

PUBLIC VERSION

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00016
Patent 10,510,842 B2

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

OBERMANN, *Administrative Patent Judge*.

JUDGMENT

Final Written Decision on Remand
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)
Denying Petitioner's Motion to Exclude
37 C.F.R. § 42.64(c)

I. INTRODUCTION

Cirrus Logic, Inc., OmniVision Technologies, Inc., and ams Sensors USA, Inc.¹ (collectively “Petitioner”) filed a Petition requesting *inter partes* review of claims 1–18 of U.S. Patent No. 10,510,842 B2 (Ex. 1001, “the ’842 patent”). Paper 1 (“Pet.”). Greenthread, LLC (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 16 (“Prelim. Resp.”). Petitioner subsequently filed a Preliminary Reply (Paper 20), and Patent Owner filed a Preliminary Sur-reply (Paper 22).

Upon review of the parties’ arguments and supporting evidence, we instituted review with respect to all grounds and claims set forth in the Petition. Paper 30 (“Inst. Dec.” or “Institution Decision”). After institution, Patent Owner filed a Response (Paper 45, “PO Resp.”), to which Petitioner filed a Reply (Paper 52, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 60, “Sur-reply”).²

Petitioner relies, *inter alia*, upon two declarations from Sanjay Banerjee, Ph.D. (Ex. 1003 (original declaration); Ex. 1060 (supplemental declaration)), and Patent Owner relies upon a declaration from Alexander D. Glew, Ph.D. (Ex. 2057).

¹ After the Petition was filed, original Petitioner ams Sensors USA Inc. merged into ams-OSRAM USA Inc. Paper 24 (Petitioner’s Updated Mandatory Notices). On April 10, 2024, the parties filed a Joint Motion to Terminate the Proceedings as to ams-OSRAM USA Inc. (Paper 26), which we granted (Paper 28). The caption of this proceeding was updated accordingly.

² Papers 30, 45, 52, and 60 were filed under seal. Redacted versions are in the record at Papers 34, 47, 53, and 62, respectively. We cite to the sealed versions of confidential exhibits and papers.

An oral hearing was held on January 28, 2025, and a transcript of the hearing is included in the record (Paper 73, “Tr.”).

On April 22, 2025, the Board entered a Final Written Decision in this proceeding (Paper 74). On July 23, 2025, Patent Owner’s request for Director Review (Paper 79) was granted, and the Final Written Decision was vacated and remanded to the Board for further proceedings (Paper 85, “Director Review Order” or “Dir. Rev. Order”).

For the reasons that follow, we again conclude that Petitioner demonstrates by a preponderance of the evidence that claims 1–18 are unpatentable.

II. BACKGROUND

A. Related Matters

The parties indicate that the ’842 patent is at issue in the following district court proceedings:

Greenthread, LLC v. Cirrus Logic, Inc., No. 1:23-cv-00369 (W.D. Tex. filed March 31, 2023);

Greenthread, LLC v. Texas Instruments Inc., No. 2:23-cv-00157 (E.D. Tex. filed April 6, 2023);

Greenthread, LLC v. OSRAM GmbH, No. 2:23-cv-00179 (E.D. Tex. filed April 19, 2023);

Greenthread, LLC v. ON Semiconductor Corp., No. 1:23-cv-00443 (D.Del. filed April 21, 2023);

Greenthread, LLC v. OmniVision Technologies, Inc., No. 2:23-cv-00212 (E.D. Tex. filed May 10, 2023); and

Greenthread, LLC v. Monolithic Power Systems, Inc., No. 1:23-cv-00579 (D. Del. filed May 26, 2023).

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Pet. 1–2; Paper 7, 1–2 (Patent Owner’s mandatory notices).

The parties also indicate that the ’842 patent is at issue in IPR2023-01243. Pet. 2; Paper 7, 2.

B. Real Parties in Interest

Petitioner identifies itself (the two parties identified in the caption) and OSRAM GmbH, Heptagon Holding CA Inc., ams-OSRAM USA Inc., ams-OSRAM AG, and GlobalFoundries, U.S., Inc., as the real parties-in-interest. Pet. 1; Paper 24, 1 (Updated Mandatory Notices); *supra* n.1 (discussing order terminating ams-OSRAM USA Inc). Patent Owner identifies itself as the real party-in-interest. Paper 7, 1.

In a transcript of a telephonic hearing concerning privity, the parties confirmed that ams-OSRAM USA Inc., Heptagon Holding CA Inc., ams Sensors USA, Inc. had all been terminated. Ex. 1076, 10:20–11:3.

C. The ’842 Patent

The ’842 Patent issued December 17, 2019, and claims the benefit of a series of continuation applications, the earliest of which was filed September 3, 2004. Ex. 1001, codes (45), (60). The ’842 patent is titled “Semiconductor Devices with Graded Dopant Regions” and “relates to all semiconductor devices and systems.” *Id.* at code (54), 1:32–33.

The ’842 patent explains that in bipolar junction transistors minority carriers are the principal device conduction mechanism, but notes that majority carriers also play a small but finite role in modulating the conductivity in such devices. Ex. 1001, 1:43–47. The ’842 patent further explains that “[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.” *Id.* at 1:55–57. According to the ’842 patent, this

improvement has not been implemented in most semiconductor devices, including various power MOSFETs and IGBTs, which “still use a uniformly doped ‘drift epitaxial’ region in the base.” *Id.* at 1:57–62. The invention of the ’842 patent implements a graded dopant concentration in these devices, which the ’842 patent contends results in two important performance enhancements: “electrons can be swept from source to drain rapidly, while at the same time holes can be recombined closer to the n+ buffer layer,” thereby improving “ t_{on} and t_{off} in the same device.” *Id.* at 3:38–43.

Figure 1 of the ’842 patent is reproduced below.

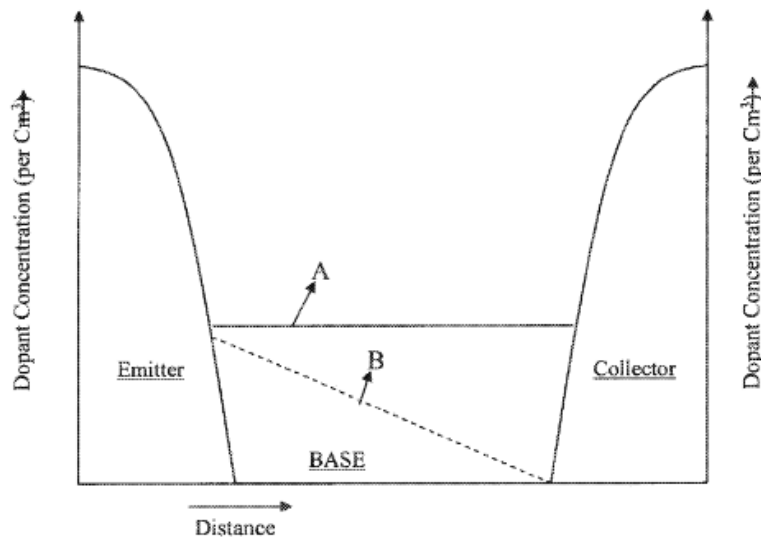


Figure 1 is labeled “Prior Art” and shows a plot of dopant concentration versus distance. Ex. 1001, Fig. 1. According to the ’842 patent, Figure 1 “illustrates the relative doping profiles of emitter, base and collector for the two most popular bipolar junction transistors: namely, uniform base (‘A’) and graded base (‘B’).” *Id.* at 2:35–38.

Figure 3A of the ’842 patent is reproduced below.

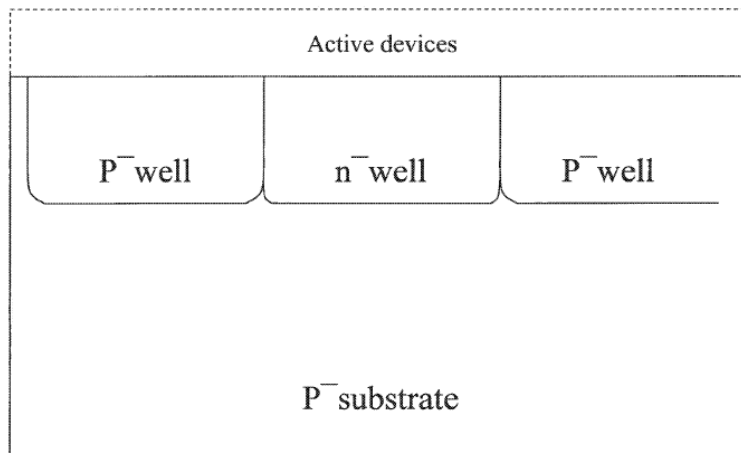


Figure 3A is labeled “Prior art (Twin well CMOS) for a CMOS integrated circuit” (“IC”), and shows a “typical” complementary metal-oxide-semiconductor (“CMOS”) very large-scale integrated circuit (“VLSI”) device that employs “a twin well substrate, on which active devices are subsequently fabricated.” Ex. 1001, 2:16–18, Fig. 3A; *see also id.* at 2:41–46 (explaining that Figure 3A shows a “commonly used prior art CMOS silicon substrate[.]” having “a typical prior art IC with two wells (one n⁻well in which p-channel transistors are subsequently fabricated and one p⁻well in which n-channel transistors are subsequently fabricated)”).

Figures 5A and 5B of the ’842 patent are reproduced below.

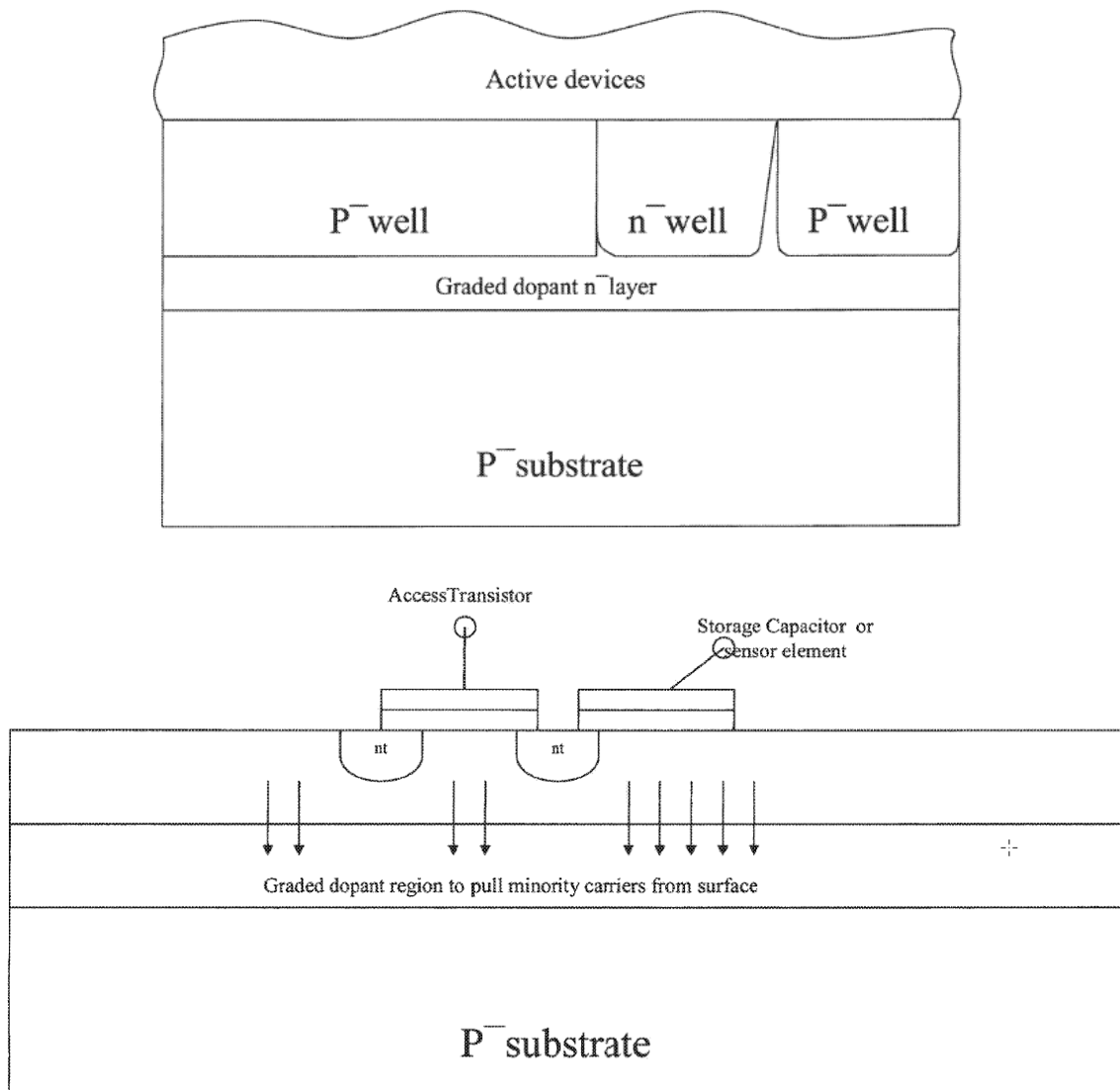


Figure 5A, the top figure, illustrates a cross section of a CMOS silicon substrate with two wells and an underlying layer using embodiments of the invention. Ex. 1001, 2:54–56. Figure 5A is labeled “[a] CMOS Substrate for digital, mixed[] signal, and sen[s]or[] IC’s.” Ex. 1001, Fig. 5A. The figure illustrates “a CMOS silicon substrate with two wells and an underlying layer,” which is labeled “Graded dopant n⁻ layer,” that is above a P⁻ substrate. *Id.* at 2:54–58, Fig. 5A. Figure 5B, below Figure 5A, depicts n-type wells in a P⁻ substrate and includes arrows facing downwards towards

the P⁻ substrate and a label: “Graded dopant region to pull minority carriers from the surface.” *Id.* at Fig. 5B.

The ’842 patent explains that “[s]purious minority carriers can be generated by clock switching in digital VSLI logic and memory ICs” and these “unwanted carriers” degrade performance of various types of devices, including digital imaging ICs. Ex. 1001, 3:47–55. According to the ’842 patent, “a novel technique is described” in which “a drift field [is used] to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate in a monolithic die as quickly as possible.” *Id.* at 3:60–64.

D. Illustrative Claim

Petitioner challenges claims 1–18 (all claims) of the ’842 patent. Claims 1 and 9 are independent, with claim 1 illustrative of the claimed subject matter.

1. A semiconductor device, comprising:

a substrate of a first doping type at a first doping level having first and second surfaces;

a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;

a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;

transistors formed in at least one of the first active region or second active region; and

at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate.

E. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 6–7):

Claims Challenged	35 U.S.C. §³	Reference(s)/Basis
1–18	103(a)	Kawagoe ⁴
1–18	103(a)	Kawagoe, Gupta ⁵
1–3, 5–11, 13–18	103(a)	Wieczorek, ⁶ Wolf ⁷
1–3, 5–11, 13–18	103(a)	Wieczorek, Wolf, Gupta

³ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. § 103, effective March 16, 2013. Because the ’842 patent has an effective filing date before that date, we refer to the pre-AIA version of § 103. Ex. 1001, code (60).

⁴ Ex. 1007, US 6,043,114, issued March 28, 2000 (“Kawagoe”). Petitioner asserts that Kawagoe is prior art under 35 U.S.C. §102(b). Pet. 6.

⁵ Ex. 1014, US 6,163,877, issued December 19, 2000 (“Gupta”). Petitioner asserts that Gupta is prior art under 35 U.S.C. §102(b). Pet. 6.

⁶ Ex. 1006, US 2003/0183856 A1, published October 2, 2003 (“Wieczorek”). Petitioner asserts that Wieczorek is prior art under 35 U.S.C. §§ 102(a), (e). Pet. 6.

⁷ Ex. 1008, Stanley Wolf and Richard N. Tauber, *Silicon Processing for the VLSI Era*, Vols. 1–4, Lattice Press (2000) (“Wolf”). Petitioner asserts that Wolf was published and publicly available no later than 2002, and is prior art under 35 U.S.C. §102(b). Pet. 6 (citing Exs. 1012, 1013, 1036). Exhibit 1008 was submitted in four parts (A–D) and includes selected portions of Wolf.

