

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

WESTERN DIGITAL TECHNOLOGIES, INC.

Petitioner,

v.

GODO KAISHA IP BRIDGE 1,

Patent Owner.

Case No. IPR2024-01494

Patent No. 11,968,909

REMOTE VIDEOTAPED DEPOSITION OF

CAROLINE A. ROSS, Ph.D.

Thursday, December 11, 2025

Digital Evidence Group

Certified Stenographic Court Reporter

Michele E. Eddy, RPR, CRR

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4 Remote Videotaped Deposition of CAROLINE A.

5 ROSS, Ph.D., a witness herein, called for

6 examination by counsel for Petitioner in the

7 above-entitled matter, pursuant to Notice, the

8 witness being duly sworn by MICHELE E. EDDY, RPR,

9 CRR, a Notary Public in and for the District of

10 Columbia, taken remotely with the witness located in

11 Boston, Massachusetts, at 11:02 a.m. Eastern Time.

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1 A P P E A R A N C E S

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21 ALSO PRESENT:

22 DeShawn White, Videographer

1 EXAMINATION INDEX

2

3 WITNESS: CAROLINE A. ROSS, Ph.D. PAGE

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11 E X H I B I T S

12 PREVIOUSLY MARKED AND REFERRED TO

13 ROSS EXHIBIT PAGE

14 Exhibit 2053 Dr. Ross Declaration 20

15 Exhibit 2087 Dr. Ross Surreply Declaration 9

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17 BUTLER EXHIBIT PAGE

18 Exhibit 1044 Article titled " Spin-dependent 12

19 tunneling conductance of FezMgOzFe

20 sandwiches" by W H. Butler,

21 X.-G. Zhang, and T C. Schulthess

22

1 EXHIBIT INDEX CONTINUED

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3 GIORDANO EXHIBIT

PAGE

4 Exhibit 1106 Articled titled "Characteristics 40

5 of Pd adsorption on the MgO 100

6 surface: Role of oxygen vacancies"

7 by Livia Giordano, Jacek

8 Goniakowski, and Gianfranco

9 Pacchioni1

10

11 BOKOR EXHIBIT

12 Exhibit 1105 Reply Bokor Declaration 40

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

2 December 11, 2025

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4 VIDEO TECHNICIAN: This is video
5 number 1 of the video-recorded deposition of
6 Dr. Caroline Ross in the matter of Western Digital
7 versus IP Bridge in the United States Patent and
8 Trademark Office before the Patent Trial and
9 Appeal Board, Case No. IPR 2024-01494.

10 This deposition is being held by
11 Zoom video remote conferencing on December 11th,
12 2025. The time on the video screen is 11:02 a.m.
13 Eastern Time. My name is DeShawn White. I am the
14 legal videographer from Digital Evidence Group.
15 The court reporter is Michele Eddy, in association
16 with Digital Evidence Group.

17 Will counsel please introduce
18 themselves for the record, followed by the court
19 reporter administering the oath.

20 MR. WILSON: Douglas Wilson of
21 Armond Wilson, LLP, for Petitioner Western
22 Digital.

1 MR. BALICH: Jason Balich of Wolf
2 Greenfield for Patent Owner IP Bridge. Also in
3 attendance is Adam Wichman of Wolf Greenfield.

4 - - -

5 CAROLINE A. ROSS, Ph.D.
6 having been duly sworn, testified as follows:

7 EXAMINATION BY COUNSEL FOR PETITIONER
8 BY MR. WILSON:

9 Q. Good morning, Dr. Ross.

10 A. Good morning.

11 Q. Can you please state your full name?

12 A. Caroline Ann Ross.

13 Q. And where are you physically located
14 this morning?

15 A. I am on the 23rd floor of 600 Atlantic
16 Avenue I think is the address, in Boston,
17 Massachusetts.

18 Q. Okay. And you are in the offices of
19 your counsel, correct?

20 A. Yes, Wolf Greenfield.

21 Q. Okay. And who else is in the room with
22 you?

1 A. Jason Balich is in the room.

2 Q. Okay. Anyone else?

3 A. No.

4 Q. Okay. You understand that you are under
5 oath this morning for purposes of this deposition,
6 correct?

7 A. Yes, I do.

8 Q. And you understand that you are not
9 permitted to discuss the substance of your
10 deposition this morning with anyone during any
11 breaks?

12 A. Yes, I understand that.

13 Q. Okay.

14 Is there any reason, medical or
15 otherwise, why you cannot testify fully and
16 truthfully this morning?

17 A. No.

18 Q. And so let's pull up -- DeShawn, let's
19 pull up Exhibit 2087.

20 And I should ask you, Dr. Ross, do you
21 have copies of any of the exhibits with you?

22 A. I've got hard copies of some of them and

1 then others are on the computer here.

2 (Ross Exhibit 2087 was previously marked
3 and referred to.)

4 BY MR. WILSON:

5 Q. Okay. And so do you have a copy of your
6 surreply declaration, Exhibit 2087?

7 A. Yes, I do.

8 Q. Okay.

9 A. I wanted to point out two typos to cite
10 exhibit numbers in the document. Is this a good
11 time to do that?

12 Q. How about give me just a second --

13 A. Sure.

14 Q. -- and then we'll get there.

15 Okay. So you have a copy of Exhibit
16 2087 in front of you, correct?

17 A. Yes.

18 Q. Okay. And can you turn to the last
19 page?

20 A. Yes.

21 Q. And that's your signature.

22 A. It is.

1 Q. And it was signed on November 19th,
2 2025, correct?

3 A. That's correct.

4 Q. And you reviewed Exhibit 2087 in
5 preparation for your deposition this morning?

6 A. Yes, I did.

7 Q. Okay. And did you find anything that
8 you felt needed to be corrected?

9 A. Yes, there are two corrections needed to
10 citations.

11 Q. Okay.

12 A. So the first one is paragraph 14.
13 There's a citation to Exhibit 1033, 2 to 3. That
14 should be Exhibit 1044, 2 to 3.

