

PUBLIC VERSION

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC D/B/A
ONSEMI and TEXAS INSTRUMENTS INCORPORATED
Petitioner,

v.

GREENTHREAD LLC,
Patent Owner.

IPR2023-01244¹
Patent 11,121,222 B2

Before KRISTEN L. DROESCH, GRACE KARAFFA OBERMANN, and
MONICA S. ULLAGADDI, *Administrative Patent Judges*.

ULLAGADDI, *Administrative Patent Judge*.

JUDGMENT

Final Written Decision on Remand
Determining All Challenged Claims Unpatentable and
Admitting Exhibits 2077 and 2079
35 U.S.C. § 318(a)

¹ Texas Instruments Incorporated, which filed a petition in IPR2024-00674, has been joined as a petitioner in this proceeding. Paper 68.

I. INTRODUCTION

A. *Background and Summary*

Semiconductor Components Industries, LLC (“Petitioner”) filed a petition for an *inter partes* review (Paper 2, “Pet.”) challenging claim 44 of U.S. Patent No. 11,121,222 B2 (Ex. 1001, “the ’222 patent”). In addition, Petitioner filed a paper explaining and ranking the parallel petitions challenging the ’222 patent, i.e., the present Petition and the petition filed in IPR2023-01242. Paper 3. Greenthread, LLC (“Patent Owner” or “PO”) filed a Preliminary Response (Paper 18, “Prelim. Resp.”). With our authorization, Petitioner filed a Preliminary Reply (Paper 22), and Patent Owner filed a Preliminary Sur-Reply (Paper 28).

Upon review of the preliminary record, we instituted *inter partes* review, pursuant to 35 U.S.C. § 314, as to the challenged claim based on the challenges set forth in the Petition. Paper 35 (“Institution Decision” or “Inst. Dec.”). Patent Owner filed a Response (Paper 46, “Patent Owner’s Response” or “PO Resp.”), Petitioner filed a Reply to Patent Owner’s Response (Paper 61, “Petitioner’s Reply” or “Pet. Reply”), and Patent Owner filed a Sur-Reply (Paper 64, “Patent Owner’s Sur-Reply” or “PO Sur-Reply”). On November 13, 2024, we held an oral hearing. A transcript of the hearing is of record. Paper 82 (“Tr.”).

On February 11, 2025, we entered a Final Written Decision in this proceeding concluding that challenged claim 44 of the ’222 patent was invalid as unpatentable. Paper 83 (“FWD”). On April 24, 2025, the Director granted Patent Owner’s request for review, vacated the Final Written Decision, and remanded to the Board for further proceedings. Paper 91 (“Director Review Order” or “Dir. Rev. Order”).

B. Director Review Order

1. Additional Discovery Concerning Privity

The Director Review Order remands “to the Board with instructions to allow discovery, narrowly tailored to [a] privity issue” concerning an alleged relationship between Petitioner and a nonparty, Intel, “such as any indemnification agreements between Petitioner and Intel and the terms and conditions of sale agreements between Petitioner and Intel related to products accused of practicing the challenged claims.” Dir. Rev. Order 3. In particular, the Director Review Order states that

[t]he Board should then determine on the full record whether Petitioner has met its burden of demonstrating it is not time-barred under § 315(b); that is, whether Patent Owner has produced some evidence to support its argument that Intel should be named as a privy so as to have put the issue into dispute.

Id. (citing *Worlds Inc. v. Bungie, Inc.*, 903 F.3d 1237, 1242–44 (Fed. Cir. 2018)).

2. The Location of the “Graded Dopant Concentration”

The Director Review Order found “the Board abused its discretion by not fully addressing the arguments” because

[t]he Board declined to consider Patent Owner’s arguments “concerning the location of the graded dopant concentration,” finding these arguments untimely as first presented in the Sur-Reply. [FWD] 45 (citing Patent Owner’s Sur-Reply argument that the prior art’s disclosure refers to “gradients and carriers *outside the active region*”). Patent Owner, however, timely presented these arguments in the Response. *See* Paper 59, 24–25 (arguing that the prior art’s carriers are not in the active regions and, therefore, “the carriers that its graded dopant concentration affects are in the wrong place”).

Dir. Rev. Order 4. The Director Review Order indicates that, on remand, “if the petitions are not time-barred, [the Board] is to consider and address

Patent Owner’s arguments concerning the location of the graded concentration.” *Id.*

3. *Motion to Strike District Court Claim Construction Orders*

The Director Review Order determined that the Board’s “refusal to admit and consider the claim construction orders was legally erroneous because the orders were not ‘evidence.’” Dir. Rev. Order 5. According to the Director Review Order, “[t]he refusal also was an abuse of discretion because the orders were responsive to Petitioner’s arguments and thus timely.” *Id.* at 5–6.

Under the circumstances here, where Patent Owner properly argued that the claim construction dispute between the parties crystallized only in Petitioner’s Reply, the Board should have admitted the district court claim construction rulings and given them “appropriate weight.”

Accordingly, on remand, if the petitions are not time-barred, the Board is to admit Exhibits 2077 and 2079 and reconsider the parties’ arguments in view of these two exhibits.

Id. at 6 (footnote omitted) (citing Patent Trial and Appeal Board Consolidated Trial Practice Guide (Nov. 2019) (“CTPG”), 47).

For the reasons that follow, we again conclude that Petitioner has established, by a preponderance of the evidence, that challenged claim 44 of the ’222 patent is unpatentable.

C. *Real Parties-in-Interest*

Each party identifies itself as a real party-in-interest. Pet. 1; Paper 5, 2. In addition, Petitioner identifies ON Semiconductor Corporation as a real party-in-interest. Pet. 1. Texas Instruments Incorporated was joined as a petitioner in this proceeding, and identifies itself as a real party-in-interest. Paper 68, 3.

D. Related Matters

The parties identify several proceedings involving the '222 patent as related matters, including *Greenthread, LLC v. ON Semiconductor Corp.*, No. 1:23-cv-00443 (D. Del.); *Greenthread, LLC v. Western Digital Corp.*, No. 1:23-cv-00326 (D. Del.); *Greenthread, LLC v. Cirrus Logic, Inc.*, 1:23-cv-00369 (W.D. Tex.); *Greenthread, LLC v. Texas Instruments Inc.*, No. 2:23-cv-00157 (E.D. Tex.); *Greenthread, LLC v. OSRAM GmbH*, No. 2:23-cv-00179 (E.D. Tex.); *Greenthread, LLC v. OmniVision Technologies, Inc.*, No. 2:23-cv-00212 (E.D. Tex.); *Greenthread, LLC v. Monolithic Power Systems, Inc.*, No. 1:23-cv-00579 (D. Del.); *Greenthread, LLC v. Intel Corp.*, No. 6:22-cv-105 (W.D. Tex.); *Greenthread, LLC v. Intel Corp.*, No. 6:22-cv-01293 (W.D. Tex.); *Greenthread, LLC v. Micron Technology, Inc.*, No. 1:23-cv-00333 (D. Del.); *Intel Corp. v. Greenthread, LLC*, IPR2023-00420 (PTAB); *Intel Corp. v. Greenthread, LLC*, IPR2023-00552 (PTAB); [REDACTED] [REDACTED]). Pet. 1–3; Paper 5, 2–5.

In addition, Petitioner challenges claims 1–9, 13–28, and 32–42 of the '222 patent in IPR2023-01242, currently pending. Paper 3, 3. Further, Patent Owner identifies two additional matters involving the '222 patent: *Cirrus Logic, Inc. v. Greenthread, LLC*, IPR2024-00020 (PTAB); and *Cirrus Logic, Inc. v. Greenthread, LLC*, IPR2024-00021 (PTAB). Paper 16, 2.

E. The '222 Patent

The '222 patent, titled “Semiconductor Devices with Graded Dopant Regions,” issued on September 14, 2021. Ex. 1001, codes (45), (54). The '222 patent “relates to all semiconductor devices and systems.” *Id.* at 1:23–

24. According to the '222 patent, in bipolar junction transistors, “[e]fforts have been made in graded base transistors to create an aiding drift field to enhance the diffusing minority carrier’s speed from emitter to collector” versus the standard “uniformly doped base.” *Id.* at 1:34–48. This improvement has not been implemented in “most semiconductor devices, including various power MOSFETs [and] IGBT’s,” which “still use a uniformly doped ‘drift epitaxial’ region in the base.” *Id.* at 1:48–53.

The invention of the '222 patent implements graded dopant concentration in these devices, which causes “[t]wo important performance enhancements.” *Id.* at 3:4–31. These include sweeping electrons “from source to drain rapidly” and simultaneously causing holes to “be recombined closer to the n^+ buffer layer,” which “can improve t_{on} and t_{off} in the same device.” *Id.* at 3:31–35.

F. Illustrative Claim 44

Petitioner challenges claim 44, which is reproduced below (with bracketing numbering added by Petitioner).

44. [pre] A CMOS Semiconductor device comprising:
- [44.1] a surface layer;
 - [44.2] a substrate;
 - [44.3] an active region including a source and a drain, disposed on one surface of the surface layer;
 - [44.4] a single drift layer disposed between the other surface of the surface layer and the substrate, the drift layer having a graded concentration of dopants extending between the surface layer and the substrate, [44.5] the drift layer further having a first static unidirectional electric drift field to aid the movement of carriers from the surface layer to an area of the substrate where there are no active regions; and

[44.6] at least one well region disposed in the single drift layer, the well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of carriers from the surface layer to the area of the substrate where there are no active regions.

Ex. 1001, 8:21–39; *see generally* Pet. (bracketed numbering).

G. Asserted Unpatentability Challenges

Petitioner asserts that claim 44 is unpatentable based on the following challenges:

Claim Challenged	35 U.S.C. §	Reference(s)/Basis
44	103(a) ²	Payne ³
44	103(a)	Sakai, ⁴ Kawagoe ⁵

Petitioner relies on the Declaration of Travis Blalock, Ph.D. Ex. 1003. Patent Owner relies on the Declaration of Alexander Glew, Ph.D. Ex. 2057.

H. Timeliness of Petition Under 35 U.S.C. § 315(b)

Pursuant to 35 U.S.C. § 315(b), “[a]n *inter partes* review may not be instituted if the petition requesting the proceeding is filed more than 1 year after the date on which the petitioner, real party in interest, or privy of the petitioner is served with a complaint alleging infringement of the patent.”

Patent Owner argues that the Petition should be dismissed because it is

² The Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) (“AIA”), included revisions to 35 U.S.C. § 103 that became effective after the effective filing date of the challenged claim. *See* Ex. 1001, codes (22), (60). Therefore, we apply the pre-AIA versions of 35 U.S.C. § 103.

³ U.S. Patent No. 4,684,971 to Payne, issued Aug. 4, 1987 (Ex. 1005, “Payne”).

⁴ U.S. Patent No. 4,907,058 to Sakai, issued Mar. 6, 1990 (Ex. 1006, “Sakai”).

⁵ U.S. Patent No. 6,043,114 to Kawagoe et al., filed Sept. 22, 1997 and issued Mar. 28, 2000 (Ex. 1007, “Kawagoe”).

untimely. PO Resp. 37. In particular, Patent Owner argues Petitioner is in privity with Intel Corp. (“Intel”) and [REDACTED] (collectively “Licensees”), who Patent Owner asserts are time-barred under 35 U.S.C. § 315(b) and licensed under the ’222 patent. *Id.* at 42–48.

Prior to institution, Patent Owner’s arguments regarding privity were based on several theories, including that Petitioner and Licensees “are ‘preceding and succeeding owners of’ the licensed and/or infringing products,” that Petitioner is a beneficiary of the Licensee’s agreements related to accused products, that Petitioner’s licensed sales encumber otherwise infringing articles, that Petitioner apparently indemnifies the time-barred parties for custom-made products, and that Petitioner serves as an “agent” of Licensees by exercising their “have made” rights under the license. *See generally* Prelim. Resp.

The question of whether Petitioner is time-barred under § 315(b) is part of the determination of whether to institute an *inter partes* review. *See Thryve, Inc. v. Click-to-Call Tech., LP*, 590 U.S. 45, 54 (2020) (“§ 315(b) expressly governs institution and nothing more”). In our Institution Decision, we determined that Patent Owner had not provided a sufficient factual basis upon which to question Petitioner’s representation that it is not time barred (Inst. Dec. 21), or that Petitioner and Intel or [REDACTED] were privies, based on any of its theories regarding privity (*id.* at 14–21). We incorporate that analysis here, and reconsider Patent Owner’s contention to the extent it is warranted by subsequent argument and evidence adduced on remand.⁶ *Id.*

⁶ With certain exceptions for redacted documents, Patent Owner’s exhibits 2001–2056 were entered prior to Institution and exhibits 2057–2100 were submitted during trial.

at 10–21; *see Achates Reference Publ'g. Inc. v. Apple Inc.*, 803 F.3d 652, 658 (Fed. Cir. 2015) (“The Board’s reconsideration of the time-bar [in the final determination] is ‘still fair[ly] characterize[ed] as part of the decision to institute.’”) (citations omitted).

Following the Director Review Order, the parties filed a Joint Paper Concerning Additional Discovery in which they indicated that the parties “have conferred but were unable to come to agreement on the proper scope of additional discovery” and provided “[t]he respective positions of the [p]arties.” Paper 103, 1. In particular, Patent Owner requests the following:

1. [a]ll sales agreements (containing terms and conditions of sale) and/or indemnification agreements related to Petitioner’s products sold to Intel, [REDACTED]; and]
2. [a]ll communications between (i) Petitioner and (ii) Intel, [REDACTED], relating to indemnification concerning products that Petitioner makes for, or sells to, Intel, [REDACTED].

Id. at 5.⁷

⁷ In a set of related cases—IPR2024-00263, IPR2024-00264, IPR2024-00265, and IPR2024-00266—involving the same entities with the exception of Texas Instruments, Inc., Patent Owner stated that it would not seek post-hearing discovery on the same discovery issue that was the subject of the Director Review Order in the first wave cases. *See e.g.*, IPR2024-00263, Paper 62, 69:10–20 (“JUDGE OBERMANN: . . . Are you or are you not requesting additional discovery in this case? MR. WHITEHURST: I am not requesting additional discovery. I believe we have satisfied *Worlds*, are on the record that is before this Panel there is only one correct outcome, and that is to terminate the IPRs as time barred JUDGE OBERMANN: So you are absolutely stating that you would not request additional discovery in these cases? MR. WHITEHURST: We are not requesting additional discovery, Your Honor.”).

On June 27, 2025, we *sua sponte* issued a Discovery Order (“Disc. Order,” Paper 106), “narrowly tailored,” consistent with the Director Review Order, ordering Petitioner to provide the following discovery to Patent Owner in this proceeding

- (a) . . . documents [including]:
 - i. [s]ales agreements between Petitioner and Intel for the Intel Accused Products;⁸ and
 - ii. [i]ndemnification agreements between Petitioner and Intel for the Intel Accused Products. *See* [Director Review Order 3].
- (b) Documents sufficient to show the asserted privity relationship between Petitioner and Intel, including any new declaration(s) that establish that no documents responsive to Subsection (a) above “exist” . . . , as well as any documents and new declaration(s) that establish (1) the time by which Petitioner became aware of the Intel litigation referenced in the [Director Review Order]; (2) whether Petitioner was the supplier of any product, or component of a product, accused of infringement in the Intel litigation; and (3) whether Petitioner was in a position to control, or actually controlled, Intel’s defense of that litigation.

Disc. Order 5, 10.

In response to our Discovery Order, Petitioner produced the Declaration of Matthew Murphy. Ex. 2103 (“Murphy Declaration”). Patent Owner cross-examined Mr. Murphy and a deposition transcript was entered into the record. Ex. 2104.⁹ Patent Owner subsequently filed a Patent Owner’s Post-Remand Brief Concerning Board-Ordered Discovery (“PO

⁸ The “products accused” consist of “the ‘Intel Accused Products’” identified in Exhibit 2048. Disc. Order 10 n.5; Paper 103, 7.

⁹ The record includes two of Exhibit 2104, a public version and a sealed version. We cite to the *sealed* version of this exhibit unless otherwise noted.

Remand Resp.,” Paper 111), Petitioner filed a Petitioner’s Responsive Post-Remand Brief (“Pet. Remand Reply,” Paper 114), and Patent Owner filed a Patent Owner’s Reply Post-Remand Brief (“PO Remand Sur-Reply,” Paper 115). We conducted a telephonic hearing on September 18, 2025 (“Remand Tr.,” Exhibit 1059).

