

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MONOLITHIC POWER SYSTEMS, INC.,
Petitioner,

v.

GREENTHREAD, LLC,
Patent Owner.

IPR2024-00469
Patent 9,190,502 B2

Before JON B. TORNQUIST, MONICA S. ULLAGADDI, and
JULIA HEANEY, *Administrative Patent Judges*.

HEANEY, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

A. *Background and Summary*

Monolithic Power Systems, Inc. (“Petitioner”) filed a Petition for *inter partes* review (Paper 1, “Pet.”) challenging claims 7 and 8 of U.S. Patent No. 9,190,502 B2 (Ex. 1001 (“the ’502 patent”)). Greenthread, LLC (“Patent Owner”) filed a Preliminary Response. Paper 10 (“Prelim. Resp.”). With our authorization, Petitioner filed a Preliminary Reply (Paper 16, “Prelim. Reply”), and Patent Owner filed a Preliminary Sur-Reply (Paper 17, “Prelim. Sur-Reply”).

We have authority to determine whether to institute an *inter partes* review. 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2023). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted “unless the Director determines . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” For the reasons set forth below, we determine the information presented in the Petition establishes a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims. Accordingly, we institute *inter partes* review on all claims and grounds challenged in the Petition.

B. *Real Parties-in-Interest*

Petitioner identifies itself as the real party-in-interest. Pet. 1.

Patent Owner identifies itself as the real party-in-interest. Paper 4, 1.

C. *Related Matters*

The parties identify several proceedings involving the ’502 patent as related matters, including *Greenthread, LLC v. Cirrus Logic, Inc.*, 1:23-cv-

00369 (W.D. Tex.); *Greenthread, LLC v. OmniVision Technologies, Inc.*, No. 2:23-cv-00212 (E.D. Tex.); *Greenthread, LLC v. OSRAM GmbH*, No. 2:23-cv-00179 (E.D. Tex.); *Greenthread, LLC v. Texas Instruments Inc.*, No. 2:23-cv-00157 (E.D. Tex.); *Greenthread, LLC v. Monolithic Power Systems, Inc.*, No. 1:23-cv-00579 (D. Del.). Pet. 1–2; Paper 4, 1–2.

The parties also identify the following proceedings as involving the ’502 patent, and no longer pending: *Greenthread, LLC v. Intel Corporation, Dell Inc. and Dell Technologies Inc.*, 6:22-cv-00105-ADA (E.D. Tex.); *Greenthread, LLC v. Intel Corporation*, 3:22-cv-02001 (D. Or.); *Greenthread, LLC v. Micron Technology, Inc. et al.*, 1:23-cv-00333 (D. Del.); *Greenthread, LLC v. Western Digital Corporation et al.*, 1:23-cv-00326 (D. Del.); *Greenthread, LLC v. Samsung Electronics Co., Ltd. et al.*, 2:19-cv-000147 (E.D. Tex.). Pet. 1–2; Paper 4, 4.

The parties also identify four *inter partes* review proceedings involving the ’502 patent, namely IPR2020-00289, IPR2023-00548, IPR2024-00018, and IPR2024-00265. Pet. 2–3; Paper 4, 2.

D. The ’502 Patent

The ’502 patent, titled “Semiconductor Devices with Graded Dopant Regions,” issued on November 17, 2015. Ex. 1001, codes (45), (54). The ’502 patent “relates to all semiconductor devices and systems,” including Bipolar Junction Transistors (BJT). *Id.*, 1:17–30.

The ’502 patent explains that in bipolar junction transistors, minority carriers are the principal device conduction mechanism, but majority carriers also play a small but finite role in modulating the conductivity in such devices. Ex. 1001, 1:27–30. The ’502 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" versus the standard "uniformly doped base" bipolar junction transistors. Ex. 1001, 1:38–40. The '502 patent explains that 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." Ex. 1001, 1:40–44. The invention of the '502 patent implements a graded dopant concentration in these devices, which 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." Ex. 1001, 3:13–18.

Figure 1 of the '502 Patent is reproduced below.