15 Q. Okay.

16 A. And then there's one on paragraph 18.
17 There's a citation to Exhibit 2043, 101 to 102.
18 And that should be 2053, 101 to 102.

19 Q. Okay. When you say Exhibit 2053, you
20 are referring to your prior declaration; and those
21 are page numbers of your prior declaration,
22 correct?

1 A. That's correct.

2 Q. Okay. Okay. So other than those
3 typographical errors that you've corrected, is
4 there anything else in Exhibit 2087 that you feel
5 needs to be corrected?

6 A. No.

7 Q. Okay. So you are confident in all the
8 opinions that are expressed in Exhibit 2087,
9 correct?

10 A. Yes.

11 Q. And you worked with Wolf Greenfield in
12 preparing Exhibit 2087?

13 A. That's right.

14 Q. Who specifically did you work with?

15 A. Adam Wichman mostly.

16 Q. Did you speak with anyone at IP Bridge
17 in the course of preparing your declaration,
18 Exhibit 2087?

19 A. No, I didn't.

20 Q. And do you know whether anyone at IP
21 Bridge reviewed your -- your surreply declaration,
22 Exhibit 2087, before it was submitted?

1 A. I have no idea.

2 Q. Now, take a look at Exhibit 2087,
3 paragraph 2.

4 A. Yes, I have that.

5 Q. And paragraph 2 identifies the
6 additional documents that you considered in
7 preparing this Exhibit 2087 over and above the
8 previous materials that you considered in this
9 case, correct?

10 A. Yes.

11 Q. Was there anything else you considered
12 that you didn't list here?

13 A. No.

14 Q. Okay. Now, do you have a copy of Butler
15 Exhibit 1044?

16 A. Yes, I have that.

17 (Butler 1044 was previously marked
18 and referred to.)

19 BY MR. WILSON:

20 Q. Okay. Let's take a look at Exhibit
21 1044, and I want to look at page 5.

22 And on page 5, do you see the heading B,

1 "Effect of symmetry at K parallel equals 0"?

2 A. Yes.

3 Q. The first sentence under that heading,
4 Butler says, "In order to better understand the
5 conductance we examine the tunneling density of
6 states for K parallel equals 0 for the individual
7 energy bands."

8 Did I read that correctly?

9 A. Yes.

10 Q. How does examining the tunneling
11 densities of states for the individual energy
12 bands help Butler understand the conductance?

13 A. Well, those tunneling states are
14 representations of the -- these Bloch states of
15 the electrons which are tunneling through the
16 barrier. I'm not sure how much -- what is it
17 exactly you want to hear from me about this?

18 Q. Okay. So in what way does examining the
19 tunneling densities of states help Butler
20 understand conductance? How does it affect
21 conductance?

22 MR. BALICH: Objection, relevance.

1 THE WITNESS: Should I continue?

2 MR. BALICH: Please.

3 A. Okay. So the tunneling densities of
4 states decay through the barrier, and one can use
5 the plots in figure 7 to understand which plot --
6 which of these states decays quickly or slowly,
7 and therefore that is related to the transport of
8 electrons within those states.

9 Q. Okay. Let's take a look at page 3 of
10 Butler. Now, you see figure 3 -- figures 3 and 4.
11 Do you see those?

12 A. Yes.

13 Q. Okay. If you notice the Y axis in these
14 densities of states plots, it shows densities of
15 states in states per hartree. Do you see that?

16 A. Yes.

17 Q. Okay. And that's true in both figures 3
18 and 4, correct?

19 A. Well, figure 3 and 4, yes, they are both
20 labeled in the same way on the Y axis.

21 Q. Okay. If you notice in figure 3, the
22 Y-axis scale ranges from 0 to 80 states per

1 hartree, correct?

2 A. Yes.

3 Q. And in the -- in figure 4, the Y-axis
4 scale ranges from 0 to 50 states per hartree,
5 correct?

6 A. That's right.

7 Q. Now, let's take a look at figure 7.

8 A. Yes.

9 Q. Figure 7 contains four charts of
10 tunneling densities of states, correct?

11 MR. BALICH: Objection, scope.

12 A. Yes, it has four plots -- four subplots
13 in it.

14 Q. Okay. In each of the charts, densities
15 of states is shown on the Y axis, correct?

16 MR. BALICH: Objection, scope.

17 A. Well, they're labeled as densities of
18 states.

19 Q. Right.

20 And the Y axis here in figure 7 has no
21 units. Do you see that?

22 A. There are no units expressed on those

1 plots, correct.

2 Q. Why is that?

3 MR. BALICH: Objection, scope.

4 A. I didn't have -- I don't have an opinion
5 about why Butler labeled his plots that way. This
6 isn't something I considered.

7 Q. Okay. The Y axis shown in figure 7 is
8 not states per hartree, correct?

9 MR. BALICH: Objection, scope.

10 A. It's not labeled as such. They're
11 relative, I believe.

12 Q. Okay. So the X axis in each of the
13 figures or each of the -- yes, each of the figures
14 in figure 7 starts on the left with layer 2 and
15 moves to the right with increasing layer numbers,
16 correct?