The briefs comingle analyses of the issues of real party in interest (RPI) and privity, and often use the terms interchangeably. *See, e.g.*, PO Remand Resp. 2; PO Remand Sur-Reply 2. The two terms, however, describe distinct concepts with differing effects under the statute. *See, e.g.*, 35 U.S.C. § 312(a)(2) (petition must identify all RPIs, but not privies). Prior to analyzing the parties’ arguments, we summarize the concept of privity below.

1. Statutory Bar as Nonparty Preclusion

The one-year statutory bar of § 315(b) “helps to ensure that *inter partes* review provides a quick and cost effective alternative to litigation, and is not used as a tool for harassment or litigation gamesmanship.” *Johnson Health Tech. Co. v. Icon Health & Fitness, Inc.*, IPR2014-01242, Paper 16 at 3 (PTAB Feb. 11, 2015) (citing H.R. REP. NO. 112-98 at 48, *as reprinted in* 2011 U.S.C.C.A.N. at 78). In this sense, § 315(b) is analogous to the common-law doctrines of claim preclusion and issue preclusion, which “preclude parties from contesting matters that they have had a full and fair opportunity to litigate,” thereby “protect[ing] their adversaries from the expense and vexation attending multiple lawsuits, conserv[ing] judicial resources, and foster[ing] reliance on judicial action by minimizing the possibility of inconsistent decisions.” *Montana v. United States*, 440 U.S.

147, 153–54 (1979). Our Practice Guide, therefore, looks to these doctrines of preclusion in interpreting the language of § 315(b). *See* CTPG 12–17.

Like the common-law preclusion doctrines, the preclusive effect of § 315(b) also extends beyond those who were parties to the prior lawsuit. Because nonparty preclusion risks binding those who have not had a full and fair opportunity to litigate, the Supreme Court has cautioned that there is a general rule against nonparty preclusion, subject only to limited exceptions. *See Taylor v. Sturgell*, 553 U.S. 880, 892–93 (2008). In *Taylor*, while noting that it was not a “definitive taxonomy” (*id.* at 893 n.6), the Court set forth a list of six “categories” under which nonparty preclusion may apply.¹⁰

(1) “[A] person who *agrees to be bound* by the determination of issues in an action between others is bound in accordance with the terms of his agreement.” *Id.* at 893.

(2) “[N]onparty preclusion may be justified based on a variety of *pre-existing substantive legal relationships* between the person to be bound and a party to the judgment,” such as “preceding and succeeding owners of property, bailee and bailor, and assignee and assignor.” *Id.* at 894.

(3) “[I]n certain limited circumstances,” such as class actions, “a nonparty may be bound by a judgment because she was *adequately represented* by someone with the same interests who was a party to the suit.” *Id.* The Court later elaborated that this exception applies only if there are “special procedures to protect the nonparties’ interests, or an understanding by the concerned parties that the first suit was brought in a representative capacity.” *Id.* at 900.

(4) “[A] nonparty is bound by a judgment if she *assumed control* over the litigation,” because that person “has had the

¹⁰ For clarity, we omit internal quotation marks and citations throughout the list of categories enumerated in *Taylor*, and add emphasis on certain key phrases, and generally cleaned up the quotations.

opportunity to present proofs and argument . . . even though he was not a formal party to the litigation.” *Id.* at 895.

(5) “[A] party bound by a judgment may not avoid its preclusive force by *relitigating through a proxy*,” such as “when a nonparty later brings suit as an agent for a party who is bound by a judgment.” *Id.*

(6) “[A] *special statutory scheme*,” such as bankruptcy or probate, “may expressly foreclose successive litigation by nonlitigants . . . if the scheme is otherwise consistent with due process.” *Id.*

Having listed these categories, the Court then held that a broader doctrine of nonparty preclusion, termed “virtual representation,” was inconsistent with Federal common law, and risked violating due process. *Id.* at 898–900.

Therefore, nonparty preclusion cannot be based on mere “identity of interests and some kind of relationship between parties and nonparties.” *Id.* at 901.

2. *Caselaw on Privity*

“[T]he mere existence of some relationship between a petitioner and another entity is not sufficient” to place that petitioner in privity with that entity. *Google LLC v. DDC Technology, LLC*, IPR2023-00707, Paper 27 at 37 (PTAB Oct. 25, 2023). Instead, “that relationship must be related to [an earlier] lawsuit and be sufficiently close that it can be fairly said *the petitioner had a full and fair opportunity to litigate the validity of the patent in that lawsuit*.” *Id.* (emphasis added). In other words, privity concerns “whether the petitioner and the prior litigant’s relationship—as it relates to the [earlier] lawsuit—is sufficiently close that it can be fairly said that the petitioner had a full and fair opportunity to litigate the validity of the patent in that lawsuit,” or “whether the petitioner is simply serving as a proxy to allow another party to litigate the patent validity question that the other party

raised in an earlier filed litigation.” *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1319 (Fed. Cir. 2018).

Though expansive, the concept of privity has boundaries set by due process. As the Court held in *Taylor*, extending the preclusive concept of privity to those in “virtual representation,” through identity of interest and a determination that the relationship of the parties is “‘close enough’ to bring the second litigant within the judgment,” is impermissible. *See Taylor*, 553 U.S. at 898. Only if the nonparty can be said to have had a “full and fair opportunity to litigate” can that nonparty be precluded as a privy. *Id.* at 892–93; *see also Aspex Eyewear, Inc. v. Zenzi Optical, Inc.*, 713 F.3d 1377, 1382 (Fed. Cir. 2013) (“[a] full and fair opportunity to litigate is the touchstone of any preclusion analysis.”).

Courts examine different aspects of the parties’ relationship, depending on the issue for which privity is being asserted. *See Int’l Nutrition Co. v. Horphag Research, Ltd.*, 220 F.3d 1325, 1329 (Fed. Cir. 2000) (“[a] variety of relationships between two parties can give rise to the conclusion that a nonparty to an action is ‘in privity’ with a party to the action”). For example, the parties’ contractual relationship (privity of contract) regarding a product is relevant when determining whether an injunction against the sale of that product applies. *See In re Cyclobenzaprine Hydrochlorine Extended-Release Capsule Patent Litigation*, 504 F. App’x 900, 906 (Fed. Cir. 2013) (unpublished). In other situations—for example, in the case of a judgment with respect to a particular property interest—the relationship between the parties with respect to the transfer of the property may be the focus. *See Int’l Nutrition*, 220 F.3d at 1329. Therefore, the same two parties may be in privity for certain purposes, but not for others. *Id.*

In the context of § 315(b), the goal of the preclusion is to prevent successive challenges to a patent by those who previously have had the opportunity to make such challenges in prior litigation. As such, the focus of our privity inquiry is on the relationship between the parties *during the prior lawsuit*. In other words, we ask whether the instant petitioner and the prior litigant’s relationship—as it relates to the lawsuit—is sufficiently close that it can be fairly said that the petitioner has had a full and fair opportunity to litigate the validity of the patent in the lawsuit.

In this sense, our privity inquiry will typically fall into *Taylor*’s fourth category of nonparty preclusion, which applies to situations in which the petitioner “has had the opportunity to present proofs and argument” such that it can be said to have “assumed control” over the action. *Taylor*, 553 U.S. at 895 (internal quotations omitted). Our Practice Guide reflects this, noting that control is a “common consideration” in the privity inquiry. CTPG 16.

Furthermore, we note that *actual* assumption of control of the lawsuit is not necessary for a finding of privity; the opportunity, or legal right, to assume control is sufficient. “Substantial control . . . connotes the availability of a significant degree of effective control in the prosecution or defense of the case—what one might term, in the vernacular, the power—whether exercised or not—to call the shots.” *Gonzalez v. Banco Central Corp.*, 27 F.3d 751, 758 (1st Cir. 1994); *see Arris Group, Inc. v. C-Cation Techs., LLC*, IPR2014-00746, Paper 22 at 10 (PTAB Nov. 24, 2014) (inquiring into whether party exercised, or could have exercised, control over District Court action); *see also* CTPG 16 (quoting 18A Charles Alan Wright, Arthur R. Miller & Edward H. Cooper, Federal Practice &

Procedure § 4451 (2d ed. 2011)) (“control generally means that ‘it should be enough that the nonparty has the actual measure of control or *opportunity to control* that might reasonably be expected between two formal coparties’”) (emphasis added).

Finally, privity is based on “flexible and equitable considerations,” and, therefore, neither the Practice Guide nor our decisions set any bright-line test for when privity exists. CTPG 14. Nor should the preceding discussion be understood to mandate that all § 315(b) privity relationships must fall within the fourth “assumed control” category set forth in *Taylor*. Common to our cases, however, is a focus on the relationship between the parties in the context of the prior lawsuit, and an inquiry as to whether the petitioner’s relationship with the prior litigant was sufficiently close that it can be said that the petitioner had, or will have, a full and fair opportunity to litigate the validity of the patent in that prior action.

If we are satisfied that petitioner has “enjoyed its day in court” through its relationship with the litigant, it is fair to consider the parties to be privies. In *Taylor*, the Court held that “a party bound by a judgment may not avoid its preclusive force by relitigating through a proxy. Preclusion is thus in order when a person who did not participate in a litigation later brings suit as the designated representative of a person who was a party to the prior adjudication . . . [I]t also seems clear that preclusion is appropriate when a nonparty later brings suit as an agent for a party who is bound by a judgment.” *Taylor*, 553 U.S. 895.

3. *Patent Owner’s Privity Arguments on Remand*

Patent Owner argues that it “has presented far more than ‘some evidence’ that time-barred parties, including Intel, should have been named

as [an] RPI in the Petition.” PO Remand Resp. 2 (footnote omitted). Patent Owner also argues that it “maintains that Petitioner is in privity with both [REDACTED], two other time-barred parties” and “that discovery should have been granted as to these parties for at least the reasons presented in PO’s portion of the Joint Paper Concerning Additional Discovery.” *Id.* at 2 n.3 (citing Paper 103, 2–5).

Based on those allegations, Patent Owner takes issue with the Murphy Declaration as “merely repeat[ing] its previously-offered attorney argument without providing any additional detail, documentation, or substantiation to those arguments.” PO Remand Resp. 4; *see id.* at 5–6. Patent Owner contends that Mr. Murphy “did not contact anyone within the company or at Intel to discuss whether any Intel parts (accused or otherwise) include any of Petitioner’s components.” *Id.* at 6; *see id.* at 7–11.

Patent Owner contends, *instead*, that “[a]ll Mr. Murphy ‘confirmed’ was that Petitioner does not sell the Intel Accused Products (IAPs) to Intel, something that PO has never alleged.” PO Remand Resp. 6. Patent Owner takes the position that “Petitioner has not established whether or not it was the ‘supplier of any . . . **component** of a product[] accused in the Intel litigation,’ as required by the Board.” *Id.* at 8 (citing Disc. Order 10) (alterations by Patent Owner). Patent Owner further contends that Petitioner’s Declarant, Mr. Murphy, did not consult with the parties or people who would possess relevant information and that Petitioner failed to present any documentary evidence supporting Mr. Murphy’s statements. *Id.* at 9–15.

4. *Petitioner's Privity Arguments on Remand*

Petitioner contends that “Intel and onsemi are not in privity,” and Patent Owner’s “speculative and disproven arguments are not sufficient under *Worlds* or any other known jurisprudence to indicate that onsemi is time-barred.” Pet. Remand Reply 1, 11. According to Petitioner, “[t]he evidence is undisputed that ‘onsemi does not currently and has never sold any of the Intel Accused Products’ and ‘onsemi does not currently and has never sold any component of the Intel Accused Products.’” *Id.* at 1 (footnote omitted) (citing Ex. 2103 ¶ 7). Petitioner contends that “discovery has confirmed that Intel *never* sought indemnity from onsemi for the Intel [l]itigation, which makes sense because no onsemi products were at issue in the case.” *Id.* at 11 (citing Ex. 2103 ¶¶ 7, 8); *see id.* at 6.

5. *Analysis of the Parties' Privity Arguments*

Our analysis below concerns whether Petitioner is in privity with Intel. *See* Dir. Rev. Order 3. *Worlds* is a seminal case that addresses burdens on the parties when § 315 is at issue. In *Worlds*, the Court held that “an IPR petitioner’s initial identification of the real parties in interest should be accepted unless and until disputed by a patent owner.” *Worlds*, 903 F.3d 1242. The Court also “agree[d] that a patent owner must produce *some evidence* to support its argument that a particular third party should be named a real party in interest.” *Id.* “[T]here can be no doubt that the IPR petitioner bears the ultimate burden of persuasion to show that its petitions are not time-barred under § 315(b) based on a complaint served on an alleged real party in interest more than a year earlier.” *Id.* Although *Worlds* addressed RPI, it more broadly discussed § 315 in general, which covers both RPI and privity.

In the present proceeding, Patent Owner did not produce “some evidence” tending to show that Petitioner is in privity with Intel and the burden never shifted to Petitioner. Even if Patent Owner did produce sufficient evidence to put the relationship between Petitioner and Intel into dispute, the evidence adduced during trial and on remand sufficiently supports Petitioner’s position and, in particular, satisfies Petitioner’s burden to show it is not time barred under § 315(b).

The evidence adduced during trial and on remand does not support a finding that the relationship between Petitioner and Intel is sufficiently close such that both should be bound by the trial outcome and related estoppels, nor does it suggest, without more, that the parties were litigating either the district court action or the IPRs as proxies for one another. In a nutshell, the record is devoid of evidence tending to show that Petitioner controlled, or had an opportunity to control, the litigation. To the contrary, as explained below, the only record evidence on point supports Petitioner’s position that it did not control, or have any opportunity to control, the litigation.

Petitioner contends that Patent Owner “does not (and cannot) dispute that onsemi was not aware of the Intel litigation until Friday, April 21, 2023, when Greenthread sued onsemi.” Pet. Remand Reply 1 (citing Ex. 2103 ¶¶ 9, 10). Petitioner further contends that “[b]ecause the Intel litigation was dismissed the very next Monday, April 24, 2023, as a matter of timing, it would have been impossible for onsemi to be involved in the Intel litigation, much less exercise any control over it.” *Id.* Mr. Murphy credibly testifies that onsemi was not “in a position to control,” nor did onsemi “actually control any aspect of Intel’s defense of the Intel [l]itigation.” Ex. 2103 ¶ 10; *see id.* ¶ 9.

In light of the assertions of lack of *actual* participation in and control of, or opportunity to control, the Intel litigation by Petitioner, and the lack of evidence as to whether Intel controlled or had an opportunity to control Petitioner's decisions in the Petitioner-initiated IPRs¹¹, we next consider Petitioner and Intel's relationship, as it relates to the Intel litigation. We consider whether that relationship is sufficiently close such that the Intel litigation would have given Petitioner a full and fair opportunity to litigate the validity of the challenged claim of the '222 patent or whether Petitioner "is simply serving as a proxy to allow" Intel "to litigate the patent validity question that" Intel "raised in an earlier filed litigation." *See WesternGeco*, 889 F.3d at 1319, 1320 ("[T]he privity analysis is broader than simply inquiring whether PGS controlled or had an opportunity to control ION's decisions in the ION patent infringement litigation, or whether ION controlled or had an opportunity to control PGS's decisions in the PGS-initiated IPRs.").

In response to the Board's Discovery Order, Petitioner produced evidence, none of which supports Patent Owner's argument that Intel should be named as a privy so as to put the issue into dispute. *See Dir. Rev. Order 3*. It is worth emphasizing here that, contrary to Patent Owner's position (*see, e.g., PO Remand Resp. 2, 15*), the Director did not indicate that Patent Owner had met its burden of production under the *Worlds* decision. To the contrary, the Director remanded to the Board to allow discovery to determine, on the full record, "whether Patent Owner has produced some

¹¹ Patent Owner does not argue that Intel is an RPI to the present proceeding and there is no evidence in the record for this.

evidence to support its argument that Intel should be named as a privy *so as to have put the issue into dispute*.” Dir. Rev. Order 3 (emphasis added).

Notwithstanding Patent Owner’s arguments, addressed below, we find persuasive Petitioner’s Declarant’s testimony that

[b]ecause onsemi has never sold any of the Intel Accused Products or any component of any of the Intel Accused Products to Intel (*or to anyone else*), I can confirm that onsemi has never signed and does not possess any customer agreements, sales agreements, indemnification agreements, or any other documents concerning the sale of the Intel Accused Products.

