

1 UNITED STATES PATENT AND TRADEMARK OFFICE

2
3 BEFORE THE PATENT TRIAL AND APPEAL BOARD

4
5 SAMSUNG ELECTRONICS CO., LTD.,

6 Petitioner,

7 v.

8 ACORN SEMI, LLC,

9 Patent Owner.

10
11 Case Nos. IPR2020-01183, 01204, 01205, 01206, 01207,
12 01279 and 01282

13 VIDEO-RECORDED ZOOM DEPOSITION UPON ORAL EXAMINATION OF
14 KELIN J. KUHN, PHD
15 VOLUME 1

16
17 8:59 A.M.

18 TUESDAY, JULY 6, 2021

19 (ALL PARTICIPANTS AT THEIR RESPECTIVE LOCATIONS)

20 WITNESS LOCATION: WINTHROP, WASHINGTON

21
22
23 Reported by: Tami Lynn Vondran, CRR, RMR

24 Washington CCR #2157; Oregon CSR #20-0477
25

A P P E A R A N C E S

(ALL PARTIES APPEARING REMOTELY)

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I N D E X

EXAMINATION BY:

PAGE:LINE

Mr. Maier 6: 8

(Afternoon Session) Mr. Maier 114: 9

EXHIBITS FOR IDENTIFICATION

PAGE:LINE

(NO EXHIBITS MARKED)

1 WITNESS LOCATION: WINTHROP, WASHINGTON

2 TUESDAY, JULY 6, 2021

3 8:59 A.M.

4 --000--

5
6 (This deposition is being taken via
7 videoconference and all parties, the
8 witness, the videographer and the court
9 reporter are appearing remotely.)
10

11 THE VIDEOGRAPHER: We are going on the record
12 at 8:59 a.m. on July 6th, 2021.

13 Audio and video recording will continue to
14 take place unless all parties agree to go off the
15 record.

16 This is media unit 1 of the video-recorded
17 deposition of Dr. Kelin Kuhn, taken by counsel for the
18 Petitioner in the matter of Samsung Electronics Company
19 versus Acorn Semi, LLC, filed in the United States
20 Patent and Trademark Office, Case No. IPR2020-01183.

21 This deposition is being conducted using
22 Remote Counsel technology, and all participants are
23 attending remotely.

24 My name is Alan Morgan from the firm Veritext,
25 and I'm the videographer. The court reporter is Tami

1 Vondran from the firm Veritext.

2 I am not authorized to administer an oath. I
3 am not related to any party in this action, nor am I
4 financially interested in the outcome.

5 If there are any objections to proceeding,
6 please state them at the time of your appearance,
7 beginning with the noticing attorney.

8 Will all present please state their name and
9 affiliations for the record.

10 MR. MAIER: Cosmin Maier from Desmarais LLP on
11 behalf of the Petitioner. And also with me is Christian
12 Dorman and Sam Ha, also from Desmarais LLP.

13 MR. PHILLIPS: Matthew Phillips from the law
14 firm Laurence & Phillips IP law representing the patent
15 owner, Acorn Semi, LLC.

16 THE WITNESS: And Kelin Kuhn. I'm the
17 witness. And I'm representing Acorn.

18 THE VIDEOGRAPHER: Will the court reporter
19 please swear in the witness.

20

21 KELIN J. KUHN, PhD,
22 sworn as a witness by the Certified Court Reporter,
23 testified as follows:

24

25 THE COURT REPORTER: Thank you.

1 Please proceed.

2 MR. MAIER: Before we begin, I'll note that
3 there are some additional IPR numbers that this
4 deposition relates to, but counsel for patent owner and
5 I can take that up and confer later.

6

7 EXAMINATION

8 BY MR. MAIER:

9 Q. Good morning.

10 A. Good morning.

11 Q. Can you please state and spell your full name.

12 A. My name is Kelin Jo Kuhn. And that's

13 K-e-l-i-n, J-o, K-u-h-n.

14 Q. And where do you live, Dr. Kuhn?

15 A. I live in Winthrop, Washington State.

16 Q. What is your address?

17 A. My mailing address is P.O. Box 609, Winthrop,
18 Washington 98862.

19 Q. And what is your home address?

20 A. My home address is 43 Davis Lake Ranch Road,
21 also Winthrop, Washington 98862.

22 Q. Are you currently employed?

23 A. I'm presently retired.

24 Q. You do some consulting work in your
25 retirement; correct?

1 A. That's correct.

2 Q. What is Confluence Technology Services?

3 A. That's the name of my small business.

4 Washington State has a business tax arrangement. They
5 don't have sales tax; they have business tax. So
6 Confluence Technology Services is the small business
7 name that I use to pay the taxes to the Washington State
8 government.

9 Q. And that's for the purposes of your work in
10 consulting?

11 A. That's correct.

12 Q. In general, what is the business of Confluence
13 Technology Services?

14 MR. PHILLIPS: Objection; scope.

15 A. So I basically provide a range of technical
16 consulting services generally to, you know, clients who
17 have specific needs. There's a list of people I've
18 worked with in my CV. The work falls in both expert
19 witness -- expert witness work like we're talking about
20 here. I've done some nonexpert consulting on legal
21 matters, and I've done consulting on nonlegal matters as
22 well.

23 Q. (BY MR. MAIER) What percentage of your work
24 relates to legal matters as opposed to purely technical
25 consulting?

1 A. Do you mean percentage of time or percentage
2 of income?

3 Q. Let's take them one by one.

4 In terms of the percentage of time,
5 approximately what percentage of time does your work
6 relate to legal disputes as compared to purely technical
7 consulting?

8 A. I would say 25 percent of my time is purely
9 technical consulting, and 75 percent is legal disputes
10 of one type or another.

11 Q. And approximately what percent in terms of
12 income does your work relate to legal disputes as
13 compared to technical consulting?

14 MR. PHILLIPS: Objection; scope.

15 A. Keep in mind that I have -- keep in mind, I
16 have a retirement income package. So I have income that
17 comes to me independent of any consulting I do or do not
18 do.

19 So if I compare my consulting to my retirement
20 income package, depending on what year, it ranges from,
21 you know, negligible in comparison to my retirement
22 income to as much as my retirement income depending on
23 what year it is.

24 Q. (BY MR. MAIER) So I'm putting aside your
25 retirement package, and I just want to focus on the

1 income derived from your consulting work in connection
2 with Confluence Technology Services.

3 Do you have that in mind?

4 A. Okay. Can you reask the question then?

5 Q. Yes.

6 In terms of your consulting work,
7 approximately what percentage in terms of income is
8 derived from legal disputes as compared to purely
9 technical consulting?

10 A. The majority of the income is from legal
11 disputes of one type or another.

12 Q. And majority could be 51 percent. But are you
13 intending to say it's closer to 90 or 100 percent?

14 A. It's closer to --

15 MR. PHILLIPS: Objection to form.

16 A. It's closer to 90 or 100 percent.

17 Sorry, it's not closer to 100 percent. But I
18 would say, you know, without having -- going through the
19 detailed invoices, 90 percent would be a good number.

20 Q. (BY MR. MAIER) And you understand that the
21 oath you took today requires you to tell the truth;
22 correct?

23 A. I understand that.

24 Q. Is there any reason that you cannot provide
25 truthful, accurate and complete testimony today?

1 A. None that I'm aware of.

2 Q. Okay. And where are you currently physically
3 located?

4 A. I'm physically in Winthrop, Washington.

5 Q. At your home?

6 A. At my home.

7 Q. Is there anyone else with you in the room
8 today?

9 A. No.

10 Q. And other than the video connection we're
11 speaking over now, are you in any communication
12 electronically or otherwise with anyone else such as
13 Acorn's counsel?

14 A. I'm certainly not in communication with
15 Acorn's counsel. I do want to alert you to a situation
16 regarding my elderly mother simply to be aware of.

17 My 95-year-old mother is under caregiver care.
18 I have forwarded my voice phone to the caregiver, but I
19 have retained a message connection to the caregiver in
20 case of an emergency. The phone is on vibrate. I may
21 glance down to see if it says "emergency, emergency."
22 But I will be picking up calls or messages during the
23 break from the caregiver.

24 If you have an elderly parent, there are
25 typically little issues that come up during the day that

1 need to be dealt with. I call these things micro
2 emergencies. And I will certainly inform you of such
3 issues, but this is all related to the care of my
4 elderly mother, not related to the case.

5 Q. Got it. Thank you.

6 And I totally understand that, having gone
7 through a similar situation with my father about a year
8 and a half ago. So let me know if there's anything that
9 comes up, and we can take a break and do whatever we can
10 to make this go easy.

11 Okay. Do you understand that you are not to
12 discuss the substance of your testimony with counsel for
13 Acorn during any breaks in your deposition?

14 A. Yes. And I also understand if the deposition
15 is to run multiple days as on the schedule, I am not to
16 discuss with counsel between those days.

17 Q. And you understand that you are not to
18 communicate off the record regarding the substance of
19 your testimony with counsel for Acorn during this
20 deposition; correct?

21 A. I understand that. That's correct.

22 Q. Do you have any materials with you today,
23 whether in hard copy or electronic form, that you intend
24 to rely on?

25 A. I have an unmarked copy of my declaration in a

1 binder in front of me.

2 And I have on the computer screen a folder
3 that contains citations, unmarked copies of citations
4 from that declaration. And I also have on the side
5 computer screen the exhibit folder from Veritext.

6 Q. What is that folder with unmarked copy of
7 citations? What is -- what are you describing there?

8 A. I have -- I will just walk you through the
9 folder.

10 I have copies of the patents. I have copies
11 of papers of mine that I have cited. And I have copies
12 of various other documents I've cited. I can read you
13 the list, if you're comfortable with that or, you know,
14 move them off or whatever you wish. It's just to ease
15 the proceedings as we go forward.

16 Q. Okay. No, that's what I needed to know.

17 Okay. And you do not have access to a live
18 transcript of today's deposition; correct?

19 A. I do not.

20 Q. You understand that there are seven IPR
21 proceedings related to five Acorn patents?

22 A. I'm not sure of the precise number. I
23 actually have seven patents on my list, but I believe
24 what you said is correct. I'm not 100 percent certain.

25 Q. Now, you submitted, to the best of your

1 knowledge, a declaration in each of the IPR proceedings
2 between Acorn and Samsung on behalf of patent owner;
3 correct?

4 A. That's correct.

5 Q. And you submitted substantively the same
6 declaration across each proceeding; correct?

7 A. I believe I submitted essentially identically
8 the same declaration with possible different numbers on
9 the first page.

10 Q. Okay.

11 A. I'm not sure how to validate that, but my
12 understanding is it is more than substantively the same
13 declaration; it is the same declaration, sans some
14 numbering differences.

15 Q. Right.

16 Now you also participated as an expert witness
17 in the underlying litigation between Acorn and Samsung;
18 correct?

19 A. That's correct.

20 Q. What was your role in the underlying
21 litigation?

22 A. I was covering enablement.

23 Q. Did you have access to any Samsung
24 confidential materials as part of your role in the
25 litigation?

1 A. Yes.

2 Q. And you signed on to the protective order in
3 the underlying litigation?

4 A. Yes.

5 Q. Have you ever previously served as an expert
6 witness in an IPR proceeding?

7 A. Yes.

8 Q. How many times?

9 A. There was an -- I may have to -- may I refer
10 to my CV? Because I want to make sure I get this right.

11 Q. Yeah, absolutely.

12 A. Would that be okay?

13 Q. Yep.

14 A. Okay. So I'm going to open up my CV. And I'm
15 actually going to start at the bottom and work backwards
16 through the list.

17 GlaserWeil. I did KAIST versus Samsung. And
18 that's right, there were actually six IPRs that were in
19 that case. And my memory is they came in three groups
20 of two. And I do not recall if I did one deposition or
21 two for those. But there were definitely IPRs involved
22 there.

23 Then moving sort of forward in time, Womble
24 Bond Dickinson, which was KIPB, was actually an EPR.

25 And then more recently, in the matter of IP

1 Bridge versus Micron, I've been engaged in an IPR -- in
2 fact two IPRs on that as well and recently gave a
3 deposition on both of those IPRs, which is actually
4 captured in the first item, Wolf Greenfield. They have
5 a different company doing the IPR than the litigation.
6 And so there's actually two IPRs covered in the Wolf
7 Greenfield.

8 Q. Do you generally understand that in an
9 instituted IPR proceeding there's a petition followed by
10 a patent owner preliminary response, followed by an
11 institution decision, followed by a patent owner
12 response?

13 A. That is the pattern I've seen in several of
14 these IPRs.

15 I don't know enough about the proceedings to
16 know if there are other patents.

17 Q. Now, your declarations in these IPR
18 proceedings were submitted with Acorn's patent owner
19 responses; correct?

20 A. I don't know that for sure.

21 Q. Well, did you submit a expert declaration with
22 patent owner's preliminary responses?

23 A. I -- my expert declaration is dated 4/18/21.
24 And I don't know how that date matches up with the
25 various preliminary and final responses.

1 Q. And I think -- I think it's pretty -- what I'm
2 trying to get at is the patent owner served preliminary
3 responses. And I didn't see your declaration attached
4 to them. And your patent owner -- the patent owner
5 served patent owner responses, and your declaration was
6 attached to those.

7 So I think the question I'm getting at is you
8 submitted a single declaration in connected -- in
9 connection with these IPR proceedings; correct?

10 A. That's correct. And I do recall having
11 glanced through the preliminary response and possibly
12 even citing it in the creation of this declaration.

13 So I believe, but I'm not 100 percent sure,
14 that this declaration was submitted after that
15 preliminary response was submitted.

16 Q. Okay. And just so we keep the record clear,
17 because there are multiple substantively identical
18 versions of your declaration, the one that I'm going to
19 refer to, and the one that's uploaded into the Exhibit
20 Share folder, is Acorn Exhibit 2070 in IPR 2020 -- okay?

21 (Court reporter clarification.)

22 Q. (BY MR. MAIER) Yeah, it's Acorn Exhibit 2070.
23 And it's in IPR 2020-01204.

24 A. So the hard copy I have in front of me is
25 actually IPR 2020-01279.

1 Is there any concern with me continuing to use
2 that as my reference documentation?

3 Q. No, because the paragraph numbering and all
4 the texts should presumably be identical; right?

5 A. It should be. And, again, if we run into some
6 issue, I can download the other one and use it. But I
7 believe they are identical for the paragraph numbering;
8 it's just the number that differs.

9 Q. Right. Okay.

10 When were you first contacted regarding these
11 IPR proceedings?

12 A. I don't know exactly. I'd have to check my
13 records, but March-ish of this year.

14 Q. So approximately March 2021 is when you were
15 contacted regarding these IPR proceedings?

16 A. That's right, March 2021.

17 Q. And when were you first contacted regarding
18 the underlying litigation between Acorn and Samsung?

19 A. I was first contacted regarding the litigation
20 mid to late November. Again, I'd have to check my
21 records for the exact date, but Thanksgiving time frame
22 of 2020.

23 Q. Who first contacted you regarding the
24 litigation?

25 A. I don't recall if it was Christina Rayburn or

1 Neil Armstrong, but it was one of the two of them.

2 Q. Who first contacted you regarding the IPR
3 proceedings?

4 A. Boy, I really don't recall that well. I
5 believe Christina contacted me telling me there would be
6 an IPR proceeding. And I believe Matt Phillips was my
7 first contact, but I don't have a good memory of that.

8 Q. Approximately when did you start working on
9 the IPR proceedings?

10 A. I remember that there was a relatively short
11 timeline. And I believe I began working on the IPR soon
12 after I was contacted. So it was perhaps a few days for
13 an engagement letter, and then I started work
14 immediately.

15 Q. So approximately March or April 2021 is when
16 you first started working on the IPR proceedings; is
17 that fair?

18 A. That's fair.

19 I certainly started working on it -- I believe
20 I was contacted in March. I started working on it soon
21 thereafter. And so a very fair timeframe would be March
22 and then up to April 18th, which is the date which I was
23 working on that.

24 Q. What is your hourly rate in connection with
25 these IPR proceedings?

1 A. \$500 an hour.

2 Q. Is that the same hourly rate that you charged
3 for your work in the underlying litigation?

4 A. Yes.

5 Q. Is that the same hourly rate that you charge
6 for your work in non-litigation consulting matters?

7 A. Yes, with some caveats. I have three rates.
8 I have a rate that I give when I'm doing a technical
9 evaluation with no commit on either side.

10 You know, in some consulting arrangements you
11 give a free hour to the client, but what if the client
12 has a more complicated problem and you still don't know
13 you can help? So I usually run a week or two at a
14 350 rate to determine if I'm going to be able to help
15 the client or not.

16 My standard rate is 500 an hour. And there
17 have been several occasions under which the client has
18 asked for something either very strongly out of scope or
19 in an extraordinarily short time frame that I have run a
20 rate of 650 per hour.

21 Q. What do you mean by "out of scope"?

22 A. If a client -- in one case a client contacted
23 me with a three-week deadline for a report. And the
24 client was brand new to the project. And so I had a
25 dual job: One job was educating the client on the case,

1 and the second was writing the report. And I'm going to
2 call that out of scope because the usual relationship
3 begins, you know, two years in advance of trial, you get
4 to know the client and so on and so forth. And this
5 particular one was extremely last minute. Everything
6 happened at once.

7 Q. So this 650-an-hour rate was charged in the
8 context of litigation consulting?

9 A. I've actually charged that rate twice. Once
10 was in the context of a litigation consulting
11 arrangement that was very last minute, including a
12 training component for the new legal team.

13 And the second time was in a non- -- I don't
14 want to say non-litigation. In a complicated
15 non-patent-related matter that was related to an
16 internal technology issue at Intel. And I am under NDA
17 to Intel, so I can't go into a lot of details, but I
18 also charged a higher rate on that case -- or that
19 project.

20 Q. And in connection with the IPR proceedings,
21 your rate in preparing for the deposition and writing
22 the declaration is the same as the rate you're charging
23 for your testimony today; correct?

24 A. I don't distinguish between all the nuances of
25 what I'm doing. I have a standard rate that I'd apply

1 to large blocks of things. I have this reduced rate if
2 I've not made a commitment. You know, if you go into a
3 project, at some point there's a commitment you're going
4 to stay to the end of the project. And so the lower
5 rate applies to these, you know, probationary things.

6 Q. Yeah.

7 A. But I don't distinguish between, you know,
8 incremental rates for various kinds of things. It's
9 just \$500 an hour for everything.

10 Q. Got it.

11 Approximately how many hours have you spent
12 working on these IPR proceedings?

13 A. I'd need to look my records for the exact
14 number, but it's between 20 and 30 hours.

15 Q. And approximately how many hours have you
16 spent working on the litigation between Acorn and
17 Samsung?

18 A. Boy, I haven't looked at those numbers in
19 quite a while. I would have to make a wild guess on
20 that. Yeah, it's more than 50, but less than 100. And
21 I feel a little uncomfortable because I have not
22 reviewed those numbers in quite a while.

23 Q. Yeah, and I don't mean to ask you to guess, so
24 that -- your broad range is fine for the purposes of
25 this.

1 Prior to being contacted by Acorn's lawyers
2 regarding the IPR proceedings or litigation, had you
3 ever heard of the patent owner Acorn Semi, LLC?

4 A. No.

5 Q. So before Acorn's lawyers contacted you about
6 the litigation between Acorn and Samsung in
7 approximately November 2020, you had never heard of the
8 patent owner Acorn Semi, LLC; correct?

9 MR. PHILLIPS: Objection; answered.

10 A. I'm going to rephrase because it also had a
11 negative in there.

12 Prior to November of 2020, when I was
13 contacted by counsel for Acorn, I had not heard of the
14 Acorn company.

15 Q. (BY MR. MAIER) In your declarations, you
16 primarily cited to U.S. Patent No. 7,084,423 because it
17 is the earliest patent in the family; correct?

18 A. I cited to -- I'm going to just call that the
19 '423 patent, if I may. I cited to that patent. It is
20 my understanding that is the earliest patent in the
21 family. And it is also my understanding that that
22 patent specification is representative of all the other
23 ones.

24 Q. And I think you say in paragraph 96 of your
25 declaration, quote, "I focus on the disclosure in the

1 '423 patent (because it is the first patent submitted)"?

2 A. That's correct.

3 And the second part is "and all the
4 specification citations are to the '423 patent."

5 Q. Okay.

6 A. And my third paragraph, which is the other one
7 is, you know, the idea that this patent is
8 representative of the others.

9 Q. If you have that patent in the Exhibit Share,
10 it's Exhibit No. 1003 in IPR 2020-01204.

11 Can you let me know if you can open that?

12 A. Exhibit 1024?

13 Q. It's -- so the IPR --

14 A. Oh, Exhibit --

15 Q. 1003 is the exhibit number.

16 A. Got it.

17 Oh, hang on. Give me a second here. I
18 actually want to download it. And let me see if I can
19 determine how to do that.

20 Q. Yeah. And this is just the '423 patent, so if
21 you have another copy you want to refer to, that's fine
22 as well.

23 A. Yeah, I do have a local copy, but let me
24 download this in case you have a Bates number on it that
25 you want me to use.

1 Q. Okay.

2 A. Oh, that worked. Okay.

3 All right. I'm actually opening up
4 Exhibit 103 [sic].

5 Q. And I think you said earlier that you'll
6 understand if I refer to Exhibit 1003 from the 1204
7 proceeding simply as the '423 patent; correct?

8 A. Yes.

9 Q. The named inventors on the '423 patent are
10 Daniel E. Grupp and Daniel J. Connelly; correct?

11 A. Yes.

12 Q. Now, prior to being contacted by Acorn's
13 lawyers, had you ever heard of the named inventors
14 Daniel E. Grupp or Daniel J. Connelly?

15 A. I had heard of Daniel Connelly prior to being
16 contacted by Acorn -- or by the Acorn counsel.

17 Q. And in what context did you hear of Daniel
18 Connelly?

19 A. I was writing a paper for Transactions on
20 Electron Devices. And I was -- the paper was a review
21 paper, and so I was doing extensive background research
22 for the paper. And as part of that research, I
23 encountered a paper by Dr. Connelly.

24 Q. What was the subject matter of the paper on
25 electron devices that you were working on?

1 A. I will -- let me refer to my CV, and I will
2 tell you the title of the paper and also perhaps answer
3 that question more fully. But I want to make sure I get
4 the title correct.

5 Here we go. It's paper 38 in my CV,
6 "Considerations for Ultimate CMOS Scaling." And it's
7 IEEE Transactions on Electron Devices, volume 59, No. 7.
8 And it was a 2012 publication. It was an extensive
9 paper; and I probably started writing it quite early in
10 2012, if not in 2011.

11 Q. So approximately the first time that you had
12 heard of either of the named inventors on the Acorn
13 patents was sometime in 2012; correct?

14 MR. PHILLIPS: Objection; form.

15 A. Yeah, the first time I had run into the name
16 of Daniel Connelly in a way that I remember it was in
17 connection with writing that ultimate CMOS paper.

18 Q. (BY MR. MAIER) And that occurred in
19 approximately the year 2012?

20 A. Prior to the publication of the paper.
21 Sometime between 2011 and 2012.

22 Q. Prior to being contacted by Acorn's lawyers
23 regarding the IPR proceedings or the litigation, had you
24 been aware of any of the challenged patents in these IPR
25 proceedings?

1 A. No.

2 Q. How would you describe the field of the Acorn
3 patents in these IPR proceedings?

4 MR. PHILLIPS: Objection; form.

5 A. My best answer to that is probably going to be
6 to cite from the patent's abstract, which is "An
7 electrical device in which an interface layer is
8 disposed between and in contact with a metal and a
9 silicon-based semiconductor, the interface layer being
10 of a thickness effective to depin the Fermi level of the
11 semiconductor while still permitting current to flow
12 between the metal and the semiconductor."

13 And that happens to be the abstract of the
14 '423 patent.

15 Q. (BY MR. MAIER) And when did you first learn
16 of the inventions described and claimed in the Acorn
17 patents?

18 MR. PHILLIPS: Objection; form.

19 Q. (BY MR. MAIER) Actually, let me withdraw
20 that. That's a valid objection. Let me take it step by
21 step.

22 When did you first learn of the inventions
23 disclosed in the Acorn patents?

24 A. I first learned of the concept underlying the
25 inventions disclosed in the Acorn patents sometime

1 between 2008 and 2009.

2 Q. And how did you first learn of the concepts
3 underlying the inventions disclosed in the Acorn
4 patents?

5 A. I was in a meeting at Intel when someone in
6 the meeting, who I believe was Niloy Mukherjee,
7 presented a PowerPoint presentation. And the PowerPoint
8 presentation described a interface -- a dielectric
9 interface layer whose purpose was to passivate the
10 semiconductor surface and had a separation layer whose
11 purpose was to provide a separation between the metal
12 and the semiconductor. And the most vivid part of this
13 memory was a picture closely resembling Figure 8 that
14 was shown in this meeting.

15 Q. And were there any citations or other
16 references supporting the disclosure of this figure that
17 you're referring to?

18 A. This was an Intel internal meeting. The
19 meeting was given by the research group, and the meeting
20 was discussing advances in contact resistance. And the
21 slide and the subsequent extensive discussion around the
22 slide did not have any citations that I recollected.

23 There were certainly no citations to a patent
24 because Intel had an internal rule that technology
25 people were recommended to not view or otherwise cite

1 patents to not search for them.

2 And so at the time I saw the picture that
3 closely resembled Figure 8, I did not realize that it
4 was not Intel. I thought it was an Intel internal
5 figure and experiment.

6 Q. Well, to be clear, it could have been; right?
7 You don't know where that figure came from; right?

8 A. Oh, that's fair. The -- yes, my point is is
9 that at the time I first saw the concept -- a time I
10 also describe in this -- in my declaration -- the very
11 characteristic figure was essentially the same as that
12 shown in the patent. The idea was essentially the same
13 as described in the patent.

14 But at the time, I was unaware of the
15 existence of either Dr. Connelly's work or the patent
16 itself. And I, at that moment, assumed without thinking
17 about it very hard, because I was mostly thinking about
18 the idea, that that work was -- somehow had some Intel
19 history that I had not dug into.

20 Q. When -- you mentioned Dr. Connelly's work.
21 When did you first learn of Dr. Connelly's work?

22 MR. PHILLIPS: Objection; answered.
23 Objection; form.

24 A. This is a -- this is, again, between my first
25 seeing of the idea, which was some point in time late in

1 2008 or 2009, and my writing of the TED paper sometime
2 in 2011 and 2012, I had become aware of Dr. Connelly's
3 work, and I believe that it was with the writing of that
4 paper. And -- but it was substantially after I had seen
5 the work in an Intel context.

6 Q. (BY MR. MAIER) Upon learning of Acorn's
7 alleged inventions, did you immediately suggest
8 implementing it in any of the junction structures you
9 were working on?

10 MR. PHILLIPS: Objection; scope.

11 A. Well, let me back up.

12 When I first saw the idea, I did not know it
13 was an Acorn invention. I did not in fact know it was
14 an Acorn invention until I was approached by Heuston
15 Hennigan and suddenly realized there was a patent on it.

16 Up until November of 2012, when I became aware
17 there were patents on this, I had not assumed the
18 concept was patented. So that's my first observation.

19 So your first part of your question kind of
20 made an assumption that there was implementation of the
21 Acorn patents. At the time I ran into the idea, I was
22 unaware that it was patented.

23 Second, I ran into the idea in a context where
24 a research team member who was responsible for the area
25 of the metal-semiconductor junction was presenting the

1 information. And there was a well-established path for
2 which the research efforts would flow into the
3 development community. So I was excited by the idea. I
4 thought the idea was incredibly innovative. But at that
5 point in time, my job was not doing metal semiconductor
6 research or development. At that particular time, I was
7 worried about Intel's implementation of FinFETs in
8 22 nanometers. And I investigated the idea for a month
9 or two out of personal curiosity, and then I moved
10 forward with my day job and allowed the team who owned
11 the idea to continue to work with.

12 Q. (BY MR. MAIER) So from the time that you
13 first learned of Acorn's alleged inventions, have you
14 ever recommended to anyone in industry implementing
15 those alleged inventions in their structures?

16 A. I find this question concerning because the --
17 I want to separate the idea from my knowledge of the
18 invention because, again, when I first ran into the idea
19 I was not aware it was patented. And I was also not
20 aware the idea was patented throughout my career at
21 Intel. I only recently became aware there was a patent
22 on it.

