certify that it is a true and accurate
6 record of my testimony (with the exception
7 of the corrections listed below):

8	Page	Line	Correction
9	_____	_____	_____
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C E R T I F I C A T E

I, JUNLAN WANG, PH.D., do hereby
certify that I have read the foregoing
transcript of my testimony, and further
certify that it is a true and accurate
record of my testimony (with the exception
of the corrections listed below):

Page	Line	Correction
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Signed under the pains and penalties of
perjury this _____ day of _____ ,
2025.

JUNLAN WANG, PH. D.

C E R T I F I C A T E

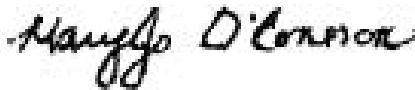
COMMONWEALTH OF MASSACHUSETTS

SUFFOLK, SS.

I, MaryJo O'Connor, a Notary Public
in and for the Commonwealth of
Massachusetts, do hereby certify:

That JUNLAN WANG, PH.D., the
witness whose testimony is hereinbefore set
forth, was duly sworn by me and that such
testimony is a true and accurate record of
my stenotype notes taken in the foregoing
matter to the best of my knowledge, skill
and ability.

IN WITNESS WHEREOF, I have hereunto
set my hand and Notarial Seal this 30th day
of May 2025.



MARYJO O'CONNOR, RDR/RMR
Notary Public

My Commission expires:
September 12, 2025