17 A. Yes.

18 MR. BALICH: Objection, scope.

19 Q. And the Bloch states in figure 7 are
20 shown as separate lines, correct?

21 MR. BALICH: Objection, scope.

22 A. Each plot shows several data sets which

1 are labeled with different Bloch states.

2 Q. Okay. Now, if we look at the upper
3 left-hand figure in figure 7, and you see Butler's
4 Delta 1, density of state, shown in that figure --
5 do you see that?

6 A. Yes.

7 Q. The Delta 1 density of state shown in
8 the upper left figure of figure 7 only includes
9 Delta 1 electrons, all of which had majority span,
10 correct?

11 MR. BALICH: Objection, scope.

12 A. If you are asking what does that figure
13 represent, it's labeled at the top as "Majority
14 density of states." It doesn't include minority
15 densities of states.

16 Q. Right.

17 So all of the Delta 1 electrons
18 reflected in the density of states shown in the
19 upper left figure of figure 7 are majority
20 electrons, correct?

21 MR. BALICH: Objection, scope.

22 A. Well, that is what the plot is labeled

1 as.

2 Q. Okay. Do you notice that all of the
3 Bloch states shown, for example, in the upper left
4 figure of figure 7 start at about 1?

5 MR. BALICH: Objection, scope.

6 A. By "start at," do you mean on the
7 left-hand side of the axis?

8 Q. Yes.

9 A. Yeah, they're all -- they're all
10 normalized to some value, which comes at about 1
11 at the left.

12 Q. Okay. Why are they all normalized to
13 about 1?

14 MR. BALICH: Objection, scope,
15 relevance.

16 A. Well, that's Butler's choice in
17 presenting his calculations.

18 Q. Okay. If we take, for example, the
19 upper left-hand figure of figure 7, it's
20 impossible to tell how many majority Delta 1
21 states there are in the left electrode compared
22 to, for example, how many minority Delta 5 --

1 Delta 5 states there are, correct?

2 MR. BALICH: Objection, scope,
3 relevance.

4 A. I haven't analyzed the absolute numbers
5 of those states.

6 Q. Okay. And you couldn't determine that
7 from figure 7, could you?

8 MR. BALICH: Objection, scope,
9 relevance.

10 A. I -- I haven't considered that question.

11 Q. Okay. So you don't know whether you
12 could determine the number of Delta 1 states --
13 the number of -- sorry, let me strike that.

14 You don't know as you sit here today
15 whether you could determine the number of Delta 1
16 majority states compared to the number of Delta 5
17 minority states from figure 7 --

18 MR. BALICH: Objection, scope,
19 relevance.

20 Q. -- right?

21 A. This isn't something I considered in my
22 surreply declaration, so I don't -- I don't know

1 the answer to that.

2 (Ross Exhibit 2053 was previously marked
3 and referred to.)

4 BY MR. WILSON:

5 Q. Okay. Do you have in front of you a
6 copy of Exhibit 2053, your original declaration?

7 A. Yes, I do.

8 Q. Okay. Take a look at paragraph 90,
9 which is on page 54 or PDF 57.

10 Do you have that?

11 A. Yes, I do.

12 Q. Okay. You see there you're discussing
13 Butler's figure 7, correct?

14 A. Yes.

15 Q. And you have a color-coded version there
16 on page 54, correct?

17 A. That's right.

18 Q. Okay. In paragraph 90 you say, "As
19 shown by the top left plot (parallel state), the
20 largest conductance in the majority spin-up
21 channel (red to red) is predicted to be via Delta
22 1 state tunneling (i.e., majority Delta 1 spin-up

1 electrons tunneling to majority vacant Delta 1
2 spin-up states) due to the large density of states
3 of majority of Delta 1 states in iron(100) and
4 effective coupling to and slow decay evanescent
5 Delta 1 states in the MgO barrier."

6 Did I read that correctly?

7 MR. BALICH: Objection to scope.
8 Counsel, the purpose of this deposition is to ask
9 Dr. Ross questions about her surreply report. I
10 can ask her to step out of the room if you want to
11 discuss where this deposition is going.

12 MR. WILSON: So this deposition is
13 directly addressing the points in her surreply
14 declaration. And if you want, you can ask her to
15 step out of the room and I can explain it to you,
16 but I think it's fairly obvious to everyone. I
17 don't think it's complicated.

18 MR. BALICH: Sure, let's have --
19 let's have her step out of the room for a moment.

20 (Witness exited the room.)

21 MR. BALICH: The door is closed.
22 How does this relate to the surreply report?

1 MR. WILSON: In her surrepley, she
2 offers the opinion that the densities of states in
3 figures 3 and 4 have nothing to do with
4 conductance. And she is here actually in
5 paragraph 90 opining to the opposite, and so I'm
6 entitled to cross-examine her on her prior
7 opinions that are inconsistent with her current
8 opinions. And you may not see that yet or the
9 inconsistency yet, but you will.