23 So in some sense my answer to your question
24 is, well, at no point did I recommend the use of Acorn's
25 alleged inventions because I didn't know that they were

1 Acorn inventions.

2 Q. Let's turn back to the concept. And let me go
3 back and make sure I use the words that you used.

4 Since the time that you learned of the concept
5 underlying the alleged inventions disclosed in the Acorn
6 patents, have you recommended to anyone in industry
7 implementing those underlying concepts?

8 MR. PHILLIPS: Objection; scope.

9 A. So in my 2012 TED paper -- and I come back to
10 that for two reasons. First, because I spent an
11 enormous amount of energy trying to make that paper an
12 industrially relevant paper. I even won an award for
13 that one. I have a section in it discussing the metal
14 to semiconductor junction.

15 And in that section I reference several
16 different studies that I felt relevant to the community.
17 One of those studies was an overview paper by Semitech
18 whose author was Brian Coss. And that study had in it
19 an extensive biography, which included a number of
20 studies on these metal-insulator-semiconductor
21 structures, including the paper itself that was a
22 metal-insulator-semiconductor paper.

23 So by including that reference in a
24 well-regarded review paper, I was certainly alerting the
25 culture to the possibility of the use of these

1 structures and of this concept.

2 Q. (BY MR. MAIER) So by your 2012 TED paper, you
3 intended to recommend the use of the underlying concepts
4 of the Acorn patents to industry?

5 A. Not quite.

6 What I'm going to do, if I may -- may I pull
7 up that paper? Is that acceptable?

8 Q. Yeah, that's fine because I want to make sure
9 we're being accurate, so whatever you need to do to give
10 an accurate answer.

11 A. Okay.

12 Okay. So in the paper -- and I'm actually
13 working off the IEEE transactions paper itself. I'm
14 working off a version that doesn't have a Bates number.
15 But it would be page 1814 of the paper. I have a
16 section on resistance and next-generation transistors.

17 And in this section I first describe the
18 importance of device parasitic resistance by pointing
19 out it impacts circuit performance by reducing drive
20 current and thus increasing delay. Obviously its
21 importance to all.

22 I then go through and describe several
23 different key issues. One I describe is the fundamental
24 resistivity of the materials.

25 I also describe the key issue of the

1 source/drain extension, something that's often called
2 the tip or the LDD.

3 And then finally, I discuss the issue of the
4 Schottky barrier height. And in particular what I say
5 is "Reducing the Schottky barrier height at the contact
6 interface still remains critically important in the
7 ultimate CMOS device. Techniques such as implant" --
8 and that's reference 7 -- "and alloy" -- reference 8 --
9 "modulation, as well as more speculative techniques such
10 as dipole modulation" -- reference 9 -- "are actively
11 being researched."

12 And then my last sentence here is "Metal
13 source/drain devices are an extension of these methods
14 as they become an intriguing option where near-band-edge
15 Schottky metal solutions are identified."

16 And the particular paper that I'm referring
17 to, I selected reference 9 with some care. Reference 9
18 is a paper by Coss. And its title is "Contact
19 resistance reduction to FinFET source/drain using novel
20 dielectric dipole Schottky barrier height modulation
21 method."

22 That particular paper is a industrially
23 sponsored -- it's a Semitech paper or Semitech-sponsored
24 paper. It talks about FinFETs. And it talks about the
25 variety of metal source/drain enhancement techniques

1 that use this metal-insulator-semiconductor structure,
2 the concept of which is what is described in the Acorn
3 patents.

4 Q. Did your 2012 TED paper actually cite
5 Dr. Connelly's paper?

6 A. No.

7 Q. But you knew of Connelly's -- Dr. Connelly's
8 paper before publishing your 2012 TED paper; correct?

9 A. Yes.

10 Q. Why didn't you cite Dr. Connelly's paper?

11 A. Dr. Connelly's paper didn't include a FinFET
12 implementation.

13 Q. And why is that important?

14 A. Well, the paper was about the ultimate CMOS.
15 In the paper, I'm talking about FinFETs and nanowires.
16 The paper in itself has close to 200 references, so I
17 had to be very selective in the references. And
18 whenever possible, if I was talking about a particular
19 topic area, I selected a reference that discussed the
20 closest thing to the overall concept of the paper that I
21 could. In this case, there was no nanowire reference,
22 but there was an excellent review-style FinFET
23 reference, so I used that one.

24 Q. Okay. Now, in your declaration, you assert
25 that the challenged claims are enabled by the '423

1 patent specification; correct?

2 A. Yes.

3 Q. In your declaration, you also assert that the
4 '423 patent specification provides adequate written
5 description for the challenged claims; correct?

6 A. Yes.

7 MR. PHILLIPS: Objection; form.

8 Q. (BY MR. MAIER) Which of those two opinions
9 are you more confident in?

10 MR. PHILLIPS: Objection; form.

11 A. I don't understand the question. Can you
12 restate it?

13 Q. (BY MR. MAIER) Which of your two opinions
14 directed to, one, enablement and, two, written
15 description are you more confident that you are correct
16 about?

17 MR. PHILLIPS: Same objection. And also
18 objection; foundation.

19 A. Yeah, I kind of don't know how to answer that.
20 I haven't thought about the question in that way.

21 Q. (BY MR. MAIER) Well, let me put it a
22 different way.

23 Are you more confident that the challenged
24 claims are enabled by the '423 patent specification or
25 that the challenged claims have adequate written

1 description support?

2 MR. PHILLIPS: Same objections.

3 A. I don't think I can say one or the other.
4 That's a -- you know, that's like saying, "Do you like
5 red cups more or blue cups more?" I don't know.

6 Q. (BY MR. MAIER) It would be blue cups for me.
7 But -- so I guess we could say that you're
8 equally confident in both your enablement and written
9 description opinions; is that fair?

10 MR. PHILLIPS: Objection to form.

11 A. Yeah, I'm not sure I've spent any time
12 thinking about an assessment of a confidence rating. I
13 kind of feel we're treading off into my emotional
14 response to things, which seems to be a little out of
15 scope.

16 Q. (BY MR. MAIER) Well, do you believe that the
17 challenged patents are weaker when it comes to
18 enablement or that they're weaker when it comes to
19 written description?

20 MR. PHILLIPS: Objection; form. Objection;
21 foundation.

22 A. I haven't thought about it that way. I mean,
23 that's the kind of thing that I have to go off and think
24 about for a very long time, and I just haven't thought
25 about the question in that form.

1 Q. (BY MR. MAIER) Okay. Well, we do have a few
2 days. So my question really is just which do you think
3 is the stronger argument, enablement or your positions
4 on written description. And I appreciate that you might
5 need some time to think of -- think those through.

6 MR. PHILLIPS: Same objections.

7 Q. (BY MR. MAIER) So let's dive into some
8 details.

9 I've marked -- well, I've uploaded to the
10 Exhibit Share what has already been marked as
11 Exhibit 1001 in IPR 2020-1206. And that's U.S. Patent
12 No. 9,905,691.

13 Can you let me know if you can find that.

14 And file name is (01206) - Ex. 1001, and then
15 it lists the '691 patent.

16 A. Yes, I have it. I'm downloading it.

17 Q. Take your time, and let me know when you have
18 it.

19 A. Okay.

20 There it is. Okay. I have what I believe is
21 Exhibit 1001 open, which is the Grupp '691 patent.

22 Q. I'll let you check in on that. Let me know if
23 you're ready for me to proceed.

24 A. Thank you.

25 Good. No concerns.

1 Q. Okay. Can you please turn to claim 1 of the
2 '691 patent.

3 A. I have Claim 1.

4 Q. And I'm going to direct you to the last
5 element of Claim 1. The last element of Claim 1 of the
6 '691 patent states "wherein said passivating dielectric
7 tunnel barrier layer comprises a metal oxide and a
8 semiconductor oxide"; correct?

9 A. That's what it says, yes.

10 Q. What is a passivating dielectric tunnel
11 barrier layer?

12 MR. PHILLIPS: I object to the question.
13 Form. And the previous question.

14 A. Okay. There's also a complexity, and I don't
15 quite know how to deal with this, that -- I believe that
16 this is one of the phrases that in the litigation the
17 court construed a meaning for. And so I'm starting to
18 be concerned I'm going to say things that are relevant
19 to the litigation when I don't intend to.

20 Q. (BY MR. MAIER) Well, all we have is the
21 record before us in the IPR proceeding. And I know you
22 gave opinions that these claims are valid; right?

23 A. That's correct.

24 Q. And in order to do so, you must have
25 understood the claims; correct?

1 A. That's correct.

2 Q. So what understanding did you apply to the
3 phrase "passivating dielectric tunnel barrier layer" in
4 these IPR proceedings?

5 A. Okay.

6 MR. PHILLIPS: Objection. I have an
7 objection -- a running objection to the form of any
8 question referring to Claim 1 as stated on Column 18.

9 Q. (BY MR. MAIER) Dr. Kuhn, do you need me to
10 repeat my question?

11 A. No. I'm attempting to figure out an accurate
12 and concise way to answer it.

13 Let me start with the word "passivating."
14 Let's go there.

15 The patent itself talks at length about
16 passivation. And a POSA would understand passivation to
17 mean a process by which the surface states of a
18 semiconductor are bonded so as to eliminate surface
19 defects associated with those states.

20 Dielectric is a material that is -- a
21 dielectric is another word for an insulator.

22 And tunnel barrier means typically to a POSA a
23 layer thin enough that an electron or hole can tunnel
24 through.

25 And layer has a plain and ordinary meaning of

1 a thin film of something.

2 Q. And in Claim 1 of the '691 patent, the
3 passivating dielectric tunnel barrier layer comprises a
4 metal oxide and a semiconductor oxide; correct?

5 A. That's what Claim 1 says.

6 MR. PHILLIPS: Objection; form.

7 Q. (BY MR. MAIER) In the challenged claims, is
8 the metal oxide layer precluded from being a passivating
9 layer?

10 A. I actually discuss that in my declaration, and
11 I'd like to turn to that.

12 And in particular, I would like to turn to
13 paragraph 101 of my declaration. And I state
14 "Preliminarily, the interface layer may be a single
15 layer or may be a compound layer including both a
16 'passivating material' and an additional 'separation' or
17 'spacer' layer. 'In some cases'" -- and here I'm
18 quoting from the patent. "In some cases, the
19 passivation material may be the sole component of the
20 interface layer 520, while in other cases the interface
21 layer 520 may be a compound layer that includes both a
22 passivation and a separation layer."

23 Q. Are you finished?

24 A. Yes.

25 Q. So that didn't quite answer my question. So

1 let me ask it again.

2 In the challenged claims for which you
3 provided expert testimony, is the metal oxide layer
4 precluded from being a passivating layer?

5 A. Again, I'm going to refer back to my
6 declaration. And I'm going to refer to paragraph 104
7 here. And this -- I'll read this because this is a
8 subtle and important point and I want to get it right.

9 "The '423 patent teaches that the passivation
10 layer alone may not be sufficient to provide MIGS
11 separation (in addition to passivation) and that an
12 additional MIGS separation layer may be required."

13 Quoting from the patent again, "As explained
14 below, this may necessitate including a separation layer
15 in addition to a passivation layer within the interface
16 layer, depending on the passivation material selected."

17 And here's my opining on this. "From this
18 description, a POSITA would understand that the
19 separation layer, when paired with a passivation layer,
20 does not itself perform a passivation function, but is
21 solely intended to provide the proper thickness and band
22 structure so that the MIGS states arising in the metal
23 cannot pin the Fermi level of the junction."

24 Q. Okay. And respectfully, Dr. Kuhn, I can
25 certainly read the declaration, so my question is just a

1 little -- I want to get your take on this point.

2 I think I know the answer, but I want to make
3 sure I know it.

4 In the challenged claims, is it your opinion
5 in the interpretation that you use to analyze the
6 challenged patents that the metal oxide layer is
7 precluded from being a passivating layer?

8 MR. PHILLIPS: Objection; form.

9 A. Well, I'm going to go back to the same
10 paragraph because I believe it does answer your
11 question. And I've opined on this here.

12 "A POSITA would understand that the separation
13 layer" -- and the separation layer may be a metal oxide
14 -- "when paired with a passivation layer, does not
15 itself perform a passivation function." And I believe
16 that's the answer to your question.

17 Q. (BY MR. MAIER) So it's your opinion that when
18 the metal oxide layer is paired with another passivation
19 layer, it is outside the scope of the claims for that
20 metal oxide layer to perform a passivation function;
21 correct?

22 MR. PHILLIPS: Objection; form.

23 A. No. That's a much more complicated question.
24 That's a scope question.

25 I'm doing a POSA, a POSITA interpretation

1 question based on the language in the patent that
2 describes a passivation layer and a separation layer.
3 The passivation layer passivates. The separation layer
4 when combined with the passivation layer need not
5 passivate -- does not passivate.

6 Q. (BY MR. MAIER) Well, that's two different
7 things. You said need not passivate and does not
8 passivate. And that's really my question, which one?

9 Is the metal oxide layer of the challenged
10 claims precluded from being a passivation layer? Or do
11 the challenged claims encompass metal oxide layers that
12 can passivate the semiconductor?

13 MR. PHILLIPS: Objection; compound; form.

14 Q. (BY MR. MAIER) And I'll withdraw that
15 question and ask it step by step, but that's really what
16 I'm trying to get at.

17 Are you saying that the metal oxide layer just
18 cannot passivate the semiconductor? Or are the claims a
19 little bit broader than that and they could encompass
20 metal oxides that can passivate the semiconductor that
21 don't passivate the semiconductor?

22 So that's what I'm getting at. So let me ask
23 it in both steps.

24 I'll ask you the question about whether it's
25 precluded first, and then I'll ask you the question

1 about whether it's allowed.

2 In the challenged claims, is the metal oxide
3 layer precluded from being a passivating layer?

4 A. I've not thought of that in that direction.

5 Let me go the other direction for a moment and
6 kind of walk my way into this.

7 I've thought about it and discussed in
8 paragraph 105 that a passivation material that is also
9 an oxide would not be considered a separation layer.
10 I've thought about that and developed an opinion on
11 that. So if you have a passivation layer that is an
12 oxide, you would not say, well, that's a separation
13 layer; that would be the passivation layer.

14 But you appear to be asking the inverse
15 question which is when we have a passivation layer is
16 the metal oxide prohibited from being a passivation
17 layer? And I don't know. I have not thought about that
18 version of the question. You know, I've opined on the
19 various versions I've thought about, but the version of
20 is it precluded, that's a very deep question, and I
21 don't know the answer to that.

22 Q. Okay. And let me ask it the other way. And
23 you may not have an answer here either.

24 Can the challenged claims -- and I want to be
25 clear here, actually, just for context. The challenged

1 claims all discuss a metal oxide. And there are other
2 layers like the contact layer and there's a
3 semiconductor oxide layer and there's, I think, the
4 underlying silicon, but they all have this metal oxide
5 layer in them.

6 Do you recall that from your work?

7 A. So that was a very long question.

8 Can you break that up into smaller questions?
9 Because you were exclaiming something and then, boom,
10 there was a "do you recall that." So can you do it in
11 smaller pieces so I can confirm I recall or don't recall
12 each piece?

13 Q. Yeah. And I'll give you the actual question
14 because that was mostly just to give you context, and it
15 wasn't a question that I was really looking for an
16 answer to. So let me -- here's the question.

17 Do the challenged claims encompass metal oxide
18 layers that can passivate the semiconductor?

19 MR. PHILLIPS: Objection; scope.

20 A. Yeah, I have not opined on that version of the
21 question. I've opined on a number of things around
22 that. I've opined, as we discussed, on "a POSITA would
23 understand that the separation layer, when paired with a
24 passivation layer, does not itself perform a passivation
25 function." I've opined on that. That's paragraph 104.

1 I've also opined on the reverse, which is if
2 you have a passivation material that's an oxide, it
3 would not be considered a separation layer. I've opined
4 on that in 105.

5 But the very specific question of "do the
6 claims preclude that," that question I've not opined on,
7 and I'm not in the position to do that today.

8 If you know of a place in my declaration where
9 you believe I've opined on that, we can talk about it.
10 But my memory is is that I've not opined on that version
11 of the question.

12 Q. (BY MR. MAIER) And that's fair enough because
13 that's what I'm trying to figure out is whether you have
14 a position on that or not.

15 And it sounds like -- so the metal oxide layer
16 is the separation layer.

17 Do you recall that?

18 A. We've agreed that the passivation layer
19 passivates. We've also agreed that there's a separation
20 layer, which could be a metal oxide, does not have to be
21 a metal oxide. And I believe we also agreed, per my
22 paragraph 104, that the separation layer when paired
23 with the passivation layer does not in itself perform a
24 passivation function. I think that's all stuff we've
25 mutually agreed on.

1 The question that we're debating here is
2 whether it's precluded from having a passivation
3 function --

4 Q. Right.

5 A. -- and I have not opined on that.

6 Q. Okay. So I think that's what I was looking
7 for. I just wanted to make sure that you didn't have a
8 position on that one way or another.

9 A. I have not opined on that. That is a
10 complicated question, and I have just not sat down and
11 thought that through.

12 Q. And because the questions were a little bit
13 disjointed here, let me just make it clear for the
14 record.

15 You have not provided an opinion one way or
16 the other whether the metal oxide separation layer is
17 precluded from having a passivation function; correct?

18 A. I have not opined one way or the other whether
19 the separation layer or the metal oxide separation layer
20 is prohibited from having any passivation function.

21 Q. Okay.

22 A. That's correct.

23 MR. MAIER: Okay. And I think -- we've been
24 going an hour, so I don't know what you like to do -- if
25 you like to do breaks every hour, whether you like to

1 keep rolling. What do you prefer?

2 THE WITNESS: This is a good time for a break.
3 I need to go make sure that there's no emergency with
4 that one little page and have a cup of coffee.

5 How about ten minutes?

6 MR. MAIER: Yeah, absolutely.

7 THE VIDEOGRAPHER: Going off the record. The
8 time is 10:08 a.m.

9 (Brief break taken.)

10 THE VIDEOGRAPHER: We are back on the record.
11 The time is 10:24 a.m.

12 Q. (BY MR. MAIER) Dr. Kuhn, the '423 patent
13 discloses a metal-interface layer-semiconductor contact
14 structure; correct?

15 A. In general, yes.

16 Q. The interface layer may comprise a metal oxide
17 separation layer and a semiconductor oxide passivation
18 layer; correct?

19 A. In general, yes.

20 Q. What is a metal oxide?

21 A. At the highest level -- and I know this sounds
22 a little facetious, but it's not. At the highest level,
23 it's an oxide of a metal.

24 Q. And for these next set of questions, if it's
25 helpful, in your Exhibit Share folder I have a copy of

1 the periodic table. You probably don't need it, but I
2 put it there anyway.

3 And let me know when you're ready for my next
4 question.

5 A. Okay. Let me actually download that.

6 Q. I think it's an okay source, the American
7 Chemical Society.

8 A. Oh, a very nice periodic table. I have that.

9 Q. Yeah, I have gone through -- I went through
10 about ten different versions, and this one looked the
11 prettiest.

12 A. Okay. I have that open.

13 Q. Okay. How many different metal oxides exist?

14 A. I don't know.

15 Q. What are all of the different metal oxides
16 that you can name?

17 A. Well, I've named a lot of them in my
18 declaration, so that's a good place to start. And I'm
19 on paragraph 110 because I have them clumped in groups
20 of relevance to this patent.

21 And the groups start out with -- and I'm just
22 going to paraphrase my way through this. But there is a
23 group that are materials that are well known in
24 semiconductor manufacturing and have extensive research
25 emphasis because of high-k metal gate. And the three

1 here I list are aluminum oxide, titanium oxide and
2 tantalum oxide. And these are families of materials.

3 And then I also list, later in the paragraph,
4 materials well established in the industry that aren't
5 quite as extensively researched as the high-k materials.
6 That would be indium oxide, magnesium oxide, zinc oxide
7 tungsten oxide, molybdenum oxide and yttrium oxide.

8 And as we get into this, I also want to make a
9 caveat, because it's come up before, is there are
10 materials that are clearly inappropriate. Uranium oxide
11 was one example that came up at one point. And that's
12 clearly inappropriate because it's radioactive and you
13 don't mix radioactivity and semiconductors.

14 And there is some others that are
15 inappropriate as well that a POSITA would understand
16 based on CMOS processing, and I list two here, silver
17 oxide and gold oxide, which are just not compatible with
18 silicon CMOS.

19 And then there is some materials that POSITA
20 would not consider because they have extensive
21 well-publicized other issues. And I provide one example
22 here, which is lead oxide. And to a large extent, these
23 are materials I am either familiar with or have worked
24 with at some point, some obviously more than others.

25 Q. Each metal oxide has multiple species;

1 correct?

2 A. That's a more complicated question than it
3 sounds.

4 You can have various equilibrium compounds for
5 a metal oxide. So, for example, Ti oxide might have
6 TiO₂ or Ti₂O₃ or Ti₃O₅, something like that. Those are
7 equilibrium stable compounds.

8 But in the semiconductor industry, you can
9 also have nonequilibrium compounds because these
10 products are fabricated in nonequilibrium conditions.

11 So there are potential for many more
12 possibilities within a family than the traditional
13 stable equilibrium compounds.

14 Q. Okay. I think I understand.

15 And even each of those metal oxide species may
16 have different crystal structures; correct?

17 A. Boy, that's challenging as well. I can think
18 of several circumstances under which the same compound
19 name crystallizes in different forms depending on
20 different conditions. And, again, we have the
21 equilibrium and nonequilibrium case. So I would say
22 unless you have detailed data, you do need to assume the
23 possibility to crystallize in multiple forms for the
24 same chemical formula.

25 Q. And I think I've seen a crystal structure

1 called face-centered cubic.

2 Are you familiar with that?

3 A. Yes.

4 Q. Do you know how many different crystal
5 structures titanium dioxide has?

6 A. No.

7 Q. Okay. So can you go to paragraph 98 of your
8 declaration, which I believe you referred to just a
9 couple of minutes ago, and let me know when you're
10 there.

11 A. I'm there.

12 Q. Now, it's your contention that the spacer
13 layer, i.e., the MIGS separation layer, is to be an
14 oxide of whatever metal is used as the metal in the
15 metal-semiconductor junction; correct?

16 MR. PHILLIPS: Objection; form.

17 A. I want to read the whole sentence there
18 because there is a nuance that the last part of the
19 sentence misses. The whole sentence is "First, a POSITA
20 would recognize from the TiO2 spacer layer example that
21 a desirable embodiment for the spacer layer (i.e., the
22 MIGS separation layer) is to be an oxide of whatever
23 metal is used as the metal in the metal-semiconductor
24 junction."

25 The key phrase that I felt was missing was

1 "desirable embodiment."

2 Q. (BY MR. MAIER) Got it.

3 So do the challenged claims require the metal
4 oxide layer to be the same metal type as the metal
5 layer?

6 MR. PHILLIPS: Objection; form. Objection;
7 scope.

8 A. I haven't done an analysis of all the claims.
9 Could we start with a particular one and work
10 through it?

11 I'm afraid you gave a broad answer on that one
12 because there are a lot of different claims in these
13 patents. Can we do an example?

14 Q. (BY MR. MAIER) I mean, we sure can. But you
15 gave the same opinion with respect to every single
16 challenged claim; right? You didn't distinguish between
17 claims in your declaration?

18 A. That may or may not be true, but I'd feel
19 better if I could look at the precise wording. Can we
20 do that?

21 Q. Yeah. I mean, pick whatever patent you want.
22 Here, I'll upload -- the '423 has actually already been
23 invalidated, so let me upload -- I'll upload the '336.

24 A. Okay.

25 Q. Let me know when you see it in the marked

1 exhibit folder.

2 A. I'm actually just jumping to the copy I have.

3 Q. Yep, that's no problem.

4 A. And do you have a favorite claim you want to
5 talk about?

6 Q. Sure, let me just scroll down to it.

7 Okay. Let's take Claim 1.

8 A. Okay.

9 Q. You should see a reference that says "the
10 interface layer comprising a metal oxide"?

11 A. Yes. "The interface layer comprising a metal
12 oxide and configured to reduce a height of a Schottky
13 barrier" and so on.

14 Q. And then you can also see in Claim 13 there's
15 a reference to "an interphase layer comprising a metal
16 oxide"?

17 A. Yes.

18 Q. Okay.

19 A. Okay.

20 Q. So do the challenged claims require the metal
21 oxide layer to be the same metal type as the metal
22 layer?

23 MR. PHILLIPS: Objection; form.

24 A. So if we look at --

25 MR. PHILLIPS: Objection; scope.

1 A. If we look at Claim 1, the metal oxide layer
2 is neither required nor prohibited to be the same metal
3 as the contact metal.

4 Q. (BY MR. MAIER) And the same is true for
5 Claim 13?

6 MR. PHILLIPS: Same objection.

7 A. And 13 is a little more complicated because 13
8 describes a conductor, not specifically a metal. And so
9 I would say in Claim 13 the language "conductor
10 separated from the semiconductor by an interface layer
11 comprising a metal oxide" neither requires nor prohibits
12 the metal to be the same or different from the
13 conductor.

14 Q. (BY MR. MAIER) And I think the same is true
15 for all. You have not provided an opinion in this case
16 that says that any of the challenged claims require the
17 metal oxide layer to be the same metal type as the metal
18 layer; correct?

19 A. My opinion on this that I've provided is
20 around the desirable embodiment as we discussed in
21 paragraph 98. I don't believe I've provided an opinion
22 on the claims themselves as to whether any specific
23 claim requires or prohibits.

24 Q. And I think that's an important distinction
25 because we're talking about a patent case where the

1 claims have to be enabled, the claims have to have
2 written description and not so much as what one might
3 subjectively desire.

4 So let me ask the question just so we have it
5 clear.

6 You do not assert that any challenged claim
7 requires the metal oxide layer to be the same metal type
8 as the metal layer of the claimed structures; correct?

9 MR. PHILLIPS: Objection; form.

10 A. I assert -- or I opine in paragraph 98 that a
11 POSITA would recognize it's a desirable embodiment to
12 have the metal the same metal as in the metal oxide.
13 And I also opine that the Ti, TiO2 example strongly
14 suggests to a POSITA a relationship between the spacer
15 layer and the metal.

16 Q. (BY MR. MAIER) But that relationship is not
17 required by the claims; correct?

18 A. I don't recall opining on whether that
19 relationship is required or not.

20 Q. So the challenged claims can encompass a
21 structure where the metal layer comprises a metal that
22 is different than the metal used in the metal oxide
23 layer; correct?

24 A. My attention has been on what I believe the
25 desirable embodiment is, which is the case for which the

1 metal and the metal oxide are the same.

2 I have not thought deeply about what I would
3 consider an undesirable embodiment, which is the metal
4 and the metal oxide are different.

5 Q. So it's your opinion that it would be
6 undesirable if the claimed structure had a metal layer
7 that comprised a different metal than the metal used in
8 the metal oxide layer?

9 A. No, I've not opined on it to that level. I've
10 only opined on this in one direction. I've opined on
11 the direction that it would be desirable, that it would
12 be a desirable embodiment and a POSITA would recognize
13 the relationship between the spacer layer and the metal
14 from the Ti, TiO₂ example. I had not opined on the
15 other direction.

16 Q. And I think the following questions will
17 explain exactly why.

18 If you could turn to the '423 patent.

19 A. Okay.

20 Q. And this is, again, Exhibit 1003 in the 1204
21 proceeding, if you're looking at it on Exhibit Share.

22 A. Okay. I have the '423 patent open.

23 Q. Can you please turn to Column 13 at lines 56
24 to 65.

25 A. Okay. I'm -- I was. Hang on.

1 Okay. I'm on Column 13, lines 62 to 65. Did
2 I hear that correctly?

3 Q. No, I apologize. It's Column 13, lines 56
4 through 65.

5 Let me --

6 A. I am on -- I'm there.

7 Q. Okay. That passage lists metals that could be
8 used as the metal layer in the claimed Acorn structures;
9 correct?

10 A. Yes.

11 Q. And that is not an exhaustive list of metals
12 that could be used as the metal layer in the claimed
13 Acorn structures; correct?

14 A. The word "exemplary" is used, which I believe
15 means an example of but not restricted to.

16 Q. And I believe the word "exemplary" is what you
17 had quoted in paragraph 99 of your declaration as well,
18 so thank you for that clarification.