III. ANALYSIS

A. Legal Standard

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter 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.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). 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 in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

In order to determine whether an invention would have been obvious at the time the application was filed, we consider the level of ordinary skill in the pertinent art. *Graham*, 383 U.S. at 17. In assessing 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) (quotation omitted).

Petitioner contends that a person of ordinary skill in the art (“POSITA”) 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. 10 (citing Ex. 1003 ¶¶ 47–50). Petitioner further contends that “[a]dditional education might compensate for a deficiency in experience, and vice-versa.” *Id.*

Patent Owner contends that a person of ordinary skill in the art would have “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.” PO Resp. 5 (citing Ex. 2057 ¶¶ 17–18). According to Patent Owner, “[a]dditional education in a relevant field or industry experience may compensate for a deficit in one of the other aspects of the requirements stated above.” *Id.*

Upon review of the parties’ arguments and the prior art of record, we adopt Petitioner’s definition of the person of ordinary skill in the art as it is consistent with the disclosures of the ’842 patent and the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (holding that the prior art itself can reflect the appropriate level of ordinary skill in the art). We note, however, that neither party asserts that the outcome of this proceeding would differ based on the minor differences between the two parties’ definitions of an ordinarily skilled artisan. Nor does either party question whether the opposing party’s declarant is a person of ordinary skill in the art under either proposed definition.

C. Claim Construction

In this proceeding, the claims of the ’842 patent are construed “using the same claim construction standard that would be used to construe the

claim in a civil action under 35 U.S.C. [§] 282(b).” 37 C.F.R. § 42.100(b). Under that standard, the words of a claim are generally given their “ordinary and customary meaning,” which is the meaning the term would have had to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc).

Both parties agree that express claim construction is not necessary in order to resolve the issues presented in the Petition. Pet. 10–11; PO Resp. 5–6. We note, however, that Patent Owner asks that we “clarify” that “the plain and ordinary meaning of ‘aid carrier movement’ requires that a carrier move in the specified direction.” PO Resp. 6. Patent Owner also asserts that the “aid carrier movement” limitation cannot be met “in situations where there is no carrier movement—an absurd result.” *Id.* We address these “aid carrier movement” arguments below in our discussion of the obviousness ground based on Kawagoe.

D. Timeliness of the Petition

Pursuant to 35 U.S.C. Section 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 untimely. PO Resp. 33. In particular, Patent Owner argues Petitioner is in privity with [REDACTED]⁸ Intel Corp. (“Intel”),

⁸ During the pre-institution phase of this proceeding, Patent Owner asserted a privity relationship between Petitioner and [REDACTED] but identified no evidence sufficient to support a finding that Petitioner provided a product

and [REDACTED] (collectively “Licensees”), who Patent Owner asserts are time-barred under Section 315(b) and licensed under the ’842 patent. *Id.* at 43–44.

Prior to institution, Patent Owner’s arguments regarding privity were based on several theories, including that “[b]y making custom licensed products for Licensees, Petitioners step into their shoes, and serves as their ‘agent,’ by exercising Licensees ‘have made’ rights under the license.” Prelim. Resp. 3. Patent Owner also argued that Petitioner and the Licensees are “preceding and succeeding owners of licensed (or infringing) products,” that Petitioner is a beneficiary of the Licensees’ agreements related to accused products, that Petitioner’s licensed sales encumber otherwise infringing articles, and that Petitioners apparently indemnify the time-barred parties for custom-made products. *See id.* at 3, 22–30.

The question of whether Petitioner is time-barred under Section 315(b) is part of the determination of whether to institute an inter partes

that was accused of infringement in the [REDACTED] litigation. *See* Prelim. Resp. 3–4 (identifying the [REDACTED] litigation), 7–12, 16–18, 26–29 & n.6 (declining to identify any product provided by Petitioner that was accused in the [REDACTED] litigation). During the trial phase of this proceeding, by contrast, Patent Owner expressly limited its privity assertions to Petitioner’s alleged relationships with Intel and “both [REDACTED] and [REDACTED] two other time-barred parties,” effectively waiving any argument that Petitioner is time barred based on a privity relationship with [REDACTED] Paper 90, 2 n.3. In view of that waiver, we do not address any alleged privity relationship with [REDACTED]. Alternatively, because Patent Owner produced no evidence at any time during this proceeding sufficient to establish that Petitioner had an opportunity to control the [REDACTED] litigation or is acting as a proxy for [REDACTED] in this proceeding, we find that Petitioner was not in privity with [REDACTED] during the [REDACTED] litigation and no time bar arises on that basis under Section 315(b). *See id.*

review. *See Thryve, Inc. v. Click-to-Call Techs., LP*, 590 U.S. 45, 54 (2020) (Section “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. 23–24), or that Petitioner and Intel were privies, based on any of its theories regarding privity. *Id.* at 12–24. We incorporate that analysis here, and reconsider Patent Owner’s contentions only to the extent it is warranted by subsequent argument and evidence adduced on remand. *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).

The Director Review Order remands “to the Board with instructions to allow discovery, narrowly tailored to [a] privity issue” relating to an alleged relationship between Petitioner and a non-party, Intel, “as the Board already has authorized in” a number of related cases. 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 [Section] 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)).

On July 25, 2025, we issued a Discovery Order (“Disc. Order,” Paper 87), “narrowly tailored,” consistent with the Director Review Order, ordering Petitioner to provide the following discovery to Patent Owner in the present proceeding (as well as in IPR2024-00001):

(a) . . . documents [including]:

[i. s]ales agreements between Petitioner and Intel for the Intel Accused Products;⁹ and
[ii. i]ndemnification agreements between Petitioner and Intel for the Intel Accused Products. *See* IPR2023-01242, Paper 94, 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 2–3.

In response to our Discovery Order, Petitioner produced and Patent Owner filed the Declarations of Terence Ng (Ex. 2080), Elizabeth Leach (Ex. 2081), and Robert Cleary, Jr. (Ex. 2082). Patent Owner cross-examined these witnesses and filed deposition transcripts for each respective declarant (Exs. 2083, 2084, 2085).¹⁰ Patent Owner subsequently filed Patent Owner’s Post-Remand Brief Concerning Board-Ordered Discovery (“PO Remand Resp.,” Paper 94), Petitioner filed Petitioner’s Responsive Post-Remand

⁹ The “products accused” consist of “the ‘Intel Accused Products’” identified on pages 4–8 of Exhibit 2021, namely, the Intel “products accused of practicing the challenged claims” in Patent Owner’s prior litigation.

¹⁰ The record includes two of each of Exhibits 2083, 2084, and 2085, a public version and a sealed version. We cite to the *sealed* version of each of these exhibits.

Brief (“Pet. Remand Reply,” Paper 98), and Patent Owner filed Patent Owner’s Reply Post-Remand Brief (“PO Remand Sur-Reply,” Paper 100).¹¹

We conducted a telephonic hearing on September 19, 2025 (“Remand Tr.,” Ex. 1076). Having considered the evidence of record, we determine that Petitioner is not in privity with Intel, and the Petition is not time-barred under Section 315(b).

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 (arguing that time-barred parties “should have been named as RPIs” after submitting that Petitioner was required “to produce ‘actual evidence’ to prove lack of privity”); PO Remand Sur-Reply 2 (focusing on Petitioner’s alleged “failure to provide any meaningful evidence of a lack of privity” then referring to burden of proof to show proper identification of “all real-parties-in-interest”).

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 real parties-in-interest, but not privies). Prior to analyzing the parties’ arguments, for clarity, we summarize the concept of privity below.

1. Statutory Bar as Nonparty Preclusion

The one-year statutory bar of Section 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.*, Case IPR2014-01242, Paper 16 at 3 (PTAB Feb. 11, 2015) (citing H.R.

¹¹ We cite to Papers 94, 98, and 100, which are the sealed versions of the above-identified documents.

REP. NO. 112-98 at 48, *as reprinted in* 2011 U.S.C.C.A.N. at 78). In this sense, Section 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 Section 315(b). *See* CTPG 12–17.

Like the common-law preclusion doctrines, the preclusive effect of Section 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.¹²

(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

¹² We omit internal quotation marks and citations throughout the list of categories enumerated in *Taylor*, add emphasis on certain key phrases, and generally cleaned up the quotations.

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 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,” is inconsistent with Federal common law, and risks 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 Section 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.

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*, Case IPR2014-00746, slip op. at 10 (PTAB Nov. 24, 2014) (Paper 22) (inquiring into whether party exercised, or could have exercised, control over District Court action); *see also* Practice Guide, 77 Fed. Reg. at 48,759 (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 Section 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 Arguments

Patent Owner argues that it “has presented far more than ‘some evidence’ that time-barred parties, including Intel, should have been named as RPIs.” PO Remand Resp. 2. Patent Owner also argues that it “maintains that Petitioners are in privity with both [REDACTED] and [REDACTED] two other time-barred parties,” and “that discovery should have been granted as to these parties for at least the reasons presented in the Joint Paper Concerning Additional Discovery in the Wave 1 (*onsemi*) IPRs.” *Id.* at 2–3 n.3 (citing IPR2023-01242, Paper 108 at 2–5).

With respect to *Cirrus Logic*, Patent Owner argues that it “is a fabless semiconductor company that sells component parts to Intel through distributors” and that its “declarant [Elizabeth Leach] confirmed that its Standard T&Cs, which indemnify its customers for infringement claims (EX2026), apply to *all* customers, including Intel.” *Id.* at 2–3 (citing Ex. 2084, 17:14–20, 26:12–13, 55:10–16, 63:6–15).

With respect to *OmniVision*, Patent Owner argues that it “has historically supplied ‘a variety of [OV] products, primarily image sensors,’ to Intel” and that its [REDACTED] and that he has historically ‘fielded [] indemnity requests’ on behalf of OV.” *Id.* at 3 (alterations by Patent Owner) (citing Ex. 2085, 25:2–9, 27:19–21, 39:12–17, 47:7–16; Ex. 2015 (Intel data sheet listing OV image sensors)).

With respect to *Global Foundries*, Patent Owner similarly argues “GF is a ‘custom manufacturer’ touting Intel as one of its customers” and that [REDACTED]

[REDACTED]
[REDACTED] *Id.* (citing Ex. 2014, 19; Ex. 2083, 19:6–8, 18:10–12, 37:5–11, 37:22– 38:3 (Intel purchase orders), 38:8–22 (Intel manufacturing agreements); Ex. 2033).

Based on those allegations, Patent Owner takes issue with Petitioner’s declarations as “merely repeat[ing] its previously-offered attorney argument without providing any additional detail, documentation, or substantiation.” PO Remand Resp. 4–5; *see id.* at 5–6. Patent Owner contends that “[t]hese declarants did not contact anybody within their companies (save for one *uncorroborated* assertion from Cleary) or, more importantly, at Intel to discuss whether any Intel parts (accused or otherwise) include any of Petitioners’ components.” *Id.* at 7; *see id.* at 7–10.

Patent Owner contends, *instead*, that “[a]ll these declarants ‘confirmed’ was that Petitioners do not sell the Intel Accused Products (IAPs) to Intel, something that PO has never alleged.” *Id.* at 7. Patent Owner takes the position that “[n]one of the Petitioners have established whether or not they were the ‘supplier of any . . . **component** of a product[] accused in the Intel litigation,’ as required by the Board.” *Id.* at 8 (citing Disc. Order 3). Patent Owner further contends that Petitioner’s Declarants did not consult with the parties or people who would possess relevant information and that Petitioner failed to present any documentary evidence supporting their Declarants’ statements. PO Remand Resp. 10–15.

4. *Petitioner’s Arguments*

Petitioner contends that it “is not in privity with Intel, and the IPR petition is not time-barred.” Pet. Remand Reply 1. According to Petitioner, it “does not have any sales or indemnification agreements with Intel or indemnity obligations to Intel for the IAPs.” *Id.* Petitioner further contends

that, “Intel neither sought indemnity from Petitioner nor contacted any Petitioner regarding *Greenthread, LLC v. Intel Corp.*, 6:22-cv-105 (W.D. Tex.) (‘Intel Litigation’).” *Id.* Petitioner also contends that “[n]o Petitioner either controlled or was in a position to control Intel’s defense” at least because “Petitioner was not even aware of the Intel Litigation until PO filed complaints against CL and OV.”¹³ *Id.* With respect to each of GlobalFoundries, Cirrus Logic, and OmniVision, Petitioner presents specific reasons why these companies could not have produced the IAPs or components thereof, which we address in detail in the next subsection.

5. *Analysis of the Parties’ Arguments*

Our analysis below concerns whether Petitioner is in privity with Intel. *See* Dir. Rev. Order 3; Remand Tr. 13:4–14:17 (Petitioner’s counsel asserting that privity, not RPI, is in dispute in the present proceeding). *Worlds* is a seminal case that addresses burdens on the parties when Section 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 at 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 Section 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

¹³ The parties use the following abbreviations: CL for Cirrus Logic, OV for OmniVision, and GF for Global Foundries.

more broadly discussed Section 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 Section 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 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 “[n]o Petitioner either controlled or was in a position to control Intel’s defense,” at least because “each Petitioner was not even aware of the Intel Litigation until PO filed complaints against CL and OV.” Pet. Remand Reply 1. According to Petitioner’s Declarant Terrence Ng, GlobalFoundries “became aware of the Greenthread Intel Litigation only around June 2023” and “was not aware of the Greenthread Intel Litigation before that.” Ex. 2080 ¶ 11. Declarant Elizabeth Leach testifies that “Cirrus Logic did not become aware of any litigation involving Greenthread . . . and Intel until after Cirrus Logic itself was sued by

Greenthread on March 31, 2023.” Ex. 2081 ¶ 8. Likewise, Declarant Robert Cleary, Jr. testifies that, with the filing of Greenthread’s infringement complaint in the Eastern District of Texas, “OmniVision first became aware of the complaint on the next day, May 11, 2023” and “first became aware of the Greenthread Intel Litigation and the Intel IPR proceedings on May 15, 2023.” Ex. 2082 ¶ 10.

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 IPRs¹⁴, we next consider Petitioner’s 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 claims of the ’842 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. *See* Dir. Rev. Order 3. It is worth emphasizing here

¹⁴ Patent Owner does not argue that Intel is an RPI to the present proceeding and there is no evidence in the record for this.

that, contrary to Patent Owner’s position (*see, e.g.*, PO Remand Resp. 2), 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 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) (citing *Worlds*, 903 F.3d at 1242–44).

We are not persuaded that Petitioner is in privity with Intel because the evidence of record supports the following findings: (1) “[n]o Petitioner has supplied any IAPs” (Pet. Remand Reply 3); (2) each of Petitioner’s Declarants “has stated under penalty of perjury and under oath that it has not supplied any components of the IAPs;” (*id.* at 6) (3) “[s]ince Petitioner has not supplied any IAPs (or components thereof) to Intel, there are no agreements pertaining to the IAPs, as confirmed by Petitioner’s investigations (*id.* at 10); and (4) Petitioner did not have control over the Intel litigation it was “not even aware of the Intel Litigation until PO filed complaints against CL and OV” (*id.* at 1; *see id.* at 10–11).

Notwithstanding Patent Owner’s arguments, addressed below, we find persuasive Petitioner’s Declarants’ testimony. Specifically, with respect to *GlobalFoundries*, Declarant Ng has been in sales at GlobalFoundries U.S. Inc. since 2019, and “was promoted to Sales Director in 2022” which required him to “provid[e] customers commercial support and work[] with customers to bring future business to GF.” Ex. 2080 ¶ 4. In 2023, Declarant Ng’s “responsibilities included managing GF’s sales relationship with Intel.” *Id.* ¶ 5. We are persuaded Ng’s experience supports that he had sufficient knowledge to attest to his testimony that Global Foundries “has never

manufactured or sold any Intel Accused Products to Intel, and . . . is unaware of having supplied any components of Intel Accused Products.” *Id.* ¶ 8.

According to Petitioner, Declarant Ng “explained that GF lacks the process technology to manufacture Intel processors and flash memories enumerated in PO’s infringement contentions.” Pet. Remand Reply 4 (citing Ex. 2083, 15:12–15, 48:11–17). Petitioner contends that GlobalFoundries



Id. (citing Ex. 2083, 18:13–19:5, 24:8–14). Petitioner persuasively contends that “none of these products can be incorporated into an IAP because they are not designed to be components of a microprocessor or flash memory.” *Id.* at 8 (citing Ex. 2083, 16:1–3, 48:5–17). Petitioner also persuasively contends that Declarant Ng’s “testimony confirms that GF does not and cannot provide any components that are included in the IAPs” because “[t]he IAP processors are manufactured as one piece of silicon (e.g., a 300 mm wafer) which does not have any components from third parties.” *Id.* at 8. In support, Declarant Ng “testified that [the] ‘[p]rocessor is one piece. So either you make it or you don’t, so there are no different parts of it.’” *Id.* (second alteration by Patent Owner) (citing Ex. 2083, 16:1–3).