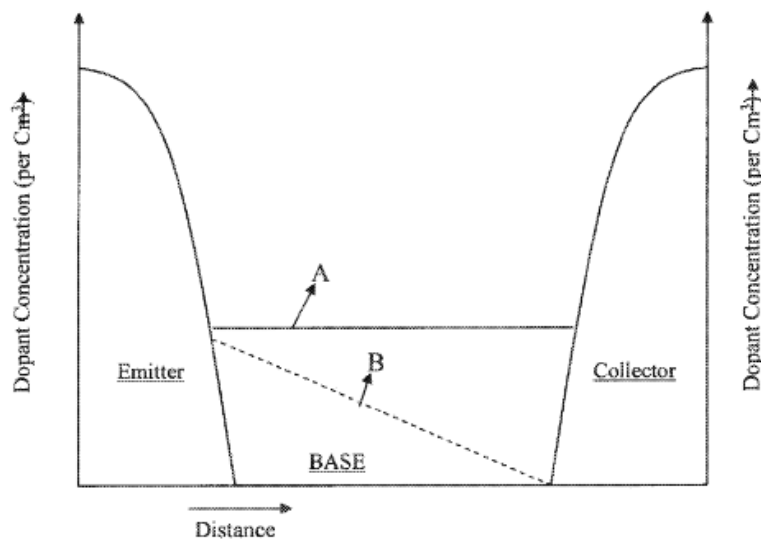


Figure 1 is labeled "Prior Art" and "illustrates the relative doping profiles of emitter, base, and collector for the two most popular bipolar junction transistors: namely, A—uniform base, and B—graded base." Ex. 1001, 2:17–19.

Figure 3A of the '502 patent is reproduced below.

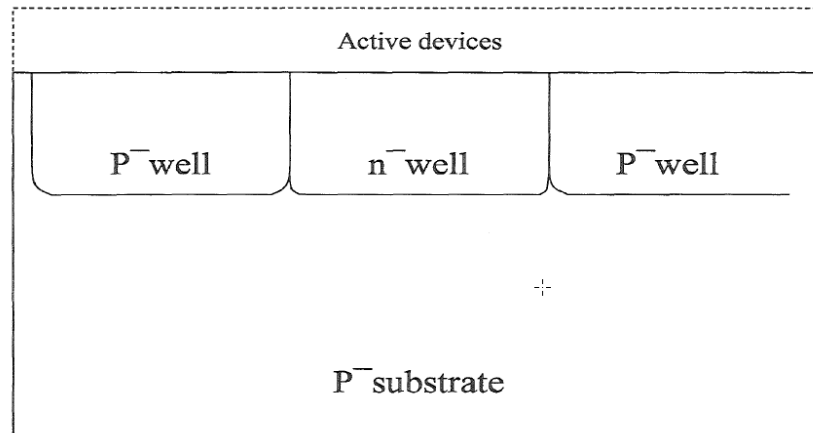


Figure 3A is labeled “Prior art” and shows a cross-sectional view of a “commonly used CMOS silicon substrate with two wells (one n- well in which p-channel transistors are subsequently fabricated, and one p- well in which n-channel transistors are subsequently fabricated).” Ex. 1001, 2:22–27, Fig. 3A.

Figure 5A of the ’502 patent is reproduced below.

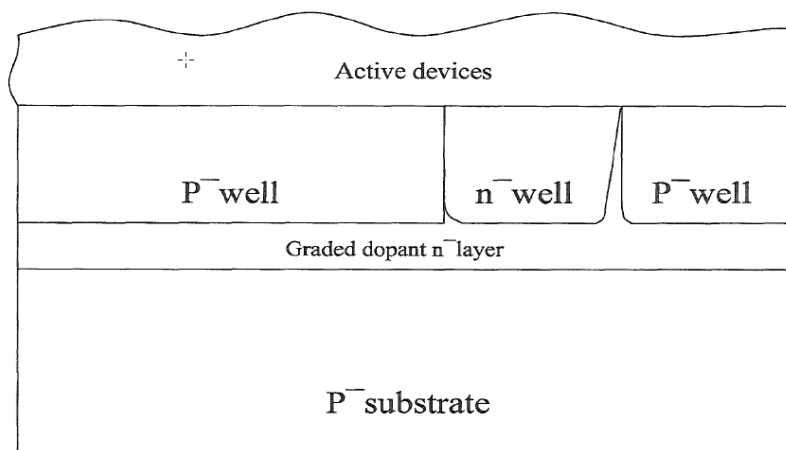


Figure 5A illustrates a cross section of a CMOS silicon substrate with two wells and an underlying layer using embodiments of the invention. Ex. 1001, 2:31–35. According to the ’502 patent, “[s]purious minority carriers can be generated by clock switching in digital VLSI logic and memory ICs,” and these “unwanted carriers can discharge dynamically-held

‘actively held high’ nodes,” and serve to degrade performance of various types of devices, including digital imaging ICs. Ex. 1001, 3:25–34. The ’502 patent further explains that “a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface.” Ex. 1001, 3:39–42. In particular, “[i]n a preferred embodiment, the subterranean n– layer has a graded donor concentration to sweep the minority carriers deep into the substrate.” Ex. 1001, 3:42–44.