19 Can each of the metals listed at Column 13,
20 lines 56 to 65, of the '423 patent form a metal oxide?

21 A. I looked into this at one point. And some of
22 these do not form metal oxides.

23 Q. Do you know which ones?

24 A. My memory on this is not totally clear, but I
25 believe that gold does not form a conventional oxide.

1 Q. Now, is it your contention that a person of
2 skill in the art reading this list at column 13 of the
3 '423 patent would readily understand that the patent
4 discloses the genus of metal oxides?

5 A. I'm not sure I understood that question. The
6 word "genus" hung me up. Can you try the question
7 another way?

8 Q. Do you have an understanding of the terms
9 "genus" and "species" in the context of your written
10 description opinions?

11 A. I have an understanding of the word "genus"
12 and "species" with regards to taxonomy of animals.

13 Q. Okay. So the answer is "no"?

14 A. I think the answer is no.

15 Q. Okay. Let me try to use slightly less
16 legalese then.

17 A. Thank you.

18 Q. It's your opinion -- so, strike that.

19 Your opinions are based in part on the
20 preexisting knowledge that a person of ordinary skill in
21 the art would have had prior to the alleged inventions;
22 correct?

23 A. Yes.

24 Q. So I want to test that a bit and go through
25 this list.

1 So keep the list of metals at Column 13 of the
2 '423 patent in mind. We'll go through them one by one.
3 Okay?

4 A. Okay.

5 Q. Prior to 2002, were POSITAs aware that they
6 could use aluminum as the metal layer in a
7 metal-interface layer-semiconductor junction?

8 A. Okay. If we're going to ask the question in
9 that form, it's going to be very hard for me to answer
10 because it requires me knowing the literature prior to
11 2002 for each of these metals.

12 I am more willing to answer the question to
13 the form, would a POSITA be aware of the properties of
14 the metal and metal oxide in a semiconductor
15 environment. Is that fair? Or do you really want the
16 question in the form of the metal-semiconductor
17 junction?

18 Q. Well, let's do it both ways. And you may just
19 tell me you don't know the answer to this more specific
20 question.

21 A. Okay.

22 Q. And I do want to rephrase what you said a
23 little bit because semiconductor environment is a little
24 vague, so I want to narrow it down a little bit.

25 Let me try it this way and see if this is

1 something you can do.

2 Prior to 2002, were POSITAs aware that they
3 could use aluminum as the metal in a semiconductor
4 structure?

5 A. Yes, because aluminum had been used as a
6 metallization, a back-end metallization and even, I
7 believe, as a gate material. So POSITAs -- prior to
8 2002. So POSITAs were certainly aware of the use of
9 aluminum in the front end of a process prior to 2002.

10 Q. Okay. And now I'm going to go to my more
11 specific question which deals with metal-interface
12 layer-semiconductor junctions.

13 Prior to 2002, were POSITAs aware that they
14 could use aluminum as the metal layer in a
15 metal-interface layer-semiconductor junction?

16 A. I would need to speculate on that one because
17 of the widespread use of metal as a wiring layer. It is
18 possible that there was significant work in aluminum in
19 the metal-semiconductor junction prior to that. I just
20 don't know the exact references or literature.

21 But on that one, I would say, I believe that's
22 true, but I could not cite to a reference to prove that.

23 Q. Okay. Fair enough.

24 Prior to 2002, were POSITAs aware that they
25 could use an aluminum oxide in the interface layer of a

1 metal-interface layer-semiconductor junction structure?

2 A. Now, that one's more interesting because prior
3 to 2002, POSITAs were certainly aware they could use an
4 aluminum oxide in the gate of a transistor structure.

5 One of the things the Acorn patent did is
6 bring a startling awareness to the community -- or the
7 Acorn ideas did is bring a startling awareness to the
8 community that you could use that same material in the
9 metal source/drain junction.

10 I do not know if there was any literature
11 prior to 2002 that potentially discussed the use of an
12 aluminum oxide in the junction. But certainly from my
13 own experience in the 2002 time frame, the use of an
14 aluminum oxide in the broader community was understood
15 to be in the gate.

16 Q. Prior to 2002, were POSITAs aware that they
17 could use indium as the metal layer in a metal-interface
18 layer-semiconductor junction structure?

19 A. Now, here's where I'm going to have to
20 restrict myself to CMOS. My testimony has been focused
21 on CMOS. There are questions of III-Vs and other
22 materials that I've not opined on in this declaration.

23 So with regards to this declaration, indium is
24 not a material that is normally used as a metallization
25 in a semiconductor CMOS process. It is used in the back

1 end for some solder relationships, and it's also used as
2 an implant dose. But I'm unaware of work of indium
3 being used in the front end.

4 Q. So that's interesting because the '423 patent
5 says to use this as one of the options of the metal
6 layer, doesn't it?

7 A. The '423 patent says that.

8 Q. Okay.

9 A. There's also discussion of whether the '423
10 patent applies to materials beyond silicon.

11 And my answer only was with reference to
12 silicon. I'm not opining on the other materials.

13 Q. So I want to do this in the context of the
14 claims, so I don't want to limit it to CMOS because
15 we're trying to figure out --

16 A. Okay.

17 Q. -- what these patents disclose.

18 A. Okay.

19 Q. And I want to know whether -- you know,
20 whether people knew that these types of things could be
21 used because that goes to whether there's, you know,
22 written description support here.

23 So let me ask this: Prior to 2002, were
24 POSITAs aware that they could use an indium oxide in the
25 interface layer of a metal-interface layer-semiconductor

1 junction?

2 A. Can we go back?

3 Q. Sure.

4 A. Because if we are expanding the discussion to
5 other semiconductors, then the indium answer is
6 different.

7 Q. Okay. So right now we're in the context of
8 metal-interface layer-semiconductor structures for use
9 at a source/drain context -- contact.

10 A. Okay.

11 Q. That's the universe because that's what the
12 patents relate to; right?

13 A. Okay, okay.

14 Q. Do you want to me to start back with aluminum
15 or are we good on --

16 A. I'm fine with -- I'm fine with my answer to
17 aluminum because silicon is certainly a semiconductor,
18 and so that answers your question.

19 The tension came with indium because indium is
20 not a metal commonly used in CMOS. So I answered the
21 question for CMOS.

22 Can you take a shot at the question again for
23 the record for a general semiconductor and I'll reanswer
24 it for the general case?

25 Q. And, again, when we refer to "the general

1 case," I want to be speaking in particular for the
2 metal-interface layer-semiconductor junctions disclosed
3 in the challenged patents. Okay?

4 A. Okay.

5 Q. So prior to 2002, were POSITAs aware that they
6 could use indium as the metal layer in a metal-interface
7 layer-semiconductor junction?

8 A. Prior to 2002, I believe that there was use of
9 indium in III-V materials as a metal contact layer.
10 From my own experience in MBE, I periodically used
11 indium as a contact layer.

12 Q. Prior to 2002, were POSITAs aware that they
13 could use an indium oxide in the interface layer of a
14 metal-interface layer-semiconductor junction?

15 A. I don't believe so.

16 Q. Prior to 2002, were POSITAs aware that they
17 could use titanium as the metal layer in a
18 metal-interface layer-semiconductor junction?

19 A. Titanium has commonly been used as the metal
20 often in the form of Ti nitride or even pure Ti. So
21 that was known prior to 2002.

22 So the answer is, yes, people were aware you
23 could use titanium as the metal in the
24 metal-insulator-semiconductor junction.

25 Q. Prior to 2002, were POSITAs aware that they

1 could use a titanium oxide in the interface layer of a
2 metal-interface layer-semiconductor junction?

3 A. POSITAs may have been aware of experiments
4 using such a layer, but the idea that such a layer could
5 be used to reduce resistance as described by the Acorn
6 patents I do not believe was known.

7 And let me say this another way because I want
8 to be precise here.

9 There's a plethora of physics experiments that
10 can be seen at any point along the flow of the
11 semiconductor community. The idea that someone put
12 Ti oxide on Ti and ran an experiment, there's a high
13 probability someone did that. I don't have it in front
14 of me, but I think it's not unlikely. But I believe the
15 belief that you could put that oxide layer in to reduce
16 the resistance, I do not believe that was known prior to
17 2002.

18 Q. Right. So I think you answered a narrower
19 question than the one I asked because you limited it to
20 a specific purpose. So let me ask my broader question
21 again.

22 Prior to 2002, were POSITAs aware that they
23 could use titanium oxide in the interface layer of a
24 metal-interface layer-semiconductor junction?

25 A. I don't know.

1 Q. Prior to 2002 -- and we're just going down the
2 list in the '423.

3 A. Uh-huh.

4 Q. Prior to 2002, were POSITAs aware that they
5 could use chromium as the metal layer in a
6 metal-interface layer-semiconductor junction?

7 A. I'm unfamiliar with the use of chromium in a
8 metal-semiconductor layer junction, so that's an "I
9 don't know" on that one.

10 Q. Prior to 2002, were POSITAs aware that they
11 could use a chromium oxide in the interface layer of a
12 metal-interface layer-semiconductor junction?

13 A. I don't know.

14 Q. Prior to 2002, were POSITAs aware that they
15 could use tantalum as the metal layer in a
16 metal-interface layer-semiconductor junction?

17 A. Tantalum is a material that has been widely
18 explored in the semiconductor community. I believe,
19 without having significant evidence, but I believe that
20 it was used prior to 2002.

21 Q. Prior to 2002, were POSITAs aware that they
22 could use a tantalum oxide in the interface layer of a
23 metal-interface layer-semiconductor junction?

24 A. I don't know.

25 Q. Prior to 2002, were POSITAs aware that they

1 could use cesium as the metal layer in a metal-interface
2 layer-semiconductor junction?

3 A. I have no knowledge of cesium's use in a
4 semiconductor junction, so that's an "I don't know" on
5 that one.

6 Q. And sorry if this gets repetitive, but we'll
7 just go through all of them.

8 A. Uh-huh.

9 Q. Prior to 2002, were POSITAs aware that they
10 could use a cesium oxide in the interface layer of a
11 metal-interface layer-semiconductor junction?

12 A. I don't know.

13 Q. Prior to 2002, were POSITAs aware that they
14 could use magnesium as the metal layer in a
15 metal-interface layer-semiconductor junction?

16 A. I don't know.

17 Q. Which one was that? I think I just did
18 magnesium; right?

19 A. You were on magnesium, yes. You're about to
20 do magnesium oxide.

21 Q. All right. Prior to 2002, were POSITAs aware
22 that they could use a magnesium oxide in the interface
23 layer of a metal-interface layer-semiconductor junction?

24 A. I don't know.

25 Q. Prior to 2002, were POSITAs aware that they

1 could use erbium as the metal layer in a metal-interface
2 layer-semiconductor junction?

3 A. The answer to this one may be yes. Erbium
4 periodically cycles up as a potential conventional
5 Schottky barrier material. So I believe -- and, again,
6 without proof in front of me, I believe that POSITAs
7 were aware of that in 2002.

8 Q. Prior to 2002, were POSITAs aware that they
9 could use an erbium oxide in the interface layer of a
10 metal-interface layer-semiconductor junction?

11 A. This answer is somewhat the same as aluminum.
12 Erbium oxide was being explored in the gate. I'm
13 unaware of any use of erbium oxide in the junction
14 itself prior to 2002.

15 Q. And here is my favorite one, ytterbium,
16 because that's what I focused on in grad school.

17 Prior to 2002, were POSITAs aware that they
18 could use ytterbium as the metal layer in a
19 metal-interface layer-semiconductor junction?

20 MR. PHILLIPS: Objection; form.

21 A. The rare earth metals, erbium and ytterbium
22 and lanthanum and praseodymium, periodically cycle up as
23 potential contact materials. So there's a possibility a
24 POSITA would have been aware of work in this area for
25 the use of ytterbium in a junction.

1 Q. (BY MR. MAIER) Prior to 2002, were POSITAs
2 aware that they could use a ytterbium oxide in the
3 interface layer of a metal-interface layer-semiconductor
4 junction?

5 A. I believe -- and I don't have proof in front
6 of me. But I believe prior to 2002 there was some use
7 of ytterbium oxide in the gate, but I'm unaware of any
8 use in the source/drain junction.

9 Q. Prior to 2002, were POSITAs aware that they
10 could use manganese as the metal layer in a
11 metal-interface layer-semiconductor junction?

12 A. I don't know.

13 Q. Prior to 2002, were POSITAs aware that they
14 could use a manganese oxide in the interface layer of a
15 metal-interface layer-semiconductor junction?

16 A. I don't know.

17 Q. Prior to 2002, were POSITAs aware that they
18 could use lead as the metal layer in a metal-interface
19 layer-semiconductor junction?

20 A. I do opine on this at some level by pointing
21 out that lead has environmental issues. That's page 110
22 of my report. POSITAs were certainly well aware, prior
23 to 2002, that lead was a material that was desirous to
24 be removed from semiconductor processing to the maximum
25 extent possible.

1 Q. Prior to 2002, were POSITAs aware that they
2 could use a lead oxide in the interface layer of a
3 metal-interface layer-semiconductor junction?

4 A. Somewhat the same answer as the previous,
5 little bit of a different flavor.

6 I don't believe that there was -- that POSITAs
7 were aware of the possibility of the use of lead oxide
8 because of the concerns about the environmental issues
9 with lead in semiconductor processing.

10 Q. So they knew you could use it, but you would
11 probably get fired if you did use it?

12 A. Somewhat the other way around. I don't know
13 if they knew they could use it. I'm unaware of that.
14 But there was so much emphasis in the community at that
15 time on trying to get rid of lead. And remember, lead
16 is very rarely used in the front end to begin with.
17 There was lots of emphasis on getting rid of lead in the
18 back end in packaging and so on. So a POSITA would be
19 very well aware of the environmental concerns.

20 Q. And I won't even ask it for uranium since I
21 assume if anyone tried to use that it probably didn't go
22 so well for this -- the product.

23 A. Radioactive materials and semiconductors do
24 not mix well.

25 Q. Okay. So let's keep rolling through the list.

1 I think we're -- you know, we're getting there.

2 Prior to 2002, were POSITAs aware that they
3 could use silver as the metal layer in a metal-interface
4 layer-semiconductor junction?

5 A. People are periodically fascinated by silver
6 because it's so conductive. And I believe there was
7 significant work done over the years, certainly prior to
8 2002, on the use of silver as a contact material.

9 The gotcha here is that silver oxide has some
10 well-known deleterious processing concerns. And I do
11 reference that in paragraph 110 as well. So a POSITA
12 would be aware of the use of silver and probably also
13 aware of some of the challenges of silver.

14 Q. Prior to 2002, were POSITAs aware that they
15 could use a silver oxide in the interface layer of a
16 metal-interface layer-semiconductor junction?

17 A. I don't know.

18 Q. Prior to 2002, were POSITAs aware that they
19 could use yttrium as the metal layer in a
20 metal-interface layer-semiconductor junction?

21 A. I don't know on that one.

22 Q. Prior to 2002, were POSITAs aware that they
23 could use an yttrium oxide in the interface layer of a
24 metal-interface layer-semiconductor junction?

25 A. I don't know.

1 Q. Prior to 2002, were POSITAs aware that they
2 could use zinc as the metal layer in a metal-interface
3 layer-semiconductor junction?

4 A. I don't know on zinc.

5 Q. Prior to 2002, were POSITAs aware that they
6 could use a zinc oxide in the interface layer of a
7 metal-interface layer-semiconductor junction?

8 A. Zinc oxide has periodically been explored as a
9 gate material in transistors. So as with the other
10 questions I've answered the same way, a POSITA was most
11 likely, prior to 2002, aware of the possibility of zinc
12 oxide as a gate material, but probably not aware of its
13 use in a metal-semiconductor junction.

14 Q. Prior to 2002, were POSITAs aware that they
15 could use platinum as the metal layer in a
16 metal-interface layer-semiconductor junction?

17 A. Yes. Sorry. I'm laughing.

18 Platinum is really expensive. We had a
19 situation at Intel where we brought a platinum target
20 in, and it came in in an armed truck with armed guards
21 around it.

22 So, yes, people were aware of the use of
23 platinum in a metal-semiconductor junction as a metal.

24 Q. I always wondered about that because in the
25 Olympics, the gold medal is the highest, but in credit

1 cards, platinum is always the highest.

2 A. Yeah.

3 Q. It looks like if you can set a world record in
4 the Olympics, you should get a special platinum medal.

5 A. Yeah. This particular time they really did,
6 they brought the target in with armed guards. It was
7 the talk of the building for a month. I don't know if
8 the armed guards had to stay around the tool the entire
9 time. I was afraid to ask. But they brought it in with
10 armed guards, and they took it out with armed guards.

11 Q. Oh, when you say "armed guards," you're
12 talking guns?

13 A. Yes.

14 Q. Wow.

15 A. They came in with an armored truck and people,
16 you know, with guns escorting this thing. Anyway.

17 Q. All right.

18 A. So the answer is yes, by the way, to the
19 question on the metal --

20 Q. Okay.

21 A. You probably should ask it again for the
22 record. Sorry I got off on this story.

23 Q. Yes, yes.

24 Prior to 2002, were POSITAs aware that they
25 could use platinum as the metal layer in a

1 metal-interface layer-semiconductor junction?

2 A. Yes, platinum had been explored numerous times
3 as a possible contact metal.

4 Q. Prior to 2002, were POSITAs aware that they
5 could use a platinum oxide in the interface layer of a
6 metal-interface layer-semiconductor junction?

7 A. I don't know.

8 Q. Prior to 2002, were POSITAs aware that they
9 could use gold as the metal layer in a metal-interface
10 layer-semiconductor junction?

11 A. I'm going to give a two-part answer to that.
12 From the standpoint of a silicon-based process, gold was
13 typically not used because it causes defects in the
14 silicon. From the standpoint of III-V processes, gold
15 was used.

16 So in an overall view, a POSITA would be aware
17 of the use of gold as a contact metal in a
18 metal-semiconductor junction.

19 Q. And this is a question I think we'll need to
20 talk a little bit about, and it might sound kind of
21 silly at first.

22 But prior to 2002, were POSITAs aware that
23 they could use a gold oxide in the interface layer of a
24 metal-interface layer-semiconductor junction?

25 MR. PHILLIPS: Objection; form.

1 A. Well, I don't believe gold forms a significant
2 oxide. And I could be mistaken on that.

3 Q. (BY MR. MAIER) Okay.

4 A. So I'm going to say first, I don't believe it
5 forms an oxide. But, second, if it does form an oxide
6 and I'm simply unaware of it, I don't know if a POSITA
7 would be aware of that information.

8 Q. And I think you're right. Because my
9 understanding is gold is a noble or inert metal that
10 doesn't oxidize unless you have very high pressures, and
11 semiconductors are usually formed in vacuum.

12 Is that consistent with your understanding?

13 A. Well, I've not studied gold. And I'm always
14 really hesitant to make these broad statements about
15 materials I've not studied.

16 My first layer of understanding is that gold
17 does not readily form an oxide. However, as I mentioned
18 before, semiconductors are nonequilibrium systems. And
19 you can have things happen inside a semiconductor that
20 you would not normally predict to happen in a typical
21 environment.

22 So let's leave it at I don't believe gold
23 forms an oxide, and I don't know if any -- a POSITA
24 would be aware of any use of -- any potential gold oxide
25 formed by a process I'm unaware of in a semiconductor --

1 in a metal-semiconductor junction.

2 Q. And this kind of ties back to the questions I
3 was asking you earlier.

4 Do you remember when I was asking you whether
5 the claims require the metal to be of the same type as
6 the metal in the metal oxide?

7 Do you remember those?

8 A. I remember the questions, not the exact
9 wording.

10 Q. And the reason I was asking that is because,
11 you know, I see here in the '423 patent, as cited at
12 paragraph 99 of your declaration, that gold is one of
13 the options that the patent gives for the metal layer.
14 But then I look at the metal oxide, and I see that gold
15 doesn't form a metal oxide, which tells me that in the
16 claims they're not required to use the same metal for
17 the metal layer of the same type in the metal oxide
18 layer.

19 And that is a very poor question, but do you
20 see where I'm going with that?

21 A. Well, it's a very interesting line of
22 reasoning --

23 MR. PHILLIPS: Objection; form.

24 A. It's a very interesting line of reasoning
25 you're proposing. Again, I would have to go away and

1 think about that. I've spent very little time thinking
2 about gold. Gold is not a material used in the
3 semiconductor -- in the CMOS semiconductor industry at
4 any significant level in the front end.

5 And as I mentioned before, I've not opined on
6 the whole question of required versus desired. I've
7 opined on the idea that it's a desired embodiment. I've
8 opined on the idea that the passivation layer itself
9 passivates. You know, we talked about that earlier.
10 But this question of whether it's expressly excluded,
11 I've not opined on that.

12 Q. (BY MR. MAIER) Well, this is sort of the
13 question that is at the heart of the dispute here
14 because we're trying to figure out -- this term "metal
15 oxide" in the patent claims, we're trying to figure out
16 how broad is this, what does it encompass and what is
17 outside so that, you know, you don't infringe or you
18 don't invalidate through the use of a particular metal
19 oxide.

20 So the scope of what falls within this term is
21 sort of at the heart of what I'm asking about, so that's
22 why I've been kind of asking these questions.

23 Let me ask you this: If an inventor tomorrow
24 figured out a way to make gold oxidize such that it
25 would be suitable for use in the interface layer of a

1 metal-interface layer-semiconductor junction, would the
2 challenged claims encompass a gold oxide as the claimed
3 metal oxide layer?

4 MR. PHILLIPS: Objection; form. Objection;
5 scope.

6 A. Wow, that's a wondrous hypothetical. I don't
7 know. You know, it's the kind of thing you would have
8 to see. I -- we've kind of gone down this path with
9 gold. We've talked about gold potentially not forming
10 an oxide under typical conditions. We've talked about
11 gold potentially forming an oxide under nonequilibrium
12 conditions. But I can't opine on a hypothetical gold
13 oxide and a hypothetical metal-semiconductor junction
14 without some additional information about how that would
15 work.

16 Q. (BY MR. MAIER) Well, let me just give you
17 a -- you know, a structure.

18 Titanium gold oxide that is discovered
19 tomorrow by an inventor, silicon dioxide, silicon
20 structure. Is that within the scope of the challenged
21 claims or would that not infringe the challenged claims?

22 MR. PHILLIPS: Objection; form. Objection;
23 scope.

24 A. I don't know. I'd have to think through it.
25 There's a lot of questions about, you know, does it

1 perform the passivating function? Does it perform the
2 MIGS separation function? I'd have to look at the claim
3 itself. You know, at a high level, we're talking about
4 a patent where most of the claims say something to the
5 effect of "we need to depin the Fermi level" or "we need
6 to provide MIGS separation." And we'd have to look at a
7 specific claim, and we'd have to look at the structure,
8 and we'd see if the structure met the claim we're
9 talking about.

10 Q. (BY MR. MAIER) And I'm happy to do that. I
11 can take you to one that doesn't require the whole
12 depinning. We can go to the '395 patent, if you want.

13 But I think my question is just a little bit
14 broader. And let me ask it more generally.

15 If an inventor formed a metal oxide that was
16 not known at the time of the alleged invention, and
17 formed a structure that had all of the other limitations
18 of the claims, would the claims encompass that newly
19 discovered metal oxide?

20 MR. PHILLIPS: Objection; form. Objection;
21 scope.

22 A. In some sense, you're asking me to give a
23 legal opinion that I'm not sure I'm qualified to give.
24 Let me repeat back what I believe to be true.

25 If every aspect of the claim is met, then the

1 claim is enabled; correct?

2 By putting this in infringement version: If
3 every aspect of the claim is infringed, the claim itself
4 is infringed. I don't think the day in which a material
5 is discovered matters. I may be wrong.

6 I think the -- this feels very much like a
7 legal question around timing, and I'm not sure I
8 understand the law remotely close enough to answer it.

9 Q. (BY MR. MAIER) Yeah, well, it is a legal
10 question because I'm -- you know, you're opining that
11 claims are enabled which requires a legal --

12 A. Uh-huh.

13 Q. You know, you're opining that the claims are
14 supported by the written description, which is a legal
15 standard to meet.

16 A. Uh-huh.

17 Q. And I'm trying to explore what that would
18 encompass. So --

19 A. Let me -- let me do the hypothetical back at
20 you. Okay?

21 Q. All right. I'll --

22 A. Because your -- your hypothetical assumes a
23 material that's not known to science, which bothers me
24 very much. I think that's where I'm getting stuck. So
25 let me go back and do the hypothetical in the other

1 direction.

2 Let's say we had -- and it's not going to be
3 on silicon. But let's say we have a gold metal which
4 meets the conditions for a contact. We have a gold
5 oxide separation layer which meets the conditions for a
6 separation layer. And we have a unspecified passivation
7 layer. And then we have the semiconductor. That would
8 seem to be a perfectly reasonable embodiment of the
9 patent.

10 The patent does not say you can't use gold.
11 And the patent does not say you can't use gold oxide.
12 And one of the things I've learned in the semiconductor
13 industry is in speculating you can't do something is
14 usually followed by the next week somebody doing it.

15 And so I'm very reluctant to say that, you
16 know, our vague understanding of gold says you can't
17 make an oxide. But I'm more than willing to say that if
18 you could and it met the conditions in the claim, then I
19 would say it would be enabled.

20 Q. And supported by the written description?

21 A. I'd assume so.

22 Q. Okay.

23 All right. Let's keep -- let's get back to
24 our list. I think we're more than halfway through.

25 A. Okay.

1 All right. Let me find the list again. I
2 went down a rathole here and lost it. Can you remind me
3 where it is?

4 Q. It's in the '423 patent, Column 13, around
5 line 56-ish.

6 And we're going to start with tungsten --

7 A. Okay.

8 Q. -- so let me know when you're ready.

9 A. Okay.

10 Okay. I'm here. We did platinum. We did
11 gold. We're on tungsten. Sounds good.

12 Q. Yes.

13 Okay. Prior to 2002, were POSITAs aware that
14 they could use tungsten as the metal layer in a
15 metal-interface layer-semiconductor junction?

16 A. Tungsten was very commonly used as a contact
17 metal, so the answer would be yes.

18 Q. Prior to 2002, were POSITAs aware that they
19 could use a tungsten oxide in the interface layer of a
20 metal-interface layer-semiconductor junction?

21 A. I don't know.

22 Q. And I know we've gone an hour now, but are you
23 okay to just finish this list before --

24 A. I want to finish the list. Yeah, if we break
25 and try to go back into the list, we're going to get

1 lost. Let's get the list done.

2 Q. All right. Let's keep rolling.

3 Prior to 2002, were POSITAs aware that they
4 could use nickel as the metal layer in a metal-interface
5 layer-semiconductor junction?

6 A. Yeah, nickel was commonly explored prior to
7 2002. Nickel has some weird problems, but POSITAs were
8 certainly aware of the possibility.

9 Q. Prior to 2002, were POSITAs aware that they
10 could use a nickel oxide in the interface layer of a
11 metal-interface layer-semiconductor junction?

12 A. I don't know.

13 Q. Prior to 2002, were POSITAs aware that they
14 could use molybdenum as the metal layer in a
15 metal-interface layer-semiconductor junction?

16 A. I don't know.

17 Q. Prior to 2002, were POSITAs aware that they
18 could use a molybdenum oxide in the interface layer of a
19 metal-interface layer-semiconductor junction?

20 A. I don't know.

21 Q. Prior to 2002, were POSITAs aware that they
22 could use copper as the metal layer in a metal-interface
23 layer-semiconductor junction?

24 A. Yes, with some concerns about copper diffused
25 in the silicon system. Different answers for different

1 material systems. So that one is a yes.

2 Q. Prior to 2002, were POSITAs aware that they
3 could use a copper oxide in the interface layer of a
4 metal-interface layer-semiconductor junction?

5 A. I don't know.

6 Q. And I guess you would agree that it would be
7 unsuitable to use copper as the metal layer in the
8 metal-interface layer silicon semiconductor junction;
9 correct?

10 A. You can use copper in the contact. You have
11 to be extraordinarily careful in touching the copper to
12 the semiconductor surface itself.

13 Q. And that's because copper diffuses very fast
14 into silicon and would degrade the silicon?

15 A. It creates deep-level traps in the silicon.
16 That doesn't prohibit the usual configuration, which
17 would be copper and, for example, a Ti nitride layer.
18 But POSITAs in 2002 would -- you know, copper was coming
19 into its own as a back-end layer about that time.
20 POSITAs would be very well aware that a copper contact
21 directly on silicon poses some risk. And so they
22 certainly would be aware of the research and aware of
23 the materials and aware of the risk.

