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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CIRRUS LOGIC, INC.,
OMNIVISION TECHNOLOGIES, INC., and
TEXAS INSTRUMENTS, INC.,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00001[1] (Patent 10,734,481 B2)
IPR2024-00016 (Patent 10,510,842 B2)
IPR2024-00019[2] (Patent 11,316,014 B2)
IPR2024-00020 (Patent 11,121,222 B2)

Record of Oral Hearing
Held: January 28, 2025

Before GRACE KARAFFA OBERMANN, JON B. TORNQUIST, MONICA S. ULLAGADDI, and JULIA HEANEY, *Administrative Patent Judges*.[3]

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[1] Texas Instruments Inc., which filed a petition in IPR2024-00772, has been joined as a party to this proceeding.
[2] Texas Instruments Inc., which filed a petition in IPR2024-00774, has been joined as a party to this proceeding.
[3] This is not an expanded panel. The panel for IPR2024-00001 includes Judges Obermann, Tornquist, and Ullagaddi. The panel for IPR2024-00016 and IPR2024-00019 includes Judges Tornquist, Ullagaddi, and Heaney. The

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panel for IPR2024-00020 includes Judges Obermann, Tornquist, and Ullagaddi.

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GREENTHREAD, LLC

The above-entitled matter came on for hearing on January 28, 2025, commencing at 1:00 p.m., via video teleconference.

1 P R O C E E D I N G S
2 - - - - -
3 JUDGE ULLAGADDI: Good afternoon. We are here for oral
4 arguments and Inter Partes Review matter numbers 2024-00001 involving
5 U.S. Patent Number 10,734,481; 2024-00016, involving U.S. Patent Number
6 10,510,842; 2024-00019, involving U.S. Patent Number 11,316,014; and
7 finally, 2024-00020, involving U.S. Patent Number 11,121,222. In these
8 cases, Cirrus Logic, Omnivision Technologies, Inc., and Texas Instruments
9 constitute Petitioner, and Greenthread is the Patent Owner.
10 I am Judge Ullagaddi. The panel for IPR2024-00001 and 2024-
11 00020 includes Judges Ullagaddi, Obermann, and Tornquist. The panel for
12 IPR2024-00016 and IPR2024-00019 includes Judges Tornquist, Heaney,
13 and Ullagaddi. I would like to start by getting appearances of Counsel.
14 Who do we have on behalf of Petitioner?
15 MR. WEIDENFELLER: Thank you, Judge Ullagaddi. This is
16 Scott Weidenfeller with Covington & Burling on behalf of Petitioner. With
17 me, also from Covington, are Anupam Sharma, and Raj Paul. Also for
18 Petitioner are David Bluestone of Barack Ferrazzano Kirschbaum &
19 Nagelberg, and Bert Greene from Duane Morris. And I can speak for our
20 client, GlobalFoundries, Michael LeStrange, and Emre Yuzak are also
21 joining Mr. Bluestone and Mr. Greene. I'm not sure about the other parties.
22 JUDGE ULLAGADDI: Thank you, Counsel. Do you plan to
23 discuss anything confidential today?
24 MR. WEIDENFELLER: No, Your Honor.
25 JUDGE ULLAGADDI: And who do we have on behalf of

1 Patent Owner?
2 MR. WHITEHURST: Good afternoon, Judge Ullagaddi. This
3 is Alan Whitehurst from McKool Smith for the Patent Owner, Greenthread.
4 And with me to your left, my right, is my colleague, Nicholas Matich. And
5 on the line with us today is Dr. Rao, one of the co-founders of Greenthread
6 and the inventor of the patents at issue. And also on the line is Gerald
7 Toumayan, Greenthread's president and head of licensing.
8 JUDGE ULLAGADDI: Thank you. And do you plan on
9 discussing anything confidential today?
10 MR. WHITEHURST: No, we do not.
11 JUDGE ULLAGADDI: Very good. The parties -- the Judges
12 have the parties' demonstratives. Please remember when referring to the
13 demonstratives to identify what slide you're on so we can all follow along
14 and make the transcript clear. Also, I would like to remind everyone that
15 recording of this proceeding, either by audio or video, is prohibited.
16 As set forth in our oral hearing order, each party will have 60
17 minutes to argue. We will begin by hearing from Petitioner first, who bears
18 the burden of -- to show unpatentability of the challenged claims by a
19 preponderance of the evidence. Patent Owner will then respond to
20 Petitioner's arguments and thereafter, Petitioner can spend any of its
21 remaining time, not more than half, to respond to Patent Owner's arguments.
22 Petitioner's rebuttal may not be more than half of the allotted total time and
23 thereafter, Patent Owner may use its time that is reserved for sur-rebuttal.
24 Petitioner's Counsel, would you like to reserve any time for rebuttal today?

1 MR. WEIDENFELLER: Yes, Your Honor. We'd like to
2 reserve 30 minutes, please.
3 JUDGE ULLAGADDI: Okay. That leaves 30 minutes in your
4 main case and when you are ready, you may begin.
5 MR. WEIDENFELLER: Thank you, Your Honor. I'll turn it
6 over to Mr. Sharma.
7 MR. SHARMA: Good morning, Your Honor. Just want to
8 clarify one thing, Your Honor. I see in the order the parties -- the Board
9 granted party's request to have 90 minutes for each side?
10 JUDGE ULLAGADDI: Just give me one second to check that.
11 MR. SHARMA: Thanks, Your Honor.
12 JUDGE ULLAGADDI: Yes, you're right. A total of 90
13 minutes, so --
14 MR. SHARMA: Thank you.
15 JUDGE ULLAGADDI: -- that's 30 minutes for rebuttal for
16 Petitioner, and then 60 minutes for Petitioner's main case; is that accurate?
17 MR. SHARMA: Yes, Your Honor.
18 JUDGE ULLAGADDI: Okay, thank you.
19 MR. SHARMA: Good morning, Your Honor. We have
20 prepared some demonstratives. With your permission, I will share my
21 demonstratives, if you give me a moment. Can the Board see Petitioner's
22 demonstratives?
23 JUDGE ULLAGADDI: Yes.
24 MR. SHARMA: Thank you, Your Honor. This is Exhibit 1072

1 for the Petitioners. Your Honor, here on Slide number 2, we have filed
2 seven petitions in this case and all were granted. The top row shows four
3 petitions that are at issue today. They are called the Active Region Claims.
4 The other three petitions, we call them the Drift Layer Claims. Those are set
5 for the discussion on Friday, January 31st.
6 We're on Slide number 3 now. This gives you a high level over
7 map of what we're trying to cover today. We'll give a quick overview of
8 how we map the prior art onto the claims. We will spend majority of the
9 time on the disputed limitations. Greenthread disputes two limitations, a
10 graded dopant concentration, and a second, doping type. It also disputes
11 some dependent claims. I will address the graded dopant concentration
12 limitation, and my colleague, Mr. Paul will cover the second doping type
13 limitation, and the dependent claims, which pertain to isolation region.
14 And first, we are on Slide number 5 now. Slide 5, 6, and 7, we
15 excerpted independent claim for each of the four patents at issue, and the
16 point -- this point out high level that all of these claims have very similar
17 requirements and very similar structures. And on Slide number 10 and 11,
18 we summarize for the Board's benefit, the various grounds that we asserted
19 and the prior art that was asserted for each of those grounds. As is clear
20 from Slides 10 and 11, we rely primarily on two combinations. One is the
21 Kawagoe patent and second one is Wieczorek publication combined with the
22 Wolf textbook.
23 I am on Slide number 13 now. We just can give a quick
24 overview of how we have mapped the claims, independent claims, for each

1 of these patents onto the prior art. On Figure 13 -- on Slide 13, we have
2 excerpted the cover of the Kawagoe patent. The patent was filed in 1997
3 and published in March 2000, almost four years before the priority date of
4 the Greenthread patents.
5 And I'm on Slide 14 now. We have some figures from the
6 Kawagoe patent on the left, and then we have the claims -- limitations of
7 Claim 1 of the '842 patent on the right. As shown on the left, we have
8 Figure 23, all the way on the left, from the Kawagoe patent. The figure
9 shows a P type transistor and N type transistor. Together, they form a
10 CMOS transistor. And on the right-hand side is a graph, which is Figure 17
11 of Kawagoe patent, and it shows how the gradient changes in the active
12 region and the well region of Kawagoe.
13 One thing to note here that the Y axis represents the surface of
14 the semiconductor, and the X axis represents how the depth of the
15 semiconductor. Now, on the right-hand side is the claim -- the structural
16 claim, an apparatus claim with many structural requirements. And in the
17 Petition, we have explained how each of these structures map onto the
18 disclosure of Kawagoe patent. At the high level, at the first limitation, it
19 requires a substrate. So on the left-hand side of Figure 23, the NMOS and
20 PMOS transistors are formed in the substrate. Kawagoe discloses a
21 substrate.
22 The next two limitations require an active region, a first active
23 region and a second active region. And the two transistors on the left, 4P
24 and 4N from Figure 23, are formed in the active regions. So it discloses

1 active regions, and it also discloses an N well and a P well . The limitation
2 Number 4 requires transistors. That's clear from the figure on the left that
3 there are two transistors on this substrate.
4 And the last limitation highlighted in gold requires that the first
5 and second active regions have a graded dopant concentration to aid carrier
6 movement. And that is shown in the graph on the right-hand side. That's
7 Figure 17 from Kawagoe patent. And if you see the gold line, the gold line
8 shows that as one moves from the surface into the substrate, the gradient of
9 the concentration decreases.
10 I'm on Slide 15 now and we're showing Claim 1 of the '481
11 patent. It has the same limitations as the '842 patent. We do similar
12 mapping. Something additional in the '481 patent is the well region. That's
13 the last limitation with the green box, and it's shown on the left-hand side on
14 Figure 23, it shows the N type well region and a P type well region.
15 We're on Slide 16 now. We show the mapping of the '014. In
16 the interest of time, I will skip because this is substantially the same as the
17 previous two patents. On Slide 17, we show the mapping for the Claim 1 of
18 the '222 patent. And again, this is very similar to the previous two patents,
19 and we make the same arguments for all of these.
20 Now, the second prior art reference we rely upon is the
21 Wieczorek publication. It was filed in 2002 and published in October 2003,
22 almost one year before Greenthread's priority date. The Wieczorek -- I'm on
23 Slide 19 now -- and we excerpted some figures from the Wieczorek
24 publication, in particular, Figures 1b and 2b. And the disclosure of

1 Wieczorek is substantially similar to the Kawagoe patent.
2 On the left, Wieczorek patent show -- publication shows a
3 transistor. The purple portions marked 131 are the N-type -- the purple
4 portions, Your Honor -- I apologize -- are the source and the drain regions,
5 and the light purple portion between the two is the channel region, and the
6 green is the well region. Right in the middle of 134, it depicts the gate. On
7 the right-hand side is a graph that shows how the gradient of the active
8 region changes. Here the X axis denotes the surface, and the Y axis denotes
9 the depth. And as you can see, starting from X axis, as one moves into the
10 substrate, the graded concentration changes. It becomes less as you go
11 deeper into the substrate.
12 JUDGE TORNQUIST: Counsel, this is Judge Tornquist. Can I
13 ask a quick question? Is there --
14 MR. SHARMA: Sure.
15 JUDGE TORNQUIST: -- anything about the Wieczorek
16 reference that is stronger than the Kawagoe reference for the independent
17 claims?
18 MR. SHARMA: No, Your Honor. I think they are
19 coextensive. A few things of the Wieczorek reference, have a very brief
20 reference. So it does not disclose some of the details like substrate and
21 multiple transistors and so on to combine them with the Wolf reference. But
22 overall, we rely on Kawagoe as the single reference obviousness. It contains
23 all the limitations and all the discussion.
24 JUDGE TORNQUIST: Okay, thank you.

1 MR. SHARMA: Yeah. To discuss some of the details of how
2 the transistors are formed, like having a substrate doping type and so on,
3 those are not disclosed in Wieczorek because I -- as I mentioned earlier, the
4 publication is very brief. For such routine fact issues, one can easily rely
5 upon the Wolf textbook that discloses all the details of the transistor. As far
6 as the inventive aspect of the Greenthread patent is concerned, that is
7 disclosed in the Wieczorek reference.
8 And here on the following slides, we show the mapping
9 between the independent claims to the Wieczorek patent, and since the
10 mapping is largely the same, I will skip the next few slides. Same, likewise,
11 on the claim -- on Slide Number 22, we show the mapping of the '481
12 patent, to Wieczorek. Slide 23 deals with '014 patent and its mapping on
13 Wieczorek. And Slide 24 is the '222 patent.
14 Finally, for some of the dependent claims, we are required to
15 show that the same transistor may be formed in the multiple active regions.
16 We rely on the Gupta reference for that. It was published in -- issued on
17 December 2000 before the priority date. And the Gupta reference over here
18 shows that multiple transistors are formed in the same active region. And
19 finally, some of the dependent claims require that the transistors be used in a
20 CMOS sensor and rely on the Silverbrook patent.
21 And I'm on Slide 27 now, and the Silverbrook patent was issued
22 in September 2003. And on Slide 28, the excerpted portions of Silverbrook
23 that show how the CMOS transistors can be used to form a CMOS sensor.
24 So that's the high-level mapping of claims onto the two key prior art

1 combinations, Kawagoe and Wieczorek combined with Wolf.
2 Now, we can take a closer look on some of the limitations that
3 are disputed right now. The first limitation that Greenthread disputes is
4 called the graded dopant concentration to aid carrier movement. I may refer
5 to that as shorthand as a graded dopant concentration limitation or a gradient
6 limitation.
7 We're on Slide Number 30 now. Before we begin, I just want
8 to point something important over here. The excerpted Claim 1 of the '842
9 patent and the -- and it's clear from looking at the claims that these are
10 apparatus claims. The preamble calls for a semiconductor device and all the
11 other limitations are structural limitations. They require a substrate, active
12 regions, transistors, and also active regions having a particular type of
13 gradient.
14 If a semi -- if you're doing infringement analysis, if a
15 semiconductor contained all these features, that semiconductor would be
16 infringing these claims. Likewise, if you are looking at the prior art and the
17 prior art discloses a semiconductor that had all the structural limitations,
18 then that prior art would render these claims invalid, and that is the situation
19 we have. As Petitioners have shown in the Petition, that the Kawagoe patent
20 discloses all of the structural limitations of Claim 1 of the '842, and the Wolf
21 and Weiczorek combination does the same. Now this is true for all the
22 claims because every claim that is at issue here in this proceeding is an
23 apparatus claim. They all contain structural limitations.
24 Now, the reason we have this slide here is to point out that

1 Greenthread is trying to argue that the claims require the carrier movement.
2 They're trying to convert this into method claim. It has an affirmative step
3 of having carrier movement. That is incorrect. We have cited the
4 *ParkerVision* case. Federal Circuit has addressed this issue. Federal Circuit
5 said apparatus claims cover what a device is and not what a device does. If
6 Greenthread -- well, Greenthread argues that there should be movement of
7 carriers. Greenthread is talking about what a device ought to do or what a
8 device does, and that is incorrect. We have looked at the prior art and say
9 are the structural features present and what is the device that has been
10 claimed.
11 The second issue I will point out as you go through the process,
12 I'll draw your attention to the last limitation. It says that the active regions
13 have one graded dopant concentration to aid carrier movement. Okay. This
14 is a structural limitation and aid carrier movement is simply modifying what
15 the graded dopant ought to do. It should be oriented properly, that is aiding
16 movement, and not impeding movement.
17 And one more thing you will hear, Your Honors, from
18 Greenthread is that the other factors that must be considered. The talk -- and
19 these other factors are grown as the case is progressed. Initially, they talked
20 at the POR stage Greenthread mentioned that there are things like magnitude
21 and intrinsic resistance, temperature, stress, and that list has grown. With
22 their sur-reply, they want to add gate electrodes and gate oxides and so on.
23 Just because we brief later just today that the claims will require the other
24 factors. The specification does not describe the other factors, and what's

1 most important is during the file prosecution, the examiner asked about the
2 other factors and other parameters, and the Patentee -- or Greenthread told
3 their patent office that it doesn't matter. What matters is the graded dopant
4 concentration.
5 Now, I'm on Slide 31. We have excerpted that graded dopant
6 concentration from all the four patents, and you can see it's the same
7 limitation in all of them. And we believe this limitation is disclosed both by
8 Kawagoe and the Wieczorek plus Wolf combination.
9 I'm on Slide 32 now and we'll take a closer look at the
10 Wieczorek -- sorry -- take a closer look at the Kawagoe patent. There again,
11 showing Figure 23 on the left and Figure 17 on the right from Kawagoe
12 patent. On the left, we are focusing on the N-type transistor marked as 4N,
13 and it has a well region called P, it's marked as 6P. It's a P-type well region
14 and it's colored in green.
15 Now, on the bottom, we have excerpted Column 17 of
16 Kawagoe, and let me draw your attention to what Kawagoe says about the
17 gradient in the P, in the 6P or the P-well. Kawagoe says thus the impurity
18 concentration of the P-well, 6P, as the green well above, is given such that a
19 gradient that is gradually lowered in the depthwise direction from the surface
20 of the epitaxial layer 2E. And then it goes on to describe what are the
21 benefits of that one is.
22 But before we go to the benefits, it's clear that Kawagoe
23 discloses a gradient or the P-well P that goes down or decreases as you go
24 from the surface into the substrate. And as I mentioned earlier, the graph on