E. Illustrative Claim

Claim 7 is the only independent claim challenged, and is reproduced below.

7. A semiconductor device comprising:

[7.1] a surface layer;

[7.2] a substrate;

[7.3] an active region including a source and a drain, disposed on one surface of said surface layer;

[7.4] a single drift layer disposed between the other surface of said surface layer and said substrate,

[7.5] said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and

[7.6] at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

Ex. 1001, 4:52–67 (bracketed numbering added by Petitioner).

F. Asserted Unpatentability Challenges

Petitioner asserts that claims 7 and 8 are unpatentable based on the following challenges:

Claims Challenged	35 U.S.C. § ¹	Reference(s)/Basis
7, 8	103	Onoda ²
7, 8	103	Onoda, Nishizawa ³
7, 8	103	Kawagoe ⁴

Petitioner relies on the declaration of Dr. Stephen Campbell. Ex. 1003.

II. ANALYSIS

A. Legal Standards

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

A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the claimed invention and the prior art are such that the claimed

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (2011) amended 35 U.S.C. § 102 and § 103, and took effect on March 16, 2013. Because applications from which the ’502 patent claims priority were filed before this date, the pre-AIA version of § 102 and § 103 applies.

² Japanese Unexamined Patent Application Publication No. H8-279598, published Oct. 22, 1996 (Ex. 1043). We cite to a certified translation. Ex. 1042.

³ U.S. Patent No. 5,384,476, filed June 9, 1987 and issued January 24, 1995, to Nishizawa et al. (Ex. 1046, “Nishizawa”).

⁴ U.S. Patent No. 6,043,114, filed September 22, 1997 and issued March 28, 2000, to Kawagoe et al. (Ex. 1007, “Kawagoe”).

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

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

cautious of arguments reliant upon *ex post* reasoning.” *KSR*, 550 U.S. at 421.

B. Level of Ordinary Skill in the Art

Petitioner asserts 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. 5 (citing Ex. 1003 ¶ 17). According to Petitioner, “[a]dditional education might compensate for a deficiency in experience, and vice-versa.” *Id.* On the present record, Patent Owner does not contest Petitioner’s definition of a person of ordinary skill in the art. Prelim. Resp. 1–32.

In light of the record before us, and for purposes of this Decision, we adopt Petitioner’s proposal regarding the level of ordinary skill in the art. Based on our review of the ’502 patent and the prior art of record, we determine that the definition offered by Petitioner comports with the qualifications a person would have needed to understand the ’502 patent and the prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required “where the prior art itself reflects an appropriate level and a need for testimony is not shown”) (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985)).

C. Claim Construction

In an *inter partes* review, we construe claim terms according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning.” *Phillips*, 415 F.3d

at 1312. “[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Id.* at 1313. “Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification.” *Id.*

Neither party proposes any claim terms for construction. Pet. 5–7; Prelim. Resp. 1–32. After considering the arguments and information presented in the Petition and Preliminary Response, we agree that we do not need to construe any terms expressly in order to determine whether to institute trial. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”)).

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

Pursuant to 35 U.S.C. § 315(b), an “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 this Petition should be dismissed because it is untimely. Prelim. Resp. 14. In particular, Patent Owner argues that Petitioner is in privity with [REDACTED] [REDACTED] (collectively, “Licensees”), who Patent Owner asserts are time-barred under 35 U.S.C. § 315(b) and licensed under the ’502 patent. *Id.* at 14–32.

Patent Owner advances several theories supporting its privity arguments, including that Petitioner and Licensees “are ‘preceding and succeeding owners of’ the licensed and/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 Petitioner acts as Licensees’ “agent” for Licensees’ “have made” rights. Prelim. Resp. 13–32.

Although Petitioner is a party to a lawsuit involving the ’502 patent, Patent Owner does not assert the Petition is time-barred based on this lawsuit—presumably because the Petition was filed within a year of the service of the complaint in the lawsuit involving the ’502 patent against Petitioner. *Compare* Pet. 1 (indicating related litigation commenced May 26, 2023) *with*, Paper 3, 1 (according a filing date of February 3, 2024 to the present Petition). Instead, Patent Owner asserts the Petition is time-barred because Petitioner is allegedly in privity [REDACTED].