24 Q. Prior to 2002, were POSITAs aware that they
25 could use cobalt as the metal layer in a metal-interface

1 layer-semiconductor junction?

2 A. Cobalt is periodically examined as a metal
3 replacement layer for, for example, tungsten. So, yes,
4 they would be aware of that.

5 Q. Prior to 2002, were POSITAs aware that they
6 could use a cobalt oxide in the interface layer of a
7 metal-interface layer-semiconductor junction?

8 A. I don't know.

9 Q. Last one.

10 Prior to 2002, were POSITAs aware that they
11 could use palladium as the metal layer in a
12 metal-interface layer-semiconductor junction?

13 A. I don't know.

14 Q. Prior to 2002, were POSITAs aware that they
15 could use a palladium oxide in the interface layer of a
16 metal-interface layer-semiconductor junction?

17 A. I don't know.

18 MR. MAIER: Okay. You want to take
19 ten minutes?

20 THE WITNESS: Yes, this is a good place to
21 stop.

22 MR. MAIER: Yep. All right. Let's take
23 ten minutes.

24 THE VIDEOGRAPHER: Going off the record. The
25 time is 11:20 a.m.

1 (Brief break taken.)

2 THE VIDEOGRAPHER: We're back on the record.

3 The time is 11:33 a.m.

4 Q. (BY MR. MAIER) Dr. Kuhn, I want to turn back
5 to something you pointed me to earlier. And it's that
6 paragraph 110 of your declaration.

7 Can you let me know when you're there?

8 A. I'm here.

9 Q. You refer to a quote "world-wide emphasis on
10 high-k dielectrics at the time of the patent (families
11 such as aluminum oxide, titanium oxide, and tantalum
12 oxide)."

13 Do you see that?

14 A. Yes.

15 Q. What did you mean by that statement?

16 A. One of the things about this collection of
17 Acorn patents is they're very Lego-block like. They are
18 taking processes and techniques already well known in
19 the industry and putting them together in a different
20 way.

21 And I've mentioned this in several places, but
22 there's the idea that you're taking stuff that people
23 know well and then you're putting it together in a way
24 that has this insulating layer in the middle which is
25 the core of the invention, which people just didn't

1 perceive of doing it that way.

2 And at the time in the early 2000s, the
3 semiconductor community as a whole was engaged in a very
4 intense focus on replacing the silicon dioxide gate
5 dielectric that was used in the conventional CMOS device
6 with what's called a high-k gate dielectric.

7 And so there was a spurt of active research
8 across the world looking at a variety of even incredibly
9 exotic materials all for their use in high-k gate
10 dielectric.

11 I mean, people don't use praseodymium oxide by
12 accident; right? You have to really want to have a
13 really good reason to do that. And so the -- there was
14 a tremendous focus in this period. And so one of the
15 things a POSITA had available to them in the community
16 was a great depth of knowledge on certain of these
17 materials that were being used as high-k gate
18 dielectrics.

19 Q. So prior to 2002, would the metal oxides you
20 list there -- aluminum oxide, titanium oxide and
21 tantalum oxide -- would POSITAs have recognized those as
22 all potential options for use in an interface layer of
23 an MIS junction?

24 MR. PHILLIPS: Objection; form.

25 A. Well, if you're asking if they would have

1 recognized them for use in an interface layer to reduce
2 contact resistance, I would say no. That was not
3 obvious prior to the 2002 patents.

4 If you're saying if it would be used in a
5 general metal-interface layer-semiconductor structure,
6 well, a gate -- a transistor gate is a metal-interface
7 semiconductor-layer structure. So the answer would of
8 course be yes.

9 Q. (BY MR. MAIER) Great.

10 So let me, I guess, break that down. So let
11 me ask my broader question first without a specific
12 purpose for using these structures and then we can
13 ask --

14 A. Okay.

15 Q. -- the one that's limited to the specific
16 purpose.

17 So prior to 2002, POSITAs would have
18 recognized that aluminum oxides, titanium oxides and
19 tantalum oxides were all options for use in the
20 interface layer of an MIS junction structure; correct?

21 A. But I'm confused now. You said it's a
22 junction. That implies a use.

23 Q. Well, so I'm talking --

24 A. I mean --

25 Q. I'm trying to -- I'm using junction to talk

1 about the connection that's above the source or drain.

2 A. But that means it's in the source/drain. That
3 implies a use. If you were -- if you were to say
4 were -- was a POSITA aware of the use of aluminum,
5 aluminum oxide and silicon in a semiconductor structure,
6 I'd say, sure, because of the work being done in high-k
7 gate dielectrics.

8 But when you stick junction in there, well, a
9 junction -- that's the junction's purpose is to conduct
10 current into the transistor or into the whatever. Or in
11 the case of a Schottky junction, to not conduct current.

12 So I'm trying to separate are we talking about
13 a specific application or are we talking about this in
14 broad terms?

15 Q. I'm talking about just the structure used for
16 a contact to a source/drain.

17 A. Okay.

18 Q. So -- and then I'll ask about the purpose.
19 But let me start with this.

20 Would -- prior to 2002, POSITAs were aware
21 that they could use an aluminum oxide, a titanium oxide
22 and a tantalum oxide interchangeably for the interface
23 layer of an MIS junction structure; correct?

24 MR. PHILLIPS: Objection; form.

25 A. Okay. So I have -- given all what I said

1 before, I have to answer this no.

2 Prior to 2002, a POSITA would not be aware of
3 the use of -- or the three -- aluminum oxide, titanium
4 oxide and tantalum oxide in a junction as you said in
5 the source/drain region of a transistor.

6 Q. (BY MR. MAIER) Okay. So let me broaden it.

7 So I see you're -- I think the source/drain
8 region is what's tripping us up. So let me ask the
9 higher level then first.

10 I'm not going to mention over the source/drain
11 of a transistor.

12 Prior to 2002, POSITAs would have known that
13 aluminum oxide, titanium oxide and tantalum oxide were
14 interchangeable for use in an interface layer of a
15 metal-interface layer-semiconductor structure; correct?

16 A. No. And actually as I think more about the
17 question, I'm developing more concerns about it. We may
18 have to do these one at a time.

19 To begin with, you're using the three layers
20 as interchangeable, which I find concerning because
21 we've not talked about any of the other characteristics
22 of this junction.

23 Also we're still back to this problem. When
24 you say a junction, a junction implies current flow, so
25 we've got current flow through this thing.

1 And so the most honest answer I can give to
2 the way the question is phrased is prior to 2002, a
3 POSITA would not have been aware of the use of aluminum
4 oxide or titanium oxide or tantalum oxide in a junction
5 intended to conduct current.

6 Q. Well, so I -- my question purposefully omitted
7 the word "junction." And I may have --

8 A. Oh, I'm sorry.

9 Q. So I'm -- I'll ask the question again, and I'm
10 not going to use the word "junction."

11 A. Okay.

12 Q. Prior to 2002, POSITAs would have known that
13 they could use aluminum oxide, titanium oxide and
14 tantalum oxide in the interface layer of a
15 metal-interface layer-semiconductor structure; correct?

16 MR. PHILLIPS: Objection; form.

17 A. That version I feel more comfortable with
18 because, prior to 2002, a POSITA would have been aware
19 that one could use a aluminum oxide, titanium oxide or a
20 tantalum oxide in a metal-insulator-semiconductor
21 structure. And the justification for that is the work
22 on high-k gate dielectrics.

23 Q. (BY MR. MAIER) And I think it's even broader
24 than that. Because I've seen papers from the 1980s that
25 describe, for example, aluminum, aluminum oxide, silicon

1 structures.

2 Is that consistent with your understanding?

3 MR. PHILLIPS: Objection; scope; foundation.

4 A. I've not seen those papers. I'm relying only
5 on my own experience.

6 Q. (BY MR. MAIER) Okay. So I think we've got
7 the first step of agreement. So let me confirm that,
8 then I'm going to go to -- then I'm going to use the
9 word "junction."

10 So I think we agree that prior to 2002,
11 POSITAs would have known that they could use aluminum
12 oxide, titanium oxide and tantalum oxide in the
13 interface layer of a metal-interface layer-semiconductor
14 structure, period; right?

15 MR. PHILLIPS: Objection; form.

16 A. Okay. So prior to 2002, a POSITA would have
17 been aware that they could use aluminum oxide or
18 titanium oxide or tantalum oxide in a metal -- a
19 metal-insulator-semiconductor structure.

20 Q. (BY MR. MAIER) Okay. So now let me go to the
21 word -- to the junction -- or let me go to, I think,
22 what you first brought up.

23 You believe that prior to 2002 it was unknown
24 to POSITAs that using an aluminum oxide or titanium
25 oxide or tantalum oxide interface layer would reduce the

1 specific contact resistivity of a junction structure;
2 correct?

3 A. Yes, I believe that prior to 2002, a POSITA
4 would not have been aware that the use of a aluminum
5 oxide or a titanium oxide or a tantalum oxide would
6 reduce the resistance of a metal-insulator-semiconductor
7 junction.

8 Q. Okay.

9 All right. So I think we worked our way and
10 kind of cleared up what was known and what you're saying
11 was not known.

12 A. Uh-huh.

13 Q. Are you aware of any metal oxide that was
14 first used as the metal oxide layer in a metal, metal
15 oxide, semiconductor oxide silicon structure after 2011?

16 A. That's an extraordinarily difficult question
17 to answer. One of the things that I've learned in
18 writing review papers is that the first use of anything
19 is extraordinarily difficult to figure out.

20 I have gotten in serious trouble by publishing
21 that the first paper in such-and-so was paper so-and-so,
22 only to get an irate email when the paper publishes
23 saying "No, no, I published it first." And I get
24 inundated by all these people who claim they published
25 it before whatever I used.

1 So trying to decide what the first of
2 something is I've found personally is extraordinarily
3 difficult to do.

4 Q. But aren't you crediting Acorn for being the
5 first to come up with this idea of using an insulating
6 layer in a metal-semiconductor junction to reduce
7 contact resistivity?

8 A. I didn't perceive your question as being that
9 question. I perceived your question as being a broader
10 and more generic question about the use of an insulator
11 in general. I'm thinking of physics papers. So I may
12 have simply misperceived your question. But there's a
13 broad community of surface scientists who publish
14 material X on material Y on material Z papers who are
15 not thinking of its application in a transistor
16 source/drain, for example. And those papers are widely
17 spread and often very old.

18 So if we're talking about the specific case of
19 the semiconductor junction used to feed the source/drain
20 of a transistor, I believe Acorn's idea was the first.
21 But if we're talking about physics-level discussion of
22 those layers, perhaps in a diode analysis or in a
23 surface science analysis, that's must harder to
24 determine.

25 Q. So let me try to ask a more specific question.

1 In the context of the claimed structures,
2 metal, metal oxide, semiconductor, silicon, are you
3 aware of any metal oxides used in such a structure for
4 the first time after 2011?

5 MR. PHILLIPS: Objection; form.

6 A. I want some clarification on this. I'm going
7 to ask a clarifying question. And I'm going to do it --
8 a hypothetical just to make sure I understand what
9 you're asking.

10 Let me invent a material called Acorn-inium.
11 And are you asking me if I'm aware of the use of
12 Acorn-inium in a metal-insulator-semiconductor junction
13 after 2011?

14 Q. (BY MR. MAIER) So that's sort of my
15 hypothetical. But let's not make it Acorn-inium --

16 A. Okay.

17 Q. -- because I want to understand if someone
18 else other than Acorn, other than Samsung, just someone
19 completely unrelated, has come up with using a metal
20 oxide layer in a metal, metal oxide, semiconductor
21 oxide, silicon structure after 2011?

22 MR. PHILLIPS: Objection; scope.

23 A. I don't know that one. And my focus on
24 metal-insulator-semiconductor structures kind of peaked
25 between about 2007 and 2011. That was, you know, when I

1 was on a FinFET project. And after that my contact to
2 the community died off.

3 There could easily have been such an
4 innovation, but I was off doing other things and was not
5 aware of it. So the answer to that is I don't know in
6 that time frame.

7 Q. (BY MR. MAIER) So let's assume for the
8 purpose of this hypothetical that there was an
9 innovation where a new metal oxide was first used in a
10 metal-metal oxide-semiconductor oxide-silicon structure
11 after 2011.

12 In your opinion, would the challenged claims
13 encompass that new metal oxide?

14 MR. PHILLIPS: Objection; form. Objection;
15 scope.

16 A. Yeah, it would be kind of nice to know what
17 this metal oxide was. That's very hard to answer on
18 that level of a hypothetical.

19 What if it was uranium oxide?

20 Q. (BY MR. MAIER) That's a good one. All right.
21 Let's do this. And I promise you there's a reason for
22 these questions, but let's take this absurd example.

23 We get new technology that allows for a safe
24 uranium oxide to exist at room temperature. And someone
25 today puts that uranium oxide into a metal, metal oxide,

1 semiconductor oxide, silicon structure in the context of
2 the challenged claims here. Those challenged claims
3 recite a metal oxide.

4 So my question is would those challenged
5 claims that encompass a metal oxide cover this newly
6 discovered uranium oxide?

7 MR. PHILLIPS: Objection; form; scope.

8 A. I don't know. This feels like a broader legal
9 question about timing, which I find concerning. Also,
10 you know, there are some questions about, let's look at
11 the claim, let's look at uranium oxide. I don't feel
12 comfortable answering that question. I just don't know
13 enough about either the material, the hypothetical or
14 the importance of the timing in this discussion because
15 this kind of feels like it's a legal aspect that I'm
16 unaware of the nuances.

17 Q. (BY MR. MAIER) Yeah. And to be frank, I
18 mean, all of these are -- these questions are for legal
19 purposes, right, that's why we're here. But let me try
20 to ask it more from a technical perspective.

21 And what I'm trying to get at here is how
22 broad is the metal oxide in the claims? Like how can I
23 narrow that down, if I can, you know, to make sure I
24 don't infringe or something or the prior art doesn't
25 invalidate?

1 So the question is directed to how broad is
2 metal oxide as recited in the claims, each of the
3 challenged claims?

4 So let me ask -- try to ask a technical
5 question.

6 Assume that you have a newly discovered metal
7 oxide and it is used in a metal, metal oxide,
8 semiconductor oxide, silicon structure that meets every
9 limitation of the challenged claims.

10 Would that newly discovered metal oxide be
11 encompassed by the claimed metal oxides of the
12 challenged claims?

13 MR. PHILLIPS: Objection; scope. Objection;
14 form.

15 A. I'm having trouble answering that in the
16 general, but I'll shoot you back an answer in the
17 specific and see if that works for you.

18 Let's say that someone discovered a new
19 crystallographic orientation -- and I believe you used
20 the word "species" -- and a new species of Ti oxide, and
21 demonstrated that in a metal-insulator-semiconductor
22 source/drain junction, I certainly believe that would
23 fall within the claims.

24 Q. (BY MR. MAIER) Okay.

25 All right. I appreciate you bearing with me

1 through these hypotheticals. Although as an expert,
2 that's the fun thing about having an expert witness is
3 you get to ask hypotheticals.

4 Let's switch gears a little bit. Let's
5 talk --

6 A. Okay.

7 Q. -- about the properties of these metal oxides,
8 et cetera.

9 What are the properties of a metal oxide that
10 are relevant in a metal-interface layer-semiconductor
11 junction?

12 A. Well, the first -- and I'm not sure if it's a
13 property or a characteristic. It's an oxide of a metal,
14 as we've discussed before. And the next property is --
15 and I want to find where I discuss this because I
16 thought a lot about this, and I want to make sure that
17 I'm getting the language right.

18 Yeah, let me jump to paragraph 107 because
19 this is critical in my thought process. The --

20 Q. I'm there.

21 A. Paragraph 107 of my declaration.

22 The MIGS separation layer, which is the layer
23 we're talking about potentially being a metal oxide is
24 described as a dielectric. And that's important in my
25 thought process for the properties of this layer. So

1 it's a dielectric; it's not a metal.

2 Now, I do opine -- and I'm not going to turn
3 to the paragraph. I'll just freewheel this.

4 I opine that the properties of the metal
5 oxide -- it can't be a metal. Because if it's a metal,
6 it's making its own MIGS. So we know on one hand the
7 thing is not a metal. And we know also that the patent
8 specifically expressly describes it as a dielectric. So
9 we now have two things that we believe about this layer.
10 It's an oxide of a metal, and it's a dielectric.

11 And as we've talked back and forth several
12 times, it is -- the desirable embodiment is it is a --
13 intended to be an oxide but an oxide without the purpose
14 of the passivation.

15 We've also discussed -- I've not opined on
16 whether it can passivate a little bit, but I have opined
17 that its purpose is not passivation. There's a
18 passivating layer that does that.

19 So there's kind of three things there that I
20 do describe in my declaration. It's an oxide of a
21 metal. It's a dielectric. And its primary function is
22 not passivating, it's separating.

23 Q. I actually don't think that's quite right, and
24 I'll tell you why.

25 A. Okay. Fair.

1 Q. So in the patent, the MIGS separation layer
2 could be a titanium dioxide; right?

3 A. Yes.

4 Q. Titanium dioxide isn't an insulator?

5 MR. PHILLIPS: Objection; form.

6 A. I believe it is an insulator. What do you
7 believe it is?

8 Q. (BY MR. MAIER) I believe it's a
9 semiconductor. Would you agree with that?

10 A. Now we can get into the interesting debate
11 between a semiconductor and an insulator. However, are
12 we agreed that it has an energy band gap?

13 Q. Yeah. And I thought that the patents define
14 that in such a way that the semiconductor -- you would
15 be considered a semiconductor if you had a tunnel
16 barrier of, I believe, less than one electron volt.

17 A. I disagree.

18 Can you show me where in the patent it says a
19 semiconductor is defined as something that's less than
20 1 EV?

21 Q. Yeah. Let me find the right cite for you.
22 Let's finish the properties questions first, and then I
23 can come back to this --

24 A. Okay.

25 Q. -- and we can go through the math because the

1 math might take us some time.

2 But let's just go through the properties piece
3 first.

4 A. Okay. So let me go back and reanswer my
5 question to get us restarted.

6 And I'll add a little nuance on what I define
7 a dielectric to be.

8 Q. Yeah.

9 A. So I'm saying that the properties of the layer
10 are it needs to be an oxide of a metal, it needs to not
11 serve a significant passivation function and it needs to
12 be a dielectric.

13 And I'm further going to say that a dielectric
14 would be understood to be a material with a band gap
15 that is not doped.

16 Q. And that last part, is that supported in the
17 patent anywhere?

18 A. Yeah, I think it is.

19 So where would you like to go? Do you want to
20 ask me a different question or do we want to keep on
21 this one?

22 Q. Yeah, let's come back to this. Because I feel
23 like we're now on two separate branches.

24 A. Yeah, I think we are, so --

25 Q. We'll come back to the

1 semiconductor-versus-insulator question later, and let's
2 do the different properties.

3 So let me actually start with my list.

4 Is the electrical conductivity of the metal
5 oxide relevant to a metal-interface layer-semiconductor
6 junction of the challenged claims?

7 A. I don't believe so.

8 Q. And why not?

9 MR. PHILLIPS: Objection; form to the last
10 question.

11 A. Okay. So sorry. I got distracted by
12 somebody's phone call. Can you reask the last question?

13 Q. (BY MR. MAIER) Yeah. So I'll go back two
14 questions and then I'll ask the one.

15 A. Okay.

16 Q. So is the electrical conductivity of the metal
17 oxide layer relevant in a metal-interface
18 layer-semiconductor junction?

19 A. The electrical conductivity of the material --
20 for example, ohm centimeters -- is not relevant. But
21 the electrical conductivity of the junction as in a
22 tunnel junction is.

23 Q. And I'm focusing on the metal oxide layer for
24 these questions.

25 Why is the electrical conductivity of the

1 metal oxide layer not relevant?

2 A. Okay. So now we have to be very precise. The
3 electrical conductivity of the metal oxide can mean two
4 different things, and I don't know which one you mean.

5 The electrical conductivity of the metal oxide
6 layer could be the electrical conductivity of the metal
7 oxide as it is in bulk. So, in other words, I could --
8 pick a material. I could take titanium oxide and say
9 "What's the conductivity of that?"

10 That is not important in this -- in this
11 situation because we're tunneling through that layer.
12 But of course the conductivity of the layer as it's
13 formed that we're tunneling through is important.

14 Q. So let's break those down into two separate
15 questions then. And tell me what words are the most
16 appropriate to use here. Because I'm going to refer to
17 one -- I'm just going to try and take your words.

18 I'm going to refer to one as bulk
19 conductivity, and I'll refer to the other as tunneling
20 conductivity.

21 Are those okay terms or are there better ones?

22 A. I like that. Let's use those.

23 Q. Okay. Is the bulk conductivity of the metal
24 oxide layer relevant in the metal-interface
25 layer-semiconductor structures of the challenged claims?

1 A. In general, not.

2 Q. And you said, "In general, not." Why are you
3 qualifying it?

4 A. I'm qualifying it because I'm -- I was
5 qualifying it a little because of concern there might be
6 a conductive metal oxide that would confuse us. But let
7 me be less qualifying and say, if it's a metal oxide
8 that meets all the other conditions. If it's, you know,
9 a dielectric -- and we can debate what that means. But
10 if it's a dielectric, and if it doesn't have a
11 significant passivation function, then its bulk
12 conductivity is not going to be that important.

13 Q. What if it's a semiconductor? Is its bulk
14 conductivity important in that scenario?

15 A. Is it a doped semiconductor?

16 Q. Let's say no.

17 A. Then I would say not because I would say a
18 doped semiconductor -- and, again, this gets into the
19 elaborates of band structure. Remember, at the level
20 we're talking about, you can get materials that will
21 work because their specific band structure works with
22 other materials in your stack but that would not be
23 generically obvious to a POSITA.

24 So if I flip this around, a POSITA who's
25 implementing such a structure would tend to say "I want

1 to use a well-understood dielectric. I want to use a
2 well-understood metal. I want to use a well-understood
3 semiconductor" because that is the most straightforward
4 way to implement the structure. But that doesn't mean
5 you can't make this work with a more complex structure.

6 Q. So I guess the right way to say it then is
7 that the bulk conductivity of the metal oxide layer in
8 the metal-interface layer-semiconductor structures of
9 the challenged claims may or may not be relevant
10 depending on the particular materials; correct?

11 A. Let me --

12 MR. PHILLIPS: Objection.

13 A. -- rephrase.

14 I'm going to say the band structure of the
15 material is more important than the bulk conductivity.

16 How about that?

17 Q. (BY MR. MAIER) Okay. But if the -- if the
18 bands are in close alignment, then the bulk conductivity
19 would be relevant in such a structure; right?

20 A. But my answer still stands. The band
21 structure is more important than the bulk conductivity
22 because the band structure will determine the bulk
23 conductivity and it will determine the tunneling
24 properties. So the band structure determines
25 everything.

1 The simple bulk conductivity measurement that
2 someone would make on a block of material and post in,
3 you know, CRC Handbook is not as important as the band
4 structure.

5 Q. Is the tunneling conductivity of the metal
6 oxide layer relevant in the metal-interface
7 semiconductor structures of the challenged claims?

8 A. Yes. In some sense the tunneling conductivity
9 can be understood as one of the composite curves in
10 Figure 8.

11 Q. Based on the teachings of the '423 patent,
12 what ranges of electrical -- or I'm sorry, tunneling
13 conductivity would be suitable for the metal oxide layer
14 of the challenged claims?

15 MR. PHILLIPS: Objection; scope.

16 A. That is -- that is -- I've not -- several
17 answers to that. First, I've not thought deeply about
18 that question. I don't believe that that is expressly
19 stated in the patent.

20 Q. (BY MR. MAIER) Okay.

21 A. If it is, we can -- you can point to some
22 place and we can add it to our list of things to talk
23 about.

24 Q. Yeah, I don't think it is, and so I just
25 wanted to confirm that you didn't have -- if the answer

1 to some of these is "I don't know," then that's totally
2 fine. I just wanted to see if you had a position on
3 that.

4 Okay. Let me -- let's keep going through the
5 list. I've got about ten of them. So let's try to
6 finish these up --

7 A. Okay.

8 Q. -- before lunch.

9 Is the melting point of the metal oxide layer
10 relevant in the metal-interface layer-semiconductor
11 structures of the challenged claims?

12 A. To the extent that it is understood that this
13 is implemented in a semiconductor device, which means it
14 can't melt in front of you.

15 Q. So the -- I think you said -- I think the
16 answer to that was yes with a qualification. But the
17 way it comes out on the transcript is it's unclear
18 whether you're agreeing or disagreeing with me, so let
19 me ask it again. Because the answer was to the
20 extent -- you know, let me ask it again.

21 Is the melting point of the metal oxide layer
22 in the claimed metal-interface layer-semiconductor
23 structures relevant?

24 A. The melting point is not relevant as long as
25 the structure can be implemented in a source/drain

1 junction as we've described.

2 The caveat here is if we had a metal oxide
3 that was only active at minus 77K [verbatim] and not at
4 room temperature, that would not be suitable.

5 If we had a metal that melted at room
6 temperature, that would not be suitable. There is an
7 understanding that this needs to be implemented in a
8 metal-semiconductor junction, and that carries somewhat
9 the burden that -- it's at a reasonable temperature and,
10 you know, it's implemented in a reasonable device, that
11 it's not some pathological thing.

12 Q. Based on the teachings of the '423 patent,
13 what ranges of melting points would be suitable for the
14 metal oxide layer of the challenged claims?

15 A. I don't know.

16 Q. Fair enough.

17 Next one. Is the band gap energy of the metal
18 oxide relevant to the metal-interface
19 layer-semiconductor structure of the challenged claims?

20 A. Yes, particularly if the band gap is zero.

21 Q. What are the reasons for the -- strike that.

22 What are the reasons that a metal oxide's band
23 gap energy matters in the challenged claims?

24 A. Because if the metal oxide's band gap is zero
25 or less, i.e., if it has overlapping bands, it's a

1 metal, not a dielectric.

2 Q. Based on the teachings of the '423 patent,
3 what ranges of band gap energy would be suitable for the
4 metal oxide layer of the challenged claims?

5 A. The patent does not specify a range of
6 energies, but it does specify that a electrically
7 conductive substance has a Fermi level that sits in a
8 partially filled band.

9 So turning this around -- let me make the
10 answer easier. Can we do that one again for the record?

11 Q. Sure.

12 A. I'm trying to do two ideas at once again.

13 Q. Sure.

14 Based on the teachings of the '423 patent,
15 what ranges of band gap energy would be suitable for the
16 metal oxide layer of the challenged claims?

17 MR. PHILLIPS: Objection; scope.

18 A. I don't know. And I don't believe the patent
19 describes that expressly.

20 Q. (BY MR. MAIER) Fair enough.

21 Is the diffusivity in silicon of the metal
22 oxide relevant in the metal-interface
23 layer-semiconductor structures of the challenged claims?

24 MR. PHILLIPS: Objection; scope.

25 A. I don't believe the patent speaks to this

1 expressly.

2 Q. (BY MR. MAIER) Is the -- sorry, I lost my
3 place. Strike that.

4 Is the mechanical hardness of the metal oxide
5 relevant in a metal-interface layer-semiconductor
6 structure of the challenged claims?

7 MR. PHILLIPS: Objection; scope.

8 A. The patent does not describe the mechanical
9 hardness expressly.

10 Q. (BY MR. MAIER) Are the optical properties of
11 the metal oxide layer relevant in the metal-interface
12 layer-semiconductor structure of the challenged claims?

13 MR. PHILLIPS: Objection; scope.

14 A. Insofar as they affect the band structure,
15 yes.

16 Q. (BY MR. MAIER) And what are the reasons that
17 a metal oxide layer's electron affinity matters in the
18 metal-interface layer-semiconductor structure of the
19 challenged claims?

20 A. The electron affinity appears in the
21 straightforward theory for a metal-semiconductor
22 junction. And it is generally accepted that if you
23 unpin the junction, you will see a Schottky barrier
24 height that is determined by the difference between the
25 work function and the affinity in the way that is

1 described at the beginning of the patent.

2 Q. Based on the teachings of the '423 patent,
3 what ranges of electron affinity would be suitable for
4 the metal oxide layer of the challenged claims?

5 MR. PHILLIPS: Objection; scope.

6 A. The patent does not -- the patent does not
7 expressly describe that range, to my knowledge.

8 MR. MAIER: And I see we're past noon. I
9 think I've reached a decent point for a break, if you
10 want to take lunch now.