1 Figure 17 shows how the gradient changes. Again, the Y axis shows the
2 surface of this semiconductor and the X axis shows the depth. And the gold
3 bar shows that the surface that a gradient concentration is N_W. And as you
4 go into the substrate, it gradually gets lower until it's at N_S at line W_W.
5 JUDGE ULLAGADDI: Counsel, could I ask a question about
6 this figure?
7 MR. SHARMA: Yes, Your Honor.
8 JUDGE ULLAGADDI: The N_W – all of the doping in this
9 green and lavender are P-type doping, correct?
10 MR. SHARMA: Yes. Yes, Your Honor.
11 JUDGE ULLAGADDI: Thank you.
12 MR. SHARMA: And on the left-hand side, I'll show Your
13 Honor in a minute that the transistor on the left 4P has N-type doping, all of
14 it. So I just want to clarify one thing, Your Honor, that in the P is all P-type
15 doping; however, you have source and drain regions that are shown in deep
16 purple. Those are sources and drain regions and will have the N-type
17 doping. You normally start with the substrate, which is all P-type, and then
18 youcounterdope, or heavily dope, and that becomes the N-type.
19 JUDGE TORNQUIST: Counsel, this is Judge Tornquist. This
20 slide and a couple that are going to come up were objected to by Patent
21 Owner, specifically the blue arrow showing the electric field facing towards
22 the surface, and the red electrons moving to the right. Do you have a
23 response to that? Did Dr. Banerjee sufficiently support this figure?
24 MR. SHARMA: Yes, Your Honor. Dr. Banerjee in his

1 declaration in the first 20–25 paragraph explain how N-type, P-type
2 semiconductors are doped. What are the properties, what elements they use,
3 boron and arsenic, and he also explained how the electric fields are formed
4 based on the type of doping and what kind of -- and what impact it will have
5 on the carriers. It's all disclosed in Dr. Banerjee's declaration in paragraphs
6 1 to 22. And the declaration is Exhibit --
7 JUDGE ULLAGADDI: 1060?
8 MR. SHARMA: Yeah, 1060. Thank you.
9 JUDGE TORNQUIST: Okay, thank you.
10 MR. SHARMA: Now, just looking at the figure on the right-
11 hand side, you can see the gradient is going from the top to the bottom. This
12 is an N-type -- it's a P-type doping, so this means it has been put P-type
13 dopants, and Dr. Banerjee explained that the P-type dopants decrease going
14 from surface into the substrate in the electric field pointing to the top.
15 Now, since electric field is pointing to the top, it will have an
16 impact on the carriers, based on the polarity of the carriers. In this case, the
17 dopant type is P-type, therefore, the minority carriers will be electrons and
18 majority carriers will be holes. Here, the electric field will push or aid
19 movement of the electrons from the surface into the substrate. And this is all
20 explained in Dr. Banerjee's declaration on paragraphs 1 to 25.
21 Now, Kawagoe goes on to explain what is the benefit or
22 purpose of this doping. It says in Column 16, that the dopant
23 concentration -- so the benefit is that the influence to be caused by the
24 carriers (or electrons) due to the alpha ray is lower. And that goes on to

1 explain how it is done. Specifically, electrons produced by the alpha ray are
2 attracted to the substrate body by the concentration gradient and prevented
3 from entering the P-well 6p. So the soft errors can be reduced.
4 So when alpha ray strikes a substrate -- if it strikes on the
5 surface of the substrate, the alpha particle will go inside the substrate. As
6 the particle goes from the substrate -- from the surface into the substrate, it
7 will create carriers, electrons and holes. And the electrons that are created in
8 the -- near the surface, in the active region shown in the purple, or other -- p-
9 well, the electric field will aid the movement into the substrate. Likewise, if
10 there are any electrons in the substrate, the electric -- the dopant gradient and
11 the electric field will prevent them from moving back into this p-well.
12 JUDGE ULLAGADDI: But they do go through the substrate at
13 some point? They just don't come back to the surface; is that correct?
14 MR. SHARMA: Yeah. That's the purpose -- yeah, that's the
15 purpose of the gradient is that the gradient will aid movement into the
16 substrate and then prevent movement back into the p-well. Did that address
17 your question, Your Honor? Okay. Did I address your question or --
18 JUDGE ULLAGADDI: Oh, yes. You did. I'm sorry.
19 MR. SHARMA: Okay. I'm moving on to Slide Number 33.
20 This one, we are focusing on the P-type transistor on the left-hand side.
21 Here the dopant on the well region is N-type, and it is highlighted in purple.
22 And on the top, we have the source and drain of the P-type transistors that
23 are in green region between. And the Kawagoe patent explains how the
24 doping is done in the N well region. It says on the bottom, on line 15 --

1 Slide 15, line 62 onwards, that (INDISCERNIBLE - TECHNICAL
2 DIFFICULTIES) is the purple on the left and the impurity concentration
3 gradually lowered in the depthwise direction from the principal surface in
4 the graded concentration and (INDISCERNIBLE - TECHNICAL
5 DIFFICULTIES) detection there. So as shown over here on Figure 17 of
6 that (INDISCERNIBLE - TECHNICAL DIFFICULTIES) on the right, the
7 gradient is shown by the same curve, and the dopant concentration goes
8 down. This time --
9 JUDGE ULLAGADDI: Mr. Sharma, can I pause you just for
10 one second, please?
11 MR. SHARMA: Yeah.
12 JUDGE ULLAGADDI: We're hearing some background
13 typing noises. If you can all ensure that you are muted, we'd appreciate it.
14 Thank you. You may continue, Mr. Sharma.
15 MR. SHARMA: Your Honor, in this one on Figure 17 on the
16 right, it shows the gradient for the N-type. So this N-type gradient, the
17 electric field would be opposite, and you see in the blue line on the top, it
18 says electric field that's pointing downwards. Again, that responds to Dr. --
19 Judge Tornquist's questions earlier, Greenthread has objected to this green
20 arrow, blue arrow. And again, our response, as Dr. Banerjee explained, the
21 electric fields and the dopant concentrations, and how the carriers would
22 move, in the supplemental declaration, this exhibit was submitted with our
23 Reply.
24 And again, this is N-type doping, so the minority carriers are

1 holes, and electric field will aid the movement of the holes into the substrate.
2 Likewise, the electric field in the gradient will impede movement of the
3 holes from the substrate into the n-well that is the purple region. That was
4 Slide 33.
5 I'm moving on to Slide 34 right now. And this is Dr. Banerjee
6 and his supplemental declaration relied on his own textbook, another
7 textbook by Sze. That's Exhibit 1061, on how the electric -- how the doping
8 is done and how these gradients are created. On the left, it shows that you
9 can create N-type dopant. It could be dope -- semiconductor with N-type
10 dopant, such as arsenic. Arsenic is a donor, and when arsenic is doped, it
11 creates positive ions. Likewise on the right-hand side, we show what
12 happens if the semiconductor has been doped with boron. Boron is a P-type
13 and when doped in the semiconductor, it creates negative ions. And donor
14 acceptor referred to that because arsenic donates an electron to the Coulomb
15 bond boron accepts. These all -- well-accepted terminology and Dr.
16 Banerjee cited to textbooks what they are.
17 I am on Slide 35 now and I will show that if you see how the
18 doping is done and what is the impact, it's the same figures, same electric
19 field, but we have shown if the gradient is changing, what happens. In this
20 case, there's a P-type doping. There are a bunch of boron atoms and you
21 will see more boron atoms on the surface, and there are fewer of them in the
22 substrate. This means the concentration is going down. Just the
23 representation to show what is happening.
24 And what happens with this boron, it creates a positive --

1 negative ion, you have lots of negative ions on the surface, and as you go
2 into the substrate, there are fewer negative ions. And this is what causes the
3 electrons to be moving to the right, because the electrons are being repelled
4 from lots of negative ions, and they're attracted to a place where there are
5 fewer ions.
6 I'll go to Slide 36 now. Now, this doingthe same thing, what
7 happens if you're doping the N-type. Here in this case, since N-type, it has
8 been doped by arsenic. Again, there are more arsenic ions on the top.
9 Beneath the surface, a few arsenic ions into the surface. Again, since arsenic
10 appears a positive ion, you have lots of positive ions on the surface, you
11 have very few positive ions into the substrate. And this will push the holes
12 or drag the holes from the surface into the substrate. That is the basic
13 physics of how Kawagoe dopants work with respect to positive and negative
14 ions, and why the N-type will push the holes into the substrate. And on
15 Figure 35 -- on Slide 35, why the P-type doping will push the electrons into
16 the surface.
17 JUDGE TORNQUIST: Counsel, this is Judge Tornquist. Can
18 you go back to Slide 35?
19 MR. SHARMA: Yes, Your Honor.
20 JUDGE TORNQUIST: There's been a lot of terms thrown
21 around during prosecution and during this case. I wanted to make sure I
22 understand them. With this graded dopant concentration that you're showing
23 in -- which is Figure 17 --
24 MR. SHARMA: Yes.

1 JUDGE TORNQUIST: -- does that create a single electric
2 field?
3 MR. SHARMA: Yes, Your Honor. In this case, if there is
4 adopant concentration that is going down, but that dopant concentration
5 would create electric field and --
6 JUDGE TORNQUIST: Is it unidirectional?
7 MR. SHARMA: In this case, if you just look where the dopant
8 concentration over here, it will be unidirectional.
9 JUDGE TORNQUIST: Okay. And will it be static?
10 MR. SHARMA: In this case, yes, Your Honor. If the field has
11 been created by the ions that have been doped into the substrate, they will be
12 static, which means that if there's no change, once the ions have implanted,
13 they are frozen, the field will always exist.
14 JUDGE TORNQUIST: Okay, thank you.
15 MR. SHARMA: Yeah. And that's -- Your Honor, as opposed
16 to a dynamic field that you apply a voltage, if you create a field, but once
17 you take the voltage away, the field goes away. And the file history of the
18 '195 patent, Greenthread clarified that this is a static field because it's cleared
19 by a dopant gradient, and that dopant gradient was implanted. It will not
20 change, it will not change. The field always stays.
21 JUDGE ULLAGADDI: Counsel, to follow-up on that a little
22 bit, does Petitioner's theory work then irrespective of whether the transistor
23 is turned on or off, whether a threshold voltage is applied?
24 MR. SHARMA: Your Honor, these are apparatus claims and

1 comprising claims. The claims simply call for a graded dopant
2 concentration. Claims don't call for anything. As long as the dopant
3 concentration is there, there will be electric field it will act on the carriers.
4 Now, the direction of the field and the dopant type will determine what the
5 force is and the direction of the force. Now, if the transistor -- if something
6 is turned on, suppose you apply a voltage on these, like gate voltage, that
7 usually will overwhelm the electric field, but that's not claimed and not
8 described.
9 JUDGE ULLAGADDI: Thank you.
10 MR. SHARMA: Yeah.
11 JUDGE TORNQUIST: I have one more question. This is
12 Judge Tornquist, and you might be getting to this, but there's been a fair
13 amount of discussion in the later briefing about Brownian motion.
14 MR. SHARMA: Yes, Your Honor.
15 JUDGE TORNQUIST: When I read your Petition, I didn't
16 understand you to be actually relying on Brownian motion to show a
17 disclosure of the claim limitations; is that correct?
18 MR. SHARMA: Yes, Your Honor. That is correct. And we --
19 JUDGE TORNQUIST: Sorry, I didn't mean to cut you off. So
20 as I understood it, what you were just trying to say was that the electrons are
21 free to move and not in a crystal lattice, but that you're really relying on this
22 downward-sloping gradient to show movement.
23 MR. SHARMA: Yes.
24 JUDGE TORNQUIST: If it is even necessary, but that it's

1 capable?
2 MR. SHARMA: Yes, it is -- that is correct, Your Honor. And
3 that will be -- I will get some slides to it later, but briefly, to address your
4 question, in the Patent Owner Response, Greenthread's expert, Dr. Glew,
5 mentioned that the carriers are not free to move. They are tied to electron
6 atoms and use a certain voltage for the electrons to move, and we have failed
7 to show those voltage. In the response, Dr. Banerjee submitted a declaration
8 where he explained that, at room temperature, there are plenty of electrons in
9 the conduction band and they're free to move. And not only they are
10 constantly moving and that's what's called Brownian motion.
11 Now, if there’s no field applied -- the electrons will move, but
12 they won't be any net motion of current. Once you apply electric field,
13 either externally or through a gradient, then the force will act on those
14 things. And our purpose was to show -- and Your Honor got it right, is you
15 don't need to overcome any forces, intrinsic resistance or magnitude. All
16 you need is an electric field that will cause the motion.
17 MR. TORNQUIST: Okay, thank you.
18 MR. SHARMA: All right. Just going back to Judge
19 Ullagaddi's question. Your Honor, the electric field will always be present.
20 I just wanted to mention that even if you apply external voltage, that may
21 overwhelm the electric field from the gradient, but the gradient is always
22 there and the force will always be pointing according to the gradient and the
23 dopant type, and that's what's called a static field. It never goes away.
24 JUDGE ULLAGADDI: Thank you.

1 MR. SHARMA: Now, this is to sum up what we had
2 mentioned before. It's going back to Figures 17 and 23 of Kawagoe patent.
3 It's focusing on the 4N transistor on the -- highlighted in green. The electric
4 field is pointing upwards over here. This electric field will aid the
5 movement from the surface into the substrate. In this case, the minority
6 carriers and electrons, and the gradient will also impede the movement on
7 this substrate into the well region. And that's what Kawagoe references. It
8 mentions that specifically, electrons produced by alpha ray are attracted to
9 the substrate body by concentration gradient. This means the aiding
10 movement on the -- shown in the grid above -- and prevent it from entering
11 the p-well and that is impeding, shown in the red arrow below.
12 Now, Greenthread has challenged that the -- there won't be any
13 carriers in the active region and they have -- so with your permission, Your
14 Honor, I'm going to go out of sequence. I'm going to jump to Slide Number
15 74. And here, we are at Slide number 75 now and we have a figure from
16 Greenthread's Patent Owner reply, and also presenting Dr. Glew's
17 declaration. Here Greenthread argued that Kawagoe contemplates carriers
18 only in the substrate. They're shown in the yellow highlight over here.
19 These are highlights from Greenthread's brief and they're Greenthread made
20 these highlights. They argue that Kawagoe says the carriers cannot go up
21 into the n-well or p-well. They said Kawagoe does not talk about carriers
22 from the active region or the n and p-well going into the substrate.
23 That is incorrect because of a few reasons. First of all,
24 Greenthread themselves admits that they may be carriers. In the Patent

1 Owner Response, they do mention, the fact that Kawagoe's transistors
2 presumably have carriers in the active region is beside the point. Your
3 Honor, that is not beside the point. There will be carriers in the active
4 region, and as Greenthread has told in the file history, once you have a field,
5 the field will act upon the carriers. So there are carriers in the active region
6 in Kawagoe.
7 Going to Slide Number 76, the excerpted Figure 5B from the
8 patent. Greenthread has mentioned that this Figure 5B is embodiment of its
9 invention here they talk about active carriers in the transistor. They mention
10 that unwanted minority carriers from the active circuity at the surface. So
11 basic operation of transistor CMOS is based on the carriers holes, and
12 electrons flow back and forth between the source and the drain. That's how
13 transistors operate. Kawagoe disclosed the same type of CMOS transistors.
14 If there are carriers in the Greenthread patents or transistors, there would be
15 carriers in the Kawagoe patent.
16 Now, we are on Slide 77 now. This is trying to dig further on
17 what Kawagoe has mentioned. Kawagoe mentioned that one of the purposes
18 is to mitigate the effects of alpha rays. We're pointing to the Wang reference
19 at Exhibit 1009 from 2009, and also, Baumann publication from 2004. This
20 shows what happens when a alpha ray strikes a semiconductor. That's
21 shown over here. The alpha particle hits the surface. It creates ions or
22 electrons and carriers, all the way down from the surface into the substrate.
23 So if an alpha particle were to hit the surface over here, it would create
24 carriers in the active region in the well -- and all of the way into the

1 substrate. The carriers from the active region where the dopant gradient is
2 will be attracted to the substrate and to the extent the electrons on the
3 substrate, they will not move back up.
4 JUDGE ULLAGADDI: Counsel, do you have a response to Patent
5 Owner's position that these alpha ray strikes have an extremely low
6 probability of creating electrons in the active region and would rather
7 actually create more, deep in the substrate?
8 MR. SHARMA: Your Honor, that is correct. We understand
9 when the alpha ray particles hit, they do create more electrons deep in the
10 substrate because when they hit the surface, they are at a very high velocity.
11 As they go into the substrate, the velocity slows down, they create more
12 carriers. But Your Honor, that is besides the point. The claims don't require
13 there should be a certain number of carriers in the active region. All they
14 say is a dopant concentration to aid carrier movement, as long -- and both
15 Wang and Baumann demonstrate there will be carriers in the active region.
16 It doesn't matter if they have more there or less than compared to the
17 substrate. As long as they are there, therewill be a field and they will move
18 according to the field.
19 I'm on Slide 78 now. So this is your point, Judge Ullagaddi.
20 This is an excerpt from Nishizawa reference on Slide 78. This was cited by
21 Greenthread in the Patent Owner Response, but if you look closely into the
22 reference, it helps our case. Figure 35 shows the N region. In Figure 13,
23 that's in the active region, it's the N-type source region. It's highlighted in
24 green. And Nishizawa states that alpha particle will begin to create electron-

1 hole pairs after it has entered into semiconductor substrate to a certain
2 distance. Several thousand electrons will flow into the n+ type region 13.
3 That's in the active region. And if there's a dopant gradient over there, the
4 gradient will act on these electrons and it will push them down deeper into
5 the substrate.
6 So in conclusion, Your Honor, Greenthread's position that there
7 are no carriers in the active region in Kawagoe and all the carriers are
8 limited to the substrate is belied both by the discussion of Kawagoe and by
9 other references, and also by their own patent. And just to
10 (INDISCERNIBLE) we're not going to rely only on the alpha ray. We also
11 mentioned that Kawagoe discloses transistors, CMOS transistors, just like
12 the CMOS transistors disclosed in Greenthread patents will have carriers in
13 them. Likewise, the CMOS transistors created by Kawagoe will also have
14 carriers in them.
15 Your Honor, I'm going to jump back to Slide Number 38 now.
16 Your Honor, we have -- this is all we have to say on the Kawagoe reference.
17 I want to quickly touch upon the Wieczorek publication. We're on Slide
18 Number 38 now. We excerpted Figure 2a and Figure 2b from Wieczorek.
19 This shows how the dopant concentration is created in Wieczorek.
20 Wieczorek mentions that you can first create deep implants, which is shown
21 on the left. You can see the implant number 124, 114, 123 and so on. These
22 are different implants called retrograde implants that are created. Wieczorek
23 says you anneal the substrate, and that causes the atoms or the ions to
24 diffuse. And then Wieczorek says that because of heat treatment, the ions