1. Legal Standards

“A person who was not a party to a suit generally has not had a ‘full and fair opportunity to litigate’ the claims and issues settled in that suit.” *Taylor v. Sturgell*, 553 U.S. 880, 892 (2008). Thus, in general, Petitioner should not be precluded from addressing the unpatentability of a patent based on the filing of previous lawsuits involving [REDACTED]. *See id.* (explaining that, in general, one is not bound by a judgment “in which he is not designated as a party or to which he has not been made a party by service of process”); *WesternGeco LLC v. ION Geophysical Corp.*, 889 F.3d 1308, 1319 (Fed. Cir. 2018) (noting the “general rule against nonparty preclusion”). This rule is deeply rooted in the “historic tradition that

everyone should have his own day in court.” *Taylor*, 553 U.S. at 892–93. (quoting *Richards v. Jefferson County*, 517 U.S. 793, 798 (1996)).

An exception to this deeply-rooted rule exists for parties that are in privity with a defendant in an earlier litigation. *See WesternGeco*, 889 F.3d at 1319 (noting that “the standards for the privity inquiry must be grounded in due process”).

The Supreme Court in *Taylor* identified considerations where nonparty preclusion would be justified, including:

- (1) an agreement to be bound; (2) pre-existing substantive legal relationships between the person to be bound and a party to the judgment (e.g., “preceding and succeeding owners of property”); (3) adequate representation by someone with the same interests who was a party (e.g., “class actions” and “suits brought by trustees, guardians, and other fiduciaries”); (4) assumption of control over the litigation in which the judgment was rendered; (5) where the nonparty to an earlier litigation acts as a proxy for the named party to relitigate the same issues; and (6) a special statutory scheme expressly foreclosing successive litigation by nonlitigants.

Id. (citing *Taylor*, 553 U.S. at 894–95).

As this list of considerations indicates, “the 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,” or the evidence must demonstrate that 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.” *Id.*; *WesternGeco*, 889 F.3d at 1319; *see also Ventex Co. v. Columbia Sportswear North America, Inc.*, IPR2017-00651, Paper 148 at 10, 12 (PTAB Jan. 24, 2019) (precedential) (finding privity where the two parties “had a specially structured, preexisting, and well established business relationship with one another, including indemnification and exclusivity arrangements”).

A petitioner’s “initial identification of the real parties in interest [and privies] should be accepted unless and until disputed by a patent owner.” *Worlds Inc. v. Bungie, Inc.*, 903 F.3d 1237, 1243 (Fed. Cir. 2018). In order to raise such a dispute, “a patent owner must produce *some* evidence that tends to show that a particular [time-barred] third party should be named a [privity].” *Id.* at 1244. The amount of evidence a patent owner must produce does not rise to the level of that required to overcome a burden of production. *Id.* at 1244 n.8. One potential formulation of the amount of evidence required is “evidence that ‘reasonably brings into question the accuracy of a petitioner’s’” assertion that it is not time-barred. *Id.* (quoting *Atlanta Gas Light v. Bennett Regulator Guards, Inc.*, IPR2013-00453, Paper 88 (PTAB Jan. 6, 2015) (addressing the amount of evidence required from a patent owner to question a petitioner’s identification of the real parties-in-interest)). Although the “burden remains with the petitioner to establish” the timeliness of its petition, it need not respond until the patent owner reasonably brings into question the accuracy of the assertion that the petition is not time-barred. *Id.* at 1242.

2. Licensees as Alleged Privies

In the subsections below, we address Patent Owner’s arguments that Licensees are privies of Petitioner under § 315(b).

a. Agency

Patent Owner argues that “Petitioner is Licensees’ contractor exercising their rights under the license, including by making accused products on their behalf under the ‘have made’ clause.” Prelim. Resp. 28–30. We disagree.

First, Patent Owner’s agency argument is not based on the applicable legal standard. For purposes of privity under § 315(b), the relevant question is whether Petitioner is acting as an agent for [REDACTED] in filing a petition for *inter partes* review. *See Taylor*, 553 U.S. at 895 (preclusion “is appropriate when a nonparty later brings suit as an agent for a party who is bound by a judgment”). As the Federal Circuit explains, the rationale behind § 315(b)’s time bar is “to prevent successive challenges to a patent by those who previously have had the opportunity to make such challenges in prior litigation.” *WesternGeco*, 889 F.3d at 1319. Here, Patent Owner does not assert that Petitioner is acting as an agent for [REDACTED] in this proceeding. Any such assertion would be appropriate only based on evidence suggesting that any of these parties is controlling Petitioner’s conduct in the proceeding. *See Taylor*, 553 U.S. at 906 (cautioning that “preclusion is appropriate only if the putative agent’s conduct of the suit is subject to the control of the party who is bound by the prior adjudication”). No such evidence is in this record.