11 THE WITNESS: Okay. Is that the end of that
12 series of questions?

13 MR. MAIER: That's the end of that series.

14 THE WITNESS: Okay. It's a good time for a
15 break.

16 MR. MAIER: Okay. How long do you -- let's go
17 off the record.

18 THE VIDEOGRAPHER: Going off the record. The
19 time is 12:14 p.m.

20 (Deposition recessed at 12:14 p.m., to be
21 reconvened at 12:45 p.m.)
22
23
24
25

AFTERNOON SESSION

12:46 P.M.

--000--

THE VIDEOGRAPHER: We're back on the record.
The time is 12:46 p.m.

EXAMINATION RESUMED

BY MR. MAIER:

Q. Dr. Kuhn, what are the different species in the titanium oxide genus?

MR. PHILLIPS: Objection; scope.

A. You asked me this question once before. And I'm still struggling with the species and genus. Let me respond first that I don't know how many chemical compounds exist within the Ti oxide family. I'm certainly aware of TiO, TiO₂, Ti₂O₃ and Ti₃O₅, but there certainly could be others as well.

Q. (BY MR. MAIER) Ti₄O₇, for example?

A. I don't know.

Q. What about Ti₃O?

A. Again, there's two aspects here. One is what materials are -- or what compounds exist that are chemically stable called an equilibrium condition and what compounds exist in a nonequilibrium condition.

1 And so if one is talking nonequilibrium
2 physics, which can happen in a semiconductor junction,
3 I'm just not aware of what possible materials
4 combinations would exist in that environment. I've not
5 studied that.

6 Q. Do the claims that recite an oxide of titanium
7 exclude any of the titanium oxides either in the stable
8 environment or the semiconductor nonstable environment?

9 MR. PHILLIPS: Objection; scope.

10 A. Well, I'm going to need to look through the
11 claims. And do you have a specific claim? Do you want
12 to talk about an order? Would you like me to look
13 through them all and confirm or deny that question?

14 Q. (BY MR. MAIER) I mean, it doesn't matter to
15 me which one you look at, but, I mean, let's look at the
16 '336 patent. And I can point you to a specific claim.

17 Just tell me when you've pulled up the '336
18 patent.

19 A. I have the '336 patent open.

20 Q. Okay. I may have picked one that doesn't have
21 that. But let me find one that has an oxide of
22 titanium. Bear with me.

23 And I'm going to point you to the '395 patent,
24 Claim 17. I don't believe that's up on the Exhibit
25 Share. So just for completeness, I'll upload it right

1 now.

2 A. I actually have a copy as well. So --

3 Q. I'll put it on --

4 A. -- '395 patent and what --

5 Q. Yeah, I'll put it on the record --

6 A. Sounds good --

7 Q. -- just to make sure we have it complete.

8 But this is Exhibit 1101 in the 1282 IPR
9 proceeding. It's U.S. Patent 10,090,395.

10 And let me know when you have Claim 17 of the
11 '395 patent up.

12 A. I have the '395 patent up and I'm on Claim 17.

13 Q. Okay. Do you see that the last element refers
14 to an oxide of titanium?

15 A. I see that.

16 MR. PHILLIPS: Objection; scope.

17 Q. (BY MR. MAIER) Now, you listed a number of
18 species of titanium oxide, including TiO, Ti₂O, TiO₂,
19 Ti₂O₃ and Ti₃O₅; correct?

20 A. No. I think I listed TiO, TiO₂. I don't
21 think I listed Ti₂O.

22 Q. Oh, okay. I thought you had. Maybe it came
23 up differently.

24 Let me -- let me -- let me start again just to
25 make sure I'm not attributing species to you that you

1 didn't say.

2 What are the different species of titanium
3 oxide that you are aware of?

4 MR. PHILLIPS: Objection; scope.

5 A. I'm aware of TiO, TiO₂, Ti₂O₃ and Ti₃O₅. And
6 there may be other equilibrium species I'm not aware of,
7 as well as nonequilibrium species.

8 Q. (BY MR. MAIER) Do the claims that recite an
9 oxide of titanium exclude any of the titanium oxides
10 that you listed or titanium oxides that may exist but
11 that you are not aware of?

12 MR. PHILLIPS: Objection; scope. Objection;
13 form.

14 A. Claim 17 in patent '395 has the language
15 "comprising an oxide of titanium."

16 Q. (BY MR. MAIER) So I want to know if that's
17 limited to a particular subset of oxides of titanium or
18 whether it could encompass more. That's my question.

19 MR. PHILLIPS: Objection; form --

20 Q. (BY MR. MAIER) And that's --

21 MR. PHILLIPS: -- and scope.

22 Q. (BY MR. MAIER) -- a valid objection, but let
23 me -- let me rephrase to the form objection.

24 Do the claims that recite an oxide of titanium
25 exclude any of the titanium oxides that you listed or

1 any other titanium oxides that may exist but that you
2 are not currently aware of?

3 MR. PHILLIPS: Objection; scope.

4 A. Okay. So I'm going to only address the
5 specific claim we're talking about, which is the '395
6 patent, Claim 17. And the language on that says "said
7 interface layer comprising an oxide of titanium and an
8 oxide of the semiconductor."

9 That language does not use the word
10 "excluding" anywhere, so I do not believe it excludes
11 anything, nor does it have a list of which oxides are
12 included, so I don't think it's specific about the
13 oxide. It simply says "comprising an oxide of
14 titanium."

15 Q. (BY MR. MAIER) Okay. And I thought that all
16 of the claims that recite an oxide of titanium, you
17 know, were the same. But if you want, let's go through
18 every single one individually so we can confirm that
19 your answer is the same.

20 So another exhibit in the Exhibit Share is the
21 '691 patent, Exhibit 1001 from the 1206 proceeding,
22 Claim 6.

23 Let me know when you have that.

24 A. I have Claim 6.

25 Q. Do you see the reference to "an oxide of

1 titanium"?

2 A. Yes, Claim 6 has similar language to the claim
3 we just looked at -- similar but not identical,
4 actually. And it says "comprises an oxide of titanium."

5 MR. PHILLIPS: Objection; scope to the last
6 question.

7 Q. (BY MR. MAIER) Does claim 6 of the '691
8 patent exclude any of the titanium oxides that you
9 listed or any other titanium oxides that may exist but
10 that you are not aware of?

11 MR. PHILLIPS: Objection; scope.

12 A. The language written in the claim is
13 "comprises an oxide of titanium." The word "exclude" or
14 "excluded" is not used, and there is no specific list of
15 oxides.

16 Q. (BY MR. MAIER) So none of those oxides are
17 excluded in your opinion?

18 A. The word "excluded" is not used.

19 MR. PHILLIPS: Same objection.

20 Q. (BY MR. MAIER) Turn to Claim 19 of the '691
21 patent.

22 A. I have it.

23 Q. Do you see the reference to the oxide of
24 titanium?

25 A. "Comprises an oxide of titanium." Yes, I see

1 that.

2 Q. Does Claim 19 of the '691 patent exclude any
3 of the titanium oxides that you listed or any other
4 titanium oxides that may exist but that you are not
5 aware of?

6 MR. PHILLIPS: Objection; scope.

7 A. The language in Claim 19 does not use the word
8 "exclude."

9 Q. (BY MR. MAIER) And therefore it does not
10 exclude any of the titanium oxides you listed or other
11 titanium oxides that may exist but that you are not
12 aware of; correct?

13 MR. PHILLIPS: Same objection.

14 A. Okay. So the language in Claim 19 is
15 "comprises an oxide of titanium." There is no
16 exclusionary language in the claim.

17 Q. (BY MR. MAIER) Turn to the '167 patent, which
18 is not uploaded but I will upload now, and you can let
19 me know when you have it.

20 A. I actually have a copy.

21 Q. Let me put it up on the Exhibit Share just so
22 we have a complete record. This is Exhibit 1001 from
23 the 1205 proceeding.

24 Can you turn to Claim 6 of the '167 patent.

25 A. Claim 6?

1 MR. PHILLIPS: I'm sorry. I'm not seeing it
2 on Exhibit Share yet.

3 MR. MAIER: '167? No?

4 MR. PHILLIPS: Oh, it was just slow.
5 All right. I'm caught up. Thanks.

6 A. I'm on -- excuse me. I'm on '167, and I'm on
7 Claim 6.

8 Q. (BY MR. MAIER) Do you see the reference to an
9 oxide of titanium?

10 A. I do. I see the language "comprises an oxide
11 of titanium."

12 Q. Does Claim 6 of the '167 patent exclude any of
13 the titanium oxides that you listed or any other
14 titanium oxides that may exist but that you are not
15 aware of?

16 MR. PHILLIPS: Objection; scope.

17 A. The language in Claim 6 does not use the words
18 "excluding" or "excluded."

19 Q. (BY MR. MAIER) And therefore it does not
20 exclude any of the titanium oxides you listed or other
21 titanium oxides that may exist but that you are not
22 aware of; correct?

23 MR. PHILLIPS: Same objection.

24 A. Okay. So the language that's in Claim 6 says
25 "comprises an oxide of titanium." There is no

1 exclusionary language in Claim 6. There is no list of
2 included titanium oxide compounds or excluded titanium
3 oxide compounds. It simply says "comprises an oxide of
4 titanium."

5 Q. (BY MR. MAIER) Does the '423 patent
6 anywhere --

7 A. Excuse me.

8 Q. Let me know when you're ready.

9 A. I'm ready.

10 (Court reporter clarification.)

11 MR. MAIER: I'll repeat it. I want to start
12 it when Dr. Kuhn is ready.

13 A. I think I'm done coughing. You can start
14 again.

15 Q. (BY MR. MAIER) Okay. I know when coughs hit
16 me, they tend to last for a little while.

17 Okay. Does the '423 patent anywhere exclude
18 any of the titanium oxides that you listed or any other
19 titanium oxides that may exist but that you are not
20 aware of?

21 MR. PHILLIPS: Objection; scope.

22 A. So let me answer the direct question first.
23 And I'm going to answer it electronically since we are
24 electronic.

25 I ran a search on the '423 patent, and the

1 word "exclude" or "exclusions" is not showing up in a
2 search.

3 So the first level, I do not believe the
4 patent uses language such as "excludes" or
5 "exclusionary."

6 Now, I've not analyzed the patent in detail to
7 answer a more in-depth version of that question, which
8 is is there some language subtlety in here that would
9 exclude certain oxides of titanium. I do not believe
10 such language exists. But if you are aware of the place
11 in the patent that you think it does, perhaps we should
12 highlight that and talk about it.

13 Q. (BY MR. MAIER) Okay. Thank you. Fair
14 enough.

15 Okay. Let's switch gears.

16 And what I would like to direct you to is
17 patent owner's response in the 1204 proceeding. It's --
18 the filing has paper 27 in it, if you look at the
19 Exhibit Share.

20 A. Okay. Let me download that.

21 Q. Yeah, take your time.

22 A. Okay. I believe I have this. Let me
23 double-check I have the right one. It's "01204 paper 27
24 Response"?

25 Q. Yes.

1 A. Okay. I have it, and I'm opening it up.

2 I have it open. Where would you like me to
3 go?

4 Q. Page 14, please.

5 A. Oh, is it page 14 as in the corner or page 14
6 in the PDF file?

7 Q. Page 14 of 57 as shown in the bottom right
8 corner.

9 A. Okay. I'm there.

10 Q. The last sentence of the first paragraph on
11 page 14 states, "And a POSITA would understand that the
12 resistivity values achievable with the invention are
13 quite low, perhaps even negligible or too low to
14 measure."

15 Did I read that correctly?

16 A. Yes, that appears to be correct. It's the
17 last paragraph -- sorry, it's the last sentence in the
18 first paragraph on the page which is kind of half a
19 paragraph. It's like the fourth sentence on the page.
20 That one?

21 Q. Yep.

22 A. Got it. Yes, you read that correctly.

23 Q. Do you agree with that statement?

24 A. Yes, I agree with that.

25 Q. Do the challenged claims encompass specific

1 contact resistivities of 0.8 ohms microns squared?

2 MR. PHILLIPS: Objection; scope.

3 A. I don't believe that there is a claim with 0.8
4 in it. If I'm mistaken, perhaps you could point me to
5 that claim.

6 Q. (BY MR. MAIER) Well, it's in every claim.
7 There is -- well, in the claims that recite a specific
8 contact resistivity -- and you can look at any ones you
9 want -- but they recite ranges with no lower bound.

10 Do you remember test- -- giving a declaration
11 testimony about those claims?

12 A. Yes.

13 Q. Okay. And so my question is do the challenged
14 claims encompass within their claimed ranges specific
15 contact resistivities of 0.8 ohms microns squared?

16 A. Yes. Although it's not stated expressly.

17 Q. Do the challenged claims encompass specific
18 contact resistivities of 0.5 ohms microns squared?

19 A. Yes, although it's not stated expressly.

20 Q. Do the challenged claims encompass specific
21 contact resistivities of 0.1 ohms microns squared?

22 A. Most likely, but it's not stated expressly.

23 Q. And you say "most likely" because you're not
24 sure?

25 A. I say most likely because there is a lower

1 bound of measurement that in fact I believe was stated:
2 "Perhaps even negligible or too low to measure."

3 Oh, I believe we can agree that if you can't
4 measure it, then you've hit a fundamental lower limit.
5 And while I don't know precisely where the measurement
6 limit is in the systems, I do recall that Schroder,
7 which is one of my references, does not show values
8 lower than .1, and that is a measurement reference.

9 So for values lower than .1, I'm going to be
10 adding the qualifier, it is covered as long as it's
11 measurable.

12 Q. Well, that's not right, is it?

13 A. What do you mean?

14 MR. PHILLIPS: Objection; form.

15 Q. (BY MR. MAIER) The claims depend on how good
16 the measurement technology is?

17 A. My position is that if you can't measure
18 something, you've hit a fundamental lower limit; right.

19 Q. Well, I want to challenge that a little bit
20 because there may be lower specific contact
21 resistivities, but we just don't yet have the tools to
22 measure such low numbers; right?

23 A. I agree.

24 Q. Okay. Do the challenged claims encompass
25 specific contact resistivities of 0.01 ohms microns

1 squared?

2 A. Same comment as before more vehemently, which
3 is if the value is measurable then the claims would
4 encompass it. If it's not measurable, it's not
5 measurable.

6 Q. Do the challenged claims encompass specific
7 contact resistivities of 0.001 ohms microns squared?

8 A. Same comment. The challenge if the zero -- I
9 forgot how many zeros you had in there. If 0.001 claims
10 is measurable, 00.1 contact resistivity is measurable,
11 then the claims encompass it.

12 Q. Wait. I think you said 00.1, so let's --

13 A. Yeah, can we switch -- can we switch to
14 scientific notation here on these? Otherwise I'm going
15 to lose track of how many zeros you had.

16 Q. If you switch to scientific notation, you will
17 lose the questioning attorney, so --

18 A. Oh, okay.

19 Q. -- bear with me with microns, but I'll try to
20 go slow.

21 A. Okay. May I do something? Can I ask
22 permission for something? Can I take notes so I can
23 keep track of how many zeros he has? Am I allowed to do
24 that?

25 Q. Yeah. And I'll just be very clear. There's

1 going to be two zeros before the 1 after the decimal
2 point for the next question.

3 A. Okay.

4 All right. So let's start over from the point
5 when I lost track of how many zeros you had.

6 Q. Some might call this one one-thousandth.

7 A. Let's do zeros.

8 Q. Okay. Do the challenged claims encompass
9 specific contact resistivities of 0.001 ohms microns
10 squared?

11 A. My opinion is the contact resistivity claims
12 encompass the value of 0.001 ohms per microns squared so
13 long as that value is measurable. If it's not
14 measurable, it's not measurable.

15 Q. And if it's not measurable, does that mean the
16 claims do not encompass such low values of contact
17 resistivities?

18 MR. PHILLIPS: Objection; form.

19 A. I don't know quite how to answer that question
20 because it's more of a legal question.

21 In my opinion, the claim encompasses those
22 values in a broad sense. But if you can't measure it,
23 how would you know that a particular structure fit the
24 claims? So it -- you know, on one hand the claim
25 permits, you know, the Figure 8 to be drawn over a

1 multiplicity of regions. But if I can only measure down
2 so far, I can only measure down so far.

3 Q. (BY MR. MAIER) And that's sort of my
4 confusion. Because the sentence we looked at in
5 paper 27 says, "And a POSITA would understand that the
6 resistivity values achievable with the invention are
7 quite low, perhaps even negligible or too low to
8 measure." So to me that implies that the claims cover
9 specific contact resistivities that are even too low for
10 us to measure with existing technology.

11 Is that your understanding?

12 MR. PHILLIPS: Objection; form.

13 A. So this, again, gets into an area where I
14 don't know the nuances of the law on the patents.
15 In one aspect the claim clearly covers that region. But
16 if one were to, for example, attempt to prove that the
17 claim infringed, if you can't measure it, you can't show
18 it's in that region.

19 Q. (BY MR. MAIER) So let me break that down into
20 two steps.

21 A. Okay.

22 Q. The challenged claims encompass within their
23 scope specific contact resistivity values below
24 .001 ohms microns squared even if you can't measure
25 them; correct?

1 A. The claims would encompass that. But whether
2 you could demonstrate that might not be within the
3 capability of your measurement technology.

4 Q. Okay. Based on the teachings of the '423
5 patent, what is the lowest specific contact resistivity
6 value in ohms microns squared achievable with the
7 claimed invention?

8 A. I don't believe the patent expressly states a
9 limit.

10 Q. Based on the teachings of the '423 patent,
11 what is the lowest specific contact resistivity value in
12 ohms microns squared with a Ti, TiO₂, SiO₂, Si contact
13 structure?

14 MR. PHILLIPS: Objection; scope.

15 A. The patent teaches a methodology -- and I will
16 say in broad terms, the patent teaches the methodology
17 described in Figure 8. It teaches how to select
18 materials and structures to meet that methodology in
19 Figure 8. But I do not believe it gives an express
20 lower number for -- and unfortunately I've forgotten
21 which structure you had, but let me say for the titanium
22 oxide version of the structure.

23 Q. (BY MR. MAIER) Okay.

24 A. You may have to reask that one. And I will
25 write down which structure it was so I can respond

1 directly to it.

2 Q. No, you got it right.

3 So you mentioned that the patent teaches how
4 to select materials. So let me follow up on that a
5 little bit.

6 Based on the teaching of the '423 patent, what
7 materials and thicknesses would achieve a specific
8 contact resistivity of .5 ohms microns squared?

9 A. The patent does not teach how to reach a
10 specific value. It teaches a methodology to reach a
11 lowest value for a materials set.

12 Q. We'll, make it a little repetitive here, but
13 let me just go through these questions.

14 A. Okay. And I'm going to take notes. That's
15 what I'm doing to the side so I can try to respond with
16 the same level of detail you're asking me the questions.

17 Q. Okay. Just remember those notes could be
18 discoverable, so don't put anything down that you don't
19 want us to see.

20 A. Uh-huh. Sure.

21 Q. Okay. And, again, I'm looking for names of
22 materials and thicknesses.

23 Based on the teaching of the '423 patent, what
24 materials and thicknesses would achieve a specific
25 contact resistivity of 0.1 ohms microns squared?

1 A. The patent does not teach a specific
2 combination of materials and thicknesses to reach
3 0.01 ohms per microns squared. It teaches a broad
4 enough -- a broad methodology by which one can obtain a
5 minimum resistance for any particular materials system.

6 Q. Based on the teaching of the '423 patent, what
7 materials and thicknesses would achieve a specific
8 contact resistivity of 0.01 ohms microns squared?

9 A. Okay. So, again, the '423 patent does not
10 teach specific materials and thicknesses to reach a
11 target of 0.01 ohms microns squared. It teaches a
12 general methodology to find the minimum contact
13 resistance for a specific set of structures, materials
14 and fabrication conditions.

15 Q. Okay. Last one.

16 Based on the teaching of the '423 patent, what
17 materials and thicknesses would achieve a specific
18 contact resistivity of 0.001 ohms microns squared?

19 A. Sorry. Didn't we do that one already? Have I
20 lost track? 0.001?

21 Q. Yeah, but this -- these -- this is a second
22 set of questions. So the first ones were what do the
23 claims encompass. And now I'm looking for materials and
24 thicknesses.

25 A. Okay.

1 Q. Let me ask the question again so we have a
2 clean record.

3 A. Okay.

4 Q. Based on the teaching of the '423 patent, what
5 materials and thicknesses would achieve a specific
6 contact resistivity of 0.001 ohms microns squared?

7 A. Okay. So the '423 patent does not teach any
8 specific materials or thicknesses to achieve the contact
9 resistivity of 0.001 ohms per microns squared. Instead
10 it teaches a general method to find the lowest contact
11 resistivity for a subset of materials and thickness
12 conditions.

13 Q. And the '423 patent teachings does not provide
14 any guarantee that any materials would in fact achieve a
15 specific contact resistivity less than 1 ohm microns
16 squared; correct?

17 MR. PHILLIPS: Objection; form.

18 A. I don't believe the word -- the patent uses
19 the word "guarantee" anywhere.

20 Q. (BY MR. MAIER) Well, the '423 patent
21 teachings does not provide any disclosure of any
22 materials that would in fact achieve a specific contact
23 resistivity less than 1 ohm micron squared; correct?

24 A. You're going to have to feed that one back at
25 me. I'm going to have to take notes on that. One more

1 time, same question.

2 Q. The '423 patent doesn't teach one of skill in
3 the art what materials or thicknesses to choose in order
4 to achieve a specific contact resistivity that is less
5 than 1 ohm micron squared; correct?

6 A. The '423 patent teaches a set of materials and
7 thicknesses in a general framework, the Figure 8
8 framework, so that a POSA can obtain arbitrarily low
9 contact resistances -- I'm going to start over on that
10 one. Arbitrary is not the right word.

11 Q. Let me pose the question again so we have it
12 clean --

13 A. Why don't you pose the question for a clean
14 record because I don't like the word "arbitrary." That
15 wasn't the word I wanted. Do the question again; I'll
16 try for a clean record.

17 Q. And to be clear, I'm looking for material
18 names and thickness numbers.

19 The '423 patent doesn't teach one of skill in
20 the art what materials or thicknesses to choose in order
21 to achieve a specific contact resistivity that is less
22 than 1 ohm microns squared; correct?

23 A. The '423 patent does not teach specific
24 materials nor specific thicknesses to achieve a contact
25 resistance of less than 1 ohm microns squared. It

1 teaches a general methodology represented by Figure 8 to
2 find the minimum contact resistance for a general
3 materials processing thickness condition.

4 Q. But the general methodology taught in the '423
5 patent does not provide any guarantee to a person of
6 ordinary skill in the art that if he or she follows that
7 methodology, he or she will achieve a specific contact
8 resistivity of less than 1 ohm microns squared; correct?

9 MR. PHILLIPS: Objection; form.

10 A. I'm not sure any patent guarantees anything.
11 The word "guarantee" is not used in the patent. I may
12 be misunderstanding the point of the question, but I'm
13 not sure guarantee comes into this.

14 Q. (BY MR. MAIER) Let me phrase it a different
15 way.

16 If a person of ordinary skill in the art
17 followed the methodology provided in the '423 patent,
18 could you testify that he or she would in fact achieve a
19 specific contact resistivity of less than 1 ohm microns
20 squared?

21 A. I can't testify to what a particular group or
22 person implementing the '423 patent is going to find.
23 They are running a methodology that's described by the
24 Figure 8 graph and its accompanying detail. They are
25 working with a material system in their own factory and

1 material capability in their own factory. They're going
2 to follow the methodology -- they're going to get a
3 minimum point in the curve under most conditions. The
4 patent specifies what to do if they don't find a minimum
5 point in the curve. But the patent does not provide a
6 number for what the minimum point is going to be for any
7 particular person's experiment.

8 Q. Okay. Did you -- have you spoken with any of
9 the named inventors regarding their alleged invention in
10 the challenged patents?

11 A. I certainly haven't spoken with any of the
12 named inventors in preparing the declaration for the
13 IPR. It is possible at some point in the past year or
14 so that I spoke to a named inventor in a large meeting,
15 because there were some large meetings with Acorn. But
16 I've not had a personal contact with the named inventors
17 at any time that would have been a large meeting
18 scenario. And I have not had any contact with the
19 inventors or with Acorn in the process of writing the
20 declaration for this IPR.

21 Q. Okay.

22 MR. PHILLIPS: And I want to add for the
23 record -- and sorry about the dog barking in the
24 background -- instruction to the witness not to reveal
25 the content of any discussion with counsel, even if a

1 named inventor was present during that discussion.

2 Q. (BY MR. MAIER) Yeah, and I'm not planning on
3 going into any of those details, so we should be okay.

4 What was --

5 A. Okay. So I do want to add -- I want to add a
6 nuance here.

7 Q. Sure.

8 A. Keep in mind that there was an overlap of
9 about two months, more like a month, where the Acorn
10 litigation was proceeding to trial and I was also
11 engaged in the IPR.

12 Now, to the best of my recollection, there was
13 no meeting with Acorn other than with the lawyers in
14 that period of time for any reason, either litigation or
15 the declaration. But I do want to make sure that you
16 understand that there's a period of time when two things
17 were happening at once. And, you know, there may have
18 been a broad meeting that occurred that I do not have a
19 good recollection of.

20 Q. Okay. And I think that this following
21 question will clear it up.

22 In forming your opinions in these IPR
23 proceedings, you are not relying on any discussions or
24 facts you may have learned from any of the named
25 inventors of the challenged patents; correct?

1 A. Okay. So I want to answer that one carefully.

2 In forming my opinions for this patent I've
3 had no -- sorry. In forming my opinions for this
4 declaration for the IPR, I've had no conversations about
5 the IPR with the named inventors or with any of the
6 other present people at Acorn. Of course I formed my
7 opinions based on Acorn's writings, but I've not had
8 personal contact with them relevant to this declaration.

9 Q. Okay. I think I understand.

10 What was the lowest specific contact
11 resistivity that the inventors had achieved as of the
12 time they filed the '423 patent?

13 MR. PHILLIPS: Objection; scope.

14 A. I don't know. I don't know.

15 Q. (BY MR. MAIER) Okay. And I take it you don't
16 know what materials they would have used; correct?

17 A. I don't know.

18 MR. PHILLIPS: Same objection.

19 Q. (BY MR. MAIER) And I take it you don't know
20 what the thicknesses of any layers they used were?

21 MR. PHILLIPS: Same objection.

22 A. I don't know.

23 Q. (BY MR. MAIER) At the time the '423 patent
24 was filed, what was the lower limit in ohms microns
25 squared for specific contact resistivity in a

1 metal-interface layer-semiconductor junction?

2 A. I don't know.

3 Q. Since the time that the '423 patent was filed,
4 have you kept yourself informed regarding advances in
5 the field of the patent?

6 MR. PHILLIPS: Objection; form.

7 A. I'm going to have a somewhat long answer
8 because field of the patent is a little complicated.

9 I have kept up with the innovations in overall
10 transistor architecture as we've moved from planar
11 devices to FinFETs to nanowires to nanoribbons and so
12 on. As a transistor architect, I've paid a great deal
13 of attention to confinement.

14 I've also kept up, to a lesser extent, with
15 novel innovations in the field -- you know,
16 piezoelectric transistors, TFTs and whatnot.

17 With regards to the more specific question of
18 metal-semiconductor junctions, I have not kept up with
19 progression in the art with the exception of some
20 research efforts I did for the trial testimony where I
21 did a literature review of the values that had been
22 achieved in the industry in more recent years for the
23 specific contact resistance.

24 Q. (BY MR. MAIER) Since the time that the '423
25 patent was filed, do you know whether practitioners had

1 been able to achieve a lower limit for specific contact
2 resistivity than was achievable at the time the '423
3 patent was filed?

4 MR. PHILLIPS: Objection; scope.

5 A. I am aware that the contact resistance values
6 that I encountered in my study that was done for
7 inclusion in my declaration for trial was substantially
8 lower than the contact resistance values I had been
9 assuming based upon my Intel experience six years
10 earlier.

11 Q. (BY MR. MAIER) What is the inherent lower
12 limit in ohms microns squared for specific contact
13 resistivity of a metal-interface layer-semiconductor
14 junction?

15 MR. PHILLIPS: Objection; form.

16 A. Well, you could certainly say zero was an
17 inherent lower limit. And you could say a negative
18 number is an inherent lower limit.