In view of the foregoing, it follows that GlobalFoundries “never entered into any sales agreements with Intel (or with any other party) regarding the Intel Accused Products or entered into any indemnification agreements with Intel (or with any other party) regarding the Intel Accused

Products.” Ex. 2080 ¶ 8. In support, Declarant Ng testified during deposition as follows:

Q. And the latter part of that sentence states: And GF is unaware of having supplied any components of Intel accused products. Do you see that?

A. Yes.

Q. What do you mean by “unaware”?

A. GF doesn't make or sell any of these components.

Q. And what do you mean when you're saying “any of these components”?

A. These processors or the NAND flash of accused product, I guess, yeah, uh-huh.

Remand Tr. 13:8–19.

With respect to *Cirrus Logic*, Declarant Leach has “been employed by Cirrus Logic in various positions for more than 14 years,” has “held various sales roles during that period,” and is now “the Manager [of] Sales Administration for Cirrus Logic, Inc.” Ex. 2081 ¶ 2. We determine, on that basis, that she is qualified to know “Cirrus Logic’s product sales and customers, including whether any Cirrus Logic products have been sold to Intel Corporation.” *Id.* ¶ 3. We are persuaded her experience supports that she had sufficient knowledge to attest that “Cirrus Logic does not currently and has never sold any of the Intel Accused Products” and “has never sold any component of the Intel Accused Products to Intel.” *Id.* ¶ 6.

Declarant Leach persuasively testifies that Cirrus Logic has not provided to Intel

Pet. Remand Reply 9 (citing Paper 79, 3). Indeed, Patent Owner apparently acknowledges this point as its Request for Director review of our Final Written Decision states that “CL collaborates

with Intel to manufacture audio chips that are *compatible with* Intel’s processors *for use in laptops*.” Paper 79, 3 (emphasis added). As such, it follows that Cirrus Logic “never signed, created, or received any sales agreements or indemnification agreements relating to the Intel Accused Products,” that “Intel has never submitted to [Declarant Leach]” or “[her] team an indemnification request regarding the Intel Accused Products,” nor has ever “tendered any patent infringement indemnification request to Cirrus Logic regarding the Intel Accused Products,” as confirmed by Cirrus Logic’s legal team. Ex. 2081 ¶¶ 6, 7.

With respect to *OmniVision*, Declarant Cleary is “OmniVision’s General Counsel” and has been since August of 2019. Ex. 2082 ¶ 4. He “worked in the legal department of OmniVision since January 2018.” *Id.* We are persuaded his experience supports that he had sufficient knowledge to attest to his testimony. Declarant Cleary persuasively testifies that he “confirmed that OV does not design and is not involved in the design of processors or flash memory products, and has never sold any IAPs to Intel,” “has only supplied image sensors to Intel” and [REDACTED] [REDACTED] Pet. Remand Reply. 4–5 (citing Ex. 2082 ¶¶ 7, 8; Ex. 2085, 10:22–11:1, 25:6–11, 27:19–28:8). According to Petitioner, Declarant Cleary

also repeatedly explained that PO’s components argument is misguided because OV supplied image sensors, which cannot function within a processor or flash memory device. An image sensor must receive light, and as such, would not be a component of a processor or flash memory. As PO appears to admit, image sensors are separate components and not integrated into processors or flash memory.

Id. at 9 (citing Ex. 2085, 25:6–11, 27:10–13, 36:2–3, 45:22–46:4, 50:14–52:1, 51:6–12, Paper 79, 10). Patent Owner apparently acknowledges that

“image sensors are separate components and not integrated into processors or flash memory” because in its Request for Director Review of the Final Written Decision, Patent Owner states that it “produced evidence that tends to show that OV sold image sensor chips (directly or indirectly) to Intel for use in Intel’s camera systems.” Paper 79, 10.

Petitioner also states that Patent Owner’s “own infringement contentions from the Intel Litigation confirm that IAPs do not have any components that are supplied by the Petitioner.” Pet. Remand Reply. 6. In particular, Petitioner notes that “[e]xhibits to those contentions demonstrate that, as part of the Intel Litigation, PO procured a wide variety of Intel processors and flash memories and conducted detailed teardown analyses of those products, i.e., PO disassembled those products and analyzed the internal structure of the IAPs.” *Id.* (citing Ex. 2021, 48–112). Petitioner contends that, accordingly, Patent Owner’s

own infringement contentions from the Intel Litigation confirm that PO was aware that the accused Intel processors are a single chip and do not contain any components that are supplied by any third parties, much less Petitioner. Otherwise, PO would have eagerly identified such components and suppliers of such components in its infringement contention.

Mirroring the Intel processors, PO stated in its infringement contentions that *Intel* designs and fabricates the accused flash memory products. Specifically, PO alleged that “flash memory products [are] designed or manufactured (in whole or in part) by Intel” and excerpted . . . [an] image . . . stating that “exemplary product was manufactured by Intel and bears Intel die marks.”

Id. at 7 (citing Ex. 2021, 8).

In view of the foregoing, it follows that “OmniVision has never entered into any sales agreements with Intel (or with any other party)

regarding the Intel Accused Products or entered into any indemnification agreements with Intel (or with any other party) regarding the Intel Accused Products.” Ex. 2082 ¶ 8.

We see no issue as to Petitioner’s inability to provide purchase orders or other documents that would prove a negative—that Petitioner did not sell the IAPs or components thereof to Intel. Patent Owner alleges that Petitioner’s Declarants “cabined their ‘investigations’ to just reviewing the list of IAPs.” PO Remand Resp. 7. According to Patent Owner, for example, Declarant “Leach admitted that she *did not investigate* whether any amplifiers of DACs manufactured by CL fabs or foundries are included in Intel products.” *Id.* at 9 (citing Ex. 2084, 29:22–30:21). This is beyond the scope of the Discovery Order, which required, sales and indemnifications agreements “*between* Petitioner and *Intel* for the Intel Accused Products,” “as well as any documents and new declaration(s) that establish . . . whether Petitioner was the supplier of *any product, or component of product, accused of infringement in the Intel litigation.*” Disc. Order 2–3 (emphasis added). The Discovery Order did not specifically require Petitioner to adduce evidence concerning whether Petitioner supplied products or components to Intel for use in or with other Intel products not accused in the Intel Litigation.

6. *Indirect Sales and Third-Party Resellers*

Patent Owner takes the position that Petitioner’s Declarants’ investigations included insufficient efforts to learn whether any of its parts or products are or were, in any way, incorporated into Intel processors in post-transfer, downstream transactions because “none of Petitioner’s declarants contacted their company’s distributors, resellers, affiliates, or the fabs and foundries that manufacture Petitioner’s parts.” PO Remand

Resp. 11–12. The Discovery Order did not specifically require Petitioner to produce evidence beyond agreements between Petitioner and Intel concerning products accused of practicing the challenged claims. Disc. Order 2–3. Stated differently, the Discovery Order did not require Petitioner to produce evidence of any *indirect* sales of its components or products to Intel that occurred after Petitioner surrendered control of the items. Disc. Order 2–3; *cf.* PO Remand Resp. 2–3 (“CL is a fabless semiconductor company that sells component parts to Intel through distributors”) (citing Ex. 2026; Ex. 2084, 17:14–20, 26:12–13, 55:10–16, 63:6–15). Such evidence, in any case, would be insufficient to establish privity between Petitioner and Intel based on control of, or an opportunity to control, the relevant litigation.

According to Patent Owner, Cirrus Logic’s Declarant “confirmed that its Standard T&Cs, which indemnify its customers for infringement claims (EX2026), apply to *all* customers, including Intel.” PO Remand Resp. 3 (citing Ex. 2084, 55:10–16, 63:6–15). Similarly, Patent Owner contends that OmniVision’s Declarant confirmed that its “[REDACTED],” and that he has historically ‘fielded [] indemnity requests’ on behalf of OV.” *Id.* (alterations by Patent Owner) (citing Ex. 2085, 39:12–17, 47:7–16). Patent Owner also contends that GlobalFoundries’s Declarant confirmed that its “[REDACTED]” “[REDACTED]” “[REDACTED]” *Id.* (citing Ex. 2083, 37:5–11, 37:22–38:3, 38:8–22; Ex. 2033). Petitioner’s Declarants’ testimony “confirm[] that Intel did not make any indemnity demands to any Petitioner.” Pet. Remand Reply 10 (citing Ex. 2080 ¶¶ 11, 12; Ex. 2083,

49:6–21; Ex. 2081 ¶¶ 7, 9; Ex. 2084, 62:8–21; Ex. 2082 ¶¶ 9, 11, 12); *see e.g., id.* at 1–2. We agree with Petitioner that

[l]ack of demand from Intel simply underscores the fact that Petitioner has not supplied the IAPs (or any components thereof). If Intel believed that Petitioner supplied any of the accused technology, Intel would have been highly motivated to ask Petitioner to indemnify Intel for those claims.

Pet. Remand Reply 10–11.

*7. 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 Cirrus Logic, OmniVision, or GlobalFoundries products in *non-accused* Intel products (PO Remand Resp. 2–3), this argument is unavailing. A “manufacturer-customer relationship alone does not establish privity” at least because any such relationship does not concern supplying *IAPs or components thereof*. *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”). The Discovery Order did not specifically require evidence of sales of components to Intel for integration in non-accused Intel products because, even if such evidence existed, it would be insufficient to establish privity between Petitioner and Intel based on control of, or an opportunity to control, the relevant litigation.

8. Providing Custom Products to Customers

To the extent that Patent Owner suggests that, because “CL ‘engineers work closely’ with customers to make custom products” or “GF is a ‘custom manufacturer’ touting Intel as one of its customers,” such collaboration

implies privity, presumably with Intel, we disagree. PO Remand Resp. 3 (citations omitted). Generally collaborating and making custom products is not dispositive and, instead, what matters for privity is that Petitioner did not make the Intel Accused Products or components thereof such that Petitioner was in a position to or had opportunity to control the relevant litigation and should not be provided a second bite at the same apple. *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 Electronics Co. Ltd. v. Netlist Inc.*, IPR2022-00615, Paper 64 at 22–26 (PTAB June 30, 2023)(same).

We did not order a particular style or depth of investigation (*see* Disc. Order 2–3), 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 the Discovery Order required any of Petitioner’s Declarants to undertake discovery from Intel to determine whether any IAPs that were accused of infringement in the related litigation included components sold or manufactured by Petitioner, much less contact distributors, manufacturing fabrication plants, or corporate affiliates as part of their investigation to discover whether any of Petitioner’s products ultimately were included in such IAPs. *See, e.g.,* PO Remand Resp. 10–12. The respective Declarations produced by Petitioner are sufficient to comply with the Discovery Order.

With respect to the same Petitioner in a related case, when Patent Owner was asked what discovery it sought to substantiate its privity theory, Patent Owner stated that “no additional discovery is needed.” IPR2024-

00017, Ex. 3011, 1. Thus, it is not clear to us what Petitioner could have produced that would satisfy Patent Owner's demands for an adequate investigation. Moreover, we are directed to no evidence of inaccuracies, inconsistencies, or any other impropriety, particularly as Petitioner's Declarants testified under penalty of perjury.

We further agree with Petitioner's contention that Patent Owner's teardown analyses of the IAPs do not tend to show that the IAPs "contain any components that are supplied by any third parties, much less Petitioner," "[o]therwise, PO would have eagerly identified such components and suppliers of such components in its infringement contentions." Pet. Remand Reply 7. Thus, the teardown analyses support Petitioner's view that the accused products in the Intel litigation are limited to the enumerated Intel products listed on pages 4–8 of Exhibit 2021. *Id.* at 7–8; *see* Ex. 2021, Appendix A-1 through A-6 (Intel Accused Products analysis). Our analysis, in that regard, comports with the Director's mandate, in IPR2023-01242, 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. *See* IPR2023-01242, Paper 94, 3. The resounding answer is no.

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. Further, the record is devoid of evidence that Petitioner had any opportunity to control the Intel litigation.

As for Patent Owner’s argument that it “maintains that Petitioners are in privity with both [REDACTED] and [REDACTED] two other time-barred parties,” and “that discovery should have been granted as to these parties for at least the reasons presented in the Joint Paper Concerning Additional Discovery in the Wave 1 (*onsemi*) IPRs,” we decline to address this argument. PO Remand Resp. 2–3 n.3 (citing IPR2023-01242, Paper 108 at 2–5). The Director Review Order made clear that our original 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 January 23, 2023 (*see* Ex. 2009), and the Petition in the present proceeding was filed in October of 2023—[REDACTED] could not reasonably be, based on the evidence before us, considered a party giving rise to a time bar under Section 315(b). [REDACTED] is not alleged to be an RPI or privy of Petitioner. *See* PO Resp. 36 (identifying Licensees as [REDACTED] Intel, and [REDACTED]). Rather, [REDACTED] is alleged to be an RPI of an alleged RPI—[REDACTED] (*see* PO Resp. 34–35)—a degree of separation that is not contemplated by the clear language of the statute.

E. Objective Indicia of Non-obviousness

Objective indicia of non-obviousness, or secondary considerations of non-obviousness, serve “an important role as a guard against the statutorily proscribed hindsight reasoning in the obviousness analysis,” and must be

considered in every case in which they are presented. *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328 (Fed. Cir. 2016). Objective indicia of non-obviousness may include evidence of a long-felt need in the art, praise within the industry, skepticism in the industry about whether or how a problem could be solved, copying, and commercial success. *Id.* at 1132–37.

To be probative of non-obviousness, Patent Owner must prove there is a nexus between the presented evidence and the merits of the claimed invention. *See Demaco Corp. v. F. Von Langsdorff Licensing Ltd.*, 851 F.2d 1387, 1392 (Fed. Cir. 1988).

1. The Parties' Arguments

Patent Owner contends that during its prior litigation with [REDACTED] RPX Corp. (“RPX”) approached Patent Owner about negotiating a license for [REDACTED] PO Resp. 26 (citing Ex. 2072 (Rao Declaration)). Patent Owner contends it never threatened [REDACTED] [REDACTED] with litigation in any way prior to the license negotiations. *Id.* Patent Owner further contends that as part of litigation settlements at least five large, sophisticated parties have taken licenses, with eight major semiconductor companies now having paid more than \$50 million for licenses to just one patent family. *Id.* at 29.

Patent Owner does not specifically address the nexus requirement, but asserts that licenses taken without threat of litigation are especially probative of non-obviousness, and contends even litigation-inspired licenses have some probative value. PO Resp. 26–27, 29 (citing *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012); *Fox Factory Inc. v. SRAM LLC*, IPR2017-00472, Paper 64 at 44). Patent Owner contends [REDACTED] are sophisticated

companies who frequently file IPR petitions, yet both paid for licenses covering just the single patent family at issue here. *Id.* at 26–27.

Petitioner argues in its Reply that licenses that result from settlement require affirmative evidence of nexus because it is often cheaper to take a license than to defend infringement suits, and [REDACTED] licenses were made through RPX, which structures its arrangements to avoid litigation costs. Pet. Reply 27–28. Petitioner further argues that a recent license for the relevant patent family was made for a greatly reduced amount. *Id.* at 28.

Patent Owner argues in its Sur-reply that “[p]aying money for a patent license, when no litigation is threatened only makes sense if the licensee thinks the patent is valid and valuable.” Sur-reply 24. Patent Owner further argues that the sales volume for the recent licensee was lower than Patent Owner’s other licensees, which “confirms the value” of Patent Owner’s patents. *Id.*

2. Analysis of the Parties’ Arguments

The ’842 patent is part of a family of patents related to graded dopant concentrations in transistors. Ex. 1001, code (60). Patent Owner provides persuasive evidence that the patent family at issue has generated significant licensing revenue both from settlements during litigation and during direct negotiations with parties who had not been threatened with litigation. “Unlike products,” moreover, “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).