1 have become substantially uniformly distributed.
2 And Wieczorek talking about substantially uniformly
3 distributed it's comparing the profile in Figure 2A to Figure 2B. Figure 2A,
4 you can see, there are lots of peaks over there, and as compared after
5 annealings, Figure 2B has few peaks. So it's more uniform than the Figure
6 2A.
7 One objection that Greenthread has made about Wieczorek
8 reference is that the element 200 on the top on Figure 2B does not show a
9 graded dopant profile. There are two problems with their argument. First,
10 this argument was made only in the sur-reply. Therefore, it caused the
11 Board not to consider it. If they had an objection to Wieczorek, they should
12 have made that in their Patent Owner Response. But even if the Board were
13 to consider their objection or their argument, it is without merit.
14 First of all, Wieczorek says over here that once you diffuse or
15 heat up the substrate, the dopant atoms would up-diffuse, as said over here
16 highlighted on the left. Due to the up-diffusion of the dopant atoms, the heat
17 treatment, the retrograde profile, become more uniform. Now, what is the
18 consequence of up-diffusion?
19 If you go to Slide Number 39, this is an excerpt from Dr.
20 Banerjee's declaration. That's Exhibit 1003 that was filed with the Petitions.
21 And Dr. Banerjee considered what is the effect of up-diffusion. Dr.
22 Banerjee mentioned that nonetheless, Wieczorek explains the graded dopant
23 concentration is such prior art CMOS devices peak at the surface of the
24 substrate and decrease with depth. So the up-diffusion pushes the dopants

1 up and the peak is formed at the substrate or the surface, and as you go
2 down to the substrate, they will decrease because dopants have nowhere to
3 go other than the substrate, when they stop over there, and that's away from
4 the peak. This is unrebutted testimony. Dr. Glew did not object it or
5 respond to that. Only we have attorney arguments that are made by
6 Greenthread in their sur-reply.
7 So Your Honors, at this stage, I feel that really what we are
8 shown for Greenthread -- Kawagoe application -- patent -- and what we are
9 shown for Wieczorek and Wolf combination is sufficient to render the
10 claims invalid. Now, Greenthread has made some arguments, counter-
11 arguments about magnitude, about other factors and so on. We just walk to
12 walk you through the slides on the -- the -- some slides that summarize the
13 file history and show that the argument that Greenthread made back in 2012
14 are consistent with the arguments now. And the arguments they're making
15 now in 2024 are inconsistent with the argument they made twelve years ago
16 in order to get the patent.
17 So this is -- I'm on Slide Number 40 now. This is the -- there
18 are two important issues to keep in mind over here. The examiner made a
19 112 -- Section 112 -- first paragraph rejection for the pending claims. In
20 other words, the examiner said, the pending claims are not supported by the
21 specification of the written description at issue. The second thing the
22 examiner wanted to note, whether the movement of minority carriers is
23 affected by multiple forces in the fields. That's the question the examiner is
24 asking because he wanted to know whether the claims required multiple

1 forces of use and do those affect the movement of minority carriers. And the
2 next two pages will -- slides will show what was Greenthread's response.
3 I'm on Slide Number 41 now with respect to the file history.
4 The first thing was Greenthread said, Applicant respectfully disagrees with
5 the position. So at the time in 2012, Greenthread agreed -- disagreed with
6 the examiner. And what did Greenthread say? First thing they said was the
7 unidirectional electric field necessarily affects all the present minority
8 carriers in the same way. This means what they said was if you have an
9 electric field and you have minority carriers over there, it will necessarily
10 affect all of them. So all they need is an electric field and the carriers.
11 There will be impact on the carriers. No ifs and buts. And also cited to the
12 textbook from Andy Grove to support that.
13 Now, next statement is also very informative and they
14 mentioned that depending on the particular slope of the graded concentration
15 dopant, all minority carriers are either swept down from the surface to the
16 substrate or up on the surface to the surface layer. So what Greenthread said
17 over here is what matters is the slope of the concentration. If the slope is
18 pointing one way, it will push the carriers down on the surface to the
19 substrate, and if it is pointing back, other way around, the effect would be
20 opposite and the carriers would move from the substrate to the surface layer.
21 Now, Greenthread has come back and said that what vertical
22 slope means, both magnitude and direction. But if you look at the sentence
23 over here, they are simply talking about direction. They're talking about
24 slope pushing things up or slope pushing things down. There's no mention

1 of magnitude. If you can meant the particular slope, it includes both,
2 magnitude and direction, they should have mentioned that, but they did not
3 do that.
4 They also point to Figures 5b and 5c, so just make a note of
5 that, Your Honor. I'll come back to this in the next slide. On Slide 42 now,
6 it's continued from the same response on the file history. Examiner wanted
7 to know whether there are other parameters that one should be aware of.
8 And the examiner asked, can you figure out whether the drift field will move
9 the carriers without knowing other parameters of the device. Without main
10 parameters, do you know if it will draw all the minority carriers.
11 Greenthread, again, disagreed with the examiner and said the argument
12 appears not to consider that the graded dopant concentration itself creates a
13 built-in electric field that forces the movement of carriers into a particular
14 direction, whereby the direction of the electric field and the resulting
15 direction of the carrier movement depends solely upon the slope of the
16 graded concentration.
17 So what they meant was, first of all -- this is going back to
18 Judge Tornquist, your question -- the built-in electric field. And this is what
19 Greenthread told the Patent Office. The graded dopant concentration itself
20 creates a built-in electric field, which is a static field. And the second point
21 they mention was it's only the direction that matters because they say the
22 direction will determine if it will go up or down. And even more important
23 is the examiner was asking about other parameters of the device. They did
24 not address those parameters. They said what matters is the graded dopant

1 concentration. And then they talked about two other patents cited over here
2 and none of them discussed the magnitude. They all talk about the slope.
3 And the last sentence, also, is very -- let's start that over here.
4 Again, the examiner wanted to know whether you need to have other
5 parameters on the device to figure out the impact on the carriers. And
6 Applicant said, Applicant respectfully submits that this inherent built-in
7 unidirectional electric field is the additional parameter for ensuring all
8 minority carriers are being moved in one direction. Then they go on to say
9 that. So again, when they're talking about the additional parameter,
10 Greenthread verified that the parameter is the electric field that is caused by
11 the gradient. And since the gradient is uniformly decreasing, it has only one
12 slope, the field will be unidirectional. As Dr. Banerjee explained in his
13 declaration that if the direction of the slope changes, it changes and the field
14 will change.
15 JUDGE TORNQUIST: Counsel, this is Judge Tornquist. Can I
16 ask one question?
17 MR. SHARMA: Yes, Your Honor.
18 JUDGE TORNQUIST: With these changes, do we treat them
19 as binding claim construction issues, binding admissions, is it an estoppel?
20 How do we deal with these statements?
21 MR. SHARMA: Yeah. These statements explain what the --
22 what they thought. In Claim 1, they were telling the patent office that the
23 claims that were -- are focused only on unidirectional, on the graded dopant.
24 So these are defining -- they go to all issues, Your Honor. They define the

1 claim construction issue. They are telling that what matters is the gradient
2 and that impacts the field. It also somehow limits the claim, so they kind of
3 go back and read stuff into the claims. They told the examiner that other
4 parameters don't matter. They can't come back and say, oh, other parameters
5 should be read into the claims. And did that address your question?
6 JUDGE TORNQUIST: So then we also -- I figured you're
7 going to get to it -- but we also have your 30(b)(6) witness potentially saying
8 something to the opposite. So how do we deal with that?
9 MR. SHARMA: Your Honor, we'll get to that in a minute here.
10 The witness did not say anything to the opposite. Keep in mind, the -- Mr. --
11 the witness was a 30(b)(6) witness. He was a witness who testified on the
12 design and operation of the accused products. He had not reviewed the file
13 history of the patents. He had not reviewed all the back and forth with the
14 examiner. He had not reviewed prior submissions by Greenthread on claim
15 construction and so on. He was shown one document, which was a third-
16 party document. It was there now. He had never seen the document before.
17 All he said was, yeah, there are other factors that matter. Yes, and
18 the document does mention that there are other things like gate direction --
19 or the 30(b)(6) had not seen the file history. He did not know that
20 Greenthread had said other factors do not matter. The only thing that
21 matters is the dopant concentration. And obviously, the witness did not
22 know that the examiner had asked during our prosecution whether we need
23 to know other parameters or not. Again, the witness did not know that he
24 was -- that this back and forth. He was going to be talking about what would

1 happen, the generic semiconductor device, also the scope of the claims.
2 One thing I want to point out over here is on the other factors and
3 so on, one thing you will see, why is Greenthread making these admissions
4 or making these narrowing admissions in 2012. Greenthread was facing a
5 112 rejection. The examiner wanted to know where are the -- whether they
6 need to know other parameters or not, and that was the -- one of the bases
7 for the 112 rejection.
8 In response, Greenthread did not point to anything else. It all
9 defined -- the specification simply talks about slope of the gradient, the
10 specification does not talk about a magnitude. It does not say that you have
11 to have a minimum magnitude in order to affect carrier movement. It does
12 not talk about intrinsic forces that need to be overcome. It does not talk
13 about intrinsic resistance or any other forces. It does not talk about things
14 that Greenthread said, like gate-oxides, gate electrodes, and so on.
15 And if you look, Your Honor, at Slide 41 now, they pointed to
16 Figure 5B and 5C. These are the figures of the transistor that has gate
17 electrodes in them, that has gate-oxides in them. Obviously, all transistors in
18 the 70s and 80s had to be delivered -- had to be gate-oxides. There's nothing
19 in the specification that shows that how the gate electrodes, how the gate
20 oxides impact the gradient, or the field created by the gradient. There's no
21 description.
22 And therefore, at that time, facing 112, in order to get the claims
23 through, they said other factors, other parameters do not matter. The only
24 thing that matters is the graded dopant concentration. And once Greenthread

1 made these representations , the claims were issued. Only change they made
2 to the claim was to drop the term all, but in this limitation otherwise, saying
3 that the graded concentration will aid carrier movement was allowed in light
4 of these representations.
5 Now, if you look at the file briefly right now, Your Honor,
6 they've gone back and said the examiner was right. Well, Your Honor, if
7 examiner is right, then why in 2012 they were saying, Applicant respectfully
8 disagrees with the examiner. And now on Slide 42, this examiner had not
9 considered the graded dopant concentration. This is a nose of wax. Back in
10 2012, they relied only on the slope to get the claims allowed. Now they're
11 going to read up all the other things that should be read into the claims.
12 Which are not in the claims, not in the specification, and they specifically
13 told the Patent Office do not matter.
14 Now, on Slide 43 now, even though Greenthread objects are --
15 disagrees that the Kawagoe and Wieczorek with Wolf don't render the
16 claims invalid. Over the course of depositions in the case, Dr. Glew has
17 made some admissions. On Slide 43, we point out that Dr. Glew admitted
18 that Kawagoe and Wieczorek show a graded dopant concentration. They
19 show how a concentration goes down as you go from surface into the
20 substrate. He's also admitted that the concentration create electric fields.
21 And he also admitted electric fields are -- they cause minority carriers to
22 drift. All this together, it proves that he admitted that Wolf, Kawagoe, and
23 Wieczorek have a graded dopant concentration that aid carrier movement
24 from surface towards the substrate.

1 And we have on Slide 44 a couple of admissions from Dr.
2 Glew. Exhibit -- the first one is from Exhibit 2057. This was also presented
3 in Greenthread's claim construction brief in the District Court. In the first
4 quote on Slide 44, Dr. Glew mentioned, when the dopant concentration is
5 graded in a particular direction, other charge carriers will move in the
6 gradient direction or opposite direction, depending on the charge carrier's
7 polarity. This phenomenon is called carrier drift.
8 It’s pretty clear that once you are grading, you have an electric
9 field and based on the polarity of the carriers, they will be impacted. Now,
10 they come back and say, oh, (INDISCERNIBLE)caveats, yes, but when they
11 made the statement in the District Court in the claim construction, they did
12 not put any caveats over there. Likewise, in his deposition transcript from
13 Exhibit 1069 of our briefing, he agreed that a field will produce a force
14 aiding movement in the direction of the force. That's just basic physics.
15 Before going to -- we'll go back to Your Honors' questions Judge
16 Tornquist asked on Slide 41 and 42. I think -- these are the representations
17 that Greenthread made to the patent office in order to get the claims allowed.
18 Examiner had objected to the pending claims and the examiner has made a
19 112 rejection. Examiner wanted to know whether there are other parameters
20 or not, and in order to get the claims through, Greenthread was very clear
21 that they disagreed with the examiner. Greenthread was also very clear that
22 other parameters don't matter and the only thing that matters is the graded
23 concentration. This should be treated as a binding admission
24 (INDISCERNIBLE) in Greenthread because they made these clarifications

1 and made these representations to the PTO to overcome a written description
2 argument. If Your Honor has no more questions, I will move on, on the file
3 history.
4 JUDGE TORNQUIST: Okay.
5 MR. SHARMA: One thing I want to point out is -- we are on
6 Slide 47 now. This is something that came up and goes back to why we
7 relied upon the Brownian Motion. In Patent Owner Response, Greenthread
8 submitted a declaration from Dr. Glew, Exhibit 2057. In fact, in 50, he
9 mentioned that -- and I'll just read the last line over here. POSITA would
10 need to know other parameters of the device, such as magnitude or
11 concentration, intrinsic resistance, and presence of other external forces to
12 move in a drift field associated with a gradient would aid carrier movement.
13 And just going through these statements over here, they are not supported by
14 the claims.
15 So if you look at the claims -- we're on Slide 48 now. Claim
16 simply calls for a graded concentration to aid carrier movement. They do
17 not require any magnitude, they do not require any other factors to be
18 considered. As you saw in the file history they clarified that all that matters
19 is the gradient and other factors and other parameters do not matter.
20 On Slide 49, the excerpted portion of the specification. Here
21 Greenthread relies on this word, relative slope. And this said, this tells you
22 magnitude and the slope, but if you read -- it's three columns long. There is
23 no discussion in the patents about the magnitude of the slope. There's no
24 discussion in the patents of how the slope -- or the magnitude, if it were

1 present, would impact any movement. The patents do not mention at all that
2 you have to have a minimum magnitude in order to aid carrier movement.
3 They simply talk about the slope, positive or negative, and that will impact
4 carrier movement.
5 JUDGE ULLAGADDI: Counsel, does Claim -- independent
6 Claim 1 cover this embodiment?
7 MR. SHARMA: Independent claim, at this point, Your Honor,
8 is on the BJT. So their embodiments are on CMOS devices or field effect
9 transistor devices. So the disclosure here, is even more scant for them. In
10 the BJT shown over here, emitter and collector. The grade is shown going
11 from emitter to the collector and that is the direction of the current flow.
12 That flow between the emitter and collector and the gradient is aligned with
13 that. In the claims at issue over here, you have the source and the drain.
14 The current flow between the source and the drain, but the electric field is
15 perpendicular to that. So the orientation and the design of the field effect
16 transistors is different.
17 JUDGE ULLAGADDI: Thank you. Counsel, you have about
18 three minutes remaining if you don't want to get into your rebuttal time.
19 MR. SHARMA: Okay, Your Honor. I'll try to speed up now,
20 but I just -- look, the point I want to make over here on Slide 50 is in
21 submission to the Patent Office just a few months ago on August 2024,
22 Greenthread mentioned relative slope means nothing more than the fact that
23 one side is relatively lower than the other. All they said was there's more
24 dopants on the emitter and less dopants on the collector. They don't say it

1 has a magnitude. All they say was that's what it is.
2 Then if you look at the file history we saw and we discussed
3 just now, Dr. Glew, has totally ignored the file history. There's no mention
4 of magnitude or resistance or other forces in the file history. Now, as you
5 recall, when we asked him -- we're on Slide 53 now -- have you looked at
6 the file history in coming up with your opinions on magnitude and so on, he
7 said, I glanced at the file history, it didn't seem relevant.
8 And on Slide 54, this is a statement from the examiner that
9 Greenthread wants to walk away. They seem to be selective on which
10 statement they agree with and that they don't agree with. Here the examiner
11 noted, the Applicant has not claimed a specific magnitude and any
12 magnitude of the drift electric field, however small, reads on the claim. And
13 the claim at issue is excerpted below. On the bottom of the claim was,
14 graded dopant concentration in either the channel region or the well region
15 to aid carrier movement away from the surface region. For the same claims,
16 very similar limitation and the examiner said, yes, there's no magnitude
17 requirement in these claims.
18 And the next two or three slides -- I'll just summarize Slide 55,
19 56. We had mentioned in our briefs that in theIntel litigation, the litigation
20 between Greenthread and Intel a few years ago, and Intel argued that the aid
21 carrier limitation is indefinite. Again, 112 -- got one rejection, and the
22 response and the briefing makes clear Greenthread said it's a very simple
23 requirement. It's on that page 55 that they mention. It equated a slope to a
24 wheelchair ramp and they said, okay, all you need is a ramp and a slope and