19 Another way to look at this is that the
20 Figure 8 patent defines a methodology for generating a
21 family of curves. And the minimum of all of those
22 families of curves is the inherent lower limit for the
23 entire patent system itself. And there's somewhat of an
24 inherent lower limit for each particular curve.

25 And I'm sort of not sure which one of these

1 you want to -- your question is referring to.

2 Q. (BY MR. MAIER) Let's go through some
3 examples.

4 What is the inherent lower limit in ohms
5 microns squared for specific contact resistivity of a
6 metal-semiconductor junction with a Ti, TiO₂, SiO₂, Si
7 structure?

8 MR. PHILLIPS: Objection; scope.

9 A. I'm looking for something specific, so give me
10 one second here.

11 Q. (BY MR. MAIER) Sure.

12 A. Okay. So your question -- and I'm going to
13 reprise the question to make sure I got it right.

14 Your question was what is the inherent limit
15 for a metal-insulator-semiconductor junction that has a
16 TiO₂ insulating layer.

17 Do I have that question right?

18 Q. No. My question was a little bit more
19 specific.

20 A. Okay. Why don't you run it again and I'll
21 take notes on the specificity -- I'll take notes on
22 that.

23 Q. Yeah. And I'm going to -- and I'm going to
24 ask for numbers and units of ohms microns squared, and
25 I'm going to ask for a -- I'll give you all four layers

1 of the structure.

2 A. Okay.

3 Q. What is the inherent lower limit in ohms
4 microns squared for specific contact resistivity of a
5 metal-semiconductor junction with a Ti, TiO₂, SiO₂, Si
6 structure?

7 MR. PHILLIPS: Same objection.

8 A. And so all I'm permitted to know is it's a Ti,
9 TiO₂, SiO₂, Si structure.

10 Do I have that correct?

11 Q. (BY MR. MAIER) Well, according to the
12 challenged claims.

13 A. Okay. So let me answer that and see if it
14 will work for you.

15 Without being able to run the experiment
16 described by Figure 8, I don't know what the inherent
17 lower limit is for a metal-semiconductor junction that's
18 Ti, TiO₂, SiO₂, Si.

19 Q. Okay. Let me -- let me take one more
20 structure as an example.

21 What is the inherent lower limit in ohms
22 microns squared for specific contact resistivity of a
23 metal-semiconductor junction with an Al, Al₂O₃, SiO₂, Si
24 structure?

25 MR. PHILLIPS: Objection; scope.

1 A. So, again, without being able to run the
2 experiment described in Figure 8 on the materials
3 system, I'm unable to give you a precise number for the
4 inherent lower limit on a metal-semiconductor junction
5 which is Al, Al₂O₃, SiO₂ and Si.

6 The inherent lower limit for any particular
7 structure is going to be the lowest point in that curve
8 as determined by the experiment. And I do not have the
9 ability to run that experiment here.

10 Q. (BY MR. MAIER) So let's talk a little bit
11 about that experiment.

12 You also provided sworn testimony in the
13 litigation between Acorn and Samsung; correct?

14 A. I provided a declaration, and I provided a
15 deposition. I was not actually at the trial.

16 Q. And you told the truth in your declaration and
17 deposition in the litigation just like you're telling
18 the truth here today; right?

19 A. I believe so, yes.

20 Q. Do you agree that it is very difficult to
21 measure the specific contact resistivity of a
22 metal-interface layer-semiconductor junction?

23 MR. PHILLIPS: Objection; scope.

24 A. So you're probably quoting out of my
25 declaration from the trial. And if we want to talk

1 about that, I'd like to have that in front of me because
2 I believe that's a part of a larger section discussing
3 measurement techniques.

4 Q. (BY MR. MAIER) Well, I'm not -- I actually
5 wasn't quoting anything. If I do quote something, I'll
6 share whatever I'm quoting from with you. But I just
7 want to ask you some questions and see whether or not
8 you agree with me.

9 A. Okay. We'll see how that goes.

10 Q. Do you agree that it is very difficult to
11 measure the specific contact resistivity of a
12 metal-interface layer-semiconductor junction?

13 MR. PHILLIPS: Same objection.

14 A. No, I disagree with that. I disagree with
15 that in the context of there's a well-established
16 procedure. It's a routine measurement to do this in a
17 semiconductor factory. It's a little harder to do it on
18 a semiconductor product, but that's just because
19 semiconductor products don't have the right test
20 structures. But overall, people have been measuring
21 specific contact resistivity for, you know, probably
22 100 years, and those techniques are very well
23 understood.

24 Q. (BY MR. MAIER) Do you agree -- you said
25 100 years?

1 A. That may be wrong, but people have been
2 measuring specific -- certainly -- I can certainly say
3 50 years and will totally agree with that. How about
4 that? 50 years.

5 Q. Do you agree that to measure the specific
6 contact resistivity of a metal-interface
7 layer-semiconductor junction, a POSITA would require a
8 special test structure?

9 A. That is correct. Because in order to extract
10 the specific contact resistance from other closely
11 spaced resistances, you need a special test structure.
12 And I do declare that in my declaration, and I provide
13 some references to Schroder.

14 If you do not use a special test structure,
15 the specific contact resistance is in series with other
16 resistances and so you end up getting -- you are not
17 able to differentiate between them.

18 Q. At the time the '423 patent was filed, who had
19 access to the special test structures required to
20 determine the specific contact resistivity of a
21 metal-interface layer-semiconductor junction?

22 A. That "who" is a big number.

23 The test structure technology has been well
24 understood for a number of years. My comment about
25 50 years is a bit of a joke, but that test structure

1 technology has been known for a very long time. I cited
2 Dieter Schroder's reference, which has been around for a
3 while. Certainly when I was in school, we made test
4 structures for specific contact resistance in R-fab. So
5 the base technology has been around.

6 Now, a semiconductor factory is uniquely
7 suited to do this swiftly and easily because there are a
8 myriad of different tests and a myriad of different test
9 structures that all have different positives and
10 negatives. And a semiconductor -- factory of
11 semiconductor development fab has those test structures
12 available in a very routine fashion. So it is a very
13 routine experiment to go run a lot and determine the
14 specific contact resistivity of a particular process
15 over a wide range of parameters.

16 Q. So what semiconductor factories had the
17 ability to easily create the special test structures
18 required to determine the specific contact resistivity
19 of a metal-interface layer-semiconductor junction?

20 MR. PHILLIPS: Objection; form.

21 A. So I can certainly tell you that any
22 semiconductor factory capable of developing and making a
23 product for sale can do this. From my own experience,
24 of course, I know that Intel has those structures
25 because I helped build them. And I'm not sure how much

1 I'm allowed to speak about Samsung, but it is my
2 understanding that Samsung has those structures as well.
3 And certainly anyone who can deliver a product into a
4 production environment has that too. So, you know, we
5 can sit down and look at the list of semiconductor
6 companies on the planet, but I think the easier answer
7 is if you can deliver a product in this space, you have
8 that capability.

9 Now, there are also organizations outside of
10 companies that have that capability, but the reverse
11 answer is easier to justify cleanly, which is if you can
12 ship a product and sell it in this space, you should
13 have that capability.

14 Q. (BY MR. MAIER) So you mentioned "should,"
15 and, you know, it's important that you're not
16 speculating here because this is under oath. So let me
17 ask you a more specific question.

18 At the time the '423 patent was filed in 2002,
19 who do you know would have had access to the special
20 test structures required to determine the specific
21 contact resistivity of a metal-interface
22 layer-semiconductor junction?

23 MR. PHILLIPS: Objection; form.

24 A. So from my personal experience where I know
25 for sure for absolute because I saw them, Intel

1 certainly did, and in 2002. So from other personal
2 experience, I have seen those structures implemented in
3 an academic setting prior to 2002 when I was at the
4 University of Washington. So UW had them. Past that, I
5 start to assume.

6 As I said, I don't know when I'm permitted to
7 talk about Samsung, but it is my understanding that
8 Samsung had those structures at the time I became aware
9 of them -- that was not 2002 -- but had them at some
10 point.

11 And past that is simply saying if Intel had
12 them, the probability that other semiconductor companies
13 had them as well is pretty high.

14 Q. (BY MR. MAIER) But you don't know for certain
15 whether any non-Intel semiconductor companies had the
16 capability to create the special test structures as of
17 2002; correct?

18 MR. PHILLIPS: Objection; form.

19 A. Well, keep in mind there's another layer of
20 this. I know Intel had them because I saw them and
21 helped build them. And in 2002, they had them. I had
22 personal experience at UW with the contact resistance
23 structure, so I know they were there from personal
24 experience.

25 There are semiconductors who published papers

1 on contact resistance. And if the papers had a
2 measurement of specific contact resistivity, they had
3 the ability to measure it.

4 Now, I haven't done a study -- because I
5 haven't been asked this question before. But I haven't
6 done a study in 2002 of the various companies and their
7 papers to prove or disprove which ones had the
8 capability. That I've not done.

9 Q. (BY MR. MAIER) What equipment is involved in
10 creating the special test structures that you refer to?

11 MR. PHILLIPS: Objection; form.

12 A. Do you want me -- do you want me to do this at
13 Intel or do you want me to do this at university?

14 Q. (BY MR. MAIER) Well, I want you to do for
15 both, but at a high level, nothing confidential, just,
16 you know, in general what types of devices, reactors,
17 et cetera, do you need to create these special test
18 structures?

19 A. So at a high level -- let me do Intel first.
20 At a high level, the way the semiconductor development
21 fab works is that every generation -- like
22 130 nanometers, 90 nanometers, 65 nanometers, and so on,
23 the lead development vehicle is a test chip. And at
24 Intel, that test chip usually had multiple seats on it.
25 And two of those seats contained thousands and thousands

1 of test structures. And they weren't obviously specific
2 contact resistance test structures; they were test
3 structures for everything. Transistor test structures,
4 back-end test structures and so on.

5 There was a vast library that was maintained
6 by Intel that contained samples of all these different
7 test structures that had been developed over many years.
8 And so at the beginning of a generation, it was the job
9 of the device engineer, a job I had at one point, to go
10 through and build these test chips by taking the
11 existing library of structures, going through and
12 modifying them for the new generation, assessing each
13 test structure to see if we wanted to keep it, adding
14 new test structures as necessary, and then creating a
15 design database that contained all these test
16 structures. And these databases were big. These were
17 thousands and thousands of structures.

18 And then upon tape-out of these vehicles, the
19 design database for the test structures would be
20 combined with the design databases from the design guys
21 and the lead vehicle would then be released for the
22 development process.

23 And so there was many steps in this, but
24 overall the key idea was you took a library of
25 historical structures, assessed the library, modified

1 the library for the new technology, update it with any
2 brilliant new ideas everybody had, generated a database
3 and then sent the database through the mass-making
4 process in order to create the reticles to have the
5 development process ready to go.

6 Q. And how long did this special test structure
7 process take from beginning to end?

8 A. Well, keep in mind that the creation of the
9 test chip is a core deliverable for a development fab
10 during the first stages of development. So that's what
11 people do.

12 And, again, it's not just specific contact
13 resistance. There are literally thousands, if not tens
14 of thousands, of these things. And it would usually be
15 about a six-month to one-year effort to go from we're
16 really, really working on to we're really, really ready
17 to tape it out.

18 It usually was drawn on a two-year time frame,
19 but people didn't really engage until about one year in.
20 And that wasn't just of course the test structures. It
21 was also all the design, collateral and, you know, the
22 yield vehicle and all of that went on this.

23 And then that vehicle would be used for one to
24 several years to test everything. All you do in the
25 development fab is run the same test vehicle round and

1 round and round in the fab, running many, many
2 experiments. And the whole idea is at the beginning you
3 want to make sure you have every possible test structure
4 for everything you're going to need for 18 months of
5 development. And then you toss this thing in the fab
6 and then you just run experiments until you're to the
7 end of the development side.

8 Q. And would any POSITA have access to these
9 libraries that you're referring to?

10 A. By my definition of a POSITA, yes.

11 Q. I thought these would be proprietary to Intel.

12 A. Oh, I see what you mean.

13 MR. PHILLIPS: Objection; form.

14 A. I misunderstood the question.

15 Any POSITA anywhere in the world is your
16 question; right?

17 Q. (BY MR. MAIER) Right.

18 A. Okay. So the answer to the question is of
19 course the proprietary libraries for a particular
20 company are only accessible by people at that company,
21 but the fundamental technology of building test
22 structures is widely known.

23 Q. How many people approximately are involved in
24 building these special test structures that you're
25 referring to?

1 A. Do you mean just the ones for contact
2 resistance or for the entire test chip?

3 Q. Give me both.

4 A. So typically the way the work breaks out is
5 that the design engineer lead takes their minions and
6 designates one more junior engineer to worry about a
7 block of test structures.

8 So, for example, I might say, "Susan, you're
9 responsible for all the resistance measurements," and,
10 "George, you're responsible for all the transistor
11 measurements."

12 And so one individual would then be
13 responsible for probably a thousand or so rows that they
14 would then work with the module owners to make sure that
15 each of these test structures for each of these
16 different things was the correct ones and drawn
17 correctly in the correct sizes and so on.

18 And so typically there would be six or so
19 engineers responsible for all the test structures. And
20 then there were typically a couple of mass designers who
21 would help do the infrastructure work. Although at this
22 point in the technology, a lot of this was automated and
23 the engineers were able to build the test structures
24 themselves automatically.

25 So, you know, six to eight engineers owning

1 the test structures for thousands of test structures,
2 each engineering, oh, maybe a thousand or so, those
3 kinds of numbers.

4 Q. And if one were to try to find a specific
5 contact resistivity of less than 1 ohm per microns
6 squared, you would need to keep running this experiment
7 with different materials and different thicknesses until
8 you hypothetically could achieve that level of specific
9 contact resistivity; correct?

10 MR. PHILLIPS: Objection; form.

11 A. Yes, so let me back up -- yeah, let me back up
12 and add a little flavor to this.

13 We sort of snapped from test structures to
14 material and the fab. I want to sort of fill in the
15 pieces.

16 Would that be okay?

17 Q. (BY MR. MAIER) Sure.

18 A. So once the development vehicle is running in
19 the fab, the engineers responsible for the process then
20 are continually running experiments on the development
21 vehicle. And so if one is running a conductivity
22 resistance experiment, you would take a lot -- a box of
23 wafers -- and you would stop it at, for example, the
24 thickness step, and you would split the wafers at the
25 thickness step for a variety of different thicknesses.

1 You might split them for different materials. Boxes of
2 wafers are usually 25. We usually leave one in the
3 front as the control. And then you send them off and
4 run a bunch of experiments on them, bring them back and
5 run them through the rest of the factory.

6 And depending on what the targets were, if you
7 had a specific target of 0.01 then there would be
8 multiple rounds typically because you'd do some sort of
9 broad experiment to kind of eliminate certain blocks of
10 materials and then come back and do more iterative
11 experiments that would refine exactly the correct
12 thickness.

13 You know, you basically do the Figure 8 family
14 of curves by figuring out which curves are close, and
15 then you draw the whole curve with one experiment.

16 Q. But nothing in the '423 patent would guide any
17 such person forming these test structures on how to in
18 fact achieve a specific contact resistivity below 1 ohm
19 microns squared; correct?

20 A. The patent describes a methodology, a
21 framework. Then -- and that's the framework I keep
22 calling the Figure 8 framework.

23 Then the patent owner takes the Figure 8
24 framework and runs that framework in their -- sorry, the
25 POSITA takes the framework and runs that framework in

1 their -- on their equipment in their facility to refine
2 and discover what minimum their process brings them, and
3 then you can iterate that framework once you get the
4 initial answer. You discover where your null is and
5 then you iterate, if necessary, to get a lower value,
6 should you need it.

7 Q. But nothing in the patent guarantees that
8 running this experiment hundreds of times for hundreds
9 of materials and hundreds of thicknesses would in fact
10 achieve a specific contact resistivity below 1 ohm
11 microns squared; correct?

12 MR. PHILLIPS: Objection; form.

13 A. The patent does not have any guarantees in it
14 that I'm aware of.

15 MR. MAIER: I want to keep talking about this
16 experiment. I know we have been going more than an
17 hour.

18 Do you need a break or do you want to keep
19 going?

20 THE WITNESS: I do need a break. That last
21 question sort of went ear -- in one ear and out the
22 other, and I think I need a little bit of coffee so I
23 can stay a little more alert on your questions.

24 MR. MAIER: Okay. Yeah.

25 THE WITNESS: So let's take ten, take us to

1 2:00 or so.

2 MR. MAIER: Okay.

3 THE VIDEOGRAPHER: Going off the record. The
4 time is 1:52 p.m.

5 (Brief break taken.)

6 THE VIDEOGRAPHER: We're back on the record.
7 The time is 2:00 p.m.

8 Q. (BY MR. MAIER) Dr. Kuhn, I want you to walk
9 me through how a POSITA would go about forming a metal,
10 metal oxide, semiconductor oxide, semiconductor
11 structure.

12 You have that in mind?

13 A. I think so. Let's keep going.

14 Q. Yeah, you can write down the notes. But,
15 again, metal, metal oxide, semiconductor oxide,
16 semiconductor.

17 A. Okay.

18 Q. And if you want to get more specific, we
19 can -- we can start going down the list in the '423
20 patent, and I think the first one is aluminum.

21 A. Okay.

22 Q. So when you're building such a structure, do
23 you typically start with the semiconductor layer?

24 A. Okay. So let me back up because I want to
25 make sure I understand this question.

1 You're asking me how a POSITA, as I defined
2 it, would build a structure of a particular type. And
3 that's going to be our subject of discussion. Do I
4 understand this correctly?

5 Q. Yeah. I want to -- because you talk about how
6 you'd build one of these structures and then measure it.

7 So I want to walk --

8 A. Uh-huh.

9 Q. -- through that process.

10 A. Okay. Fair enough.

11 Q. Okay. So we're talking about a metal, metal
12 oxide, semiconductor oxide, silicon structure. Okay?

13 A. Yes.

14 Q. And if you want a specific example, we can run
15 through them, but we can start with, you know, aluminum,
16 aluminum oxide, silicon oxide, silicon. Okay?

17 A. Okay.

18 Q. Does --

19 A. Should I just -- oh, I'm trying to find where
20 the question is here.

21 Is the question would you describe it or is
22 the question something else?

23 Q. So I gave you the context. Now I'm going to
24 walk through it step by step.

25 A. Okay.

1 Q. Do you typically start by forming the
2 semiconductor layer?

3 A. So given that I have a POSITA defined within a
4 semiconductor manufacturing facility, and thus we're
5 already working with an existent transistor structure,
6 my answer would be you would begin with the source/drain
7 region of the transistor that exists in your present
8 process.

9 Q. And how -- well, actually, I do want to step
10 back because you said in your definition of a POSITA --
11 I know you expressed some disagreement with Samsung's
12 definition of a POSITA, but I don't see anywhere that
13 you offered your own definition of a POSITA.

14 Am I right?

15 A. I believe I did.

16 MR. PHILLIPS: Objection; form.

17 A. And I believe I offered it.

18 Q. (BY MR. MAIER) I could be confusing you with
19 a different doctor.

20 A. So my declaration beginning on page 25, I
21 believe I do indeed offer a different definition of a
22 POSITA, and starting at paragraph 65.

23 Q. So that's your definition of a POSITA?

24 A. Paragraph 65 and the following.

25 Do you want to walk through this? Because

1 there is some preparatory information in paragraph 64
2 and in 66.

3 Q. Well, let's take your definition of a POSITA,
4 and let's go back to building a structure.

5 A. Okay, okay.

6 Q. So to build the structure, you typically start
7 with the semiconductor layer which in the case you've
8 described is a source/drain region of a semiconductor;
9 right?

10 A. It's the preexisting source/drain region of
11 whatever transistor you're going to be applying the
12 invention to, whether it be NMOS or PMOS.

13 Q. And how long does it take to create that
14 initial source/drain region structure.

15 A. You mean in minutes?

16 Q. In minutes, hours, whatever.

17 A. I don't recall exactly. The source/drain is
18 usually epitaxially grown. It might be an hour and then
19 the wafer is moved to the next step.

20 Q. What is the next step?

21 A. Well, I have to have a process full in front
22 of me for the particular process. But in broad terms,
23 there's two ways to do this. You either put your
24 epitaxial source/drain down and put some precontact
25 metallization down, or you wait until you fabricate your

1 interface dielectric -- you basically build the entire
2 transistor, and then you drill back through and you do
3 your contact technology through the hole after you've
4 completed the transistor.

5 We can talk about either one of these. The
6 second one is more common in modern processes. The
7 first one is a little older.

8 Q. So let's take the second one because it sounds
9 simpler to me.

10 A. Okay. All right.

11 Q. So you start by building or obtaining your
12 source/drain semiconductor layer; right?

13 A. Uh-huh. You complete your source/drain
14 fabrication. That's right.

15 Q. And then how do you form the semiconductor
16 oxide layer?

17 A. So you have to do a few things first to get at
18 it. So after you've completed your source/drain
19 regions, then you end up covering everything with a
20 thick layer of oxide, polishing off the top of the
21 oxide, doing some things around your gate that we won't
22 describe right now. And after you've completed all
23 that, what you basically have is a transistor that has
24 an oxide cover over it. So it's a -- your planar and
25 you have an oxide covering your source/drain region.

1 You then drill a hole in that oxide. At that
2 point, your hole has now recontacted the semiconductor
3 substrate. So you protected the transistor, you covered
4 it with something, you drill the hole back in, and so
5 now you have your transistor safely covered underneath
6 oxide with a bunch of details I'm leaving out, and
7 you've drilled a hole down to contact your source/drain
8 region again.

9 At that point, you can begin to practice the
10 invention in this particular embodiment.

11 You with me?

12 Q. So far. I'm a little confused that you've now
13 exposed the source draining again rather than having a
14 semiconductor oxide layer on it, but I'm assuming you'll
15 get to that point.

16 A. Yeah, because we're -- we've basically taken
17 your source/drain region, done a whole bunch of
18 processing, and then gone back in and made a place to
19 work. So you've drilled your contact back in. So now I
20 have a hole with a -- for all practical purposes -- a
21 naked source/drain region at the bottom.

22 Q. Okay.

23 A. Now here is where I can build the device
24 depending on what I want to do. So I have my
25 semiconductor substrate there. And then at this point

1 in the process, I can deposit a passivation layer if I
2 wish.

3 Subsequent to the passivation layer, I can
4 deposit the separation layer if I wish.

5 And then subsequent to that, I can deposit my
6 metal layer. And then it is quite common that your
7 contact is a bi-layer. There's a Ti nitride underlayer
8 with a tungsten contact. You don't have to do it that
9 way.

10 If you wanted an aluminum example, I believe
11 your original example was the semiconductor, silicon
12 dioxide, a metal oxide and a metal. You would then come
13 in and do a deposition of some type or possibly a growth
14 of your oxide, depending on what you're trying to do.
15 Growth would give you a thinner oxide. Then you would
16 do a deposition most likely of your metal oxide and then
17 you do a deposition of your metal itself.

18 At that point you have your metal, your metal
19 oxide, your SiO₂ and your semiconductor.

20 Q. Okay. So once you have your exposed
21 semiconductor source/drain, you can deposit a
22 semiconductor oxide passivation layer over that
23 source/drain. Correct so far?

24 A. Or grow it.

25 Keep in mind that there are two broad

1 technology classes for creating passivation layers. You
2 can deposit it with a variety of techniques, which means
3 you add something. Or you can use the existing silicon
4 and grow it. And in the case of silicon dioxide,
5 silicon plus oxygen under certain conditions will grow
6 silicon dioxide. So you can consume some of the
7 semiconductor to grow SiO₂, or you can just drop it in
8 like paint. And you have that choice.

9 Q. Okay. And I apologize if I'm going to get
10 some of this stuff wrong. I'm an EE, not a material
11 science guy.

12 But when you say that you can grow it, are you
13 talking about what's referred to as a native oxide?

14 A. Native oxide in its broadest definition is the
15 base oxide on a material. So if it's silicon, the
16 native oxide is SiO₂. And you can certainly grow SiO₂,
17 and you can also deposit SiO₂.

18 The trade-offs between the two are growth
19 consumes the silicon as it goes, so it grows down.
20 Deposition just comes in literally like paint on the
21 top. You don't have any consumption of the underlying
22 silicon.

23 Q. Got it.

24 Okay. So I'm just like picturing this as like
25 Pac-Man is eating some of the silicon atoms --

1 A. Ha.

2 Q. -- and shooting out SiO₂.

3 A. Exactly right. Typically you lose 47 percent
4 of your silicon when you grow. And so -- and it's more
5 of a -- you know, there's a larger set of trade-offs
6 whenever you do these things. But you can elect to
7 grow, in which case the oxygen will consume silicon and
8 make SiO₂ and the thing recesses a little bit.

9 Or you can come in with a deposition technique
10 and just paint the interface with SiO₂ from some
11 exterior source. And people do both kinds.

12 Q. That's interesting because if the source/drain
13 region is doped rather than just putting the -- you
14 know, growing it on undoped silicon, is there any
15 concern that if you try to grow it with doped silicon it
16 results in differences?

17 A. Oh, sure. And there's a whole subclass of
18 things. People can implant in here, if they so choose,
19 and there's a historical implant technology that people
20 sometimes use to roughen up the surface if they so elect
21 to do so.

22 You know, there's -- like anything that's been
23 reasonably well established over the years, the contact
24 process has a number of possible options that people can
25 use.

1 But sort of the sweeping all that away, the
2 base technology is you have a doped semiconductor there,
3 pretty highly doped, you have the opportunity to grow on
4 it. And you're right, if you grow on it, you have a set
5 of issues that have to do with the doping. Or you can
6 say, blah, I want to totally control my oxide entirely
7 myself, and you can just drop it in with a deposition
8 process.

9 Q. Okay. So let's -- and we'll probably get into
10 this at every layer, because now I'm realizing that
11 there -- you just have many choices you can take when
12 you're doing this type of work.

13 Let's assume we've now deposited the
14 semiconductor oxide layer on top of the source/drain.
15 Okay?

16 A. Okay.

17 Q. So the next layer we have to form is the metal
18 oxide layer.

19 What are the different ways in which you can
20 form the metal oxide layer?

21 A. Again, there's kind of two. There's always
22 the option of depositing in exactly what you want.

23 There's also the option of depositing in the
24 metal itself. This is where using the oxide that's the
25 same as the metal is nice. And then oxidizing it

1 in situ. So -- and it's almost the same set of
2 trade-offs as with the silicon and silicon dioxide layer
3 except it's upside down.

4 So you have the choice -- let's say you wanted
5 to use Al₂O₃. You could sputter Al₂O₃ in there and
6 deposit an Al₂O₃ layer.

7 And there's a variety of techniques, but let's
8 just say, you know, you just sputter in exactly what you
9 want, exactly the thickness you want.

10 The other possibility would be to put in your
11 aluminum contact and use some sort of thermal step to
12 oxidize your aluminum contact in the presence of some
13 other material. And so you could -- you know, again,
14 you have a bunch of options there. You could oxidize it
15 in the presence of SiO₂, or you could put some other
16 sacrificial material in there and oxidize in the
17 presence of that material.

18 But at a high level, you can either just avoid
19 all the complexities and deposit exactly what you want
20 at the thickness you want, or you can do fancier things
21 and attempt to grow it off your subsequent metal layer.

22 Q. Okay. So you mention a number of technical
23 terms that I didn't quite understand, so I'm going to
24 ask you a little bit about them.

25 You said "in situ"?

1 A. What I meant was whenever you do processing
2 that's contained when you process, often people call
3 that in situ. So, for example, if I take a layer of
4 aluminum -- let me use Ti.

5 If I take a layer of Ti and put it on top of a
6 layer of SiO₂, and then I heat the Ti up with the intent
7 of oxidizing the Ti, I will create an oxide layer
8 underneath the Ti I already deposited. So I'm doing
9 in situ processing; I'm not doing ex situ processing, as
10 it were.

11 Q. Okay. And is in situ -- if I were to Google
12 that, how do I spell it?

13 A. I believe it's i-n, space, s-i-t-u.

14 Q. Okay.

15 A. It just means -- I believe it's Latin for
16 inside.

17 Q. Okay. I prefer our term, much easier to say.

18 A. I can say inside, too. I mean, the idea is --
19 and, again, there's a variety of techniques. Whenever
20 describing something like this, the simplest thing to
21 describe is you just deposit everything. You deposit
22 your oxide layer, you deposit your metal oxide layer and
23 you deposit your metal, and it's all very
24 straightforward.