10 MR. BALICH: Where -- where does
11 she offer that opinion in the surrepley?

12 MR. WILSON: Paragraph 31.

13 MR. BALICH: The one that starts,
14 "When asked why he cited Equation (1)"?

15 MR. WILSON: Yes.

16 MR. BALICH: Where does it say
17 anything about the conductance?

18 MR. WILSON: She says -- she
19 distinguishes between the majority-minority
20 densities of states shown in figures 3 and 4 that
21 he computed from the electronic structure of the
22 model and the tunneling densities of states that

1 Butler calculated using Landauer conductance. But
2 she also testified earlier ...

3 MR. BALICH: I just don't see the
4 statement where you say that -- the distinctions
5 between the majority-minority densities --

6 MR. WILSON: Yeah, so --

7 MR. BALICH: -- had nothing to do
8 with conductance.

9 MR. WILSON: Paragraph 11, first
10 sentence.

11 MR. BALICH: So this is just
12 pointing out that Bokor was wrong when he said
13 that the majority and minority density states were
14 proxy for conduction. She's not taking that
15 opinion. She's trying to disprove what Bokor
16 says.

17 MR. WILSON: I don't get the
18 distinction you're drawing there. She says, "A
19 person of ordinary skill in the art would not have
20 viewed the majority and minority densities of
21 states in Butler's figure 3 as a proxy for
22 electrical conduction," and she said the opposite

1 in paragraph 90. And I'm entitled to explore it.

2 MR. BALICH: Explain to me why you
3 think she said the opposite was in paragraph 90.
4 I still don't get it.

5 MR. WILSON: It's right there. I
6 mean, she says, "The largest conductance in the
7 majority channeling is predicted to be the Delta 1
8 state tunneling due to the large density of states
9 of majority Delta 1 states in iron(100)." It's
10 right there. I mean, so ... It's incredibly
11 straightforward. All right. So why don't you
12 bring her back in. Let's continue.

13 MR. BALICH: Okay.

14 (Witness entered the room.)

15 BY MR. WILSON:

16 Q. Okay, Dr. Ross, so we were at paragraph
17 90 in Exhibit 2053, your original declaration. Do
18 you recall that?

19 A. Yes.

20 Q. Okay. Now -- and we just read the first
21 sentence there. Do you -- do you recall that
22 first sentence?

1 A. Yes.

2 Q. Okay. In that first sentence, you
3 express the opinion that the largest conductance
4 in the majority spin-up channel should be via
5 Delta 1 state tunneling due to two things, first,
6 the large densities of states of majority Delta 1
7 states in iron(100) and, second, effective
8 coupling to and slow decay of evanescent Delta 1
9 states in the MgO barrier, correct?

10 A. That is what it says.

11 Q. Okay. Why does the large density of
12 states of majority Delta 1 states in iron(100)
13 indicate that the largest conductance in the
14 majority spin-up channel should be via Delta 1
15 state tunneling?

16 A. Well, the conductance occurs by
17 electrons tunneling, and that's where electrons
18 are in that Delta 1 state.

19 Q. Okay. So you're saying the -- the large
20 density of states in the majority Delta 1
21 electrons indicates that the conductance will
22 occur primarily via those Delta 1 electrons,

1 correct?

2 A. Well, as I said in paragraph 90, that
3 channel, the Delta 1 channel, has a large density
4 of states, and it also decays slowly throughout
5 the MgO barrier.

6 Q. Okay. So how can you tell from figure 7
7 that the majority Delta 1 channel has a large
8 density of states?

9 A. Well, I believe that's what is stated in
10 the paper. The figure is part of the paper. If
11 you want, I can go through and find the relevant
12 parts of Butler if that's necessary.

13 Q. I don't think that's necessary.

14 But as you sit here today, you couldn't
15 tell from figure 7 that there's a large density of
16 states of majority Delta 1 electrons, correct?

17 MR. BALICH: Objection, scope.

18 A. I think that question is a little hard
19 to answer simply because there's a lot of
20 calculations in Butler that go into determining
21 those states. You can certainly see that there's
22 a high density of states of Delta 1 in the second

1 electrode, which is where the conduction is going
2 into. You can certainly see that from figure 7.

3 Q. Okay. But you would agree in figure 7,
4 all of the Bloch states that are shown are
5 normalized, correct?

6 A. Well, as far as I remember Butler
7 describing that figure, he normalized the Bloch
8 states on the left-hand side.

9 Q. So when you see that, for example, in
10 the upper left-hand figure, the Delta 1 Bloch
11 state is -- or Bloch density of states is higher
12 than, for example, the next one down there, the
13 Delta 5, that doesn't necessarily mean that the
14 overall density of states of Delta 1 majority
15 electrons in the right electrode is higher than
16 the Delta 5 density of states, does it?

17 MR. BALICH: Objection, scope.

18 A. I don't know the relevant sizes of those
19 states. I believe it's discussed in Butler, but I
20 don't recall it.

21 Q. Well, let's take a look at Butler, and
22 let's take a look at Butler's figure 3. And

1 that's Exhibit 1044. Do you have that?

2 A. Yes, I do.

3 Q. Okay. And you have Butler figure 3?

4 A. Yes.

5 Q. And Butler figure 3 shows that the
6 majority density of states in iron(100) is larger
7 than the minority density of states for occupied
8 states, correct?

9 A. Are you talking about the integration?
10 I mean, this is showing density of states versus
11 energy, so I'm not quite sure what you're asking.

12 Q. Yes, the -- if you want to phrase it
13 that way, the sum essentially of the density of
14 states.

15 A. Well, by definition, the majority has
16 more.

17 Q. But if we look to the right of the Fermi
18 energy in figure 3, it also shows that for
19 unoccupied electron states, the minority density
20 of states is much higher than the majority density
21 of states, correct?

22 MR. WILSON: I think we lost the

1 witness.

