

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

3 WESTERN DIGITAL TECHNOLOGIES,)
4 INC.,)
5)
6 Petitioner,)
7 Vs.)
8)
9 GODO KAISHA IP BRIDGE 1,)
10)
11 Patent Owner.)
12 /

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Case No. IPR2024-01493

12

U.S. Patent Number 10,680,167

13

14

VIDEOTAPED DEPOSITION OF CAROLINE A. ROSS, Ph.D.

15

(Taken Virtually by Petitioner)

16

Thursday, September 18th, 2025

17

9:06 a.m. EDT

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Certified Stenographic Court Reporter
Amy A. Brauser, RPR, RMR, CRR

1 VIRTUAL APPEARANCES

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19 ALSO PRESENT:

20 Mitchell Mahon, Videographer
21
22

1 VIDEOTAPED DEPOSITION OF CAROLINE A. ROSS,
2 Ph.D., a witness called on behalf of Petitioner,
3 before Amy A. Brauser, RPR RMR CRR, Certified
4 Stenographic Court Reporter and Notary Public, in
5 and for the Commonwealth of Virginia, on Thursday, the
6 18th day of September, 2025, commencing at 9:06 a.m.

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1 INDEX OF EXAMINATIONS

2 By Mr. Wilson Page 6

3 By Mr. Wichman Page 203

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5 INDEX OF EXHIBITS

6 NUMBER DESCRIPTION MARKED/IDENTIFIED

7 Exhibit 1100 Excerpts from textbook, "Silicon 65
8 VLSI Technology, Fundamentals,
Practice and Modeling"9 Exhibit 1097 Wang, et al., article, 104
10 "Deposition of in-plane textured
MgO on amorphous Si₃N₄ substrates
11 by ion-beam-assisted deposition
and comparisons with
12 ion-beam-assisted deposited
yttria-stabilized-zirconia"13 Exhibit 1098 Inaba, et al., article, "Magnetic 115
14 and Crystallographic Properties
of Co-Cr-Pt Longitudinal Media
15 Prepared on MgO Seedlayers
Deposited by ECR Sputtering"16 Exhibit 1099 Tonouchi, et al., article, 142
17 "Expatial growth of NbN on an
ultrathin MgO/semiconductor
18 system"

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

2 THE VIDEOGRAPHER: We are going on the
3 record. This is File Number 1 of the
4 videotaped deposition of Dr. Caroline A.
5 Ross, taken in the matter of Western Digital
6 versus IP Bridge in the US Patent and
7 Trademark Office, Cause Number IPR2024-01493.

8 This deposition is being held remotely
9 via Zoom video conference on September 18th,
10 2025. The time is 9:06. And my name is
11 Mitchell Mahon. I'm the legal videographer
12 from Digital Evidence Group. The court
13 reporter is Amy Brauser in association with
14 Digital Evidence Group.

15 Will counsel, please, introduce
16 themselves for the record?

17 MR. WILSON: Douglas Wilson of Armond
18 Wilson LLP for Petitioner, Western Digital
19 Technologies, Inc, and with me is
20 Monica Arnold.

21 MR. WICHMAN: Adam Wichman from Wolf
22 Greenfield for the Patent Owner, IP Bridge.

1 THE VIDEOGRAPHER: Will the court
2 reporter, please, swear in the witness?

3 CAROLINE ANNE ROSS, Ph.D.,
4 after having been first duly sworn by the certified
5 stenographer, was examined and testified as follows:

6 EXAMINATION

7 BY MR. WILSON:

8 Q. Good morning, Dr. Ross.

9 A. Good morning.

10 Q. Can you, please, state your full name?

11 A. Caroline Anne Ross.

12 Q. And where are you located this morning?

13 A. I'm in the offices of Wolf Greenfield
14 in downtown Boston.

15 Q. Okay. You've been deposed before,
16 correct?

17 A. Yes.

18 Q. Okay. And so you understand that
19 you're under oath this morning, correct?

20 A. Yes.

21 Q. And if I ask you a question and you do
22 not understand the question, will you please ask me

1 to clarify it?

2 A. Yes.

3 Q. And if you don't ask me to clarify it,
4 I'll assume that you understood. Is that okay?

5 A. I understand.

6 Q. Okay. Your -- you also understand that
7 during the course of today's deposition, you are
8 not permitted to discuss your testimony or the
9 questions asked or anything about the substance of
10 this deposition with anyone.

11 Do you understand that?

12 A. I do.

13 Q. Okay. Is there any reason as you sit
14 here this morning that you cannot testify fully,
15 truthfully and accurately?

16 A. There's no reason.

17 Q. Okay. Now, you have submitted -- well,
18 for -- today's deposition covers two IPRs. You
19 understand that?

20 A. I do.

21 Q. And those are IPR2024-01447 and
22 IPR2024-01943, correct?

1 A. Correct.

2 Q. Okay. And the 1447 IPR covers US
3 Patent 8,405,134, correct?

4 A. Yes.

5 Q. And the 01493 IPR covers US patent
6 10,680,167, correct?

7 A. Yes.

8 Q. And if I refer to these patents as the
9 '134 Patent and the '167 Patent, you'll understand
10 what I mean?

11 A. I will.

12 Q. Okay. Now, you have a copy of all of
13 the exhibits that have been submitted in these
14 IPRs, correct?

15 A. I have paper copies of some of them and
16 PDFs on a screen of others.

17 Q. But between those two, you have a
18 collection of all of the exhibits?

19 A. I believe so.

20 Q. Do you have a copy of Exhibit 2054,
21 your CV?

22 A. Yes.

1 Q. Okay. Exhibit 2054 lists no prior
2 testifying on your behalf, correct?

3 A. This one -- this -- yes, this CV
4 doesn't list legal testifying or activities of that
5 kind.

6 Q. Okay. Have you testified recently in
7 any legal proceedings?

8 A. Not recently.

9 Q. When was the most recent instance that
10 you remember?

11 A. I'm trying to remember. I don't have a
12 copy of my legal activities. But several years
13 ago.

14 Q. Do you remember anything about the
15 case, your most recent testifying experience?

16 A. What kind of details are you looking
17 for?

18 Q. The names of the parties, the subject
19 matter, the court that it was in. Anything like
20 that.

21 A. I could look up the details if you give
22 me a few minutes. I don't have that information

1 with me.

2 Q. That's okay. We'll table it for now.

3 Fair to say that as you sit here this
4 morning, you can't remember the most recent
5 testimony that you gave?

6 A. I remember some of the details, but I'd
7 like to refresh my memory to make sure I get them
8 correct.

9 Q. Okay. Fair enough.

10 Okay. Let's -- so you've been retained
11 by IP Bridge, and you're testifying for IP Bridge
12 today, correct?

13 A. Well, I'm testifying -- I was retained
14 by Wolf Greenfield on behalf of IP Bridge.

15 Q. Okay. And is Wolf Greenfield paying
16 your bills?

17 A. I hope so.

18 Q. You're not sure?

19 A. Well, I haven't -- I'm not sure where
20 the money is -- well, the money is ultimately
21 coming from IP Bridge as far as I understand it.

22 Q. Okay. But Wolf Greenfield is paying

1 you directly?

2 A. I'm dealing with Wolf Greenfield,
3 correct.

4 Q. Okay. When were you retained by Wolf
5 Greenfield?

6 A. About a year and a half ago, I think.

7 Q. So that would have been beginning of
8 2024 or first quarter, anyway?

9 A. I believe it was in the spring
10 sometime.

11 Q. The spring of 2024?

12 A. Correct.

13 Q. Okay. Now, let's take a look at your
14 declarations. You have two declarations at issue
15 today. Both have been marked Exhibit 2053. And I
16 want to start with your declaration in IPR 1447
17 that pertains to the '134 Patent.

18 THE EXHIBIT TECHNICIAN: Can I just ask
19 quickly, sir. These aren't things you need
20 me pulling up or adding to the link or
21 anything, correct?

22 MR. WILSON: That's correct.

1 THE EXHIBIT TECHNICIAN: Because I
2 don't have them. Okay. Just making sure.

3 MR. WILSON: Yeah, yeah.

4 THE WITNESS: Sorry. Is there a
5 question pending?

6 BY MR. WILSON:

7 Q. So do you have Exhibit 2053 that
8 pertains to the '134 Patent?

9 A. Yes.

10 Q. Okay. Can you look at page 116?

11 A. I have it.

12 Q. Okay. On page 116, that's your
13 signature, correct?

14 A. Yes.

15 Q. And it's dated July 12th, 2025,
16 correct?

17 A. Correct.

18 Q. Okay. And Exhibit 2053 pertaining to
19 the '134 Patent is a complete statement of your
20 opinions offered in this case regarding Western
21 Digital's Petition, correct?

22 A. Yes.

1 Q. Okay. What did you do to prepare for
2 your deposition today?

3 A. I reread the documents that I relied on
4 and I had some discussions with the attorneys at
5 Wolf Greenfield.

6 Q. All right. Did you discuss the issues
7 in your declaration with anyone other than the
8 attorneys at Wolf Greenfield?

9 A. No.

10 Q. And when you prepared your declaration,
11 Exhibit 2053, pertaining to the '134 Patent, did
12 you work with the attorneys at Wolf Greenfield?

13 A. Yes.

14 Q. Did you work with anyone other than the
15 attorneys at Wolf Greenfield?

16 A. No.

17 Q. Do you know approximately how much time
18 you spent preparing your declaration, Exhibit 2053,
19 pertaining to the '134 Patent?

20 A. I don't know exactly how long I spent
21 on that. It would be the order of maybe 20 hours.

22 Q. Okay. So since you're right there, if

1 you flip to the next page of your declaration, it
2 begins Appendix A.

3 Do you see that?

4 A. Yes.

5 Q. And Appendix A spans from page 117 all
6 the way to page 124. Correct?

7 A. Correct.

8 Q. And if we go back to Paragraph 11.

9 A. Paragraph 11.

10 Q. Okay.

11 A. Yes.

12 Q. Paragraph 11 says: (Reading)

13 In addition to the Petition,
14 Paper 1; the Board's institution
15 decision, Paper 10; and any other
16 documents cited or referenced herein,
17 Appendix A provides a list of
18 materials that I have considered in
19 forming the opinions set forth in this
20 declaration.

21 Did I read that correctly?

22 A. You did.

1 Q. Are there any other materials you
2 considered in preparing this declaration other than
3 those materials listed in Paragraph 11?

4 A. No.

5 Q. Okay. Let's take a look at
6 Exhibit 2053 pertaining to the '167 Patent.

7 A. I have it.

8 Q. Okay. And if you can turn to page 116.
9 Again, that is your signature?

10 A. It is.

11 Q. And it's dated July 12th, 2025,
12 correct?

13 A. Correct.

14 Q. And Exhibit 2053 pertaining to the
15 '167 Patent is a complete statement of your
16 opinions offered in this case regarding Western
17 Digital's Petition, correct?

18 A. Yes.

19 Q. Now, going back to both Exhibit 2053
20 pertaining to the '134 and '167 Patent, you
21 reviewed those declarations in preparation for your
22 deposition this morning, correct?

1 A. I reviewed both of my declarations in
2 preparing, correct.

3 Q. Okay. Did you find anything that you
4 thought needed to be corrected?

5 A. Yes, there were a couple of typos or
6 errors in the document.

7 Q. Okay. Do you have a list of those?

8 A. Well, yes, I do.

9 Q. Okay. What are the corrections?

10 A. In the '167 declaration, if you go to
11 Paragraph 55, there's a typo in that. It says an
12 angstrom is 10 nanometers. It should say a
13 nanometer is 10 angstroms. But the second half of
14 that sentence is correct. (Reading)

15 20 angstroms is a thickness of
16 2 nanometers.

17 That's correct.

18 Q. Anything else?

19 A. If you turn to Paragraph 164. Is it
20 164? I may have the wrong paragraph number. There
21 is a figure that's meant to be included from one of
22 the references which was missed out of the

1 declaration about a zone diagram. But I may have
2 the wrong paragraph number because I'm not seeing
3 that now. So I'll have to check that. There was a
4 missing figure.

5 Q. Is it maybe Paragraph 160?

6 A. Oh, yes. (Reading)

7 A zone diagram as shown below.

8 And it's not shown below. So that zone
9 diagram is present in Exhibit 2048.

10 Q. Okay. Anything else?

11 A. That's all I found.

12 Q. Okay. And nothing from your
13 '134 declaration?

14 A. I didn't find any errors in that one.

15 Q. Okay. Now, back to Exhibit 2053 for
16 your '167 -- for the '167 Patent. How much time
17 did you spend preparing this declaration?

18 A. Similar. There's a lot of overlap
19 between the two, so I think a similar amount of
20 time.

21 Q. Okay. So you think 20 hours total for
22 both Exhibit 2053 for the '134 Patent and for the

1 '167 Patent or you think 20 hours each?

2 A. I think closer to 20 hours each, but I
3 don't know exactly.

4 Q. Now, in Exhibit 2053 for the
5 '167 Patent, and going back to page 117, you again
6 have an Exhibit A for materials considered from
7 page 117 to page 123, correct?

8 A. That's correct.

9 Q. And you, again, at page 7 have a
10 Paragraph 11 that describes the materials reviewed
11 and considered?

12 A. I do.

13 Q. Okay. And so does Paragraph 11 again
14 describe a complete list of the materials you
15 considered in preparing this declaration?

16 A. Yes.

17 Q. Okay. And as you sit here this
18 morning, you are confident in all the opinions
19 you've offered in both of these Exhibit 2053
20 declarations, correct?

21 A. Yes.

22 Q. Okay. Now, let's go back to

1 Exhibit 2054, your CV.

2 Okay. From 1985 to 1988, you received
3 both a BA and a Ph.D. in material science and
4 metallurgy from Cambridge University, correct?

5 A. Well, the bachelor's was in 1985 and
6 the Ph.D. was in 1988.

7 Q. Okay. And then from 1989 to 1990, you
8 had a postdoctoral fellowship at Harvard?

9 A. That's correct.

10 Q. And from 1991 to 1997, you were an
11 engineer at Komag, Inc. correct?

12 A. Correct.

13 Q. And what did you work on at Komag?

14 A. Komag was a company that made hard
15 disks and recording heads at one point. So I
16 worked on thin film growth characterization and
17 recording performance.

18 Q. So were you working on the recording
19 heads for the hard disk drives?

20 A. Part of the time.

21 Q. And what was the technology involved in
22 the recording heads for hard disk drives while you

1 were at Komag?

2 A. The recording technology they used was
3 called inductive read-write heads.

4 Q. Now, the recording heads at the time at
5 Komag that you worked on did not use magnetic
6 tunnel junctions, correct?

7 A. That's correct.

8 Q. Did they use giant magnetoresistance
9 read heads?

10 A. I don't recall. The part I worked on
11 was the writing part of the head when I was at
12 Komag.

13 Q. Okay. So you worked on thin films.
14 What were the materials in the thin films, you
15 recall?

16 A. They were various materials.
17 Cobalt-based alloys, carbon alloys, underlayer
18 materials, nickel phosphorus, amorphous layers,
19 nickel niobium. Quite a variety. I also worked on
20 carbon-based lubrication layers. And there may
21 have been other materials, but that was at least a
22 set of examples.

1 Q. Okay. Did you work with, in your time
2 at Komag, alumina layers?

3 A. Yes, I did.

4 Q. Okay. In what context?

5 A. I worked with alumina in the context of
6 part of the write head of the inductive writer.

7 Q. Okay. Were the alumina layers that you
8 worked on amorphous?

9 A. It depended on how they were
10 fabricated.

11 Q. Did you work with magnesium oxide
12 layers in your time at Komag?

13 A. I don't believe so.

14 Q. Okay. And you list on your CV that
15 Komag was acquired by Western Digital in 2007,
16 correct?

17 A. I don't recall when it was acquired,
18 but I understand it was acquired by Western Digital
19 well after I left.

20 Q. Okay. Okay. In 1997, you became an
21 assistant professor at the Massachusetts Institute
22 of Technology, correct?

1 A. Yes.

2 Q. And you've been at MIT ever since,
3 correct?

4 A. That's right.

5 Q. Okay. Okay. I'm going to have you now
6 take a look at the '134 Patent, which is
7 Exhibit 1005. And it's Exhibit 1005 in either of
8 the two IPRs.

9 Do you have a copy of the '134 Patent?

10 A. Yes, I do.

11 Q. And you've reviewed the '134 Patent,
12 correct?

13 A. Correct.

14 Q. You're familiar with it?

15 A. Yes.

16 Q. So let's take a look at Column 5,
17 starting at line 62.

18 Okay. That passage begins: (Reading)

19 In the following, a MTJ device
20 according to a first embodiment of the
21 invention and a method of
22 manufacturing the same will be

1 described with reference to the
2 drawings.

3 Correct?

4 A. That's what it says.

5 Q. Okay. So this begins the description
6 of the first embodiment of the invention in the
7 '134 Patent, correct?

8 A. Yes.

9 Q. And you can see, if you keep reading
10 there at line 66, this first embodiment is an MTJ
11 device having the iron(001), MgO(001), and
12 iron(001) structure, correct?

13 A. Yes. It says Figures 2A to 2D
14 schematically show the method of manufacturing the
15 MTJ device with the stack you just described.

16 Q. Okay. And you can see, if you keep
17 reading, it says: (Reading)

18 According to the embodiment,
19 to be hereafter referred to as a
20 iron(001) magnesium oxide(001)
21 iron(001) MTJ device.

22 Did I read that correctly?

1 A. That's what it says.

2 Q. Okay. Now, at Column 6, line 3, it
3 says: (Reading)

4 First, a single-crystal
5 MgO(001) substrate 11 was prepared.

6 Did I read that correctly?

7 A. Yes.

8 Q. And it refers to this MgO(001)
9 substrate as a "seed layer." Do you see that in
10 line 6?

11 A. It describes an MgO seed layer grown by
12 molecular-beam epitaxy.

13 Q. Now, why do you have a -- an MgO(001)
14 seed layer?

15 A. Yuasa on line 4, says: (Reading)

16 In order to improve the
17 morphology of the surface of the
18 single-crystal MgO(001) substrate 11,
19 a MgO(001) seed layer 15 was grown by
20 the molecular beam epitaxy method.

21 So that's what Yuasa explains as the
22 role of the seed layer.

1 Q. Okay. What does he mean by "improve
2 the morphology of the surface"?

3 MR. WICHMAN: Objection.

4 THE WITNESS: Are you asking what -- I
5 didn't give an opinion about this aspect of
6 the patent.

7 BY MR. WILSON:

8 Q. So you don't have opinion about what a
9 person of ordinary skill in the art would have
10 regarding -- or would understand regarding his
11 explanation of improving the morphology of the
12 surface?

13 A. I didn't give an opinion about how the
14 POSA would interpret that particular statement.

15 Q. And you don't have an opinion as you
16 sit here this morning, correct?

17 A. I didn't give an -- I didn't form an
18 opinion as part of my declaration. If I need to do
19 that now, I would have to review documentation to
20 understand more about how the POSA might read that
21 particular statement.

22 Q. So as you sit here right now, you don't

1 have an opinion of what Yuasa meant by those words?

2 A. I didn't formulate an opinion about
3 that statement.

4 Q. Okay. Take a look at line 7 in
5 Column 6.

6 In line 7, the '134 Patent describes
7 growing an epitaxial iron(001) lower electrode with
8 the thickness of 50 nanometers on the MgO(001) seed
9 layer, correct?

10 A. That's what it says.

11 Q. In line 12, the '134 Patent refers to
12 electron-beam evaporation conditions for that
13 growth, correct?

14 A. It says electron-beam evaporation
15 conditions include various descriptors.

16 Q. Okay. The next sentence, it's starting
17 line 15, says: (Reading)

18 The source material of the
19 electron-beam evaporation was MgO.

20 Did I read that correctly?

21 A. Yes.

22 Q. Now, this cannot be referring to the

1 growth of the iron electrode, correct?

2 A. I believe he's discussing the MgO
3 layer.

4 Q. Okay. And that's because it would not
5 be possible to grow an iron layer using by --
6 electron-beam evaporation using MgO as a source,
7 correct?

8 A. The source is the material that one is
9 depositing from to form the film.

10 Q. Right. And so you can't deposit --
11 deposit from MgO to form iron, correct?

12 A. Unless you performed alchemy. You need
13 to use an iron-containing source to make an
14 iron-containing film.

15 Q. Okay. Down to Column 6, line 26, it
16 says: (Reading)

17 Thereafter, a MgO(001) barrier
18 layer 21 with a thickness of
19 2 nanometers was epitaxy --
20 epitaxially grown on the iron(001)
21 lower electrode, parentheses, first
22 electrode, close parentheses, at room

1 temperature, also using the MgO
2 electron-beam evaporation method.

3 Did I read that correctly?

4 A. Yes.

5 Q. Okay. So in the first embodiment
6 disclosed in the '134 Patent, the MgO -- both
7 MgO(001) layers were fabricated by electron-beam
8 evaporation, correct?

9 A. That's what Yuasa says.

10 Q. The tunnel barrier layer, the tunnel
11 barrier MgO layer, was fabricated by epitaxy,
12 correct?

13 A. Well, epitaxy isn't a fabrication
14 method. Epitaxy is a crystallographic
15 relationship.

16 Q. So the tunnel barrier layer in the
17 '134 Patent's first embodiment was formed by
18 epitaxy, correct?

19 A. Well, like I said, epitaxy describes
20 crystallographic orientation. It's not a method
21 per se.

22 Q. So epitaxy describes the method by

1 which the crystal structure is formed, correct?

2 A. An epitaxial relationship shows a
3 crystallographic relationship between two crystals.

4 Q. Okay. And so the tunnel barrier
5 MgO(001) layer in the '134 Patent's first
6 embodiment has an epitaxial relationship with the
7 iron(001) electrode underneath it, correct?