Against that backdrop, we find that there is a nexus between the objective indicia and the challenged claims based on the RPX license that includes Application No. 15/590,282, which issued as the '842 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. Patent Owner, on that point, relies on the RPX license to [REDACTED] and asserts that the technique of “creating ‘a drift field to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate’” is “part and parcel” with the RPX license. PO Resp. 28 (quoting Ex. 1001, 3:52–3:56). Nevertheless, for the four reasons set forth below, we determine that this evidence is insufficient to support a finding of non-obviousness.

First, even though Patent Owner establishes a nexus between its licensing revenue and the merits of the '842 patent, that evidence does not outweigh the strong evidence of obviousness presented by Petitioner. Patent Owner asserts that the innovative and “novel technique” of the patent family is creating “a drift field to sweep . . . unwanted minority carriers^[15] from the active circuitry at the surface into the substrate.” PO Resp. 28. For the reasons discussed below, Petitioner persuasively demonstrates that Kawagoe and Wieczorek each individually disclose a drift field to sweep carriers from the first surface to the second surface. Thus, the allegedly novel advancement of the '842 patent is found in the prior art. *See Yita LLC v. MacNeil IP LLC*, 69 F.4th 1356, 1364 (Fed. Cir. 2023) (“But our case law makes clear that objective evidence of nonobviousness lacks a nexus if it

¹⁵ The claims of the '842 patent do not require sweeping unwanted “minority carriers.” PO Resp. 28. Rather, the claims of the '842 patent are more broadly directed to “carrier movement.” Ex. 1001, 4:57–60.

exclusively relates to a feature that was *known* in the prior art—not necessarily well-known.” (internal quotations and citations omitted)).

Second, even though the RPX license conveys a right to the challenged claims sufficient to support a nexus, we decline to give significant weight to that license. We do not agree with Patent Owner that the RPX license is especially probative because [REDACTED] were under no apparent threat of litigation. *See* PO Resp. 3–4, 26–27. Although Patent Owner argues that the RPX license was not motivated by a threat of litigation, and that the expense for [REDACTED] to litigate the challenged patents “would have been trivial” (*id.* at 27), 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. 1067, 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 SK [REDACTED] entered a license under no apparent threat of litigation is not persuasive because RPX is a litigation risk mitigation service and, therefore, on this record, the license may reflect the value of avoiding the risk of litigation rather than 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.”).

Third, 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] 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] are significant compared to the potential cost of litigation. Ex. 2072 ¶ 6 (redacted) (Declaration of Mohan Rao, a founder of Greenthread, LLC (*see id.* ¶ 1)).

Fourth, and finally, 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. 28), 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.”).

For all of these reasons, 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 Kawagoe (a single reference obviousness ground) and Wieczorek and Wolf discussed below outweigh Patent Owner’s objective evidence of nonobviousness. *See Tokai*, 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.”).

F. Claims 1–18 in View of Kawagoe

Petitioner contends the subject matter of claims 1–18 would have been obvious over the disclosures of Kawagoe. Pet. 15–45.

1. 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,”¹⁶ and also has “excellent breakdown characteristics” that “drastically reduce the defect

¹⁶ Petitioner submits Exhibit 1009 (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 “[a]lpha particles [that] are emitted when the nucleus of an unstable isotope decays to a lower energy state.” Ex. 1009, Abstract, 430. Dr. Banerjee characterizes “latchup” as “a ‘short-circuit’ failure condition in poorly designed circuits.” Ex. 1003 ¶ 77.

density of the gate insulating film” of a semiconductor integrated device. *Id.* at 1:33–40.

Kawagoe discloses various “representative” 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 the 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 14:46–19:63, Figs. 16–25). Figure 1, reproduced below, depicts the device of Embodiment 1.

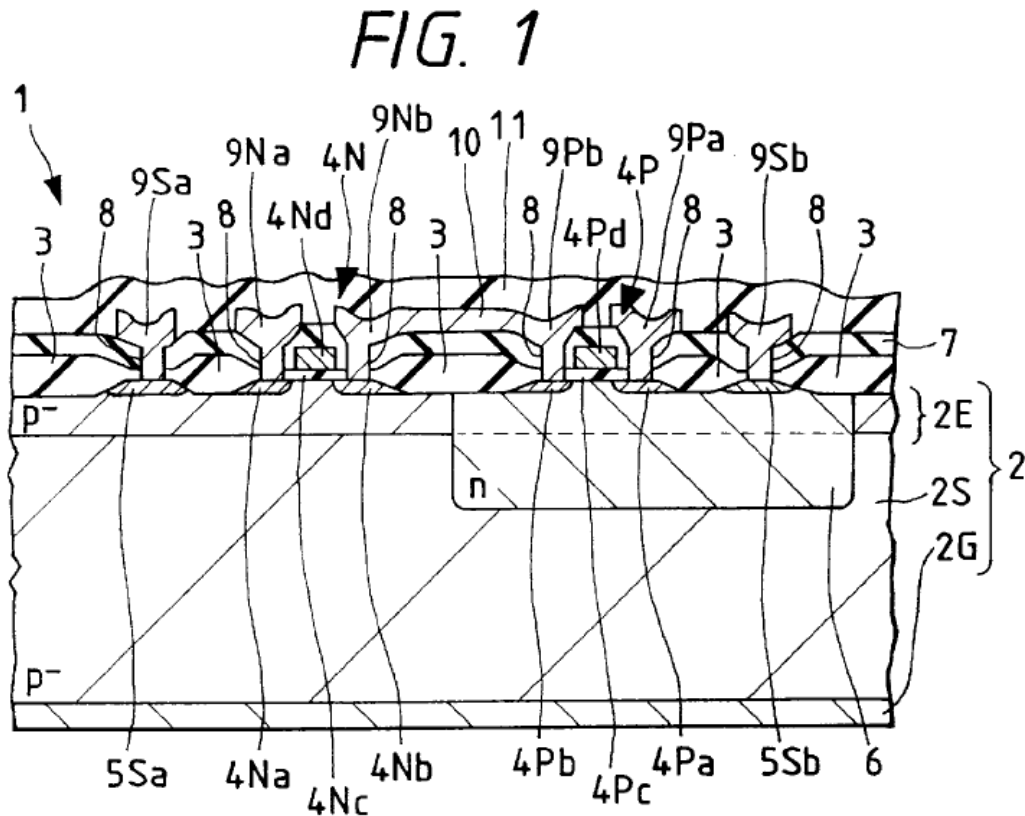


Figure 1 depicts “an essential portion of a semiconductor integrated circuit device” that includes semiconductor substrate body 2S, epitaxial layer 2E, and gettering layer 2G. *Id.* at 6:51–56, Fig. 1. Substrate body 2S and epitaxial layer 2E are doped with a p-type impurity in equal concentrations. *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.

Figure 23, reproduced below, depicts a semiconductor device of Embodiment 4 in the process of manufacture. Ex. 1007, 17:11–13.

FIG. 23

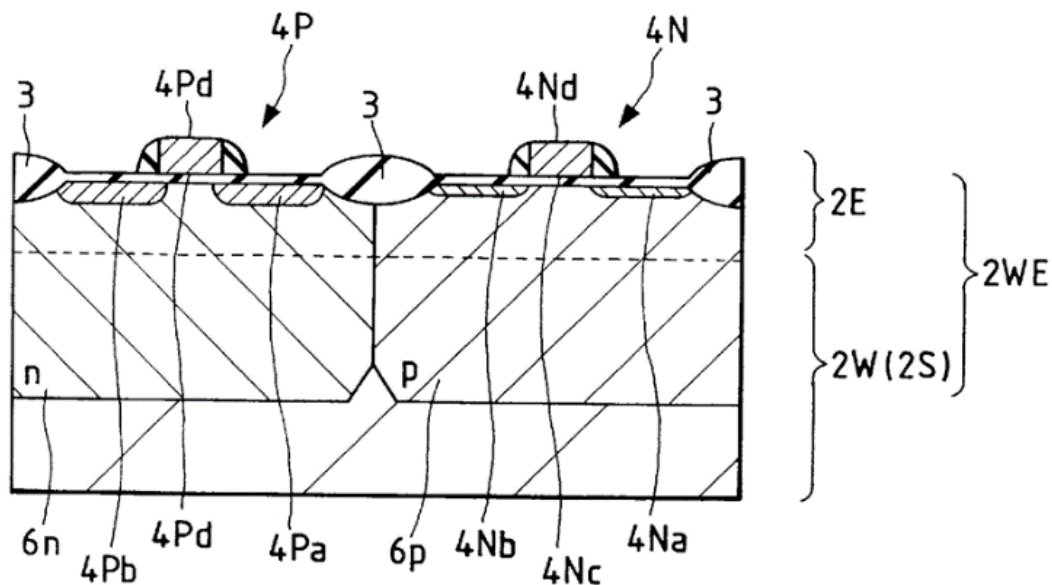


Figure 23 shows a step in a process for manufacturing the semiconductor integrated circuit device of Embodiment 4, including p-well 6p formed with nMOS 4N and n-well 6n formed with pMOS 4P. *Id.* at 6:1–4, 15:26–32, 18:3–35. In this embodiment, the impurity concentration in p-well 6p and n-well 6n decreases 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 Figure 17, which is reproduced below and illustrates properties of the semiconductor device of Embodiment 4.

FIG. 17

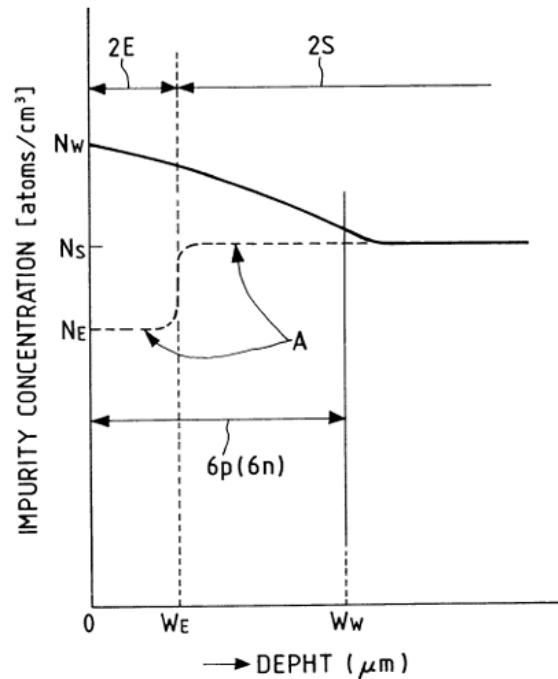


Figure 17 is a plot of impurity concentration as a function of depth in a semiconductor integrated circuit device, which shows “the p-well 6p and n-well 6n have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_w) of the epitaxial layer 2E.” Ex. 1007, 5:41–45, 15:62–16:5.

Kawagoe explains that:

the impurity concentration of the p-well 6p is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α -ray is lowered. 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 6.

Ex. 1007, 16:2–11.

2. Analysis—Independent Claim 1

The preamble of independent claim 1 recites “A semiconductor device, comprising.” Ex. 1001, 4:45. To the extent the preamble is limiting, Petitioner contends that Kawagoe discloses a “semiconductor integrated circuit device.” Pet. 15 (citing Ex. 1007, 1:13–23, 14:46–67, Figs. 16, 17, 23).

Claim 1 also recites “a substrate of a first doping type at a first doping level having first and second surfaces.” Ex. 1001, 4:46–47. Petitioner contends that Kawagoe discloses a “semiconductor substrate 2” having a first doping type (p-type), and that this substrate has a first surface (top) and a second surface (bottom). Pet. 16–17 (citing Ex. 1007, 6:50–56, 14:61–15:12, 17:10–18:38, Fig. 23 (as annotated by Petitioner); Ex. 1003 ¶¶ 67–68). Petitioner further contends that one of ordinary skill in the art would have sought to use the uniformly-doped epitaxial substrate of Embodiment 1 of Kawagoe, as opposed to Embodiment 4’s latchup-resistant substrate, to form the twin-well CMOS device of Figure 23 because this would optimize costs over latch-up resistance, and because this substrate was shown to provide “excellent film quality” and to drastically reduce defect density. *Id.* at 18–20.

Claim 1 also recites “a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed.” Ex. 1001, 4:48–51. Petitioner contends that Kawagoe discloses “semiconductor regions 4Na and 4Nb” that are used “for forming the source-drain regions of the nMOS [n-channel transistor] 4N.” Pet. 23 (citing Ex. 1007, 3:32–38, 8:45–52, 8:66–67, 14:46–55, 15:26–40). Petitioner further contends that source-drain regions 4Na/4Nb, in conjunction with the

channel region between these regions, form part of the claimed first active region. *Id.* at 23–24 (citing Ex. 1007, 8:46–65, 14:45–55, 15:26–40; Ex. 1003 ¶ 79; Ex. 1008B, 299–300). Petitioner further contends that regions 4Na and 4Nb are doped with a n-type impurity and therefore have a second doping type (n-type) opposite in conductivity to the first doping type (p-type) of the substrate. *Id.* at 24 (citing Ex. 1007, 8:67–9:3, 14:46–55, 15:26–40; Ex. 1003 ¶ 79). Petitioner contends that nMOS transistor 4N is formed in the claimed first active region and one of ordinary skill in the art would have sought to form multiple nMOS transistors in this region because this “would minimize chip area, as good layout practice dictates.” *Id.* at 24–25 (citing Ex. 1003 ¶ 80; Ex. 1014, 1:52–54, 2:17–21).

Claim 1 also recites “a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed” and “transistors formed in at least one of the first active region or second active region.” Ex. 1001, 4:52–56. Petitioner contends that source-drain regions 4Pa and 4Pb are part of the claimed second active region, which also includes the channel region that is between them and below gate 4Pd. Pet. 26 (citing Ex. 1007, 8:46–58, 9:41–46, 14:46–55, 15:26–40; Ex. 1008B, 299–301, Figs. 5-1, 5-2, 6-4; Ex. 1003 ¶ 83). According to Petitioner, as shown in Figure 23, pMOS transistor 4P is formed in the surface of this second active region, which is separate from and disposed adjacent to the first active region. *Id.* (citing Ex. 1007, 14:46–55; Ex. 1003 ¶ 83). Petitioner contends that either a single pMOS transistor 4P may be formed in the second active region, or one of ordinary skill in the art would have understood that multiple pMOS transistors could be formed in this region to minimize chip area. *Id.* at 27–28.

Claim 1 also recites “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate.” Ex. 1001, 4:57–60. Petitioner contends that Figure 17 of Kawagoe illustrates the doping concentration starting from a top surface of the substrate and including the channel region and shows that the dopant concentration is “gradually lowered in the depthwise direction *from the principal surface* (having an impurity concentration N_w) of the epitaxial layer 2E.” Pet. 28–29 (quoting Ex. 1007, 15:62–16:40, Fig. 17) (emphasis by Petitioner). According to Petitioner, the dopant concentration is thus graded in the channel region of transistor 4N, which is a portion of the first active region formed at “the principal surface” (top surface) of epitaxial layer 2E. *Id.* at 29 (citing Ex. 1003 ¶ 89). Petitioner contends the same analysis applies to the channel region of pMOS transistor 4P (a portion of the second active region). *Id.* at 30–31. Finally, Petitioner contends that, although “Figure 17 depicts the dopant concentration sloping at such a degree so as to level off” at N_s , a person of ordinary skill in the art “would have appreciated that when the device of Figure 23 is implemented using a uniformly-doped substrate as in Embodiment 1, . . . the downward slope through the p-well 6p would have the same general profile but steeper than as depicted in Figure 17.” *Id.* at 30 (citing Ex. 1003 ¶ 89). Petitioner contends this graded dopant concentration would aid the movement of carriers from the first surface to the second surface. Pet. 32 (citing Ex. 1003 ¶ 92).