Ex. 2103 ¶ 7 (emphasis added). Specifically, Mr. Murphy has been “the Vice President of Sales, Americas, at Semiconductor Components Industries, LLC (‘onsemi’)” for “approximately the last four years,” and has “been employed by onsemi and its predecessor company in various positions for more than twenty-five years.” *Id.* ¶ 3. Because of his “current role and . . . long history in sales-related roles at onsemi,” Mr. Murphy testifies that he is “familiar with . . . whether any particular onsemi product has been sold to Intel Corporation (‘Intel’) in particular.” *Id.* ¶ 4. We are persuaded that his experience supports that he had sufficient knowledge to make the attestation set forth above.

Mr. Murphy’s deposition testimony also supports his Declaration testimony. Ex. 2104, 26:9–13 (“ . . . None of the parts we [onsemi] sell would be part of a[n] Intel CPU”), 33:20–34:8 (“Q. As you sit here today testifying under penalty of perjury, can you tell me definitively whether any of the products listed on Pages 4 through 8 of Exhibit 2048, include an onsemi part or product? A. I can confirm they do not.”), 35:14–19 (“I can confirm that onsemi does not currently and has never sold any of the Intel accused products. And I can confirm that onsemi does not currently and has

never sold any component of the Intel accused products.”), 36:15–17 (“I do not sell any of these accused products or any component of those products to Intel.”), 83:6–12 (“Q. . . . Do you know whether the Intel Atom C2308 in fact included onsemi or Semiconductor Components Industries, LLC parts or elements? . . . [A.] I know that it does not include components of onsemi or Semiconductor Components Industries, LLC.”).

In response to Patent Owner’s allegation that “‘Mr. Murphy clearly admitted that he does not know’ whether the Intel Accused Products include an onsemi part,” Petitioner clarified that “Mr. Murphy misunderstood one line of questions and answered in a way that suggested he did not know whether the Intel Accused Products included onsemi components.” Pet. Remand Reply 12 (citing Ex. 2104, 62:3–17). Petitioner persuasively argues that “Mr. Murphy corrected this misunderstanding both on redirect and in the errata to his deposition.” *Id.* (citing Ex. 2104, 62:3–17, 83:6–84:11, 104:1–22). Petitioner contends, and we agree, that “[t]he full record thus shows that Mr. Murphy knows that the Intel Accused Products ***do not*** include onsemi components.” *Id.* (citing Ex. 2104, 33:20–34:8). We are neither apprised of, nor can discern evidence of, inaccuracies, inconsistencies, or any other impropriety, particularly as Mr. Murphy testified under penalty of perjury.

We agree with Petitioner that “the best source of proof for this *negative* point—*i.e.*, that onsemi *does not supply* the Intel Accused Products or components thereof—is testimony from a person knowledgeable about onsemi’s business” and agree that “Mr. Murphy’s declaration and deposition testimony resolves this question.” Pet. Remand Reply 13; *but see* PO Remand Resp. 14–15.

We did not order a particular style or depth of investigation (*see* Disc. Order 10), nor do we discern that Petitioner’s investigations were in any way insufficient. In particular, we disagree with Patent Owner’s position that compliance with our Discovery Order required Petitioner’s Declarant to contact Intel to determine whether IAPs include components sold or manufactured by Petitioner or distributors, manufacturing fabrication plants, or corporate affiliates as part of their investigation. *See, e.g.*, PO Remand Resp. 9–13. The Declaration produced by Petitioner is sufficient to comply with our Discovery Order.

We further agree with Petitioner’s contention that Patent Owner’s teardown analyses of the IAPs do not tend to show that “any onsemi product that is a component of an Intel Accused Product,” otherwise, Patent Owner would have identified that component in its infringement contentions. Pet. Remand Reply 7–8. Thus, the teardown analysis supports Petitioner’s view that the accused products in the Intel litigation are limited to the enumerated Intel products listed in Exhibit 2048. Our analysis, in that regard, satisfies the Director’s mandate that we resolve, on the full record, whether “Petitioner was a supplier of” products that were “accused of practicing the challenged claims” in the Intel litigation. Dir. Rev. Order 3. The resounding answer is no.

Indirect Sales and Third-Party Resellers

Patent Owner alleges that Petitioner “never investigated whether any of Petitioner’s affiliates, subsidiaries, or third-party resellers provide parts that Intel then incorporates into its products” and “only informed himself of the bare fact that Petitioner does not sell the IAPs themselves and effectively turned a blind eye toward any indirect sales to Intel.” PO Remand Resp 12.

According to Patent Owner, Petitioner’s Declarant, Mr. Murphy, “confirmed that he did no investigation whatsoever into Petitioner’s Terms and Conditions of Sale, indemnity clauses contained therein, or Petitioner’s indemnity obligations to Intel and other customers.” *Id.* at 13. Patent Owner contends that “Petitioner undertook no efforts to learn whether any of its parts are incorporated into Intel processors.” *Id.* at 9. The Discovery Order did not specifically require Petitioner to produce evidence beyond “agreements between Petitioner and Intel related to products accused of practicing the challenged claims.” Disc. Order 3–4. Here again, we observe, the Discovery Order comports with the Director’s mandate for us to investigate and resolve whether “Petitioner was a supplier of” products that were “accused of practicing the challenged claims” in the Intel litigation. Dir. Rev. Order 3.

Nevertheless, “Mr. Murphy also repeatedly explained that the Intel Accused Products do not include any onsemi parts or components.” Pet. Remand Reply 4–5 (emphasis added) (citing Ex. 2103 ¶ 7; Ex. 2104, 26:9–13 (“None of the parts we [onsemi] sell would be part of a[n] Intel CPU.”), 33:20–34:8, 35:14–19, 36:15–17, 83:6–12).

Incorporation of Petitioner’s Products into Non-Accused Intel Products

To the extent Patent Owner is arguing that Petitioner’s investigation is lacking for failure to determine any potential use of Petitioner’s products in *non-accused*, Intel products, even assuming, *arguendo*, that Patent Owner is correct that “[i]t is undisputed that Intel is one of Petitioner’s customers” and “Intel confirms that Petitioner is one of its suppliers,” this argument is unavailing. PO Remand Resp. 2–3 (citing Ex. 2009, 2; Ex. 2104, 63:15–17, 38:1–3; Ex. 2004, 10–13). A “manufacturer-customer relationship alone

does not establish privity,” even with indemnity provisions at least because any such relationship does not concern supplying *IAPs or components thereof*. Pet. Remand Reply 5 (quoting *Samsung Electronics Co. Ltd. v. Netlist Inc.*, IPR2022-00615, Paper 64 at 23 (PTAB June 30, 2023) (citation omitted)); see *WesternGeco*, 889 F.3d at 1321 (“Regarding the pre-suit business alliance, the Board found that ION and PGS had a contractual and fairly standard customer-manufacturer relationship regarding the accused product. This finding does not necessarily suggest that the relationship is sufficiently close” (citations omitted)).

According to Patent Owner, “[p]er its ‘Standard Terms and Conditions of Sale’ (T&Cs), Petitioner indemnifies its customers.” PO Remand Resp. 3 (citing Ex. 2010). Patent Owner asserts that “[t]hese T&Cs apply to all onsemi sales and every customer, including Intel.” *Id.* (citing Ex. 2104, 43:19–44:6, 45:14–46:5 (“Q. Are you aware as to whether or not there is a different agreement in place for sales made by onsemi to Intel? A. No.”)). Patent Owner further contends that Petitioner’s Declarant, Mr. Murphy, “confirmed that the indemnity provisions of Petitioner’s Standard T&Cs require Petitioner to ‘indemnify a buyer based upon a claim of patent infringement of a product purchased from onsemi.’” *Id.* (citing Ex. 2104, 74:15–22). Those arguments are mooted by Mr. Murphy’s unequivocal testimony on point. We agree with Petitioner that the evidence supports a finding that “discovery has confirmed that Intel *never* sought indemnity from onsemi for the Intel [l]itigation, which makes sense because no onsemi products were at issue in the” Intel litigation. Pet Remand Reply 11 (citing Ex. 2103 ¶¶ 7, 8).

Adjacency to IAPs

To the extent that Patent Owner is arguing that Petitioner’s product was accused because it is capable of being in the same system as an IAP (*see* Ex. 2006, Fig. 2; Remand Tr. 22:1–28:2), we find these arguments unavailing. That is not what Patent Owner specifically identified in its infringement contentions as practicing the challenged claim. The system(s) identified by Patent Owner are accused solely on the basis that the infringement derives from the IAPs specifically identified in the list of infringement contentions. *See e.g.*, Ex. 2048, 3–8.

Providing Custom Products to Customers

To the extent that Patent Owner suggests that, because “Petitioner . . . makes custom products for its OEM customers,” such collaboration implies privity, presumably with Intel, we disagree. PO Remand Resp. 3 (citing Ex. 2053; Ex. 2104, 29:2–13). Instead, we agree with Petitioner that “generally collaborating and making custom products” is not dispositive and, instead, “[w]hat matters for privity is that onsemi did **not** make the Intel Accused Products or components thereof.” Pet. Remand Reply 11 (citing Ex. 2103 ¶ 7). *See, e.g., WesternGeco*, 889 F.3d at 1319–22 (the parties “had a contractual and fairly standard customer-manufacturer relationship regarding the accused product,” which “does not necessarily suggest that the relationship is sufficiently close that both” parties should be considered to be in privity); *Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1340–41 (Fed. Cir. 2018)(same); *Samsung*, IPR2022-00615, Paper 64 at 22–26 (same).

Alleged Sub-license to RPX

Patent Owner contends that “Intel confirms that Petitioner is one of its suppliers” and, “[a]s a result, Petitioner received a sublicense as a ‘have made vendor’ to make and sell products to Intel under Intel’s license with PO.” PO Remand Resp. 2–3 (citing Ex. 2004, 10–13; Ex. 2022, 3).

Petitioner correctly points out that Patent Owner’s argument is unavailing because Patent Owner “has not produced the actual sublicense from RPX to Intel; an agreement between RPX and Greenthread cannot create privity between onsemi and Intel; and this RPX agreement does nothing to show a connection between onsemi and the Intel litigation.” Pet. Remand Reply 10–11.

In view of the above, the evidence adduced during trial and on remand does not support Patent Owner’s argument that Intel should be named as a privy so as to put the issue into dispute. *See* Dir. Rev. Order 3 (making plain that the question on remand is whether Patent Owner has met that burden of production). Moreover, even if Patent Owner had met their burden of production, the totality of evidence adduced during trial and on remand does not support a finding that the relationship between Petitioner and Intel is sufficiently close that both should be bound by the trial outcome and related estoppels, nor does it suggest, without more, that the parties were litigating either the district court action or the IPRs as proxies for one another. In a nutshell, the record is devoid of evidence tending to show that Petitioner controlled, or had an opportunity to control, the litigation. To the contrary, the only record evidence on point supports Petitioner’s position that it did not control, or have any opportunity to control, the litigation.

As for Patent Owner’s argument that it “maintains that Petitioner is in privity with both [REDACTED], two other time-barred parties,” and “that discovery should have been granted as these parties for at least the reasons presented in PO’s portion of the Joint Paper Concerning Additional Discovery,” we decline to address this argument. PO Remand Resp. 2 n.3. The Director Review Order made clear that our earlier Final Written Decision was remanded to consider issues of privity with respect to only Intel and we decline to enlarge the scope of the “narrowly tailored” discovery set forth in the Director Review Order. *See Dir. Rev. Order 3.*

Furthermore, [REDACTED] was served with an infringement complaint on [REDACTED], and the Petition in the present proceeding was filed on July 27, 2023—[REDACTED] could not reasonably be, based on the evidence before us, considered a party giving rise to a time bar under § 315(b). [REDACTED] is not alleged to be an RPI or privy of Petitioner. Rather, [REDACTED] is alleged to be an RPI of an alleged RPI—[REDACTED]—a degree of separation that is not contemplated by the clear language of the statute.

II. ANALYSIS

A. *Legal Standards*

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

A claim is unpatentable under 35 U.S.C. § 103(a) if “the differences between the subject matter sought to be patented and the prior art are such

that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103(a). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) when present, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

To show obviousness, it is not enough to merely show that the prior art includes separate references covering each separate limitation in a challenged claim. *Unigene Labs., Inc. v. Apotex, Inc.*, 655 F.3d 1352, 1360 (Fed. Cir. 2011). “Rather, obviousness requires the additional showing that a person of ordinary skill at the time of the invention would have selected and combined those prior art elements in the normal course of research and development to yield the claimed invention.” *Id.* (citing *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007)). “This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.” *KSR*, 550 U.S. at 418–19. On the other hand, an obviousness analysis “need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.” *Id.* at 418; accord *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1259 (Fed. Cir. 2007). Nevertheless, “[a] factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning.” *KSR*, 550 U.S. at 421.

B. Level of Ordinary Skill in the Art

In determining the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995).

Petitioner asserts that a person of ordinary skill in the art “would have had a Bachelor’s degree in electrical engineering, material science, applied physics, or a related field, and four years of experience in semiconductor design and manufacturing or equivalent work experience.” Pet. 5–6 (citing Ex. 1003 ¶ 48). According to Petitioner, “[a]dditional education might compensate for less experience, and vice-versa.” *Id.*

Patent Owner argues that

[a] person of ordinary skill in the art (POSITA) in the technology field of the Challenged Patent would be a person with at least a Bachelor’s of Science degree in electrical or computer engineering, materials science, chemical engineering, applied physics, or a related field, with emphasis on semiconductor manufacturing, or an equivalent degree, and at least four years of experience in semiconductor design and manufacturing. Additional education in a relevant field or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above.

PO Resp. 11 (citing Ex. 2057 ¶¶ 17–18).

Petitioner’s and Patent Owner’s definitions for the level of ordinary skill in the art are substantially similar. In light of the record before us, we adopt Petitioner’s proposal regarding the level of ordinary skill in the art. Based on our review of the ’222 patent and the prior art of record, we determine that the definition offered by Petitioner comports with the

qualifications a person would have needed to understand and implement the teachings of the '222 patent and the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown”) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985)). Patent Owner does not argue that the outcome of our Decision depends on which party’s definition is selected, nor does it.

C. Claim Construction

In an *inter partes* review, we construe claim terms according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b) (2023). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning.” *Phillips*, 415 F.3d at 1312. “[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Id.* at 1313. “Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification.” *Id.*

Neither party proposes any claim terms for *express* construction. Pet. 6; PO Resp. 11–12 (citing Ex. 2057 ¶¶ 20–25, 45). However, Patent Owner implicitly construes “at least one graded dopant concentration to aid carrier movement” to require carrier movement, and Petitioner disagrees. We address the implicit construction below.

After considering the arguments and information presented during trial, we agree that we do not need to expressly construe any terms in order

to decide the disputed issues. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”)).

*D. Objective Indicia of Non-Obviousness*¹²

Patent Owner alleges that a license agreement with RPX Corp. (“RPX”) (“the RPX license”) that covers the patent family including the ’222 patent is evidence supporting the objective indicia of nonobviousness. PO Resp. 2, 34–37. Patent Owner further argues that because the licensees, [REDACTED] Corp. and [REDACTED] Inc., approached Patent Owner through RPX without threat of litigation against them, the RPX license agreement is especially probative of non-obviousness. *Id.* at 34 (citing Ex. 2072). Patent Owner further argues that its invention is “part and parcel of the Greenthread’s licenses because every patent in the family contains claim language relating to using graded dopants to move carriers from the active circuitry at the surface further down into the device. *Id.* at 36 (citations omitted).

Patent Owner bears the burden of establishing that a nexus exists between the objective evidence and the claimed invention. *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019). Nexus is a legally and factually sufficient connection between the objective evidence and the claimed invention, such that the objective evidence should be considered in determining non-obviousness. *Demaco Corp. v. F. Von Langsdorff*

¹² In Section II.F, we refer to the sealed version of the Patent Owner Response (Paper 46).

Licensing Ltd., 851 F.2d 1387, 1392 (Fed. Cir. 1988). “A nexus may not exist where, for example, the merits of the claimed invention were ‘readily available in the prior art.’” *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016) (quoting *Richdel, Inc. v. Sunspool Corp.*, 714 F.2d 1573, 1580 (Fed. Cir. 1983)). “Unlike products, which may incorporate numerous features beyond those claimed or described in a patent and therefore may require careful parsing to establish a nexus, actual licenses to the subject patent do not demand the same, as they are, by their nature, directly tied to the patented technology.” *Ancora Techs. Inc. v. Roku Inc.*, 140 F.4th 1351, 1362 (Fed. Cir. 2025) (citing *Institut Pasteur & Universite Pierre Et Marie Curie v. Focarino*, 783 F.3d 1337, 1347 (Fed. Cir. 2013)).