1 that will aid movement. They did not mention that the ramp should have a
2 certain magnitude and so on.
3 JUDGE ULLAGADDI: Where was that claim construction
4 brief from?
5 MR. SHARMA: That was from the Western District of Texas,
6 Your Honor. And we put it here, Exhibit 1020, on page -- Slide 55. Okay.
7 Just a couple of minutes on Slide 59 in response to Judge Tornquist's
8 question.
9 As Dr. Glew had mentioned that you need a magnitude of the
10 gradient, and he did not say anything in his declaration why it is needed,
11 what it is needed. When we deposed him, he find -- then we find out what
12 he says. He mentioned over there that the electrons are tied to the atoms and
13 he said the threshold voltage needed to negate the electrons from the carrier.
14 And he said otherwise, collectors are tied to this thing.
15 In response on Slide 59 -- 60, Dr. Banerjee offered his
16 declaration and he mentioned that, you know, at room temperature, there are
17 plenty of electrons in the conduction band in the semiconductor, and he cited
18 from the Sze textbook to prove that. In Figure 1, he mentioned that yeah,
19 the electrons in Figure 1A, or on Slide 60, are constant Brownian Motion.
20 They are moving around and there's no electric field applied, so there will
21 not be any net movement. However, if you apply in electric field E, that's
22 shown on Figure 1b, the electrons will move. And that's the sole purpose of
23 us pointing a Brownian Motion was that Dr. Glew was wrong. Electrons or
24 carriers in a room temperature do not need a minimum (INDISCERNIBLE)

1 voltage to be freed. They are in constant motion. All you need to do is
2 apply non-negative electric field and they will move.
3 Your Honor, in the interest of time, I will stop over here, despite a
4 few things and I'll come back to that in my rebuttal time. Greenthread has
5 made multiple objections in our brief and it somehow seems to be they're
6 just throwing everything at the wall and see what sticks. Some we have
7 discussed and some you will be hearing from Greenthread. I just want to
8 point your attention to two or three things.
9 First of all -- we rely heavily on the testimony from Dr. Banerjee
10 about other factors. We've talked about -- Dr. Banerjee mentioned, there's
11 gate electrodes, they are gate-oxides, and they impact the electric field. Like
12 keep in mind that is a red herring, the claims call for graded dopant
13 concentration, and what is the electric field produced by the graded dopant
14 concentration. These are comprising claims. There may be other things.
15 It's not the Petitioner's burden to go back and look for other
16 limitations that can go up in the comprising claim. And Dr. Banerjee
17 testified that yes, he had considered all of these factors and they do not
18 matter for these claims. And you know, when you notice, when they talk
19 about gate oxide or gate electrode, the impact on the floor, they rely only on
20 Dr. Banerjee's testimony. They cannot point to anything in the
21 specifications. They cannot point to anything in the file history.
22 They will definitely talk about Mr. Warrick. They will also talk
23 about the claim constructions from Western District and Eastern District. In
24 both of those claim constructions, the court -- neither of the two courts was

1 evaluating what is they should've found out first. They're evaluating a
2 totally different issue. They try to take some language from the dicta and try
3 to cobble something together to make their case. With that in mind, if you
4 don't have any other questions, I will let my colleague, Mr. Raj, address the
5 other limitation.
6 JUDGE ULLAGADDI: Thank you, Counsel. You have
7 approximately 27 minutes remaining for rebuttal.
8 MR. SHARMA: Thank you, Your Honor.
9 JUDGE ULLAGADDI: Returning to Patent Owner's Counsel, Mr.
10 Whitehurst. Would you like to save any time for rebuttal?
11 MR. WHITEHURST: Yes, Your Honor. We were planning on --
12 it's a little unclear to us whether Mr. Raj was going to speak now or later.
13 MR. PAUL: Yeah. I was going to address a couple of issues now
14 and then save the remaining time for rebuttal, if that's okay, Your Honor.
15 JUDGE ULLAGADDI: Oh, I'm sorry. I did not understand that.
16 Okay, all right.
17 MR. PAUL: No problem.
18 JUDGE ULLAGADDI: When you're ready.
19 MR. PAUL: Okay. Can you see my screen now, Your Honors?
20 JUDGE ULLAGADDI: Yes.
21 MR. PAUL: Thank you. So I'll briefly address, in the interest of
22 time, a couple of limitations that Greenthread is disputing. And time
23 permitting, secondary considerations argument they're making, as well. So
24 on Slide 86 here, we begin with the requirement that the first active region

1 with a second doping type. So, very quickly, this term specifies, as shown
2 on the right here, that there be a first active region disposed adjacent the first
3 surface of the substrate with a second doping type opposite in conductivity
4 to the first doping type, which is referenced in the previous limitation.
5 So for example, if you have a P-type substrate, which is
6 typically the case, then this claim is -- if such a substrate has an active
7 reason, quote/unquote, "with" a second doping type opposite in conductivity,
8 and that's all it requires. Our position here is straightforward. As shown
9 here on the left, Kawagoe's device uses a P-type substrate and that's your
10 first doping type. This is a complementary MOS or CMOS structure, which
11 means there's a PMOS and an NMOS together, as Mr. Sharma described,
12 that's shown in Figure 23.
13 And the NMOS on the right, which is labeled 4N, that satisfies the
14 requirement of a first active region with a second doping type opposite in
15 conductivity. That second doping type is the N-type dopants. By definition,
16 that's going to be present in the source and during regions of Kawagoe's
17 NMOS 4N. Kawagoe itself says, as shown here in the excerpt, that
18 semiconductor regions 4A -- 4Na and 4Nb are doped with an N-type
19 impurity, such as phosphor or arsenic.
20 And going on to Slide 88, Greenthread's figures, which also show
21 an NMOS device in a P-type substrate, according to Greenthread, this also
22 has this claim requirement. Because as you see here on the lower right in
23 their Patent Owner Response, they emphasize that the claim invention is
24 clearly disclosed in Figures 5B and 5C of the challenged patent. So Figures

1 5B and 5C of the patent, as you see here, that's the same situation we saw on
2 Slide 87 in Kawagoe.
3 And now moving on to Slide 89, Greenthread's argument
4 against this limitation has been sort of a moving target from our point of
5 view. Regardless, they ultimately hinge on flawed claim construction. First,
6 in their Patent Owner Response, they seem to be suggesting that a second
7 doping type needs to be distributed throughout the entirety of what we
8 identified as a first active region.
9 So we identified the source, drain, and channel in between the
10 source and drain as the, quote/unquote, "first active region", which is
11 consistent with the plain and ordinary meaning of that term. And
12 Greenthread argues that we haven't shown that that channel portion of the
13 first active region includes the second doping type, but the claims don't
14 require that. As I showed you, it's sufficient that, you know, the word is
15 "with". A first active region with a second doping type, so it's sufficient that
16 just a source and drain regions of the active region have the N-type dopants.
17 In their sur-reply, they now seem to inject some sort of a temporal
18 requirement that sort of, again, miscasts a limitation as a method step rather
19 than a structural limitation. They suggest that the source and drain region
20 are not part of the first active region, as we understand, that's the suggestion
21 they're making. They're saying that instead, the source and drain are formed
22 later in the active region. That does not square with, you know, the fact that
23 the claim is to a device, not a method. And even their own expert, you
24 know, as you see here on the right, admitted that the source and drain

1 regions are part of the active region.
2 So we think what we presented in the Petition is sufficient and in
3 case the Board happens to agree with Greenthread's claim construction
4 argument, then meaning that the second doping type must be in the channel
5 region of the first active region, even in that situation, Kawagoe still satisfies
6 the claim requirement because specifically, as shown on the left here, the
7 PMOS transistor 4P, would meet the first active region with a second doping
8 type under that construction. The PMOS is formed in an n-well 6N. There,
9 you still have the P-type substrate here at the bottom, and now you have the
10 N-type dopants in all parts of the active region that we've identified here,
11 source, drain, and channel.
12 Greenthread is going to complain that this is an improper new
13 argument and that's wrong. The Federal Circuit made clear of this in
14 *Axonics, Inc. v. Medtronic, Inc*. in 2023, that's 75 F.4th 1374, where the
15 Federal Circuit held that where a patent owner and IPR first proposes a
16 claim construction in a Patent Owner Response, a Petitioner must be given
17 an opportunity to reply and to argue and present evidence of invalidity
18 where it relies on the same embodiments as it did in the Petition. That's
19 precisely the circumstance here.
20 JUDGE ULLAGADDI: Mr. Paul, can I ask a question about that
21 Slide 90?
22 MR. PAUL: Sure.
23 JUDGE ULLAGADDI: So there's an n-well, there are P active
24 regions -- P doped active regions, and then the channel region, that's not an

1 N-type channel region?
2 MR. PAUL: So the -- what's important to note is the type of
3 dopant, so this is an n-well and there will be N-type dopants throughout the
4 entirety of the well. Later on, you dope P-type dopants into the source and
5 drain regions specifically. The channel region, if -- when the device is
6 turned on, there will be a conducting channel. There will be electrons
7 flowing in that channel. That's a separate issue from what's the doping type
8 of that region that's in between. That channel region is still doped with N-
9 type dopants.
10 JUDGE ULLAGADDI: Okay. So couldn't that same thing happen
11 in the p-well that's an N-type source and drain, it's a P-type channel. Once
12 you add a bias or threshold voltage, it produces electrons, and therefore, acts
13 as an N-type semiconductor?
14 MR. PAUL: So this is what -- yeah, so in the scenario, you're
15 asking about the NMOS on the right?
16 JUDGE ULLAGADDI: Mm-hmm.
17 MR. PAUL: The p-well is just -- the well is a p-well. The source
18 and drain are -- have N-type dopants. And then when the NMOS is turned
19 on, you have electrons flowing from source and drain. That's due to an
20 inversion layer that's created in that channel region, but our expert explains
21 this in his supplemental declaration, Exhibit 1060. That is a separate issue.
22 The conducting channel doesn't change the type of dopants that are doping
23 in this region.
24 JUDGE ULLAGADDI: Okay.

1 MR. PAUL: So it's still going to be P-type there.
2 JUDGE ULLAGADDI: Thank you. That helps.
3 MR. PAUL: Did that satisfy your question?
4 JUDGE ULLAGADDI: Yes.
5 MR. PAUL: Okay. So in the interest of time, you know, the
6 isolation region, we demonstrated why this is -- I think we can rely on our --
7 stand on our briefing on this term, unless the Board has any specific
8 questions on this issue. If not, I'll just note that this is, again, we presented
9 an argument that even under the -- appears to be a new claim construction
10 position that the Patent Owner has offered for the first time in its Patent
11 Owner Response, that there needs to be complete physical separation at all
12 points, at all depths of the isolation region, that even under that narrowing
13 construction, you know, the same embodiment, the Board can consider
14 Kawagoe's explicit disclosure of a channel stopper region in combination
15 with a field insulating film (3) gives you that isolation region, even under
16 that narrower construction, and providing that that argument is not an
17 improper argument. Unless the Board has any questions, I'll just briefly
18 address the licenses that Greenthread relies upon for objective indicia of
19 non-obviousness and --
20 JUDGE ULLAGADDI: Counsel, just to confirm, you're not going
21 to be discussing anything confidential, correct?
22 MR. PAUL: That's correct. And I just -- at a very high level, the
23 fact that our patent has been licensed, taking a loan is generally insufficient
24 for purposes of showing commercial success. It is the Patent Owner's

1 burden, if they're relying on licenses as objective indicia to demonstrate
2 nexus. So they don't have that in this case. What they rely on is just
3 basically speculation. They say that it's -- they try to flip the burden onto the
4 Petitioner as to two of the licenses that were not due to litigation --
5 specifically due to litigation, litigation settlements. They speculate that the
6 claimed invention must be the only reason for entering the license because
7 those two entities chose to enter a license without having been sued.
8 Petitioners cannot provide any other explanation for why those two entities
9 would've entered into the licenses. Well, that's not our burden. That's our
10 position. It's their burden to make a prima facie showing of nexus and they
11 rely on, you know, a *Fox Factory* decision that was later overturned by the
12 Federal Circuit. And as to those two licenses, you know, it was made
13 through RPX that's a well-known third-party organization. Their goal is to
14 help minimize litigation costs or potential litigation costs. So that's all I
15 have to say on these issues, unless the Board has any further questions.
16 We'll -- Petitioners reserve the remainder of their time for rebuttal.
17 JUDGE TORNQUIST: I have -- this is Judge Tornquist. I have
18 one quick question. On the nexus issue, it looks like possibly what they
19 were arguing was that the one thing that's missing from the prior art in their
20 perspective is this aid carrier movement, and that's exactly what these
21 patents are discussing. So it seemed like that's how they were trying to
22 prove nexus here. How do you respond to that?
23 MR. PAUL: Well, I, you know -- we asked -- two things. Number
24 one, we asked -- we deposed their expert. They provided -- not their expert.

1 The inventor who provided a declaration. He lacked the foundation to
2 discuss why -- what were the circumstances under which those licenses were
3 granted. You know, he didn't discuss anything with anybody. He had no
4 idea about what the motivations were. In terms of whether you can
5 speculate as to why the, you know, they entered those licenses and it's to the,
6 you know -- the -- each of the -- the aid carrier movement. First of all, you
7 know, they're relying on the exact same set of evidence for all of the patents
8 that are issued in these proceedings, and the case law says that's not
9 sufficient. Each claim is different and you have to show nexus, and so nexus
10 has to be done to each of the sets of claims, and they haven't done that, and
11 that's our position. Unless there's any further questions, we'll reserve our
12 time.
13 JUDGE ULLAGADDI: Thank you, Counsel. Any further
14 questions for Petitioner's counsel? Okay. You have about 15 minutes
15 remaining in rebuttal time. All right. Returning to Patent Owner's Counsel,
16 Mr. Whitehurst. Would you like to reserve any time for rebuttal?
17 MR. WHITEHURST: Yes, Your Honor. We'd like to reserve 15
18 minutes. We plan to use 15 -- or 75 minutes in our opening arguments.
19 JUDGE ULLAGADDI: Okay. When you're ready, you may
20 begin.
21 MR. WHITEHURST: Well, may it please the Board. I'm going to
22 start with Patent Owner's Demonstrative 3. Hopefully, you have it there on
23 the screen in front of you, and today, and I'm going to be using my mouse as
24 a pointer. Hopefully, you can see that. I'm not sure if it's coming across.

1 Are you able to see my mouse?
2 JUDGE TORNQUIST: Yes, we can, but maybe move it very
3 slowly. When it moves fast, we can't see it.
4 MR. WHITEHURST: Thank you, Your Honor. I'll do exactly
5 that. We just heard a lot of argument about Kawagoe and Wieczorek. These
6 references are not new to you. You already know them quite well. I'm not
7 going to go back through them and rehash things you already know, but I am
8 going to show why the Petitions are flawed and why the Petitioners have not
9 met their burden.
10 And here on Demonstrative 3, you see an overview of the issues.
11 While these are not numbered, I just want to give the panel a quick road map
12 of the issues that I'm going to be covering today. The first bullet, issue one,
13 I'm going to start by showing that all of the claims require carrier movement
14 from the active region, and why this is an important part of Dr. Rao's
15 invention.
16 Next, issue two, I'm going to show you the testimony of
17 Petitioner's expert. Not Patent Owner's expert, but Petitioner's expert, Dr.
18 Banerjee. Even Petitioner's expert, Dr. Banerjee testified that in order to
19 move carriers from the active region, there must be an electric field that
20 starts or ends in the active region. In his own words, he said numerous
21 times, the electric field must be, one, in the correct location, and two, it must
22 point in the correct direction. And that's something I'm going to show you
23 here shortly.
24 Next, issue three, I'm going to show you why this is a problem for

1 the Petitioners. The Petitioners never identified an electric field, much less
2 one in the correct location pointing in the correct direction. Now, it would
3 be a very different situation if Kawagoe said it moves carriers from the
4 active region, but it doesn't. And it's the same situation for Wieczorek. In
5 the absence of a statement saying that these carriers move from the active
6 region, Petitioners had to at least identify an electric field, but they didn't.
7 I'm also going to show that, you know, Petition doesn't show this
8 electric field. Instead, they mention certain portions of the prosecution
9 history. And the Board mentioned these prosecution related arguments in its
10 institution decision. Now, you know that Patent Owner disagrees with these
11 arguments, but even if you side with the Petitioner on this issue, which I --
12 I'm going to show you why you should not -- but even if you do, Petitioner
13 still did not meet its burden. Why? Because even if there's a built-in field,
14 Petitioner never identified where the electric field is located and what
15 direction it's pointing.
16 Now, anything you heard today from Petitioner's Counsel about
17 the location or direction of the electric field is new argument. That's why we
18 made the objections that we did. You saw some slides with --
19 JUDGE ULLAGADDI: Counsel --
20 MR. WHITEHURST: -- blue -- yes, Your Honor?
21 JUDGE ULLAGADDI: I just -- as a placeholder for when you get
22 to this, Counsel -- Petitioner's Counsel did point to Declaration Exhibit 1060
23 from paragraphs 1 to 22 as support for where the -- what direction the
24 electric fields are pointed in. So when you're ready, if you could explain

1 why that's not sufficient, that would be very helpful to us.
2 MR. WHITEHURST: Absolutely, Your Honor. You predicted
3 where I was going to go next. And as you see, these arrows have been
4 added to Slides 32 and some of the following slides. We then conferred with
5 Counsel about this issue yesterday. When you look in the Petition, you can
6 look everywhere. You will not find this electric field. When you look in the
7 briefing, you will not find this blue arrow. When you look in Exhibit 1060,
8 you will see some general discussion about decreasing or increasing, but
9 you'll never see a discussion of Kawagoe. There's general discussion, which
10 doesn't appear in the briefs. We believe it's improper incorporation by
11 reference. They never in their Petition or any of the briefings said where the
12 electric field is in Kawagoe or Wieczorek, and then what direction it would
13 point.
14 When they cite to Exhibit 1060, if you look through it, you will not
15 find anything that looks remotely like what you see here on Slide 32. You're
16 certainly not going to see this blue arrow, and you're not going to see any
17 discussion that is specific to Kawagoe. Now, even if you allow Petitioners
18 to make a new argument about this blue arrow, which doesn't appear in the
19 Petitions, it doesn't appear in any of the briefing, and it doesn't appear in
20 their expert's declaration -- even if you allow them to rely on this blue arrow,
21 they still did not show that this blue arrow would've moved carriers from the
22 active region. And I'm going to get to that. You see here they've drawn a
23 blue arrow and they've indicated certain electrons.
24 Well, guess what? These electrons are not in the active region. To