8 A. Yes.

9 Q. Okay. Now let's take a look at
10 Column 7, line 55.

11 Now, the line 55 says: (Reading)

12 Figure 6 shows a typical
13 magnetoresistance curve of the
14 iron(001), magnesium oxide(001),
15 iron(001) MTJ device produced by the
16 above-described method.

17 Did I read that correctly?

18 A. That's what it says.

19 Q. Okay. And the MTJ device referred to
20 there is the first embodiment, correct?

21 (Witness reviews document.)

22 A. I believe so.

1 Q. Okay. If you're still unsure, you can
2 see the Column 6, line 1 where it's referred to as
3 that MTJ device.

4 Do you see that?

5 A. Yes.

6 Q. Okay. So the Figure 6 results are
7 pertaining to the first embodiment of the
8 '134 Patent, correct?

9 A. Right.

10 Q. Okay. And you can see in the next
11 sentence, starting at line 57, it says: (Reading)

12 The magnetoresistance ratio is
13 146 percent at the measurement
14 temperature at 20 Kelvin and
15 88 percent at the measurement
16 temperature of 293 Kelvin.

17 Did I read that correctly?

18 A. That's what it says.

19 Q. Okay. And 20 Kelvin is negative 253
20 degrees Celsius?

21 A. Yes.

22 Q. And 293 Kelvin is 20 degrees Celsius,

1 correct?

2 A. Yes.

3 Q. Which is considered room temperature,
4 correct?

5 A. Roughly.

6 Q. Okay. So the first embodiment shown in
7 the '134 Patent has a magnetoresistance ratio of
8 88 percent at room temperature, correct?

9 A. Figure 6 shows 88 percent, according to
10 Yuasa.

11 Q. And that's at room temperature,
12 correct?

13 A. That's what Yuasa has in Column 7.

14 Q. Let's take a look at Figure 6 of the
15 '134 Patent.

16 Okay. On the Y axis on the left, it
17 shows resistance area product, correct?

18 A. Yes.

19 Q. And that's ohms square microns,
20 correct?

21 A. That's right.

22 Q. And on the X axis at the bottom, it

1 shows magnetic field in milliteslas, right?

2 A. Yes.

3 Q. And in this figure, the bias voltage
4 that's being applied is 30 millivolts, correct?

5 A. That's what it says.

6 Q. And this is where the '134 Patent gets
7 its magnetoresistance ratio of 88 percent at
8 293 Kelvin, correct?

9 A. Well, those values are labeled on the
10 figure.

11 Q. So that's correct?

12 A. I haven't checked Yuasa's math. I
13 didn't give an opinion about the actual values in
14 Figure 6.

15 Q. Okay. Let's take a look at Column 8,
16 line 27. Now, line 27 says: (Reading)

17 Hereafter, a MTJ device
18 according to a second embodiment of
19 the invention and a method of
20 manufacturing the same will be
21 described.

22 Did I read that correctly?

1 A. Yes.

2 Q. It goes on to say: (Reading)

3 In the method of manufacturing
4 a iron(001), MgO(001), iron 001 MTJ
5 device according to the present
6 embodiment, MgO(001) is initially
7 deposited in a polycrystalline or
8 amorphous state by sputtering or the
9 like, and then an annealing process is
10 performed such that a polycrystal in
11 which the (001) crystal plane is
12 preferentially orientated or a single
13 crystal is obtained.

14 Did I read that correctly?

15 A. That's what it says.

16 Q. Now, feel free to read through the rest
17 of this paragraph down to line 44. But my question
18 is whether the '134 Patent says whether this is the
19 seed layer MgO or the tunnel barrier MgO?

20 (Witness reviews document.)

21 A. I don't have an opinion on what layer
22 that is.

1 Q. Okay. The '134 Patent doesn't say what
2 layer that is, correct?

3 A. I would have to review it more
4 thoroughly to see if it gives information about
5 that.

6 Q. Okay. As you sit here right now,
7 you're not aware of the '134 Patent stating which
8 layer in its second embodiment is formed by
9 sputtering, correct?

10 A. I didn't give an opinion on that
11 question in my declaration.

12 Q. Okay. Take a look at line -- Column 8,
13 line 51. It says: (Reading)

14 As described above, in
15 accordance with the MTJ device
16 technology of the present embodiment,
17 an annealing process is carried out
18 for crystallization after an amorphous
19 MgO has been deposited by sputtering,
20 thereby eliminating the need for
21 large-sized equipment.

22 Did I read that correctly?

1 A. That's what it says.

2 Q. But you don't know as you sit here
3 today whether that's talking about the MgO seed
4 layer or the tunnel barrier layer, correct?

5 A. That's not a question I was -- I
6 addressed in my -- in my deposition.

7 Q. In your declarations?

8 A. Declarations. Sorry.

9 Q. Okay. Now --

10 A. Would you point -- could you point me
11 to that if it's in my declaration?

12 Q. Well, you definitely discuss this
13 passage in your declaration.

14 (Witness reviews document.)

15 Q. Take a look at Paragraph 42 of your
16 '134 declaration.

17 A. I have that.

18 Q. You say in Paragraph 42: (Reading)

19 Dr. Yuasa's efforts then led
20 to the discovery that the same ideal
21 MTJ device could be made starting from
22 amorphous magnesium oxide.

1 And you cite the '134 Patent at
2 lines 43 through 60, correct?

3 A. Yes.

4 Q. And at the bottom of that paragraph,
5 you quote Column 8, lines 51 through 55, correct?

6 A. Yes, I quote his comment about an
7 annealing process carried out for crystallization
8 after an amorphous MgO has been deposited by
9 sputtering and eliminated the need for large-sized
10 equipment.

11 Q. Okay. But as you sit here today, you
12 do not know whether those passages in Column 8,
13 referring to the second embodiment of the
14 '134 Patent, are referring to the seed layer
15 magnesium oxide or the tunnel barrier layer,
16 correct?

17 A. Well, he -- Dr. Yuasa discovered that
18 amorphous MgO could be deposited and then annealed,
19 as I say in Paragraph 42, such that a poly crystal
20 in which the (001) crystal plane is preferentially
21 oriented or a single crystal is obtained.

22 So this is a comment referring to

1 crystallization of amorphous MgO.

2 Q. Right. And was that amorphous MgO used
3 to form the seed layer or the tunnel barrier layer?

4 (Witness reviews document.)

5 A. I didn't address crystallization of the
6 seed layer. I did address the crystallization of
7 the barrier, which is an (001) polycrystalline film
8 after the annealing process.

9 Q. Okay. The '134 Patent does not say
10 whether the passages you are citing in Column 8
11 pertaining to the second embodiment involve the
12 formation of a magnesium oxide seed layer or a
13 magnesium oxide tunnel barrier layer, correct?

14 A. Those passages refer to crystallization
15 of an amorphous MgO layer deposited by sputtering.

16 Q. Right. But they don't say whether that
17 amorphous MgO layer is the seed layer or the tunnel
18 barrier layer, correct?

19 A. My opinions are based on the MgO tunnel
20 barrier layer being crystallized. I didn't address
21 the question of whether the MgO seed layer -- the
22 crystallization of the MgO seed layer in my

1 declaration.

2 Q. I understand that, but my question is,
3 you're using a passage, the second embodiment, in
4 Column 8 from the '134 Patent to discuss the tunnel
5 barrier layer. And my question is where does the
6 '134 Patent say the second embodiment and an
7 amorphous layer that is annealed to crystallize is
8 the tunnel barrier layer?

9 A. Well, it certainly mentions the barrier
10 layer at the bottom of Column 8.

11 Q. It certainly does.

12 A. As being crystallized.

13 Q. And where are you referring to?

14 A. Line 62. (Reading)

15 The electrodes disposed on
16 either side of a single-crystal
17 MgO(001) layer or an oxygen-deficient
18 polycrystal MgO_x layer in which the
19 (001) crystal plane is preferentially
20 oriented comprises an amorphous
21 ferromagnetic alloy.

22 Q. And you understand, right, that

1 Column 8, line 56 says: (Reading)

2 Hereafter, a MTJ device
3 according to a variation of the
4 embodiments of the invention will be
5 described with reference to the
6 drawings.

7 So we're now on another embodiment,
8 correct?

9 A. Well, we're on a variation of the
10 embodiments. I don't know if that counts as
11 another embodiment.

12 Q. Okay. So the passage you're describing
13 is -- or the passage that you're quoting is
14 describing a variation of the embodiments. This is
15 not the second embodiment, correct?

16 A. I don't know the answer to that.

17 Q. Okay. So you don't know whether the
18 passage describing a single-crystal MgO or
19 polycrystal MgO in Column 8, lines 63 to 64 is
20 describing the second embodiment or not?

21 A. I don't know what the -- other than
22 what is stated here. It sounds like you're asking

1 for a legal definition of the difference between an
2 embodiment or variation of an embodiment. And
3 that's not a question I can address.

4 Q. So what I'm trying to understand is why
5 you're relying on the second embodiment that's
6 described in Column 8, and it's described at
7 Column 8, lines 27 through 55 as forming an
8 amorphous MgO layer and then annealing it to
9 crystallize it as a tunnel barrier layer when the
10 '134 Patent does not say that's what's described
11 there in a tunnel barrier layer.

12 MR. WICHMAN: Objection.

13 THE WITNESS: That's -- can you break
14 that question down? It sounds like there
15 were a lot of sections in it.

16 BY MR. WILSON:

17 Q. Sure.

18 You would agree that the second
19 embodiment is described in Column 8 at lines 27
20 through 55?

21 A. Right.

22 Q. Okay. Nowhere in that passage,

1 Column 8, lines 27 through 55, does it say whether
2 the magnesium oxide layer it's describing is the
3 tunnel barrier layer or the seed layer, correct?

4 A. It doesn't mention the word "seed
5 layer," I think, or "tunnel layer" in that
6 paragraph.

7 MR. WILSON: Okay. We've been going
8 about an hour. Are you ready for a break?

9 MR. WICHMAN: Why don't we take a few
10 minutes.

11 MR. WILSON: Okay.

12 MR. WICHMAN: 5, 10? What do you have
13 in mind?

14 MR. WILSON: Let's take a 10-minute
15 break.

16 THE VIDEOGRAPHER: We're going off the
17 record. The time is 10:01.

18 (Recess taken.)

19 THE VIDEOGRAPHER: We're going back on
20 the record. The time is 10:11.

21 BY MR. WILSON:

22 Q. Dr. Ross, did you discuss the substance

1 of your testimony with anyone during the break?

2 A. I did not, but I had not quite finished
3 my answer to the question before we took the break.

4 Q. Okay.

5 A. So I wanted to add that we'd mentioned
6 in those paragraphs about the barrier layer and the
7 seed layer, and I wanted to add that the person
8 skilled in the art would certainly imagine or
9 understand Yuasa to include the barrier layer
10 because of the comments about oxygen vacancies in
11 the MgO, which would be relevant to barrier layer,
12 but not to a seed layer.

13 Q. Okay. And you were thinking that
14 before we left for the break?

15 A. I was.

16 Q. Okay. So in the future, I would ask
17 that if you have more to say, you not let us take a
18 break and you get it in. Okay?

19 A. I will do that. Thank you.

20 Q. Okay. All right. Let's take a look at
21 Column 8, line 56. And we're in the '134 Patent.

22 Column 8, line 56 says: (Reading)

1 Hereafter, a MTJ device
2 according to a variation of the
3 embodiments of the invention will be
4 described with reference to the
5 drawings.

6 And it refers to Figure 11 there. Do
7 you see that?

8 A. Yes.

9 Q. So let's take a look at Figure 11.

10 Okay. Now, Figure 11 shows, according
11 to Column 8, line 56, an MTJ device according to a
12 variation of the embodiments of the invention,
13 correct?

14 A. It says -- yes, Figure 11 shows the
15 structure of the MTJ device according to the
16 variation which corresponds to Figure 1B.

17 Q. Okay. So if you're comparing
18 Figure 1B, you'll see that Figure 1B has iron
19 electrodes, correct?

20 A. Yes.

21 Q. Whereas Figure 11 has cobalt iron boron
22 electrodes, correct?

1 A. That's right.

2 Q. But you will notice that the cobalt
3 iron boron electrodes in Figure 11 do not have the
4 (001) orientation, correct?

5 A. Well, if -- (001) is not marked on the
6 figure.

7 Q. Okay. So the cobalt iron boron
8 electrodes in Figure 11 are not identified as being
9 crystalline, correct?

10 (Witness reviews document.)

11 A. It is not labeled on the figure, but
12 there's some discussion in the text.

13 Q. Let's take a look at Column 8, line 60.

14 Now, that says: (Reading)

15 As shown in Figure 11, the MTJ
16 device of the variation is
17 characterized in that, as in the MTJ
18 device of the above-described
19 embodiments, the electrodes disposed
20 on either side of a single-crystal
21 MgOx(001) layer 503 or an
22 oxygen-deficit polycrystal MgOx where

1 X is between 0 and 1, in which the
2 (001) crystal plane is preferentially
3 oriented, comprises an amorphous
4 ferromagnetic alloy, such as cobalt
5 iron boron layers 501 and 505.

6 Did I read that correctly?

7 A. Yes.

8 Q. Now, in this passage describing the
9 magnesium oxide layer in the Figure 11 embodiment
10 the '134 Patent does not describe how to make that
11 magnesium oxide layer, correct?

12 MR. WICHMAN: Objection, beyond the
13 scope.

14 THE WITNESS: So you're asking me if
15 the '134 Patent describes how to make the
16 Figure 11 structure?

17 BY MR. WILSON:

18 Q. I'm asking you if in the passage we
19 just read, Column 8, lines 60 through 66, the
20 '134 Patent describes how to make that magnesium
21 oxide layer in the Figure 11 embodiment?

22 MR. WICHMAN: Objection, beyond the

1 scope.

2 THE WITNESS: There's subsequent text
3 that says the amorphous ferromagnetic-alloy
4 can be formed by evaporation or sputtering
5 through example.

6 BY MR. WILSON:

7 Q. Okay. Does that describe how to make a
8 magnesium oxide layer?

9 A. Were you asking just about the
10 magnesium oxide?

11 Q. Yes.

12 MR. WICHMAN: Objection, beyond the
13 scope.

14 THE WITNESS: Well, the magnesium oxide
15 is described in other sections of the patent
16 specification.

17 BY MR. WILSON:

18 Q. Okay. So you agree with me, then, that
19 it does not describe in this passage at Column 8,
20 lines 60 through 66 how to make this magnesium
21 oxide layer on an amorphous cobalt iron boron
22 layer, correct?

1 MR. WICHMAN: Objection, relevance,
2 beyond the scope.

3 THE WITNESS: The POSA would read the
4 full specification, so I don't understand the
5 relevance of the question about just those
6 two sentences.

7 BY MR. WILSON:

8 Q. So let me try it a different way.

9 The -- your opinion is that a person of
10 ordinary skill in the art, seeing this Figure 11
11 embodiment, would understand that the magnesium
12 oxide layer in the Figure 11 embodiment is made in
13 the same way the magnesium oxide layer is made in
14 the other two embodiments. Is that your testimony?

15 A. I didn't --

16 MR. WICHMAN: Objection.

17 THE WITNESS: I didn't form an opinion
18 about whether Yuasa enabled the invention or
19 not.

20 BY MR. WILSON:

21 Q. So as you sit here today, you don't
22 have any opinion about whether the '134 Patent

1 teaches how to make the magnesium oxide layer in
2 the Figure 11 embodiment, correct?

3 MR. WICHMAN: Objection.

4 THE WITNESS: My testimony is related
5 to the Petitioner's declaration response to
6 that. So this isn't a question which I
7 formed or expressed an opinion about.

8 BY MR. WILSON:

9 Q. Okay. And you have no opinion about it
10 as you sit here today, correct?

11 A. I haven't been asked to form an opinion
12 on whether Yuasa's patent enabled the invention.

13 Q. Okay. Let's take a look at Column 8,
14 line 66. And the passage you just read says:

15 (Reading)

16 The amorphous ferromagnetic
17 alloy can be formed by evaporation or
18 sputtering, for example.

19 And it says: (Reading)

20 The resultant characteristics
21 are substantially identical to those
22 of the first embodiment.

1 Did I read that correctly?

2 A. That's what it says.

3 Q. Okay. So the '134 Patent says the
4 Figure 11 embodiment has characteristics that are
5 substantially identical to those of the first
6 embodiment, correct?

7 MR. WICHMAN: Objection.

8 THE WITNESS: Column 9, line 1 says:

9 (Reading)

10 The resultant characteristics
11 are substantially identical to those
12 of the first embodiment.

13 BY MR. WILSON:

14 Q. So that means the Figure 11 embodiments
15 resulting characteristics are substantially
16 identical to those of the first embodiment,
17 correct?

18 MR. WICHMAN: Objection.

19 THE WITNESS: As I answered, line 1 of
20 Column 9 says as you read it out. I haven't
21 formed an opinion of what those
22 characteristics might be or how substantially

1 identical they might be. That's not a
2 question I was asked to consider.

3 BY MR. WILSON:

4 Q. Okay. So you don't have any opinion as
5 to whether the '134 Patent discloses that the
6 Figure 11 embodiment has a TMR or a
7 magnetoresistance of 88 percent at room
8 temperature, correct?

9 (Witness reviews document.)

10 A. Sorry. Can you repeat the question?

11 Q. Sure.

12 You don't have any opinion as you sit
13 here today whether the Figure 11 embodiment in the
14 '134 Patent has a magnetoresistance of 88 percent
15 as in the first embodiment, correct?

16 A. That's not an opinion I have
17 considered. I should say that's not a question I
18 have considered.

19 Q. Now, let's take a look at the
20 '167 Patent, and that is Exhibit 1013.

21 And you've reviewed the '167 Patent,
22 correct?

1 A. Yes.

2 Q. You're familiar with it, correct?

3 A. Yes.

4 Q. You would agree that the '167 Patent
5 has a substantially identical specification to that
6 of the '134 Patent, correct?

7 MR. WICHMAN: Objection.

8 THE WITNESS: It's similar but not
9 identical.

10 BY MR. WILSON:

11 Q. Okay. In what ways is it not
12 identical?

13 (Witness reviews document.)

14 A. Well, the date of issue, for example,
15 is different.

16 Q. Okay. Let me -- let me try a different
17 question.

18 You would agree that the written
19 description of the '167 Patent is substantially
20 identical to the written description of the
21 '134 Patent, correct?

22 MR. WICHMAN: Objection.

1 THE WITNESS: I haven't compared them
2 word for word.

3 BY MR. WILSON:

4 Q. So you have several patents yourself,
5 correct?

6 A. Twenty-one.

7 Q. Okay. You understand the patent
8 prosecution process, correct?

9 A. To some extent.

10 Q. Do you know what a continuation
11 application is?

12 A. No.

13 Q. Okay. Do you know what a
14 continuation-in-part application is?

15 A. No.

16 Q. Okay.

17 Let's take a look at the '167 Patent.

18 Let's look at Column 6, line 62. I'm sorry. Let's
19 look at Column 6, line 6.

20 A. Okay.

21 Q. You can see beginning at Column 6,
22 line 6: (Reading)

1 A MTJ device according to a
2 first embodiment of the invention is
3 described.

4 And that MTJ device, it says:
5 (Reading)

6 Having the iron(001),
7 MgO(001), iron(001) structure
8 according to the embodiment to be
9 hereafter referred to as iron(001),
10 MgO(001), iron(001) MTJ device.

11 Do you see that?

12 A. Yes.

13 Q. Now, do you understand that this is the
14 same first embodiment that was described in the
15 '134 Patent?

16 MR. WICHMAN: Objection.

17 THE WITNESS: I didn't form an opinion
18 about whether the embodiments in these two
19 patents are identical or not.

20 BY MR. WILSON:

21 Q. Okay. Take a look at Column 8, line 4.
22 You can see that: (Reading)

1 Figure 6 shows a typical
2 magnetoresistance curve of the
3 iron(001), MgO(001), iron(001) MTJ
4 device produced by the above-described
5 MTJ. The magnetoresistance ratio is
6 145 percent at the measurement
7 temperature at 20 Kelvin and
8 88 percent at the measurement
9 temperature of 293 Kelvin.

10 Did I read that correctly?

11 A. Yes.

12 Q. And those are the exact same
13 characteristics of the first embodiment in the
14 '134 Patent, correct?

15 A. I didn't compare them word for word.

16 Q. But you can now, and they're the same,
17 correct?

18 A. Would you like me to compare the two
19 patents word for word?

20 Q. What I would like for you to do is
21 confirm that the first embodiment in the
22 '167 Patent has an 88 percent magnetoresistance

1 ratio at room temperature just like the first
2 embodiment in the '134 Patent.

3 (Witness reviews document.)

4 A. The two Figure 6s show the same data.

5 Q. Okay. So now take a look at Column 8
6 in the '167 Patent, line 43.

7 And it says: (Reading)

8 Hereafter, a MTJ device
9 according to a second embodiment of
10 the invention and a method of
11 manufacturing the same will be
12 described. In the method of
13 manufacturing a iron(001), MgO(001),
14 iron(001) MTJ device according to the
15 present embodiment, MgO(001) is
16 initially deposited in polycrystalline
17 or amorphous state by sputtering of
18 the like and then an annealing process
19 is performed such that a polycrystal
20 in which the (001) crystal plane is
21 preferentially oriented or a single
22 crystal is obtained.

1 Did I read that correctly?

2 A. That's what it says.

3 Q. Okay. And that description of the
4 second embodiment continues down through Column 9,
5 line 5, correct?

6 (Witness reviews document.)

7 A. Those paragraphs give additional
8 information.

9 Q. On the second embodiment, correct?

10 (Witness reviews document.)