We find that there is a nexus between the objective indicia and the challenged claim based on the RPX license that includes Application No. 16/717,950 which issued as the ’222 patent in the listing of the patent family covered by the license. *See* Ex. 2072, 19 (Appendix A, Exhibit B); *Ancora*, 140 F.4th at 1362.

Here, Patent Owner relies on the RPX license and asserts that its technique of “creating ‘a drift field to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate’” (PO Resp. 35 (quoting Ex. 1001, 3:52–56)) is “part and parcel” with the RPX license (*id.* at 36). We have considered the RPX license and Patent Owner’s argument.

Even if the RPX license conveys a right to the challenged claim sufficient to support a nexus, we decline to give significant weight to the RPX license. We do not agree with Patent Owner that the RPX license is especially probative because [REDACTED] and [REDACTED] were under no apparent

threat of litigation. *See* PO Resp. 2, 34. Although Patent Owner argues that the RPX license was not motivated by a threat of litigation, and that the expense for [REDACTED] and [REDACTED] to litigate the challenged patents “would have been trivial” (*see id.*), the weight of evidence does not support those arguments. RPX markets itself as a cost-saving service that spreads litigation cost across a large network of companies and “remove[s] patents from circulation before they become costly issues.” Ex. 1051, 1. RPX further markets itself as working on behalf of its clients to prevent potential litigation and associated legal defense costs and settlements. *Id.* at 3.

In view of this evidence, Patent Owner’s argument that [REDACTED] and [REDACTED] entered a license under no apparent threat of litigation is not persuasive because it may reflect the value of RPX as a risk mitigation service and, therefore, on this record, does not reflect the value of the challenged patent specifically. *Cf. Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1353 (Fed. Cir. 2012) (License found to be due to the merits of the claimed invention to support nonobviousness where royalties exceeding the cost of litigation reflected the value of the licensed technology); *Samsung Elec. Co. Ltd. v. Neonode Smartphone LLC*, IPR2021-00144, Paper 59 at 51 (PTAB Dec. 15, 2022) (License found to be due to an interest in “[the patent owner’s] technology exclusively” and not some “other economic reason that might discount . . . interest in exclusively licensing the technology.”).

Unlike in the *Samsung Electric* case, the record here does not provide sufficient evidence that the amount paid for the RPX license is due exclusively to the licensed technology rather than some other economic reason. In addition, unlike in the *Transocean* case, the record here includes

no evidence of the contribution that [REDACTED] and [REDACTED] made towards the lumpsum licensing fee, relative to the contribution of [REDACTED] and/or any other RPX member. The record is not sufficiently developed to determine whether the contribution amounts of [REDACTED] and [REDACTED] are significant compared to the potential cost of litigation. Ex. 2072 ¶ 6.

As to Patent Owner’s argument that the license evidences non-obviousness because “moving carriers ‘from the active circuitry at the surface’ is missing from the prior art” (PO Resp. 36), we disagree for the reasons discussed below. *See Tokai Corp. v. Easton Enters., Inc.*, 632 F.3d 1358, 1369 (Fed. Cir. 2011) (“If commercial success is due to an element in the prior art, no nexus exists.”); *Ormco Corp. v. Align Technology, Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006) (“[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent.”). Accordingly, we find the RPX licenses are not entitled to significant weight.

Having determined the weight to be given to Patent Owner’s licenses, we turn to the evidence and argument regarding the remaining *Graham* factors in evaluating Petitioner’s obviousness contentions as to the challenged claim. Even if we were to give the RPX license significant weight, we determine that Petitioner’s showings of *prima facie* obviousness, particularly in view of the strength of the grounds based on Payne (a single reference obviousness ground) and Sakai and Kawagoe discussed below outweigh Patent Owner’s objective evidence of nonobviousness. *See Tokai Corp. v. Easton Enters., Inc.*, 632 F.3d at 1371 (“A strong case of *prima facie* obviousness . . . cannot be overcome by a far weaker showing of objective indicia of nonobviousness.”).

E. Challenge Based on Payne

Petitioner contends claim 44 would have been obvious in view of Payne. Pet. 5, 11–40.

1. Overview of Payne

Payne “relates to complementary field effect transistors formed by ion implantation, and in particular to a structure and method of fabrication which permit high packing density.” Ex. 1005, 1:5–8. According to Payne, CMOS devices “comprise n-channel and p-channel devices formed in the same substrate,” and they were traditionally “formed by diffusion or implantation of a p-type ‘tub’ in an n-type silicon substrate so that the n-channel device is fabricated in the tub and the p-channel device is fabricated in the adjacent portion of the substrate.” *Id.* at 1:9–18. This method “led to the constraint that the concentration at the surface in the tub was much greater than the surface concentration of the substrate.” *Id.* at 1:18–21.

To avoid this constraint, Payne states that one method was “to form the p-channel device in a second tub of n-conductivity type and higher impurity concentration than a more lightly doped substrate.” *Id.* at 1:24–27. “Using either the single tub or twin tub approach, a considerable amount of semi-conductor area is needed due to the fact that the tub impurities will diffuse laterally as well as vertically during the drive-in to establish the desired tub depth.” *Id.* at 1:34–38. Payne states that “[t]his is particularly troublesome in the twin-tub process since any significant overlap of the two tubs results in decreased doping concentration of each tub at the boundaries which can cause punch through or field inversion channeling during device operation.” *Id.* at 1:39–43. This problem required large spacing of the source and drain regions of the transistors, and Payne seeks to avoid this need by

“provid[ing] a CMOS structure and method of manufacture which requires little semiconductor space.” *Id.* at 1:43–54.

In particular, Payne’s “device is fabricated in a silicon semiconductor substrate, 10, of ‘N--’ conductivity type which . . . is typically approximately 20 mils thick.” Ex. 1005, 2:56–60. On this substrate, tub regions 15 and 17 are formed, one “having the same conductivity type as the substrate but higher impurity concentration” and the other having the opposite conductivity type. *Id.* at 3:35–39, 4:12–14, Figs. 2–5. Surface regions 18 and 20 are formed “covering essentially the same area as” tubs 15 and 17, with each region having the same conductivity type as the tub over which it lies but with higher impurity concentration. *Id.* at 4:31–5:17, Figs. 7–9, 11.

Payne’s CMOS device includes a “p-channel device [that] includes source and drain regions, 21 and 22, respectively, of P+ conductivity type formed with[in] the N surface region, 18” and an “n-channel device [that] includes source and drain regions, 23 and 24, of N+ conductivity type formed within the P surface region 20.” *Id.* at 5:21–27, Fig. 10. Payne states that this approach can reduce the spacing between “source and drain regions of adjacent devices” from 12 microns to 5 microns. *Id.* at 5:54–6:19, Figs. 12, 13.

2. *Petitioner’s Contentions*

Petitioner argues that Payne would have taught or suggested the limitations of claim 44. Pet. 8–40.

[pre] “[a] CMOS Semiconductor device”

Petitioner argues that Payne teaches the preamble. Pet. 12. Payne discloses that “a primary object of [its] invention [is] to provide a CMOS

structure and method of manufacture which requires little semiconductor space.” Ex. 1005, 1:51–54.

Patent Owner does not contest Petitioner’s evidence pertaining to the preamble of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that Payne teaches the subject matter of the preamble of claim 44. As such, we need not and do not determine whether the preamble of claim 44 is limiting.

[44.1] “a surface layer”

Petitioner argues that Payne teaches or suggests this limitation. Pet. 12–14. Petitioner cites evidences that shows that Payne discloses a surface layer similar to that in the ’222 patent. Ex. 1001, Fig. 5(b); Ex. 1003 ¶¶ 68–70; Ex. 1005, 2:50–60, 5:21–27, 6:57–59, Fig. 10; Ex. 1030, 6, 7, 9, 12, 13; Ex. 1033. In particular, Figure 5(b) of the ’222 patent and Payne’s Figure 10 show quite similar structures, and Patent Owner’s district court claim construction brief identified the relevant structure in Figure 5(b) of the ’222 patent as a surface layer. Ex. 1030, 7, 12.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that Payne teaches this limitation of claim 44.

[44.2] “a substrate”

Petitioner argues that Payne teaches this limitation. Pet. 14–15. Payne discloses fabricating its CMOS device “in a silicon semiconductor substrate.” Ex. 1005, 1:60–65, 2:50–60, Fig. 10.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that Payne teaches this limitation of claim 44.

[44.3] “an active region including a source and a drain, disposed on one surface of the surface layer”

Petitioner argues that Payne teaches this limitation. Pet. 15–18. Payne discloses forming p-channel and n-channel transistors, each with source and drain regions. Ex. 1005, 1:5–19, 5:18–29, 6:57–59. Petitioner cites evidence that a person of ordinary skill in the art would have considered the transistors to be active regions. Ex. 1001, Fig. 5(b); Ex. 1030, 6–7, 11; Ex. 1003 ¶¶ 75–77; Ex. 1008B, 299–300.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that Payne teaches this limitation of claim 44.

[44.4] “a single drift layer disposed between the other surface of the surface layer and the substrate, the drift layer having a graded concentration of dopants extending between the surface layer and the substrate”

Petitioner argues that Payne teaches this limitation. Pet. 18–24. Payne discloses a first tub region with a surface region in it that, on the present record, appears quite similar to the single drift layer and well region of the ’222 patent. *Compare* Ex. 1003 ¶ 82; Ex. 1005, 3:28–43, 4:19–39, 5:7–17, 5:44–50, *with* Ex. 1001, Fig. 5(b); Ex. 1030, 7, 11. Payne’s Figure 11 shows a dopant concentration in tubs 15, 17 that decreases with increasing depth. Ex. 1005, 2:38–41, 5:14–17, 5:56–57, Figs. 10, 11.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that Payne teaches this limitation of claim 44.

[44.5] “the drift layer further having a first static unidirectional electric drift field to aid the movement of carriers from the surface layer to an area of the substrate where there are no active regions”

Petitioner argues that Payne teaches this limitation. Pet. 24–33. Petitioner points to the file history of parent U.S. Patent No. 8,421,195 (“the ’195 patent”) and cited references and argues that the presence of a graded dopant concentration similar to that in Payne “creates a ‘built-in’ electrical field that forces the movement of carriers into a particular direction” and that the direction in which carriers are forced with the concentration profile disclosed in Payne is downward, toward the substrate and away from the surface. Pet. 26–31 (citing Ex. 1010, 2:27–32, 5:14–22; Ex. 1020, 289–90) (emphasis omitted). Payne discloses that its active regions are located on the surface, rather than in the substrate. Ex. 1005, 1:5–15, 1:51–54, 2:50–60, 3:28–4:25, 4:31–5:12, 5:18–29, Figs. 1–10.

Patent Owner disputes Petitioner’s evidence pertaining to limitation [44.5]. We resolve the dispute about this limitation in our analysis below.

[44.6] “at least one well region disposed in the single drift layer, the well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of carriers from the surface layer to the area of the substrate where there are no active regions”

Petitioner argues that Payne teaches this limitation. Pet. 33–40. Petitioner argues that Payne’s tub region 15 satisfies this claim limitation to the same extent as the well region that Patent Owner identifies in Figure 5(b) of the ’222 patent, and that this layer has a graded concentration of dopants. Pet. 34–36 (citing Ex. 1001, Fig. 5(b); Ex. 1030, 7; Ex. 1005, 1:65–68, 4:31–39, 4:63–5:14, 5:44–55, Figs. 10–11). Petitioner contends that the presence of this layer creates a second “static unidirectional electric drift field that

aids the movement of minority carriers from the surface layer to the area of the substrate where there are no active regions.” Pet. 38–39; Ex. 1003 ¶¶ 117–121.

Patent Owner disputes Petitioner’s evidence pertaining to limitation [44.6]. We resolve the dispute about this limitation in our analysis below.

3. *Patent Owner’s Arguments*

Patent Owner disputes Petitioner’s showing with respect to Payne. *See generally* PO Resp.; PO Sur-Reply.

i.

First, Patent Owner contends that “Dr. Blalock admitted that, to determine whether a dopant concentration gradient would ‘aid carrier movement,’ he looked *only* at the direction of the slope” and “did not look at the magnitude of the slope or other possible forces acting on a carrier.” PO Resp. 17–18. Citing the testimony of Dr. Glew, Patent Owner takes the position that “the magnitude of the concentration gradient plays a big role, because a small gradient may not be sufficient to overcome the resistance of the material in which the gradient exists.” *Id.* at 18 (citing Ex. 2057 ¶ 51); PO Sur-Reply 15 (citing Ex. 2058, 89; Ex. 2058, 137–138); *see id.* at 15–16 (citing Ex. 2057 ¶¶ 50–51).

Patent Owner further argues that “[a]s Dr. Blalock testified and Dr. Glew confirms, the magnitude of the slope is essential to determine the magnitude of the force the dopant gradient places on the carrier and thus the net force.” PO Resp. 25 (citing PO Resp. § VI.A.2; Ex. 2057 ¶ 58). According to Patent Owner, “[t]he record confirms that simply grading dopants does not *guarantee* carrier movement.” PO Sur-Reply 1 (emphasis added); *see id.* at 2–3. Patent Owner further contends that “[i]n the absence

of an express teaching that a specific gradient disclosed in the prior art is ‘sufficiently graded’ to ‘aid carrier movement’ Petitioner must show that the prior art ‘*necessarily include[s]* the unstated limitation.’” *Id.* at 6–7 (citing *Transclean Corp. v. Bridgewood Servs., Inc.*, 290 F.3d 1364, 1373 (Fed. Cir. 2002); Ex. 2077¹³ (Western District of Texas *Markman* Order), 39–40).

According to Patent Owner, “the specification, like Greenthread’s statements during prosecution, describes the slope of the dopant concentration as a relevant parameter for determining whether a concentration gradient will aid the movement of minority carriers.” PO Resp. 13–14. Patent Owner quotes the specification to support its argument: “[t]he gradient can be linear, quasi linear, exponential or complimentary error function. The relative slope of the donor concentration throughout the base creates a suitable aiding drift electric field, to help the’ carriers move.” *Id.* at 14 (quoting Ex. 1001, 2:60–64); *see also* PO Sur-Reply 16 (discussing disclosures of relative slope in the ’222 patent specification).

Patent Owner also takes the position that Petitioner’s arguments reflect a change in claim construction position. PO Sur-Reply 1.

ii.

Patent Owner argues that “[t]he Petition points to Figures 10-11 of Payne for the claimed ‘graded concentration of dopants’ recited in limitation [44.4],” “[b]ut for the claimed ‘aid the movement of carriers’ feature of limitations [44.5]/[44.6], the Petition relies entirely on Greenthread’s supposed admissions”:

¹³ We also note that Exhibits 2077 through 2081, which were submitted by Patent Owner with its Sur-Reply without prior Board authorization, were stricken. Paper 80 (Motion to Strike, “Mot. Strike”).

Payne’s downward-sloping graded-dopant concentration aids the movement of minority carriers from the surface layer to the substrate—more precisely, to an area of the substrate where there are no active regions, as discussed above— *to the same extent* to which Applicant relied on the prior art and admitted to the Patent Office that such carrier movement would occur under the same scenario.

PO Resp. 24 (quoting Pet. 26) (citing Pet. 37–40); *see id.* (citing Pet. 26–33; Ex. 1003 ¶¶ 95–108, 117–121). Patent Owner further argues that “Dr. Blalock admitted that he did not calculate the slope of the graded concentration curve in Payne.” *Id.*

iii.

Patent Owner contends that “Petitioner cites Wang (Ex. 1013)^[14] in Ground I but it is not apparent (and not clearly explained in the Petition) how Wang might be in any way relevant to Ground I (which is a single reference obviousness ground based on Payne).” PO Resp. 25. According to Patent Owner,

[t]he Petition states that “Dr. Blalock explains that during a so-called single event upset (SEU), an α -ray generates millions of carriers, some of which are produced in or near the active regions at the surface of the substrate” and cites page 431 and Figure 2 of Wang. But the Petition has not clearly explained what [that] has to do with Payne or the Petition’s analysis of Payne. The

¹⁴ Petitioner submits Exhibit 1013 (Wang and Agrawal, *Single Event Upset: An Embedded Tutorial*, 21st Int’l Conf on VLSI Design, 429–434, IEEE 2008), which explains that “soft errors” are “random and not related to permanent hardware faults” and “[t]heir causes may be internal (e.g., interconnect coupling) or external (e.g., cosmic radiation),” including “alpha particles [that] are emitted when the nucleus of an unstable isotope decays to a lower energy state.” Ex. 1013, Abstract, 430.

Petition's discussion of Wang should be disregarded for that reason alone.