1 the extent they're allowed to make a new argument, rely on this blue arrow,
2 they still haven't shown movement from this purple shaded region. If
3 anything, they've shown movement from the p-well, to the p-well, or from
4 the substrate to the substrate. They still haven't met their burden of showing
5 movement from the active region. And I'm going to go --
6 JUDGE ULLAGADDI: So --
7 MR. WHITEHURST: -- into that in some more detail. I'm sorry?
8 Was there a question?
9 JUDGE ULLAGADDI: I'll let you go into it in more detail before
10 I ask my questions.
11 MR. WHITEHURST: Certainly. And if you do have a question,
12 I'm more than happy to address it. Going back to the overview, I do want to
13 keep things moving. You'll see that issue four here. I'm going to show you
14 why the active region is different from the rest of the p-well, to the extent
15 they're pointing to the p-well and showing movement. In the p-well, that
16 still doesn't mean that the carriers in the active region are going to do the
17 same thing as they would deeper in the substrate.
18 Dr. Banerjee, Petitioner's expert, explained during his deposition
19 that the active region is affected by fields from the gate and the gate-oxide.
20 Now, I'm sure you're familiar with transistors. The gate and the gate-oxide
21 are what's at the top of the active region. He explained that they create fields
22 in the active region that don't exist in other parts of the substrate, and that the
23 active region is going to act differently from other parts of the
24 semiconductor, and that's an extremely important point that I'm going to go

1 into more detail. And I'm going to show you exactly what he said.
2 Now, I don't know if you can see my cursor, but if we go to bullet
3 five, the next point that I'm going to cover is Dr. Banerjee, Petitioner's
4 expert, confirmed that carrier movement depends on the sum of all of the
5 fields in the active region. In his words, he referred to it as a vector sum and
6 he explained that the gate and the gate oxide are going to mean that things
7 are different in the active region than they are in different places.
8 Now, this is something that I'm sure you're aware of and I can
9 probably go through this very quickly, but we know that Petitioners have the
10 burden. There's no burden shifting in an IPR proceeding like this, and they
11 have the burden to analyze all of the fields in the active region. In the
12 absence of expressed teaching in Kawagoe and Wieczorek, they needed to
13 identify the electric field, indicate what direction it points, and take into
14 consideration the other fields, like the gate and the gate-oxide, and they
15 never did this.
16 The gate and the gate-oxide fields are not theoretical, hypothetical
17 fields. These are very real fields that you see in semiconductor devices.
18 Dr. --
19 JUDGE OBERMANN: Counsel? Counsel? I'm sorry. This is
20 Judge Obermann, but you're starting to spout off technical facts without a
21 slide in front of us that refers us to evidence in the record. Could you please
22 tether your arguments to slides that demonstrate that your arguments are
23 actually in the record?
24 MR. WHITEHURST: Absolutely, Your Honor. I will --

1 JUDGE OBERMANN: Thank you.
2 MR. WHITEHURST: I will do exactly that, and thank you. I
3 certainly want to be as helpful as I can, and I will do exactly that. But you
4 can see, I'm also going to address that he did not analyze these fields. I'm
5 also going to address the prosecution related arguments, why they don't say
6 what Petitioner's Counsel said. In light of Petitioner's representation, I don't
7 think I need to go into Brownian Motion in detail, but I do plan to address
8 why Kawagoe does not meet the second doping type. And if we have time,
9 we'll address some credibility issues and improper coaching that occurred
10 during Dr. Banerjee's deposition, as well as second substantial evidence of
11 objective indicia of non-obviousness.
12 With that, I'm going to go to Slide 4 and turn to the first point.
13 Looking at Slide 5, you'll see here on the screen, a representative claim from
14 each of the patents at issue today. You'll see highlighted in green a carrier
15 movement. This language appears in all four of the representative claims
16 you see here on the screen. Now, the claims don't just say, aid carrier
17 movement, period. They don't say, aid carrier movement downwards. They
18 say something different. They say, aid carrier movement from. All of the
19 claims have this preposition 'from'. And you'll see that in the first
20 representative claim on the left, Claim 1 of the '481 patent, it says,
21 specifically from the -- excuse me -- it says, from the first surface.
22 Now, if you look at the red underlining up above, you'll see that
23 the first surface is where the first active region is. So you see here in the
24 claim that it's talking about aiding carrier movement from the first surface or

1 the first active region. If we move to the right here on Slide 5, you'll see the
2 same or similar language in Claim 1 of the '842 patent. Once again, we see
3 that there's movement from the first surface or the first active region. We go
4 to the '014 patent and more specifically, Claim 1, you'll see that it says,
5 movement from the first and second active regions, and then we see the
6 same language in Claim 1 of the '222 patent.
7 Now, why is this important? Well, this is the core of Dr. Rao's
8 invention. If you look at Slide 6, what we just saw in the claims is entirely
9 consistent with Dr. Rao's patent specification. Here in Column 3 and
10 Column 4, you can see the problem that Dr. Rao was trying to solve. He
11 mentions in his specification -- you'll see it highlighted in green here -- the
12 spurious minority carriers and the unwanted carriers. Now, where are these
13 spurious minority carriers and the unwanted carriers? They're at the surface,
14 and because they're at the surface, they're interfering with the active circuity
15 of the surface.
16 So you can see here, Dr. Rao was concerned with a problem that's
17 very different from Kawagoe and the other references. He was concerned
18 about what was happening in the active region, and that's why, if we go to
19 the next slide, Slide 7, you'll see that Dr. Rao specifically mentions moving
20 these minority carriers -- and you'll see the preposition 'from' circled in red --
21 from the active circuitry at the surface into the substrate. You see similar
22 language in Column 4. Once again, we're sweeping those carriers away
23 from the surface. This is exactly what we see in the claims, as well.
24 Now, if we go to Slide 7, Figure 5B is illustrating what we first

1 saw in the claims, and then we saw in Columns 3 and 4. You'll see here that
2 Figure 5B shows how an electric field moves minority carriers -- and I'll
3 explain in this example. It's a positively charged hole. It's not just moving it
4 anywhere. It's moving it from the active region at the surface and that's
5 what --
6 JUDGE ULLAGADDI: Counsel, can I ask a question about this?
7 MR. WHITEHURST: Yes, Your Honor.
8 JUDGE ULLAGADDI: So the minority carriers here are going to
9 be the opposite of what this area, the purple area, is doped. And I believe it's
10 positively doped; is that not correct? Because it's in a p-well.
11 MR. WHITEHURST: You are correct that in NMOS, you'll see
12 here a heavily doped N-type region, a source and a drain. I wish you could
13 see my cursor. I'm not sure that you can, but this would be an example of an
14 NMOS transistor. And an NMOS transistor needs to sit in a p-well. Why
15 does it need to sit in a p-well? Because that's how you turn it on and off.
16 This N doped source and drain are separated by a P region. If it was NNN, it
17 would always be on and it wouldn't operate properly.
18 So when Dr. Rao wrote his patents, he described when you turn
19 this transistor on, what flows between the source and the drain. In an
20 NMOS transistor, these will be negative charged electrons. That means
21 those are the majority carriers. The hole here is the minority carrier and
22 you'll see that this all makes perfect sense when you properly read Dr. Rao's
23 patents. The majority carrier that flows between the source and the drain is
24 an electron. The minority carrier is what's messing up the channel and that's

1 why the graded dopant region wants to pull this hole, which is a minority
2 carrier, away from the surface so that this NMOS transistor can turn on.
3 How do we know this is true? Well, we know that holes move in
4 the same direction of an electric field. If you were to say, oh, no, the
5 minority carrier is an electron, well it would go in the opposite direction. So
6 we know from Dr. Rao's specification, when he said majority carriers, he
7 means what's flowing back and forth from the source and the drain, and the
8 minority carrier here, which is a hole, is going to move in the same direction
9 as the electric field. Now, remember, it's not just moving anywhere. It's
10 moving from the active region to somewhere else. And I'm going to show
11 you why that doesn't happen in the prior art. Now --
12 JUDGE ULLAGADDI: So I just -- I want to make sure that I
13 understand Patent Owner's -- because this is directly opposite to Petitioner's
14 Counsel position, and both of the -- both of the parties have mentioned that
15 this is a topic of basic physics. So we're going to want to get to the bottom
16 of this, but the electric field moves minority carriers. If this channel is P
17 doped -- it's a channel in a p-well, then the minority carriers are holes -- or
18 not holes, are electrons. Sorry. The holes are the majority carriers. So why
19 aren't we talking about that?
20 MR. WHITEHURST: That's where Petitioners are wrong. They're
21 reading or making an argument that's inconsistent with Dr. Rao's
22 specification. When he was talking about majority carriers and minority
23 carriers, you know, carriers carry charge. He was talking about what flows
24 back and forth between the source and the drain. You -- I can -- Your

1 Honor, I can tell from your question that you understand that this channel
2 when it's in an on state is going to have electrons flowing back and forth
3 from the source and the drain. That's how we know that the electrons are the
4 majority carriers because Dr. Rao described -- he used the term to describe
5 what's flowing between the source and the drain.
6 Petitioner, for some reason -- we pointed this out in our briefing --
7 wants to read it in terms of the well, but that's not how Dr. Rao used the term
8 in his specification. He used the term --
9 JUDGE ULLAGADDI: Can you show us where that is, please?
10 MR. WHITEHURST: Yes, and I will get that for you, but it would
11 be most likely in Column 3. Bear with me. We see in line 19, he's talking
12 about minority carriers and if Your Honor will allow me, I will certainly get
13 this information for you. I know that it came up extensively in the -- Dr.
14 Banerjee's deposition, but you can see, for example, in Column 3, lines 39,
15 40, it's talking about electrons can be swept from the source to the drain.
16 You can see there that the electrons are the majority carrier. Those are what
17 are going from the source to the drain.
18 In the holes, the spurious minority carriers, which are mentioned in
19 line 38, are what are interfering with the electrons moving from the source
20 and the drain. So you see there in Column 39, the unwanted carriers are the
21 holes because you want the electrons to go back and forth between the
22 source and the drain. What you don't want are the unwanted carriers that are
23 mentioned in line 49. And that's why you see in Figure 5B that you're
24 pulling these unwanted minority carriers. If you drop down now to Column

1 3, line 62, it says you create a drift field to sweep these unwanted minority
2 carriers away from the active circuitry at the surface. You do want to turn
3 the transistor on and you do want to create a channel of electrons.
4 What you don't want are these unwanted spurious holes collecting
5 at the surface. And that's why Dr. Rao describes here further in Column 3,
6 line 64, that you're going to sweep the minority carriers deep into the
7 substrate. And you're going to sweep the holes away from the surface.
8 Now, you can see from the figure itself that it can't be an electron, because
9 let's say, for the sake of argument, you put an electron in Slide 8 where you
10 have the green positive hole. It's not going to move deeper into the
11 substrate. It's going to go in the wrong direction. So that confirms that what
12 you're talking about here -- the only way the electric field shown in Figure
13 5B is going to pull the minority carrier down is if you're talking about a hole.
14 So when you look at Dr. Rao's description that I just went through
15 with you and then you look at Figure 5B, there is only one reasonable
16 rational conclusion that the majority carriers here are the electrons that form
17 the channel between the source and the drain, and the minority carriers are
18 the holes, the unwanted holes that are collecting at the surface and
19 preventing the channel from forming. I know this is very complicated, but I
20 greatly appreciate your question because this is something that we tried
21 extensively to clear up in the briefing. We've made this point extensively,
22 and it's a very complicated point, but it's very key to why Kawagoe does not
23 do what Dr. Rao claimed and why it is not a proper foundation reference for
24 obviousness.

1 Kawagoe was never concerned about moving a hole or an
2 unwanted carrier from the surface. Kawagoe was concerned with a very
3 different problem, keeping SEU electrons deep in the substrate, out of the p-
4 well. And I have some slides on this that I want to get to, if that pleases the
5 Board, because I'll show you why the SEU electrons had to stay in the deep
6 part of the substrate. Because if they came up into the p-well, the p-well
7 would no longer be a p-well. If you have SEU electrons flooding the p-well,
8 it would turn into an n-well and now the NMOS transistor would never work
9 the way it was intended. It would always be on.
10 But you can see here from Figure 5B and the statements in the
11 specification why Dr. Rao was concerned with a completely different
12 problem, and he claimed something completely different from what
13 Kawagoe is doing. I am now going to try to get to the slides about Kawagoe
14 as quickly as possible, but before I do, I just want to highlight for the Board
15 what Dr. Banerjee -- this is not our expert, this is Petitioner's expert -- said
16 about electric fields. I'm now am showing Slide 10 and you'll see that Slide
17 10 has paragraph 28 from Dr. Banerjee's declaration and he's discussing the
18 Kamins reference that the Board knows very well. This is Figure 3 from
19 Kamins, and to assist the Board, I've highlighted in yellow the two electric
20 fields that are formed in Figure 3.
21 And Kamins and Dr. Rao during prosecution were talking about
22 these minority carrier holes, just like I just showed you in Figure 5B, but this
23 reference was distinguished during prosecution and I'll show you why. But
24 more importantly, I'm going to show you why Petitioner's own expert

1 explained that an electric field alone, a built-in field, which they contend
2 exists, is not going to meet -- necessarily meet the claim language. You can
3 have an electric field that does not move carriers from the active region, and
4 that's exactly what we have in Kawagoe.
5 Going to Slide 11, you'll see here -- I want to properly set the
6 stage -- that Dr. Banerjee testified on page 256 of his deposition that the
7 active region is going to be -- if you look here, you'll see that the X axis is
8 measuring how deep you are in the substrate. You have here zero and Dr.
9 Banerjee testified that the active region would be somewhere between zero
10 and where this curved line 26 intersects the X axis. So you'll see this purple
11 box is where Dr. Banerjee explained the active region is.
12 Next, on Slide 12, I asked him about the flat region here, which has
13 been shaded green. Looking at Slide 12, you'll see that the dopants are flat
14 below the active region before you get to this curved line 24 where it
15 increases. And he testified there should not be any built-in electric fields in
16 that flat region.
17 Next, on Slide 13, I asked him about the electric field that's
18 highlighted in yellow. And I asked him, do you agree that the electric field
19 ends before the active region and he testified yes. Going to Slide 14, I asked
20 him, is this electric field here going to aid carrier movement from the active
21 region -- and if you look at Slide 14, he's going to give not one, but two
22 answers, why it is not going to aid carrier movement from the active region.
23 Looking at Slide 14, he answered, the electric field doesn't extend
24 all the way to the surface. Therefore, there cannot be any drift velocity of

1 the holes due to that electric field. So he's saying this electric field, which is
2 pointing upwards, is in the wrong location, but look what he said next on
3 Slide 15.
4 He said, even if it did extend all the way to the surface, it points in
5 the wrong direction and will cause the holes to move towards the surface.
6 He confirmed that not only is this electric field in the wrong location, it's
7 also pointing in the wrong direction. Well, we can go to Slide 16 and you
8 can see where I asked him about the other electric field.
9 This electric field is pointing down, and I asked him specifically on
10 pages 268 through 269, which you see on Slide 16, whether this electric field
11 here would move carriers from the purple shaded active region, and you can
12 see what Petitioner's expert said. Petitioner's expert said it is too far away
13 from the active region and therefore, will not have any impact in terms of
14 drift motion of the holes on the active region towards the substrate. I want
15 you to remember this answer because we're going to see the same thing in
16 Kawagoe.
17 You know, if the electric field is not in the right location, it's not
18 going to move carriers from the active region. If the electric field is pointing
19 in the wrong direction, it's not going to move carriers from the active region.
20 So as I mentioned, Dr. Banerjee testified extensively. I mean, it's not like
21 there was any ambiguity during his declaration. He testified at length about
22 this point.
23 On Slide 17, you see some experts from pages 272 to 274. And in
24 Dr. Banerjee's own words, which you see on Slide 18, he said, yes, you need

1 to know the direction and the spatial location. This is something you're
2 going to see throughout my presentation today. You have to know, not only
3 the direction, but also the location of the electric field.
4 Now, this is what I told you is a problem, when you have a
5 reference like Kawagoe or Wieczorek that's silent about what the carriers do
6 in the active region. At a minimum, you need to identify where the electric
7 field is and what direction it points, and Petitioners never did this. If we go
8 back and look at the Petition, you'll see here on Slide 20, we're looking at the
9 overview of Kawagoe on Slide 20. It's from the Petition, pages 12 to 13.
10 They mention a graded dopant concentration and they've highlighted in this
11 orange color, graded concentration. Well, that's not sufficient.
12 We just saw in the Kamins reference a graded concentration and
13 we even saw two electric fields, but Dr. Banerjee, Petitioner's own expert,
14 explained why you can have a graded concentration. You can even have
15 electric fields and it's still not going to meet the claim language, and the
16 requirement of moving a carrier from the active region. And if you look at
17 Slide 21, you'll see the Petition mentions the dopant concentration. They
18 even mention the downward slope, but not once do they say where the
19 electric field is located and what direction it's pointed.
20 The Petition is silent on the two points that Dr. Banerjee said you
21 have to know in order to know whether a carrier is going to move from the
22 active region. You have to know where the electric field is located and you
23 have to know what direction it's pointing, and this is not in the Petition. And
24 that's why, you know, we've said from the outset that in the absence of

1 teaching, you have to explain where the electric field is, how is it going to
2 move carriers from the active region like the claims require. If we go --
3 JUDGE TORNQUIST: This is Judge Tornquist. Can we go back
4 two slides? Yeah, to that one. The thing -- you had it. One more. The one
5 with the actual graded dopant. Yeah. But we know the graded dopant is the
6 highest at the surface and descends all the way through down through the
7 well and into the substrate on that figure, and we know this is a p-well. So
8 we know absent something else happening here, we have the field, we know
9 which direction it's facing, and maybe it didn't explicitly say that in the
10 petition, but Mr. Banerjee did in his reply declaration, that we know which
11 way this field is going to face, we know minority's carriers -- if they're
12 electrons -- are going to go away from the field, so they are going to be
13 swept down. I'm really confused about what we're missing here.
14 MR. WHITEHURST: And respectfully, we disagree that they
15 properly pointed out where the electric field is, but I will certainly address
16 this point, Your Honor. Dr. Banerjee explained that the active region is
17 completely different from the rest of the p-well, that what happens in the
18 active region has a gate field. It has a gate-oxide field. And when you look
19 at Kawagoe, what Kawagoe was trying to do was preserve the integrity of
20 the p-well. If these -- and I have some slides on this that show it much better
21 than this slide. If the electrons, the SEU electrons, move into the p-well, it's
22 no longer a p-well. Now, I'm going to explain why whatever Kawagoe is
23 doing, they were not trying to prevent non-SEU electrons. And I want to be
24 clear. I'm going to address the SEU lightning -- electrons that come from

1 the lightning strikes, and then the electrons that are in the p-well. I'm going
2 to address both.
3 The electrons in the p-well are what are used to form the channel.
4 There was no reason to sweep or pull them away. It's the opposite of what
5 Dr. Rao was describing and claiming in his patent, and I certainly do want to
6 address that point, that whatever Figure 17 is doing, it was intended to
7 preserve the integrity of the p-well. It was not trying to keep the electrons
8 away from the surface, because if it did that, you can't turn the transistor on,
9 and that's a very different situation from what we see in the claims. And
10 hopefully, I can go through that and show you in more detail why what
11 happens where the electrons are produced is different from what occurs in
12 the purple shaded active region.
13 Looking at Slide 24, you can see here that, you know, as I
14 mentioned, you have to know where the electric field -- where it's acting on
15 the carriers at issue, and you have to know that it's pointing in the correct
16 direction. Why do you have to know it's pointing in the correct direction?
17 As you see here in Slide 25, you will see that Dr. Banerjee explained during
18 his deposition that holes move in the direction of the electric field, electrons
19 move opposite. So if Petitioner had identified in its Petition what direction
20 the field was pointing, it would've been a very different situation, but they
21 were silent on this point, and absent some identification of where it would be
22 located and what direction it's pointing, they haven't met their burden of
23 showing that Kawagoe would move carriers from the active region.
24 And this brings me to the slide that I was mentioning, Your Honor.