Patent Owner argues that to be in privity with the Licensees, what matters is “‘if the prior action concerned a matter within the agency.’” Prelim. Resp. 28–29 (citing *Herrion v. Children’s Hosp. Nat. Med. Ctr.*, 786 F. Supp. 2d 359 (D.D.C.), *aff’d*, 448 F. App’x 71 (D.C. Cir. 2011); *see also id.* (citing *John Street Leasehold, LLC v. Cap. Mgmt. Res., L.P.*, 283 F.3d 73

(2d Cir. 2002); *Fiumara v. Fireman's Fund Ins. Companies*, 746 F.2d 87 (1st Cir. 1984)). This approach, however, would significantly expand the analysis set forth in *Taylor*, which noted that preclusion is only appropriate “if the putative agent’s conduct of the suit is subject to the control of the party who is bound by the prior adjudication.” *Taylor*, 553 U.S. at 906 (explaining that “courts should be cautious about finding preclusion” on the basis of agency). Moreover, the privity inquiry must take into account the rationale behind § 315(b)’s preclusion provision, which “is to prevent successive challenges to a patent by those who previously have had the opportunity to make such challenges in prior litigation.” *WesternGeco*, 889 F.3d at 1319. Patent Owner’s broad interpretation would be inconsistent with this purpose.

Even if Patent Owner’s argument that a general agency relationship is sufficient to demonstrate privity for purposes of nonparty preclusion were on solid legal footing, it lacks factual support in the record. An “essential element[] of agency” is “the principal’s ‘right to direct or control the agent’s actions.’” *In re Google LLC*, 949 F.3d 1338, 1345 (Fed. Cir. 2020) (quoting *Meyer v. Holley*, 537 U.S. 280, 286 (2003)). Patent Owner does not argue in the Preliminary Response that [REDACTED] has or had such a right with respect to Petitioner, or vice versa, much less direct us to any evidence that would tend to prove the existence of such a right. Prelim. Resp. 28–30.

b. Preceding and Succeeding Owners of Property

Patent Owner argues that Petitioner and Licensees are “preceding and succeeding owners” of “licensed and/or infringing products.” Prelim. Resp. 25–26 (citing *Taylor*, 553 U.S. at 894). Entities that are “preceding and succeeding owners of property” may be bound to a previous judgement

related to *that property*. *Taylor*, 553 U.S. at 894. This rule, however, “is extended or denied in an effort to protect conflicting property interests rather than an effort to implement concepts of participation or representation.”

18A C. Wright, A. Miller, & E. Cooper, *Federal Practice and Procedure* § 4448 (3d. ed. 2023); *see also id.* at § 4462 (“Successive Property Relationships”) (“There is no independent reason to treat the defeated litigant as the representative of his transferee. Preclusion is limited to the property involved in the judgment.”). As noted above, our relevant analysis is based on the relationships between the parties with respect to the prior proceedings or the Petition (e.g., participation or representation), not on property interests. *See WesternGeco*, 889 F.3d at 1319 (noting that the privity requirement is used “to prevent successive challenges to a patent by those who previously have had the opportunity to make such challenges in prior litigation”).

Moreover, the rule related to preceding and succeeding owners of property does not extend to the point where all manufacturers of allegedly infringing goods are in privity with the customers who buy those goods. *See, e.g., id.* 889 F.3d at 1321 (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).

Patent Owner’s evidence that Petitioner’s products are components of Licensees’ products does not come close to suggesting that “it can be fairly

said that the petitioner had a full and fair opportunity to litigate the validity of the patent” in the prior lawsuit or that petitioner is serving as a proxy to allow the customer to again challenge the patent. *WesternGeco*, 889 F.3d at 1319. Thus, Patent Owner does not present evidence that lends support to a finding that Petitioner’s and Licensees’ status as preceding and succeeding owners of allegedly infringing products renders them privies for purposes of § 315(b).

Patent Owner argues that Petitioner and Licensees are privies because Petitioner is a “beneficiary” of Patent Owner’s license with Licensees, which Patent Owner asserts is “directly related to” the accused products. Prelim. Resp. 27 (citing *Ventex*, IPR2017-00651, Paper 148). We disagree. Unlike the agreements in *Ventex*, Paper 148 at 12, Patent Owner’s license to Licensees is not evidence of a privity relationship between Petitioner and Licensees because Petitioner is not a party to the license agreement.