Id. at 25–26 (citing Pet. 29–30 (citing Ex. 1013, 431, Fig. 2)). Patent Owner further contends that Petitioner has not established public availability of Wang, “which purports to be from 2008, i.e., four years after the critical date of the Challenged Patent.” *Id.* at 25–26 (citing Ex. 1003 ¶¶ 18, 100; Pet. ix; Ex. 1009, 429 (listing Wang's copyright date as 2008)).

According to Patent Owner,

Dr. Blalock did not cite any other reference or basis for his assertion that during an SEU “some [carriers] are produced in or near the active region at the surface” Therefore, the Petition contains no evidence that a POSITA would have known about SEU carriers at the surface at the time of the Challenged Patent. Accordingly, the Petition cannot properly rely on Wang to demonstrate knowledge of a POSITA regarding any teachings of Payne.

Id. at 26 (citing Ex. 2057 ¶ 59; Ex. 1003 ¶ 100).

Patent Owner contends that “as explained by Dr. Glew—who has experience working with alpha-rays—a POSITA would have understood that in the context of alpha-rays, carriers are rarely created near the surface,” and “[t]herefore, a POSITA would not have thought Wang relevant.” PO Resp. 26–27 (citing Ex. 2057 ¶¶ 10, 60; Ex. 2060, 19:21–34 (“[T]he alpha-particle immediately after irradiation to the surface of a semiconductor body has an energy of several MeV, for example about 5 MeV, and [] accordingly, the probability of creation of electron-hole pairs is extremely low near the surface.” (alteration by Patent Owner)), 20:19–22 (“[T]he amount of electrons created which adversely affect the memory action is no greater than only 10% of the stored electric charge, and thus it can be disregarded.”); PO Resp. § IV.B.2).

iv.

Patent Owner takes issue with Petitioner's single reference obviousness challenge applying Payne:

The Petition attempts to have its cake and eat it too, purportedly pursuing an obviousness ground and yet apparently contending that Payne itself discloses all the elements of the Challenged Claim. In Ground 1 of the Petition, there is no articulated reasoning with any rational underpinning supporting the legal conclusion of obviousness with respect to any limitations of the Challenged Claim, and consequently the Petition's Ground 1 analysis is deficient.

PO Resp. 28. Patent Owner further argues that Petitioner did not demonstrate a reasonable expectation of obviousness with respect to Payne:

[T]he Petition does not analyze for Ground 1 whether a POSITA would have had a reasonable expectation of success regarding any hypothetical obviousness implementation (which the Petition does not even mention)—which is a required component of obviousness analysis even for a single-reference obviousness ground as in the Petition.

Id. at 29 (citing *In re Stepan Co.*, 868 F.3d 1342 (Fed. Cir. 2017)).

Patent Owner contends that the single reference obviousness challenge applying Payne violates Patent Owner's rights under the Administrative Procedure Act—

Patent Owner has had to allocate its resources (word count, time, and cost) without knowing whether Ground I truly is an obviousness ground or not. Clearly, secondary considerations of nonobviousness apply only in the context of an obviousness challenge, and Patent Owner has not presented arguments/evidence regarding various other secondary considerations factors out of concern about potentially wasting words on what appears to not truly be an obviousness ground.

PO Resp. 30–34.

We note that Patent Owner, however, *does* set forth objective indicia of non-obviousness in its Patent Owner Response. *Id.* at 34–37.

4. *Petitioner’s Reply Arguments*

Petitioner responds to Patent Owner’s arguments with respect to Payne. *See generally* Pet. Reply.

i.

Petitioner contends that it “is not arguing that ‘graded’ means ‘aided,’” and that Patent Owner “wrongly suggests that the ‘aid carrier movement’ limitation requires calculating the slope of a dopant concentration, which is not disclosed in the patent, not discussed in the prosecution history, and would be inconsistent with [its] statements in district court litigation.” Pet. Reply 3. Petitioner further contends that Patent Owner’s “own expert, Dr. Glew confirmed . . . that graded dopant concentrations always create electric fields that always interact with carriers—which is exactly what Petitioner argues.” *Id.* at 2 (citing Ex. 1052, 83:13–84:23); *see id.* (citing PO Resp. 14) (quoting Ex. 1020, 29). Petitioner further contends that “[a]s PO’s expert acknowledged, the challenged claims do not require any set number of carriers to move—much less ‘all minority carriers.’” *Id.* at 4 (citing Ex. 1052, 82:19–83:7).

Petitioner also argues that Patent Owner “wrongly tries to ignore the applicant’s representation that a downward-sloping graded dopant concentration was known to create an ‘inherent “built-in” unidirectional electric field’ that sweeps carriers down into the substrate.” Pet. Reply 3 (citing PO Resp. 13; Ex. 1020, 289–290).

Petitioner further takes the position that Patent Owner’s statements during prosecution “do not imply that any specific magnitude or absolute

value of slope is required.” *Id.* at 4. Petitioner supports its contention by pointing to “the specification’s statement that ‘[t]he **relative** slope of the donor concentration throughout the base creates a suitable aiding drift electric field’ does not suggest any specific magnitude is required.” *Id.* at 5 (quoting Ex. 1001, 2:60–64 (emphasis and alteration by Petitioner)).

“Instead,” Petitioner contends that “‘relative’ refers to the directionality of the slope (i.e., increasing or decreasing in concentration), which is consistent with the general presentation of gradient fields in Figures 5B and 5C” of the specification. *Id.* at 5.

ii.

In response to Patent Owner’s *second* set of arguments, Petitioner contends that “PO mischaracterizes the Payne ground” because “[t]he Petition does not ‘rel[y] entirely on Greenthread’s supposed admissions’ to show that the Payne ground satisfies the ‘aid the movement of carriers’ limitation.” Pet. Reply 13 (citing PO Resp. 23). According to Petitioner, “Payne describes a downward-sloping graded dopant concentration, and there is no dispute that the graded dopant concentration will create an electric field that points in the direction required by the claims.” *Id.* at 14 (citing Ex. 1052, 32:15–33:25, 56:20–62:15, 69:3–71:9, 75:15–23, 83:17–89:13, 92:2–94:1, 102:2–109:14, 109:25–116:3, 120:11–123:15, 147:4–151:15). Petitioner further contends that

[w]hile PO insists that hypothetical forces opposing this field may exist, no such forces are identified by PO or PO’s expert. There is also no requirement in the challenged claims that the graded dopant concentration is strong enough to move all carriers, or to accelerate any carrier to a specific speed, or to overcome a hypothetical resistance. The only requirement is “aid[ing] the movement of carriers” for carriers moving in the

recited direction. Thus, for the reasons explained in the Petition, there is no reason to doubt that the gradient dopant concentration in Payne would result in an electric field that “aids the movement of carriers” as claimed.

Id. (citing Ex. 1052, 147:4–151:15; Pet. 24–40).

Petitioner further contends that

Dr. Blalock correctly analyzed Payne, Sakai, and Kawagoe, and explained how those references generate electric fields that “aid carrier movement” in the claimed directions. These electric fields in turn apply a force on carriers going from one surface of a device to another. Because the direction of these electric fields aligns with the direction of carrier movement recited in the claims, the teachings of Payne, Sakai, and Kawagoe meet the “aid carrier movement” limitations.

Pet. Reply 2 (citing Pet. 24–40, 57–67). Petitioner contends that Patent Owner’s “own expert, Dr. Glew confirmed the physics underlying Petitioner’s analysis” when he “testified that ‘a field will provide a force in a direction aiding [] movement in the direction of the force. **That’s just basic physics.**’” *Id.* (citing Ex. 1052, 108:15–109:14) (alteration and emphasis by Petitioner).

iii.

With regard to Patent Owner’s *third* set of arguments, Petitioner contends that Patent Owner’s dispute with respect to Wang is unavailing because Wang is merely cited for background knowledge of a POSITA, which Petitioner further contends was confirmed by Patent Owner’s own prior art, Nishizawa¹⁵, which issued in 1995, before the earliest possible priority date of the ’222 patent. Pet. Reply 14. According to Petitioner,

¹⁵ U.S. Patent No. 5,384,476 issued January 24, 1995 to Nishizawa et al. (Ex. 2060, “Nishizawa”).

Nishizawa “confirms that alpha-ray strikes generate some electrons in the active region, and PO’s expert confirmed that alpha ray strikes from cosmic rays were well known before” the earliest possible priority date of the ’222 patent. *Id.* (citing Ex. 1052, 82:6–83:7, 116:4–123:15; Ex. 2057, 25 n.4; POR, 25-26.).

iv.

Petitioner contends that Patent Owner takes issue with Payne because Petitioner did not identify any claim limitation missing from Payne. Pet. Reply 15 (citing PO Resp. 27, 29). Petitioner contends that “it is well settled that a disclosure that anticipates under § 102 also renders the claim invalid under § 103, for anticipation is the epitome of obviousness.” *Id.* (citing *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1373 (Fed. Cir. 2019) (internal quotations omitted, quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983)). According to Petitioner, as in *Realtime Data*, “it does not matter if Petitioner could have raised Payne [in] an anticipation ground” because “[f]inding that all claim elements are present in Payne (as the Petition shows) is a sufficient basis to find the challenged claims are obvious in view of Payne.” *Id.*

Petitioner also contends that *M&K Holdings, Inc. v. Samsung Elecs. Co.*, 985 F.3d 1376 (Fed. Cir. 2021) is distinguishable, because although the petitioner in that case “expressly stated in its petition that [the prior art reference] did not disclose” a particular limitation, and the petitioner did not “assert or otherwise disclose the particular claim interpretation at issue,” the Board found that the prior art reference disclosed all of the limitations at issue and invalidated the challenged claim based on anticipation. Pet. Reply 15–16 (citing *M&K Holdings, Inc.*, 985 F.3d at 1385). Accordingly, “the

Court found that patent owner ‘was not put on notice that the Board might find that [the prior art reference] disclosed all of the limitations in claim 3 and might invalidate claim 3 based on anticipation.’” Pet. Reply 16.

Petitioner contends similar facts are not present in this proceeding because “Petition plainly asserts that Payne discloses or suggests every element of claim 44, as PO itself acknowledged.” *Id.* at 16 (*comparing* Pet. 11–40 *with*, PO Resp. 28). Accordingly, Petitioner contends “PO has no basis to argue unfair surprise, lack of notice, or other prejudice, *M&K Holdings* is inapplicable.” *Id.*

5. *Analysis of Petitioner’s Contentions and the Parties’ Arguments*

We have considered the cited evidence, including expert testimony, and the parties’ arguments pertaining to the limitations of claim 44 that are in dispute. Below, we set forth our findings and conclusions as to those disputed issues.

i.

With regard to the parties’ arguments concerning the “aid[ing] the movement of carriers from the surface layer to an area of the substrate where there are no active regions” limitation, we briefly summarize the prosecution of U.S. Patent Application No. 11/622,496, the application leading to the parent ’195 patent. During prosecution, the Examiner rejected claims under the pre-AIA version of 35 U.S.C. § 112, first paragraph and found that “movement of minority carriers is affected by multiple forces and fields” and that “it does not appear that simply the presence of ‘a unidirectional drift field’ in itself can achieve ‘drawing *all* minority carriers from said surface layer to said substrate.’” Ex. 1020, 270 (emphasis added); *see id.* at 289. Patent Owner responded with following argument:

[A] unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way - moving all minority carriers in the same direction because of the unidirectional drift due to the existence of the electric field. *See* “Physics and Technology of Semiconductor Devices,” A.S. Grove, pp. 224–225, John Wiley and Sons, Inc., New York, 1st Edition 1967 (“This same electric field will then be of such direction as to aid the motion of injected holes. Thus the injected minority carriers will now move not only by diffusion but also by drift due to the existence of this electric field.”). Depending on the particular slope of the graded concentration of dopant, all minority carriers are either swept “down” (from the surface layer to the substrate) or “up” (from the substrate to the surface layer). *See* Applicant’s Figs. 5(b) and 5(c).

Id. Patent Owner further argued that the Examiner’s argument that the simple presence of a “graded dopant concentration” “does not appear to ensure (without knowing the other parameters of the device) that it will draw ‘all’ minority carriers”

appears to not consider that the graded dopant concentration itself creates a “built-in” electrical field that forces the movement of carriers into a particular direction, whereby the “direction” of the electrical field and the resulting direction of the carrier movement depends *solely* on the slope of the graded concentration of dopant. With regard to the existence of a “built-in” electric field created by a graded dopant density, . . . *this inherent “built-in” unidirectional electric field is the additional parameter for ensuring that all minority carriers are being moved in one direction* and which parameter the Office Action deemed to be missing from the disclosure.

Id. at 289–90 (emphases added). Also, “without conceding its position on this issue,” Patent Owner amended the claims to no longer require “drawing all minority carriers,” and instead, requiring that the claimed “unidirectional

drift field” created by the graded concentration of dopants “aid the movement of minority carriers.”¹⁶ *Id.* at 290.

We determine that the statements made by Patent Owner during prosecution of the ’195 parent patent were clear, unambiguous, and indicate that one of ordinary skill in the art need not know whether there are other “forces and fields” in an electronic device, as the mere presence of a graded dopant concentration creating a “unidirectional drift field,” facing in the appropriate direction, will “aid the movement of minority carriers from” the surface layer to the substrate. Ex. 1020, 270, 289–290. The public was entitled to rely on these clear and unambiguous statements when considering the scope of the challenged claims. *Hockerson-Halberstadt v. Avia Group Int’l*, 222 F.3d 951, 957 (Fed. Cir. 2000) (“The prosecution history constitutes a public record of the patentee’s representation regarding the scope and meaning of the claims, and competitors are entitled to rely on those representation when ascertaining the degree of lawful conduct, such as designing around the claim invention.”).

We agree with Petitioner that, contrary to Patent Owner’s arguments in this proceeding, neither the specification nor the prosecution history requires a calculation of magnitude of a slope to meet the requirements of claim 44—all that is required is a determination of relative slope as described by direction. Pet. Reply 2–3. Petitioner’s arguments about the

¹⁶ The examined claims of the ’195 patent application generally recited “a unidirectional drift field drawing all minority carriers from said surface layer to said substrate.” Ex. 1020, 286. Patent Owner amended the claims of the ’195 patent application to recite “maintain[ing] a single static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.” *Id.*

prosecution of descendent U.S. Patent Application No. 17/728,588 (“the ’588 application”), an application that claims priority to both the ’222 patent and the ’195 patent, are similarly persuasive. During prosecution of the ’588 application, Patent Owner asserted that “relative slope ‘means nothing more than the fact that one side is relatively lower than the other.’” Tr. 24:19–24; Ex. 3011, 9.

Based on the complete record developed during trial, we find that Patent Owner’s statements during prosecution of the ’195 patent and ’588 application, along with the specification of the ’222 patent, support a determination that “a graded concentration curve” is enough to teach aiding carrier movement in a particular direction. We observe, in that regard, that the inventor “did not provide the type of detail in” the ’222 patent’s specification that Patent Owner “now argues is necessary in [the] prior art references.” *In re Epstein*, 32 F.3d 1559, 1568 (Fed. Cir. 1994).

We also find Patent Owner’s arguments pointing to a portion of the specification that discloses what it regards as a “specific slope value that is necessary to ‘aid the movement of minority carriers’” unavailing. PO Sur-Reply 13, 16. Patent Owner points to portions of the ’222 patent discloses that

the donor dopant concentration may be 10 to 100x” at one end of the gradient *compared to the other*. The next sentence recites that “[t]he gradient can be linear, quasi linear, exponential or complimentary error function. *The relative slope* of the donor concentration throughout the base creates a suitable aiding drift electric field....” In the context of a bipolar junction transistor (“BJT”), the specification recites that “the relative doping concentrations of emitter and collector regions varies from 10^{18} to $10^{20}/\text{cm}^3$, whereas the base region is 10^{14} to $10^{16}/\text{cm}^3$.

Id. at 16 (first emphasis added) (quoting Ex. 1001, 2:54–56, 2:58–63 (emphasis added)). All of the disclosed terms are relative: “the relative doping concentrations of emitter and collector regions varies from 10^{18} to $10^{20}/\text{cm}^3$, whereas the base region is 10^{14} to $10^{16}/\text{cm}^3$.” Ex. 1001, 2:54–56, 2:58–63. Further still, these concentrations are set forth with respect to a bipolar junction transistor (BJT) embodiment that is not encompassed by independent claim 44. *See* Tr. 26:1–8. In the BJT embodiment of the ’222 patent, doping concentration moves carriers from emitter to collector, that is, *within* the active region. *Id.* at 25:9–16, 25:19–23. In contrast, independent claim 44 requires moving carriers *away* “from the surface layer to an area of the substrate where there are no active regions.” *Id.* at 25:17–18, 25:23–25; *cf. id.* at 65:14–66:2.