11 A. Yes.

12 Q. Okay. Now, nowhere in that passage
13 from Column 8, line 43 to Column 9, line 5 does it
14 provide any magnetoresistance data for the second
15 embodiment, correct?

16 (Witness reviews document.)

17 A. Those paragraphs don't talk about
18 magnetoresistance.

19 Q. Okay. Now, at Column 9, line 6, it
20 says: (Reading)

21 Hereafter, a MTJ device
22 according to a variation of the

1 embodiments of the invention will be
2 described with reference to the
3 drawings.

4 And it refers to Figure 11, correct?

5 A. That's what it says.

6 Q. And can you confirm that Figure 11 in
7 the '167 Patent is the same as Figure 11 in the
8 '134 Patent?

9 A. Yes.

10 Q. And for this variation of the
11 embodiments, you can see at Column 9, line 18, it
12 says: (Reading)

13 The resulting characteristics
14 are substantially identical to those
15 of the first embodiment.

16 Correct?

17 A. That's what it says.

18 Q. And you, again, have not formed any
19 opinion about whether the resultant characteristics
20 described there include the 88 percent
21 magnetoresistance at room temperature, correct?

22 A. So in my declaration, I describe this

1 in Paragraph 41 and 42, for example.

2 Q. You're saying your '167 declaration?

3 A. Sorry. Yes. We're on the '167 Patent,
4 correct?

5 Q. Yes.

6 A. So the '167 declaration, I -- I cite
7 Yuasa in Column 9, line 20, that the -- regarding
8 the amorphous electrodes would not lead to a
9 significant deterioration of the MR ratio. So
10 that's what Yuasa reports in his patent.

11 Q. Right. And that leads you to conclude,
12 then, that when the '134 Patent refers to the
13 resulting characteristics being the same as that of
14 the first embodiment, it includes the
15 magnetoresistance ratio, correct?

16 A. That's not a question I address
17 specifically.

18 Q. So you don't have any opinion about
19 whether the Figure 11 embodiment has the same
20 magnetoresistance ratio as the first embodiment,
21 correct?

22 A. I didn't form an opinion about whether

1 the magnetoresistance ratio of the Figure 11
2 structure would be identical to what's shown in
3 Figure 7. That wasn't relevant to my declaration.

4 Q. Okay. Now, let's take a look -- let's
5 go back to your '134 declaration, and let's take a
6 look at Paragraph 65.

7 Now, in Paragraphs 65 through 73, you
8 discuss Nagahama, which is Exhibit 1027, correct?

9 A. Yes.

10 Q. And Paragraphs 65 to 67, you discuss
11 Nagahama's Figure 3 embodiment, correct?

12 (Witness reviews document.)

13 A. So the question is whether I'm talking
14 about Nagahama's Figure 3 in Paragraph 65 onwards;
15 is that right?

16 Q. Well, let's just -- let's just focus on
17 Paragraph 65. Paragraph 65 discusses Nagahama's
18 Figure 3, correct?

19 A. Yes.

20 Q. Okay. And you show Figure 3 there in
21 Paragraph 65, correct?

22 A. Yes.

1 Q. And Nagahama's Figure 3 consists of
2 four layers. First, an underlayer, nonmagnetic or
3 antiferromagnetic metal underlayer; second, an
4 ultrathin ferromagnetic layer; third, an insulating
5 layer; and fourth, a ferromagnetic electrode.

6 Correct?

7 A. That's what it shows.

8 Q. Now, in Paragraph 70, you discuss a
9 third group of embodiments in Nagahama represented
10 by Figures 12 to 13, correct?

11 A. Right.

12 Q. Okay. And in the passage, you've
13 quoted there. You say -- in Paragraph 70, you say:
14 (Reading)

15 Reference numeral 211
16 designates a silicon substrate with an
17 oxide film.

18 Correct?

19 A. That's what it says.

20 Q. Okay. Layer 212 is a magnesium oxide
21 layer of 10 nanometers, layer -- yeah, correct?

22 A. Yes.

1 Q. Layer 213 is an iron(001) crystalline
2 layer of 20 nanometers, correct?

3 A. Yes.

4 Q. Layer 214 is an amorphous alumina
5 layer, correct?

6 A. Yes.

7 Q. Layer 215 is an upper electrode
8 polycrystalline nickel iron layer, correct?

9 A. Yes.

10 Q. And layer 214 -- oh sorry, strike that.
11 Layer 216 is a gold cap layer, correct?

12 A. That's what Nagahama says, yes.

13 Q. Now, in Paragraph 71, you cite -- in
14 support of the first sentence there, you cite to
15 Nagahama Paragraph 57, correct?

16 (Witness reviews document.)

17 A. Nagahama Paragraph 57 describes the way
18 of preparing the tunnel magnetoresistive
19 development in three steps.

20 Q. Okay. Now, if you take a look at -- so
21 you're looking at Nagahama, Exhibit 1027?

22 A. Yes.

1 Q. Okay. Take a look up at Paragraph 55.

2 Do you see the reference to Figure 12?

3 A. Yes.

4 Q. Paragraph 57 is further describing the
5 Figure 12 embodiment, correct?

6 (Witness reviews document.)

7 A. Yes.

8 Q. Okay. Now, you see the quote you have
9 there, you refer to then depositing the MgO 212
10 10-nanometer layer by sputtering?

11 A. That's a quote from Paragraph 57.

12 Q. But it's actually a quote from
13 Paragraph 62, correct?

14 (Witness reviews document.)

15 A. Well, that step is to -- is described
16 in both of those paragraphs.

17 Q. Well, layer 212, it refers to
18 Figure 13, correct?

19 A. Layer 212 is in Figure 13.

20 Q. Okay. In Paragraph 71 after the
21 citation to Paragraph 57, you say: (Reading)

22 Nagahama teaches that only

1 through these steps, MgO grows
2 amorphous to be the amorphous MgO 202
3 in the early stage and then to be
4 MgO(001)-oriented, highly-oriented
5 crystal layer 203.

6 Do you see that text?

7 A. I do.

8 Q. And this statement refers to the
9 Figure 12 embodiment, correct?

10 A. Those numbers are in Figure 12.

11 Q. Okay. And as we just said, Nagahama's
12 Paragraph 55 begins the discussion of the Figure 12
13 embodiment, correct?

14 A. Yes.

15 Q. And in Paragraph 56, it says, now
16 referring to Nagahama: (Reading)

17 In this figure, reference
18 numeral 201 designates a substrate
19 which can be silicon LSI, silica or
20 the like.

21 Did I read that correctly?

22 A. That's right.

1 Q. Okay. So layer 201 could be amorphous
2 silica, correct?

3 A. 20 -- sorry. 201 designates a
4 substrate, silicon, silica or the like. It doesn't
5 say whether it's amorphous silica.

6 Q. Well, silica in this context would be
7 amorphous, correct?

8 A. Well, I don't know if Nagahama
9 specifies that.

10 Q. Well --

11 A. There are forms of --

12 Q. Sorry.

13 A. Sorry.

14 Q. Go ahead.

15 A. There are different forms of silica.

16 Q. Okay. So in your opinion, a person of
17 ordinary skill in the art, at this time, in 2004,
18 wouldn't know whether Nagahama was referring to
19 amorphous silica or crystalline silica, in this
20 context?

21 A. I don't have an opinion on that.

22 Q. Okay.

1 MR. WILSON: Now, Mitchell, I'm going
2 to need you to propagate at Exhibit 1100.
3 (Exhibit Number 1100 was marked for identification.)

4 MR. WILSON: Tell you what, not hearing
5 from Mitchell, let me propagate.

6 THE EXHIBIT TECHNICIAN: I'm so sorry.
7 I missed you. You had been mentioning the
8 patents, so I apologize. Which -- which
9 exhibit?

10 MR. WILSON: Exhibit 1100.

11 THE EXHIBIT TECHNICIAN: Got it. Just
12 a moment. Sorry about that.

13 MR. WILSON: Yeah, no worries.

14 THE EXHIBIT TECHNICIAN: Share my
15 screen.

16 MR. WILSON: I'm going to go ahead and
17 drop this exhibit in the chat as well.

18 THE EXHIBIT TECHNICIAN: And are you
19 maintaining this exhibit number, 1100?

20 MR. WILSON: Yes.

21 THE EXHIBIT TECHNICIAN: Okay. Got it.
22 I heard 2200 and I knew I didn't have that.

1 MR. WILSON: Yeah, yeah.

2 THE EXHIBIT TECHNICIAN: Got you.

3 MR. WILSON: Let me see if I can figure
4 out how to drop it in this chat.

5 THE EXHIBIT TECHNICIAN: I can if you
6 want me to.

7 MR. WILSON: Okay. Yeah. Just drop it
8 in the chat so she has a complete copy of it.

9 THE EXHIBIT TECHNICIAN: No problem.
10 Just a second.

11 MR. WICHMAN: Hold on a second,
12 Mr. Wilson, because we don't -- because we're
13 using a screen on the wall, she doesn't --
14 she's not actually able to pull it down to a
15 computer. I'm going to have to have Dr. Ross
16 log into the Zoom so she can pull the PDF
17 from the chat.

18 MR. WILSON: Okay. Yeah.

19 THE VIDEOGRAPHER: Do you want to go
20 off the record for a second?

21 MR. WILSON: Yeah, let's go off the
22 record for a second.

1 THE VIDEOGRAPHER: We're going off the
2 record. The time is 10:54.

3 (Discussion held off the record.)

4 THE VIDEOGRAPHER: We are going back on
5 the record. The time is 10:59.

6 BY MR. WILSON:

7 Q. Okay. Dr. Ross, you have now been
8 presented with Exhibit 1100, which is a textbook
9 entitled -- or excerpts from a textbook entitled
10 "Silicon VLSI Technology, Fundamentals, Practice
11 and Modeling."

12 Have you seen this textbook before?

13 A. Not in the context of this case.

14 Q. But have you seen it outside the
15 context of this case?

16 A. Yes.

17 Q. Okay. You're familiar with this
18 textbook?

19 A. Not in detail.

20 Q. Okay. But you've seen it before in
21 your career, correct?

22 A. Correct.

1 Q. Okay. This particular edition is a
2 1999 edition, as you'll see on the top of the
3 second page, or actually, you can see it on the top
4 of the first page there, copyright 1999.

5 Okay. And I want to take us to
6 page 261, which begins with a Section 6.2,
7 "Historical Development and Basic Concepts."

8 Do you see that?

9 A. Yes.

10 Q. Okay. If we flip to the next page, the
11 second page in this section, and look at the bottom
12 paragraph, the first sentence says: (Reading)

13 Oxide layers grown on silicon
14 are amorphous.

15 Did I read that correctly?

16 A. You read it correctly.

17 Q. Okay. It says: (Reading)

18 This might seem surprising
19 initially because we are oxidizing a
20 single-crystal substrate and silica
21 exists in both crystalline and
22 amorphous phases.

1 Did I read that correctly?

2 A. That's what it says.

3 Q. Okay. Nevertheless, oxide layers grown
4 on silicon are amorphous, correct?

5 Sorry. I'm not reading.

6 A. I'm looking for that.

7 Q. I'm not reading from that paragraph.
8 I'm asking you the question.

9 Oxide layers grown on silicon are
10 amorphous, correct?

11 A. Well, that's not -- that's not a
12 generally universal statement. That's referring to
13 whatever section in this textbook we're looking at.

14 Q. So continue reading. It says:
15 (Reading)

16 Any attempt to grow
17 single-crystal silica on silicon would
18 therefore result in very large
19 stresses. Such stresses could easily
20 be large enough to generate
21 crystallographic defects in the
22 silicon, which would significantly

1 degrade circuit yield and device
2 performance.

3 Did I read that correctly?

4 A. That's what it says.

5 Q. So a person of ordinary skill in the
6 art would understand in the context of silicon
7 devices, like MTJs, that when you grow an oxide
8 layer on silicon, it's amorphous, wouldn't they?

9 MR. WICHMAN: Objection.

10 THE WITNESS: I don't agree with that
11 statement.

12 BY MR. WILSON:

13 Q. Okay. So you don't agree with this
14 basic concept from a textbook, correct?

15 A. Which basic concept are you referring
16 to?

17 Q. The concept that oxide layers grown on
18 silicon are amorphous.

19 A. That is not a general -- generally true
20 statement.

21 Q. Okay. So this textbook is incorrect?

22 MR. WICHMAN: Objection.

1 THE WITNESS: My declaration did not
2 address the correctness of Plummer's
3 textbook. However, there are many oxides
4 which can be grown as crystalline layers on
5 silicon, for example, strontium titanate. So
6 you are taking that sentence out of context.

7 BY MR. WILSON:

8 Q. Okay. We're not -- we're talking about
9 silica grown on silicon, correct?

10 A. I don't know. I would have to read the
11 section of the textbook to understand what the
12 context of this statement is.

13 Q. It says right in the next sentence,
14 silica exists in both crystalline and amorphous
15 phases. What else would it be talking about?

16 MR. WICHMAN: Objection, argumentative.

17 BY MR. WILSON:

18 Q. Strike that. Let me ask you this: Is
19 silica grown on silicon amorphous?

20 A. It could be.

21 Q. Are you saying that a person of
22 ordinary skill in the art reading Nagahama would

1 not understand that silica grown on silicon in the
2 context of Nagahama's MTJs is amorphous?

3 A. This isn't a question I've considered
4 in my declaration.

5 Q. And you have no opinion on this basic
6 concept, correct?

7 A. I think your question is too general to
8 have a simple answer.

9 Q. Okay. Let's go back to Nagahama,
10 Exhibit 1027. And let's look at Paragraph 59.

11 MR. WICHMAN: So I think Mr. Mahon
12 could stop sharing his screen.

13 MR. WILSON: Yes, that's fine.

14 BY MR. WILSON:

15 Q. Okay. Paragraph 59 says: (Reading)

16 By forming the
17 highly-oriented, flat, ferromagnetic
18 tunnel magnetoresistive element,
19 including the underlayer 204, which is
20 composed of the amorphous MgO layer
21 202 and the MgO(001) crystal layer
22 203, as described above, the flat

1 tunnel magnetoresistive element
2 exhibiting quantum size effect, which
3 for the structures of the first and
4 second groups of the present invention
5 can be formed only on a single-crystal
6 substrate can be provided on an
7 amorphous substrate such as that of
8 silica and polycrystalline wires.

9 Did I read that correctly?

10 A. Yes.

11 Q. Nagahama says that the silica substrate
12 is amorphous, correct?

13 A. Nagahama says an amorphous substrate
14 such as that of silica.

15 Q. So going back to Paragraph 56. When
16 reference numeral 201 designates a substrate such
17 as silica, it is designating a potentially
18 amorphous substrate, correct?

19 A. I don't know what Nagahama means by
20 that. I haven't considered that question in my
21 declaration.

22 Q. You don't know what Nagahama means by

1 "amorphous silica substrate"?

2 A. In what context? It's not in
3 Paragraph 56.

4 Q. So why in Paragraph 59 does Nagahama
5 say that the -- the ferromagnetic tunnel
6 magnetoresistive element can be provided on an
7 amorphous substrate such as that of silica?

8 MR. WICHMAN: Objection.

9 THE WITNESS: I haven't considered
10 Nagahama's silica substrate with regard to
11 this paragraph. He's giving an example of an
12 amorphous substrate. But a person skilled in
13 the art knows there are different forms of
14 silica.

15 BY MR. WILSON:

16 Q. Okay. What you have opined, though, is
17 that a person of ordinary skill in the art would
18 not have believed that you can form MgO(001) on an
19 amorphous substrate in 2004, correct?

20 A. I've opined about the formation of
21 amorphous MgO on specific substrates or layers in
22 my declaration.

1 Q. Did you or did you not offer the
2 opinion that a person of ordinary skill in the art
3 would not believe that you would reasonably be
4 likely to succeed in forming MgO with a (001)
5 orientation on an amorphous substrate?

6 A. Are we speaking of the '167 or the
7 '134?

8 Q. Let's start with the '134.

9 A. Can you point me to the part of the
10 declaration you want to discuss?

11 Q. So let's look at Paragraph 101. The
12 last sentence of that paragraph says: (Reading)

13 Petitioner fails to show that
14 a person of ordinary skill in the art
15 would have reasonably expected that
16 the MgO layer in its Bowen, Sunai,
17 Parkin combination to meet the
18 MgO(001) limitation despite being
19 formed on a cobalt iron boron layer.

20 Did I read that correctly?

21 A. That's what it says.

22 Q. And your opinion is that is true

1 because cobalt iron boron is amorphous, correct?

2 A. Amorphous cobalt iron boron is
3 amorphous, yes.

4 Q. And your opinion is that a person of
5 ordinary skill in the art would have believed that
6 you needed a crystalline layer under the magnesium
7 oxide layer to get the (001) orientation, correct?

8 A. My opinion is that the POSA had no
9 reason to believe that MgO(001) textured film would
10 form on the amorphous cobalt iron boron.

11 Q. Okay. So my question to you is,
12 doesn't Nagahama disclose forming MgO(001) on
13 amorphous silica?

14 MR. WICHMAN: Objection.

15 (Witness reviews document.)

16 THE WITNESS: Well, Nagahama discloses
17 a number of things. Can you point to the
18 specific paragraph you're referring to?

19 BY MR. WILSON:

20 Q. Paragraph 56.

21 A. Well, 56 refers to Figure 12 in which
22 MgO crystal layer is number 203 and it's on top of

1 amorphous MgO 202.

2 Q. Which is on top of amorphous silica,
3 correct?

4 A. It's on top of substrate 201, which is
5 described as silicon LSI silica SiO₂ or the like.

6 Q. Right.

7 And in Paragraph 59, it says that that
8 silica can be amorphous, correct?

9 A. It says silica -- it says: (Reading)
10 Can be provided on an
11 amorphous substrate such as that of
12 silica.

13 Q. Okay. So in Paragraph 56, Nagahama is
14 describing forming an MgO(001) crystal layer 203 on
15 an MgO layer 202 that is amorphous on a silica
16 amorphous layer, correct?

17 A. Paragraph 56 doesn't tell the POA what
18 the silica is.

19 Q. But Paragraph 59 does, correct?

20 A. 59 gives an example.

21 Q. And it says it can be amorphous,
22 correct?

1 (Witness reviews document.)

2 A. It mentions example -- an example of an
3 amorphous substrate.

4 Q. Right. And this is the same Figure 12
5 embodiment, the Paragraph 56, correct?

6 (Witness reviews document.)

7 A. Well, my discussion of what Nagahama
8 does, in my declaration, Paragraph 71, I didn't
9 consider the crystallinity of the substrate 201.

10 Q. But you now understand that the
11 substrate 201 can be amorphous based on Nagahama's
12 disclosure, correct?

13 A. I didn't give an opinion on that. So I
14 don't feel comfortable giving a new opinion that's
15 not in my declaration of that.

16 Q. Okay.

17 MR. WILSON: Now, I think we've been
18 going for a little over an hour. If you guys
19 are ready for a break, a lunch break,
20 whatever, we can go off the record.

21 MR. WICHMAN: We can do a break.

22 It's -- our time is 11:15.

1 MR. WILSON: Okay. Sorry.

2 MR. WICHMAN: Let's go ahead and go off
3 the record. On my end, the time is 11:17.

4 (Recess taken.)

5 THE VIDEOGRAPHER: We are going back on
6 the record. The time is 11:24.

7 BY MR. WILSON:

8 Q. Okay. Dr. Ross, I would like to turn
9 to Exhibit 2006 in the '134, which is the APL2005
10 article.

11 MR. WICHMAN: There will be a PDF
12 there.

13 BY MR. WILSON:

14 Q. Do you have Exhibit 2006?

15 A. Yes.

16 Q. Okay. Exhibit 2006 is the article
17 entitled "230 percent room-temperature
18 magnetoresistance in cobalt iron boron, magnesium
19 oxide, cobalt iron boron magnetic tunnel
20 junctions." Correct?

21 A. Yes.

22 Q. And you're familiar with this article,

1 correct?

2 A. Generally.

3 Q. Well, you reference it and discuss it
4 in your declaration, correct?

5 A. Yes.

6 Q. Okay. Let's take a look at page 2, the
7 middle of the right-hand column. You can see the
8 paragraph that begins "referring to Figure 3."

9 Do you see that?

10 A. I can see that.

11 Q. Okay. About just above halfway through
12 the paragraph, there's a sentence that begins "the
13 MgO layer."

14 Do you see that?

15 A. Yes.

16 Q. It says: (Reading)

17 The MgO layer grown on cobalt
18 iron showed indistinct crystal
19 structure. The poor epitaxial growth
20 of MgO on cobalt iron may have been
21 due to the difference of fiber texture
22 for both layers.

1 Did I read that correctly?

2 A. That's what it says.

3 Q. So Dr. Yuasa was unsuccessful growing
4 MgO(001) on a cobalt iron electrode, correct?

5 A. This isn't a question I addressed in my
6 declaration.

7 Q. Okay. But you read this article,
8 correct?

9 A. I've read it.

10 Q. And you considered its teachings in
11 forming your opinions, correct?

12 A. I certainly considered it in forming my
13 opinions.

14 Q. Okay. And you would agree that
15 Dr. Yuasa was unsuccessful, as he reports in this
16 article, growing MgO(001) on a cobalt iron
17 electrode, correct?

18 A. I didn't address that specific
19 question, so I can't give you an answer to that.

20 Q. Well, but you did offer the opinion
21 that a person of ordinary skill in the art would
22 understand that MgO(001) had to be grown on

1 something like a cobalt iron(001) electrode,
2 correct?

3 MR. WICHMAN: Objection.

4 THE WITNESS: Maybe you can restate
5 that question.

6 BY MR. WILSON:

7 Q. You offer the opinion in your
8 declaration that a person of ordinary skill in the
9 art would understand -- would have understood in
10 2004 that MgO(001) required something like a cobalt
11 iron(001) electrode to be grown successfully,
12 correct?