3. *Patent Exhaustion*

Patent Owner argues that the doctrine of patent exhaustion gives rise to privity because “after Petitioners sells products under the license, any downstream user of the article sold would have an exhaustion defense against Greenthread.” Prelim. Resp. 28. According to Patent Owner, “Petitioner is effectively providing rights to third-parties under the license and, therefore, is in privity with Licensees.” *Id.* We disagree. It is true that downstream purchasers and users of Licensees’ products that incorporate products made by Petitioner may have a license (or exhaustion) defense against any claim of infringement by Patent Owner. The relevant question, however, is ultimately whether the relationship between Petitioner and Licensees is sufficiently close to justify denying Petitioner its day in court.

See Taylor, 553 U.S. at 892. Patent Owner does not sufficiently explain why a license defense supports such a privity relationship between Petitioner and Licensees.

4. *Conclusion as to Timeliness of the Petition*

As noted above, 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*, 889 F.3d at 1319. A petitioner’s “initial identification of the real parties in interest [and privies] should be accepted unless and until disputed by a patent owner.” *Worlds*, 903 F.3d at 1243. In order to raise such a dispute, “a patent owner must produce *some* evidence that tends to show that a particular [time-barred] third party should be named a [privity].” *Id.* at 1244. Here, Patent Owner argues that it has produced such evidence in several respects, but, on the present record, none of the evidence in question tends to show that any of the time-barred Licensees are privies of Petitioner for purposes of § 315(b). As such, the evidence of record does not tend to suggest that Petitioner is time-barred under 35 U.S.C. § 315(b), and does not sufficiently call into question Petitioner’s assertion that the Petition is timely filed.⁵

⁵ Pursuant to 37 C.F.R. § 42.51(b)(1)(iii), Petitioner is required to “serve relevant information that is inconsistent with a position” it has advanced during the proceeding. To the extent Petitioner is in possession of information that is inconsistent with its assertion that it is not in privity with