1 You know, we heard about lightning strikes. Well, we heard a different
2 answer today than what's in the Petition. In the Petition, if you look at page
3 32 and more specifically, footnote 10, you'll see that the Petition is talking
4 about the electrons produced by the alpha ray. Now, these electrons are
5 sometimes referred to as SEU electrons. SEU stands for sudden event upset,
6 such as a lightning strike. And footnote 10 here is explaining that when you
7 have a sudden upset event, like a lightning strike, that the electrons created
8 by the alpha ray are going to be in the substrate body below the wells, and
9 that's what you see here on Slide 26.
10 You have these electrons in the white space, which is in the
11 substrate body below the wells. In this example, Petitioner shaded the active
12 region purple, the p-well green, and according to their own footnote 10 on
13 the Petition, page 32, these SEU electrons are going to be in this white space
14 below the p-well. And if you go to Slide 27, you'll see that there's never any
15 mention anywhere in Kawagoe of moving an electron from the active region
16 shaded purple, and this is significant because I'm sure if Kawagoe had said,
17 move an electron, move a carrier from the active region, we would've seen
18 it, but that's not what Kawagoe says. You have to understand the lightning
19 strikes, the alpha rays, the problem that was Kawagoe -- that Kawagoe was
20 trying to understand to put everything in proper perspective.
21 When you read everything with the knowledge that it was
22 addressing this problem of these SEU electrons in the white area, you
23 understand what Kawagoe is saying here. And I'm reading from the bottom
24 of Column 15 and the top of Column 16. It's talking about the influence to

1 be caused by the carriers or electrons due to the alpha ray. These are the
2 SEU electrons.
3 And if you look at Slide 28, it doesn't say, you're moving an SEU
4 electron from the active region. It says something very different. It says,
5 these SEU electrons that you see on Slide 28 are prevented from entering the
6 p-well 6P. If we go to the next slide, we -- I know Your Honors are familiar
7 with this language. It says they're attracted to the substrate body 2S.
8 Kawagoe didn't have to use the word attracted. He could've said moved, he
9 could've said something else, but that was not the word choice. The word
10 choice is attracted and prevented. That's -- Kawagoe does not say that you
11 move an electron to the white space. What he's saying here is that you keep
12 the electrons in the white space. And when you say that they're attracted to
13 the substrate body 2S, it doesn't mean you're moving them there. It means
14 they stay there. They're prevented from entering the p-well.
15 Now, I want to walk through this and address each of these five
16 scenarios, so I can explain this in more detail. No matter how you read
17 Kawagoe, it does not disclose moving an SEU electron or any electron, for
18 that matter, from the active region. If we look over here on the left, you'll
19 see scenario one. This is what's really happening in Kawagoe. Over here on
20 the left, scenario one, Kawagoe was concerned with preventing SEU
21 electrons from entering the p-well. Why was Kawagoe trying to prevent
22 electrons from entering the p-well? So what?
23 Well, a p-well, we know, has more holes than electrons, so if all
24 these electrons flooded over into the p-well, it's no longer a p-well. Your

1 Honor, as we were talking about with Figure 5B, you would then have a
2 situation where you had a N-type source or a N doped, counter doped
3 source, and an N counter doped drain, and you would have a surplus of
4 electrons in the channel, and you would have an unfortunate situation where
5 the transistor is always on.
6 This is why Kawagoe says what it says. It is not concerned with
7 the active region. That was not something it was trying to solve. What it
8 was trying to do was preserve the integrity of the p-well, which has a surplus
9 of holes, by keeping the SEU electrons below the p-well. And if we look at
10 scenario two, it's similar to scenario one, but now we have an electron in the
11 white space below the p-well that moves even deeper into the substrate, but
12 this scenario two demonstrates why it's so important to know the location
13 and the direction of the electric field.
14 Here, the electric field is in the wrong place, and the SEU electron
15 is not moving from the active region. It's moving from the substrate to
16 deeper in the substrate. So you can have an electric field like Dr. Banerjee
17 explained in Kamins, but just because you have an electric field doesn't
18 mean that you're moving a carrier from the active region.
19 Now, if we move to the right on Slide 30, we'll see here scenarios
20 three and four. Now, as I mentioned, the whole point of Kawagoe was to
21 keep the SEU electrons out of the p-well. If they get into the p-well, which
22 it says it never happens, it prevents them, then it's not doing it's job. But let's
23 just say, theoretically, for the sake of argument, that you have an electron in
24 scenario three or scenario four, and you can see a similar situation to what

1 we saw in Kamins. Even if you had an electron theoretically in the p-well
2 moving in the direction shown in scenario three, or an electron theoretically
3 in the p-well like we see in scenario four, moving to the left in an upward
4 direction, neither one of these would meet the claim language. Neither one
5 of them would be moving a carrier from the active region like we see in the
6 claims.
7 Now, I'm next going to address scenario five. And to do that --
8 well, first of all, I'm going to explain why scenario five -- it's never
9 described in Kawagoe. This was not the problem that Kawagoe was
10 concerned with. It was trying to prevent the electrons from the p-well. It
11 never mentions the active region or trying to move any carrier from the
12 active region.
13 Now, Petitioner has argued, well, there are other electrons. Well,
14 I'm going to explain whether you're talking about an SEU electron or a non-
15 SEU electron. In either situation, it doesn't make sense to say that
16 Kawagoe's Figure 17 would move a carrier from the active region. And to
17 do this, it's helpful to go to Slide 31, and this is complicated and I'll go
18 through it slowly. And if you have questions, certainly do not hesitate to
19 interrupt and I can go through it in more detail because this is an incredibly
20 important point and it shows why Kawagoe cannot possibly meet the claim
21 language at issue, and why Petitioners did not meet their burden.
22 So looking at, side by side, Figure 17 on the right and Figure 23 on
23 the left, you'll see that you have a transistor 4N and it's in a p-well. You can
24 see here in the lower left, you have a P, and Petitioner, in Figure 17, has

1 shaded it green, and you can see it's also shaded green on the left in Figure 3.
2 Now, transistor 4N means that there is a source and drain, and this is going
3 to be important later when I get to the other reason why Kawagoe fails, but
4 the active region where the transistor 4N is built is a p-well. That tells you
5 that the active region is P-type, and I'll get to that in a little bit.
6 So you have a P-type active region. If you look at the '842 claims,
7 it says the active region is where the transistor 4N can be or may be built.
8 So in order to build this NMOS transistor 4N in a p-well, you have a counter
9 doped, heavily doped, source and drain that have a surplus of electrons.
10 Now, in order to turn this electron -- excuse me -- in order to turn this
11 transistor on, you would apply a gate voltage to the gate -- I believe that
12 would be 4ND, as in David here -- in order to create a channel where
13 electrons would flow back and forth between the source and the drain.
14 So Petitioner has argued, well, there could be other electrons.
15 Well, it doesn't make any sense to say that Kawagoe would take Figure 17
16 and try to pull electrons away from the active region. If you did that, then
17 you can't turn the transistor on. You can't form the N channel between the
18 source and the drain in an NMOS transistor. When you understand what's
19 really going on here, you can see why it doesn't make sense to argue whether
20 it's an SEU electron or some other electron to try to move them from the
21 active region, because -- and the electrons of interest here that we're talking
22 about are what are used to form the channel between the source and the
23 drain.
24 Now, when you understand all this and you put it in proper

1 perspective, you can only come to one conclusion. That whatever Figure 17
2 is trying to do, it's not trying to move carriers from the active region. That
3 would prevent the transistor from turning on. What it was doing was
4 keeping them in the white space below the p-well so that you could preserve
5 the integrity of the p-well, keep this p-well with a surplus of holes, so that
6 the NMOS transistor could be used for its intended purpose as a switch that
7 you could turn on and off.
8 The only way for 4N to operate properly is to have a heavily doped
9 N -- counter doped N region with a P region between it, and then another N
10 dope. So it goes NPN. If it's NNN, it would be on all the time. If you
11 sweep all the electrons away, you can't turn it on. So you can see here that
12 this is very different from the problem that Dr. Rao was concerned with. It's
13 very different from the claims, it's very different from his specification, what
14 we looked at. It's very different from Figure 5B. Kawagoe was never trying
15 to move carriers from the active region. It was trying to keep SEU electrons
16 out of the p-well.
17 I know that my time is limited, so I want to get to some of the
18 other points, if there are no questions. On Slide 31, during Dr. Banerjee's
19 deposition, he testified that when you look at the active region, it's going to
20 be very different from the rest of the p-well because of these gate and gate-
21 oxide fields. And I asked him, I said, did you calculate the magnitude for
22 any of the electric fields, and he said, I did not calculate those.
23 Now, I don't want to belabor the magnitude and sufficiency
24 arguments, but I do want to highlight for the Board that when Dr. Banerjee

1 wrote his 2005 textbook, and it appears here on Slide 33, he talked about
2 when you look at an electric field, you need to look at the magnitude. I'm
3 going to get to the prosecution history and the reasons that Dr. Rao said,
4 depending on the slope, but you can see, we also saw it from the 30(b)(6)
5 witness, Mr. Warrick, and we even saw it from Dr. Banerjee himself that a
6 force may be insufficient -- you can see it circled here in red -- to alter
7 appreciably the random path of an individual electron. He, himself, said that
8 when you look at a field, you have to look at its magnitude, and he named
9 some other important points that you can't just look at one field in isolation.
10 You have to look at what he's going to refer to as the vector sum.
11 Looking at Slide 34, you see the 30(b)(6) testimony of Cirrus
12 Logics, Vice President of Technology, Mr. Warrick, and he says, just
13 looking at a gradient, you can't tell whether it would aid carrier movement.
14 And then you can see here on the right, additional testimony. He said, not
15 only can you just -- not only can you not just look and see whether it's
16 graded, you have to take into consideration other factors. He said there may
17 be over things that might affect carrier movement besides the gradient, and
18 this is a point that we've made extensively in our briefs, and we've said time
19 and time again. And you have Dr. Banerjee commenting on the sufficiency
20 of the force. You also have Mr. Warrick discussing it here during his
21 deposition, and then you have not one, but two District Courts that have
22 looked extensively at this issue.
23 On slide 35, the Western District of Texas held a claim
24 construction hearing, issued a claim construction order, where they looked at

1 the prosecution history and looked at terms like sufficiently graded -- or I'm
2 sorry, graded dopant concentration, and have issued an order that says, the
3 graded dopant concentration has to be sufficiently graded to result in a static
4 unidirectional electric drift field to aid the movement of minority carriers.
5 So you can see here the claim construction order commenting on what is
6 required by the claims. And we see --
7 JUDGE TORNQUIST: Counsel, can I ask just a quick question
8 about that? Was that statement made in the context of indefiniteness or
9 construing the claims?
10 MR. WHITEHURST: It was addressing, I believe, a 112
11 argument, but it was in the context of claim construction, and the Court
12 looked at -- and Your Honor, I'll check on that right now. We'll get a firm
13 answer for you. But one of the things I'm going to get to is when you look at
14 claim construction, we will -- I'm sorry -- when you look at a prosecution
15 history, the Federal Circuit is being clear that you look at prosecution history
16 and if anything, you narrow the claim scope. It says you don't look at the
17 prosecution history in order to expand the claim scope.
18 So when the Western District of Texas and the Eastern District of
19 Texas have looked at claim terms, either in the context of a 112
20 indefiniteness challenge, or whether claim construction, they've always
21 looked at it with an eye towards, as the Federal Circuit has instructed, if
22 anything, we narrow the claim scope. The Petitioner is trying to do the
23 opposite. They're trying to take out a context, a statement in the prosecution
24 history, and expand the claim scope, and that's exactly what the Federal

1 Circuit has cautioned against doing. And we're trying to get you a firm
2 answer, Your Honor, on whether it was a 112 or a construction on page 15 --
3 I'm sorry -- on pages 39 and 40 of Exhibit 2074, which is shown on our
4 Slide 35.
5 Moving on to Slide 36, you'll see here that the Eastern District
6 of Texas has noted that when you look at slope, it has both a direction and a
7 magnitude, and, you know, when you understand the math behind slope and
8 the direction of the magnitude, that Applicant was never saying that all
9 gradients are going to aid carrier movement. When they said it depends on
10 the slope, they meant just that, that you have to look at both the decline of
11 the slope and the magnitude of the slope, in order to determine whether
12 there's movement.
13 I heard no ifs, ands, or buts during Petitioner's argument, but as
14 they were saying those words, they were hiding the fact that the sentence
15 they were pointing to said it depends on the slope. And that's what you'll see
16 whenever you look at the prosecution history. And in the Samsung
17 litigation, the Court looked at the exact same argument and came to the
18 opposite conclusion, that when it says that depending on the particular slope,
19 that the slope is going to have both a direction and magnitude.
20 MR. MATICH: So Judge Tornquist to respond to your question.
21 The ED text order is in the context of actual claim construction. It's in
22 subsection 4A of the brief and the Plaintiff proposed no construction,
23 Defendants proposed a construction of a single drift layer having a graded
24 concentration dopant. The Western District one, I believe, may have been in

1 the context of an indefinitenessargument.
2 JUDGE TORNQUIST: Okay, thank you.
3 MR. WHITEHURST: But Eastern District was in the context of
4 claim construction. I certainly appreciate my co-counsel helping me out
5 there. I do know I have limited time today and I certainly want to make sure
6 that I hit my other points. But here you see here on Slide 38 that two courts
7 have agreed that the slope must be sufficiently graded in order to aid the
8 movement. With that, I want to look at our fourth issue, which appears on
9 Slide 39.
10 Dr. Banerjee confirmed during his deposition that carrier
11 movement depends on a number of factors. On Slide 41, you can see that he
12 specifically mentioned externally applied forces and built-in electric fields.
13 And you can see here on Slide 42 that Dr. Banerjee testified that the gate and
14 gate-oxide create fields that affect the movement of carriers in the active
15 region. This is important because when we look at what's in the Petition,
16 Petitioner's own expert has said, whatever happens deeper down in the p-
17 well is going to be different from the active region. And when the --
18 whether it, you know -- Kawagoe mentions keeping the electrons out of the
19 p-well, it never describes what happens further above, because that was not a
20 problem that it was concerned with, and it certainly never addresses the gate
21 and the gate-oxide, which create fields that affect the movement.
22 And Dr. Banerjee went on -- he went beyond just the gate and the
23 gate-oxide. Remember, this is not Patent Owner's expert. This is
24 Petitioner's own expert that testified at length that in order to determine

1 whether there's movement, you have to look at -- as you see here on Slide
2 42, the gate, the gate-oxide are in 43, temperature gradients, on Slide 44,
3 magnetic fields. There's a whole host of things at play here, which
4 Petitioner has never addressed.
5 You know, when you look at Slide 45, you'll see that Dr. Banerjee
6 testified that in order to determine movement, you have to look at all of the
7 fields. I mean, you have Petitioner's own expert saying exactly what we
8 have been saying all along. You know, when you have a reference, you
9 have to show that it's necessarily going to do it in all instances, but here, you
10 have Petitioner's own expert saying, you can't tell because you have to look
11 at all the fields.
12 And in the essence of time, keeping things moving, looking here at
13 Slide 46, you'll see that Dr. Banerjee confirmed that carrier movement
14 depends on the sum of all the fields in the active region. In his own words,
15 he said vector sum determines the net movement. On 48, he talked about the
16 multiple forces, the vector sum. You have to look at the vector sum to get
17 the net motion. You would think this was Patent Owner's expert making
18 these statements. No, this was Petitioner's own expert making these
19 comments that you see here on Slide 48.
20 And when you look at Slide 49, you see once again, it wasn't like it
21 was a one off answer on Slide 49. Petitioner's own expert is testifying that
22 you have to look at all these built-in fields, as well as externally applied
23 forces, in order to know whether there was carrier movement from the active
24 region. And this is Petitioner's own expert here saying that you've got all

1 these fields at play. You can see why it does not necessarily occur, and it's
2 certainly not inherent.
3 Now, if we go to Slide 50, in the essence of time, I will keep
4 moving forward, but you can see, it wasn't like this was a one-off comment.
5 This is Petitioner's own expert saying over and over again that carrier
6 movement depends on a host of things on the vector sum. And the only way
7 to know the net movement is to look at the vector sum.
8 Now, 51, I think I can move through this quickly, but Your Honors
9 know that the Petitioners have the burden here. There's no burden shifting.
10 Petitioners have the burden to show that the references would necessarily do
11 what they claim that it would do. But here, you have Petitioner's own expert
12 saying the exact opposite, why it would not necessarily occur. You can see
13 here why the Petitioner cannot possibly meet its burden. It was the
14 Petitioner's expert that was talking about the gate, the gate-oxide fields, the
15 other forces at play, why whatever is shown in Kawagoe or Wieczorek
16 would not necessarily do what the claim said.
17 When you look at Slide 53, you'll see that the prior art never
18 expressly mentions moving carriers from the active region. In the situation
19 that you have before you, Petitioners have the burden to at least identify an
20 electric field that's in the correct location. We saw from Petitioner's own
21 expert why the location of the field matters. When he was looking at the
22 prior art that was of record during prosecution, he explained why not one,
23 but two electric fields would not meet the claim limitation. Petitioners also
24 had the burden to identify an electric field that points in the correct direction.