13 MR. WICHMAN: Objection.

14 THE WITNESS: My declaration describes
15 what the person skilled in the art would have
16 required in order to get MgO(100) texture as
17 taught by Bowen or Nagahama, which was a
18 (100)-oriented iron or bcc structure.

19 BY MR. WILSON:

20 Q. Okay. And Dr. Yuasa was unsuccessful
21 in growing MgO(001) on a cobalt iron electrode,
22 correct?

1 A. This article was part of Yuasa's work
2 and he was clearly successful in growing tunnel
3 barriers with iron layers, for example, in the
4 patent. So I don't think I would say he was
5 unsuccessful.

6 Q. Well, in Exhibit 2006, he reports being
7 unsuccessful at growing MgO(001) on a cobalt iron
8 electrode, correct?

9 MR. WICHMAN: Objection.

10 THE WITNESS: In this particular
11 example, I can't say what the texture of the
12 cobalt iron is, so I can't answer your
13 question.

14 BY MR. WILSON:

15 Q. Well, he reports that the MgO layer
16 grown on cobalt iron showed indistinct crystal
17 structure, correct?

18 A. The only thing that tells me is that
19 the microscopy done on that sample wasn't very
20 good.

21 Q. Well, that tells you it's not MgO(001),
22 doesn't it?

1 A. No, it just says it's indistinct. I
2 can't tell what that is.

3 Q. He next refers to the poor epitaxial
4 growth of MgO on cobalt iron, correct?

5 A. He mentions that.

6 Q. And he says: (Reading)

7 That may have been due to the
8 difference of fiber texture for both
9 layers.

10 Correct?

11 A. He says that.

12 Q. Now, do you have any idea what he means
13 by that?

14 A. It supports the understanding of the
15 POA that you need a (001) crystalline bcc layer to
16 grow (001) MgO, as taught by Bowen and Nagahama.

17 Q. Do you think it's likely that Dr. Yuasa
18 knew that in 2004?

19 A. Do I think it's likely that Yuasa knew
20 about Bowen and Nagahama?

21 Q. No. Knew that you needed a (001)
22 orientation for the cobalt iron layer to grow

1 MgO(001)?

2 A. I don't have opinion on what Dr. Yuasa
3 knew in 2005, when this was published.

4 Q. So let's back up to page 1. In the
5 lower right-hand corner of page 1, it says:

6 (Reading)

7 Thin films for MTJs were
8 deposited onto thermally oxidized
9 silicon wafer (100) using magnetron
10 sputtering system, ANELVA C7100, with
11 base pressure better than 5 times 10
12 to the minus 9 Torr.

13 Did I read that correctly?

14 A. Yes.

15 Q. If you follow on down to the bottom of
16 that paragraph, the last sentence on page 1. It
17 says: (Reading)

18 All the metal films were
19 deposited by DC sputtering while the
20 MgO layer was deposited using a RF
21 sputtering method.

22 Did I read that correctly?

1 A. You did.

2 Q. So the magnesium oxide in his example
3 was deposited by RF sputtering, correct?

4 A. That's what it says.

5 Q. Okay. The next sentence says:

6 (Reading)

7 The MTJs were annealed in a
8 high-vacuum furnace at 360 degrees
9 Celsius for two hours in a
10 magnesium -- magnetic field of 8
11 kilooersted.

12 Correct?

13 A. That's what it says.

14 Q. Now, page 2, left-hand column, the last
15 sentence in the left-hand column. The article
16 says: (Reading)

17 Surprisingly, the MgO layer
18 grown on the amorphous cobalt iron
19 boron layer showed a good crystalline
20 structure with a (001) fiber texture.
21 The lattice image of MgO(001) can be
22 clearly identified from the lower

1 interface to the upper interface,
2 indicating that the MgO(001) texture
3 developed from the initial stage of
4 growth, i.e., the nucleation stage.

5 Did I read that correctly?

6 A. That's what it says.

7 Q. Now, the lattice image is shown in
8 Figures 2A and 2B, correct?

9 A. Well, Figure 2A and B are these TEM
10 images.

11 Q. And that's in Figure 2A and 2B,
12 correct?

13 A. I don't see the lattice image in
14 Figure 2A.

15 Q. So the paragraph that he's referring to
16 here, if you go back to the middle of the left
17 column, it says: (Reading)

18 To understand the origin of
19 the difference of magnetoresistance
20 ratio in those MTJs, structural
21 analysis has been performed.

22 Figure 2A shows a HRTEM image of the

1 MTJs using cobalt iron boron as the
2 ferromagnetic electrodes.

3 Did I read that correctly?

4 A. Yes.

5 Q. So Figures 2A and 2B are the HRTEM
6 images, correct?

7 A. That's what it says.

8 Q. Okay. But you're saying in -- later in
9 that paragraph, when he refers to the lattice image
10 of MgO(001) can be clearly identified from the
11 lower interface to the upper interface, you're
12 saying that's not Figures 2A and 2B?

13 A. No. I said that wasn't Figure 2A.

14 Q. Oh, okay. So it's Figure 2B, correct?

15 A. You asked me if Figures 2A and B show
16 lattice images. From microscopists, lattice images
17 are not the same as just seeing layers. Lattice
18 imaging requires a more -- a different set of
19 imaging conditions.

20 Q. Okay. Does Figure 2B show the lattice
21 image of MgO(001) referred to in APL2005?

22 A. So your question is does Figure 2B show

1 lattice images for MgO --

2 Q. Yes.

3 A. -- or for anything else?

4 As far as I can tell. I haven't
5 considered this question in my declaration.

6 Q. Okay. So you're saying as far as you
7 can tell, it does, correct?

8 A. I can see some stripes in that image.

9 Q. Okay. Now, Figures 2A and 2B show that
10 the MTJ was complete when these HRTEM images were
11 created, correct?

12 A. By "complete," do you mean the entire
13 device is fabricated, or what do you mean?

14 Q. Yes. The entire device was fabricated
15 when the images in Figures 2A and 2B were taken.
16 Correct?

17 A. I don't know.

18 Q. So the -- at least the layers above MgO
19 cobalt iron boron layer, the tantalum layer and the
20 ruthenium layer are already applied, correct?

21 A. Those are shown in Figure 2A.

22 Q. Okay. So if we go back to the top

1 of -- the first column on page 2, where it says the
2 MTJs were annealed in a high-vacuum furnace at 360
3 degrees C for two hours in this magnetic field,
4 right, that step would have already occurred at
5 this point, correct? At the point in Figure 2.

6 A. I don't know.

7 Q. Okay. If you look just above Figure 2,
8 do you see where it says about five lines up:

9 (Reading)

10 We found that the CoFeB, the
11 cobalt iron boron, layers were
12 essentially amorphous, although some
13 parts of the cobalt iron boron layers
14 were crystallized. The partial
15 crystallization may have been caused
16 by the high annealing temperature.

17 Did I read that correctly?

18 A. Yes.

19 Q. They're referring to the results in
20 Figure 2, correct?

21 A. Yes.

22 Q. Okay. So the annealing had already

1 been performed at the time Figure 2 was taken,
2 correct?

3 A. That's implied.

4 Q. Okay. Now, looking at Figure 2, how
5 could the authors of this article, Exhibit 2006,
6 determine from Figure 2 that the MgO(001) texture
7 developed from the initial stage of growth, i.e.,
8 the nucleation stage?

9 A. I don't have an opinion on that, on how
10 they came to that conclusion. I would need to
11 research this to answer that question.

12 Q. Okay. A person of ordinary skill in
13 the art reading Exhibit 2006 could not determine
14 whether the MgO(001) was crystallized from the
15 nucleation stage based on Figure 2, correct?

16 A. I'm not sure quite what you mean. Can
17 you restate that?

18 Q. A person of ordinary skill in the art
19 could not determine from Figure 2 that the MgO(001)
20 layer shown there was -- sorry, let me strike that.

21 A person of ordinary skill in the art,
22 looking at Figure 2, could not determine that the

1 MgO(001) texture developed from the initial stage
2 of growth, i.e., the nucleation stage, correct?

3 A. I don't know how to answer that because
4 my understanding is the person skilled in the art
5 is defined as of 2004. This paper came out later
6 than that.

7 Q. Okay. Let me ask you this: Could you,
8 sitting here today, determine from Figure 2 that
9 the MgO(001) layer shown there, that its texture
10 developed from the initial stage of growth, i.e.,
11 the nucleation stage?

12 A. I wouldn't be able to answer that
13 without doing some study of this document and
14 references cited in it --

15 Q. Now --

16 A. -- to understand how Yuasa and his
17 colleagues came to that conclusion.

18 Q. Okay. Well, you understand, sitting
19 here today, that the annealing step could have
20 caused an amorphous portion of the MgO layer to
21 crystallize such that it appears fully crystallized
22 in this Figure 2, correct?

1 A. I'm not sure I understand completely.

2 Are you asking me if I can tell -- well, maybe you
3 can state that again.

4 Q. You can't tell from Figure 2 whether
5 when the first layers of the MgO layer were put
6 down they were crystallized in the (001)
7 orientation, correct?

8 MR. WICHMAN: Objection.

9 THE WITNESS: I can't discern how the
10 MgO formed just by looking now. I'm not
11 prepared to give an opinion about that
12 without doing some further study of the
13 literature.

14 BY MR. WILSON:

15 Q. Okay. Now, you said you would need to
16 look at the references that Dr. Yuasa cited in this
17 article to determine whether or not his opinion
18 that the lattice image of MgO(001) proves that the
19 texture developed from the initial stage of growth.
20 So let's look at the second column on page 2 and
21 the next sentence after he refers to the nucleation
22 stage.

1 He says: (Reading)

2 Note that MgO layer grown on
3 amorphous silicon nitride substrates
4 by ion-beam-assisted deposition is
5 also (001) textured right at the
6 inception of the deposition.

7 Did I read that correctly?

8 A. That's what it says.

9 Q. Okay. And let's take a look at
10 Footnote 14 which he cites there. And you can see
11 it is to an article by C.P. Wang in Applied Physics
12 Letter 71,2955, dated 1997.

13 Do you see that?

14 A. Yes.

15 Q. Have you seen the Wang article before?

16 A. I don't recall. Do we have an exhibit
17 number for it?

18 Q. It is not currently an exhibit in this
19 proceeding.

20 You don't recall whether you've seen
21 that article before?

22 A. I don't recall as of now.

1 Q. Okay. When you read this article, you
2 didn't look up the Wang article to see what it
3 said?

4 A. I don't recall looking up Wang.

5 Q. Okay. Let's go back to the statement
6 at the top of the second column of Exhibit 2006.

7 Dr. Yuasa here is stating that it was
8 known that an MgO layer grown on amorphous silicon
9 nitride substrates by ion-beam-assisted deposition
10 is (001) textured right at the inception of the
11 deposition, correct?

12 MR. WICHMAN: Objection.

13 Do you have a page? You just said top
14 of the column.

15 MR. WILSON: It's page 2. It's the
16 right-hand column, top of the right-hand
17 column where I just read.

18 THE WITNESS: So what's the question,
19 then?

20 BY MR. WILSON:

21 Q. Dr. Yuasa stated that: (Reading)
22 MgO layer grown on amorphous

1 silicon nitride substrates by
2 ion-beam-assisted deposition is also
3 (001) textured right at the inception
4 of the deposition.

5 Correct?

6 A. That's what Yuasa has written as a
7 citation to his Reference 14 in this paper.

8 Q. So it's possible that Dr. Yuasa when he
9 was opining that the MgO(001) texture developed
10 from the initial stage of growth, i.e., the
11 nucleation stage, that he was theorizing that based
12 on Wang's paper, correct?

13 A. I don't think the connection is that --
14 is as you've described it. He's citing an example
15 from Wang which uses ion-beam-assisted deposition
16 which is a very different kinetic growth process,
17 and he's using a silicon nitride substrate which is
18 different from the amorphous cobalt iron boron as
19 an example of an (001) textured film. I don't know
20 how thick those films are or any of the other
21 details without studying Wang.

22 Q. Now, you have in front of you

1 Exhibit 2013, correct?

2 THE WITNESS: 2013. Which one is that?

3 MR. WICHMAN: I think if you look in
4 the folder. Just click on the folder. You
5 should be able to pull it up. There you go.

6 BY MR. WILSON:

7 Q. Now, you've seen Exhibit 2013 before,
8 correct?

9 A. Yes.

10 Q. You reference it and discuss it in your
11 declarations, correct?

12 A. Yes.

13 Q. Okay. Take a look at page 2 of
14 Exhibit 2013. Okay. If you look at the second
15 column on page 2, four lines down, you see the
16 sentence that begins "the comparison between"?

17 A. Right.

18 Q. You see that sentence?

19 A. I see that sentence.

20 Q. Okay. Exhibit 2013 says: (Reading)

21 The comparison between the
22 observed and simulated images clearly

1 indicates that the magnesium oxide
2 layer grown on amorphous cobalt iron
3 boron had a highly-oriented
4 polycrystalline MgO(001) structure
5 when the thickness of the MgO was
6 greater than or equal to 5 monolayers.
7 Therefore, the magnetoresistance ratio
8 is expected to decrease significantly
9 when the thickness of the MgO is less
10 than 5 monolayers, 1.05 nanometers,
11 because the crystalline MgO(001)
12 barrier is essential to produce the
13 giant TMR effect. Thus, the observed
14 sharp drop in the magnetoresistance
15 ratio for thickness of MgO less than
16 1 nanometer can be attributed to the
17 formation of an amorphous MgO barrier
18 layer rather than the deterioration of
19 the crystalline orientation.

20 Did I read that correctly?

21 A. Yes.

22 Q. So now, we just read in Exhibit 2006

1 that Dr. Yuasa offered the opinion that the
2 MgO(001) crystallized right from the beginning of
3 the nucleation, correct?

4 A. So he gives an indication that the
5 texture developed from the initial stage of growth
6 in Exhibit 2006.

7 Q. Okay. Now, Exhibit 2013 is from a year
8 later after Exhibit 2006, correct?

9 A. Well, 2006 -- Exhibit 2006 is published
10 in 2005 and the other one was also published in
11 2005, some months --

12 Q. Okay. If you look at Exhibit 2006, it
13 says it was received 25th October, 2004, correct?

14 A. I'm sorry. I'm having trouble getting
15 both of them on my screen at once.

16 So what were we asking about, the date
17 of --

18 Q. Exhibit 2006, first page of the actual
19 article says it was received 25th October, 2004.
20 You can see it just above the abstract.

21 A. Yes.

22 Q. Okay. 2013, just above the abstract,

1 says received 10th of October, 2005?

2 A. It does say that.

3 Q. Okay. So Exhibit 2013 was submitted to
4 the journal almost a year later, after 2006 --
5 after Exhibit 2006, correct?

6 A. That's the date, but the content,
7 obviously, is changed until the point it's finally
8 accepted.

9 Q. Okay.

10 A. So the accepted dates are, perhaps,
11 more relevant.

12 Q. Okay. So -- okay. So some months
13 later, Exhibit 2013 explains that when MgO is grown
14 on amorphous cobalt iron boron, you need more than
15 a nanometer, that is more than 5 monolayers, or at
16 least 5 monolayers to get a crystalline structure,
17 correct?

18 MR. WICHMAN: Objection.

19 THE WITNESS: This is a description of
20 a specific experiment, so I can't answer
21 whether what you said is generally true.

22

1 BY MR. WILSON:

2 Q. Okay. You can see how this experiment
3 was performed. It was performed with RHEED
4 observations, correct?

5 MR. WICHMAN: Objection.

6 THE WITNESS: Well, the RHEED,
7 R-H-E-E-D, is used as part of the
8 characterization.

9 BY MR. WILSON:

10 Q. Right. And the second column of the
11 first page of the article, it says -- the middle of
12 the right-hand column, it says: (Reading)

13 We used in situ reflective
14 high-energy electron diffraction,
15 RHEED, observations in this study to
16 investigate the growth process of the
17 MgO layer and the crystallization
18 process of the cobalt iron boron
19 layer.

20 Correct?

21 (Witness reviews document.)

22 A. That's what it said.

1 Q. Okay. And you understand that the
2 RHEED process allows you to see the structure of
3 the MgO layer as it is deposited and as it grows,
4 correct?

5 A. You don't really see the structure.
6 It's not microscopy. You get some information
7 which can be used to infer something about the
8 crystal growth process.

9 Q. Okay. And the HRTEM process, or
10 microscopy that was used in Exhibit 2006, does not
11 allow you to see that growth process, correct?

12 A. The TM is looking at a sample after
13 it's been made.

14 Q. Okay. Let's take a look at
15 Exhibit 1040.

16 A. Okay.

17 Q. Exhibit 1040 is the Yoon reference
18 entitled "Growth characteristics and surface
19 roughening of vapor-deposited MgO thin films."

20 You've seen Exhibit 1040 before,
21 correct?

22 A. Yes.

1 Q. You reviewed it in preparing your
2 declaration, correct?

3 A. Correct.

4 Q. Okay. So take a look at the lower
5 right-hand -- sorry, page 2840, the second page of
6 Yoon. The bottom of the lower right-hand corner --
7 bottom of the lower right-hand column, four lines
8 up from the bottom. Do you see a "recent study"?

9 A. Yes.

10 Q. It says: (Reading)

11 Recent study on in-plane
12 textured (100) MgO films, which were
13 deposited on amorphous silicon nitride
14 substrates by ion-beam-assisted
15 deposition also showed that the
16 texturing process for MgO is a
17 nucleation process.

18 Did I read that correctly?

19 A. That's what it says.

20 Q. And Footnote 18, which it cites there,
21 again, is the Wang 1997 article. Do you see that?

22 A. Yes.

1 Q. But you didn't look up Wang or review
2 it, correct?

3 A. I don't recall.

4 Q. Okay.

5 MR. WILSON: Now, Mitchell, if you can
6 propagate Exhibit 1097.

7 (Exhibit Number 1097 was marked for identification.)

8 THE WITNESS: You'll need to help me
9 with this.

10 MR. WICHMAN: It's going to be in the
11 Zoom chat. We'll have to download it.

12 (Brief pause.)

13 BY MR. WILSON:

14 Q. Dr. Ross, do you have Exhibit 1097?

15 A. Yes.

16 Q. Okay. You can see that this is --
17 Exhibit 1097 is the article referenced in both
18 Exhibit 2006, Dr. Yuasa's paper, as well as in
19 Yoon.

20 It's entitled "Deposition of in-plane
21 textured MgO on amorphous silicon nitride
22 substrates by ion-beam-assisted deposition and

1 comparisons with ion-beam-assisted deposition

2 yttria-stabilized zirconia." Correct?

3 A. Close.

4 Q. Okay. What did I miss?

5 A. I think you said ion-beam-assisted

6 deposition yttria-stabilized-zirconia.

7 Q. Fair enough.

8 So you can see that this is the article

9 cited in Footnote 14 of Exhibit 2006 and

10 Footnote 18 of Exhibit 1040, correct?

11 A. Right.

12 Q. Okay. And now that you have the

13 article in front of you, you can see that it was

14 accepted for publication 18th of September, 1997

15 and was published in November 1997.

16 Do you see that? Look in the lower

17 left-hand corner, "Applied Physics Letters."

18 A. Yes.

19 Q. Okay. So do you recall whether you've

20 seen this article before?

21 A. I don't recall seeing it.

22 Q. Okay. If you take a look at the

1 abstract, the first few lines there, it says:

2 (Reading)

3 We report the growth of
4 in-plane textured (100) MgO on
5 amorphous silicon nitride substrates
6 by ion-beam-assisted deposition, IBAD.
7 The textured MgO can be used as a
8 structural template for subsequent
9 epitaxial thin film deposition.

10 Did I read that correctly?

11 A. Yes.

12 Q. Okay. Now, if you -- another sentence
13 down, it says: (Reading)

14 Based on transmission electron
15 microscopy, TEM, and in situ
16 reflection high-energy electron
17 diffraction, RHEED, we find that the
18 MgO texturing is a
19 nucleation-controlled process and the
20 alignment is a function of nuclei size
21 and density.

22 Did I read that correctly?

1 A. Yes.

2 Q. Okay. It continues: (Reading)

3 This differs greatly from the
4 evolutionary-type texturing process
5 observed for IBAD (100) YSZ.

6 Consequently, we are able to make
7 100-angstrom-thick MgO films with 7
8 degree in-plane alignment, whereas
9 IBAD (100) YSZ films needed to be
10 thicker than 5,000 angstroms to
11 achieve in-plane alignment better than
12 13 degrees.

13 Did I read that correctly?

14 A. That's true, although one hundred is
15 actually 100.

16 Q. Okay. Now, the last sentence there
17 says: (Reading)

18 This has important
19 implications for the economical
20 application of IBAD-induced alignment
21 in real manufacturing processes,
22 including high TC superconductor,

1 i.e., YBCO, coated tapes,
2 photovoltaics, magnetic thin films and
3 semiconductor devices.

4 Did I read that accurately?

5 A. Yes.

6 Q. Okay. So they were able to achieve
7 (100) orientation on MgO films as thin as
8 10 nanometers, correct?

9 MR. WICHMAN: Objection.

10 THE WITNESS: I haven't reviewed this
11 document.

12 BY MR. WILSON:

13 Q. Okay. 100 angstrom is 10 nanometers,
14 correct?

15 A. Yes.

16 Q. Okay. Now, if you look at the
17 right-hand column on page 1, it says: (Reading)

18 Figure 1 shows a typical
19 texturing sequence observed with the
20 in situ RHEED. When the proper
21 deposition conditions are set, the
22 RHEED pattern changes from a diffused

1 scattering pattern from the amorphous
2 silicon nitride substrate to a
3 crystalline pattern of MgO at about
4 20 angstroms, which is the limiting
5 diffraction thickness of the RHEED.