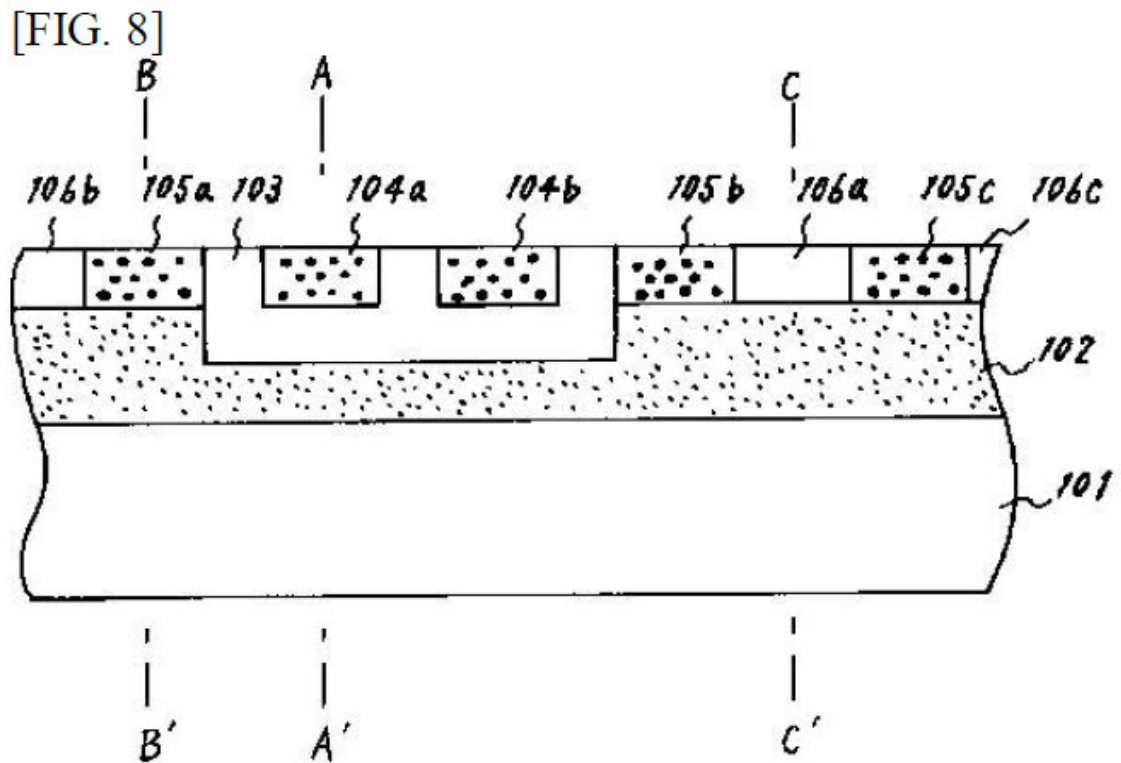
E. Ground I: Obviousness over Onoda

Petitioner contends claims 7 and 8 would have been obvious in view of Onoda (Petitioner’s Ground I). Pet. 17–43.

1. Onoda

Onoda is titled “Semiconductor Integrated Circuit Device, Nonvolatile Semiconductor Storage Device, and Manufacturing Method” and describes “a nonvolatile semiconductor storage device with improved latch-up resistance and punch-through breakdown voltage and improved junction breakdown voltage between the well regions and the semiconductor substrate.” Ex. 1042, codes (54), (57). Onoda “relates to a semiconductor integrated circuit device, to a nonvolatile semiconductor storage device, and to methods of manufacturing thereof, and, in particular, relates to a nonvolatile semiconductor storage device wherein a triple-well structure is formed in an epitaxial substrate.” *Id.* ¶ 1. Figure 8 of Onoda, reproduced below, “is a cross-sectional drawing illustrating, in step order [in conjunction with Figures 4–7], manufacturing of a semiconductor substrate 100 to which the first embodiment according to the present invention is applied.” *Id.* at 28.

Licensees, such information should be served upon Patent Owner, subject to the exceptions outlined in § 42.51(b)(1)(iii).



Onoda's Figure 8, in conjunction with Figures 4–7, depicts a method for manufacturing a flash memory structured as shown. Ex. 1042 ¶ 46. Figure 8 depicts a first semiconductor layer 101, which comprises a heavily-doped P-type silicon substrate (silicon wafer) with a dopant concentration of $1 \times 10^{19}/\text{cm}^3$ (*id.*) and a lightly-doped P-type second semiconductor layer 102 wherein the epitaxial layer 102a, as a whole, is between 1×10^{16} and $1 \times 10^{18}/\text{cm}^3$ (*id.* ¶ 47). Figure 8 also depicts an N-type first well region 103 with a depth of about $3 \mu\text{m}$ and a dopant concentration of between 1×10^{15} and $1 \times 10^{18}/\text{cm}^3$. *Id.* ¶ 48. Also shown in Figure 8 are boron implantation layers 104A, 104B, 105A, 105B, and 105C, and phosphorus implantation layers 106A through 106C. *Id.* ¶ 49.

2. *Analysis of Claim 7*

The preamble of claim 7 recites: “A semiconductor device comprising:”⁶ Ex. 1001, 4:52. Petitioner contends that “[t]o the extent the preamble is limiting, Onoda discloses a semiconductor device.” Pet. 19–20. Petitioner provides evidence to support its argument that Onoda discloses a semiconductor integrated circuit device that has both N-channel MOS (NMOS) transistors and P-channel MOS (PMOS) transistors in the circuitry of its flash memory devices. *Id.* at 20 (citing Ex. 1042 ¶¶ 52, 44, 45, 6, Fig. 2, claim 2; Ex. 1003 ¶¶ 55–57). Patent Owner does not dispute Petitioner’s contention. *See* Prelim. Resp. 2–13.

Claim 7.1 recites “a surface layer.” Ex. 1001, 4:53. Petitioner contends that “Onoda teaches a surface layer.” Pet. 20. Petitioner directs us to evidence that tends to show that Onoda discloses a surface layer similar to that in the ’502 patent. Ex. 1003 ¶¶ 58–59; Ex. 1042 ¶¶ 29, 43, 44, Fig. 3; *see* Ex. 1030, 6, 13. In particular, Figure 5(b) of the ’502 patent and Onoda’s Figure 3 show quite similar structures, and Patent Owner’s district court claim construction brief identified the relevant structure in Figure 5(b) of the ’502 patent as a surface layer. Ex. 1030, 6, 12. Patent Owner does not dispute Petitioner’s contention. *See* Prelim. Resp. 2–13.

Claim 7.2 recites “a substrate.” Ex. 1001, 4:54. Petitioner argues that “Onoda discloses ‘a semiconductor substrate 100’ on which the flash memory is formed.” Pet. 22. Onoda discloses fabricating its CMOS device “in a silicon semiconductor substrate.” *Id.* at 24 (citing Ex. 1042 ¶ 41, Fig.