2 VIDEO TECHNICIAN: Do you want to
3 go off the record, counsel?

4 MR. WILSON: Let's see if she comes
5 back quickly.

6 VIDEO TECHNICIAN: Okay.
7 (Pause in proceedings.)

8 MR. WILSON: Well, I tell you what,
9 let's go ahead and go off the record, I guess.

10 VIDEO TECHNICIAN: The time is
11 11:36 a.m. We are now off the record.

12 (Discussion off the record.)

13 VIDEO TECHNICIAN: The time is
14 11:38 a.m. We are now on the record.

15 BY MR. WILSON:

16 Q. Dr. Ross, just before we sort of lost
17 the technical connection, did you have an answer
18 to my question?

19 A. Maybe you can repeat the question.

20 Q. Sure.

21 A. I don't think I got all of it.

22 Q. Okay, sure.

1 If we look at -- in fact, actually,
2 let's -- let me try this a different way. Let's
3 look at your -- your surreply declaration, Exhibit
4 2087.

5 A. Which part of it?

6 Q. Page 6.

7 A. Page 6, yes.

8 Q. You have an annotated reproduction of
9 figure 3 at the top there.

10 A. That's right.

11 Q. Do you see that?

12 A. Yes.

13 Q. Okay. So with reference to your
14 annotated version of figure 3, if we look at the
15 right-hand side, above the Fermi level to the
16 unoccupied electron states, the minority density
17 of states is much higher than the majority density
18 of states, correct?

19 A. You're comparing the upper and the lower
20 figure?

21 Q. Yes.

22 A. Yes, well, that's inevitable.

1 Q. Okay. Okay. Let's take a look at
2 paragraph 14 of Exhibit 2087.

3 VIDEO TECHNICIAN: Counsel, could
4 you repeat that?

5 MR. WILSON: Yes, paragraph 14 of
6 Exhibit 2087.

7 A. Yes, I have that.

8 Q. Okay. Do you see about the middle of
9 the paragraph, you say, "Butler did not choose a
10 Fermi energy level--he calculated it from the
11 model." And then you corrected that cite earlier
12 today to refer to Butler, pages 2 to 3. Do you
13 recall that?

14 A. Yes.

15 Q. Okay. Let's take a look at Butler
16 Exhibit 1044 at pages 2 to 3. Now, let's start on
17 page 2, the -- do you see the heading "Electronic
18 and Magnetic Structure" on the right, in the
19 right-hand column?

20 A. Yes.

21 Q. And the first sentence under that
22 heading, Butler identifies the layer

1 Korringa-Kohn-Rostoker technique. Do you see
2 that?

3 A. Yes.

4 Q. And he refers to using that technique to
5 determine the electronic structure of his iron
6 MgO/iron MTJ, correct?

7 A. Well, that's what he says.

8 Q. Okay. And do you have any experience
9 with -- let me back up for a second. Butler
10 elsewhere abbreviates the layer
11 Korringa-Kohn-Rostoker technique to LKKR. Are you
12 familiar with that?

13 A. In Butler, I didn't study that
14 particularly.

15 Q. Okay. If I refer to it as LKKR, will
16 you understand what I mean?

17 A. Sure.

18 Q. Okay. So do you have any experience
19 with the LKKR technique?

20 A. I have experience with DFT. I
21 personally haven't coded with that technique.

22 Q. Can you describe what the LKKR technique

1 does?

2 A. Well, I haven't studied it particularly,
3 but it as used by Butler, he is -- you're solving
4 upon the densities of states throughout this
5 structure, which is heterogeneous. It has
6 different atoms and layers in it. This one avoids
7 the necessity for having a periodicity
8 throughout -- throughout the structure that you're
9 trying to solve, so it allows you to solve for
10 these heterogeneous kinds of situations.

11 Q. Okay. Now, let's look at the -- in the
12 first paragraph there, under Electronic and
13 Magnetic Structure on page 2 of Butler, in the
14 third sentence, Butler says, "The experimental
15 iron lattice constant." Do you see that?

16 A. Yes.

17 Q. He says, "The experimental iron lattice
18 constant 2.866 angstroms was used for the iron
19 lattice."

20 Did I read that correctly?

21 A. Yes.

22 Q. Okay. In the fourth sentence, Butler

1 indicates that the iron oxide distance was input
2 to the LKKR model, correct?

3 A. Well, he's just giving a value for the
4 iron oxygen spacing.

5 Q. Okay. And that's the value he used in
6 his model, correct?

7 MR. BALICH: Objection, scope.

8 A. Well, he says the iron oxide distance
9 was taken as that value, so that's presumably what
10 he did.

11 Q. Okay. All right. The fifth sentence he
12 refers to the difference between the MgO and iron
13 lattice constants was another input to his model.
14 Correct?

15 A. Well, he's giving a value for the MgO
16 lattice constant in the model.

17 Q. Okay. In the next sentence he refers to
18 the sphere radii for magnesium and for oxygen that
19 were input into his LKKR model, correct?

20 A. Well, he's saying the atomic potentials
21 were represented with these radii for magnesium
22 and oxygen.

1 Q. Okay. Now, back up in the second
2 sentence in this same paragraph, Butler indicates
3 that the LKKR model was configured to assume four
4 layers of magnesium oxide within an iron lattice,
5 correct?

6 A. Well, I think it's more complex than
7 that. He's put four layers of MgO and four layers
8 of iron on each side and then embedded that within
9 a bulk iron model.