6 Did I read that correctly?

7 A. That's what it says.

8 Q. It says: (Reading)

9 The pattern suggests that the
10 MgO molecules form well-aligned small
11 3D crystallites right at the inception
12 of the deposition, i.e., right at the
13 nucleation stage with (100) planes
14 aligning out of plane and the (110)
15 direction facing the ion source.

16 Did I read that correctly?

17 A. That's what it says.

18 Q. So Wang, Exhibit 1097, says that they
19 were able to observe a crystalline pattern in the
20 MgO at 2 nanometers of thickness, correct?

21 MR. WICHMAN: Objection.

22 THE WITNESS: Well, I haven't reviewed

1 this article, so if you would like me to
2 comment on it, I need to spend some time
3 looking at it. This isn't part of my
4 declaration.

5 BY MR. WILSON:

6 Q. Okay. And despite its reference in
7 both Exhibit 2006 and Exhibit 1040, you didn't
8 review it, correct?

9 MR. WICHMAN: Objection.

10 THE WITNESS: It's not relevant to the
11 opinions I have in my declaration.

12 BY MR. WILSON:

13 Q. Okay.

14 Let's take a look at Exhibit 2008.

15 A. I have it.

16 MR. WICHMAN: Oh.

17 THE WITNESS: It's this one
18 (indicating).

19 MR. WICHMAN: Sorry.

20 BY MR. WILSON:

21 Q. Now, Exhibit 2008 is Dr. Yuasa's 2004
22 Nature paper, correct?

1 A. Nature Materials.

2 Q. Okay. And you cited this document and
3 discussed it extensively in both your '134 and '167
4 declarations, correct?

5 A. I certainly -- yes, it's in my
6 declarations.

7 Q. Okay. You're familiar with
8 Exhibit 2008, correct?

9 A. Yes.

10 Q. Okay. Let's take a look at page 868,
11 which is the first page, and the right-hand column.
12 The beginning of that paragraph, two lines up from
13 the bottom. It says "in this study."

14 Do you see where I'm referring to?

15 A. I see it.

16 Q. It says: (Reading)

17 In this study, we prepared
18 single-crystal iron(001), MgO(001),
19 iron(001) MTJs with MgO barrier
20 thickness, t_{MgO} , from 1.2 to
21 3.2 nanometers by using molecular-beam
22 epitaxy and microfabrication

1 techniques. See methods.

2 Did I read that correctly?

3 A. Yes.

4 Q. Okay. Page 870, which is the third
5 page, do you see the heading "Methods" in the lower
6 right?

7 A. Yes.

8 Q. It says: (Reading)

9 Thin films for single-crystal
10 iron(001), MgO(001), iron(001) MTJs
11 were prepared using MBE.

12 It says: (Reading)

13 A MgO(001) seed layer was
14 first deposited on a single-crystal
15 MgO(001) substrate to improve the
16 morphology of the substrate surface.

17 Did I read that correctly?

18 A. Yes.

19 Q. Okay. Now, let's look -- let's see.

20 Same page, right-hand column . . . Okay. Sorry.

21 About the middle of the right-hand column above the

22 Methods, the last paragraph above the methods, a

1 little over halfway through that paragraph. It

2 says "iron MgO iron MTJs need not."

3 Do you see that?

4 A. I'm just looking for it. Okay.

5 Q. It says: (Reading)

6 Iron MgO iron MTJs need not,
7 in principle, be single-crystal
8 devices. Even textured iron MgO iron
9 MTJs with (001) orientation, which can
10 be prepared on any kinds of substrates
11 by using a highly-oriented MgO(001)
12 seed layer should exhibit a similar
13 huge TMR effect.

14 Did I read that correctly?

15 A. That's what it says.

16 Q. He says that the MgO(001) seed layer
17 can be prepared on any kind of substrate, correct?

18 A. His sentence says: (Reading)

19 Can be prepared on any kinds
20 of substrates by using a
21 highly-oriented MgO(001) seed layer.

22 Q. Okay. And do you see he cites

1 Footnote 21 there?

2 A. Yes.

3 Q. Okay. And if you look at the second
4 page of Exhibit 2008, you can see that Footnote 21
5 is an article authored by Inaba, among others,
6 entitled "Magnetic and crystallographic properties
7 of cobalt chromium platinum longitudinal media
8 prepared on magnesium oxide seed layers deposited
9 by ECR sputtering."

10 Do you see that?

11 A. Yes.

12 Q. Have you seen this Inaba article
13 before?

14 A. I don't recall. Is it one of the
15 exhibits?

16 Q. It is not currently.

17 MR. WILSON: Okay. So I'm happy to go
18 ahead and introduce this new exhibit. If I
19 do, I'm going to want to get through it
20 before we break. So we can either break now
21 or after this exhibit, whichever you prefer.

22 MR. WICHMAN: Dr. Ross, would you

1 prefer to take 20 minutes for lunch now

2 or . . .

3 THE WITNESS: It may depend how long
4 we're planning to spend on it.

5 MR. WICHMAN: All right. Well, I
6 suggest we take 20 minutes now for lunch and
7 then come back.

8 MR. WILSON: All right. Let's go off
9 the record.

10 THE VIDEOGRAPHER: We are going off the
11 record. The time is 12:21.

12 (Recess taken.)

13 THE VIDEOGRAPHER: We're going back on
14 the record. The time is 12:46.

15 MR. WILSON: Okay. Mitchell, can you
16 propagate Exhibit 1098.

17 (Exhibit Number 1098 was marked for identification.)

18 MR. WICHMAN: He's going to put it in
19 the chat.

20 There it is. Give me a second here.

21 MR. WILSON: Okay.

22 (Brief pause.)

1 MR. WICHMAN: Okay.

2 BY MR. WILSON:

3 Q. Okay. Dr. Ross, do you have
4 Exhibit 1098?

5 A. Yes.

6 Q. Okay. Exhibit 1098 is the Inaba
7 article that's referenced in Exhibit 2008 in
8 Footnote 21. Can you confirm that?

9 (Witness reviews document.)

10 A. Yes, that's right.

11 Q. Okay. You can see that it was
12 published in 2000?

13 A. Yes.

14 Q. Okay. Have you seen this Inaba
15 article, Exhibit 1098, before?

16 A. I don't recall seeing it before.

17 Q. Okay. If you take a look at the
18 introduction, or the abstract, sorry, the upper
19 left-hand column of the first page. It says:
20 (Reading)

21 Crystallographic and magnetic
22 properties are investigated for cobalt

1 chromium platinum, chromium titanium,
2 longitudinal media fabricated on MgO
3 seed layers, thickness is from 0 to
4 20 nanometers, prepared by electron
5 cyclotron resonance, ECR, sputtering
6 method.

7 It says: (Reading)

8 The MgO layer deposited at
9 room temperature shows well-developed
10 (100) texture. Highly (100)-oriented
11 chromium titanium and (11.0)-oriented
12 cobalt chromium platinum layers are
13 epitaxially grown on the seed layers.

14 Did I read that correctly?

15 A. Yes. Although it's 11.0. For the
16 orientation, it's not 11, it's a 11.0.

17 Q. Okay. Fair enough.

18 Do you see Section B, "Sample
19 Preparation," there on the first page?

20 A. Yes, I can see that.

21 Q. Okay. It says: (Reading)

22 We prepared cobalt chromium

1 platinum 25 nanometer, chromium
2 titanium 50 nanometer bi-layer thin
3 film specimens on MgO seed layers,
4 thickness from 0 to 20 nanometers,
5 deposited on glass substrates.

6 Did I read that correctly?

7 A. Yes.

8 Q. And glass substrates are amorphous,
9 correct?

10 A. Presumably. I don't know what glass
11 they use in this.

12 Q. Okay. A person of ordinary skill in
13 the art reading this would understand the glass
14 substrate is amorphous, correct?

15 MR. WICHMAN: Objection, relevance,
16 beyond the scope.

17 THE WITNESS: I haven't seen this
18 before, so I'd have to look at it to try and
19 understand what the POSA might have inferred
20 from this description.

21 BY MR. WILSON:

22 Q. Okay. It says -- it continues:

1 (Reading)

2 The deposition of MgO layer
3 was carried out by using the ECR
4 sputtering at an argon pressure of
5 .4 millitorr.

6 Did I read that correctly?

7 A. That's what it says.

8 Q. And it says the deposition rate is
9 .5 nanometer per second, correct?

10 A. Yes.

11 Q. Okay. Next page under
12 "crystallographic structures." Sorry. Just above,
13 actually, "Results and Discussion." Paragraph on
14 the upper left-hand column, first full paragraph.
15 Says: (Reading)

16 Crystallographic structures of
17 media specimens were investigated by
18 using an X-ray diffractometer and a
19 high spatial resolution transmission
20 electron microscope. Magnetic
21 properties were measured by using a
22 vibrating sample magnetometer.

1 Did I read that correctly?

2 A. Yes.

3 Q. Okay. Now, under the Results and
4 Discussion, it says: (Reading)

5 The crystallographic
6 properties of thin film media were
7 compared between the specimens with
8 10-nanometer-thick magnesium oxide
9 layers prepared by ECR and RF
10 sputtering methods. Specimens with no
11 MgO layers were also prepared.

12 It says: (Reading)

13 The specimens A, B and C are
14 the cobalt chromium platinum, chromium
15 titanium thin films deposited at room
16 temperature with the ECR-sputtered MgO
17 seed layer, the RF-sputtered MgO seed
18 layer, and no MgO layer, respectively.

19 It says: (Reading)

20 Figure 2 shows the X-ray
21 diffraction spectra of these
22 specimens.

1 Did I read that correctly?

2 A. That is what it says.

3 Q. Okay. If we continue down, and feel
4 free to read as much or as little of this as you
5 care to, but in that same paragraph, I'm now one,
6 two, three, four, five, six, seven, eight lines up
7 from the bottom with the sentence that begins
8 "these results mean."

9 Do you see that?

10 A. Okay.

11 Q. Okay. It says: (Reading)

12 These results mean that the
13 10-nanometer-thick MgO seed layer
14 deposited by ECR sputtering shows
15 well-developed (100) texture on which
16 chromium titanium (100) and cobalt
17 chromium platinum (11.0) planes can
18 grow epitaxially to lie the see c-axis
19 on the film plane.

20 Did I read that correctly?

21 A. That's what it says.

22 Q. Okay. And if you look at Figure 2,

1 which is at the top of that column, it shows the
2 X-ray diffraction spectra for Samples A, B and C.

3 Do you see that?

4 A. Well, I see the Figure 2.

5 Q. You can see Sample A is across the top?

6 A. That's labeled, yes.

7 Q. Okay. Sample A has the MgO seed layer,
8 correct?

9 MR. WICHMAN: Objection, beyond the
10 scope. Also relevance.

11 THE WITNESS: So what's the question?

12 BY MR. WILSON:

13 Q. Sample A has the MgO seed layer,
14 correct?

15 MR. WICHMAN: Objection, relevance,
16 beyond the scope.

17 THE WITNESS: I haven't seen this
18 document before. I can see there's a label
19 for MgO on the scan marked A, but I haven't
20 analyzed what this means.

21 BY MR. WILSON:

22 Q. Okay. Well, the Figure 2, X-ray

1 diffraction spectra, means that there's a
2 crystalline MgO layer formed underneath the other
3 layers, correct?

4 MR. WICHMAN: Objection, relevance,
5 beyond the scope.

6 THE WITNESS: I can't tell, without
7 spending some time reviewing this document,
8 what that data actually means.

9 BY MR. WILSON:

10 Q. Okay. Let's go back to Exhibit 2008,
11 page 3, or page 870, lower right-hand column. Just
12 above the Methods, it says -- this is a sentence we
13 read previously. It says: (Reading)

14 Even textured iron MgO iron
15 MTJs with (001) orientation, which can
16 be prepared on any kinds of substrates
17 by using a highly-oriented (001) seed
18 layer, should exhibit a similar huge
19 TMR effect.

20 Now, when Dr. Yuasa says that, he
21 refers to the Inaba article in Footnote 21,
22 correct?

1 A. That's what Footnote 21 is.

2 Q. And when he refers to "any kinds of
3 substrates," he's referring to the glass substrate
4 that was used to form the MgO(001) layer in Inaba,
5 correct?

6 A. Well, he's -- I haven't investigated
7 this particular question of what Yuasa means by
8 "any kinds of substrates."

9 Q. Well, he certainly, at least, means
10 glass, correct?

11 A. Well, he's citing Reference 21.

12 Q. Which discloses growing MgO(001) on a
13 glass substrate, correct?

14 MR. WICHMAN: Objection, beyond the
15 scope, relevance.

16 THE WITNESS: I haven't analyzed what's
17 in reference Exhibit 1098. I hadn't seen it
18 before today that I recall. So I don't feel
19 I can answer questions about the contents of
20 Exhibit 1098.

21 BY MR. WILSON:

22 Q. Okay. And so in forming your opinions,

1 when you read Dr. Yuasa's statement that even
2 textured iron MgO iron MTJs with (001) orientation,
3 which can be prepared on any kinds of substrates by
4 using a highly-oriented MgO(001) seed layer, you
5 weren't curious what was in that article?

6 MR. WICHMAN: Objection.

7 THE WITNESS: My opinions don't rely on
8 the contents of that article.

9 BY MR. WILSON:

10 Q. Okay. But your opinions do rely on the
11 contents of Exhibit 2008, correct?

12 A. I use Exhibit 2008, Yuasa's paper,
13 to -- as an example of secondary considerations,
14 for example. So if you could point me to the place
15 in my declaration we're talking about, then we
16 could take a look at that.

17 Q. So you have offered the opinion that a
18 person of ordinary skill in the art in 2004 would
19 not have expected to be able to successfully grow
20 MgO(001) on a cobalt iron boron layer, as we just
21 looked at in your declaration. This sentence
22 contradicts that, doesn't it?

1 MR. WICHMAN: Objection.

2 THE WITNESS: Are you asking me if my
3 statements about growing MgO(001) on
4 amorphous cobalt iron boron are relevant to
5 Inaba? Is that what you're asking?

6 BY MR. WILSON:

7 Q. I'm asking whether this sentence in
8 Exhibit 2008, Dr. Yuasa's paper, that says even
9 textured iron MgO iron MTJs with (001) orientation,
10 which can be prepared on any kinds of substrates by
11 using a highly-oriented MgO(001) seed layer
12 contradicts your opinion that a person of ordinary
13 skill in the art would not have believed that they
14 could successfully grow MgO(001) on cobalt iron
15 boron.

16 MR. WICHMAN: Objection.

17 THE WITNESS: That's a complicated
18 question, which I'm trying to work out
19 exactly what you're asking me. Maybe you can
20 break it down.

21 BY MR. WILSON:

22 Q. Would this sentence in Exhibit 2008

1 that says, Even textured iron MgO iron MTJs with
2 (001) orientation, which can be prepared on any
3 kinds of substrates by using a highly-oriented
4 MgO(001) seed layer, suggest to a person of
5 ordinary skill in the art that you can grow
6 MgO(001) on any kind of substrate?

7 MR. WICHMAN: Objection.

8 THE WITNESS: It does not suggest to me
9 that the person skilled in the art would
10 understand that you can grow iron MgO iron
11 MTJs with (001) orientation on amorphous
12 cobalt iron boron. So I don't see the
13 connection that your -- in your question.

14 BY MR. WILSON:

15 Q. You understand what a seed layer is,
16 correct?

17 MR. WICHMAN: Objection.

18 THE WITNESS: I haven't been asked to
19 give an opinion about the meaning of seed
20 layer.

21 BY MR. WILSON:

22 Q. So you don't know what a seed layer is?

1 MR. WICHMAN: Objection.

2 THE WITNESS: I haven't considered how
3 "seed layer" is construed or understood in --
4 in this case in my declaration.

5 BY MR. WILSON:

6 Q. Okay. So if you came across a
7 reference to an MgO(001) seed layer in any of these
8 documents that you've reviewed, including the '134
9 and '167 Patents, you disregarded that reference,
10 correct?

11 MR. WICHMAN: Objection.

12 THE WITNESS: I don't understand the
13 question. If I read something, I would
14 ignore it? No.

15 BY MR. WILSON:

16 Q. Okay. Well, is MgO(001) in a seed
17 layer different than MgO(001) in a tunnel barrier?

18 A. Yes, they have a different function.

19 Q. Okay. Is the structure of the layer
20 different?

21 A. It depends how it's made and what it's
22 grown on and whether it's annealed and various

1 other considerations.

2 Q. If I have an MgO(001) layer that I call
3 a seed layer, and above that, I grow an iron(001)
4 layer, and above the iron(001) layer, I grow an
5 MgO(001) layer that I call a tunnel barrier, is
6 there any difference between the tunnel barrier
7 MgO(001) layer and the MgO(001) seed layer?

8 A. Is there any difference? Any
9 difference at all? Do you mean in function or in
10 structure?

11 Q. In structure.

12 A. It depends how they're grown.

13 Q. Okay. Let's assume they're grown using
14 the same method.

15 A. It would also depend what they're grown
16 on and how thick they are.

17 Q. I just told you they were both
18 3 nanometers.

19 A. I don't think I heard 3 nanometers.

20 But the seed layer is grown on
21 something different from what the barrier layer is.
22 That influences the structure of the material that

1 grows.

2 Q. Okay. But if they are both
3 highly-oriented (001) layers, then they both meet
4 the claims' requirement of an MgO(001) layer,
5 correct?

6 MR. WICHMAN: Objection, compound,
7 vague, ambiguous.

8 THE WITNESS: I don't think I can
9 answer that without more context.

10 BY MR. WILSON:

11 Q. What else would you need to know about
12 a layer to know if it's an MgO(001) layer?

13 A. Yuasa's patents describe -- the claims
14 in Yuasa's patents describe MgO(100) layers. That,
15 and the literature I've looked at is what informs
16 my decision, my description.

17 Q. Okay. And that includes an MgO(100)
18 layer in any context, correct?

19 MR. WICHMAN: Objection.

20 THE WITNESS: The claims in Yuasa's
21 patents are concerning barrier layers. I
22 don't believe he makes claims related to seed

1 layers.

2 BY MR. WILSON:

3 Q. But he does describe MgO(001) seed
4 layers, correct?

5 MR. WICHMAN: Objection.

6 THE WITNESS: Can you show me where he
7 describes them?

8 BY MR. WILSON:

9 Q. Sure.

10 If you take a look at the '134 Patent
11 and just look at the abstract. He says three lines
12 down: (Reading)

13 A single-crystalline MgO(001)
14 substrate is prepared. An epitaxial
15 iron(001) lower electrode, a first
16 electrode, is grown on a MgO(001) seed
17 layer at room temperature followed by
18 annealing under ultrahigh vacuum.

19 Did I read that correctly?

20 A. That's what it says.

21 Q. He describes an MgO(001) seed layer,
22 correct?

1 A. He uses that term, yes.

2 Q. Okay. Is there any difference between
3 the MgO(001) that he describes as a seed layer and
4 the MgO(001) he describes as a tunnel barrier layer
5 in structure?

6 MR. WICHMAN: Objection.

7 THE WITNESS: We can, for example,
8 compare the function of those layers.
9 Column 6 describes a function of the seed
10 layer, which is --

11 BY MR. WILSON:

12 Q. Do you recall that my question asked
13 you about a difference in structure?

14 MR. WICHMAN: Counsel, let the witness
15 finish her answer.

16 BY MR. WILSON:

17 Q. Sorry. You can finish your answer.

18 A. The seed layer and the barrier layer
19 have different functions in the structure, the
20 overall MTJ structure.

21 Q. Are you finished?

22 A. Sure.

1 Q. Okay.

2 MR. WILSON: I'll object to your answer
3 as nonresponsive and move to strike it.

4 BY MR. WILSON:

5 Q. My question is, is there any difference
6 in the structure of the MgO(001) seed layer in the
7 '134 Patent and the MgO(001) tunnel barrier layer?

8 MR. WICHMAN: Objection, form.

9 THE WITNESS: I believe a POSA would
10 have expected there to be differences in the
11 structure of those two MgO layers.

12 BY MR. WILSON:

13 Q. And what do you think a person of
14 ordinary skill in the art would have expected those
15 structural differences to be?

16 A. The seed layer is grown on
17 single-crystal MgO. The barrier layer is grown on
18 either cobaltine or iron or amorphous cobaltine
19 boron. And its structure depends on what it's
20 grown on.

21 Q. Okay. Well, Yuasa, the '134 Patent --
22 let me strike that.

1 The '134 Patent describes a tunnel
2 barrier of MgO(001) grown on iron(001), correct?

3 A. One of the embodiments has that
4 structure.

5 Q. Okay. The Figure 11 embodiment then
6 describes a tunnel barrier layer of MgO(001) grown
7 on amorphous cobalt iron boron, correct?

8 A. Yes.

9 Q. Are there structural differences in
10 those two tunnel barrier layers?

11 MR. WICHMAN: Objection, form.

12 THE WITNESS: I think the POSA would
13 think yes.

14 BY MR. WILSON:

15 Q. Okay. But they still both meet the
16 claim limitation of an MgO(001) layer, correct?

17 A. Which claim limitation? Which claim?

18 Q. So -- okay. Let's take a look at '134,
19 Claim 1. Column 10 about line 8.

20 A. Okay.

21 Q. It says: (Reading)

22 Wherein said tunnel barrier

1 layer comprises a single-crystalline
2 magnesium oxide in which (001) crystal
3 plane is preferentially oriented or a
4 polycrystalline magnesium oxide in
5 which (001) crystal plane is
6 preferentially oriented.