Patent Owner asserts that Petitioner’s contentions with respect to independent claim 1 fail because (1) a graded dopant concentration does not inherently aid carrier movement; (2) the Petition fails to otherwise

demonstrate that Kawagoe discloses the “aid carrier movement” limitation; (3) the Petition fails to demonstrate that Kawagoe discloses a “first active region . . . with a second doping type opposite in conductivity to the first doping type”; and (4) objective indicia of non-obviousness establish that the challenged claims would not have been obvious. PO Resp. 13–20, 22–24, 26–29. We addressed Patent Owner’s objective indicia arguments above. Below, we address the remaining arguments.

a. Graded Dopant Concentration and Aid Carrier Movement

(1) The Parties’ Arguments

Petitioner contends that Kawagoe includes a graded dopant concentration that extends from the principal surface to the substrate, as shown in Figure 17 of Kawagoe, and that Kawagoe expressly teaches that the resulting electric field will attract electrons and keep them in the substrate. Pet. 30–32 (citing Ex. 1007, 16:2–11, Figs. 17, 23; Ex. 1003 ¶¶ 89–90). Although Kawagoe discusses electrons near the surface of or inside the substrate, Petitioner presents evidence that single event upsets, such as those caused by an α -ray strike, occur in both the channel and the source/drain regions of a transistor. *Id.* at 32–33 (citing Ex. 1009, 431). In particular, Dr. Banerjee testifies that “during a so-called single event upset (SEU), an α -ray generates millions of carriers, some of which are provided in or near the active region at the top surface of the substrate.” Ex. 1003 ¶ 92 (citing Ex. 1009, 431 (“A particle can induce SEU when it strikes at the channel region . . . of [a] transistor.”)). When such electrons are produced in Kawagoe, Petitioner contends that the downward sloping gradient will aid the movement of such carriers from the surface to the substrate. Pet. 33–35 (citing Ex. 1003 ¶¶ 93–94).

Petitioner contends this conclusion is confirmed by the Applicant's express statements made during prosecution of a parent application and in Patent Owner's briefing before the district court. Pet. 33–35 (citing Ex. 1016, 289–290; Ex. 1020, 2, 29; Ex. 1010, 2:27–32, 5:13–27). For example, during prosecution of a parent application the Applicant presented claims requiring a “drift layer having a graded concentration of dopants extending between said surface layer and said substrate to create a unidirectional drift field drawing all minority carriers from said surface layer to said substrate.” Ex. 1016, 234. These claims were rejected under 35 U.S.C. § 112, first paragraph, with the Examiner asserting that although the specification was enabling for “a unidirectional drift field,” it did “not reasonably provide enablement for ‘drawing all minority carriers from said substrate to said surface layer.’” *Id.* at 269. The Examiner explained that “[i]t is not clear if simply the application of ‘a unidirectional drift field’ is sufficient to achieve the effect of ‘drawing all minority carriers from said substrate to said surface layer.’” *Id.* at 270. According to the Examiner, “[i]n a complex electronic device, movement of minority carriers is affected by multiple forces and fields . . . [and] 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.’” *Id.*

The applicant respectfully disagreed with the Examiner's assertions, stating:

[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).

Ex. 1016, 289. In response to the Examiner’s assertion 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” from the surface layer to the substrate, the Applicant asserted that this argument

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 (emphasis added). Along with this argument, the Applicant amended its claims to remove the requirement that the drift field “draw[] all” minority carriers from said surface layer to said substrate, and replaced it with “to aid the movement of minority carriers from said surface layer to said substrate.” *Id.* at 286. The Examiner thereafter dropped the § 112, first paragraph rejection with respect to the movement or aiding the movement of carriers and, after one further set of amendments, allowed the claims. *Id.* at 301, 315, 330–334, 345–347.

Petitioner contends Patent Owner's representations before a district court are consistent with the Applicant's assertions during prosecution. Pet. Reply 6–7 (citing Ex. 1020, 25, 28; Ex. 2057 ¶ 33); Pet. 33. In that proceeding, Patent Owner's counsel stated

Electric drift fields are a well-known phenomenon that cause carriers to move, and 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 minority carriers. If it isn't present, then it doesn't. The claim turns on the presence of the 'unidirectional electric drift field,' and the phrase 'to aid the movement of minority carriers' merely states what the 'unidirectional electric drift field' does.

Ex. 1020, 26–27; *see also id.* at 28 ("The intrinsic record consistently confirms that electric fields aid the movement of the carriers.").

In this proceeding, Patent Owner reverses course and contends a "'graded dopant concentration' does not inherently 'aid carrier movement.'" PO Resp. 7. Patent Owner reasons that the claims require movement of carriers and there may be other forces in play within a transistor that affect such movement. *Id.* at 6–10. Consistent with the testimony of its witness, Dr. Glew, Patent Owner contends that Dr. Banerjee testified on cross-examination that carrier motion is determined by the sum of the forces acting on the carrier, or the net force. *Id.* at 7; Sur-reply 4. According to Patent Owner, Dr. Banerjee conceded that there are many different potential forces at play in a semiconductor device, such as "periodic crystalline potential," "externally applied forces or a built-in electric field," temperature, magnetic fields, the Hall effect, and forces due to the gate and gate oxide. Sur-Reply 4–5 (citing Ex. 2078, 82:9–12, 83:19–84:1, 84:16–21, 113:18–114:13, 138:11–20, 140:11–21, 183:11–20, 219:16–220:20, 222:19–22). Patent Owner contends Dr. Banerjee's and Dr. Glew's testimony is

consistent with both the Examiner's findings during prosecution and with Petitioner 30(b)(6)¹⁷ witness, Mr. Scott Warrick, who agreed that "there's a long list of . . . physical attributes which affect the movement of carriers" and one could not tell based solely on the presence of a graded dopant concentration that the gradient would "aid carrier movement." PO Resp. 7 (citing Ex. 2056, 72:6–8, 95:2–5, 96:1–13). According to Patent Owner, Petitioner cannot interpret the claims one way when comparing them to an accused product and another way when comparing them to the prior art. *Id.* (citing *Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1351 (Fed. Cir. 2001)).

(2) Analysis

Although there may be myriad forces acting upon carriers in a transistor, the Applicant made clear during prosecution that the "aid carrier movement" limitation did not require an analysis of these parameters, and the '842 patent does not mention such forces or the need to account for them. Ex. 1016, 289–290. Rather, "a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way - moving all minority carriers in the same direction" and "this inherent 'built-in' unidirectional electric field . . . ensur[es] that all minority carriers are being moved in one direction." *Id.* The public was entitled to rely upon these clear and unambiguous assertions regarding the effect of a unidirectional drift field when considering the scope of the challenged claims. *See Hockerson-*

¹⁷ Pursuant to 30(b)(6) of the Federal Rules of Civil Procedure ("FRCP"), "a party may name as the deponent a public or private corporation, a partnership, an association, a governmental agency, or other entity" and the "named organization must designate one or more officers, directors, or managing agents," to testify on its behalf.

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 representations concerning 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.”). Thus, evidence of a sloping dopant concentration gradient that creates a unidirectional drift field in the appropriate location and pointing in the appropriate direction is sufficient to demonstrate the “aid carrier movement” limitation of the claims. Ex. 1020, 26 (Patent Owner’s counsel representing before the district court that “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.”).

Patent Owner contends that the Applicant never said that all graded dopant concentrations aid carrier movement. PO Resp. 10. Patent Owner contends that if any “graded dopant concentration” would “aid carrier movement,” then there was no reason to include the separate claim phrase, which strongly implies that a “‘graded dopant concentration’ does not inherently ‘aid carrier movement.’” *Id.* We disagree. The term “to aid carrier movement from the first surface to the second surface of the substrate” is not superfluous as it indicates the direction and area in which the graded dopant concentration must aid carrier movement (from the first surface to the substrate). Thus, the use of both terms “graded” and “aided” does not imply that a “‘graded dopant concentration’ does not inherently ‘aid carrier movement,’” as asserted by Patent Owner.

Patent Owner also contends that the Applicant’s statements during prosecution have been misconstrued. PO Resp. 10–13. Patent Owner asserts that its argument during prosecution was that movement of carriers

“[d]epend[s] on the particular slope of the graded concentration of dopant[s]” and that it was responding to an Office Action regarding a claim that required a “single static unidirectional electric drift field to aid the movement of carriers,” which was an “additional parameter” that ensured “that all minority carriers are moved in one direction.” *Id.* at 12–13 (citing Ex. 1016, 286, 289–90).

Patent Owner’s arguments are not persuasive. During prosecution the Applicant stated that “the graded dopant concentration itself creates a ‘built-in’ electric field that forces the movement of carrier into a particular direction,” and this direction “depends solely on the slope of the graded concentration of dopant.” Ex. 1016, 289–290. Thus, the graded dopant concentration creates the “additional parameter” that ensures that “all minority carriers are moved in one direction.” *Id.*

Patent Owner contends “Petitioner’s position that *any* gradient aids carrier movement leads to absurd results that are plainly inconsistent with the claim language.” PO Resp. 8. According to Patent Owner, Petitioner’s “graded” entails “aided” assumption (or claim construction) “implies that a gradient can ‘aid’ movement of carriers that do not move at all.” *Id.* And, as noted above, Patent Owner contends that an assumption that a graded dopant concentration will necessarily aid carrier movement is inconsistent with the Examiner’s assertions during prosecution, Petitioner’s 30(b)(6) witness’s testimony, and at least two district courts’ conclusions. *Id.* at 8–9.

The Examiner’s assertions and the Applicant’s responses during prosecution are addressed above. Patent Owner’s arguments with respect to Petitioner’s 30(b)(6) witness and its arguments before the district courts are addressed below.

(i) Testimony of Petitioner's 30(b)(6) Witness

Patent Owner contends that during the deposition of Cirrus Logic's 30(b)(6) witness, Mr. Warrick, he agreed that "there's a long list of . . . physical attributes which affect the movement of carriers" and he could not say if the downward sloping gradient of a particular accused product met the "aid carrier movement" limitation "because there's other things that might affect carrier movement besides the gradient." PO Resp. 7 (citing Ex. 2056, 72:6–8, 95:2–5, 96:1–13).

Petitioner contends Patent Owner "blatantly mischaracterizes the deposition" of Mr. Warrick, as the question Mr. Warrick was actually asked was whether "there's anything that affects the *ease of* carrier movement." Pet. Reply 12–14 (quoting Ex. 2056, 71:22–72:8). According to Petitioner, because other factors may affect the speed or acceleration of carrier movement, Mr. Warrick's statements did not suggest that these forces could overwhelm the drift field and preclude it from aiding carrier movement. *Id.* at 14. Petitioner also contends Patent Owner never established the "there" it was referring to, or whether the direction of the gradient was suited to aid movement "downward," let alone that Mr. Warrick understood such to be the case. *Id.* at 14.

With respect to Petitioner's 30(b)(6) testimony, we note that Mr. Warrick was testifying as a corporate representative of Cirrus Logic in the district court proceeding. Patent Owner does not contend that Mr. Warrick is one of ordinary skill in the art or that he considered the Applicant's assertions during prosecution regarding the meaning and scope of the "aid carrier movement" limitation during prosecution. Ex. 1016, 289–90. Nor does Patent Owner contend that Mr. Warrick considered Patent Owner's representations to the district court that "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 minority carriers.” Ex. 1020, 26.¹⁸ And, although Mr. Warrick provided a statement that is generally consistent with both Patent Owner’s arguments in this proceeding and the Examiner’s initial assertion during prosecution, the Applicant expressly stated during prosecution that this reasoning was incorrect in view of the scope of the claims. Ex. 1016, 289–290. As such, we find that Mr. Warrick’s testimony does not evidence that a sloping dopant concentration gradient in the appropriate direction and location will not necessarily aid the movement of carriers.

(ii) The District Courts’ Findings

Patent Owner contends that “two District Courts have previously agreed with [Patent Owner] that not *all* doping gradients *must* aid carrier movement.” PO Resp. 9. In particular, Patent Owner contends the Western District of Texas “unequivocally stated, ‘a graded concentration . . . that is [not ‘sufficiently graded’] will not aid in the movement of minority carriers,’” and the Eastern District of Texas understood that direction alone does not determine whether a gradient aids carrier movement, as the magnitude of the gradient must also be considered. *Id.* (citing Ex. 2074, 39–40; Ex. 2075, 15).

Before the Western District of Texas, Petitioner (Cirrus Logic) asserted that the term “graded dopant concentration” was indefinite, as it was unclear where the boundary between “graded” and “uniform” doping concentrations would be. Ex. 2074, 32. Patent Owner argued in response that

¹⁸ We refer to the original pagination of this exhibit, not the page numbers added by Petitioner.

the patent provides sufficient guidance as to the meaning of the claim term, with “graded” meaning varying or not “uniform.” *Id.* at 37–38

(“Greenthread contends that Figure 1 in the ’195 Patent depicts the difference between uniform and graded concentrations, namely, that the concentration in the former is the same across a region while in the latter, the concentration has a slope.”). The District Court determined that the term was not indefinite for multiple reasons and that “graded” “describes a sloped doping concentration.” *Id.* at 39–41. According to the court, a graded dopant concentration must 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 U.S. Patent No. 8,421,195. *Id.* at 39–40.

We discern no finding in the 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 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 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 Western District of Texas, would “aid in the movement of minority carriers.” Ex. 2074, 39–40; Ex. 1020, 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 minority carriers. If it isn’t present, then it doesn’t.”), 28 (“The intrinsic record consistently confirms that the electric fields aid the movement of the carriers.”).

Before the Eastern District of Texas, the parties disputed the proper construction of the term “single drift layer . . . having a graded concentration of dopants generating a first static unidirectional drift field.” Ex. 2075, 10. The plaintiff asserted that no construction was necessary, whereas the defendant 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.* The Court explained that the dispute distilled into two issues: (1) whether the graded concentration of dopants could only increase or decrease; and (2) whether the “single drift layer” is necessarily a single layer. *Id.* at 13–14.

In addressing the question of whether the graded concentration of dopants could both increase and decrease in the drift layer, the Court rejected the defendant’s suggestion that the prosecution statement that the direction of the electrical field and the 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 15. In rejecting this argument, the Court found that the Applicant (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 *Grove*,” relied upon by the Applicant during prosecution, “discloses a dopant concentration that both increases and decreases in the drift layer.” *Id.* at 15–16. Contrary to Patent Owner’s arguments, the Court’s conclusion regarding the scope of the claims is 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.*

(3) Conclusion

In view of the foregoing, we determine that Petitioner and the public at-large were entitled to rely upon the Applicant's statements during prosecution that a graded dopant concentration will create a unidirectional electric drift field in a particular direction and this field will "aid carrier movement." Ex. 1016, 298–299.

b. *Carrier Movement in Kawagoe*

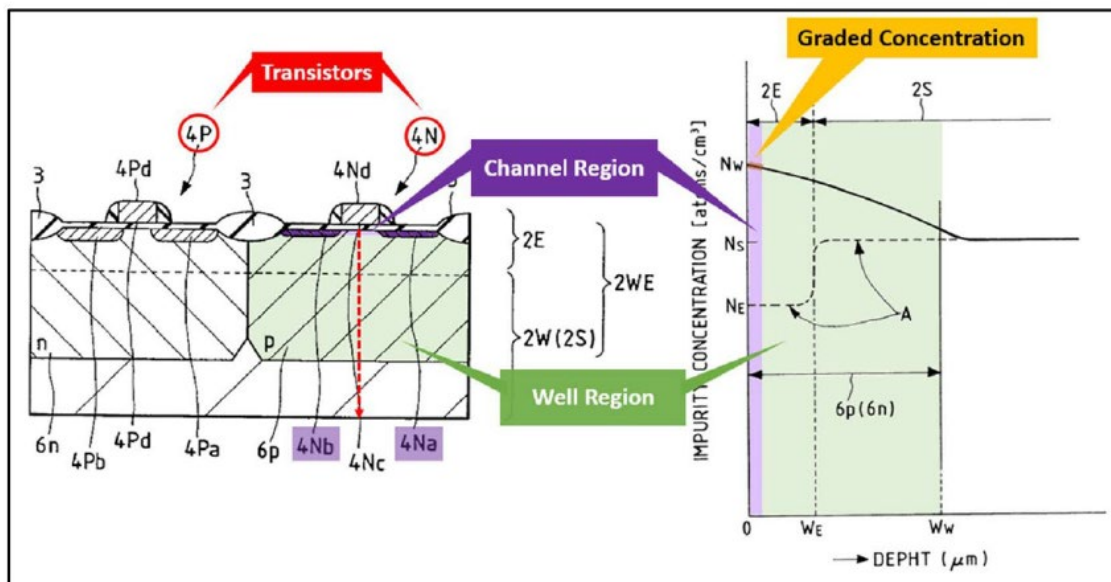
Petitioner demonstrates that Kawagoe discloses a graded dopant concentration that decreases from the top surface of the substrate towards a second surface of a substrate. Pet. 28–30. Dr. Banerjee persuasively testifies that this graded dopant concentration creates a static, unidirectional electric field that aids the movement of any carriers (electrons) present from the first surface to the second surface of the substrate. Ex. 1060 ¶¶ 21 ("In a doped semiconductor device, a graded concentration of dopants that is monotonically increasing or decreasing in a particular direction will induce a static electric drift field."), 23–24 (explaining that if the semiconductor is doped with a p-type dopant, the static electric field will point towards the surface and opposite to the direction of the slope of the graded concentration and minority carriers (electrons) will drift in a direction opposite to the direction of the electric field); Ex. 1003 ¶¶ 93–96.