We find persuasive, Petitioner’s quotation from the testimony of Patent Owner’s expert, Dr. Glew—“a field will provide a force in a direction aiding [] movement in the direction of the force. **That’s just basic physics.**” Pet. Reply 2 (citing Ex. 1052, 83:13–84:23, 108:15–109:14) (emphasis by Petitioner). We agree with Petitioner that claim 44 does not require that movement of any particular number of carriers, let alone a need to move all the carriers. *See* Pet. Reply 12–13. We further agree that independent claim 44 is not a method claim—as Petitioner’s counsel explained during the hearing:

[Petitioner’s Counsel]: We’re not dealing with a method claim that has an affirmative step of aiding carrier movement. When the claims say, “one graded dopant concentration to aid carrier movement,” the aid carrier movement limitation is modifying a characteristic of the graded dopant concentration.

Tr. 7:14–18.

In *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018), the Court held that “[a]pparatus claims cover what a device *is*, not what a device *does*.” *ParkerVision*, 903 F.3d at 1361 (quoting *Hewlett-Packard Co. v. Bausch and Lomb Inc.*, 909 F.2d 1464, 1468 (Fed. Cir. 1990)). “[A] prior art reference may anticipate or render obvious an apparatus claim—depending on the claim language—if the reference discloses an apparatus that is reasonably capable of operating so as to meet the claim limitations, even if it does not meet the claim limitations in all modes of operation.” *Id.* Thus, to effectively challenge claim 44, Petitioner must show “a graded concentration of dopants” that is *capable* of “aid[ing] the movement of carriers from the surface layer to an area of the substrate where there are no active regions” as claimed. We are persuaded Petitioner has done so by showing that Payne discloses a graded concentration curve with a slope, in a particular direction, in Figures 10 and 11 of Payne, that is not only reasonably capable, but actually does, move carriers in the claimed direction.

We next address Patent Owner’s arguments that, during prosecution, Patent Owner “disagreed with the Examiner’s conclusion that the claim at issue there (which never issued) should be rejected, but was not disagreeing with the relevant part of the Examiner’s statement” that “[a] gradient is not the only force acting on a carrier.” PO Sur-Reply 13–14. As to the hypothetical opposing forces that Patent Owner asserts are missing from Petitioner’s analysis, neither the specification nor the prosecution history nor any of the prior art mention such forces or a need to compensate for them. We agree with Petitioner that “[t]he challenged claims also do not require

the graded dopant concentration be strong enough . . . to overcome a hypothetical resistance.” Pet. Reply 14.

We disagree with Patent Owner that “Petitioner must show that” these hypothetical opposing forces “would never overwhelm the gradient.” PO Sur-Reply 8. Patent Owner also argues that “[t]he fact that a reference does not explicitly discuss a force does not mean that the force is absent or that a POSITA would disregard it.” *Id.* Even if “it is undisputed that [some] resistance is ‘always’ present” as Patent Owner argues (*id.* (citing Ex. 1052, 146:16–18 (emphasis by Patent Owner))), we disagree with Patent Owner that “[t]o carry its burden, Petitioner must affirmatively show that the other forces are absent or the gradient is stronger” (*id.*). Here again, where the inventor “did not provide the type of detail in his specification that” Patent Owner “now argues is necessary in” Payne, we find “that one skilled in the art would have known how to implement the features of the reference[.]” *In re Epstein*, 32 F.3d at 1568.

Transclean is distinguishable from the facts at issue in the present proceeding because it concerned “anticipation by inherent disclosure” which “is appropriate only when the reference discloses prior art that must necessarily include the unstated limitation.” *Transclean Corp.*, 290 F.3d at 1373 (citing *Cont’l Can Co. v. Monsanto Co.*, 948 F.2d 1264, 1268–69 (Fed. Cir. 1991)). The challenges in the present proceeding, including that based on Payne, are based on obviousness, and are not based on an assertion of inherent disclosure. To the contrary, as explained above, Petitioner relies on the “capability” of a prior art device to perform a claimed function and the *express* disclosure in Payne of a graded dopant concentration that extends from the surface to the substrate. *See ParkerVision*, 903 F.3d at 1361–62.

ii.

In response to the parties’ *second* set of arguments, we disagree with Patent Owner that Petitioner “‘relies entirely on Greenthread’s supposed admissions’ to show that the Payne ground satisfies the ‘aid the movement of carriers’ limitation.” Pet. Reply 13 (citing PO Resp. 23). According to Petitioner, “Payne describes a downward-sloping graded dopant concentration, and there is no dispute that the graded dopant concentration will create an electric field that points in the direction required by the claims.” *Id.* at 14 (citing Ex. 1052, 32:15–33:25, 56:20–62:15, 69:3–71:9, 75:15–23, 83:17–89:13, 92:2–94:1, 102:2–109:14, 109:25–116:3, 120:11–123:15, 147:4–151:15). Petitioner further persuasively contends that

[t]here is also no requirement in the challenged claims that the graded dopant concentration is strong enough to move all carriers, or to accelerate any carrier to a specific speed, or to overcome a hypothetical resistance. The only requirement is “aid[ing] the movement of carriers” for carriers moving in the recited direction. Thus, for the reasons explained in the Petition, there is no reason to doubt that the gradient dopant concentration in Payne would result in an electric field that “aids the movement of carriers” as claimed.

Id. (citing Ex. 1052, 147:4–151:15; Pet. 24–40); *see also* Pet. Reply 2 (citing Pet. 24–40, 57–67).

As set forth above, Petitioner’s arguments are supported by Patent Owner’s “own expert, Dr. Glew, [who] confirmed the physics underlying Petitioner’s analysis” when he “testified that ‘a field will provide a force in a direction aiding [] movement in the direction of the force. **That’s just basic physics.**”” *Id.* (citing Ex. 1052, 108:15–109:14) (second alteration and emphasis by Petitioner). Contrary to Patent Owner’s view, Petitioner’s

arguments are supported by evidence, including the wording of the challenged claim, and do not rely exclusively on Patent Owner's admissions.

iii.

With regard to the parties' arguments concerning Wang's priority date, Petitioner contends that it "supported [its challenge] with citations to Wang" that were "known before the priority date" because the Nishizawa reference, which issued in 1995, "confirms that alpha-ray strikes generate electrons in the active region, and PO's expert confirmed that alpha ray strikes from cosmic rays were well known before" the earliest possible priority date of the '222 patent. Pet. Reply 15 (citing Ex. 1052, 82:6–83:7, 116:4–123:15; Ex. 2057, 25, n.4; PO Resp. 25–26). Even though Wang was published four years after the earliest possible priority date of the '222 patent, Petitioner supports its contention that other evidence in the record supports the assertions for which Petitioner relied on Wang and accordingly, that the evidence relied upon would have been understood by a POSITA as of the earliest possible priority date of the '222 patent.

iv.

Petitioner contends, and we agree, that "it is well settled that a disclosure that anticipates under § 102 also renders the claim invalid under § 103, for anticipation is the epitome of obviousness." Pet. Reply 15 (citing PO Resp. 27, 29; *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1373 (Fed. Cir. 2019) (internal quotations omitted, quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983))). Contrary to Patent Owner's arguments, Petitioner need not have chosen between applying Payne as part of an anticipation challenge, or an obviousness challenge in which a limitation or element is missing from the prior art. Petitioner's obviousness

challenge applying Payne is permissible and comports with precedent. Thus, we agree, that “[f]inding that all claim elements are present in Payne (as the Petition shows) is a sufficient basis to find the challenged claims are obvious in view of Payne.” Pet. Reply 15.

M&K Holdings, Inc. v. Samsung Elecs. Co., 985 F.3d 1376 (Fed. Cir. 2021) is distinguishable from the facts at issue in the present proceeding, because our findings and conclusions with respect to Petitioner’s obviousness challenge over Payne do not deviate from what Petitioner presented—that is, we do not consider an anticipation theory in opposition obviousness challenge presented by Petitioner. Patent Owner was on notice that Petitioner intended Payne to be applied in an obviousness challenge, and disclosed, taught, or suggested all of the limitations of claim 44, as Patent Owner itself acknowledged. *See* Pet. Reply 16 (*comparing* Pet. 11–40 *with*, PO Resp. 28). Accordingly, we agree with Petitioner that “PO has no basis to argue unfair surprise, lack of notice, or other prejudice, [and] *M&K Holdings* is inapplicable.” *Id.*

v.

In light of the Director Review Order, we now admit the district court claim construction rulings in Exhibits 2077 and 2079 submitted by Patent Owner with its Sur-Reply and “give[] them ‘appropriate weight,’” pursuant to the Director Review Order. Dir. Rev. Order 6 (citing CTPG 47). Patent Owner contends that “two district courts have held that the mere gradient itself does not satisfy the ‘aid carrier movement’ limitation.” PO Sur-Reply 4; *see id.* at 12 (“Two district courts have agreed with Greenthread that magnitude is relevant, without reading a ‘specific slope’ into the claims.”) (citations omitted).

With regard to the Western District of Texas Markman Order, Patent Owner contends that the Court “said that ‘the graded concentration has to be sufficiently graded’ to create the electric field that will cause movement and that ‘a graded concentration . . . that is [not “sufficiently graded”] will not ‘aid movement.’” PO Sur-Reply 4 (alterations by Patent Owner) (quoting Ex. 2077, 39–40 (“WDTX Markman Order”)). The Defendant in that case, Cirrus Logic, asserted that the term “graded dopant concentration” was indefinite, as the boundary between “graded” and “uniform” doping concentrations is unclear. Ex. 2077, 32 (citing Ex. 2062 (“the ’195 patent”), 3:45–49; *Berkheimer v. HP, Inc.*, 881 F.3d 1360, 1364 (Fed. Cir. 2018)).

Patent Owner argued in response that the patent provides sufficient guidance as to the meaning of the claim term, with “graded” meaning varying or not “uniform.” Ex. 2077, 37–38 (“Greenthread contends that Figure 1 in the ’195 Patent depicts the difference between uniform and graded concentration, namely, that the concentration in the former is the same across a region while in the latter, the concentration has a slope.”). According to Patent Owner, “[t]he ‘particular slope’ determines the magnitude of the gradient’s force, and this is how the District Court understood the claims.” PO Sur-Reply 13; *see id.* (citing Ex. 2077, 39–40).

With regard to the Eastern District of Texas Markman Order, Patent Owner contends that the court “said that ‘the slope [of the gradient] has both a direction and a magnitude and [d]efendant [incorrectly] suggests that the direction of the drift electric field depends solely on the direction of the slope of the graded concentration.’” PO Sur-Reply 4–5 (alterations by Patent Owner) (quoting Ex. 2079, 9 (“EDTX Markman Order”)). The parties disputed the proper construction of the term “single drift layer . . . having a

graded concentration of dopants . . . said drift layer further having a first static unidirectional electric drift field.” Ex. 2079, 5 (alterations in original). Patent Owner asserted that “no construction [was] necessary,” whereas Defendant [REDACTED] argued that the term should be construed as a “single layer whose concentration of dopants either increases across the layer or decreases across the layer.” *Id.* According to Patent Owner, the EDTX court understood that direction alone does not determine whether a gradient aids carrier movement, as the magnitude of the gradient must also be considered. PO Sur-Reply 5 (citing Ex. 2080, 20).

The EDTX court explained that the dispute distilled into two issues: (1) “whether ‘graded concentration of dopants’ necessarily means the concentration only decreases or only increases across the layer”; and (2) “whether the ‘single drift layer’ is necessarily a single layer.” Ex. 2079, 7.

In addressing the first issue, namely, whether the graded concentration of dopants could both increase and decrease in the drift layer, the EDTX court rejected the suggestion that the prosecution statement concerning the direction of the electrical field and that carrier movement “depends solely on the slope of the graded concentration of dopant” demonstrates that “the slope must be only increasing or only decreasing to maintain a unidirectional drift field.” *Id.* at 8. In rejecting this argument, the EDTX court found that the patentee affirmatively argued during prosecution “that a graded dopant concentration will provide a unidirectional electric drift field to move the minority carriers in a single direction,” and that “[t]his does not clearly foreclose a situation in which the slope of the concentration may be both increasing and decreasing in the drift layer.” *Id.* Contrary to Patent Owner’s arguments, therefore, the EDTX court’s conclusion regarding the scope of

the claims appears consistent with both the Applicant's assertion during prosecution and Petitioner's arguments in this proceeding, i.e., that "a graded dopant concentration will provide a unidirectional electric drift field to move the minority carriers in a single direction." *Id.* at 9.

The WDTX court determined that the term was not indefinite for multiple reasons and that "graded" "describes a sloped doping concentration." Ex. 2077, 39–41. According to the WDTX court, a "graded [dopant] concentration has to be sufficiently graded to result in a 'static unidirectional electric drift field to aid the movement of minority carriers,'" as recited in claim 1 of the '195 patent. *Id.* at 39–40.

We discern no finding in the WDTX court's Order that one must quantify the magnitude of the field in order to know if the electric field will "aid the movement of minority carriers." First, the WDTX court was not addressing the same argument raised by Patent Owner in this proceeding. Rather, it was addressing whether the term "graded dopant concentration" is indefinite.

Second, the WDTX court's Order can reasonably be interpreted to require only that the graded dopant concentration be sufficiently graded to create a "static unidirectional electric drift field," as recited in the claims, which, as the Applicant argued during prosecution and in its claim construction brief before the WDTX, would "aid in the movement of minority carriers." Ex. 2077, 39–40; Ex. 1030¹⁷, 26 ("a [person of ordinary skill in the art] would have readily recognized that when a 'static unidirectional electric drift field' is present that it aids the movement of

¹⁷ We refer to the native numbering in Exhibit 1030.

minority carriers. If it isn't present, then it doesn't."), 28 ("[t]he intrinsic record consistently confirms that the electric fields aid the movement of the carriers."). Against that backdrop, we find unpersuasive Patent Owner's inconsistent contention here "that 'the graded concentration has to be sufficiently graded' to create the electric field that will cause movement and that 'a graded concentration . . . that is [not "sufficiently graded"] will not 'aid movement.'" PO Sur-Reply 4 (alterations by Patent Owner) (quoting Ex. 2077, 39–40).

Conclusion

In view of the foregoing and notwithstanding Patent Owner's alleged objective indicia of nonobviousness discussed below, we are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 44 is unpatentable as obvious over Payne.

F. Challenge Based on the Combination of Sakai and Kawagoe

Petitioner contends that claim 44 would have been obvious in view of the combination of Sakai and Kawagoe. Pet. 5, 40–74.

1. Sakai

Sakai "relates to . . . a CMOS, in which an isolation region between two well regions of opposite conductivity types, each including an insulated gate field effect transistor . . . , is made very small in size to make possible a high-speed operation and large scale integration." Ex. 1006, 1:7–13.

According to Sakai, "[i]n a conventional device . . . , in order to prevent the punch through and short channel effect," doped regions must be placed at least "several micrometers" apart, "which makes it difficult to increase the packing density of CMOS." *Id.* at 1:26–43. To increase the packing density, Sakai describes a process in which the CMOS is formed in "a double well

structure, in which” shallow wells are formed within deep wells, and source and drain regions are formed within the shallow wells. *Id.* at 1:55–2:5.

2. *Kawagoe*

Kawagoe discloses a process for manufacturing a semiconductor integrated circuit device using an epitaxial wafer, i.e., a semiconductor wafer having a semiconductor single crystal epitaxial layer grown over a polished semiconductor substrate. Ex. 1007, 1:13–27, 2:31–35. According to Kawagoe, “[t]he epitaxial wafer is advantageous in that it is excellent in suppressing the soft errors and resisting to the latchup,” as well as “drastically reduc[ing] the defect density of the gate insulating film” of a semiconductor integrated device. *Id.* at 1:33–40.

Kawagoe discloses various “[r]epresentative[]” processes, including processes in which the single crystal (epitaxial) layer contains an impurity of the same type and in the same concentration as the substrate body. Ex. 1007, 2:55–3:9. According to Kawagoe, the impurity concentration of the substrate body can be made higher than that of epitaxial layer “so that the resistance of the semiconductor substrate body can be relatively lowered to improve the resistance to the latchup.” *Id.* at 4:1–8. Kawagoe discloses a process for manufacturing a semiconductor integrated circuit device including a step of forming a semiconductor region (well) extending below the epitaxial layer and having an impurity concentration that decreases with increasing depth below the epitaxial layer. *Id.* at 3:10–25. According to Kawagoe, the well can be used for forming a complementary Metal-Oxide-Semiconductor.Field-Effect-Transistor (“MOS.FET”) circuit. *Id.* at 3:32–38.