10 Q. Now, the second paragraph under that
11 heading "Electronic and Magnetic Structure," the
12 last sentence of that paragraph, Butler says, "The
13 Fermi energy was maintained equal to that of the
14 bulk iron as the self-consistent electronic
15 structure was calculated for the entire system
16 consisting of bulk iron plus the 12 embedded
17 layers."

18 Did I read that correctly?

19 A. Yes.

20 Q. So what Butler is explaining is that as
21 the calculations were iterating to solve for the
22 electronic structure of his iron MgO system, he

1 was holding the Fermi energy constant and not
2 recalculating it with each iteration, correct?

3 A. Well, he's not -- he's not giving a lot
4 of computational details in this -- in this
5 description other than to mention he's using bulk
6 iron.

7 Q. Okay. So what do you think he meant by
8 "The Fermi energy was maintained equal to that of
9 the bulk iron"?

10 MR. BALICH: Objection, form.

11 A. Well, it's a -- it's a boundary
12 condition. This is a self-consistent calculation,
13 so you allow it to iterate until it reaches a
14 self-consistent solution. And you have to have
15 starting conditions, like the positions and the
16 types of the atoms. Since this is 12 layers of
17 atoms or MgO plus iron embedded in bulk iron. The
18 boundary condition for that bulk iron has to
19 approximate to bulk iron, which means that bulk
20 lattice parameter and the bulk Fermi energy. So
21 it's the starting point of the calculation, the
22 boundary conditions for calculating how the

1 layered structure, what some electronic structure
2 actually looks like.

3 Q. And what Butler is saying that as he
4 performed his iterative calculation, he held the
5 Fermi energy equal to that of the bulk iron with
6 each iteration, correct?

7 A. Well, he wasn't quite so explicit. He
8 just said the Fermi energy was maintained equal to
9 that of bulk iron as a self-consistent electronic
10 structure was calculated for the entire system, et
11 cetera.

12 Q. Right. But in some sense he is
13 maintaining the Fermi energy as equal to that of
14 the bulk iron, correct?

15 A. Well, he says the Fermi energy was
16 maintained equal to that of bulk iron, so that's
17 some -- that's how he's explaining what he did.

18 Q. Right. He could have changed the Fermi
19 energy or let it be recalculated at the interface
20 with each iteration, correct?

21 A. Well, he couldn't have changed the Fermi
22 energy because it's a -- it's a property of bulk

1 iron. So if he wanted to do a calculation with
2 bulk iron, he's chosen the appropriate lattice
3 structure, lattice parameter, and so forth, and
4 he's choosing the appropriate conditions to model
5 bulk iron, which includes the Fermi level.

6 Q. Okay. So do you believe then that the
7 Fermi level of the bulk iron was an input to his
8 calculation?

9 A. Well, it's a boundary condition. Since
10 he's embedding his calculation in bulk iron, it's
11 the only logical choice for modeling bulk iron, is
12 to use the properties of bulk iron in the
13 calculation.

14 Q. Okay. So it would have been -- Butler
15 would have had input the Fermi level of bulk iron
16 into his calculation at the starting point,
17 correct?

18 A. Well, I don't know if he input it or
19 just used -- there are many calculations of iron.
20 This would be a very standard library of DFT
21 results that one would pull out of, just like the
22 lattice constant and the crystal structure.

1 Q. So, in other words, he either pulled --
2 pulled the value of the Fermi energy here for bulk
3 iron out of a reference work or out of a prior
4 calculation -- DFT calculation, correct?

5 A. I don't think he says -- I don't -- it
6 certainly doesn't say in this paragraph where the
7 actual number came from.

8 Q. But at some point he looked up a number
9 for the Fermi energy of bulk iron and set it as
10 that in his calculation, right?

11 MR. BALICH: Objection, form.

12 A. I don't know if that's the procedure
13 that he would have gone through if -- when he did
14 this calculation. He doesn't explain.

15 Q. Okay. So you don't know as you sit here
16 where he got the Fermi energy level that he used
17 in his calculation?

18 MR. BALICH: Objection, scope.

19 A. Well, all I can say is that sentence
20 that you are pointing to doesn't explain it, but
21 there's plenty of data out there just like there's
22 data for the lattice constant that you've got in

1 the highlighted sentence in the first paragraph.

2 He hasn't given a citation for that either.

3 Q. Okay. All right. Let's take a look at
4 Exhibit 1106 Giordano.

5 A. Okay, I've got Giordano.

6 (Giordano Exhibit 1106 was previously marked
7 and referred to.)

8 BY MR. WILSON:

9 Q. Okay. And you are aware that Dr. Bokor
10 cited Giordano in his reply declaration to which
11 you responded, correct?

12 A. Yes.

13 Q. So you reviewed Giordano in the course
14 of preparing Exhibit 2087, your surreply
15 declaration, correct?

16 A. That's right.

17 Q. Okay. So you're familiar with Giordano?

18 A. Well, I'm familiar with it in the
19 context of Dr. Bokor's statements about it.

20 (Bokor Exhibit 1105 was previously marked
21 and referred to.)

22 ///

1 BY MR. WILSON:

2 Q. Okay. Let's take a look at Exhibit
3 1105, if you have a copy of that, which is
4 Dr. Bokor's reply declaration.

5 A. Okay, which part of this?

6 Q. So if you have his reply declaration, I
7 want to look at page 6, paragraph 9, rolling over
8 to page 7, still in paragraph 9. And I want to
9 focus on figure 3 of Giordano, which he -- he put
10 a copy of there in paragraph 9. Do you see that?