Patent Owner contends that Petitioner's arguments with respect to both Kawagoe and Wieczorek fail because "it restricts its analysis to the direction of the gradient—and nothing else." PO Resp. 13. With respect to Petitioner's Kawagoe-based arguments, Patent Owner also contends these arguments are deficient because (1) the Petition fails to consider the relevant factors that affect carrier movement; (2) Kawagoe's concentration gradient

actually impedes carrier movement; (3) Kawagoe's carriers are not in the active region; (4) Petitioner relies upon a post-priority date reference to make up for Kawagoe's deficiency; and (5) carriers generated by alpha-ray strikes are not at the "surface" or in the "active regions" of semiconductor devices. We address these arguments in turn.

(1) Analysis of the Relevant Factors

Petitioner persuasively demonstrates that Kawagoe discloses a downwardly sloping dopant gradient that extends from the top surface of the substrate to the bottom surface. Pet. 28–30. This is depicted in the annotated figures reproduced below:



Kawagoe's Figures 23 (left) and 17 (right) are annotated by Petitioner to show the regions in which the gradient concentration is lowered in a depthwise direction. As Figure 17 shows, the dopant concentration is "gradually lowered in the depthwise direction from the principal surface (having an impurity concentration NW) of the epitaxial layer 2E" to and through the substrate Ww. Ex. 1007, 15:67-16:2. Dr. Banerjee persuasively testifies that this graded concentration of dopants creates a static,

unidirectional electric field that will apply a force on carriers (electrons) in a direction facing downwards towards the lower surface of the substrate. Ex. 1060 ¶ 21; Ex. 1003 ¶¶ 93–96. The Applicant was clear during prosecution that such a static, unidirectional electric field will “necessarily” aid carrier movement, and other potential forces present in the transistor need not be considered. Ex. 1016, 289–290. Indeed, Dr. Glew confirmed that it is “just basic physics” that an electric field will aid movement in the direction of the force and Patent Owner has confirmed this conclusion during district court proceedings. Ex. 1069, 108:15–23 (Dr. Glew testifying that “a field will provide a force in a direction aiding – direction – aiding movement in the direction of the force. That’s just basic physics.”); Ex. 1020, 25–26 (“Electric fields are well-known phenomenon that cause carriers to move, and 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 minority carriers.’ If it isn’t present, then it doesn’t.”). Thus, Petitioner persuasively demonstrates that Kawagoe discloses the limitation: “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate.” Ex. 1001, 4:57–60.

To the extent other factors within the transistor were relevant to the inquiry, Patent Owner identifies no force in Kawagoe that it contends could overwhelm or negate the electric field created by the downward sloping gradient of Kawagoe. Rather, in its Response Patent Owner contends Petitioner failed to account for the inherent resistance of silicon. PO Resp. 7–8. Petitioner persuasively argues, however, that an inherent resistance may slow the movement of carriers, but it would not prevent their movement. Pet. Reply 11.

In its Sur-reply, Patent Owner identifies a series of potential forces that Dr. Banerjee testified could influence carrier movement, including three broad categories of forces (1) “periodic crystalline potential,” (2) “externally applied forces or a built-in electric field,” and (3) “random forces, . . . such as lattice vibrations or static random forces due to structural defects in the crystal.” PO Sur-reply 4 (citing Ex. 2078, 80:18–81:5, 82:9–12, 83:19–84:1, 84:16–21). Dr. Banerjee testified on re-direct, however, that these forces are either not mentioned in the ’842 patent or would not be sufficient to overcome or negate the downward-facing electric field of Kawagoe. Ex. 2078, 319:10–22, 320:1–14.¹⁹ Patent Owner and Dr. Glew present no persuasive evidence to suggest that these forces are present in Kawagoe, or if they are that they are sufficiently large to negate the field expressly disclosed in Kawagoe and relied upon by Dr. Banerjee. PO Resp. 7–8; PO Sur-reply 4–5. Patent Owner merely speculates that such forces might overwhelm the electric field and asserts that Dr. Banerjee did not quantify them. In addition, Kawagoe expressly discloses that carriers are prevented from entering the substrate by the electric field created by the graded dopant

¹⁹ Prior to re-direct, Dr. Banerjee met with counsel for approximately 20 minutes. Ex. 2078, 339:9–20; Sur-reply 13–14. When asked if he discussed his testimony during this time, counsel instructed the witness not to answer. Ex. 2078, 339:21–340:4. As asserted by Patent Owner, this gives the appearance of improper witness coaching. *See* Sur-reply 13–14. Counsel is warned that such behavior may lead to the Board giving redirect testimony little to no weight. In this case, however, Patent Owner does not move to strike or exclude Dr. Banerjee’s re-direct testimony. Moreover, Dr. Banerjee was able to clearly articulate why the three categories of forces mentioned during cross-examination would either not affect whether the electric field of Kawagoe would “aid carrier movement” or are not mentioned or contemplated in the ’842 patent.

concentration, which appears to be strong evidence that the field is not negated by other forces in the transistor. Ex. 1007, 16:2–11.

(2) Impedes Carrier Movement

Kawagoe discloses that the dopant gradient is designed such that “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.”

Ex. 1007, 16:7–9. Patent Owner contends that this passage demonstrates that Kawagoe’s graded dopant concentration actually inhibits carrier movement into the relevant area of the transistor. PO Resp. 15–16. And, “[s]ince Kawagoe teaches inhibiting carrier movement, it does not teach aiding carrier movement.” *Id.* at 16.

This argument is not persuasive because whether Kawagoe’s electric field aids or inhibits carrier movement simply depends on the location of the carrier. A carrier below the substrate will be inhibited from exiting the lower surface of the substrate and travelling towards the first surface of the substrate, whereas an electron carrier that exists between the first and second surfaces will be drawn by the electric field created by the graded dopant concentration towards the substrate. Pet. 31; Pet. Reply 19–20 (“In other words, aiding downwards is consistent with inhibiting movement in the opposite direction.”); 1060 ¶ 21; Ex. 1003 ¶¶ 93–96.

(3) Kawagoe’s Carriers Are Not in the Active Region

Patent Owner contends that the carriers of Kawagoe are in the wrong place, i.e., generated below area 6p and prevented from entering it. PO Resp. 16–17. Patent Owner further contends that the evidence of record demonstrates that single-event upsets are quite rare in the channel region of a transistor. *Id.* at 18–20.

Patent Owner’s arguments are not persuasive for at least two reasons. First, the challenged claims are drawn to an apparatus. *See ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018) (“Apparatus claims cover what a device *is*, not what a device does.” (citation 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”); Ex. 1063, 242:2–15, 244:18–245:9 (Dr. Glew admitting that the p-well of Kawagoe has electrons present and “any electric field will act on all charged particles within its vicinity”).

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. 32 (citing Ex. 1003 ¶ 92; Ex. 1009, 431 (“A[n] [α]-particle can induce SEU when it strikes at the **channel region** of . . . [a] transistor.”); Ex. 2060, 19:21–20:22; Ex. 1065, 301. 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. 16–17 n.4 (citing Ex. 2060, 19:21–20:22 (“[T]he probability of creation of electron-hole pairs is extremely low near the surface.”)). In particular, Patent Owner points to Nishizawa’s²⁰ disclosure that “the amount of electrons created which adversely affect the memory action is no greater than only 10% of the stored

²⁰ US 5,384,479, issued January 24, 1995. Ex. 2060 (“Nishizawa”).

electric charge, and thus it can be disregarded.” Ex. 2060, 20:19–22.

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. 1060 ¶ 21; Ex. 1003 ¶¶ 93–96. 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.

(4) Post-Priority Date Reference

Patent Owner contends that Petitioner relies upon a post-priority date reference to demonstrate that α -ray strikes will generate carriers (electrons) at the surface of the device. PO Resp. 17–18. And, because the Petition relies upon post-priority date disclosures, Patent Owner contends the “Petition contains no evidence that a POSITA would have known about SEU carriers in the active region at the time of the Challenged Patent.” *Id.* at 18.

This argument is not persuasive for multiple reasons. First, the apparatus claims at issue do not require actual movement of carriers, only the capability to move such carriers if present. *See ParkerVision*, 903 F.3d at 1361. Second, Petitioner’s ground is based on Kawagoe alone, and not in combination with a non-prior art reference, and Petitioner persuasively demonstrates that the fact that α -ray strikes could generate carriers in the active region of a transistor was first disclosed well-before the priority date of the ’842 patent. Pet. Reply 21 (citing Ex. 1065, 301; Ex. 2060, 19:41–42, Figs. 34–36). Third, Patent Owner concedes that single-event upsets in the active region will occur, but just with a much lower probability than strikes

in the bulk of the substrate. PO Resp. 19.²¹ Finally, Petitioner does not propose changing the configuration of Kawagoe in any way based on knowledge that SEUs will occur. Thus, what a person of ordinary skill in the art would have understood about SEUs and generated carriers in the relevant time period does not affect whether Kawagoe's graded dopant concentration would aid carrier movement. Pet. Reply 21 ("Petitioner is *not* proposing to modify Kawagoe in view of Wang.").

(5) Conclusion

For the reasons set forth above, Petitioner persuasively demonstrates that Kawagoe teaches or suggests "at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate."²²

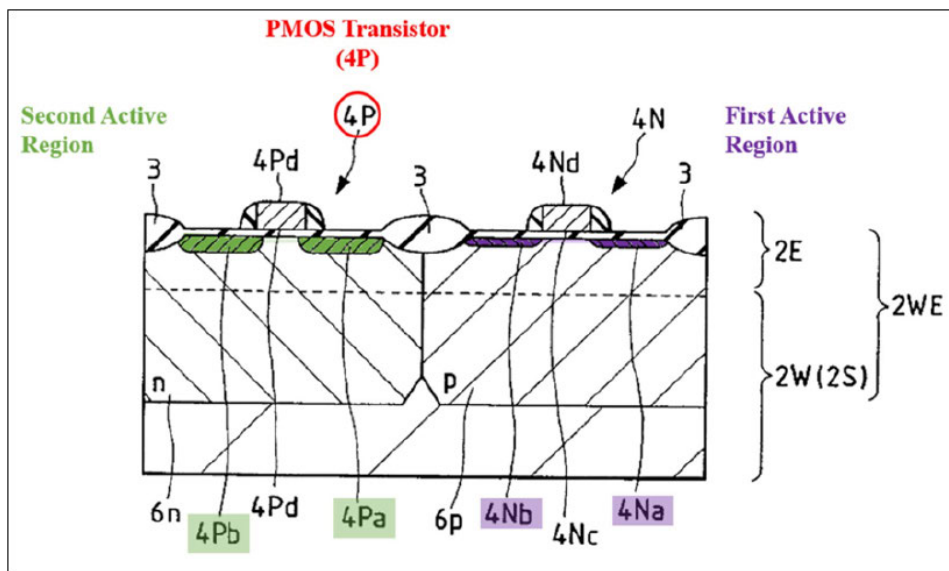
²¹ Nishizawa explains that for an alpha-particle of 5 MeV, the probability of creating electron-hole pairs is extremely low near the surface, and the alpha-particle will begin to create electron-hole pairs after it has entered into the substrate a certain distance. Ex. 2060, 19:24–34. Thus, the number of electron-hole pairs in the region of the surface (to 0.8 μm from the surface) is about 1/50 or less the total number of electron hole-pairs that are created in the semiconductor body by a single alpha-particle. *Id.* at 19:34–41. Even at this reduced rate, however, "several ten thousand electrons" will flow into the active regions of the transistor from a single alpha-particle strike. *Id.* at 19:41–42. Nishizawa also explains that this number will increase when the angle of incidence is less than 90°, as this shifts electron-hole pair creation "towards and closer to the surface of the device." *Id.* at 19:58–67.

²² During the oral hearing, Patent Owner's counsel asserted that in an NMOS the minority carriers are actually holes and the majority carriers are electrons. Tr. 61:16–23. We need not address whether this argument is correct or new, as the challenged claims only require that the "graded dopant concentration" "aid carrier movement," and it is undisputed that an electron is a carrier. Ex. 1001, 4:57–60.

c. “first active region ... with a second doping type opposite in conductivity to the first doping type”

Claim 1 recites “first active region ... with a second doping type opposite in conductivity to the first doping type.” Ex. 1001, 4:48–50. Petitioner contends that Kawagoe discloses “semiconductor regions 4Na and 4Nb” that are used “for forming the source-drain regions of the nMOS [n-channel transistor] 4N.” Pet. 23 (citing Ex. 1007, 3:32–38, 8:45–52, 8:66–67, 14:46–55, 15:26–40).

Annotated Figure 23 of Kawagoe is reproduced below (Pet. 27):



Referring to annotated Figure 23 above, Petitioner contends that source-drain regions 4Na/4Nb, in conjunction with the channel region, form part of the claimed first active region. *Id.* at 23–24 (citing Ex. 1007, 8:46–65, 14:45–55, 15:26–40; Ex. 1003 ¶ 79; Ex. 1008B, 299–300). Petitioner further contends that source-drain region 4Pb and 4Pa, as well as the channel region between them, constitute a second active area that is n-type. *Id.* at 26–27. Petitioner asserts that, because regions 4Na and 4Nb are doped with a n-type impurity they have a second doping type (n-type) opposite in conductivity to

the first doping type (p-type) of the substrate. *Id.* at 24 (citing Ex. 1007, 8:67–9:3, 14:46–55, 15:26–40; Ex. 1003 ¶ 79).

Patent Owner contends that Petitioner’s mapping fails because the channel region between source-drain regions 4Na/4Nb is doped p-type, which is the same doping type that Petitioner identified for the first doping type of the first active region. PO Resp. 23 (citing Pet. 16, 23–24, 40).

Petitioner argues in response that Patent Owner incorrectly presumes that the claim language requires the second doping type to be distributed throughout the entire active layer. Pet. Reply 24. Petitioner contends this defies the plain language of the claim, which requires “a first active region . . . *with* a second doping type opposite in conductivity to the first doping type.” *Id.* Petitioner contends its understanding is consistent with Figures 5B and 5C of the ’842 patent, which Patent Owner asserted “clearly show” the “claimed invention” and depict a NMOS having n-type source and drain and a p-type substrate. *Id.* (citing PO Resp. 3–4; Ex. 1001, Figs. 5B–5C; Ex. 1060 ¶¶ 99–100). Petitioner further argues that Kawagoe’s PMOS 4P is formed in an n-well and even though it is p-doped, the n-type dopants remain in the device. Pet. Reply 24–25. Thus, Petitioner contends PMOS 4P is “a first active region” having “a second doping type.” *Id.* at 25.

Patent Owner argues in its Sur-reply that the “claims require that the active region have doping *opposite* to the substrate.” Sur-reply 16. According to Patent Owner, the claims refer to the source and drain as a “device” and the active region as a “region,” and Petitioner’s understanding of the claim would render the claim language superfluous because Dr. Banerjee concludes that every active region has both n- and p-type doping. *Id.* (citing Ex. 1060 ¶ 101).