7 Now, in both cases, the first
8 embodiment in the '134 Patent and the Figure 11
9 embodiment, the tunnel barrier layer MgO(001)
10 satisfies this limitation, correct?

11 A. Yes.

12 Q. Okay. Let's turn to . . .

13 A. Can you just confirm you asked me if
14 the tunnel barrier in those two embodiments
15 satisfies this claim. Is that what you asked me?

16 Q. I asked you if the tunnel barrier, the
17 MGO(001) tunnel barrier in the first embodiment,
18 and the Figure 11 embodiment, satisfies this
19 limitation "wherein" clause in Claim 1?

20 MR. WICHMAN: Objection, form.

21 BY MR. WILSON:

22 Q. Okay.

1 A. That's okay.

2 Q. I want to take a look now at 1036,
3 which is Wulff.

4 Now, you've seen Exhibit 1036 before,
5 correct?

6 A. Yes.

7 Q. Okay. You offer opinions on this in
8 your declarations, correct?

9 A. I offer opinions about how it doesn't
10 add to the knowledge of the person skilled in the
11 art.

12 Q. Okay. If we look on the first page,
13 lower right-hand corner, Wulff says: (Reading)

14 Apart from epitaxy, MgO grows
15 with strong preferential (100)
16 orientation regardless of the
17 substrate selection.

18 Did I read that correctly?

19 A. That's what it says.

20 Q. Now, if we back up one sentence -- or
21 actually -- yeah, one sentence. It says:
22 (Reading)

1 At a substrate temperature of
2 300 degrees Celsius, MgO films were
3 deposited on several semiconductors by
4 RF sputtering of a pure MgO target.

5 And do you see Footnote 8?

6 A. I see that.

7 Q. Okay. Well, let's keep reading. It
8 then says: (Reading)

9 Apart from epitaxy, MgO grows
10 with strong preferential (100)
11 orientation regardless of the
12 substrate selection. The authors
13 report that the substrate's
14 temperature strongly affected the
15 surface morphology of
16 3-nanometer-thick layers.

17 Now, your opinion, let's turn to
18 Exhibit 2053, Paragraph 146.

19 MR. WICHMAN: Which Exhibit 2053?

20 MR. WILSON: Sorry. '134 Patent.

21 BY MR. WILSON:

22 Q. Actually, let's look at Paragraph 145

1 first.

2 It says -- you said: (Reading)

3 Neither Wulff nor Yoon

4 investigated the microstructure of MgO

5 tunnel barrier films on the order of

6 10-nanometers-thick or less as used in

7 MTJs.

8 Did I read that correctly?

9 A. Yes.

10 Q. You said in Paragraph 146: (Reading)

11 Wulff described the behavior

12 of MgO films with thicknesses

13 exceeding 100 nanometers, e.g.,

14 .1 micron.

15 Did I read that correctly?

16 A. Yes.

17 Q. Okay. As you just saw, and let's turn

18 back to Wulff, Wulff is describing growing

19 (100)-oriented MgO regardless of the substrate

20 selection at -- in 3-nanometer-thick layers,

21 correct?

22 A. Wulff isn't doing that experiment.

1 This is part of the introduction of the paper.

2 Q. Wulff is describing what was already
3 known in the art, what was already reported in the
4 art, correct?

5 A. He's -- he's citing -- he's citing
6 literature, as one typically does in papers.

7 Q. Okay. And he's citing literature that
8 reports apart from the epitaxy, MgO grows with
9 strong preferential (100) orientation regardless of
10 the substrate selection with reference to
11 3-nanometer-thick layers, correct?

12 MR. WICHMAN: Objection.

13 THE WITNESS: This is not work that
14 Wulff has done. This is something he's
15 apparently citing, and he's not giving a
16 reference number for it.

17 BY MR. WILSON:

18 Q. Well, he cites it in Footnote 8,
19 correct?

20 MR. WICHMAN: Objection.

21 THE WITNESS: I haven't -- I don't
22 recall reading Footnote 8. Is this one of

1 the exhibits?

2 BY MR. WILSON:

3 Q. No, not yet.

4 So you read Wulff and came to the
5 opinion that Wulff didn't discuss MgO layers
6 smaller than 100 nanometers thick and you weren't
7 curious when you saw this citation in his
8 description that MgO layers as thin as 3 nanometers
9 could be formed on any substrate?

10 MR. WICHMAN: Objection.

11 THE WITNESS: Dr. Bokor does not --
12 Dr. Bokor refers to Wulff and Yoon. I don't
13 believe Dr. Bokor refers to this particular
14 reference.

15 My declaration is in response to the
16 Petitioner's expert's declaration, the -- and
17 the Petitioner's, what's the right word,
18 Complaint; is that right? My declaration is
19 not -- did not address this particular
20 reference, which was not part of Dr. Bokor's
21 testimony.

22

1 BY MR. WILSON:

2 Q. Okay. You didn't address this
3 statement in Wulff either, referring to 3-nanometer
4 MgO layers, correct?

5 A. This isn't work that Wulff did.

6 Q. But it's a statement in Wulff, correct?

7 A. There are a lot of statements in Wulff.
8 Dr. Bokor commented on the relevance of Wulff, and
9 my comments are in response to that.

10 Q. So if Wulff reported 100 nanometer
11 layers of MgO(001) and also reported that it was
12 known they could be grown as thin as 3 nanometers,
13 you don't think that's relevant to your opinion,
14 that he doesn't address anything less than
15 100 nanometers?

16 A. Wulff's experiments do not address
17 thinner films.

18 Q. Okay.

19 A. And Dr. Bokor did not address that part
20 of Wulff.

21 MR. WILSON: Okay. Mitchell, can you
22 propagate Exhibit 1099?

1 (Brief pause.)

2 MR. WILSON: Well, I think we may have
3 lost Mitchell. I will see if I can propagate
4 it to you.

5 THE EXHIBIT TECHNICIAN: Sorry. I'm
6 here. I'm having some tech issues. It has
7 nothing to do with the video. I apologize.
8 But can you repeat the number?

9 MR. WILSON: 1099.

10 THE EXHIBIT TECHNICIAN: All right.
11 I'll put it in the chat right now.

12 MR. WILSON: Okay, great.

13 THE EXHIBIT TECHNICIAN: I'm sorry.
14 I'm having some -- I have three computers
15 running and have got a little tech issue.
16 But 1099 I will drop in right now.
17 Apologies, everyone.

18 (Exhibit Number 1099 was marked for identification.)

19 THE WITNESS: Not in the Zoom.

20 THE EXHIBIT TECHNICIAN: You'll see it
21 in just -- there you go. Now it should be in
22 there.

1 THE WITNESS: Okay.

2 THE EXHIBIT TECHNICIAN: And I'll share
3 it as well.

4 MR. WICHMAN: Did you download it?

5 THE WITNESS: I think so. It's hard to
6 get it to show on the screen. I think I
7 downloaded it.

8 (Brief pause.)

9 BY MR. WILSON:

10 Q. Okay. Dr. Ross, do you now have
11 Exhibit 1099?

12 A. Yes.

13 MR. WICHMAN: Hold on. I need to get
14 it. Okay.

15 BY MR. WILSON:

16 Q. Okay. Can you confirm that
17 Exhibit 1099 is, in fact, the article cited in
18 Footnote 8 of Wulff?

19 (Witness reviews document.)

20 A. Looks like it.

21 Q. And you can see that Exhibit 1099 is
22 entitled, "Epitaxial growth of NbN on an ultrathin

1 MgO/semiconductor system," and it was published in
2 August 1987.

3 Do you see that?

4 A. Yes.

5 Q. Okay. Have you ever seen Exhibit 1099
6 before?

7 A. No.

8 Q. Okay. Let's look at the abstract at
9 the top of the first page of the actual article.
10 It says: (Reading)

11 NbN epitaxial growth on
12 ultrathin MgO/semiconductor system was
13 carried out by reactive sputtering.
14 It was revealed that (100)-oriented
15 NbN epitaxy was achieved on a
16 (100)-oriented silicon substrate by
17 introducing a MgO buffer layer as thin
18 as 5 angstroms at the interface.

19 Did I read that correctly?

20 A. Yes.

21 Q. If we take a look at page 962.
22 Actually, let's just jump to page 964.

1 So middle of the left-hand column, do
2 you see "an amazing result," the paragraph that
3 begins "an amazing result"?

4 A. I can see that paragraph.

5 Q. Okay. It says: (Reading)

6 An amazing result of this
7 technique is that the NbN epitaxy is
8 achieved on 5-angstrom MgO silicon
9 even though the MgO silicon structure
10 has a large lattice mismatch,
11 8.8 percent.

12 Now, if we go down a few lines, it
13 says: (Reading)

14 To study the mechanism of the
15 MgO growth with the (100) orientation,
16 we carried out the NbN growth on MgO
17 thermally oxidized silicon substrate
18 where the silicon substrate was
19 oxidized in an oxygen atmosphere at
20 1000 degrees C for one hour. The NbN
21 epitaxial layer was then obtained even
22 on a 10-angstrom magnesium oxide

1 silica structure, which suggests that
2 the mechanism of the epitaxy cannot be
3 explained by the epitaxial growth of
4 MgO, but rather by the natural
5 orientation or the graphoepitaxy of
6 MgO.

7 Did I read that correctly?

8 A. That's what it says.

9 Q. Okay. The 10-angstrom or 1-nanometer
10 MgO layer grown on silica is grown on an amorphous
11 layer, correct?

12 MR. WICHMAN: Objection, beyond the
13 scope.

14 THE WITNESS: I haven't seen this
15 article before, so I need to spend some time
16 reading it to understand what these authors
17 did and how they came to their conclusions.

18 BY MR. WILSON:

19 Q. Okay. You can set Exhibit 1099 aside.

20 Now, let's take a look at Exhibit 2065.

21 MR. WICHMAN: Mr. Mahon, you might want
22 to stop sharing your screen.

1 MR. WILSON: Yeah, you can stop
2 sharing.

3 BY MR. WILSON:

4 Q. Dr. Ross, do you have Exhibit 2065?

5 A. Yes, I do.

6 Q. Okay. This is an article you cited
7 entitled "Microstructural evolution during film
8 growth," by Petrov, among others, correct?

9 A. Yes.

10 Q. And so you're familiar with
11 Exhibit 2065, correct?

12 A. Yes, broadly.

13 Q. Okay. Let's go to the second column --
14 actually, let's go to page S118, which is
15 effectively the second page of the article.

16 Okay. And you see in the left-hand
17 column the heading Roman numeral II, "Growth of
18 Pure Elemental Polycrystalline Films"?

19 A. Yes.

20 Q. Okay. Is magnesium oxide a pure
21 elemental film?

22 A. No.

1 Q. Okay.

2 So the passage you cite at the
3 beginning of the second paragraph under that
4 heading says: (Reading)

5 The nucleation barrier is
6 generally expected to be small,
7 leading to randomly oriented islands
8 for low-temperature deposition on
9 amorphous substrates.

10 Do you see that?

11 A. I see that sentence.

12 Q. Okay. And you would agree that
13 sentence has no relevance to the magnesium oxide,
14 correct?

15 A. No. Can you point me to my -- the page
16 in my declaration you've referred to?

17 Q. Sure. Take your '134 declaration,
18 page 64, Paragraph 159.

19 A. Okay.

20 Q. You say: (Reading)

21 A person of ordinary skill in
22 the art would not have been able to

1 predict what crystal orientations
2 would form nucleate on an amorphous
3 surface in the thicknesses used for
4 MTJ barriers, i.e., less than
5 10 nanometers, because it was known
6 that initial crystal formation on
7 amorphous substrates results in
8 randomly oriented islands of crystals
9 which may evolve into a preferred
10 texture as the film grows thicker.

11 And you cite Exhibit 2065 at page S118,
12 correct?

13 A. That's right.

14 Q. Okay. Now, let's look at page S126,
15 which you also cite.

16 Now, if you look at the very upper
17 left-hand corner of page S126, the second sentence
18 says: (Reading)

19 In both cases, however,
20 competitive texture evolution follows
21 random nucleation on the amorphous
22 substrate.

1 Did I read that correctly?

2 A. You read that correctly.

3 Q. And that's the purpose for which you
4 are citing Exhibit 2065 in Paragraph 159, correct?

5 A. Yes, the random nucleation on the
6 amorphous substrate.

7 Q. Okay. Now, if we turn back to
8 page S124, at the beginning of this section, it
9 says: (Reading)

10 In this section, we discuss
11 irradiation effects observed when the
12 ion flux is increased while
13 maintaining E_i less than or equal to
14 20 electron volts.

15 Did I read that correctly?

16 A. Yes.

17 Q. Do you have any idea as you sit here
18 what compound is being studied in this section?

19 A. I will have to go back and look at the
20 references, but there's a number of compounds
21 mentioned.

22 Q. Okay. Take a look at the next column

1 over on page S124 where it says, last sentence in

2 that first fractional paragraph: (Reading)

3 We use tantalum nitride

4 deposition as an example to illustrate

5 the primary observations.

6 Did I read that correctly?

7 A. That's right.

8 Q. This paper, including this section,

9 says nothing about magnesium oxide, correct?

10 A. I don't know. I'd have to reread it.

11 It's been a while since I read it.

12 Q. Okay. Well, you don't refer in your

13 declaration to any reference to magnesium oxide in

14 this paper, correct?

15 A. This reference I'm citing is that --

16 it's a review article about crystal growth and for

17 growth of a wide range of materials, for example,

18 compounds and elements. The initial stages of

19 crystal growth on amorphous substrates are random.

20 And this is the range of literature that a person

21 skilled in the art might be looking at to

22 understand how thin layers grow on amorphous

1 substrates.

2 Q. Okay. You don't think a person of
3 ordinary skill in the art might have looked at any
4 of the other exhibits that we've referred to today,
5 Wang 1997, Tonouchi, Inaba? You don't think they
6 might have looked at those articles as well?

7 MR. WICHMAN: Objection.

8 THE WITNESS: None of those references
9 are references I discussed, at least the --
10 let me take that back. You showed me a
11 couple of references which were things I had
12 not considered or cited in my declaration.
13 So I can't comment on whether the person
14 skilled in the art would have read those
15 without reading them myself.

16 BY MR. WILSON:

17 Q. Well, two of those references are cited
18 by Dr. Yuasa himself, correct?

19 A. Yes.

20 Q. Okay. So does that help you understand
21 whether a person of ordinary skill in the art in
22 this field would have looked at those references?

1 MR. WICHMAN: Objection, beyond the
2 scope.

3 THE WITNESS: I don't see the relevance
4 since Yuasa's publication was after the
5 patent.

6 BY MR. WILSON:

7 Q. Okay. All of the articles that I
8 showed you, Wang 1997, Inaba, Tonouchi, are
9 pre-2004 articles, correct?

10 MR. WICHMAN: Objection, compound.

11 THE WITNESS: I can go back and look at
12 them. So which one? Tonouchi was 1987.
13 Which was the other one?

14 BY MR. WILSON:

15 Q. Wang 1997 was 1997, correct?

16 A. Correct.

17 Q. And Inaba, Inaba was 2000, correct?

18 A. Correct.

19 Q. Okay. Let's take a look at
20 Exhibit 1062, Parkin.

21 Okay. You have Exhibit 1062?

22 A. Yes, Parkin's patent.

1 Q. And you're familiar with Exhibit 1062,
2 correct?

3 A. Correct.

4 Q. Okay. Now, the Petition in this case
5 relied on Parkin's Figure 3A embodiment. Do you
6 recall that?

7 A. I recall that.

8 Q. Okay. And if we go down to
9 Column 17 -- well, actually, let's back up. You
10 can see Column 16, line 47 begins discussion of the
11 Figure 3A embodiment.

12 Do you see that?

13 A. Yes.

14 Q. Okay. And you will recall -- actually,
15 let's go down to Column 17, line 11. You can see
16 the substrate is formed from an amorphous silica
17 layer formed on a silicon substrate. Then there's
18 an underlayer or bottom electrical lead of
19 100 angstroms of tantalum. Then there's an
20 antiferromagnetic layer 116 of iridium manganese
21 150 angstroms. And next, a ferromagnetic layer
22 115, 35 angstroms of cobalt iron is deposited. And

1 then you have an MgO tunnel barrier layer 120 prime
2 is then formed on top of the lower ferromagnetic
3 electrode 110 prime.

4 And then when we get down to Column 17,
5 line 40: (Reading)

6 The MTJ device shown in
7 Figure 3A is completed by forming the
8 top ferromagnetic electrode, which is
9 the storage layer. The storage layer
10 is comprised of an amorphous
11 ferromagnetic layer 175. For example,
12 the layer 175 may be comprised of
13 75-angstrom-thick cobalt iron boron.

14 So is all of that correct?

15 MR. WICHMAN: Objection.

16 THE WITNESS: I believe you were
17 reading the text from the Column 17.

18 BY MR. WILSON:

19 Q. Yes, I was. I just want to make sure
20 you agree with it.

21 MR. WICHMAN: Objection.

22 THE WITNESS: I'm not sure what I'm

1 agreeing to.

2 BY MR. WILSON:

3 Q. Did I read it correctly?

4 A. Well, you didn't read every word of it.

5 Q. Right.

6 Okay. But the layers that Parkin
7 describes for the Figure 3A embodiment are the ones
8 I identified, correct?

9 A. Well, let's see. There's the
10 substrate, silicon with silica, tantalum, iridium
11 manganese, then cobalt iron, ferromagnetic layer,
12 tunnel barrier, and then, for example, cobalt iron
13 boron storage layer.

14 Q. Okay.

15 A. And then -- and then there would be
16 tantalum nitride and ruthenium on top.

17 Q. Okay. Okay. So if we go back up in
18 Column 17, line 7, it says: (Reading)

19 The MTJ device of Figure 3A
20 may also be inverted, such that the
21 reference ferromagnetic electrode is
22 formed above the tunnel barrier and

1 the storage layer is formed beneath
2 the tunnel barrier.

3 Did I read that correctly?

4 A. That's what it says.

5 Q. So Parkin is saying that you can put
6 the amorphous cobalt iron boron layer underneath
7 the MgO layer, correct?

8 A. He's saying -- he says the storage
9 layer is formed beneath the tunnel barrier.

10 Q. Right. And the storage layer may be
11 comprised of 75 angstroms cobalt iron boron,
12 correct?

13 A. It may be. According to line 43, it
14 may be comprised of cobalt iron boron.

15 Q. So Parkin taught forming an MgO(001)
16 layer above an amorphous cobalt iron boron storage
17 electrode, correct?

18 A. I don't believe he described the
19 structure of the MgO in this inverted device.

20 Q. Well, the MgO in the Figure 3A
21 embodiment is highly-textured MgO tunnel barrier,
22 as seen at Column 18, line 50, correct?

1 A. Column 18, line 50, it doesn't say
2 which figure it's referring to.

3 Q. Well, this is still the Figure 3A
4 embodiment, correct?

5 If you look down at line 63, he's
6 describing the TMR of the device at Figure 3A. Do
7 you see that?

8 A. Hang on. Which column are we in?

9 Q. Column 18. Just about 12 lines down
10 from what you were just reading.

11 A. Oh, I see.

12 Q. So when he talks about the
13 highly-textured (100) MgO tunnel barrier, he's
14 talking about Figure 3A, correct?

15 A. Well, this line 63 just says the TMR of
16 the device of Figure 3A being larger than that of
17 prior art alumina tunnel barriers. But that's not
18 the inverted one.

19 Q. Okay. So you're saying he doesn't
20 disclose what the tunnel barrier layer is in the
21 inverted example?

22 A. He says it's inverted.

1 Q. Okay. And when he says --

2 A. But that --

3 Q. Sorry. Go ahead.

4 A. I was going to say the line you pointed
5 out, Column 17, line 3, merely says the device may
6 be inverted. It doesn't give any further details
7 in that --

8 Q. Right.

9 A. -- section.

10 Q. It says: (Reading)

11 The MTJ device of Figure 3A
12 may also be inverted such that the
13 reference ferromagnetic electrode is
14 formed above the tunnel barrier and
15 the storage layer is formed beneath
16 the tunnel barrier.

17 Did I read that correctly?

18 A. That's what it says.

19 Q. Okay. So why would a person of
20 ordinary skill in the art reading that think the
21 tunnel barrier had changed?

22 A. Because the tunnel barrier is now being

1 grown on the storage electrode amorphous cobalt
2 iron boron, or whatever is being used, rather than
3 what was in 3A. And the structure depends on how
4 the layers are built up.

5 Q. So even though Parkin doesn't describe
6 a difference in that scenario, your opinion is that
7 a person of ordinary skill in the art would expect
8 a difference, correct?

9 A. My opinion in the declaration is that
10 the person of skill in the art wouldn't have known
11 what was going to happen.

12 Q. Okay. And so in order -- in your mind,
13 in order for Parkin to properly teach this, he
14 would have had to explain how he knew that MgO(001)
15 would grow on an amorphous cobalt iron boron layer,
16 correct?

17 MR. WICHMAN: Objection.

18 THE WITNESS: I don't know what Parkin
19 knew about this other than what's in the
20 patent. And he just says the structure may
21 be inverted. This is a very incomplete
22 description. For example, we don't know

1 which of the layers are actually flipped,
2 every single one of them or just the storage
3 in the reference electrode. So the person of
4 skill in the art would not know how the MgO
5 would grow in this inverted structure.

6 BY MR. WILSON:

7 Q. So in order to convince a person of
8 ordinary skill in the art that this would actually
9 work, as he's described it, you're saying he would
10 have had to explain how he knew that the MgO(001)
11 would grow on the cobalt iron boron layer, correct?

12 MR. WICHMAN: Objection.

13 THE WITNESS: Parkin doesn't teach the
14 person of skill in the art that the -- how
15 the MgO will grow on the amorphous cobalt
16 iron boron, so she would have to look for
17 other indications, and this is described in
18 my declaration about what the other
19 literature cited by Dr. Bokor says about MgO
20 growing on amorphous layers.