11 A. Yes.

12 Q. Okay. And you can see from the caption
13 under figure 3 that figure 3 shows density of
14 states for a palladium layer absorbed on the
15 regular A and on the oxygen deficient B magnesium
16 oxide(100) surface. Do you see that?

17 A. Yes.

18 Q. Okay. You would agree that Giordano was
19 able to calculate density of states and Fermi
20 level before and after adding oxygen vacancy
21 defects to a metal absorbed to the surface of
22 magnesium oxide(100), correct?

1 MR. BALICH: Objection, scope.

2 A. He's not calculating it for the -- it's
3 two separate calculations even though they are
4 shown on the same plot.

5 Q. Right.

6 A. So I'm not sure what your question was
7 about, but they are two separate calculations.

8 Q. Yeah. My question is specifically
9 directed to the oxygen vacancy defect, side B in
10 figure 3, and so let me -- let me ask it again to
11 clarify.

12 You would agree that Giordano was able
13 to calculate the density of states and Fermi level
14 after adding -- and oxygen vacancy defect to a
15 metal absorbed to the surface of magnesium
16 oxide(100), correct?

17 MR. BALICH: Objection, scope.

18 A. Well, the oxygen vacancy defects are not
19 being added to the metal, so that part of your
20 statement is not accurate.

21 Q. Okay. Let me -- let me ask it again
22 then.

1 You would agree that Giordano was able
2 to calculate densities of states and Fermi level
3 after adding oxygen vacancy defects to magnesium
4 oxide with a metal absorbed to the surface of the
5 magnesium oxide, correct?

6 MR. BALICH: Objection, scope.

7 A. Well, that's what figure 3 is showing
8 according to Giordano.

9 MR. WILSON: Okay. Thank you,
10 Dr. Ross. I don't have any further questions.

11 MR. BALICH: We can go off the
12 record.

13 MR. WILSON: Sure.

14 VIDEO TECHNICIAN: The time is
15 11:58 a.m. You are now off the record.

16 (A brief recess was taken.)

17 VIDEO TECHNICIAN: The time is
18 12:11 p.m. We are now on the record.

19 EXAMINATION BY COUNSEL FOR PATENT OWNER

20 BY MR. BALICH:

21 Q. Okay. Dr. Ross, if you could take a
22 look at your surreply declaration, Exhibit 2087,

1 paragraph 11 -- paragraph 14.

2 A. Yes, I have that.

3 Q. And what would be the physical meeting
4 of any calculated density states if Butler did his
5 electronic structure calculation for the 12 layers
6 embedded in bulk iron but used a different Fermi
7 energy for the boundary condition as compared to
8 the one he did use of bulk iron?

9 A. If you choose a different Fermi level,
10 it's equivalent to having more or fewer electrons
11 in the system, so that would correspond to a
12 different material. For example, if you had some
13 copper or some cobalt or nickel, that would
14 provide additional electrons, and it would push
15 the Fermi level up, so it would be a calculation
16 that wouldn't correspond to the pure iron case.

17 Q. And then if you could turn to paragraph
18 11 of your surreply declaration, which is Exhibit
19 2087.

20 Dr. Ross, in a density of states
21 analysis, which electrons contribute to electrical
22 conduction?

1 A. The ones that can conduct are the ones
2 near the Fermi energy.

3 Q. And which electrons are near the Fermi
4 energy?

5 A. Well, you can think of the density of
6 states like a jug, for example, and the electrons
7 are water and you fill up the water until you've
8 used -- fill up the jug with water until you've
9 used up all the water. So there's a finite number
10 of electrons in the system, and you fill up the
11 states from low energy at the bottom until you've
12 used them all up. So the Fermi level just shows
13 the top energy that's occupied, in fact, at 0
14 Kelvin. At finite temperatures, there's a few
15 above and below the Fermi energy that can also
16 contribute to conduction, but they're quite close
17 to the Fermi energy.

18 Q. In your opinion, did Dr. Bokor
19 understand that principle of solid state physics?

20 A. Well, I think that's a rather general
21 question, but I would say I disagree with his
22 interpretation that one can arbitrarily place the

1 Fermi level wherever one likes on the density of
2 states because the density of states is calculated
3 for a given material, in this case, iron, and it
4 has a certain number of electrons, so that's where
5 they end up. And if you change the material, like
6 hallowing it, you would certainly move the Fermi
7 level, but you would also modify the density of
8 states, so it's not generally correct to say I'm
9 going to choose a different Fermi level without
10 considering what the physical meaning of that
11 statement is.

12 Q. Do you continue to stand by your
13 testimony in paragraph 11 of your surreply
14 declaration?

15 A. Oh, yes.

16 Q. And then if you could turn to your
17 original declaration, Exhibit 2053, paragraph 90,
18 let me know when you're there.

19 A. Yes, I've got that.

20 Q. Is there anything in paragraph 90 of
21 your original declaration, Exhibit 2053, that's
22 inconsistent with your testimony in your surreply

1 declaration, Exhibit 2087, paragraph 11?

2 A. No, there isn't.

3 MR. BALICH: I have no further
4 questions at this time.

5 MR. WILSON: Okay. Just a few
6 questions.

7 FURTHER EXAMINATION BY COUNSEL FOR PETITIONER
8 BY MR. WILSON:

9 Q. Dr. Ross, if you could look at -- let's
10 just go back to Exhibit 1105, Dr. Bokor's
11 declaration, paragraph 9 that we looked at
12 earlier.