25 But you do have options, particularly for

1 simplification, is you grow your oxide off your silicon,
2 you grow your metal oxide off your metal layer. And
3 those are also options available to the processing.

4 Q. All right. So let me take each of those in
5 turn then.

6 So let's go back to our example. We've got
7 the aluminum -- or sorry, we don't have that yet. We
8 have the silicon source/drain substrate. And on top of
9 that we've deposited a semiconductor oxide.

10 Right so far?

11 A. So far, yeah, we deposited our oxide.

12 Q. And then one way in which we could form our
13 metal oxide layer is to deposit aluminum in situ on the
14 silicon oxide layer; right?

15 A. Not quite, not quite. Let me walk through
16 them.

17 The most straightforward one is you deposit
18 your silicon dioxide, you deposit your aluminum oxide
19 and then you put your aluminum contact in. That's the
20 most straightforward.

21 Q. Okay.

22 A. And that's -- just think of it as painting. I
23 paint down my silicon oxide layer. I paint down my
24 aluminum oxide layer. And then I deposit in my metal.
25 And there's my contact structure.

1 Q. Okay. And then the other method is you
2 deposit -- I think the right word is "deposit." No, no,
3 I didn't say it right.

4 The next step is -- no, that is right. Strike
5 all that. Let me start over.

6 The next step is you deposit aluminum directly
7 on the silicon dioxide layer and apply heat to it, and
8 that can also form an aluminum oxide layer; is that
9 right?

10 A. There's a general path.

11 MR. PHILLIPS: Objection; form.

12 A. Let me be very careful here because we're
13 going from the general to the specific. Let me back up
14 and talk about in general what always works, and then we
15 can talk about details.

16 Q. (BY MR. MAIER) Okay.

17 A. In general, for all these systems, you have
18 the option of depositing your passivation layer and
19 depositing your metal oxide separation layer and then
20 depositing your contact. And frankly, given the
21 intricacies of semiconductor processing, let's just
22 stick to that. Because I'm not sure where you're going
23 with these questions, and semiconductor questions can
24 lead us off down many, many paths which may not be
25 relevant to the patent.

1 But in asking the question of a POSITA, what
2 would a POSITA do? First, a POSITA would simply deposit
3 the films in order and run the experiment in Figure 8.

4 Q. And so I do want to ask about the other option
5 just so I have the full picture.

6 So the other option to form the metal oxide
7 layer is to deposit the metal directly on the silicon
8 oxide layer; right?

9 A. You do have an option. I'm going to describe
10 it more generically. Remember, I said you could grow
11 silicon dioxide on silicon. You also have the option of
12 growing your metal oxide on your metal.

13 And the details of that option depend
14 significantly on the metal system and the heat and
15 whether it's laser annealed and a bunch of other
16 nuances. And I'm not familiar with those details for
17 any of these specific systems.

18 But the high-level concept is either you
19 simply deposit in everything you want in the order you
20 want, or you grow it off of a -- either your substrate
21 or you grow it off of the metal itself.

22 Q. Okay. I think I'm getting it.

23 I'm still confused a little bit about the
24 growing piece.

25 So in the situation where you are growing the

1 metal oxide layer from the metal layer, how does that
2 work in general?

3 MR. PHILLIPS: Objection; scope.

4 A. So in very broad terms -- and I don't want to
5 get into specifics on this because we're getting into a
6 bunch of metal chemistry I don't know well. But in
7 broad terms, it is possible to create an oxide layer by
8 providing an oxygen source. And then having the metal
9 on top of the oxygen source, silicon dioxide being an
10 option, silk or something like that being another
11 option, but some source of oxygen. And then you grow
12 the oxide on the undersurface of your metal layer. That
13 is a possible path.

14 Now, again, we're speaking in broad terms
15 here. I am not a surface chemist, and there's a whole
16 lot of excellent and wonderful work done in this space
17 that I'm just not aware of.

18 Q. (BY MR. MAIER) But if we ran your experiment
19 in that way, where you're growing the metal oxide layer
20 from the metal, wouldn't that consume the silicon oxide
21 layer such that we no longer have a metal, metal oxide,
22 silicon oxide, semiconductor structure?

23 MR. PHILLIPS: Objection; scope.

24 A. Again, we would have to get in the specifics
25 here. But let me make the broad comment. Well, if I

1 made the SiO₂ 5 microns thick, it's clearly not going to
2 consume it.

3 The details of exactly how thick you would
4 need to make each layer to have the particular physics
5 work out would be, you know, a layer of detail I think
6 that we don't really need to get into in this
7 deposition. It is certainly experts who would be able
8 to determine, you know, how thick you would need the
9 layers to be and what their composition would be and so
10 on.

11 You know, that's not a question I'm prepared
12 to go into any more detail than I have. It is possible.
13 And I think one could sit down and straightforwardly
14 engineer it, but it's not one I'm willing to do here in
15 the deposition.

16 Q. (BY MR. MAIER) Is the metal layer typically
17 thicker than the silicon oxide layer?

18 A. Well, it's a contact, right. It's
19 100 nanometers long.

20 Q. Sorry. Because I might not be following. I
21 guess the answer is yes. And not only yes, but yes, you
22 dummy lawyer.

23 A. Sorry. Keep in mind that the simplified
24 structure we're talking about, there's a great big
25 semiconductor source/drain, a little thin silicon

1 dioxide layer, a little thin metal oxide layer and a
2 great big contact. We're not talking anything more
3 subtle than that. So the contact is very large in
4 comparison to the two little layers we're talking about.

5 Q. So if you put a great big metal contact on
6 this little silicon dioxide layer, wouldn't you just
7 consume the silicon dioxide layer so we now no longer
8 have our structure of metal, metal oxide, silicon oxide,
9 semiconductor?

10 MR. PHILLIPS: Objection; scope.

11 A. Keep in -- keep in mind, we're really
12 engineering a process here which is probably not the
13 purpose of this declaration. But keep in mind the tool
14 suite that a process integration engineer has available
15 to them. People do not take wafers and stick them in
16 ovens and bake them for hours and hours anymore. There
17 are very rapid anneals available -- flash anneals, laser
18 anneals. You know, there's a whole technology on
19 extremely short thermal cycles. Otherwise we couldn't
20 build transistors.

21 Q. (BY MR. MAIER) Yeah, but keep --

22 A. And so --

23 Q. I was just going to say, keep in mind that
24 we're talking about building these structures using your
25 experiment in the 2002 time frame when the patent was

1 filed.

2 Was that the same -- true back then as it is
3 today?

4 A. Well, obviously we're better at it today. But
5 2002 isn't 1945. 2002 was around the 130 nanometer
6 generation. And people were able to build transistors
7 at that time with gate lengths substantially shorter
8 than a micron. All the same concepts hold true; the
9 scale is just a little bigger.

10 And I think the fundamental point here is
11 thermal engineering and a transistor has always been a
12 very well-defined art for every generation because of
13 the need to keep the implants in place.

14 And so as the transistors get smaller, the
15 thermal cycle capability gets better because that's the
16 driving force from making good thermal engineering is
17 not having your implants diffuse, which is a harder
18 problem than limiting your thermal cycles, for example,
19 in this hypothetical contact structure.

20 Q. So would one of ordinary skill in the art
21 prior to 2002 have known how to implement this process
22 in a way that the metal layer does not consume the
23 entirety of the semiconductor layer when forming the
24 metal oxide layer?

25 MR. PHILLIPS: Objection; scope.

1 A. So keep in mind, we've ratholed down on a
2 particular process. As I said initially when we started
3 this highly detailed discussion, the most
4 straightforward thing for a POSITA to do is simply
5 deposit all the layers. We got into this much more
6 complicated discussion -- I'm not sure why we got into
7 it, but we got into it because this might be a more
8 efficient or a more cost-economical way to do it.

9 But if a POSITA was simply running this in the
10 fab for the first time, I don't think they would be
11 doing these elaborate strategies. They would just
12 deposit each of the layers and go.

13 Q. (BY MR. MAIER) And I think I understand the
14 depositing one, but I want to dig deep into this other
15 one that I don't understand yet. And I know it might
16 sound silly to dig through each option, but that's sort
17 of one of the -- one of the things us lawyers have to do
18 to make sure we understand all angles. So I do want to
19 dig into it a little bit more.

20 Because my -- you know, we're talking about a
21 POSITA trying to run this experiment to create these
22 structures so that they can --

23 A. Right.

24 Q. -- later try to measure specific contact
25 resistivity.

1 A. Right.

2 Q. And I want to -- the way I'm hearing it is you
3 put a thick metal layer on a thin silicon oxide layer.
4 But to me that experiment wouldn't result in the metal,
5 metal oxide, silicon oxide, semiconductor structure
6 because one would expect the entire silicon oxide to be
7 consumed.

8 Am I wrong about that?

9 MR. PHILLIPS: Objection; scope.

10 A. Okay. I am -- I am totally lost here.
11 We've -- we started out with a discussion about how a
12 POSITA would run a straightforward experiment. And I
13 proposed he/she deposits a silicon dioxide layer and
14 he/she deposits a metal oxide layer and then deposits a
15 metal. And we talked about aluminum. And that would be
16 you deposit your silicon dioxide layer, you deposit your
17 Al₂O₃ layer, and you deposit your aluminum, then you
18 send it through the factory and measure it.

19 Now, there are other ways to do this. And
20 we're talking about another hypothetical way, which is
21 interesting. But I've not studied whatever system
22 you're talking about in enough detail to be able to go
23 beyond that broad brush strokes.

24 It is possible to grow an oxide on the bottom
25 of your contact. And that's all I'm able to say at this

1 point.

2 You know, I've not done a study at all of the
3 various options on this. So I'm -- you know, we can sit
4 and talk about it, but mostly what you're going to get
5 from me is I've not analyzed this in detail. We're
6 already working in Al₂O₃, which I'm less familiar with.
7 And I don't know how to answer any of your detailed
8 questions. And I certainly haven't opined on any of
9 this in my declaration.

10 Q. (BY MR. MAIER) Well, what would prevent the
11 metal layer from consuming the entirety of the silicon
12 oxide layer if one were to grow these structures or form
13 these structures in that manner?

14 MR. PHILLIPS: Objection; scope.

15 A. Good engineering. Good engineering would be
16 my best answer.

17 Q. (BY MR. MAIER) And what do you mean by good
18 engineering?

19 A. Properly --

20 MR. PHILLIPS: Same objection.

21 A. Properly tuning the thickness of the layers
22 and the temperature cycling to achieve the results. I
23 can't give you a more detailed answer than that. I
24 haven't thought through the physics of this.

25 Q. (BY MR. MAIER) Let me make sure then that you

1 don't have anything to say about a couple of other
2 topics.

3 Do you know what a diffusion barrier is?

4 MR. PHILLIPS: Objection; scope.

5 A. I know what -- I know what a diffusion barrier
6 is in conjunction with the Ti nitride barrier that's
7 usually put inside a contact hole to provide a barrier
8 to the tungsten. That's the most common use of the word
9 I'm familiar with.

10 Q. (BY MR. MAIER) Do you know of any other types
11 of diffusion barriers that are used in metal insulating
12 layer semiconductor contacts?

13 MR. PHILLIPS: Same objection.

14 A. The only diffusion barrier I'm familiar with
15 from my work is either TiNi or tantalum nitride inside
16 the contact hole used as a diffusion barrier for the
17 tungsten.

18 Q. (BY MR. MAIER) So you can provide no opinion
19 one way or another regarding whether a diffusion barrier
20 would form between a metal or -- and silicon oxide in a
21 contact structure; correct?

22 MR. PHILLIPS: Objection; scope.

23 A. I have not been asked to opine on that topic,
24 and I certainly cannot form an opinion here today.

25 Q. (BY MR. MAIER) I want to talk a little bit

1 about your background, particularly while you were a
2 professor.

3 A. Okay. Can I open up my CV?

4 Q. Yeah. And actually it might be more helpful
5 for you to open up your declaration at paragraph 68.

6 A. Okay. 68.

7 Okay. I'm at paragraph 68.

8 Q. You stated that while you were a professor you
9 focused on group III to V semiconductors; is that right?

10 A. That's correct.

11 It's III-V, yes, that's correct.

12 Q. III-V.

13 So that would be group III, IV and V
14 semiconductors?

15 A. No. The notation in that form actually means
16 from III and V of the periodic table, not IV. So it's
17 gallium arsenide, indium gallium arsenide, indium
18 gallium phosphide, those kinds of materials. It's kind
19 of the culture's code word for "I'm not working on
20 silicon; I'm working on gallium arsenide."

21 Q. Okay. And I'm trying to pull up my little
22 periodic table here, which you have as well.

23 So what are the group III-V semiconductors
24 that you worked on while at -- as a professor?

25 A. So I primarily worked on gallium arsenide,

1 which is row 4 in your table. I also did work with
2 aluminum gallium arsenide and indium gallium arsenide,
3 one up and one down in the column. And I also did a
4 little bit of work with gallium phosphide, which is you
5 just -- you don't use arsenic, you use phosphorous --
6 aluminum phosphide and indium phosphide, and also what
7 are called the quaternaries -- things like indium
8 aluminum arsenic phosphorous, gallium aluminum arsenic
9 phosphorous, that sort of thing.

10 I did no work with antimony.

11 So the square in the periodic table that's
12 got -- the square missing a hole -- that's got aluminum,
13 phosphorus, gallium, arsenic and indium was my primary
14 work in that area.

15 I may have worked a little with antimony.
16 It's kind of that box of six.

17 Q. Did any of your past work relate to group IV
18 semiconductors?

19 A. Prior to joining Intel, my work with group IV
20 tended to be in the context of teaching or being taught.

21 For example, when I was at Stanford and was a
22 graduate student, I actually did my PhD thesis on
23 silicon and took the Stanford silicon processing class.
24 And then I switched to gallium arsenide and did my
25 post-doc and subsequent ten years of work primarily in

1 gallium arsenide and then switched back to silicon when
2 I moved on from the university.

3 Q. And I think you were talking about your time
4 prior to Intel. At Intel did any of your work relate to
5 group IV semiconductors?

6 A. Silicon is a group IV semiconductor. So all
7 my work related to group IV.

8 Q. All right.

9 All right. Thank you for that clarification.

10 So this periodic table doesn't really tell us
11 in any box what counts as a group IV semiconductor. For
12 example --

13 A. No, most -- yeah, you're supposed to have a
14 giant III sitting over the 13 and a giant IV sitting
15 over the 14, and a giant V sitting over the 15, and they
16 didn't do that.

17 Q. Oh, okay. So the group IV semiconductors are
18 the column under 14?

19 A. Yes.

20 Q. Okay. And which of those elements are
21 group IV semiconductors?

22 A. Well, silicon is a group IV semiconductor.
23 Germanium is a group IV semiconductor. Tin is not.
24 Although you can do a tin germanium that is a
25 semiconductor. And lead is not. Fluorine is not. And

1 same thing with carbon: Carbon is not. But the classic
2 group IV semiconductors are silicon and germanium. And
3 there are some semiconducting materials that have tin as
4 well.

5 Q. So carbon is not a group IV semiconductor?

6 A. I've never used carbon as a semiconductor. It
7 may be a semiconductor. I just don't know its band
8 structure well enough. It's certainly not one that I
9 have worked with. But silicon carbide is a group IV
10 semiconductor, so let me back that out. I've not worked
11 with silicon carbide, so let me rephrase that.

12 Carbon all by itself, I'm not very familiar
13 with. But carbon in the form of silicon carbide I have
14 had some peripheral contact with.

15 Q. And I think I can skip a lot of this because
16 what I'm trying to get at is -- let me ask this.

17 You did not provide any opinion regarding
18 whether the claim element group IV semiconductor has
19 adequate written description; correct?

20 A. I never addressed that element, that's
21 correct.

22 Q. Okay. All right. So we can leave that then.

23 Do you want to take a break or do you want to
24 go to the next section?

25 We've been going -- I lost track.

1 A. Let's go to the next section and then take a
2 break.

3 Q. Okay. You mentioned that a person of ordinary
4 skill in the art would be someone with sufficient prior
5 knowledge to understand the concepts in the Acorn
6 patents; right?

7 A. Well, I actually -- and I'm quoting from my
8 declaration here, paragraph 65, "a POSITA reading the
9 Acorn patents would likely be someone in a position to
10 understand the patents and know practically how to apply
11 their teachings in an environment that could eventually
12 lead to a product."

13 Q. Right.

14 Okay. The Acorn patents refer to work done by
15 somebody named Tersoff, T-e-r-s-o-f-f; correct?

16 A. The scientist Tersoff's work is cited in the
17 Acorn patents; that's correct.

18 Q. Are you familiar with the work of Tersoff?

19 A. I have looked through the work of Tersoff.
20 I've also looked through the work of Heine, which is
21 also referenced in the patents. Tersoff's work has led
22 into further work in the community. And I do have a
23 joint paper with John Wager in 2017 that applied
24 Tersoff's work and some of the later work in a more
25 electrical engineering context.

1 Q. What did Tersoff -- I assume it's a doctor
2 Tersoff; is that right?

3 A. I assume so. I don't know.

4 Q. Let's give him that title.

5 Is he alive, do you know?

6 A. I don't know.

7 Q. All right. Well, let's call him Dr. Tersoff,
8 whether he is or not.

9 What did Dr. Tersoff discover?

10 MR. PHILLIPS: Objection; form; scope.

11 A. I don't think he -- I don't think he actually
12 discovered things so much as stated them more clearly.
13 And I want to turn to the patent here because the patent
14 actually has a pretty good description, in a relatively
15 small space, of Tersoff's contribution.

16 So give me a second here.

17 Q. (BY MR. MAIER) Sure.

18 A. Yeah, I'm looking at the patent, Column 2.
19 And there's a nice --

20 Q. Can you say which patent? I'm sorry to
21 interrupt you, but just what patent and what column and
22 line number.

23 A. I'm so sorry. I'm in '423.

24 Q. Okay.

25 A. Okay. And I'm actually on page 1. And I kind

1 of want to spend a little time on page 1 because this --
2 I actually thought this was nicely done for a patent.

3 And what the authors do on page 1 is in
4 Column 1 they start out on line 38 and talk about
5 Schottky theory. And they describe it well and simply,
6 putting the basic equation in.

7 And then they jump down at the bottom to a
8 very well-known observation, between lines 58 and 64,
9 that every time you attempt to exercise Schottky theory,
10 you get the wrong answer. If you try to observe your
11 variations in barrier heights, you observe a weaker
12 variation of the barrier height with work function that
13 is implied by the model.

14 My own experience is you observe no
15 correlation with the model.

16 Then, of course, you have Bardeen's model,
17 which reversed it. So they briefly describe that. And
18 in sort of the fast form, Bardeen's model assumes
19 everything pins.

20 And then here there was a nice paragraph
21 starting in Column 2, line 20. And I'm going to jump
22 down to "Nevertheless, in 1984, Tersoff proposed a model
23 that goes a long way towards explaining the physics of
24 such junctions. See Tersoff, 'Schottky Barrier Heights
25 and the Continuum of Gap States,' this Phys. Rev.

1 letter.

2 And then he also talks about Tersoff's model,
3 which is built on work of Heine and Flores and -- I
4 don't know how to say that name. And he also cites
5 several other basic papers here.

6 And this kind of block of text between line 25
7 and one -- line 34 is actually a really nice summary
8 of -- a short multi-sentence summary of the kind of
9 development in the world of the MIGS model that, you
10 know, is one of several models that's discussed in the
11 community for exactly what the interface states that a
12 metal-insulator-semiconductor interface are doing.

13 Q. You mentioned MIGS. That's metal-induced gap
14 states; correct?

15 A. That's correct.

16 Q. What are metal-induced gap states?

17 A. The short answer is they're -- when you
18 terminate the metal, you have evanescent wave functions
19 that extend beyond the edge of the metal and can induce
20 states in the semiconductor.

21 And the patent actually, I think, says this
22 better than I do. At line 38: "That is, the wave
23 functions of the electrons in the metal do not terminate
24 abruptly at the surface of the metal, but rather decay
25 in proportion to the distance from that surface (i.e.,

1 extending inside the semiconductor)." And then he goes
2 through some additional discussion.

3 But the point is here at the bottom that these
4 evanescent wave functions -- that is, the wave functions
5 of the electrons in the metal -- are inducing states
6 inside the semiconductor itself.

7 Q. So Tersoff recognized that metal-induced gap
8 states could pin the Fermi level of a metal
9 semiconductor interface; correct?

10 A. In essence, yes.

11 Q. And metal-induced gap states increase -- or I
12 should probably state it more precisely. Strike that.

13 The effects of metal-induced gap states
14 increase the closer the metal is to the semiconductor;
15 correct?

16 A. Yes, although I tend to think about it the
17 other way around. Since these are evanescent states
18 sort of protruding from the metal, the further away you
19 get, the less impact they have.

20 Q. So Tersoff recognized that there are these
21 metal-induced gap states and that the further the metal
22 is from the semiconductor, the lower the effects of
23 those metal-induced gap states are; correct?

24 A. That's how I think about it. And, again, the
25 way the patent states it is "The pinning is due to

1 so-called metal-induced gap states (MIGS), which are
2 energy states in the band gap of the semiconductor that
3 become populated due to the proximity of the metal."

4 So the patent describes it the way you did
5 that the closer it is, the more important it is. And I
6 sometimes think about it the other way, which is the
7 further away it is, the less important it is. I think
8 both are equally relevant.

9 Q. When you say the patent describes "it," the
10 "it" is referring to Tersoff's work; right?

11 A. Well, specifically the "it" I was actually
12 using in the previous statement was "it" being the
13 metal-induced gap states.

14 Q. Okay. So Tersoff's work indicated that
15 separating the metal from the semiconductor would reduce
16 the effects of MIGS because the wave functions don't
17 penetrate as far into the semiconductor; correct?

18 A. Correct. And the reverse as well. The
19 pinning occurs when the proximity of the metal to the
20 semiconductor is closer.

21 Q. It was known prior to 2002 that one way to
22 separate a metal from a semiconductor in a junction was
23 to insert an interface layer between the metal and the
24 semiconductor; correct?

25 MR. PHILLIPS: Objection; scope.

1 A. It was certainly -- yeah, it was certainly
2 known that you could have interface layers between
3 metals and semiconductors. It was also known -- and I
4 was doing MBE in about 1980 -- mid 1980s. And it was
5 certainly known that you could put passivation layers
6 between metals and semiconductors. So those two facts
7 were known.

8 And, of course, it's sort of trivially obvious
9 that you could make a metal insulator metal junction --
10 or a metal-insulator-semiconductor junction.

11 I think all those independent pieces were
12 known. The piece that I think was not known is that you
13 could drop the resistance by doing so.

14 Q. (BY MR. MAIER) And you also mentioned
15 Bardeen, B-a-r-d-e-e-n.

16 A. That's correct.

17 Q. And I use the word "discover," but maybe
18 that's not the right word, so feel free to correct me.

19 But what did Bardeen discover or recognize?

20 A. Bardeen made a different model. I'm not sure
21 he discovered or realized; he just presented an
22 alternative view of the world. And I'm going to cite
23 first from the patent and second from my declaration
24 because I have a cool picture in my declaration.

25 But from the patent I'm on -- and this is

1 '423, Column 2, line 13 or so. "Bardeen's model assumes
2 that the surface states are sufficient to pin the Fermi
3 level in the semiconductor at a point between the
4 valence and the conduction bands. If true, the barrier
5 height at a metal-semiconductor junction should be
6 independent of the metal's work function."

7 And in my declaration, I have a picture of
8 this on page 15. I have a picture of both. I have a
9 picture of ideal Schottky theory and a picture of
10 Bardeen theory.

11 Q. Okay. I'm there.

12 A. And if you look on -- are you there?

13 Q. Yeah.

14 A. You see the black line?

15 Q. Yes.

16 A. The black line shows ideal Schottky theory
17 where I change the metal work function, the Schottky
18 barrier height moves right along with it in a straight
19 line.

20 And then I show the ideal Bardeen theory,
21 which is the red line. I change the metal work
22 function, and absolutely nothing happens; I am pinned at
23 mid gap.

24 Q. So does that mean that Bardeen thought that no
25 matter what metal you put there you would have the same

1 Schottky barrier height?

2 A. That's what Bardeen's model says. I don't
3 know what Bardeen thought. I know that in practice
4 there's a remarkable number of materials that love to
5 pin at mid gap.

6 If you just start growing metal-semiconductor
7 junctions without an enormous amount of attention to
8 what you're doing, they will pin at mid gap.

9 So Bardeen's model was simply a model.
10 Schottky's model is a model. They are the two opposite
11 ends of the spectrum on models. One is we have no
12 pinning whatsoever. And the other one is we pin
13 totally. I don't know what either of these people
14 thought about it. I'm not in the position to speak on
15 that.

16 Q. And I want to explore a couple more things,
17 and we'll take a break in like maybe five, ten minutes.

18 A. Okay.

19 Q. What does it mean to passivate the
20 semiconductor surface?

21 A. Generally when people use the word
22 "passivate," they mean to terminate the dangling bonds
23 on the surface.

24 Q. And I think the patent speaks to this too. It
25 doesn't require terminating all dangling bonds. Let me

1 actually point you to Column 3 of the '423 patent,
2 lines 24 to 29. And it also talks about this point at
3 Column 5, lines 1 to 6, if you want to look there as
4 well. And then let me know when you --

5 A. I like column -- yeah, I like Column 5, 1 to
6 6. "The interface layer functions to passivate the
7 semiconductor surface (that is, terminating the dangling
8 bonds that may otherwise be present at the semiconductor
9 surface so as to assure chemical stability of the
10 surface)."

11 So that's a nice definition of passivation.

12 Q. But it seems like that definition is somewhat
13 intentioned with the definition at Column 3, lines 24 to
14 29, because that definition doesn't require terminating
15 all dangling bonds, it allows for terminating just
16 substantially all, implying that you don't have to
17 terminate them all.

18 A. So I lost what the question was.

19 Q. Sure.

20 The question is passivating the semiconductor
21 surface means terminating all or substantially all
22 dangling bonds that may otherwise be present at the
23 semiconductor surface; correct?

24 A. So in my experience, passivating the
25 semiconductor surface means terminating as many bonds as

1 you can. So that would fall into the definition, I
2 think, of substantially all, if possible.

3 Q. Okay. So Bardeen recognized that placing a
4 passivation layer between a metal and semiconductor in a
5 junction would passivate the semiconductor surface;
6 correct?

7 A. I don't recall Bardeen saying that.

8 Can you show me where you're -- you have that?

9 Q. Well, that's what I thought Bardeen said. So
10 let me ask it in a different way maybe without Bardeen
11 in there.

12 It was known before the alleged invention of
13 the challenged patents that inserting an interface layer
14 between a metal and semiconductor in a junction could
15 passivate the semiconductor surface; correct?

16 A. The physics of passivation, i.e., of using a
17 layer, often a very thin layer, to terminate either all
18 or mostly the dangling bonds on the surface was a
19 technology that was known prior to 2002; that's correct.

20 Q. And together, reducing the effects of MIGS and
21 passivating the semiconductor surface results in
22 depinning the Fermi level; correct?

23 A. So the Acorn patents describe passivating the
24 surface. They describe a separation layer that
25 separates the MIGS states. That's what's described in

1 the patents; that's correct.

2 MR. MAIER: Okay. Do you want to take a quick
3 break now or --

4 THE WITNESS: I do. I think this would be a
5 good point.

6 MR. MAIER: Okay. Ten minutes?

7 THE WITNESS: Yeah. And after we -- let's go
8 off the record because I have a process question to ask
9 before we take our break.

10 MR. MAIER: Sure.

11 THE VIDEOGRAPHER: Going off the record. The
12 time is 2:56 p.m.

13 (Brief break taken.)

14 THE VIDEOGRAPHER: We are back on the record.
15 The time is 3:12 p.m.

16 Q. (BY MR. MAIER) Dr. Kuhn, just a couple basic
17 questions in the next section.

18 Inserting an --

19 A. Taking me one second here to get my papers
20 organized.

21 Q. Sure.

22 A. Okay. I'm ready.

23 Q. Inserting an interface layer between a metal
24 and semiconductor in a junction was known prior to the
25 alleged invention of the challenged patents; correct?