Upon review of the parties' arguments and supporting evidence, including the express disclosures of the '842 patent, we determine that Petitioner persuasively demonstrates that Kawagoe discloses a "first active region . . . with a second doping type opposite in conductivity to the first doping type." Pet. 24–26 (citing Ex. 1007, 8:46–65, 14:46–55, 15:26–40; Ex. 1003 ¶¶ 79, 81; Ex. 1008B, 299–300, Figs. 5-2, 6-4). Petitioner demonstrates that the active region of a transistor includes the source, drain, and channel region between them. *Id.* at 24. For example, Wolf's textbook states that "[t]he active regions are those in which transistor action occurs; i.e., the channel and the heavily doped source and drain regions." Ex. 1008B, 299. This first active region of Kawagoe has two types of dopants; the source and drain are doped n-type and the channel is doped p-type. Ex. 1007, Fig. 23. The first doping type identified by Petitioner is that of the p-well, or p-type dopants. Thus, the active region has "a second dopant type" (n-type) that is opposite in conductivity to the "first doping type" (p-type). We discern nothing in the language of the claim or in the written description of the '842 patent that would require that the "second dopant type" be the only type of dopant in the "first active region," and the configuration relied upon by Petitioner conforms to that depicted in Figures 5B and 5C of the '842 patent, which Patent Owner asserts disclose the claimed invention. *See* PO Resp. 4 ("The claimed invention is clearly disclosed in, e.g., Figs. 5B-5C of the Challenged Patent, and the corresponding parts of the specification."). As such, Petitioner persuasively demonstrates that Kawagoe discloses a "first active region . . . with a second

doping type opposite in conductivity to the first doping type,” as recited in claim 1.²³ Ex. 1001, 4:48–51.

d. Conclusion with Respect to Claim 1

For the foregoing reasons, Petitioner persuasively demonstrates that Kawagoe teaches or suggests every limitation of claim 1 of the '842 patent. Petitioner also provides a persuasive explanation as to why one of ordinary skill in the art would have used the uniformly doped epitaxial substrate of Kawagoe as the starting material in lieu of Embodiment 4's latchup-resistant substrate to form the twin-well CMOS devices of Figure 23. Pet. 20–23. And, as discussed above in Section III.D, Patent Owner's objective indicia of non-obviousness lack nexus and are entitled to little weight, but even if we gave them more weight, they would not overcome Petitioner's strong case of obviousness. Accordingly, Petitioner demonstrates by a preponderance of the evidence that claim 1 would have been obvious in view of Kawagoe.

3. Analysis—Claim 7

Claim 7 depends from independent claim 1 and further requires “wherein the first active region and second active region are each separated by at least one isolation region.” Ex. 1001, 5:8–10.

²³ For example, there is no limitation in claim 1 that would require the first active region to have a “conductivity” that is opposite than the substrate (containing the first doping type). Rather, it is the second doping type that must be opposite in conductivity to the first doping type, and there is no dispute that the n-type dopants of the source and drain are opposite in conductivity to the p-type dopants in the channel region and p-well.

Annotated Figure 23 of Kawagoe is reproduced below:

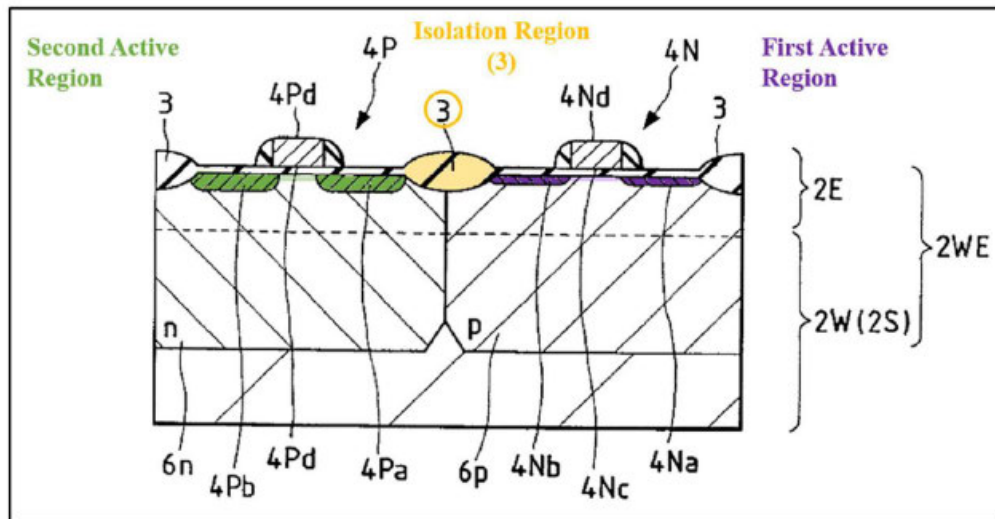


Figure 23 above contains colored annotations showing the first active region (purple), the second active region (green) and isolation region 3 (yellow).

Pet. 39. Petitioner contends field insulating film 3 of Kawagoe is an isolation region that separates the first and second active regions. *Id.* (citing Ex. 1007, 8:40–52, 15:37–40, 17:62–18:8; Ex. 1008A, 818–20, Fig. 16-11(f); Ex. 1003 ¶ 103).

Patent Owner contends Petitioner fails to appreciate that region 4Na and 4Nb “are made as deep as about 0.5 μm and formed in the range of thickness of the epitaxial layer 2E.” PO Resp. 25 (quoting Ex. 1007, 9:3–6). Thus, according to Patent Owner, the first and second active regions extend to about the depth of the epitaxial layer 2E and abut each other laterally and therefore “are not separated by Kawagoe’s field insulating film 3.” *Id.* at 25–26 (citing 2057 ¶ 63).

As depicted in Figure 23, field insulating film 3 physically separates the first and second active regions. Ex. 1007, Fig. 23. We discern no requirement in the claims or written description that this film extend as deep as the first and second active regions. In any event, Petitioner presents

evidence that field insulating film 3 *may* extend as deep as the first and second active regions. Pet. Reply 26 (citing Ex. 1007, 8:36–40, 9:3–6, 9:47–53, 17:22–25; Ex. 1060 ¶¶ 102–103). To the extent the isolation region must be in between the first and second active regions at all points and field insulating film 3 is not so positioned, Petitioner also demonstrates that a “channel stopper region” is formed below the field insulating film and is used to ensure that errant carriers do not migrate from one transistor to another. *Id.* (citing Pet. 39; Ex. 1007, 8:43–45, 20:53–56, Fig. 26A; Ex. 1069, 142:4–143:11; Ex. 1060 ¶¶ 52, 104). Petitioner persuasively demonstrates that these two structures, in combination, also act as an isolation region. *Id.*

In view of the foregoing, Petitioner demonstrates by a preponderance of the evidence that dependent claim 7 would have been obvious in view of Kawagoe.

4. Analysis—Dependent Claims 2–6, 8, 17, and 18

Claims 2–6, 8, 17, and 18 all depend from independent claim 1. Petitioner identifies where Kawagoe teaches or suggests every limitation of claims 2–6, 8, 17, and 18, including a substrate that is p-type (claim 2), a substrate that is n-type (claim 3), a substrate with epitaxial silicon on top of a non-epitaxial substrate (claim 4), a first active region and second active region that contain one of either p-channel and n-channel devices (claim 5), first and second active regions that contain either p-channel or n-channel devices in n-wells or p-wells, respectively, and each well has a graded dopant (claim 6), wherein the graded dopant is fabricated with an ion implantation process (claim 8), wherein the first and second active regions are formed adjacent the first surface of the substrate (claim 17), and wherein

the transistors formed in the first and second substrates are CMOS transistors requiring a source, a drain, a gate, and a channel region (claim 18). Pet. 36–40, 43–45.

Patent Owner does not address Petitioner’s contentions with respect to claims 2–6, 8, 17, and 18, apart from its arguments discussed above with respect to independent claim 1.

Upon review of the parties’ arguments and supporting evidence, we find that Petitioner demonstrates by a preponderance of the evidence that claims 2–6, 8, 17, and 18 would have been obvious in view of Kawagoe.

5. Analysis—Independent Claim 9

Independent claim 9 mirrors the language of independent claim 1, except it requires that the first and second active regions allow transistors to “be formed in the surface thereof.” Ex. 1001, 5:19–20, 5:22–23; Pet. 40–41.

Petitioner persuasively demonstrates that transistors may be formed in the surface of the first and second active regions of Kawagoe, and Patent Owner does not argue otherwise. Pet. 40–41.

Patent Owner contends the subject matter of claim 9 would not have been obvious in view of Kawagoe for the same reasons set forth above with respect to independent claim 1. PO Resp. 13–26.

Upon review of the parties’ arguments and supporting evidence, we determine that Petitioner demonstrates by a preponderance of the evidence that the subject matter of claim 9 would have been obvious in view of Kawagoe.

6. Dependent Claims 10–16

Claims 10–16 each depend from independent claim 9. Ex. 1001, 6:1–20. The subject matter of claims 10–16 generally tracks that of dependent

claims 2–8. *Compare id.* at 4:61–13, *with id.* at 6:1–20. Petitioner contends Kawagoe discloses the subject matter of claims 10–16 for the same reasons as discussed above with respect to claims 2–8. Pet. 42–43.

Patent Owner does not address Petitioner’s arguments with respect to claims 10–16, apart from its arguments regarding independent claims 1 and 9.

For the reasons set forth in the Petition, we determine that Petitioner persuasively demonstrates that Kawagoe discloses every limitation of claims 10–16. Pet. 42–43. Thus, Petitioner demonstrates by a preponderance of the evidence that claims 10–16 would have been obvious in view of Kawagoe.

7. Conclusion

For the reasons set forth above, Petitioner demonstrates by a preponderance of the evidence that claims 1–18 would have been obvious in view of Kawagoe.

G. Claims 1–18 in View of Kawagoe and Gupta

Petitioner contends the subject matter of claims 1–18 would have been obvious in view of the combined disclosures of Kawagoe and Gupta. Pet. 69–76.

Independent claims 1 and 9 each require an active region where transistors may be formed. Ex. 1001, 4:55–56, 5:24–25. Petitioner contends that these limitations require only evidence that a transistor may be formed in these active areas, but to the extent multiple transistors are required, this would have been obvious in view of Gupta. Pet. 69–70.

Patent Owner does not contend that Kawagoe fails to teach or suggests the “transistor” elements of independent claims 1 or 9. Thus, we

need not address Petitioner’s additional arguments with respect to Kawagoe and Gupta.

H. Claims 1–3, 5–11 and 13–18 over Wieczorek and Wolf

Petitioner contends the subject matter of claims 1–3, 5–11 and 13–18 would have been obvious in view of the combined disclosures of Wieczorek and Wolf. Pet. 45–69.

1. Wieczorek

Wieczorek relates “to a semiconductor device, such as a field-effect transistor, having an improved retrograde dopant profile in a channel region of the transistor element.” Ex. 1006 ¶ 2. Wieczorek explains that a retrograde channel dopant profile is one where “the concentration of dopants increases from the gate insulation layer to the areas located deeper down the channel region.” Ex. 1006 ¶ 6. According to Wieczorek, although a retrograde channel dopant profile is desirable, it is “very difficult to obtain.” *Id.* Wieczorek notes that “the dopant concentration immediately after the implantation process exhibits a desired retrograde dopant profile” (*id.* ¶ 9), but during heat treatment, “the initially retrograde profile in the vicinity of the surface of the semiconductor device . . . may have become substantially uniformly distributed” due to diffusion of the dopant atoms (*id.* ¶ 11).

Petitioner relies on Figures 1b and 2b (reproduced below), which Wieczorek uses to illustrate the prior art.

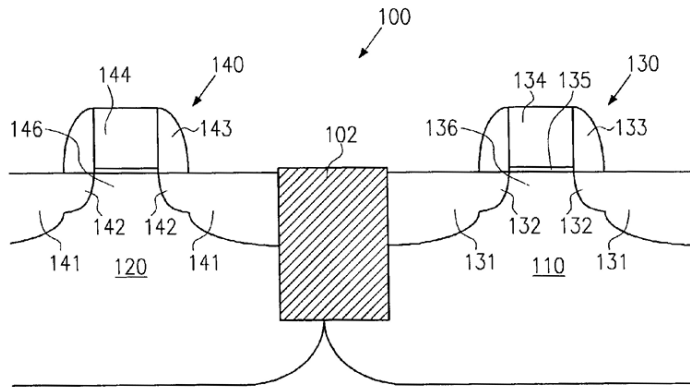


FIG. 1b
(Prior Art)

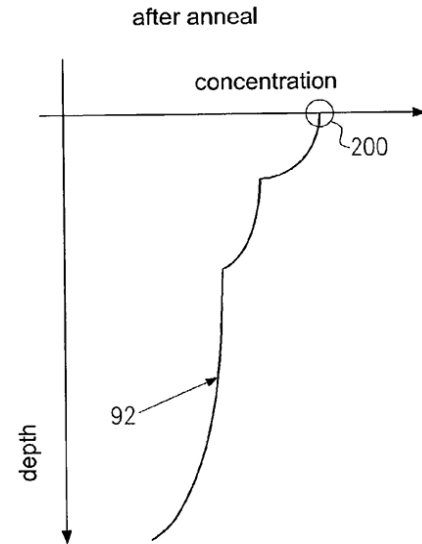


FIG. 2b
(Prior Art)

Wieczorek Figure 1b shows a conventional semiconductor device at an advanced manufacturing stage. Ex. 1006 ¶¶ 12, 20. The device includes P-channel transistor 140 with source and drain regions 141 in N-well structure 120 and N-channel transistor 130 with source and drain regions 131 in P-well structure 110. *Id.* ¶ 12. Shallow trench isolation 102 separates N-well structure 120 from P-well structure 110. *Id.* ¶ 7. Wieczorek Figure 2b is a graph of dopant concentration versus depth of N-well structure 120 and P-well structure 110 and shows “a typical dopant profile with respect to the depth of the respective well structure” after ion implantation and heat treatment. *Id.* ¶¶ 9–11, 13, 21.

2. *Wolf*

Wolf is a four-volume textbook titled “Silicon Processing for the VLSI Era.” Ex. 1008. A portion of the textbook focuses on CMOS technology. Ex. 1008A, 807–40.

3. Analysis—Claim 1

The preamble of independent claim 1 recites “A semiconductor device, comprising.” Ex. 1001, 4:45. To the extent the preamble is limiting, Petitioner persuasively demonstrates that Wieczorek discloses a “semiconductor device 100.” Pet. 47 (citing Ex. 1006 ¶ 12; Ex. 1003 ¶ 123).

Claim 1 also recites “a substrate of a first doping type at a first doping level having first and second surfaces.” Ex. 1001, 4:46–47. Petitioner contends that Wieczorek in combination with Wolf discloses this limitation. In support, Petitioner provides an annotated version of Figure 1b of Wieczorek, which is reproduced below.

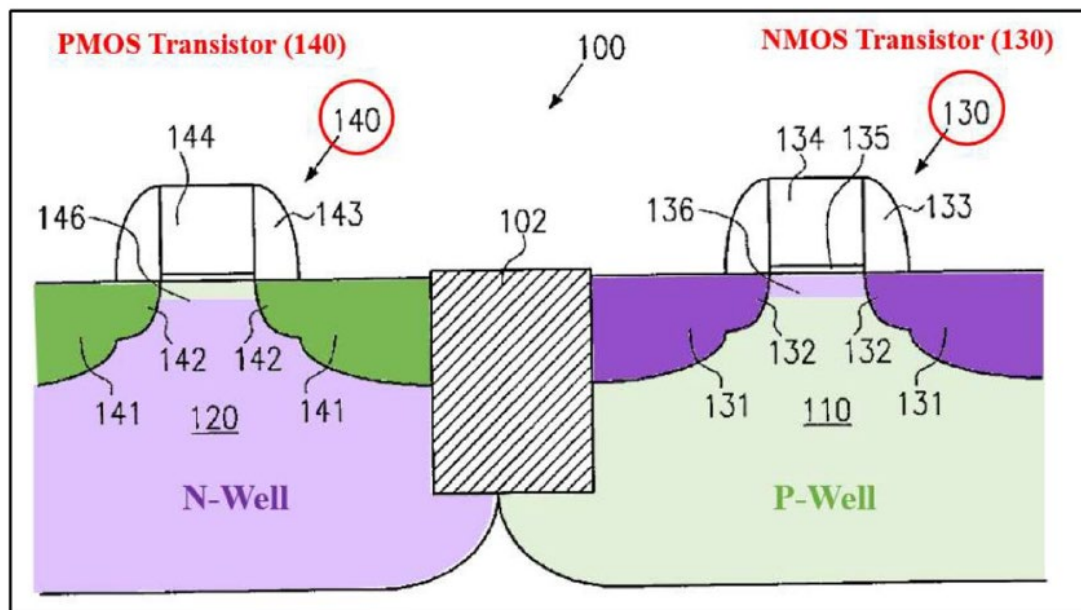


Figure 1b is annotated to show N-channel transistor 130 (nMOS) with source/drain regions 131 and 132 (purple) and channel region 136 (light purple) formed in P-well 110 (light green). Pet. 47–48. Figure 1b is also annotated to show P-channel transistor 140 (pMOS) with source/drain regions 141 and 142 (green) and channel region 146 (light green) formed in N-well 120 (light purple). *Id.*

Petitioner contends that Wieczorek explains that the P-well and N-well structures may be formed on any “appropriate substrate,” but does not explicitly specify what that appropriate substrate may be. *Id.* at 47–48 (citing Ex. 1006 ¶ 4; Ex. 1003 ¶ 125). Petitioner asserts, however, that one of ordinary skill in the art would have understood that a twin well approach is “independent of the starting material type” for the substrate, and such an ordinarily skilled artisan would have consulted Wolf to confirm that a “**uniform**, lightly doped *p*- or *n*- type substrate” is a suitable substrate that is commonly used in twin-well CMOS devices.²⁴ *Id.* at 48 (citing Ex. 1008C, 523–24, 530; Ex. 1008B, 387–389; Ex. 1003 ¶ 126). According to Petitioner, one of ordinary skill in the art would have found it obvious to use a uniformly doped *n*- or *p*- type substrate as “[d]oing so would amount to combining known prior art elements . . . according to known methods . . . to obtain predictable results.” *Id.* at 49 (citing Ex. 1003 ¶ 127). Petitioner identifies the top of the device as the claimed “first surface” and the bottom of the substrate as the claimed “second surface.” *Id.* at 50 (citing Ex. 1003 ¶ 128).