1 They didn't do that and they certainly had a burden to analyze the gate, the
2 gate-oxide, and the other fields in the active region, which once again, they
3 did not do.
4 In the essence of time, I'm going to keep moving forward, but in
5 our demonstratives, on Slide 56, you'll see similar situations where the P tab
6 has consistently said that Petitioner bears the burden of proof and needs to
7 show a reasonable expectation of success. Petitioner has certainly not done
8 this here. Petitioner's own expert -- not our expert -- Petitioner's own expert
9 has said that you have all these different fields at play and explained why a
10 carrier in the active region would not necessarily do what the claims require.
11 Moving on to Slide 58, as I mentioned, Dr. Banerjee admitted
12 during his deposition that he did not analyze any of the fields in the active
13 region. If you look at Slide 59, you'll see Dr. Banerjee's testimony here that
14 when he looked at Kawagoe, he did not calculate the magnitude for any of
15 the electric fields. When you look at Slide 60, he admitted that he did not
16 calculate the magnitude for the electric field due to the gate or the gate-
17 oxide. If you look at 61, he explained why the electric field created by the
18 gate and the gate-oxide will affect the net electric field and the net carrier
19 movement.
20 So you see Petitioner's own expert here explaining all the reasons
21 why he can't possibly -- why Petitioner cannot possibly meet its burden of
22 showing that a carrier in the active region would do what the claims say. He
23 testified again on Slide 62, you see his testimony from pages 241 and 242,
24 where he admitted that he had not determined the starting point of

1 Kawagoe's electrons.
2 I do want to address quickly -- I'm not going to spend a lot of time
3 on Wieczorek. We already heard from Petitioner's Counsel why it doesn't
4 answer or plug any of the holes that we see in Kawagoe. So I'm not going to
5 spend a lot of time on Wieczorek, but looking at Slide 66, you can see that
6 Wieczorek itself, when describing reference number 200, it says, it's not
7 even necessarily graded. It may be that substantially uniform.
8 Moving on to Slide 67, I do want to address quickly Petitioner's
9 prosecution related arguments, and they also make an argument about claim
10 construction brief. I want to show why Petitioner is misreading both the
11 prosecution and the claim construction brief, and taking them out of context.
12 If we go to Slide 68, you can see that Kawagoe does not mention
13 electric field in the active region, and for the reason I've mentioned,
14 Petitioners have not identified such a field. This is why when you look at
15 paragraph -- excuse me -- Slide 69, you'll see on page 33 and then page 34
16 of the Petition, Petitioners are going to rely instead on a claim construction
17 brief -- that's what you see on the left -- and then a prosecution history on the
18 right. And I'm going to show why both of these are misrepresentations.
19 If you go to Slide 70, Petitioners cited to this claim construction
20 brief and said that Greenthread said that all graded dopant concentrations
21 will move carriers from an active region. That's not true. If you look
22 carefully at what Greenthread actually said, it did not say what Petitioner
23 said. It said something completely different. If you look on the right, you'll
24 see that Greenthread said the electric field must move the carriers from the

1 surface layer.
2 So the very brief that Petitioner was citing to, doesn't say what they
3 say it says. It says what I've been telling you today, that in order to meet the
4 requirements of the claims, the challenged claims at issue, you have to move
5 the carriers from the surface layer. That's not what's happening in Kawagoe.
6 Kawagoe is completely silent on this point, and Petitioner's own expert
7 explained all the reasons why it's not necessarily going to occur.
8 When you look at the prosecution history on Slide 71, again,
9 Greenthread never said that all graded dopant concentrations will move
10 carriers from an active region. I think Counsel's words were, no ifs, ands,
11 and buts, but as he was saying that he ignored this language right here,
12 depending on the particular slope. And we have no one, but two District
13 Courts that have noted that when you mention slope, it's both the direction
14 and the magnitude. And that's -- you see it not once, but then again on the
15 next page. It says it depends on the slope. You have to look at the slope in
16 order to determine whether carrier movement occurs.
17 Now, even if carrier movement occurs, it does not necessarily
18 mean that it's going to move from the active region to somewhere else, and
19 that's missing from all the prior art references and Petitioner has not shown
20 why it would necessarily occur, which they're required to do. They have the
21 burden. There's no burden shifting to us, the Patent Owner, to show that --
22 show this. It was Petitioner's burden. They didn't identify an electric field in
23 the Petition, they didn't mention it in the brief, in the declaration. They have
24 some general figures, but they certainly are not -- never annotated Kawagoe

1 or Wieczorek to show where the electric field is, and they certainly didn't
2 show its direction.
3 If you look at Slide 72, this is exactly what we've been saying all
4 along, that when you -- that not all graded dopant concentrations are going
5 to aid carrier movement, but here on Slide 72, it's not us telling you this. It's
6 Petitioner's own expert confirmed that, you know, as he explained, electric
7 field has to be in both, the correct location, and point in the correct direction,
8 and Petitioner didn't do either of these two things. Their own expert -- if we
9 go back to the prosecution history, you'll see that not only did Applicant say,
10 depending on the particular scope, but they also said from the surface layer.
11 And again, when you look at Petitioner's arguments, they've not
12 proven that anything in the prior art is going to move carriers from the active
13 region, like the claims require. They haven't identified the fields, location,
14 or the direction, like Dr. Banerjee mentioned on -- in the testimony of --
15 JUDGE ULLAGADDI: Counsel? You're at an hour and 15
16 minutes, unless you want to start eating into your rebuttal time.
17 MR. WHITEHURST: Let me look real quickly at the other slides.
18 I'm not going to spend any time on the Brownian Motion. I -- as I
19 mentioned in the beginning, there was improper coaching during Dr.
20 Banerjee's deposition. I don't think I need to go into that today and the
21 panel -- the Board is already familiar with the license agreements. So we'll
22 rest on the papers, but before I do, I do want to address an additional reason
23 why Kawagoe fails. This begins on Slide 80. If you go to 81, I will quickly
24 cover this.

1 You'll see highlighted in green that there must be an active region
2 with a second doping type opposite, but I want to flag an issue that Mr. Paul
3 overlooked. When you look at the claims of the '842 patent, Mr. Paul was
4 directing you to the source and the drain, but if you look at the '842 patent, it
5 says the active region within which transistors can be formed, and then it
6 says, a second active region within which transistors can be formed, and
7 then it says you form a transistor in one of them.
8 Why is this important? This is important because the claims
9 themselves say that an active region does not necessarily have to have a
10 source and a drain. Now, when you know this and you put everything in
11 context, it confirms that when Dr. Rao obtained his claims, he was referring
12 to the well, the channel region where you could counter dope and form a
13 source and a drain. He referred to the active region as what's in the well. So
14 when -- it's not as Counsel argued. It's not the source and the drain that
15 determines what the second doping type is. It's the well or the channel
16 region, and we know this from the 842 Claim 1, when it says, within which
17 transistors can be formed.
18 Now, if as Mr. Paul argued it had to be the source and the drain,
19 then you couldn't determine what the doping type is of a well where a
20 transistor hasn't been formed yet. This confirms that the second doping type
21 is referring to the well, the channel before you form the source and drain.
22 And this is why -- an additional reason why Petitioners, all their Petitions,
23 fail. The Petition map, the first doping type to a P-type, and then they said
24 the channel is -- or they mapped it to a transistor where the channel is also P-

1 type. They're not opposite doping types.
2 Now, I think we were accused of a moving target. I don't believe
3 that's the case and I'll show you why, and we certainly did not make a new
4 claim construction argument. It was Petitioner that kept changing their
5 positions when we pointed out that they had mapped both, the first doping
6 type and the second doping type, both of them the P-type. They were the
7 ones that coined the argument in their reply -- they're not supposed to be
8 making new arguments in their reply -- that it was the source and the drain
9 that were the second doping type. This was a new argument that they made
10 at the 11th hour, and we pointed out why that doesn't make sense because
11 when you look at the '842 claims, it says where a transistor can be built.
12 So the doping type of the transistor is determined before you build
13 the source and the drain, number one. And number two, under Petitioner's
14 belated argument, the transistor would have two doping types. Well, that
15 renders the surrounding claim language superfluous if they're going to say
16 the substrate is P-type, and then the active region is both N-type and P-type.
17 They would effectively be saying anytime you have N-type and P-type, it's
18 opposite in conductivity, which just doesn't make sense.
19 Now, again, moving target, again, I don't believe -- I certainly don't
20 believe it was us that was making the moving target. Petitioners then argue
21 that a different transistor 4P satisfied these claim limitations, but these are
22 not in the Petition. I heard Petitioner's Counsel try to say that we made a
23 new claim construction. That's not the case. There's no excuse for why, if
24 they wanted to map a different transistor, they had a burden to put it in their

1 Petition. They're certainly not allowed to map a new transistor for the first
2 time in their reply, and that's why we've cited to the Federal Circuit decision
3 on Slide 87. With that, I'll reserve the rest of my remaining time, unless
4 Your Honors have any questions that I can address at this time.
5 JUDGE ULLAGADDI: No questions from me. You have about
6 nine minutes remaining for rebuttal. Any other questions from the panel?
7 No? Okay. Let us take a brief five-minute break and return at 4:13.
8 MR. WHITEHURST: Thank you, Your Honors.
9 COURT REPORTER: Okay. We're going off record and the time
10 is 4:07 p.m. Eastern Standard.
11 (Whereupon, the above-entitled matter went off the record at 4:07
12 p.m. and resumed at 4:13 p.m.)
13 JUDGE ULLAGADDI: In that case, we're going to return to
14 Petitioner's Counsel. You have approximately 15 minutes remaining for
15 your rebuttal. Although, if we have significant questions, we may add some
16 time to that, if necessary. When you're ready, you may begin.
17 MR. SHARMA: Yeah, I'm ready now. Thank you, Your Honor. I
18 have a few things that I want to rebut and go through those, but if there are
19 any questions as if the Board wants me to focus on, I can focus on those
20 first.
21 JUDGE ULLAGADDI: I have a couple questions and it's up to
22 you when and -- when you want to deal with it, but can you distinguish
23 *Transclean* on page 2 of Patent Owner's response? And do you have a
24 response to the Eastern District of Texas, it says, claim construction order

1 requiring a sufficient grading for the aid carrier movement limitation.
2 MR. SHARMA: Okay, Your Honor. So let me -- let me go to the
3 answer you are requesting. Let me see if I can share. It looks like I am not
4 sharing the screen here. Your Honor, I'm going to address your questions on
5 the Western District of Texas where it talks about sufficient grading, and I'd
6 ask my colleague, Mr. Paul, to address the *Transclean*.
7 Let me go to Slide Number 83 and Petitioner's Exhibit 1072.
8 Okay. We are Slide number 83 on Exhibit 1072. Your Honor, on this one,
9 as Judge Tornquist asked, the Court was evaluating a 112 issue. The
10 Petitioners had argued the graded dopant concentration was indefinite and
11 then Greenthread argued that no, it is not indefinite. They offered the plain
12 and ordinary meaning of graded. They said, graded or varying concentration
13 of dopants. So the Court was not evaluating whether graded requires a
14 minimum magnitude or sufficient magnitude to aid movement. Court was
15 simply evaluating whether the term is definite or indefinite.
16 And the basis for the -- and I'm on Slide 84 now -- the basis of our
17 argument was if you look on the left-hand side, this is Figure 1 from the
18 Greenthread patents. It shows a uniform and a graded dopant concentration.
19 Well, this is an idealized view of what a concentration looks like.
20 On the right-hand side is a Figure 24 from Sze textbook which is
21 cited in the claim construction order, Exhibit 2074. Here you can see it is a
22 varying concentration. It also has a slope. Our point was the patent does not
23 give any guidance as to what is uniform versus what is graded, and a person
24 skilled in the art would not know when something is uniform versus when

1 something is graded because in the real life, a semiconductor -- there will
2 always be some gradations and always be some variations.
3 The figure on the left is an idealized view. Unfortunately, the
4 Court did not agree with Defendants. The Court did say that it was definite,
5 and when Court was talking about sufficiently graded in the order, the Court
6 was distinguishing uniform with graded concentration. The Court said,
7 okay, a person of skill in the art would know when something is uniform
8 versus when something is graded, and that's where the word sufficiently
9 points to.
10 Although the Court is not clear, the Court may also be referring
11 to -- is this indicia of the grading because the carrier requires that they
12 should aid movement from location to location, so it's possible, of course,
13 sufficiently graded to mean it was a grading from surface towards the
14 substrate.
15 Again, the point emphasized over here is Greenthread points to the
16 claim construction order, but if you look at the briefing, they don't point to
17 anywhere in the briefing, and that's because neither party was asking the
18 Court to evaluate whether the graded dopant concentration should have a
19 minimum grading in order to aid movement. They should have simply said
20 definite or not, and the Court said it was definite and says a person of skill in
21 the art would know when it was sufficiently graded to be not uniform.
22 JUDGE ULLAGADDI: Thank you.
23 MR. SHARMA: Going back to Greenthread's demonstratives, I
24 want to start at Slide number 8. So we're on Exhibit -- I don't know the

1 exhibit number, Your Honor, but we're on the demonstratives of
2 Greenthread on Slide number 8. And I want to spend quite a bit of time on
3 this one. We're going to point a bunch of errors about the slide on the whole
4 concept over here.
5 First of all, Patent Owner points to only Patent Owner responsive
6 brief as 45 at page 4. There's no discussion of this ordinary mapping of what
7 minority carriers are and what majority carriers are. Greenthread has come
8 up with a new mapping which is based on how transistors are operating and
9 how majority carriers and minority carriers change when transistor is
10 operating. That is completely incorrect. I will go through places where, in
11 the file history, Greenthread has taken an opposite position, places that Dr.
12 Banerjee explained how to -- how convention defines majority and minority,
13 based on the gradient type, and how Dr. Glew has not offered any opinion to
14 rebut that.
15 And especially if you -- and Greenthread has mentioned that this
16 has extensive briefing on this issue that is incorrect. The fact this points to
17 only one brief at page number 4, that is (INDISCERNIBLE). Now, the
18 paragraph points to Dr. Glew's declaration on paragraphs 1 to 33. That's
19 Exhibit 2057. Now, if you look at paragraphs 1 to 33 of Exhibit 2057,
20 there's no discussion of this ordinary mapping that if you turn the transistor
21 on, the definition of majority and minority carrier changes.
22 So therefore this is all a creation or argument for attorney
23 argument with no support from Dr. Glew or in his declaration from
24 paragraphs 1 to 33 that are cited on page 4 of 45. Now, other problems with

1 this one is, interestingly, Greenthread has taken a different position, but
2 before I spend time on this slide, let me go to the slide referring to Kamins.
3 On Slide 10 of Kamins, this is the one they extensively spent time
4 on. Kamins is also part of the file history, and if you see Figure 3 of
5 Kamins, it shows an electric field pointing to the left and pointing to the
6 right. It says, N-type substrate, and the line below that Greenthread has
7 quoted, it says, Kamins states the minority carrier holes created below the
8 maximum are accelerated by electric field deeper into the substrate while
9 carriers created above the maximum dopant are accelerated towards the
10 surface.
11 And again, this is the excerpt from Dr. Banerjee's declaration, but
12 he's citing to Kamins, Column 3, line 8 to 14; and also Column 2, line 64.
13 So Dr. -- here Dr. Banerjee points to Kamins, and Kamins, which is a prior
14 art, showed that if your N-type substrate with minority carriers has holes and
15 in this case, they move to the left, based on the electric field pointing to the
16 left. And also, they move to the right when the electric field points right. So
17 is it (INDISCERNIBLE - TECHNICAL DIFFICULTY) peak over there
18 electron -- minority holes move one way because electric field on the left,
19 and they move to the right with the electric field to the right. So again, this
20 is one evidence from the intrinsic evidence or intrinsic record how the
21 person of skill in the art interpret minority carriers in the P-type substrate.
22 Let me take you to -- on Exhibit 1070, this is a submission that
23 Greenthread made to the Patent Office in August 2024, and he has also
24 clarified what is a minority and majority carriers. I highlighted over here --

1 okay, so the -- so several slides, I'll pick the best one. But I'm making just
2 one boundary with the base and connector, and the other boundary is the
3 base. The base is just a region disclosed between through which holes, and
4 they clarified what holes are. Minority carriers for the PNP transistor.
5 Now, what is a PNP transistor? P-type refers to the source and the
6 drain. N refers to the channel in the middle. So here, Greenthread in this
7 declaration of Dr. Rao, specified over here that the minority carriers in the
8 N-type are holes. Obviously, Dr. Rao reviewed the specification, he
9 reviewed the submission to Patent Office, if he believed to the contrary, he
10 would've said no, don't submit this, fix this. Not only once. If you look at
11 the sentence thereafter, here Dr. Rao said, the electrons as minority carriers
12 for the NPN transistor.
13 Now, the N refers to the source and the drain and the P refers to the
14 channel in the middle. Again, what are the minority carriers over here?
15 Electrons. And that is consistent with the position that Petitioners have
16 taken and it's totally inconsistent with the position that Greenthread is
17 espousing today for the first time in this briefing. And again, Dr. Rao has
18 testified that he reviews every submission that goes to the Patent Office. If
19 he was mistaken, then he should have clarified it at the time.
20 I'm pointing to Exhibit 70 and file histories on page 11 of 16.
21 That's where they made this claim. And earlier in the paragraph, also they're
22 making the same clarification where the dopant type, this is -- decides what
23 is majority, what is minority. It is not decided by when the transistor is
24 operating or not. And then not one. And let me point to on the place on the