1 A. The wording on that is making me a little
2 uncomfortable. Creating a metal-insulator-semiconductor
3 structure was known, but your wording was inserting an
4 insulating layer into a metal-semiconductor junction,
5 which is back to a debate we had earlier about the
6 purpose of doing this. And if the implied purpose is to
7 reduce resistivity, I'd say no, that wasn't known.

8 Q. Did you require -- when you were reading these
9 claims, did you require the structures to have some
10 intended purpose?

11 MR. PHILLIPS: Objection; form.

12 A. So in reading the claims, I also took into
13 account the overall specification. And the overall
14 specification's purpose is pretty clear. The claims
15 themselves are clear they're referring to a
16 semiconductor device. And I believe in the assessment
17 of these claims you do need to take into account the
18 teachings of the specifications. Otherwise, you know,
19 you might be applying them to airplanes or something.

20 Q. (BY MR. MAIER) Well, let me ask it this way
21 because this may be a matter of how we're interpreting
22 the claims.

23 In order to determine whether a particular
24 structure infringes the claims or -- use of prior art --
25 satisfies the claims, do we need to know the designer's

1 purpose for building that structure?

2 MR. PHILLIPS: Objection; scope.

3 A. So if I take a look at the '423 patent and I
4 look at Claim 1, the claim starts out with the preamble,
5 "An electrical device, comprising." I don't believe the
6 preamble is limiting. It certainly tells you what he's
7 building. He's not building an aircraft.

8 Then it goes through the description. And it
9 closes with the wherein clause that "the electrical
10 device has a specific contact resistance of less than or
11 equal to a 1,000 ohm microns squared."

12 So certainly for this claim, it's clear what
13 is meant. The description is clear. The final
14 resistance is clear. And placing the claim in the
15 context of the specification makes it clear that the
16 whole device structure is intended to be used as, for
17 example, the source/drain region or something of a
18 similar nature. Again, we're not talking about an
19 airplane here.

20 Q. (BY MR. MAIER) So here's the problem that I
21 think we're having. Because you're talking about
22 intentions and purposes, which we can't know unless we
23 get into the mind of the person designing the structure.

24 The way I read these claims and this patent is
25 that the structure has to have some sort of result, but

1 it doesn't matter whether the person building the
2 structure, you know, specifically intended for any
3 particular result.

4 Are you following me?

5 MR. PHILLIPS: Objection; form.

6 A. I'm not sure we're saying different things,
7 although we are certainly saying things with different
8 language.

9 I believe -- and, again, I'm back on '423,
10 Claim 1. I can -- I believe we agree that the clause
11 "wherein the electrical device has a specific contact
12 resistance of less than or equal to approximately
13 1,000 ohm microns squared" is clear what the device is
14 supposed to be doing.

15 We can have a debate about how low "less than"
16 goes. But the device is supposed to be producing a
17 specific contact resistance with a number equal to or
18 lower than something.

19 Q. (BY MR. MAIER) Right.

20 And, you know, not all of the claims have that
21 resistivity clause. And we can look at those. But
22 let's stick with the ones that do.

23 And I do think this is something that comes up
24 often in depositions where we're using words to mean the
25 same thing, but we're using different words. I think

1 you're right that we agree on this.

2 To determine whether something meets the
3 claims, we don't need to know the intention of the
4 person building it.

5 Do you agree with that?

6 A. If we're talking about an infringement
7 discussion, my understanding is what is necessary is to
8 show that each of the elements in the claim is met by
9 the infringing widget. And so if this is a discussion
10 about infringement, I think we're in agreement. It
11 needs to show all the elements in there. And there's
12 some fuzz about the preamble. But I certainly think we
13 can say it needs to be a metal, it needs to be a
14 silicon-based semiconductor and so on down the elements
15 of the claim.

16 Q. And the structure has to result -- strike
17 that.

18 The resulting structure in order to satisfy
19 the claims that include a limitation directed to
20 specific contact resistivity satisfy the claims if they
21 in fact result in a reduction of contact resistivity
22 regardless of what the person building the structure
23 intended; right?

24 MR. PHILLIPS: Objection; form.

25 A. Yeah, that was a really snarly question.

1 My answer to that is I do not believe intent
2 matters in infringement. I believe if you can map all
3 the elements of the infringing widget to the elements of
4 the claims, you've infringed.

5 Q. (BY MR. MAIER) Perfect. You said exactly
6 what I was trying to get at, which is the subjective
7 intent of the person building the structure or the
8 person creating the prior art doesn't matter when we're
9 comparing the claims to the prior art for a product;
10 right?

11 MR. PHILLIPS: Objection; form.

12 A. For infringement -- for infringement, that's
13 my understanding.

14 Q. (BY MR. MAIER) Well, are you --

15 A. Yes, for infringement, that's my
16 understanding.

17 Q. Are you interpreting the claims differently
18 for purposes of infringement versus invalidity?

19 A. I'm not sure how we got into invalidity here.
20 I've not opined on obviousness; I've not opined on
21 anticipation. If we're including the things I've opined
22 on in validity, then, yes. I'm a little -- I'm confused
23 where we're going.

24 Q. Yeah. And all I'm trying to do is make sure I
25 understand how you're interpreting these claims.

1 And for you, it's purposes of invalidity
2 because you're opining on invalidity, not infringement.
3 But the point is that, you know, it's a rule of patent
4 law that you have to interpret claims the same way for
5 purposes of infringement and invalidity.

6 Do you understand that?

7 A. Okay. I think I --

8 MR. PHILLIPS: Objection --

9 A. -- I think we're now back on the same page.

10 Q. (BY MR. MAIER) Yeah.

11 A. I'm a little -- so we -- I've, a little, lost
12 track of which question I'm answering, to be honest.

13 Can we reset the conversation with a question?

14 Q. Yeah. So let me ask it more simply.

15 Contact structures that include a metal
16 insulating layer semiconductor structure were known
17 before the alleged invention of the challenged patents;
18 correct?

19 A. Actually, I'm not sure in that form. What I
20 heard -- and I should be taking notes again. I believe
21 you asked contact structures that contained
22 metal-insulator-semiconductors were known before the
23 infringed patent. I'm not sure of that. Contact
24 structures that included metal silicide semiconductor
25 was certainly known. Arbitrary structures, including a

1 metal-insulator-semiconductor, was certainly known. A
2 MOS capacitor is one.

3 But the moment you use the word "contact" and
4 put the word "insulator" in there, I'm not so sure that
5 was known.

6 And I think the place where we're having the
7 debate is there's an enormous amount of literature on
8 metal-insulator-semiconductor structures. I mean, the
9 MOS capacitor is a metal-insulator-semiconductor
10 structure, but it's not a contact.

11 And my contention -- possibly wrong, but my
12 contention is that the metal-insulator-semiconductor
13 structure as used for a contact, a particular
14 semiconductor contact, is what the Acorn patents
15 introduced.

16 Q. That's the inventive part of the Acorn
17 patents; is that right?

18 A. In my mind --

19 MR. PHILLIPS: Objection; form.

20 A. In my mind the inclusion of an insulating
21 layer in a metal semiconductor -- sorry, a
22 metal-insulator-semiconductor contact -- and here I've
23 got a purpose -- but to create a graph like Figure 8,
24 let's say that, is the inventive element.

25 I mean, certainly

1 metal-insulator-semiconductor structures are well known,
2 and contact structures, which were metal typically on
3 something metallic were known, but the addition of an
4 insulator in a contact was the new thing.

5 Q. (BY MR. MAIER) Okay. So this is very
6 important.

7 How sure about that opinion are you?

8 MR. PHILLIPS: Objection; form.

9 A. Let me put it this way: So far in this case
10 I've been exposed to a certain amount of literature.
11 And, again, we're back to there's physics studies where
12 people put everything on everything and measure
13 everything. But when we're talking about this kind of a
14 focused graph of resistance with a minimum and a slope,
15 where there's a minimum point and you're balancing your
16 passivation against your tunneling and you're doing so
17 by the use of one or multiple insulators, I believe that
18 idea is original with Acorn.

19 I may be wrong, but from what I've seen so
20 far, I believe Acorn invented or discovered or whatever
21 the right word is that concept that the pieces were
22 there before. People knew how to put a
23 metal-insulator-semiconductor structure. People had
24 studied metal-insulator-semiconductor junctions and
25 diodes and there's, you know, historical physics work.

1 But putting all these pieces together to say:
2 Look, we are going to put the passivation layer, we're
3 going to drop the resistivity down, but we're going to
4 make it thin enough so that it doesn't tunnel -- that
5 piece, which I put a box around and say Figure 8, and
6 the things that support it -- in my mind that was what
7 was inventive about this patent.

8 Q. (BY MR. MAIER) And so I'm going to -- I think
9 you told me the answer to my question.

10 Metal-interface layer-semiconductor junctions
11 and diodes were known before the alleged inventions of
12 the challenged patents; correct?

13 A. The world knew about pin diodes, for example.
14 The world knew about metal-insulator-semiconductor
15 structures. And, again, one of the things about this
16 invention that I think differs from a lot of inventions
17 is this invention has a new idea supported by a vast
18 ensemble of existing work.

19 So these guys said: Look, we have this body
20 of work here. It talks about passivation layers. We've
21 got this body of work that talks about MIGS. We can put
22 this together and say: Look, if you put this kind of an
23 insulating layer inside this kind of a structure, you
24 will get this wonderful optimization exercise.

25 And I believe that was the element of novelty

1 of this particular patent. It Lego-blocked together
2 well-known ideas but in a new format.

3 Q. So I don't -- my question was -- you know, I'm
4 trying to ask questions that build on each other, so I
5 want to start with --

6 A. Uh-huh.

7 Q. You know, the simple contact -- strike that.

8 The simple concept of a contact having the
9 form metal, metal oxide, silicon oxide, silicon was
10 known before the Acorn patents; correct?

11 A. I don't think so.

12 What you just asked was the concept of metal,
13 metal oxide, silicon oxide, silicon. I don't think that
14 stack in a contact was known. I could be wrong, but I
15 don't -- I've not seen a paper on that or that
16 particular discussion.

17 Now, again, there are numerous physics papers
18 that measure all sorts of things. But the concept, you
19 know, underlying the patent, this business of we're
20 going to passivate and we're going to have a MIGS
21 separation layer, and we're going to have this
22 characteristic Figure 8 curve, and we're going to use
23 this -- let me get this right -- metal, metal oxide,
24 semiconductor oxide structure, I believe that is the
25 novelty.

1 Q. Right.

2 But I didn't mention anything about MIGS. I
3 didn't mention anything about passivating. I didn't
4 mention anything about the purpose of reducing
5 resistivity. I didn't ask about any of that. What I
6 wanted to ask was just the first step.

7 You said these are all building blocks that
8 were put together in a new way. I'm trying to establish
9 what those building blocks were.

10 MIGS was known; right?

11 A. So, again -- again, two -- you know, one of
12 the things is I don't have an infinite library here
13 in front of me.

14 If there's a particular paper that you want to
15 discuss, let's put it on the table and discuss it.

16 Q. Well, I'm only going to put on the table what
17 you've opined on, which is what I'm trying to do to not
18 get these scope objections. So that's why I wanted to
19 ask you just whether in your knowledge -- let me ask it
20 this way.

21 Is it your opinion that the first people to
22 ever come up with the concept of a metal, metal oxide,
23 silicon oxide, silicon contact structure were the Acorn
24 inventors?

25 MR. PHILLIPS: Objection; answered.

1 A. Said that way, with the use of the word
2 "structure," no, because a metal, metal oxide,
3 semiconductor oxide, semiconductor is the gate
4 dielectric of a transistor.

5 I may have misheard you, but the stack I heard
6 was metal, metal oxide, semiconductor oxide,
7 semiconductor structure. That is a cross-section
8 through the gate of a transistor.

9 Q. Well, I used the word "contact structure."
10 And I used --

11 A. Okay.

12 Q. Right. So let me ask it again. And I want to
13 make sure you get every word.

14 Is it your opinion that the Acorn inventors
15 were the first to come up with the concept of a metal,
16 metal oxide, silicon oxide, silicon contact structure?

17 MR. PHILLIPS: Objection; answered.

18 A. I am not aware of another structure that meets
19 the conditions of the Acorn claims.

20 Q. (BY MR. MAIER) That was not my question,
21 respectfully.

22 A. Okay. Let me take another shot at it.

23 Q. Yeah.

24 A. I am not --

25 Q. Let me --

1 A. Why don't you ask it again to make a clean
2 record, yeah.

3 Q. Is it your opinion that the Acorn inventors
4 were the first to come up with the concept of a metal,
5 metal oxide, silicon oxide, silicon contact structure?

6 MR. PHILLIPS: Objection; answered.
7 Objection; scope.

8 A. Okay. So keep in mind I have not done a study
9 of all or any of the prior art in preparing my
10 declaration.

11 Given the limited amount of knowledge I have
12 available to me right now, I believe Acorn is the first.
13 I may be wrong. But I have not done a detailed study to
14 answer the question you asked. The best I can do is say
15 with the information I have today, without having done a
16 detailed study to answer that question, I believe they
17 were the first to do it.

18 Q. (BY MR. MAIER) Okay.

19 Okay. That's what I was looking for.

20 What are the benefits, if any, of reducing the
21 specific contact resistance of a junction?

22 A. If the junction is the source/drain of a
23 transistor, if you reduce the contact resistance, you
24 reduce the -- sorry, if you reduce the contact
25 resistance, you increase the drive current. It's not

1 quite one to one, but it's surprisingly good.

2 And when you increase the drive current of a
3 transistor, you increase the frequency of the
4 transistor. And ultimately after the designers get done
5 with it, you increase the speed or other performance
6 characteristics of the part.

7 Q. Is reduced power consumption one of the
8 benefits of reducing the specific contact resistance of
9 a junction?

10 A. Absolutely. When you increase the drive
11 current, you can always trade off increased drive
12 current for decreased power. You just readjust the VT.

13 So in the semiconductor community when you're
14 doing transistor design, drive current and power are
15 endlessly traded off against each other. So you can
16 have the same drive current and lower power. You can
17 have more drive current and the same power. Or you can
18 set it anywhere in between you want.

19 Q. The benefits of reduced power consumption in a
20 junction structure were known before the alleged
21 invention of the challenged patents; correct?

22 A. People have certainly known for many years
23 that improving the contact resistance in a transistor is
24 good. People have known for many years that improving
25 the drive current is good. And people have known for

1 many years that improving the drive current can be
2 traded off with power. Those are fundamental axioms, I
3 guess, of the transistor design business and have been
4 known for many years.

5 Q. Is copper oxide a metal oxide?

6 A. Well, copper is certainly a metal. And copper
7 oxide would be a metal oxide. I would agree with that.

8 Q. Barium oxide is a metal oxide?

9 A. I don't know about barium oxide. I don't
10 remember if barium is a metal or not.

11 Q. I think it's an alkaline earth metal. And
12 you've got your periodic table, if you want to check.

13 A. Well, but I dislike looking at periodic tables
14 to determine if something is a metal. I prefer to look
15 at band structure.

16 So let me answer that with a qualification.
17 If barium is a metal, I would consider the oxidized form
18 of barium a metal oxide.

19 Is that fair?

20 Q. That's fair.

21 Is lanthanum oxide a metal oxide?

22 A. No. Lanthanum oxide, from memory, is a high-k
23 gate dielectric material.

24 Q. Is lanthanum --

25 A. Oh, I'm sorry. I'm sorry. I'm getting tired.

1 I so misspoke. Let me start over on that.

2 Ask that question again, and I will give you a
3 correct answer for the record this time.

4 Q. Is lanthanum oxide a metal oxide?

5 A. Yes. Lanthanum is a rare earth metal. And
6 lanthanum oxide is a metal oxide and also happens to be
7 a high-k gate dielectric material.

8 Q. Lanthanum copper oxide, La_2CuO_4 , is a metal
9 oxide; correct?

10 A. Wow.

11 MR. PHILLIPS: Objection; scope.

12 A. I would have to look into that. Lanthanum is
13 a metal. We agreed on that. It's a rare earth metal.
14 Copper is a metal. But I'm not sure what happens if you
15 make a compound of lanthanum and copper.

16 It gets a little more complicated with alloys.
17 Because I don't know if it's an alloy or if there's a
18 reaction and it turns into something with different
19 properties. So I'm going to do an "I don't know" on
20 that one.

21 Q. (BY MR. MAIER) So you don't know whether the
22 challenged claims encompass lanthanum copper oxide as
23 the claimed metal oxide; right?

24 MR. PHILLIPS: Same objection.

25 A. I've not assessed lanthanum copper oxide at

1 any level, so I don't know. It's not a situation of I
2 know that they're included or excluded. I simply don't
3 know.

4 Q. (BY MR. MAIER) Lanthanum barium copper oxide
5 is a metal oxide; correct?

6 MR. PHILLIPS: Objection; scope.

7 A. Somewhat the same thing. These are materials
8 I'm unfamiliar with and have not worked with. I would
9 need to do a deeper analysis.

10 Q. (BY MR. MAIER) And you can't say one way or
11 another whether the challenged claims encompass
12 lanthanum barium oxide; correct?

13 MR. PHILLIPS: Same objections.

14 A. I'm sort of hung on step one of this. I don't
15 even know if the alloy of lanthanum and barium is a
16 metal, so I can't get to the point of knowing if it's a
17 metal oxide.

18 So, again, these more complex materials I
19 would need to review and study more deeply to answer
20 that question.

21 Q. (BY MR. MAIER) Do you know whether yttrium
22 barium copper oxide is a metal oxide?

23 MR. PHILLIPS: Objection; scope.

24 A. Same answer as the previous three.

25 Same answer as the previous three: I don't

1 know. I have not studied it.

2 Q. (BY MR. MAIER) Are you aware whether
3 lanthanum barium copper oxide is a superconductor?

4 MR. PHILLIPS: Objection.

5 A. I do not know. There's a lot of work with
6 compounds like that, and I am not familiar with that
7 work.

8 Q. (BY MR. MAIER) Do you know whether yttrium
9 barium copper oxide is a superconductor?

10 MR. PHILLIPS: Objection; scope.

11 A. Same answer. There's a lot of interesting
12 work in the superconducting field, and I am not aware of
13 that work at any level.

14 Q. (BY MR. MAIER) And you may not know the
15 answer to these either, but I'm going to ask them anyway
16 just to make sure.

17 If you used a superconducting metal oxide as
18 the interface layer of the claimed structure, do you
19 know how the resistance to current due to electron
20 emission would be affected as a function of oxide
21 thickness?

22 MR. PHILLIPS: Objection; scope. And
23 objection; form.

24 A. That sounds -- that sounds like a PhD thesis
25 to me. And no, I do not know the answer.

1 Q. (BY MR. MAIER) I have my PhD materials
2 science colleague with me, so --

3 A. So he can give that one to his students, yes.
4 I don't know the answer to that one.

5 Q. Okay. Just a couple more, and then I think we
6 can break for the day and let you take care of your
7 business.

8 If you used a superconducting metal oxide as
9 the interface layer of the claimed structure, how do you
10 expect the resistance to tunneling current to be
11 affected as a function of oxide thickness?

12 MR. PHILLIPS: Objection; scope. Objection;
13 form.

14 A. My goodness. I'm going to put that in the
15 future PhD thesis category. I do not know the answer.

16 Q. (BY MR. MAIER) If you used a superconducting
17 metal oxide as the interface layer in the claimed
18 structures, how do you expect the resistance to total
19 current or the specific contact resistance to be
20 affected as a function of oxide thickness?

21 MR. PHILLIPS: Objection; scope. Objection;
22 form.

23 A. Same answer. Someone is generating wonderful
24 PhD thesis questions. And I don't know the answer to
25 this one either.

1 MR. MAIER: All right. Well, I would say
2 let's break here for the day.

3 THE WITNESS: Okay.

4 MR. MAIER: And then we'll pick up tomorrow.
5 I'm hoping it only takes three to four hours. And then
6 I'm 99 percent sure we don't need to do Thursday.

7 THE WITNESS: Okay. It takes what it takes to
8 do it right. And so we'll start at 9:00.

9 And, again, for tomorrow afternoon, kind of
10 the same thing. If we can end 4:30 or before, that way
11 I can close things off with my mom and the caregiver and
12 all the emergencies of the day.

13 MR. MAIER: Yep, absolutely. You know, having
14 been in that position recently, I totally understand.

15 All right. So let's break for today. And
16 we'll reconvene at 9:00 a.m. Pacific tomorrow morning.

17 THE WITNESS: Sounds good. Thank you all.

18 MR. MAIER: Oh, actually. I'm sorry. Let's
19 do one more thing. I forgot those two papers right
20 there where --

21 (Court reporter clarification.)

22 MR. MAIER: Let's keep this on the record.

23 I just want to upload those two papers that
24 she referenced earlier and just have her confirm that
25 they are in fact the ones she was referencing.

1 Q. (BY MR. MAIER) So let me just do that real
2 quick before we break. I apologize.

3 A. That's okay.

4 Q. I should have done that sooner.

5 A. Let me get back into this thing.

6 Q. Yeah.

7 A. Our little download tool is slow. So I will
8 cycle it and see what happens.

9 Q. Yeah, this shouldn't take too long. I'm
10 uploading the TED paper now. And I'll update the Coss
11 paper now. And let me know when you see those.

12 A. Okay. The TED paper is on, and I'm
13 downloading it.

14 I think I'm downloading it.

15 Okay. The TED paper is the correct one, and
16 it looks complete.

17 I'm not seeing the Coss paper.

18 Oh, there it is. Forget that, I just saw it,
19 okay.

20 And the Coss paper is the correct one as well,
21 and it looks complete. So I think we're good for those
22 two.

23 Q. Yeah. And one more question.

24 So I do think the Coss paper was part of the
25 record, so I've uploaded Exhibit 2114. The file name

1 has 2012 Coss in it.

2 So when you see that, can you just confirm for
3 me that it's the same Coss paper as the one you talked
4 about this morning?

5 A. Okay. Give me a second here to find that.
6 It's -- it wasn't in when I first checked, so I'm
7 re-syncing it.

8 Okay. Let's take a look at that.

9 Q. And I've highlighted, if it helps, the -- what
10 I thought you were reading from.

11 MR. PHILLIPS: So, Cosmin, is the highlighting
12 something that you added or is it --

13 MR. MAIER: It's something I've added because
14 for some reason the way we had labeled this in -- I
15 think the way it had been labeled in the exhibit is
16 2012, but the one that you sent us was 2011. And it
17 looks like this is the 2011. I think what we've
18 highlighted is what she was reading from, but
19 essentially I just want to confirm that it's the same
20 paper.

21 THE WITNESS: Yeah, I'm double-checking
22 because it's a black-and-white version. And so I'm
23 going to pull my original here and just make absolutely
24 sure. Because Coss is profoundly interested in
25 publishing, so -- whoop, that's not it.

1 It looks like it is. Yeah, it does look like
2 the same paper.

3 Okay. So I have confirmed that Exhibit 2114
4 is a black-and-white version of the paper that I was
5 referring to. And all I referenced in that paper, by
6 the way, was just Reference 7. I don't believe I
7 actually quoted from the paper.

8 MR. MAIER: Okay. I think we can go off the
9 record.

10 THE WITNESS: Okay. Sounds good.

11 THE VIDEOGRAPHER: We're off the record at
12 3:46 p.m.

13 And this concludes today's testimony given by
14 Dr. Kelin Kuhn.

15 All media will be retained by Veritext on a
16 local secure drive and redundantly stored in the
17 Veritext-managed Amazon S3 cloud services for
18 preservation purposes.

19 (Deposition adjourned at 3:46 p.m.)

20 (Signature was reserved.)

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REPORTER'S CERTIFICATE

I, TAMI LYNN VONDRAN, the undersigned Certified Court Reporter pursuant to RCW 5.28.010 authorized to administer oaths and affirmations in and for the State of Washington, do hereby certify that the sworn testimony and/or proceedings, a transcript of which is attached, was given before me at the time and place stated therein; that any and/or all witness(es) were duly sworn to testify to the truth; that the sworn testimony and/or proceedings were by me stenographically recorded and transcribed under my supervision, to the best of my ability; that the foregoing transcript contains a full, true, and accurate record of all the sworn testimony and/or proceedings given and occurring at the time and place stated in the transcript; that a review of which was requested; that I am in no way related to any party to the matter, nor to any counsel, nor do I have any financial interest in the event of the cause.

WITNESS MY HAND AND DIGITAL SIGNATURE this 12th day of July, 2021.



TAMI LYNN VONDRAN, CRR, RMR, CCR, CSR
Washington CCR #2157, Expires 10-6-2021
Oregon CSR #20-0477, Expires 3-31-2023

1 MATTHEW PHILLIPS, ESQ.

2 mphilips@lpiplaw.com

3 July 12, 2021

4 RE: Samsung Electronics Co. v. Acorn Semi, LLC

5 7/6/2021, Kelin J. Kuhn , Ph.D. (#4675863)

6 The above-referenced transcript is available for
7 review.

8 Within the applicable timeframe, the witness should
9 read the testimony to verify its accuracy. If there are
10 any changes, the witness should note those with the
11 reason, on the attached Errata Sheet.

12 The witness should sign the Acknowledgment of
13 Deponent and Errata and return to the deposing attorney.
14 Copies should be sent to all counsel, and to Veritext at
15 erratas-cs@veritext.com

16
17 Return completed errata within 30 days from
18 receipt of testimony.

19 If the witness fails to do so within the time
20 allotted, the transcript may be used as if signed.

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22 Yours,

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1 Samsung Electronics Co. v. Acorn Semi, LLC

2 Kelin J. Kuhn , Ph.D. (#4675863)

3 E R R A T A S H E E T

4 PAGE _____ LINE _____ CHANGE _____

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25 7/22/21
Date

1 Samsung Electronics Co. v. Acorn Semi, LLC

2 Kelin J. Kuhn , Ph.D. (#4675863)

3 ACKNOWLEDGEMENT OF DEPONENT

4 I, Kelin J. Kuhn , Ph.D., do hereby declare that I
5 have read the foregoing transcript, I have made any
6 corrections, additions, or changes I deemed necessary as
7 noted above to be appended hereto, and that the same is
8 a true, correct and complete transcript of the testimony
9 given by me.

10
11 Kelin J. Kuhn
12 Kelin J. Kuhn , Ph.D.

7/22/21
Date

13 *If notary is required

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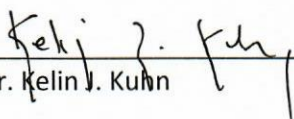
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ERRATA FOR DEPOSITION OF DR. KUHN – JULY 6-7, 2021

<u>Page:Line</u>	<u>Correction</u>
15:16	"patents" → "petitions"
30:1	"for" → "from"
45:9	"exclaiming" → "explaining"
54:15	"interphase" → "interface"
94:15	"oxide silicon" → "oxide, silicon"
95:616-17	"widely spread" → "widely read"
95:23	"must" → "much"
102:20	"EV" → "eV"
141:13	"reprise" → "rephase"
146:4	"R-fab" → "our fab"
151:3	"mass" → "mask"
153:6	"one more" → "one or more"
172:10	"silk" → "SiLK"
186:25	"this" → "this is a"
193:13	"intentioned" → "in tension"
204:4	"doesn't" → "does"
228:12	"an idea which" → "an idea, which"
228:13	"mid-separation" → "MIG-separation"
228:20	"structures and" → "structures. And"
228:25	"table with" → "table, with"
229:15	"challenge" → "challenged"
230:2	"challenge" → "challenged"
230:5	"challenge" → "challenged"
230:8	"challenge" → "challenged"
230:11	"challenge" → "challenged"
230:15	"challenge" → "challenged"
231:1	"challenge" → "challenged"
231:9	"challenge" → "challenged"

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232:25 "challenge" → "challenged"
243:22 "challenge" → "challenged"
245:11 "challenge" → "challenged"
245:12 "challenge" → "challenged"
245:15 "challenge" → "challenged"
245:18 "challenge" → "challenged"
245:20 "challenge" → "challenged"
246:4 "challenge" → "challenged"
249:22 "challenge" → "challenged"
250:24 "did not" → "determined"
251:6-7 "this way is" → "this way, in"
251:16 "challenge" → "challenged"
255:24 "require" → "requiring:"
264:3 "challenge" → "challenged"
264:10 "silicone" → "silicon"
264:16 "pre-carrier" → "free-carrier"
276:14 "35" → "III-V"
278:11 "adsorb" → "adsorbed"
281:21 "option" → "opposition"


Dr. Kelin J. Kuhn

Date: 7/22/21

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