Claim 1 also recites “a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity

²⁴ Petitioner contends Wolf is “a well-known textbook,” and relies on Wolf for teaching “known fundamental features and concepts related to semiconductor manufacturing, with particular emphasis on CMOS devices.” Pet. 46 (citing Ex. 1008A, Chapter 16; Ex. 1003 ¶ 122). According to Petitioner, a person of ordinary skill in the art would have understood and expected that the teachings of Wolf would apply to Wieczorek’s conventional CMOS device, and would have looked to Wolf for additional details related to conventional CMOS devices. *Id.* Patent Owner does not dispute this assertion.

to the first doping type and within which transistors can be formed.”

Ex. 1001, 4:48–51. Petitioner contends that Figure 1b of Wieczorek shows nMOS transistor 130 that includes “heavily N-doped ***source and drain regions*** 131, including lightly doped extensions 132” and “channel region 136.” Pet. 51 (citing Ex. 1006 ¶¶ 4, 12–13). Petitioner further contends that nMOS transistor 130 is formed in the surface of the first active region, which is adjacent the surface of the substrate and, because the source-drain regions are N-doped, the first active region has a second doping type that is opposite in conductivity to the first doping type (P-type). *Id.* at 52–53.

Claim 1 also recites “a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed” and “transistors formed in at least one of the first active region or second active region.” Ex. 1001, 4:52–56. Petitioner contends that P-channel transistor 140 of Wieczorek includes heavily P-doped source and drain regions 141, lightly doped extensions 142, and channel region 146, which are part of the claimed second active region. Pet. 54–55 (citing Ex. 1006 ¶¶ 4, 7, 12–13; Ex. 1003 ¶¶ 135–138; Ex. 1008B, 298–301, Figs. 5-1, 5-2, 6-4)). According to Petitioner, this second active region is disposed adjacent to the first active region and transistors (one or more), such as P-channel transistor 140, can be formed in the surface of this second active region. *Id.* Petitioner also contends that Wieczorek discloses forming multiple pMOS transistors in the second active region. *Id.* at 55–56 (citing Ex. 1006 ¶4; Ex. 1003 ¶ 137).

Claim 1 also recites “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate.” Ex. 1001, 4:57–60. Petitioner contends that the doping

concentration of the substrate of Wieczorek is shown in Figure 2b (reproduced above), and shows a dopant concentration that is highest at the surface of the substrate and decreases with depth. Pet. 56–58 (citing Ex. 1006 ¶¶ 4, 9, 11–13, Figs. 2a-2b; Ex. 1008B, 298–301, Fig. 5-2; Ex. 1003 ¶ 141). Petitioner further contends that Wieczorek’s downward-sloping graded dopant concentration aids carrier movement from the first surface to the second surface of the substrate. *Id.* at 59–60 (citing Ex. 1003 ¶¶ 144; Ex. 1010, 2:27–32, 5:13–22).

Patent Owner contends the “Petition’s Wieczorek grounds fail for similar reasons as the Kawagoe grounds: Wieczorek does not say that the dopant gradient it discloses has any effect on carriers at all.” PO Resp. 20 (citing Ex. 2057 ¶¶ 56–57). Patent Owner contends a downward sloping gradient concentration alone is not sufficient to establish the “aid carrier movement” claim limitation, and “Dr. Benerjee’s declaration does not indicate that he calculated the slope of the graded concentration curve in Wieczorek.” *Id.* at 21. “Indeed,” according to Patent Owner, “it would have been impossible for him to make such a calculation, because the dopant gradient Petitioners point to in Figure 2B (and Wieczorek generally) does not have any values from which one could calculate a slope.” *Id.* at 21–22.

Patent Owner’s arguments are not persuasive. Petitioner persuasively demonstrates that Wieczorek discloses a graded dopant concentration that extends from the first surface to a second surface of the substrate and decreases with depth. Pet. 57 (citing Ex. 1006 ¶¶ 9, 11, 13, Figs. 1b, 2b). Dr. Banerjee persuasively testifies that the decreasing dopant concentration that extends from the first surface to the second surface of the substrate will create a static, unidirectional drift field that will “aid carrier movement.” Ex. 1003 ¶¶ 141–144; Ex. 1060 ¶¶ 19–24. Patent Owner’s counter-arguments

are not persuasive for the same reason discussed above with respect to Kawagoe.

In its Sur-reply, Patent Owner contends that Dr. Banerjee admitted during his deposition that a flat or non-graded dopant concentration would not create any electric field, and Patent Owner asserts that Wieczorek “does not have a graded dopant concentration in the active region (or surface) because the doping “profile in the vicinity of the surface of the semiconductor device 100, as indicated by reference number 200, may have become substantially uniformly distributed.” Sur-reply 22–23 (citing Ex. 2078, 209:5–9, 212:19–213:1, 260:6–13; Ex. 1006 ¶ 11).

In his first declaration, Dr. Banerjee acknowledged the disclosure referenced by Patent Owner, and testified that Wieczorek’s “description is made relative to the ‘initial retrograde profile’ shown in Figure 2a” and is not inconsistent with his “understanding that Wieczorek still teaches and depicts a graded dopant concentration that is downward-sloping from the top surface of the substrate.” Ex. 1003 ¶ 141.

Patent Owner did not address Dr. Banerjee’s testimony or conclusions with respect to Figures 2a and 2b in its Response. Rather, Patent Owner chose to wait until its Sur-reply to address this evidence and Dr. Banerjee’s conclusions. Regardless, Patent Owner fails to address Dr. Banerjee’s specific testimony that Figure 2b of Wieczorek discloses the graded dopant profile *after annealing*. Ex. 1003 ¶ 141 (citing Ex. 1006 ¶¶ 9, 11, 13 (“[T]he initial dopant concentration, as shown in FIG. 2a, will be even more strongly affected so that, after the plurality of heat treatments, the actual dopant concentration will be represented by the graph shown in FIG. 2b.”)). Thus, despite Wieczorek’s statement that its dopants are “substantially uniformly distributed” after annealing, Figure 2b demonstrates that the graded dopant

profile of Wieczorek is not “flat,” as asserted by Patent Owner. Ex. 1006 ¶ 13, Fig. 2b.

Upon review of the parties’ arguments and supporting evidence, we determine that Petitioner persuasively identifies where Wieczorek and Wolf teach or suggest every limitation of challenged claim 1. Pet. 47–60.

Petitioner also provides a persuasive, undisputed rationale as to why one of ordinary skill in the art would have sought to combine Wieczorek and Wolf. *Id.* at 45–46 (asserting that Wolf is a “well-known text book” and one of ordinary skill in the art would have “understood and expected that the teachings of Wolf would apply to Wieczorek’s conventional CMOS device”). Thus, Petitioner persuasively demonstrates that claim 1 would have been obvious in view of Wieczorek and Wolf.

4. Independent Claim 9 and Dependent Claims 2, 3, 5–8, 10, 11, and 13–18

Petitioner contends the subject matter of independent claim 9 and dependent claims 2, 3, 5–8, 10, 11, and 13–18 would have been obvious in view of Wieczorek and Wolf. Pet. 61–69. In support of its arguments, Petitioner identifies where these references teach or suggest every limitation of these claims. *Id.*

Patent Owner does not address Petitioner’s arguments with respect to these claims, apart from its arguments related to independent claim 1. *See e.g.*, PO Resp. 20–22.

Upon review of the parties’ arguments and evidence, we determine that Petitioner persuasively identifies where every limitation of claims 2, 3, 5–11, and 13–18 is disclosed in Wieczorek and Wolf. Thus, Petitioner demonstrates by a preponderance of the evidence that these claims would have been obvious in view of Wieczorek and Wolf.

I. Reliance on Dr. Banerjee's Testimony

Patent Owner contends that Dr. Banerjee's testimony is "unreliable and should be disregarded for numerous reasons." PO Resp. 29. In particular, Patent Owner contends that Dr. Banerjee's declaration is unreliable because (1) he did not write and/or validate each statement or assertion made in his declaration; and (2) Dr. Banerjee has a monetary conflict of interest due to his pre-existing relationship with Texas Instruments ("TI"), which has joined IPRs addressing all asserted patents. PO Resp. 29–33; Sur-reply 12–14.

1. Manner of Drafting the Declaration

Patent Owner contends Dr. Banerjee admitted that he did not write his entire declaration and included material that was provided to him by Petitioner's attorneys, which he did not necessarily verify. PO Resp. 29–30. Patent Owner further asserts that Dr. Banerjee's declaration relies on the same grounds as those presented by Dr. Travis Blalock in another proceeding related to the '842 patent and his analysis "matches Dr. Blalock's declaration nearly verbatim." *Id.* at 30 (citing Ex. 1003; Ex. 2076). According to Patent Owner, "it is apparent that Petitioners just asked Dr. Banerjee to sign on to Dr. Blalock's existing analysis, and Dr. Banerjee complied." *Id.* at 31. Patent Owner also contends that Dr. Banerjee included a paragraph in his declaration stating that "[a]n internet search for [the Wolf textbook title]" "limited to the '.edu' domain yields over 800 results," but he did not do that search himself or confirm that it is accurate. *Id.*

Declarants have broad latitude in how they research, structure, and draft their declarations. They may rely upon information that they personally

identified or information provided by the parties' attorneys. They may also adopt nearly verbatim a previous declarant's testimony. Indeed, this procedure is often employed when a previous declarant is no longer able to testify in a proceeding. *See Jeisys Medical Inc v. Serendia, LLC*, IPR2024-00384, Paper 8 (PTAB March 1, 2024). This does not make the declaration inherently unreliable or necessarily entitled to less weight.

Through effective cross-examination, counsel may identify portions of a declaration that the declarant cannot explain or justify. In that case, the declarant's testimony on those matters may be entitled to less or even no weight, and if it happens repeatedly may lead to a conclusion that the entire declaration should be given little to no weight. Patent Owner identifies no testimony related to the key, disputed issues in this case, however, that Dr. Banerjee could not explain or provide the basis for his testimony. As such, we find that the manner in which Dr. Banerjee's declaration was drafted does not require that we disregard or give less weight to his testimony.

2. Conflict of Interest

Patent Owner contends that Dr. Banerjee depends on research funding from private industry for his career advancement and has only two active private grants, one of which is from TI²⁵ and provides \$90,000 for his lab. Sur-reply 12 (citing Ex. 2078, 29:4–7, 29:14–30:4, 46:22–47:7). Dr. Banerjee also indicated that he plans to pursue additional funding from TI in the future. *Id.* at 13 (citing Ex. 2078, 49:15–50:1).

²⁵ TI is not a party to this proceeding.

Declarants are often well paid for their efforts. *See* Ex. 1003 ¶ 2 (Dr. Banerjee explaining that he is being compensated \$675 per hour in this proceeding). This does not make their testimony inherently unreliable. In any event, at least because TI is not asserted to be a party or RPI to the present proceeding, Dr. Banerjee’s financial interest with TI does not have the potential to bias his testimony. Even if TI was a party or RPI to the present proceeding, such financial interest does not make Dr. Banerjee’s testimony inherently unreliable or inadmissible.

IV. MOTION TO EXCLUDE

Petitioner moves to exclude the declaration of Dr. Rao (Ex. 2072). Paper 63 (“Mot.”). Dr. Rao’s declaration contains six paragraphs, which are provided to support Patent Owner’s arguments with respect to objective indicia of non-obviousness. Ex. 2072. In his declaration, Dr. Rao identifies specific licenses and how much licensing revenue Patent Owner has received from each party. Ex. 2072 ¶ 2. Dr. Rao also testifies that Patent Owner never threatened litigation against [REDACTED] or any of their affiliates, and received \$30,000,000 from RPX for the license to [REDACTED]. *Id.* ¶¶ 4, 6.

Petitioner contends Dr. Rao did not personally negotiate the licenses and learned of the facts from others and “was unaware of the amount each licensee contributed to the total payment under the first RPX license.” Mot. 3. As Dr. Rao lacked personal knowledge of the facts alleged in the declaration, Petitioner contends the declaration should be excluded under Federal Rules of Evidence 402, 403, and 602.

We are not persuaded by this argument. Dr. Rao provides the identified licenses in the Appendix to his declaration and appears to have personal knowledge of much of his declaration testimony. For example, although he did not personally negotiate the licenses, he appears to have personal knowledge that they were entered into and how much licensing revenue was received. It is also sufficient for Dr. Rao to note that he is not aware of Greenthread ever threatening [REDACTED] with litigation, without having to rely upon potential hearsay testimony. As such, we decline to exclude his declaration.

We note, however, that Dr. Rao testifies that the RPX license provided rights to future patents Patent Owner may acquire, and he asserts that this “is a standard term in RPX licenses and many other licenses to ensure permanent peace between the parties.” Ex. 2072 ¶ 3. As Dr. Rao does not adequately explain his basis for the testimony regarding the standard terms of RPX’s licenses, we give this testimony little weight. Mot. 5.

In view of the foregoing, Petitioner’s Motion to Exclude Exhibit 2072 is *denied*.

V. CONCLUSION²⁶

For the foregoing reasons, we determine that Petitioner demonstrates by a preponderance of the evidence that claims 1–18 are unpatentable. Our conclusions are summarized below.

Outcome of Decision on Director Remand:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–18	103(a)	Kawagoe	1–18	
1–3, 5– 11, 13–18	103(a)	Wieczorek, Wolf	1–3, 5–11, 13– 18	
1–18	103(a)	Kawagoe, Gupta ²⁷		
1–3, 5– 11, 13–18	103(a)	Wieczorek, Wolf, Gupta ²⁸		
Overall Outcome			1–18	

²⁶ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

²⁷ Because we find that claims 1–18 would have been obvious over Kawagoe alone, we do not address whether these same claims would have been obvious over Kawagoe and Gupta.

²⁸ Because we find that claims 1–18 would have been obvious over Kawagoe, and that claims 1–3, 5–11, and 13–18 would have been obvious over Wieczorek and Wolf, we do not address whether these same claims would have been obvious over Wieczorek, Wolf, and Gupta.

Final Outcome After Director Remand:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–18	103(a)	Kawagoe	1–18	
1–3, 5– 11, 13–18	103(a)	Wieczorek, Wolf	1–3, 5–11, 13– 18	
1–18	103(a)	Kawagoe, Gupta ²⁹		
1–3, 5– 11, 13–18	103(a)	Wieczorek, Wolf, Gupta ³⁰		
Overall Outcome			1–18	

VII. ORDER

For the foregoing reasons, it is:

ORDERED that Petitioner demonstrates by a preponderance of the evidence that claims 1–18 of the ’842 patent are unpatentable;

ORDERED that Petitioner’s Motion to Exclude Exhibit 2072 is *denied*;

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

²⁹ Because we find that claims 1–18 would have been obvious over Kawagoe alone, we do not address whether these same claims would have been obvious over Kawagoe and Gupta.

³⁰ Because we find that claims 1–18 would have been obvious over Kawagoe, and that claims 1–3, 5–11, and 13–18 would have been obvious over Wieczorek and Wolf, we do not address whether these same claims would have been obvious over Wieczorek, Wolf, and Gupta.

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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 the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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