21 BY MR. WILSON:

22 Q. Okay. Let's take a look at Column 22,

1 line 29. And you can see this is the beginning of
2 the discussion of the Figure 11 embodiment?

3 A. Yes.

4 Q. And it says: (Reading)

5 Figure 11 shows another
6 representative embodiment of the
7 current invention in which the
8 structure of the devices shown in
9 Figures 3A and 3B is inverted so that
10 the storage layer or electrode is
11 formed beneath the tunnel barrier and
12 the reference electrode is formed
13 above the tunnel barrier.

14 Did I read that correctly?

15 MR. WICHMAN: Objection, beyond the
16 scope, relevance.

17 THE WITNESS: You did read the text.

18 BY MR. WILSON:

19 Q. Correctly?

20 A. As it's written.

21 Q. Okay.

22 Have you looked at Figure 11 in Parkin?

1 MR. WICHMAN: Objection, beyond the
2 scope, relevance.

3 THE WITNESS: Figure 11 is not part of
4 my declaration because Dr. Bokor doesn't
5 address Figure 11.

6 BY MR. WILSON:

7 Q. Okay. Well, you expressed confusion
8 over what Parkin disclosed as far as which layers
9 would swap places when the Figure 3A embodiment is
10 inverted. And Figure 11 gives such an example,
11 correct?

12 MR. WICHMAN: Objection, beyond the
13 scope, relevance.

14 THE WITNESS: I didn't state any
15 opinions about Figure 11 in my declaration.

16 BY MR. WILSON:

17 Q. Okay. Let's look -- if we look at
18 Column 22, line 56, you can see that: (Reading)

19 The storage magnetic electrode
20 510 is formed on the underlayer 512 by
21 deposition of a layer 515 comprising
22 an amorphous ferromagnetic alloy.

1 And it says at line 62: (Reading)

2 In Figure 11, a layer 515 of
3 cobalt iron boron is deposited which
4 is 60 angstroms thick.

5 Do you see that?

6 MR. WICHMAN: Objection, beyond the
7 scope, relevance.

8 THE WITNESS: I can see that.

9 BY MR. WILSON:

10 Q. Okay. If you look down at line 66, it
11 says: (Reading)

12 An interface layer 520 of a
13 crystalline cobalt iron may also be
14 used.

15 Did I read that correctly?

16 MR. WICHMAN: Objection, beyond the
17 scope, relevance.

18 THE WITNESS: You read what's written.

19 BY MR. WILSON:

20 Q. Okay. So you understand when it says
21 "may also be used," the cobalt iron layer is
22 optional, correct?

1 MR. WICHMAN: Objection, beyond the
2 scope, relevance.

3 THE WITNESS: I didn't formulate an
4 opinion about that question because, as I
5 mentioned before, Figure 11 isn't discussed
6 in my declaration and it wasn't discussed by
7 Dr. Bokor's declaration.

8 BY MR. WILSON:

9 Q. So you don't feel comfortable
10 testifying about Parkin's Figure 11 as you sit here
11 today?

12 MR. WICHMAN: Objection, beyond the
13 scope, relevance.

14 THE WITNESS: My understanding is that
15 my role today is to testify about my
16 declaration, and this is not part of my
17 declaration.

18 BY MR. WILSON:

19 Q. Well, also part of your role today is
20 to be cross-examined based on information in the
21 record that is inconsistent with your declaration.

22 Do you understand that?

1 MR. WICHMAN: Objection, argumentative.

2 THE WITNESS: Well, if you say so.

3 BY MR. WILSON:

4 Q. Well, and that includes information,
5 whether you chose to discuss it or not. Do you
6 understand that?

7 MR. WICHMAN: Objection.

8 BY MR. WILSON:

9 Q. Let's take a look at Exhibit --

10 MR. WILSON: Actually, so we've been
11 going for a little over an hour. Are you
12 ready for a break or would you prefer to keep
13 going?

14 THE WITNESS: We can take a break.

15 THE VIDEOGRAPHER: We are going off the
16 record. The time is 2:01.

17 (Recess taken.)

18 THE VIDEOGRAPHER: We are going back on
19 the record. The time is 2:13.

20 BY MR. WILSON:

21 Q. Okay. Dr. Ross, let's take a look
22 at -- actually, let's take a look at your

1 '134 declaration, Paragraph 225.

2 Do you have that?

3 A. I have -- I have Paragraph 2 -- what is
4 it, 225?

5 Q. 225.

6 Begins "Third, contrary to the
7 Petition's suggestion." Do you see that?

8 A. Yes.

9 Q. So you opine in Paragraph 225 that a
10 person of ordinary skill in the art would have
11 understood that Exhibit 1060 does not teach that
12 cobalt iron boron crystallizes when annealed.

13 You say: (Reading)

14 Exhibit 1060 provided X-ray
15 diffraction patterns for devices with
16 a gold layer.

17 Did I read that correctly?

18 A. That's what it says.

19 Q. And you are aware that Exhibit 1060 is
20 Jimbo, correct?

21 A. Yes, it's Jimbo.

22 Q. Okay. So in Paragraph 226 of your

1 declaration, you go on to say: (Reading)

2 Gold, which has a fcc(111)
3 structure, has a (200) diffraction
4 peak at 44 degrees, indicating
5 crystals of the (200) orientation,
6 precisely where Jimbo, Exhibit 1060,
7 labels a cobalt iron fcc(111) peak.

8 You say: (Reading)

9 When interpreting X-ray
10 diffraction scans, a person of
11 ordinary skill in the art would
12 consider possible diffraction peaks
13 from all the components of the sample.
14 It happens due to the crystal
15 structure and lattice parameter of
16 gold, that there is a strong gold peak
17 from the fcc gold(200) crystal planes
18 at a very similar diffraction angle to
19 peak -- to the peak from fcc cobalt
20 iron(111) planes.

21 Have I read that correctly so far?

22 A. Yes.

1 Q. So you say: (Reading)

2 In a sample with both gold and
3 fcc cobalt iron, these peaks would be
4 very hard to distinguish. Therefore,
5 a perfectly reasonable interpretation
6 of the peak at 44 degrees is that it
7 comes from gold which is present in
8 the sample and is known as a strong
9 scatterer due to its high atomic
10 number.

11 Now, did I read that correctly?

12 A. You did.

13 Q. So what you are opining is that a
14 reasonable interpretation of Jimbo's peak at
15 44 degrees is that it comes from gold, correct?

16 A. That is a reasonable interpretation of
17 it.

18 Q. Okay. You cannot rule out, reviewing
19 Jimbo, that there was, in fact, crystallization of
20 the cobalt iron boron, correct?

21 A. The person skilled in the art can't
22 tell how much of that peak comes from cobalt iron

1 versus gold.

2 Q. Right. So all you're saying is a
3 plausible alternative interpretation of Jimbo's
4 data is that the 44-degree peak came from gold
5 instead of cobalt iron, correct?

6 A. It's a factor that the POSA would need
7 to consider.

8 Q. Okay. And so in your opinion, Jimbo
9 needed some additional test data to determine which
10 of those two interpretations of his X-ray
11 diffraction data is correct?

12 A. Which of the two possible
13 interpretations that you referred to.

14 Q. In other words, whether his 44-degree
15 peak or -- sorry, let me strike that. Let me start
16 over.

17 In your opinion, Jimbo needed some
18 additional test data to determine whether the
19 44-degree X-ray diffraction peak was from gold or
20 from crystallized cobalt iron, correct?

21 A. Jimbo -- you can't tell from Jimbo's
22 Figure 1 what caused that peak, whether it's cobalt

1 iron, fcc(111) or whether it's gold(200).

2 Q. Right. And so he would have needed
3 some additional test data to get to the bottom of
4 that question, correct?

5 A. Yes. I made that comment.

6 Q. Okay. Okay. And let's look at Jimbo
7 now, which you have in front of you, correct?

8 A. I do.

9 Q. Okay. Let's look at page 309 of Jimbo.
10 Now, in the upper left-hand column,
11 Jimbo says, he refers to Fourier transforms of
12 cobalt K-edge EXAFS oscillations, correct?

13 A. That's in the caption of Figure 2.

14 Q. No. I'm reading from the main body of
15 the text. Page 309, upper left-hand column.

16 You see it says: (Reading)

17 From Fourier transforms of
18 cobalt K-edge EXAFS oscillations,
19 long-range ordering extending farther
20 than second or third nearest neighbor
21 atoms is not thought to exist.

22 You see that?

1 A. Yes, I do.

2 Q. Okay.

3 He goes on to say -- now, you
4 understand that EXAFS is the extended X-ray
5 absorption structure spectroscopy, correct?

6 A. I do.

7 Q. He goes on to say in that same passage:
8 (Reading)

9 After annealing at 400 degrees
10 Celsius, however, the shape of FT
11 spectrum becomes to suggest fcc
12 structure. The results of EXAFS as
13 well as XRD imply that the cobalt iron
14 boron layer of 10 nanometers thick is
15 amorphous in the as-deposited state
16 and start crystallizing after
17 annealing at 250 degrees Celsius.

18 Did I read that correctly?

19 A. That's what it says.

20 Q. Okay. So Jimbo, in fact, relied not
21 just on X-ray diffraction, but on cobalt K-edge
22 EXAFS oscillations as well to determine that the

1 cobalt iron boron layer had, in fact, crystallized,
2 correct?

3 A. Jimbo says his EXAFS and XRD imply
4 crystallization, but there's very little in that
5 EXAFS data. There's no numerical values or
6 reference data, so it's not particularly clear.

7 Q. Okay. If you take a look at Figure 2
8 where he provides the cobalt K-edge EXAFS
9 oscillation after annealing at various
10 temperatures, which shows both as-deposited and
11 annealed at 400 degrees Celsius.

12 Do you see that?

13 A. Yeah, that's right.

14 Q. And then in Figure 4, he again shows it
15 with the second, third and fourth nearest neighbor
16 sites indicated with R2, R3 and R4, which grows on
17 annealing, correct?

18 A. Well, he's got some peaks labeled R2,
19 R3, R4 in that structure.

20 Q. Okay. In your declaration criticizing
21 Jimbo's interpretation of the crystallization of
22 cobalt iron boron, you don't mention his EXAFS

1 data, correct?

2 A. I didn't mention EXAFS in my
3 declaration.

4 Q. Okay. But Jimbo did, in fact, have
5 additional test data over and above the X-ray
6 diffraction data on which he based his conclusion
7 that cobalt iron boron had crystallized, correct?

8 A. Well, he has EXAFS data and -- but he
9 doesn't have any quantification of that data.

10 Q. And Figure 4 is not a quantification of
11 that data?

12 A. Well, it's a set of plots, but there's
13 no relationship between the Fourier transform and
14 the crystal structure or crystal size.

15 Q. Well --

16 A. So you can't read crystal structure or
17 crystal size or orientation or any of those kind of
18 things directly off that EXAFS oscillation data.

19 Q. So are you saying he misinterpreted his
20 EXAFS data as well as his X-ray diffraction data?

21 A. Well, I don't know how to quantify
22 mis -- he misinterpreted his X-ray data. There's

1 no doubt about that. He didn't even consider the
2 contribution of the gold. And X-ray is the primary
3 way that a material scientist would look for
4 crystallization.

5 For the EXAFS data, there is no
6 relationship between what's shown and crystal
7 structure like fcc. You can't tell from that
8 whether you have fcc or not.

9 Q. But you --

10 A. You can tell there's a -- sorry. I
11 hadn't finished.

12 You can tell there's a change in the
13 nearest neighbor coordination, but you have to do
14 additional work to determine what it is that
15 actually happened.

16 Q. Okay. But the change in the nearest
17 neighbor orientation indicates that the cobalt iron
18 boron is -- or that the cobalt is becoming or
19 changing into a crystalline structure, correct?

20 A. We can't tell from the X-ray data.

21 Q. I'm talking about the EXAFS data.

22 A. Jimbo makes some general comments, but

1 the person of skill in the art reading that would
2 not be able to tell what crystallization took
3 place, i.e., what structure was formed from that
4 EXAFS data. It merely shows a change in nearest
5 neighbor coordination of cobalt.

6 Q. Okay. But that does indicate that the
7 cobalt is crystallizing, correct?

8 A. It indicates to me and to a POSA that
9 there's a change in the local environment of the
10 cobalt. It doesn't tell the POSA exactly what
11 happened.

12 Q. Okay. So at page 310, when -- in the
13 lower left-hand column, when Jimbo says, In the
14 as-deposited film, long-range order peaks
15 corresponding to the second, third and fourth
16 nearest neighbor sites, indicated with R2, R3, R4,
17 is very weak; after annealing at 300 degrees
18 Celsius, the shape of FT spectrum indicates fcc
19 structure, you just disagree with him, correct?

20 A. Well, you said a lot of things.
21 Which -- maybe we can break them down so I can tell
22 you if I agree with them.

1 Q. So let's talk about the last sentence:

2 (Reading)

3 After annealing at 300 degrees
4 Celsius, the shape of FT spectrum
5 indicates fcc structure.

6 You disagree with that statement,
7 correct?

8 A. Jimbo hasn't shown any data that one
9 could compare with that to -- he asserts it's
10 consistent with an fcc structure. I don't know
11 where he gets that conclusion from.

12 Q. Okay.

13 Okay. Let's take a look at
14 Exhibit 1055, which is Wang. Not the Wang we
15 referred to earlier.

16 Do you have Exhibit 1055?

17 A. Yes.

18 Q. You're familiar with Exhibit 1055,
19 Wang, correct?

20 A. Broadly.

21 Q. Okay. You reference it in your
22 declaration, correct?

1 A. Yes, but I haven't read it for a while.

2 Q. Okay. So if you take a look at
3 page 2270, which is the second page of Wang,
4 heading C, Cobalt iron boron - alumina - cobalt
5 iron boron junctions.

6 Do you see that?

7 A. Yes.

8 Q. And Section C, that first sentence
9 there states: (Reading)

10 With such a large increase of
11 TMR value by changing the free layer
12 from nickel iron cobalt to cobalt iron
13 boron, it is natural to replace both
14 the free and pinned layers to cobalt
15 iron boron to further increase the TMR
16 value.

17 Did I read that accurately?

18 A. That's what it says.

19 Q. Now, the next sentence says: (Reading)

20 Such SDT junctions were
21 fabricated with a stack structure of
22 silicon(100), silicon nitride,

1 ruthenium, cobalt iron boron, alumina,
2 cobalt iron boron, and chromium
3 manganese platinum.

4 Did I read that correctly?

5 A. Yeah.

6 Q. Okay. In this stack structure, alumina
7 is the tunnel barrier, correct?

8 A. That's right.

9 Q. And the chromium manganese platinum is
10 used to form an antiferromagnet with the cobalt
11 iron boron layer, correct?

12 A. Well, it's intended to be an
13 antiferromagnetic pinning layer.

14 Q. Okay. Okay. You can set Wang aside.
15 And let's go back to Exhibit 2006.

16 A. All right.

17 Q. Okay. Take a look at page 2, the lower
18 right-hand column. And I'm looking a little less
19 than halfway down the paragraph, right about even
20 with the top of Figure 2A. It says "it should also
21 be noted."

22 Do you see that?

1 A. Yes.

2 Q. It says: (Reading)

3 It should also be noted that
4 at the present stage, we cannot
5 exclude a possibility of local
6 crystallization of a few monolayers of
7 cobalt iron boron at the electrode
8 barrier interfaces which could not be
9 detected in the HRTEM observation.

10 Did I read that correctly?

11 A. That's what Yuasa says.

12 Q. Okay. And Dr. Yuasa did not know
13 whether that few monolayers of cobalt iron boron at
14 the electrode barrier interface had crystallized or
15 not, correct?

16 MR. WICHMAN: Objection.

17 THE WITNESS: In this particular paper
18 and this experiment from this one
19 high-resolution TEM, he just says he can't
20 exclude a possibility of local
21 crystallization of a few monolayers of cobalt
22 iron boron at the electro barrier interfaces

1 because his measurement technique is
2 incapable of showing that.

3 BY MR. WILSON:

4 Q. Okay. The HRTEM microscopy technique
5 did not have that high of a resolution to be able
6 to see crystallization that small, correct?

7 A. Well, what he said in there, he can't
8 exclude the possibility of crystallization of a few
9 monolayers.

10 Q. Okay. So Dr. Yuasa was saying it's
11 theoretically possible that the annealing caused a
12 portion of the cobalt iron boron layers to
13 crystallize, but he doesn't know, correct?

14 MR. WICHMAN: Objection.

15 THE WITNESS: Well, as I mentioned
16 before, his comments in this paper for this
17 particular experiment says he can't exclude
18 the possibility of crystallization of a few
19 monolayers of cobalt iron boron.

20 BY MR. WILSON:

21 Q. Right. So he's not saying it happened.
22 He's saying he can't exclude the possibility,

1 correct?

2 A. Well, that's what he said.

3 Q. Okay. Take a look at your '167
4 declaration, Exhibit 2053, for the '167 Patents.
5 And I want to look at page 103, starting at
6 Paragraph 290.

7 Okay. In this section, you begin
8 discussing Exhibit 2006, the Yuasa APL2005 paper,
9 and its application to the '167 Patent, correct?

10 A. So Paragraph 290 discusses the --
11 Exhibit 2006.

12 Q. Right.

13 A. Right.

14 Q. And in Paragraph 295, you say:
15 (Reading)

16 Yuasa APL2005 also disclosed a
17 possibility of local crystallization
18 of a few monolayers of cobalt iron
19 boron at the electrode barrier
20 interfaces.

21 Correct?

22 A. That's what it says.

1 Q. Now, in Paragraph 296, you say:

2 (Reading)

3 A person of ordinary skill in
4 the art would have recognized that the
5 crystallized monolayers of cobalt iron
6 boron met the claimed first and second
7 cobalt iron boron layers that are
8 entirely crystallized after the
9 annealing, thus meeting, for example,
10 independent Claims 1 and 11 and the
11 entirely crystallized limitations in
12 Claims 2, 4, 6 and 12 through 13.

13 Did I read that correctly?

14 A. Yes.

15 Q. Okay. So in your opinion, if, in fact,
16 there were a few monolayers of cobalt iron boron
17 that crystallized in Yuasa's MTJ, that would be
18 sufficient to meet the entirely crystallized
19 limitation of Claim 2, for example.

20 A. Can I break that down a bit?

21 Q. Sure.

22 A. Can you just repeat that?

1 Q. Sure.

2 Well, in your opinion -- well, let's --
3 in fact, let's pull up -- just to put a finer point
4 on it, let's pull up the '167 Patent. That is
5 Exhibit 1013. And if we look at Claim 1.

6 Claim 1, do you have it there?

7 A. Claim 1 of '167?

8 Q. Yes, Claim 1 of '167 says: (Reading)

9 A method of manufacturing a
10 magnetic tunnel junction, MTJ, device
11 comprising: Forming a first cobalt
12 iron boron layer that is amorphous;
13 forming a magnesium oxide layer over
14 the first cobalt iron boron layer;
15 forming a second cobalt iron boron
16 layer that is amorphous over the MgO
17 layer; and annealing the first and
18 second cobalt iron boron layers in the
19 MgO layer, wherein the first and
20 second cobalt iron boron layers are
21 crystallized by the annealing.

22 Okay. I'm just going to stop there.

1 Now, if we look at Claim 2, Claim 2

2 says: (Reading)

3 The method of Claim 1, wherein

4 the annealing, the first and second

5 cobalt iron boron layers are entirely

6 crystallized.

7 Did I read that correctly?

8 A. Yes.

9 Q. Okay. So now back to your declaration,
10 your '167 declaration at Paragraph 296. Here, you
11 offer the opinion that if, in fact, a few
12 monolayers of the otherwise amorphous cobalt iron
13 boron layer in Yuasa, Exhibit 2006, if those few
14 monolayers had, in fact, crystallized, that would
15 be sufficient to meet the crystallized cobalt iron
16 boron layers as well as the entirely crystallized
17 after the annealing cobalt iron boron layers,
18 correct?

19 A. That's right.

20 Q. Okay. So the fact that there is
21 additional cobalt iron boron in the original layers
22 that has not crystallized does not prevent you from

1 satisfying the entirely crystallized cobalt iron
2 boron layer limitation, correct?

3 A. I didn't construe the claims about the
4 meaning of all the claim terms beyond what was
5 understood by a POSA. And this is my opinion that
6 had there been a layer of crystallized cobalt iron
7 boron, if it were like Yuasa said, a layer of -- or
8 a few monolayers of crystallized cobalt iron boron,
9 that would be a crystallized layer of cobalt iron
10 boron.

11 Q. And it would be an entirely
12 crystallized layer of cobalt iron boron, correct?

13 A. That part of it. If it's -- if it's
14 locally crystallized at -- let me go back. If
15 Yuasa speculates that there is crystallization of a
16 few monolayers of cobalt iron boron at the
17 interface, if by that he means there's a continuous
18 layer of crystallized cobalt iron boron, then
19 that's a layer which is crystallized.

20 Q. Well, but he didn't say that, did he?

21 A. He doesn't use the word "entirely
22 crystallized." He comments about a possibility

1 of -- he can't exclude the possibility of
2 crystallization of a few monolayers at the
3 interface.

4 Q. Okay. And in your opinion in
5 Paragraph 296, that is sufficient to constitute an
6 entirely crystallized cobalt iron boron layer,
7 correct?

8 A. So my opinion was that if these layers
9 had been there, you would have a completely
10 crystallized layer. I didn't comment about the
11 remainder of the cobalt iron boron or any of the
12 other layers in the structure.