13 A. Okay.

14 Q. And do you see figure 3 in Giordano
15 there?

16 A. All right. I've got figure 3 of
17 Giordano.

18 MR. BALICH: Counsel, I didn't ask
19 any questions about this exhibit or Giordano.

20 MR. WILSON: No, you didn't. But
21 you did ask questions that made it relevant.

22

1 BY MR. WILSON:

2 Q. So, Dr. Ross, when you -- you would
3 agree that -- based on Giordano, that when you add
4 oxygen vacancies to MgO, the Fermi level moves up,
5 correct?

6 MR. BALICH: Objection. Outside
7 the scope.

8 A. So, Giordano's figure shows a change in
9 both the Fermi level and the density of states
10 between the two situations he modeled, one with
11 and one without oxygen vacancies.

12 Q. Okay. And in both cases, both sections
13 A and B of figure 3, we're dealing with palladium
14 on magnesium oxide, correct?

15 MR. BALICH: Objection, scope.

16 A. Well, that is how the figure is labeled,
17 yes.

18 Q. Okay. So the fact that the Fermi level
19 moved from when oxygen vacancy defects were added
20 didn't mean that you were now dealing with
21 something other than palladium on magnesium oxide,
22 correct?

1 MR. BALICH: Objection to scope.

2 A. You are dealing with palladium on oxygen
3 deficient magnesium oxide, which is a different
4 electronic situation than perfect magnesium oxide.

5 MR. WILSON: Okay. All right. I
6 don't have any further questions.

7 VIDEO TECHNICIAN: Counsel, does
8 this conclude for today's deposition?

9 MR. BALICH: Hold on one second.

10 VIDEO TECHNICIAN: Okay.

11 FURTHER EXAMINATION BY COUNSEL FOR PATENT OWNER
12 BY MR. BALICH:

13 Q. Dr. Ross, did Butler's model have any
14 oxygen vacancies?

15 A. No, he didn't consider oxygen vacancies
16 in his model.

17 Q. Would a POSA have known how to change
18 Butler's model to introduce oxygen vacancies?

19 A. You would have to redo all the
20 calculations with the defects. And certainly
21 Butler didn't address any of that, so you would
22 have to set up the whole calculation again.

1 MR. BALICH: I have no further
2 questions.

3 MR. WILSON: I don't have any
4 further questions.

5 VIDEO TECHNICIAN: Counsel, does
6 this conclude for today's deposition?

7 MR. WILSON: It does.

8 MR. BALICH: Yes.

9 VIDEO TECHNICIAN: Okay. This
10 concludes for today's deposition. The date is
11 December 11th, 2025, and the time is 12:20 p.m.
12 We are now off the record.

13

14 (Signature having not been discussed, the
15 deposition of Dr. Caroline A. Ross was concluded at
16 12:20 p.m.)

17

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22

1 CERTIFICATE OF SHORTHAND REPORTER

2

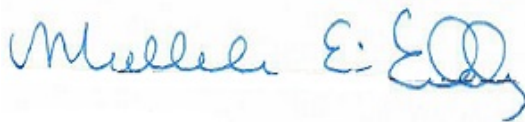
3 I, Michele E. Eddy, Registered Professional
4 Reporter and Certified Realtime Reporter, the court
5 reporter before whom the foregoing deposition was
6 taken, do hereby certify that the foregoing
7 transcript is a true and correct record of the
8 testimony given; that said testimony was taken by me
9 stenographically and thereafter reduced to
10 typewriting under my supervision; and that I am
11 neither counsel for, related to, nor employed by any
12 of the parties to this case and have no interest,
13 financial or otherwise, in its outcome.

14 IN WITNESS WHEREOF, I have hereunto set my hand
15 and affixed my notarial seal this 15th day of
16 December, 2025.

17

18 My commission expires July 31, 2027

19



20

21 MICHELE E. EDDY
22 NOTARY PUBLIC IN AND FOR
THE DISTRICT OF COLUMBIA

1 Case: Western Digital Tech., Inc. vs IP Bridge 1

2 Witness Name: Caroline A. Ross, Ph.D.

3 Deposition Date: 12/11/2025

4

5

6 Please be advised that the transcript in the above

7 referenced matter is now complete and ready for signature.

8 The deponent may come to this office to sign the transcript,

9 a copy may be purchased for the witness to review and sign,

10 or the deponent and/or counsel may waive the option of

11 signing. Please advise us of the option selected.

12 Please forward the errata sheet and the original signed

13 signature page to counsel noticing the deposition, noting the

14 applicable time period allowed for such by the governing

15 Rules of Procedure. If you have any questions, please do

16 not hesitate to call our office at (202)-232-0646.

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6 SIGNATURE PAGE

7 Case: Western Digital Tech., Inc. vs IP Bridge 1

8 Witness Name: Caroline A. Ross, Ph.D.

9 Deposition Date: 12/11/2025

10 I do hereby acknowledge that I have read

11 and examined the foregoing pages

12 of the transcript of my deposition and that:

13 (Check appropriate box):

14 () The same is a true, correct and

15 complete transcription of the answers given by

16 me to the questions therein recorded.

17 () Except for the changes noted in the

18 attached Errata Sheet, the same is a true,

19 correct and complete transcription of the

20 answers given by me to the questions therein

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1 Errata Sheet

2 NAME OF CASE: Western Digital Tech., Inc. vs IP Bridge 1

3 DATE OF DEPOSITION: 12/11/2025

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 Page _____ Line _____ Reason _____

21 From _____ to _____

22 Page _____ Line _____ Reason _____

23 From _____ to _____

24 _____

25 CAROLINE A. ROSS, PH.D.

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