Kawagoe describes seven embodiments, including Embodiment 1 (Ex. 1007, 6:41–12:40, Figs. 1–8) and Embodiment 4 (*id.* at 14:46–19:64,

Figs. 16–25). According to Embodiment 1, a semiconductor integrated circuit device includes semiconductor substrate body 2S, epitaxial layer 2E, and gettering layer 2G. *Id.* at 6:51–56, Fig. 1. Substrate body 2S and epitaxial layer 2E are doped with p-type impurity in equal concentrations. *Id.* at 6:60–7:3, 10:51–55, 11:12–16. Embodiment 1 includes n-channel MOS.FET (“nMOS”) 4N and p-channel MOS.FET (“pMOS”) 4P, the latter being formed in n-well 6, which is doped with n-type impurity and extends below the epitaxial layer. *Id.* at 8:46–52, 9:32–40, 11:18–24, 11:43–50, Figs. 1, 5, 7.

According to Embodiment 4, substrate body 2S and epitaxial layer 2E are doped with p-type impurity, and the impurity concentration of substrate body 2S is higher than that of epitaxial layer 2E “to improve the resistance to the latchup.” Ex. 1007, 14:64–15:6, 15:13–17, 16:16–21, 19:59–63, Fig. 17. Embodiment 4 includes p-well 6_p formed with nMOS 4N and n-well 6_n formed with pMOS 4P. *Id.* at 15:26–40, 17:40–18:35, Figs. 16, 21–23. In Embodiment 4, the impurity concentration in p-well 6_p and n-well 6_n decreases with increasing depth below the epitaxial layer. *Id.* at 15:62–16:15, 17:55–61, Fig. 17. Kawagoe discloses that the concentration gradient reduces soft errors by attracting carriers (electrons) to the substrate and preventing them from entering the p-well. *Id.* at 16:2–11.

Petitioner relies on Kawagoe Figures 17 and 23, which illustrate Embodiment 4 and are reproduced below.

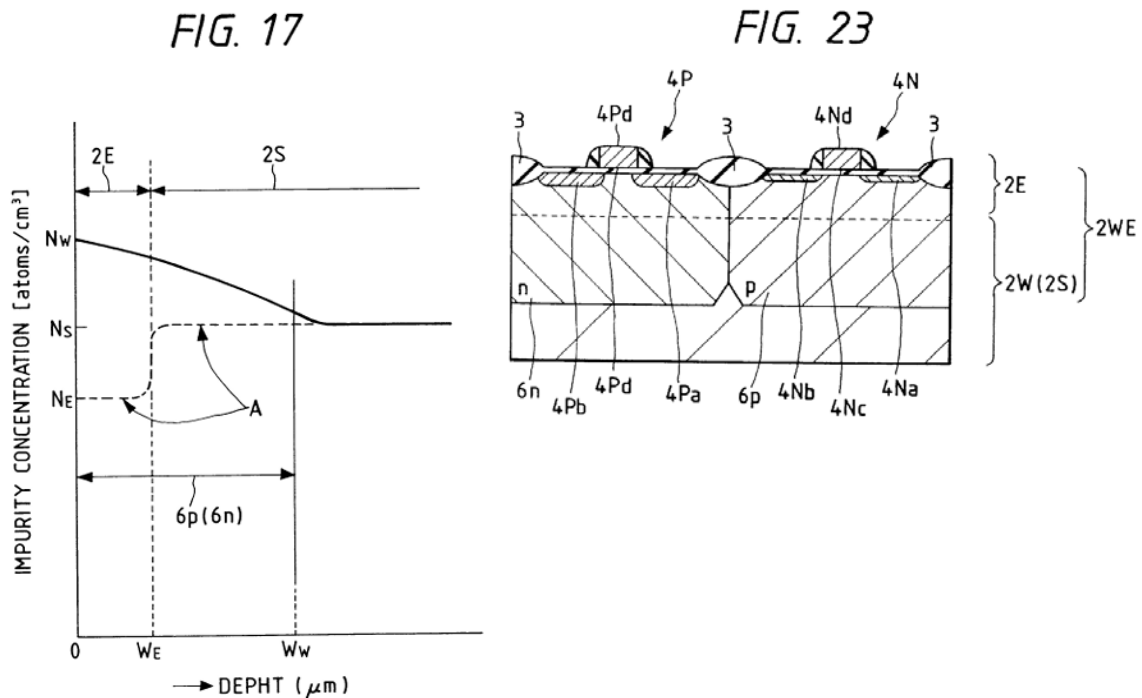


Figure 17 is a plot of impurity concentration as a function of depth in a semiconductor integrated circuit device, which shows “the p-well 6*p* and n-well 6*n* have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_w) of the epitaxial layer 2E.” Ex. 1007, 5:41–45, 15:62–16:40. Figure 23 shows a step in a process for manufacturing a semiconductor integrated circuit device, including p-well 6*p* formed with nMOS 4N and n-well 6*n* formed with pMOS 4P. *Id.* at 5:1–4, 15:26–32, 18:3–35.

3. *Petitioner's Contentions*

Petitioner argues that the combination of Sakai and Kawagoe would have taught or suggested the limitations of the challenged claim and that a person of ordinary skill in the art would have had reason to combine the teachings of Sakai and Kawagoe. Pet. 5, 40–74.

Reason to Combine Sakai and Kawagoe

Petitioner argues that a person of ordinary skill in the art would have had a reason to combine the teachings of Sakai with those of Kawagoe. Pet. 54–57. Petitioner argues specifically that the combination of Sakai and Kawagoe would have achieved both Sakai’s benefit of improving the packing density of CMOS chips and Kawagoe’s benefit of reducing soft errors. On the present record, Sakai discloses that “[i]t is an object of the present invention to provide a CMOS which is very high in packing density,” and Kawagoe discloses that “the impurity concentration of” its wells “is given such a gradient that . . . the influence to be caused by the carriers (or electrons) due to the α -ray is lowered . . . so that the soft errors can be reduced.” Ex. 1006, 1:55–56; Ex. 1007, 16:2–11. Petitioner cites evidence that a person of ordinary skill in the art would have known that “as geometries have been scaled down to produce circuits of greater density, alpha-particle-induced soft-error rates have also become a concern.” Pet. 55; Ex. 1008B, 583. Petitioner establishes that a person of ordinary skill in the art would have had a reason to combine the teachings of Sakai with those of Kawagoe with a reasonable expectation of success.

[pre] “[a] CMOS Semiconductor device.”

Petitioner argues that the combination of Sakai and Kawagoe teaches the preamble. Pet. 40–41. Sakai “relates to a complementary semiconductor device (hereinafter referred to as ‘CMOS’).” Ex. 1006, 1:6–13. Patent Owner does not contest Petitioner’s evidence pertaining to the preamble of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that the combination of Sakai and Kawagoe teaches the subject

matter of the preamble of claim 44. As such, we need not and do not determine whether the preamble of claim 44 is limiting.

[44.1] of claim 44 recites “a surface layer.”

Petitioner argues that the combination of Sakai and Kawagoe teaches this limitation. Pet. 41–43. Petitioner cites evidence that Sakai discloses a surface layer similar to that in the ’222 patent. Pet. 42 (citing Ex. 1001, Fig. 5(b); Ex. 1003 ¶¶ 127–129; Ex. 1005, 1:28–30, 1:68–2:5, 4:25–29, 5:53–55, 5:59, 6:16–17, Fig. 10D; Ex. 1030, 6, 7, 9, 12, 13; Ex. 1033). In particular, Figure 5(b) of the ’222 patent and Sakai’s Figure 10D show quite similar structures, and Patent Owner identified the relevant structure in Figure 5(b) of the ’222 patent as a surface layer. Ex. 1030, 7, 12.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that the combination of Sakai and Kawagoe teaches this limitation of claim 44.

[44.2] “a substrate”

Petitioner argues that the combination of Sakai and Kawagoe teaches this limitation. Pet. 43–45. Sakai discloses “a silicon substrate . . . made of N-silicon or P-silicon.” Ex. 1006, 4:13–14.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that the combination of Sakai and Kawagoe teaches this limitation of claim 44.

*[44.3] “an active region including a source and a drain,
disposed on one surface of the surface layer”*

Petitioner argues that the combination of Sakai and Kawagoe teaches this limitation. Pet. 45–48. Sakai discloses forming p-channel and n-channel

transistors, each with source and drain regions. Ex. 1006, 5:53–55, 5:64–6:4, 6:16–17, Fig. 10D. Petitioner cites evidence that a person of ordinary skill in the art would have considered the transistors to be active regions. Ex. 1001, Fig. 5(b); Ex. 1030, 6–7, 10–12; Ex. 1003 ¶¶ 133–138; Ex. 1008B, 299–300.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that the combination of Sakai and Kawagoe teaches this limitation of claim 44.

[44.4] “a single drift layer disposed between the other surface of the surface layer and the substrate.”

Petitioner argues that the combination of Sakai and Kawagoe teaches this limitation. Pet. 48–50. Sakai discloses a deep P-well region and a deep N-well region that, on the present record, appear quite similar to the single drift layer and well region of the ’222 patent. *Compare* Ex. 1003 ¶¶ 140–143; Ex. 1006, 1:57–67, 5:56–6:4, 7:32–37, Fig. 10D, *with* Ex. 1001, Fig. 5(b); Ex. 1030, 7, 11, 16.

Patent Owner does not contest Petitioner’s evidence pertaining to this limitation of claim 44. We determine that Petitioner demonstrates by a preponderance of evidence that the combination of Sakai and Kawagoe teaches this limitation of claim 44.

[44.5] “the drift layer having a graded concentration of dopants extending between the surface layer and the substrate, the drift layer further having a first static unidirectional electric drift field to aid the movement of carriers from the surface layer to an area of the substrate where there are no active regions.”

Petitioner argues that the combination of Sakai and Kawagoe teaches this limitation. Pet. 50–54. Sakai discloses that the dopant concentration in its shallow well regions is higher than the dopant concentration in its deep

well regions. Ex. 1003 ¶¶ 144–151; Ex. 1006, 5:56–6:4. Petitioner argues that a person of ordinary skill in the art would have understood that, because these varying dopant concentrations were “formed ‘through ion implantation techniques and thermal diffusion techniques,’” the concentration would gradually decrease with increasing depth. Pet. 51 (citing Ex. 1003 ¶¶ 144–151; Ex. 1006, 5:56–6:4, 6:24–28, 6:52–58, 8:35–38). In addition, Kawagoe discloses that the wells of its CMOS device “have their impurity concentrations gradually lowered in the depthwise direction.” Ex. 1007, 15:62–16:40, Figs. 17, 23.

Petitioner argues that the combination of Sakai and Kawagoe teaches this limitation. Pet. 57–61. Petitioner argues that the presence of a graded dopant concentration in the combination of Sakai and Kawagoe “creates a ‘built-in’ unidirectional electric drift field . . . to aid the movement of minority carriers from the surface layer to an area of the substrate where there are no active regions.” Pet. 59–60 (citing Ex. 1003 ¶¶ 160–165). Sakai discloses that its active regions are located on the surface, rather than in the substrate. Ex. 1006, Fig. 10D.

Patent Owner disputes Petitioner’s evidence pertaining to limitation [44.5]. We resolve the dispute about this limitation in our analysis below.

[44.6] “at least one well region disposed in the single drift layer, the well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of carriers from the surface layer to the area of the substrate where there are no active regions.”

Petitioner argues that the combination of Sakai and Kawagoe teaches this limitation. Pet. 61–67. Petitioner contends that, in the combination of Sakai and Kawagoe, each shallow well is disposed in a single drift layer and has a graded dopant concentration. Pet. 61–63 (citing Ex. 1003 ¶¶ 169–174;

Ex. 1006, 1:57–67, 5:56–6:4, 7:32–37, Figs. 10D, 11E; Ex. 1007, 15:62–16:7). Petitioner contends that the combination of Sakai and Kawagoe satisfies this claim limitation to the same extent as the well region Patent Owner identifies in Figure 5(b) of the '222 patent. *Id.* (citing Ex. 1001, Fig. 5(b); Ex. 1030, 7). Petitioner contends that the presence of this layer creates a second “static unidirectional electric drift field that aids the movement of minority carriers from the surface layer to the area of the substrate where there are no active regions.” Pet. 65–67; Ex. 1003 ¶¶ 175–178.

Patent Owner disputes Petitioner’s evidence pertaining to limitation [44.6]. We resolve the dispute about this limitation in our analysis below.

4. *Patent Owner’s Arguments*

Patent Owner disputes Petitioner’s showing with respect to the combination of Sakai and Kawagoe. *See generally* PO Resp.; PO Sur-Reply.

i.

First, Patent Owner contends that the Petition fails to demonstrate that the combination of Sakai and Kawagoe teaches limitations [44.5] and [44.6] of claim 44. PO Resp. 19. Patent Owner contends that “Dr. Blalock admitted . . . that he did not calculate or consider the slope” and only focused on the direction of the slope of Kawagoe’s graded dopant concentration. *Id.* at 19–20 (footnote omitted). According to Patent Owner, “Dr. Blalock admitted that the magnitude of the slope is necessary to calculate the net force on carriers, and it is the *net* force that determines carrier movement.” *Id.* at 20 (citing PO Resp. § VI.A.2 (citing Ex. 2058, 89, 187–188)).

ii.

Second, Patent Owner contends “Kawagoe’s concentration gradient *impedes* carrier movement.” PO Resp. 20 (citing PO Resp. § VI.A.2) (bold

and underline emphasis omitted)). Patent Owner takes issue with Petitioner's truncating of a quotation from Kawagoe and, based on the complete quote from Kawagoe, contends that Kawagoe "teach[es] that the graded concentration actually *inhibits* carrier movement." *Id.* at 21. Patent Owner reproduces the quotation from Kawagoe as follows:

Specifically, the electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient and *prevented from entering the p-well 6p* so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p.

Id. (quoting Ex. 1007, 16:7–11 (emphasis by Patent Owner, highlighting omitted)); *see id.* (citing Ex. 2057 ¶ 52). Instead, Patent Owner argues that

Dr. Blalock admitted that, according to Kawagoe, SEUs generate "electrons produced in the large substrate body below the wells"—far below the surface layer. Kawagoe's electrons are *below* p-well 6p, and prevented from moving *upward* into p-well 6p. Kawagoe's 6p extends to the very top of the device. Therefore, carriers travelling vertically could only enter 6p from below.

Id. at 22 (citing Ex. 2057 ¶ 54; Ex. 2076 ¶ 94, n.6) (footnote omitted); *see id.* (citing Ex. 2057 ¶ 53). According to Patent Owner, "[a] force also cannot push in one direction and 'aid movement' in the opposite direction." PO Sur-Reply 2. Patent Owner further argues that "Petitioner does not dispute Dr. Glew's . . . testimony that 'if two forces are acting on an object in opposite directions, both forces cannot aid its movement.'" PO Resp. 15–16 (citing Ex. 2057 ¶¶ 50–51). Patent Owner further contends,

Dr. Glew confirms (citing Nishizawa) that Kawagoe is discussing carriers outside the surface layer. Nishizawa explicitly states that that probability carriers from an alpha ray at the top of a device is "extremely low" and any such carriers can be "disregarded."

PO Resp. 22–23 n.11 (citing Ex. 2060).

iii.

Third, Patent Owner further contends that “[a]s explained by Dr. Glew—who has experience working with alpha rays/alpha particles—a POSITA would have understood that in the context of alpha-rays, carriers are rarely created near the surface.” PO Resp. 26–27 (citing Ex. 2057 ¶¶ 10, 60; Ex. 1007, 16:7–11; Ex. 2060, 19:21–34 (“the alpha-particle immediately after irradiation to the surface of a semiconductor body has an energy of several MeV, for example about 5 MeV, and that, accordingly, *the probability of creation of electron-hole pairs is extremely low near the surface*” (emphasis by Patent Owner)), 20:19–22 (“[T]he amount of electrons created which adversely affect the memory action is no greater than only 10% of the stored electric charge, and thus it can be disregarded.”)). Based on this understanding, Patent Owner contends that, “[t]herefore, a POSITA would not have thought Wang relevant.” *Id.* at 27 (citing PO Resp. § IV.B.2 (discussing Wang); Ex. 2057 ¶ 60).