13 Q. Okay. So you're saying if there were a
14 few monolayers of cobalt iron boron that had been
15 crystallized, that would be sufficient not only to
16 meet the crystallized limitation, but also the
17 entirely crystallized limitations in Claims 2, 4, 6
18 and 12 through 13, correct?

19 A. Yes. A POSA would have recognized that
20 if Yuasa did have layers of fully crystallized
21 cobalt iron boron at the interface, that would have
22 been fully crystallized. However, Yuasa doesn't

1 say that for sure; he says he can't exclude the
2 possibility.

3 Q. Okay. Now, in your opinion, if those
4 few monolayers of crystallized cobalt iron boron
5 existed, would they have boron in them?

6 A. That's not a question I addressed.

7 Q. So it is irrelevant to whether the
8 crystallized cobalt iron boron in Yuasa satisfies
9 the claims of the '167 Patent whether there's any
10 boron in the crystallized portion or not, correct?

11 MR. WICHMAN: Objection.

12 THE WITNESS: I didn't construct the
13 claims. That wasn't part of my declaration
14 about the meaning of crystallized cobalt iron
15 boron.

16 BY MR. WILSON:

17 Q. Well, in Paragraph 296, you offer the
18 opinion that Yuasa's paper, Exhibit 2006, describes
19 practicing the claims of the '167 Patent. So I'm
20 asking you, did you consider whether or not the
21 hypothetical crystallized layers in Yuasa's
22 Exhibit 2006 would have had boron in them?

1 A. Yuasa doesn't address that question in
2 Exhibit 2006. So my comment about 2000 --
3 Exhibit 2006 don't relate to boron distribution
4 because that's not covered in that exhibit.

5 Q. Okay. Well, my question is, do you
6 need to know if there's boron in the crystal or
7 entire crystal to know whether it practices the
8 claims of the '167 Patent?

9 A. The claims just say crystallized cobalt
10 iron boron. The first and second layers are
11 crystallized or entirely crystallized. So the
12 distribution of the boron is not included in the
13 claim.

14 Q. So in your understanding, Claim 1, for
15 example, when it says, Wherein the first and second
16 cobalt iron boron layers are crystallized by the
17 annealing, it's irrelevant whether there is any
18 boron remaining in the crystals at the time they
19 crystallize due to the annealing, correct?

20 A. No. I didn't consider that question
21 because that wasn't part of the -- the declaration
22 to respond to the grounds of the Petitioner to

1 invalidate the patent.

2 Q. So I am asking --

3 THE VIDEOGRAPHER: We need to go off
4 the record for a second. We're having an
5 audio issue over here.

6 MR. WILSON: Okay.

7 THE VIDEOGRAPHER: Going off the
8 record. The time is 2:50.

9 (Discussion held off the record.)

10 THE VIDEOGRAPHER: We are going back on
11 the record. The time is 2:53.

12 BY MR. WILSON:

13 Q. Okay. Dr. Ross, my question is, do you
14 need to know whether there is boron in the few
15 monolayers, the hypothetical few monolayers of
16 cobalt iron boron crystals in Dr. Yuasa's
17 Exhibit 2006 to know whether it is practicing
18 Claims -- Claim 1 of the '167 Patent?

19 A. Do I need to know where the boron went?
20 I didn't consider the question of what happened to
21 the boron during these growth and annealing
22 processes because that wasn't relevant to the

1 questions I had to answer in the declaration.

2 Q. Okay. My question is different. My
3 question is, looking at Claim 1 of the '167 Patent,
4 do you need to know if when the cobalt iron boron
5 layer is crystallized, if there is boron remaining
6 in the crystalline structure in order to determine
7 whether it meets Claim 1?

8 A. I haven't considered that question, so
9 I can't give you an answer to that question.

10 Q. Okay. So you determined that
11 Dr. Yuasa's Exhibit 2006, disclosure of the
12 potential crystallization of a few monolayers, you
13 offered the opinion that that satisfies the claims
14 of the '167 Patent without knowing whether there's
15 any boron in those crystals or not, correct?

16 A. It's correct that Exhibit 2006 does not
17 discuss the fate of the boron and neither do the
18 claims, so that question was not something I
19 considered.

20 Q. Okay. So in your opinion, it's
21 irrelevant to whether you're practicing the claims
22 of the '167 Patent whether there is boron remaining

1 in the crystals of the cobalt iron boron layers

2 once they are crystallized, correct?

3 A. No, I can't say whether it's relevant

4 or not because I didn't consider that question.

5 Q. Well, so you don't know as you sit here

6 whether it's relevant or not to whether you

7 practice the claims of the '167 Patent?

8 A. Well, the claims of the '167 Patent

9 don't say anything about boron, so that's not a

10 question I addressed in my declaration.

11 Q. Okay. So the claims of the '167 Patent

12 refer to cobalt iron boron layers, correct?

13 MR. WICHMAN: Objection.

14 BY MR. WILSON:

15 Q. Let's start with Claim 1. It says:

16 (Reading)

17 Forming a first cobalt iron

18 boron layer that is amorphous.

19 Do you see that?

20 A. Which one are we on? The one, the --

21 Q. '167.

22 A. Okay.

1 (Witness reviews document.)

2 A. Okay.

3 Q. So Claim 1 of the '167 Patent recites:

4 (Reading)

5 Forming a first cobalt iron

6 boron layer that is amorphous.

7 Do you see that?

8 A. Yes.

9 Q. And then it says: (Reading)

10 Wherein the first and second

11 cobalt iron boron layers are

12 crystallized by the annealing.

13 Do you see that?

14 A. Yes.

15 Q. So my question is, does Claim 1 require

16 that when you crystallize a cobalt iron boron

17 layer, there remains boron in the crystal structure

18 that is formed?

19 A. I don't have an opinion on that

20 question. It's not a question I considered in my

21 declaration, so I can't answer it off the cuff now.

22 Q. Okay. And in the process of

1 determining that Exhibit 2006 discloses an example
2 that practices Claim 1 and Claim 2 of the
3 '167 Patent, you did not know whether the
4 hypothetical few monolayers of crystallized cobalt
5 iron boron actually had any boron remaining in
6 them, correct?

7 A. Yuasa does not discuss the fate of the
8 boron in these few monolayers of crystallized
9 material that may be present.

10 Q. Okay. Let's take a look at Claim 1 of
11 the '134 Patent.

12 A. Okay.

13 Q. Now, Claim 1 of '134 Patent says:
14 (Reading)

15 A magnetoresistive device
16 having a tunnel barrier junction
17 structure, the magnetoresistive device
18 comprising: A first ferromagnetic
19 material layer deposited on a
20 substrate; a second ferromagnetic
21 material layer; and a tunnel barrier
22 layer located between the first and

1 second ferromagnetic material layers.

2 And now I'm going to skip to the last
3 limitation. It says: (Reading)

4 At least said first
5 ferromagnetic material layer is
6 crystallized and comprises cobalt iron
7 boron.

8 Did I read that correctly?

9 A. That's what it says.

10 Q. Okay. Now, you also opined that
11 Exhibit 2006's few monolayers of hypothetical
12 crystallization satisfied Claim 1 of the
13 '134 Patent, correct?

14 A. This is part of the secondary
15 considerations.

16 Q. It's at Paragraph 259, page 105.

17 (Witness reviews document.)

18 A. Okay.

19 Q. So in Paragraph 259, you explain how
20 Exhibit 2006 satisfies each of the limitations of
21 Claim 1, correct?

22 A. Yes.

1 Q. And at the bottom, you say: (Reading)
2 Limitation 1[e] and Claim 2 by
3 disclosing at least partial
4 crystallization of the cobalt iron
5 boron layers and local crystallization
6 of a few monolayers of cobalt iron
7 boron at the electrode barrier
8 interfaces.

9 Did I read that correctly?

10 A. Yes.

11 Q. So you opine that Exhibit 2006
12 discloses an example that satisfies Claims 1 and 2
13 of the '134 Patent.

14 Now, my question is, did you consider
15 whether or not Claim 1 and Claim 2 of the
16 '134 Patent require that once crystallized, there
17 remains boron in the crystal structure of the
18 cobalt iron boron layer?

19 A. That's not a question I considered in
20 my declaration.

21 Q. Okay. But you agree that Exhibit 2006
22 does not disclose whether, in fact, there remains

1 boron in the crystallized -- hypothetically
2 crystallized cobalt iron boron monolayers, correct?

3 A. I didn't consider the fate of the boron
4 in any of the readings I did because it wasn't
5 relevant to my declaration.

6 Q. Okay. And in your opinion, it's not
7 relevant to whether or not Claims 1 and 2 are
8 practiced by Exhibit 2006, correct?

9 A. No, I can't give an opinion on that
10 because, as I say, I didn't consider redistribution
11 of boron during crystallization because it wasn't
12 part of the grounds of the Petitioner which I was
13 responding to in my declaration.

14 Q. So Exhibit 2006 was not part of the
15 grounds in the Petition, correct?

16 A. 2006 is a reference I discussed in
17 my -- in my declarations as part of the secondary
18 considerations.

19 Q. Okay. You understand that in order to
20 determine whether or not an example in Exhibit 2006
21 practices Claims 1 and 2 of the '134 Patent, you
22 need to understand the scope of those claims, what

1 they cover and what they do not cover.

2 Do you understand that?

3 A. Well, broadly speaking.

4 Q. Okay. So my question is, does Claim 1
5 of the '134 Patent cover Exhibit 2006's example if
6 there remains no boron in the few monolayers of
7 crystallized cobalt iron boron?

8 A. Well, the claims don't describe where
9 the boron goes and neither does Exhibit 2006, so I
10 can't answer that question based on comparing --
11 let me say that again. I can't answer that
12 question because the Exhibit 2006 doesn't discuss
13 where the boron goes and the claims don't talk
14 about it either.

15 Q. Okay. So take a look at Claim 1 of the
16 '134 Patent. It says: (Reading)

17 At least said first
18 ferromagnetic material layer is
19 crystallized and comprises cobalt iron
20 boron alloy.

21 Do you see that?

22 A. Yes.

1 Q. So you do not read that limitation as
2 requiring that the crystals include boron, correct?

3 A. I didn't consider the construction of
4 that part of the claim.

5 Q. Well, I'm asking you to consider it
6 now.

7 A. I don't think I could give you a good
8 answer without spending some time to review what
9 that claim actually means in terms of boron content
10 or redistribution during the annealing process.

11 Q. Okay. So as you sit here today, you do
12 not know whether the limitation in Claim 1 that
13 says, At least said first ferromagnetic material
14 layer is crystallized and comprises cobalt iron
15 boron alloy, requires that there remain boron in
16 the crystallized layer, correct?

17 A. I'm not aware of the claim
18 constructions that might be applied to this
19 statement, so I didn't consider how much or where
20 the boron ends up in the annealing process that
21 crystallizes it. All I am seeing is that the layer
22 is crystallized and it comprises cobalt iron boron.

1 And since Yuasa in Exhibit 2006 clearly says he
2 starts with cobalt iron boron and there may be or
3 he can't exclude the possibility of crystalline
4 layers, then we have cobalt iron boron and
5 crystallinity.

6 Q. But you would agree if Claim 1 of the
7 '134 Patent requires that there be boron in the
8 crystals that have formed, you can't say whether
9 Exhibit 2006 actually practices Claim 1, correct?

10 A. That sounds like a legal question about
11 what that -- hypothetically, what that claim means,
12 and I don't think I'm able to answer that.

13 Q. So I'm not asking you to interpret the
14 claim. I'm asking you a hypothetical. If it is
15 interpreted to mean that there must remain boron in
16 the crystals when the cobalt iron boron layer is
17 crystallized, you couldn't say that Exhibit 2006
18 actually practices that claim, correct?

19 A. Since that's a hypothetical question,
20 if I was told that the crystallized cobalt iron
21 boron had to contain boron, I would need to take
22 another look at Exhibit 2006 to answer that

1 question.

2 Q. Okay. Well, you testified earlier,
3 correct me if I'm wrong, that Exhibit 2006 doesn't
4 say what happens to the boron if, in fact, there
5 are a few monolayers of crystallized cobalt iron
6 boron, correct?

7 A. It doesn't say so in those sentences
8 that we've been reading through. I don't know if
9 there's any other information elsewhere in that
10 document.

11 MR. WILSON: Okay. We can go off the
12 record. Give us a 10-minute break, but we
13 are probably done.

14 THE VIDEOGRAPHER: Okay. We're going
15 off the record. The time is 3:08.

16 (Recess taken.)

17 THE VIDEOGRAPHER: We are going back on
18 the record. The time is 3:20.

19 BY MR. WILSON:

20 Q. Dr. Ross, at any point during the
21 deposition today, did you discuss your testimony or
22 my questions or expected questions with anyone?

1 THE WITNESS: Are we on?

2 MR. WICHMAN: We're on.

3 THE WITNESS: No, I did not discuss any
4 of those things with anyone.

5 MR. WILSON: Okay. We have no further
6 questions.

7 MR. WICHMAN: All right. Mr. Wilson, I
8 would like to take 15 minutes to go through
9 my notes to consider whether we need
10 redirect.

11 MR. WILSON: Okay. Sure.

12 MR. WICHMAN: Okay. 15 minutes. Off
13 the record. Thanks.

14 THE VIDEOGRAPHER: We are going back
15 off the record. The time is 3:21.

16 (Recess taken.)

17 THE VIDEOGRAPHER: We are going back on
18 the record. The time is 3:38.

19 MR. WICHMAN: Okay. Mr. Wilson, IP
20 Bridge has a few questions for redirect.

21 MR. WILSON: Okay.

22

1 EXAMINATION

2 BY MR. WICHMAN:

3 Q. Dr. Ross, could you put the -- your
4 declaration from the one -- on the '134 Patent in
5 front of you. That is Exhibit 2053 on the
6 '134 Patent. Just let me know when you have it.

7 A. I have it.

8 Q. Could you turn to Paragraph 159 on
9 page 64?

10 A. Yes, I have that.

11 Q. Okay. Do you recall that Mr. Wilson
12 asked you about this paragraph?

13 A. Yes, he did.

14 Q. And he asked you about this first
15 sentence concerning the random-oriented islands of
16 crystals in a form -- that would form in a thin
17 film. Do you recall that?

18 A. Yes, we talked about that.

19 Q. Okay. And do you see the second
20 sentence of Paragraph 159 states that, In a study
21 of the crystalline structure of thin films of
22 magnesium oxide deposited on amorphous substrates,

1 IBM found that films of magnesium oxide thinner
2 than 500 angstroms, 50 nanometers, showed a random
3 orientation?

4 A. That's right.

5 Q. And is that finding in Exhibit 2067, in
6 your opinion, consistent with the teachings in
7 Petrov, Exhibit 2065, that you also cite in this
8 paragraph?

9 MR. WILSON: Objection, leading.

10 THE WITNESS: Yes, the IBM document,
11 Exhibit 2067, is specific for MgO, whereas
12 Petrov is a review article which covers a lot
13 of different materials.

14 BY MR. WICHMAN:

15 Q. And can you explain what your
16 understanding of of what it means that a film of
17 magnesium oxide thinner than 50 nanometers shows a
18 random orientation?

19 MR. WILSON: Objection, outside the
20 scope.

21 THE WITNESS: The IBM study looked at
22 the crystallographic orientation of MgO, and

1 in their study, these thin films show a
2 random orientation, which means that there's
3 no preferred orientation like a (100)
4 orientation. It means that the grains are --
5 or the crystals are randomly oriented.

6 BY MR. WICHMAN:

7 Q. And does it remain your testimony that
8 a POSA would not have been able to predict what
9 crystal orientations would form or nucleate on an
10 amorphous surface in the thickness used for
11 magnetotunnel junction barriers?

12 A. Yes, I stand by that statement.

13 Q. In the same declaration, Exhibit 2053
14 in the '134 Patent, could you turn to page 93?

15 A. I have it.

16 Q. Okay. And Paragraph 226. Let me know
17 when you're there.

18 A. Yes, I can see it.

19 Q. Okay. Do you see that this first
20 sentence refers to gold having a (200) diffraction
21 peak at 44 degrees?

22 A. Yes.

1 Q. And you recall that Mr. Wilson asked
2 you about this sentence too, right?

3 A. I do.

4 Q. And this sentence cites Exhibit 2058?

5 A. Yes.

6 Q. Can you pull up Exhibit 2058?

7 MR. WILSON: Objection, outside the
8 scope.

9 BY MR. WICHMAN:

10 Q. So let me know when you have it.

11 THE EXHIBIT TECHNICIAN: Just to
12 clarify, you don't want me to pull that up,
13 right, sir?

14 MR. WICHMAN: The witness has it.

15 THE EXHIBIT TECHNICIAN: Okay. Got it.

16 BY MR. WICHMAN:

17 Q. Can I help you?

18 A. Please do.

19 Q. Okay. Dr. Ross, do you have
20 Exhibit 2058 in front of you?

21 A. Yes.

22 Q. What is that exhibit?

1 A. This is the powder diffraction file for
2 gold.

3 Q. And what is a "powder diffraction
4 file"?

5 MR. WILSON: Objection, outside the
6 scope.

7 THE WITNESS: Well, this is my
8 Exhibit 2058, which is the predicted
9 diffraction peaks for gold in this case in an
10 X-ray diffraction experiment.

11 BY MR. WICHMAN:

12 Q. And where did this exhibit come from?

13 MR. WILSON: Objection, outside the
14 scope.

15 THE WITNESS: I downloaded this from
16 the database in the X-ray lab at MIT.

17 BY MR. WICHMAN:

18 Q. And how is this information used by a
19 person of ordinary skill in the art?

20 MR. WILSON: Objection, outside the
21 scope.

22 THE WITNESS: You can see in my

1 Paragraph 226 that there's -- I make the
2 statement that there's a strong gold peak
3 from the fcc gold(200) crystal planes at a
4 very similar diffraction angle to the peak
5 from fcc cobalt iron(111) planes.

6 The reason I know that is because the
7 powder diffraction file tells me what angle
8 all the peaks will be at for a given material,
9 and it also tells me the expected intensities
10 of those peaks, so I know that there's a
11 strong peak at 44 degrees from polycrystalline
12 gold.

13 BY MR. WICHMAN:

14 Q. So can you point where in Exhibit 2058
15 did you find that information?

16 MR. WILSON: Objection, outside the
17 scope.

18 THE WITNESS: There's a table called
19 "Peak List" on page 2, and you can see the
20 second line of data. Number 2, it's (200).
21 It gives the 2 theta value, which is
22 44.393 degrees, and it gives the intensity,

1 which is 52 percent.

2 So that can be read from that table or
3 visually in the graph on page 3, that shows
4 the peaks and you can see there's a peak at
5 44 degrees, roughly.

6 BY MR. WICHMAN:

7 Q. And is that the same location where
8 Jimbo, Exhibit 1060, identified a peak?

9 MR. WILSON: Objection, outside the
10 scope.

11 THE WITNESS: Yes, Jimbo's Figure 1,
12 Exhibit 1060, labels a peak at 44 degrees as
13 cobalt iron fcc(111).

14 MR. WICHMAN: No further questions.

15 MR. WILSON: We don't have any
16 questions.

17 MR. WICHMAN: Okay. The witness will
18 read and sign. And I believe we can go off
19 the record.

20 MR. WILSON: Yep. We can go off the
21 record.

22 THE VIDEOGRAPHER: All right. We are

1 going off the record. The time is 3:46.

2 (Signature reserved.)

3 (Deposition concluded at 3:46 p.m.)

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1 CERTIFICATE OF NOTARY PUBLIC

2

3 I, Amy A. Brauser, RPR RMR CRR, the officer
4 before whom the foregoing deposition was taken, do
5 hereby certify that the witness was duly sworn by me
6 prior to the taking of the foregoing deposition; that
7 the testimony of said witness was taken by me to the
8 best of my ability and thereafter reduced to
9 typewriting under my direction; that I am neither
10 counsel for, related to, nor employed by any of the
11 parties to the action in which this deposition was
12 taken, and further that I am not a relative or
13 employee of any attorney or counsel employed by the
14 parties thereto, nor financially or otherwise
15 interested in the outcome of the action.

16 This is the 25th day of September, 2025.

17

18



19

20

Amy A. Brauser, RPR RMR CRR
Notary Public
for the Commonwealth of Virginia

21 Notary Registration No.: 7675529

22 My Commission Expires: January 31, 2028

1 Case: Western Digital vs Godo Kaisha IP Bridge 1

2 Witness Name: Caroline A. Ross, Ph.D.

3 Deposition Date: 09/18/2025

4

5

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5 Case: Western Digital vs Godo Kaisha IP Bridge 1

6 Witness Name: Caroline A. Ross, Ph.D.

7 Deposition Date: 09/18/2025

8 I do hereby acknowledge that I have read
9 and examined the foregoing pages
10 of the transcript of my deposition and that:
11 (Check appropriate box):

12 () The same is a true, correct and
13 complete transcription of the answers given by
14 me to the questions therein recorded.

15 () Except for the changes noted in the
16 attached Errata Sheet, the same is a true,
17 correct and complete transcription of the
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1 Errata Sheet

2 NAME OF CASE: Western Digital vs Godo Kaisha IP Bridge 1

3 DATE OF DEPOSITION: 09/18/2025

4 NAME OF WITNESS: Caroline A. Ross, Ph.D.

5 Reason Codes: 1. To clarify the record.

6 2. To conform to the facts.

7 3. To correct transcription errors.

8 Page _____ Line _____ Reason _____

9 From _____ to _____

10 Page _____ Line _____ Reason _____

11 From _____ to _____

12 Page _____ Line _____ Reason _____

13 From _____ to _____

14 Page _____ Line _____ Reason _____

15 From _____ to _____

16 Page _____ Line _____ Reason _____

17 From _____ to _____

18 Page _____ Line _____ Reason _____

19 From _____ to _____

20

21

22

CAROLINE A. ROSS, PH.D.

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