1 file history that says, Exhibit 1016, the file history for the '195 patent.
2 Okay. Again here, also, they clarified what is minority and
3 majority carriers. And again, this file history also proves, and on page 254
4 of 391 on Exhibit 1016. Okay. Here in this page 7 of 9, Dr. Rao is talking
5 about holes, PNP transistor, emitter to (INDISCERNIBLE) so emitter to
6 collector. In other words, drift field for the holes minority carriers is
7 unidirectional. So what is Dr. Rao talking in this sentence over here? He's
8 talking about the holes for the PNP transistor. Again, the channel is N-type,
9 so the minority carriers would be holes because it's -- the dopant determines
10 what is majority, what is minority. What did he say they were? He said
11 they were minority carriers and they are consistent with the positions the
12 Petitioner has taken, and directly contradicts the position that Greenthread
13 has taken today.
14 Not only this. Let me point you to Dr. Banerjee's declaration. I
15 will come to other issues, but here, Dr. Banerjee on paragraphs 81 and 85 of
16 this Exhibit 1060. I'll just point the Board to that because I don't have time
17 to go through all this one, but here, Dr. Banerjee explained that the identity
18 of majority and minority carriers does not change when the MOSFET is
19 turned on. He explained over here, and he also cited to the textbook
20 declaration, where the textbook explained that majority/minority carriers are
21 recommended based on doping type.
22 Again, I request the Board to look at paragraphs 81 through 85 in
23 Exhibit 1060 and also, look at the deposition testimony of Dr. Banerjee. Dr.
24 Banerjee was questioned on this one extensively by Greenthread. It's on

1 Exhibit -- his testimony is on Exhibit 1078, and on pages 280 to 300, he was
2 questioned repeatedly on the disclosure of the Greenthread patents, which he
3 explained repeatedly that the – what's majority, what's minority is based on
4 dopant -- of this dopant type. Not based on the transistors operating or not
5 operating. And also, I'll refer the Board to earlier paragraphs 1 through 20
6 of the declaration where he explains this.
7 So coming to the other points, I think on the issues of arrows and
8 so on, here is the deposition, here is the excerpt from Dr. Banerjee's report,
9 Exhibit 1060. He had shown over here if you have a P-type dopant how the
10 electric field will point and he also mentions that if you have a N-type
11 dopant, everything will be opposite, so he amply explained that in his file, I
12 think.
13 Lastly, Greenthread spent a bunch of time on electric field. On this
14 one, I'll just point to the Board that if you look at the '842 patent, the same is
15 true for everything. The claims require first and second -- second active
16 regions having one graded dopant concentration to aid carrier movement.
17 Now, there's no requirement in the claims that there be an electric field.
18 However, there are other claims that we were discussing on Friday, they do
19 require an electric field. Here, all Petitioners need to show that they are
20 active regions, they have a graded dopant concentration that moves carrier
21 and we have met that burden. And I think Judge Tornquist pointed out if
22 you look at the Kawagoe reference, it shows that the gradient goes from the
23 surface, all the way to the bottom.
24 Now, the last couple of points, over here just point to a couple of

1 places in the file history, so in the demonstratives. Yeah, so I think on this
2 slide, I'll refer the Board to demonstrative 1072, from 69, 70, 71, and 72, and
3 73, where Dr. Banerjee explains what the so-called gate-oxide other factors
4 are. He said he considered them. He said these occur in every transistor.
5 They occurred in the transistors that Dr. -- that are described in the
6 Greenthread patents, and he considered them and said, these don't matter
7 when you render whether there's a gradient in the semiconductor or the
8 gradient disclosed in the patent.
9 On this one, Dr. Banerjee is questioned. He explained it. Dr. --
10 one thing which I had mentioned earlier, in their file history, Greenthread
11 pointed to Figures 5B and so on with this, and embodied the invention.
12 They have gate-oxides, they have gate electrodes and never once
13 Greenthread mentioned in the file history or in the specification that it would
14 impact the electric field. They told the Patent Office a couple of times that
15 all that matters is the gradient, the other so-called factors do not matter. And
16 all they're trying to do is trying to inject new requirements into the claim
17 when none exists. And they never brought these things up when the
18 examiner was asking about other factors, other parameters. There are
19 Greenthread patents that have gates in them, they have electrodes in them,
20 but they don't mention anything at that time.
21 Lastly, on Banerjee's -- they point to Banerjee's declaration
22 statement and say he has changed his testimony. That is incorrect. They
23 told Dr. Banerjee -- they had his textbooks with him, and on Slide 64 of
24 Exhibit 1072. They don't ask him about his question, they -- so that they can

1 come back and mischaracterize his textbook behind his back. If they're
2 concerned about this section over here, they should've asked him about it.
3 But most important is the explanation he follows. He says that this force,
4 the force electric field, is insufficient to alter the random path of a negative
5 electron. Most important is appreciably.
6 Dr. Banerjee explained that the electrons move at a very high
7 speed, 10 to power seven centimeter per second. These electric fields are
8 pretty weak, so they don't affect the field. It will not be appreciative. That
9 is not true they don't affect. The do affect. And what's important? Next
10 sentence. The effect when averaged over all the electrons, however, is the
11 net motion of the group in the minus X direction. Now, this is because on
12 the right-hand side, he shows the field is going from positive X direction -- if
13 the field goes to positive X, electrons will move on the minus X. So again,
14 this is a mischaracterization of Dr. Banerjee's textbook.
15 JUDGE ULLAGADDI: Just to let Patent Owner's Counsel know,
16 I understand we are going over time and Patent Owner's Counsel will be
17 granted the same amount of time over to rebut Petitioner's arguments.
18 MR. WHITEHURST: Thank you, Your Honor.
19 MR. SHARMA: Okay. I will ask my colleague, Mr. Raj, if he can
20 respond to Judge Ullagaddi's question on *Transclean*.
21 MR. PAUL: Sure. Just very briefly, you know, the *Transclean*
22 case, the reliance on that is misplaced because it hinges on their flawed
23 understanding that the claims require movement and it does not require
24 movement. You know, we cited the *Enzo* case which is instructive. It says

1 that a reference includes an inherent characteristic. If that characteristic is a
2 natural result flowing from the reference's explicitly explicated limitations.
3 That's what we have here.
4 Kawagoe explicitly discloses a graded dopant concentration, so
5 does Wieczorek. And so the natural result of that based on Banerjee's
6 explanation, Dr. Glew's admissions, Greenthread's prior statements and prior
7 litigation, and the file history statements made clear that, you know, when
8 you have a graded dopant concentration, natural result of that is an electric
9 field, that in turn exerts a force on electrons in the claimed direction.
10 JUDGE ULLAGADDI: Thank you. Any further questions for
11 Petitioner's Counsel from the panel? Okay. Looks like no. Petitioner's
12 Counsel got about four minutes extra, so you are at 81 minutes, so that
13 would give you 13 minutes to go. And when you're ready, you may begin.
14 MR. WHITEHURST: Thank you, Your Honors. I certainly
15 appreciate the additional time, but I'm not sure that I'll need it. I can be very
16 brief here. I just want to address real quick four points. First, we just heard
17 Petitioner's Counsel argue that the claims don't require movement. If you
18 look at the claim language itself, it's saying a carrier movement from point A
19 to somewhere else. I'm not sure how Petitioner can reconcile their argument
20 with the plain meaning of the face of the claims.
21 I just want to make a real quick second point. We just heard
22 Counsel make arguments based on Dr. Banerjee testimony that appears on
23 Slides 70 through 73 of Petitioner's demonstratives. You'll note that we've
24 objected to those slides because they occurred after improper coaching and

1 it's just conclusionary leading questions, so I hope you'll take a closer look at
2 that. My two remaining points, I want to go back to a question that Your
3 Honor, Judge Ullagaddi, asked earlier and Petitioner's Counsel just made a
4 new argument. If we could display the screen, I believe you have it in front
5 of you. This is Exhibit 1001 from the IPR ending in '001, I believe. You're
6 seeing on the screen the '481 patent.
7 Your Honor, you asked me earlier about the majority carriers and
8 the minority carriers. I apologize. I missed the very best quote that I
9 should've gone straight to, and I apologize I did not raise this earlier, but it
10 goes to the new argument that we just heard from Petitioner's counsel. On
11 the screen, hopefully you can see the '481 patent, which is Exhibit 1001
12 there at the top of Column 2. Column 2, lines 1 through 2, it says, in
13 contrast to BJTs, MOS devices are majority carrier devices for conduction.
14 So when you read that, you'll see that they -- when Dr. Rao used the
15 majority carrier, he wasn't talking about the well, he was talking about
16 what's carrying the charge, what's conducting between the source and the
17 drain.
18 So there at the top of Column 2, you see a clear answer to your
19 question earlier, and I hope that fully resolves the issue, and shows why
20 Petitioner's new argument just now was wrong. But in addition to that, we
21 also have the testimony that I discussed earlier. And you'll see that it says,
22 the conduction is channel dominated. What is going on in a MOS device
23 like we see in Figure 5B the majority carrier is what is carrying the charge in
24 the channel between the source and the drain, and it's saying the channel can

1 be surface in one plain and plainer devices. What it's referring to there is a
2 surface channel MOSFET. So if you go here, you'll see that the majority
3 carrier is what's connecting the source and the drain, and that tells you that
4 the minority carrier there is the hole.
5 So with my final point, I want to go back to a question that was
6 asked by Judge Tornquist. I'm told I could've done a much better job
7 answering your question. I apologize that I didn't answer it better earlier. If
8 I could put up Slide 31, and I apologize for flipping through the slides like I
9 am, but I want to get to Slide 31 as quickly as possible. And Judge
10 Tornquist, I believe you asked me earlier why the field wouldn't be the same
11 throughout the entire p-well. Well, that's because the active region sees
12 fields that are different from the rest of the p-well. What happens in the
13 active region is going to be different from what occurs in the rest of the p-
14 wells. And to show you evidence in the record of that, I would like to go to
15 Slide 49.
16 You can't just have one field all the way through the p-well,
17 because if you look at Slide 49, this is Dr. Banerjee's deposition testimony.
18 He said, you either do a vector sum of the built-in static fields to the doping
19 gradient, as well as the externally applied fields, which can change from,
20 you know, one situation to the other. So here is Dr. Banerjee saying that
21 when you look at different parts of the semiconductor, you have to look at
22 the vector sum for each. So what we see in the purple active region is going
23 to be different from the green p-well.
24 Why is that the case? To answer that question, you go to Slide 42.

1 When you go to Slide 42, you see further testimony from Dr. Banerjee.
2 Again, this is not our expert. This is Petitioner's own expert explaining why
3 the purple active region is different from the green p-well. And you'll see
4 that Dr. Banerjee testified on pages 222 through 224 of his deposition that
5 when you look at the purple active region, you're going to have a gate and a
6 gate-oxide creating fields that aren't present in the rest of the p-well.
7 And that's why you can't just draw one arrow from the top of the p-
8 well to the bottom, and it's going to depend on other things, and Dr.
9 Banerjee testified at length how when you're in the active region, you're
10 going to have these built in fields that are due to the gate and the gate-oxide
11 that you're not going to have elsewhere in the p-well. Those were the four
12 points that I wanted to address. I hope I did it in under my time limit, but I
13 certainly would like to answer any further questions, be of any assistance, if
14 there are any outstanding issues that I can provide additional clarification on.
15 JUDGE ULLAGADDI: Any further questions from the panel? I
16 do have one question. Can you distinguish *ParkerVision*?
17 MR. WHITEHURST: Can you give me one second --
18 JUDGE ULLAGADDI: Sure.
19 MR. WHITEHURST: -- real quick? Yes, Your Honor. I can
20 definitely distinguish *ParkerVision*. I apologize if I don't have all the cites,
21 but I know that I briefed this issue extensively in both the Eastern District
22 and Western District of Texas litigations. We've had, certainly, challenges
23 from the Defendants in those cases on this very point, and in every situation,
24 the Court has sided with us on this issue. When you look at *IPXL* and it's

1 progeny, we know that claims regularly recite functionality. You can say,
2 configured to do X. You can say, capable of doing Y.
3 When you mention something such as aid carrier movement from
4 the active region to somewhere else, that is not taking an apparatus claim
5 and turning it into a method claim. It's very different. What it's doing is
6 claiming a particular graded dopant concentration, which has the capability
7 or it's configured to do something else.
8 So as many people call it, it would be referred to as functional
9 claiming. You see functional limitations in claims on a regular basis. This
10 does not mean you're taking an apparatus claim and impermissibly turning it
11 to a method claim. No. What you're doing is claiming something. In this
12 case, a graded dopant concentration, that has the functionality or the
13 capability to aid carrier movement from an active region or the first surface,
14 or the surface layer to somewhere else.
15 So we definitely disagree with Petitioner's citation to the
16 *ParkerVision* case here. This is not a situation where you have a method
17 limitation in an apparatus claim. You have functional claiming where the
18 apparatus claim claims a necessary function or capability.
19 JUDGE OBERMANN: Can I just ask a question? This is Judge
20 Obermann. So is your position that the claim requires an apparatus that's
21 capable of this function?
22 MR. WHITEHURST: So I -- I believe the answer is yes. If I --
23 and I -- to answer that question, I think it's helpful to go to Slide 5, which
24 hopefully we'll -- we're -- you can see on the screen in front of you, and

1 you'll see that here in the '481, and I apologize -- I just wanted to make sure
2 that I had the claim language correct before answering your question. I
3 certainly wasn't trying to dodge it in any way. But when you look at '481, I
4 just wanted to make sure I had the language correct. It says a graded dopant
5 concentration to aid carrier movement, so you're not seeing here a method
6 claim in an apparatus. What it's doing is reciting the functionality or
7 capability of what the graded dopant concentration is. So I believe I fully
8 answered your question, but I just want to make sure.
9 JUDGE OBERMANN: Well, then under this case, isn't it enough
10 to show that the prior art discloses a structure that's capable of that function?
11 MR. WHITEHURST: So when we look at Kawagoe, that's not the
12 case. I believe I understand your question correctly. When you look at Dr.
13 Rao's patents, you have a disclosure that expressly says, graded dopant
14 concentration, and I'm going to put up Slide 8, just to give you an example.
15 When you look at Slide 8 and Figure 5B, it says, graded dopant region to
16 pull minority carriers from surface.
17 So here, you have an explicit statement by Dr. Rao that the graded
18 dopant region is pulling minority carriers from the surface. The graded
19 dopant concentration that's in this region is configured capable of doing
20 exactly what Dr. Rao says. When you look at Kawagoe, we don't see a
21 corresponding statement in Kawagoe. You can read Kawagoe from
22 beginning to end and you will never see language that says, it is pulling
23 minority carriers or moving carriers from the active region. And that's the
24 point that I really hope to make today, that, you know, if Kawagoe had said

1 move carriers from the active region, we would be in a very different
2 situation. That is not the case.
3 It is silent on this issue, and the point that I hope I've made today
4 that in a reference such as Kawagoe or Wieczorek where it's silent on this
5 point, that's when Petitioner has the burden to at least, one, identify electric
6 field, show where the location is, show that it's pointing in the right
7 direction, and show that there are not other electric fields that are going to
8 move it in the opposite direction. In the absence of an expressed statement
9 like Dr. Rao made here in his specification in Figure 5B, Petitioner had the
10 burden to show that in every possible situation, it would necessarily do what
11 the challenge claims do.
12 JUDGE OBERMANN: And where in your patent specification
13 does it have those details that explain how you get to the claimed structure?
14 MR. WHITEHURST: Well, one is right on the face of Figure 5B.
15 When you look at Figure 5B, it says right on the face of it, graded dopant
16 region, number one, and number two, it's -- we know -- Judge Ullagaddi
17 asked me about this earlier -- we know that this is a p-well, and we know
18 that this is an NMOS transistor and n-well, and Dr. Rao even drew the
19 electric field. So you have one, a mention of a graded dopant region; two,
20 he's actually illustrated here that electric field; and he's told you, three, this
21 electric field, which he drew in to Figure 5B, is moving the minority
22 carriers, which in this case would be a hole from the surface.
23 When you look at the corresponding parts of the specification that
24 are describing Figure 5B, you see additional detail. But to answer your

1 question, I believe it's clear right here on the face of Figure 5B, when you
2 mention a graded dopant region, you actually show the location of the
3 electric field, and you show the direction I'm pointing. That is --
4 JUDGE ULLAGADDI: Counsel, I think you're -- if you can wrap
5 up your thought, we'd appreciate it.
6 MR. WHITEHURST: I believe I've completed my thought. And
7 unless there are no further questions, I have nothing more to add. I certainly
8 don't want to go over my time, unless the panel would like me to go on
9 further.
10 JUDGE ULLAGADDI: Any further questions from the panel?
11 Okay. Hearing no further questions, we thank you for the opportunity to
12 investigate the record with you and your attentiveness to our questions. We
13 invite you to remain on the line to clarify matters for the Court Reporter, if
14 needed. And with that, we are adjourned. Thank you.
15 (Whereupon, the above-entitled matter went off the record at 4:49
16 p.m.)

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IPR2024-00001 (Patent 10,734,481 B2)
IPR2024-00016 (Patent 10,510,842 B2)
IPR2024-00019 (Patent 11,316,014 B2)
IPR2024-00020 (Patent 11,121,222 B2)

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