Instead, Patent Owner argues that “Dr. Glew confirms (citing Nishizawa) that Kawagoe is discussing carriers outside the surface layer” and “Nishizawa explicitly states that that probability of carriers from an alpha ray at the top of a device is ‘extremely low’ and any such carriers can be ‘disregarded.’” PO Resp. 22–23 n. 11 (citing Ex. 2060).

iv.

Fourth, Patent Owner also argues that “[a]ll of Kawagoe’s (purported) teachings about a gradient that ‘aids carrier movement’ refer to gradients and carriers *outside the active region*.” PO Sur-Reply 9 (emphasis added). According to Patent Owner, “[t]he carriers Kawagoe discusses are

‘prevented from entering the wp-well,’ and are thus below it.” *Id.* (citing Paper 46, 21). Patent Owner further contends that “Dr. Glew testified that Kawagoe only describes that this dopant gradient is able to keep SEU electrons out of the well,’ and says nothing about drawing carriers ‘from the . . . active regions.’” *Id.* at 9–10 (citing Ex. 1052, 121:11–17, 122:6–9). Patent Owner also argues that “Petitioner offers no analysis of Kawagoe’s electric field to show that it has the same effect in the active region as further down.” *Id.* at 10.

In its Sur-Reply, Patent Owner contends that Petitioner advances a new claim construction and that it could not cross-examine Petitioner’s expert, Dr. Blalock, on a rebuttal declaration because he did not submit one. PO Sur-Reply 1. Patent Owner further contends that “[t]he Western District of Texas said that “the graded concentration has to be sufficiently graded’ to create the electric field that will cause movement and that ‘a graded concentration...that is [not “sufficiently graded”] will not’ ‘aid movement.’” *Id.* at 4 (citing Ex. 2077, 39–40) (footnote omitted). Petitioner also contends that, “[i]n another decision, the Eastern District of Texas said that ‘the slope [of the gradient] has both *a direction and a magnitude* and [d]efendant [*incorrectly*] suggests that *the direction* of the drift electric field depends solely on the direction of the slope of the graded concentration.” *Id.* at 4–5 (citing *Greenthread, LLC v. Samsung Elecs. Co.*, 2020 WL 1911200, at *9 (E.D. Tex. Apr. 20, 2020) (Ex. 2079)).

5. *Petitioner’s Reply Arguments*

Petitioner responds to Patent Owner’s arguments with respect to the combination of Sakai and Kawagoe. *See generally* Pet. Reply.

i.

Petitioner contends that its “arguments relating to ‘aid the movement of carriers’ do not rely on an assertion that ‘graded’ means ‘aided.’” Pet. Reply 1 (citing PO Resp. 12) (footnote omitted). Petitioner takes the position that

the Petition and Dr. Blalock correctly analyzed Payne, Sakai, and Kawagoe, and explained how those references generate electric fields that “aid the movement of carriers” in the claimed directions. These electric fields in turn apply a force on carriers going from one surface of a device to another. Because the direction of these electric fields aligns with the direction of carrier movement recited in the claims, the teachings of Payne, Sakai, and Kawagoe meet the “aid the movement of carriers” limitations.

Id. at 1–2 (citing Pet. 24–40, 57–67). Petitioner contends that “PO wrongly suggests that the ‘aid the movement of carriers’ limitation requires calculating the slope of a dopant concentration, which is not disclosed in the patent, not discussed in the prosecution history, and would be inconsistent with PO’s statements in district court litigation.” *Id.* at 3.

ii.

In response to Patent Owner’s *second* set of arguments, Petitioner responds that Patent Owner’s

argument that Kawagoe only teaches “using a graded slope to *impede* carrier movement” is incomprehensible. As PO’s expert Dr. Glew admitted, whether an electric field from a graded dopant concentration aids movement or impedes movement ***depends on the direction of the movement***. It, thus, makes no sense to say an electric field would impede all movement (nor aid all movement): any given electric field will aid electron movement in one direction and impede electron movement in the opposite direction.

Id. at 6 (citing PO Resp. 14–15; Ex. 1052, 83:13–89:13, 92:2–97:8, 102:2–109:14, 109:25–116:3, 121:19–123:15).

Citing Kawagoe’s teaching that “electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well,” Petitioner contends that this “means an electric field aids carrier movement ‘to the substrate body 2S’ and impedes carrier movement in the opposite direction from ‘entering the p-well.’” *Id.* (citing Ex. 1007, 16:2–11, Figs. 17, 23).

iii.

With regard to Patent Owner’s *third* set of arguments, Petitioner further contends that

[w]ithout expert support, PO also wrongly states in footnote 11 that Kawagoe’s concentration gradient would prevent carriers ***above*** well region 6p from entering the well. This is wrong and contrary to the testimony of PO’s own expert. As shown in Figures 17 and 23 . . . (and confirmed by Dr. Glew), the graded concentration in Kawagoe consistently decreases from the surface to the substrate, which means the resulting electric field points in the same downward direction above and below well 6p. Pet. Reply 10–11 (citing PO Resp. 22; Ex. 1007, Figs. 17, 23; Ex. 1052, 110:18–116:3).

Petitioner further contends that “[b]ecause there are electrons in the active region of Kawagoe—regardless of any alpha ray strikes—PO’s discussion of alpha rays is largely irrelevant.” *Id.* at 12 (citing PO Resp. 22–27). Petitioner argues that “Petitioner referenced Kawagoe’s discussion of alpha rays because it illustrates features of the electric field generated by the graded dopant concentration in Kawagoe, but that electric field exists

regardless of whether an alpha ray strike ever occurs.” *Id.* Pointing to Nishizawa, Petitioner further contends

Nishizawa says after an alpha ray strike “several ten thousand electrons will flow into the n+ type region 13,” which is part of the active region. Because the challenged claims do not require a specific number or portion of electrons, it does not matter whether more electrons are also created in the substrate—an alpha ray strike still creates thousands of electrons in the relevant region.[□] Additionally, Nishizawa discloses various examples—which PO ignores—where an alpha ray strike actually generates the majority of electron-hole pairs at a depth closer to a device’s “top-most surface,” contradicting PO’s assertion that the probability of generating electron-hole pairs in this area would be “extremely low.”

Id. at 12–13 (citing Ex. 2060, 19:41–42, 19:54–20:11; Figs. 34–36; Ex. 1052, 82:6–83:7, 116:4–123:15, 123:17–128:11; PO Resp., 22–27) (footnote omitted)).

6. *Analysis of Petitioner’s Contentions and the Parties’ Arguments*

We have considered the cited evidence, including expert testimony, and the parties’ arguments pertaining to the limitations of claim 44 that are in dispute. Below, we set forth our findings and conclusions as to those disputed issues.

i.

With regard to the parties’ arguments concerning the “aid[ing] the movement of carriers from the surface layer to an area of the substrate where there are no active regions” limitation, for substantially the same reasons set forth above in Section II.E.5, Patent Owner’s arguments are unavailing. That is, no particular magnitude or specific numerical value of slope must be shown in order to satisfy claim 44. Petitioner demonstrates that the combination of Sakai and Kawagoe teach the relative slope encompassed by

the scope of independent claim 44. Our reasoning above, presented in the context of the ground based on Payne, applies with equal force here with respect to the challenge applying Sakai and Kawagoe.

ii.

As to the parties' arguments concerning whether Kawagoe discloses aiding or inhibiting the movement of carriers, Petitioner persuasively argues that it is inaccurate to assert that "an electric field would impede all movement" *or* would "aid all movement." Pet. Reply 6. We agree with Petitioner that an "electric field will aid electron movement in one direction and impede electron movement in the opposite direction." *Id.* (citing Ex. 1052, 83:13–89:13, 92:2–97:8, 102:2–109:14, 109:25–116:3, 121:19–123:15); *see id.* (citing Ex. 1007, 16:2–11, Figs. 17, 23). We determine that Patent Owner's expert, Dr. Glew, also agrees. Ex. 1052, 103:25–104:4, 104:14–16, 105:22–106:6. Thus, we agree with Petitioner that Kawagoe's disclosure that "electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well," means an electric field aids carrier movement 'to the substrate body 2S' and impedes carrier movement in the opposite direction 'entering the p-well.'" Pet. Reply 6 (citing Ex. 1052, 83:13–89:13, 92:2–97:8, 102:2–109:14, 109:25–116:3, 121:19–123:15; Ex. 1007, 16:2–11, Figs. 17, 23).

With respect to Patent Owner's argument that "Petitioner does not dispute Dr. Glew's . . . testimony that 'if two forces are acting on an object in opposite directions, both forces cannot aid its movement,'" we determine that this is not the relevant inquiry. PO Sur-Reply 2 (citing Ex. 2057, 29). Patent Owner's litigation position is more on point: "Electric drift fields are a well-known phenomenon that cause carriers to move, and a POSITA

would have readily recognized that when a ‘static unidirectional electric drift field’ is present that it aids the movement of the minority carriers. If it isn’t present, then it doesn’t.” Ex. 1030, 26 (Patent Owner’s Responsive Claim Construction Brief in a related litigation, *supra* § I.C). Patent Owner’s litigation position is also that “[t]he drift field points to one direction and charge carriers, when free to move, respond to the drift field by moving in *one direction or the other depending on their charge polarity.*” *Id.* at 27 (emphasis added). More particularly, Patent Owner contends in the related litigation that

Defendants argue that the claims do not recite a range of doping, a particular doping profile, or a particular result. But this is not the test for indefiniteness. While the claims require that the graded dopants create an electric field that aids movement of the carriers, *they do not require a specific range of doping, a particular doping field, or a particular result, and this information is not necessary to understand the scope of Dr. Rao’s invention.*

Id. at 28 (emphasis added). Thus, Patent Owner’s arguments in this proceeding are unavailing and are inconsistent with positions taken during related litigation.

iii.

With regard to the parties’ arguments concerning alpha ray strikes, we are persuaded by Petitioner’s arguments that Kawagoe’s disclosure that “electrons [are] produced by the α -ray” is illustrative to show how Kawagoe discloses how the graded dopant concentration performs. Even assuming, *arguendo*, that Patent Owner is correct that “the alpha-particle immediately after irradiation to the surface of a semiconductor body has an energy of several MeV” and “the probability of creation of electron-hole pairs is

extremely low near the surface” (PO Resp. 26–27 (citing Ex. 2057 ¶ 60; Ex. 2060, 19:21–34, 20:19–22) (emphasis omitted)), we agree with Petitioner that alpha ray strikes are not even required for the Kawagoe’s graded dopant concentration to create an electric field that will have an effect on a carrier depending on its charge polarity. Pet Reply 12 (citing Ex. 2060, 19:41–42, Figs. 34–36); *see id.* at 13 (citing Ex. 2060, 19:54–20:11).

Further still, Patent Owner’s own evidence, namely, Nishizawa, does not support its position—Nishizawa discloses that

[t]he number of electron-hole pairs which are created in that portion of semiconductor region up to a depth of about 0.8 μm from the surface of the semiconductor body is about 1/50 or less of the total number (which is of the order of 10^6) of those electron-hole pairs which are created in the semiconductor body by a single alpha-particle, where [the] alpha-particle is irradiated in a vertical direction. *In other words, several ten thousand electrons will flow into the n^+ type region 13.*

Ex. 2060, 19:34–42 (emphasis added). Nishizawa further discloses that

in case [an] alpha-particle is irradiated with an inclination there onto, the situation will become different. For example, in case an alpha-particle having an initial energy of 5 MeV impinges onto the surface of a silicon semiconductor body at an angle of incidence of 30° , this alpha-particle will enter into silicon up to a depth of 25 μm . However, the depth measured from the topmost surface of the device is 12.5 μm . Also, *as the initial energy of alpha-particle attenuates, the site at which electron-hole pairs are created in a large number will shift toward and closer to the surface of the device.*

Id. at 19:56–67 (emphasis added).

ParkerVision guides us that the relevant inquiry is whether the graded dopant concentration is *capable* of performing the claimed limitation, *not* how likely the claimed limitation is to be performed or occur. Not only is

Kawagoe’s graded dopant concentration capable of creating an electric drift field absent an alpha ray strike, Petitioner persuasively points out that even if an alpha ray strike were required, Nishizawa indicates that the alpha ray strike could produce electrons near the surface of the CMOS device. *See* Pet. Reply 12–13 (citing Ex. 2060, 19:41–42, 19:54–20:11); Ex. 2060, 19:34–42, 19:56–57.

iv.

In our earlier Final Written Decision that was vacated, we declined to consider Patent Owner’s arguments concerning the location of the graded dopant concentration, because we determined those arguments to be untimely. *See, e.g.*, FWD 51 (citing PO Sur-Reply 9–11). According to Patent Owner, “[a]ll of Kawagoe’s (purported) teachings about a gradient that ‘aids carrier movement’ refer to gradients and carriers outside the active region” and “[t]he carriers Kawagoe discusses are ‘prevented from entering the p-well,’ and are thus below it.” PO Sur-Reply 9 (citing PO Resp. 21). Patent Owner further argues that “Dr. Glew testified that Kawagoe ‘only describes that this dopant gradient is able to keep SEU electrons out of the well,’ and says nothing about drawing carriers ‘from the . . . active regions.’” *Id.* at 9–10 (alterations by Patent Owner) (citing Ex. 1052, 122:6–9; 121:11–17).

In light of the Director Review Order, we expressly consider these arguments from Patent Owner. Patent Owner’s arguments are not persuasive for at least two reasons. First, the challenged claim is drawn to an apparatus. *See ParkerVision*, 903 F.3d at 1361 (“Apparatus claims cover what a device is, not what a device does.” (emphasis omitted)). Thus, Petitioner need not demonstrate actual movement of carriers in Kawagoe, only that the device is

capable of moving such carriers when they are present in the active regions. *Id.* (noting that “a prior art reference may anticipate or render obvious an apparatus claim— depending on the claim language—if the reference discloses an apparatus that is reasonably capable of operating so as to meet the claim limitations, even if it does not meet the claim limitations in all modes of operation”).

Second, Petitioner persuasively demonstrates that although α -ray strikes are far more common in the bulk of the substrate, they will occur in the active region of the transistor, including the channel region. Pet. 29 (citing Ex. 1003 ¶ 100; Ex. 1013, 431 (“A[n] [α -]particle can induce SEU when it strikes at the *channel region* of . . . [a] transistor.” (emphasis added)), Fig. 2); *see, e.g.*, Ex. 2060, 19:21–20:22. Patent Owner does not appear to disagree, but presents evidence that such strikes are rare and can be discounted with respect to the behavior of the device. PO Resp. 22–23 n.11 (“Nishizawa explicitly states that [the] ‘probability of carriers from an alpha ray at the top of a device is “extremely low” and any such carriers can be “disregarded.”’”). In particular, Patent Owner points to Dr. Glew’s testimony on Nishizawa’s disclosure that “the amount of electrons created which adversely affect the memory action is no greater than only 10% of the stored electric charge, and thus it can be disregarded.” Ex. 1052, 127:24–128:2. Petitioner persuasively demonstrates that the graded dopant concentration of Kawagoe will direct these carriers from the first surface to second surface of the substrate. Ex. 1003 ¶¶ 160–178. That such strikes are rare is irrelevant because (1) the claims do not require actual movement of carriers, and (2) even if the claims required movement, the claims do not

limit how frequently such movement must occur, i.e., frequently as opposed to very rarely.

v.

Our discussion of the district court claim construction rulings in Exhibits 2077 and 2079 set forth above in Section II.E.5 applies with equal force to the challenge based on Sakai and Kawagoe.

Conclusion

In view of the foregoing and notwithstanding Patent Owner's alleged objective indicia of nonobviousness discussed below, we are persuaded that Petitioner establishes, by a preponderance of the evidence, that claim 44 is unpatentable as obvious over the combination of Sakai and Kawagoe.

III. CONCLUSION

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/ Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
44	103(a)	Payne	44	
44	103(a)	Sakai, Kawagoe	44	
Overall Outcome			44	

IV. ORDER

For the reasons given, it is:

ORDERED that the Order Granting Motion to Strike (Paper 79) is vacated-in-part with respect to Exhibits 2077 and 2079;

ORDERED that the district court claim construction orders (Exhibits 2077 and 2079) are admitted as evidence;

ORDERED that Petitioner has established, by a preponderance of evidence, that challenged claim 44 of the '222 patent is unpatentable as obvious under 35 U.S.C. § 103(a);

FURTHER ORDERED that, in view of the motions to seal, this Decision is filed “Board and Parties Only”;

FURTHER ORDERED that, after conferring, the parties shall, within one week of this Decision, jointly submit to the Board via email to Trials@uspto.gov, a version of this Decision to be filed in the public record, with any redactions proposed by either party; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of this Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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