⁶ We need not determine at this preliminary stage whether the preamble is limiting.

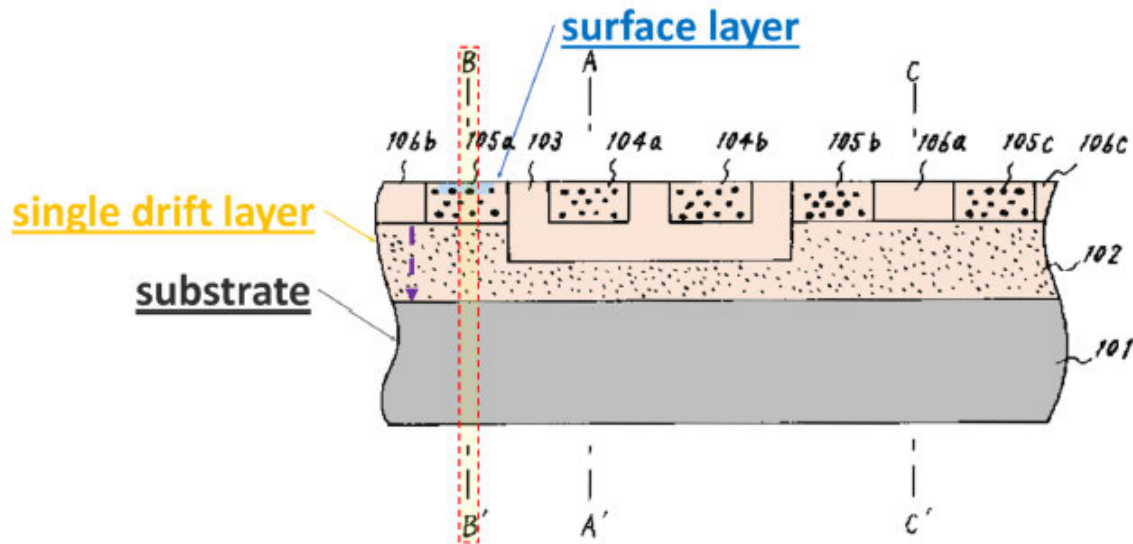
3; Ex. 1030, 6, 15). Patent Owner does not dispute Petitioner's contention. *See* Prelim. Resp. 2–13.

Claim 7.3 recites “an active region including a source and a drain, disposed on one surface of said surface layer.” Ex. 1001, 4:55–56. Petitioner argues that Onoda discloses this element. Pet. 24–28. Petitioner relies on Onoda's Figure 3 to illustrate that “the surface layer contains a source and a drain which form an active region.” *Id.* at 24 (citing Ex. 1042, Fig. 3, ¶¶ 29, 43, 44, claim 2). Petitioner directs us to evidence that a person of ordinary skill in the art would have considered the transistors to be active regions. Ex. 1001, Fig. 5(b); Ex. 1030, 4–5, 7, 11; Ex. 1003 ¶¶ 62–65; Ex. 1008, 299; Ex. 1008B, Fig. 5–1. Patent Owner does not dispute Petitioner's contention. *See* Prelim. Resp. 2–13.

Claim 7.4 recites “a single drift layer disposed between the other surface of said surface layer and said substrate.” Ex. 1001, 4:57–58. Petitioner argues that Onoda discloses this element. Pet. 28–30 (citing Ex. 1003 ¶¶ 66–71). Onoda discloses a first tub region with a surface region in it that, on the present record, appears quite similar to the single drift layer and well region of the '502 patent. *Compare* Ex. 1042, Figs. 3, 5, 8, 10–12, ¶¶ 41–51, *with* Ex. 1001, Fig. 5(b); Ex. 1030, 7, 11. Additionally, Onoda's Figure 11 shows a dopant concentration in second semiconductor layer 102 that decreases with increasing depth. Ex. 1042 ¶¶ 46–50, 52, Figs. 8, 11. Patent Owner does not dispute Petitioner's contention. *See* Prelim. Resp. 2–13.

Claim 7.5 recites “said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.”

Ex. 1001, 4:58–62. Petitioner argues that Onoda discloses this element. Pet. 30–34. Petitioner provides an annotated version of Onoda’s Figure 8, reproduced below.



As shown in the annotated version of Onoda’s Figure 8, Petitioner maps the claimed substrate to Onoda’s first semiconductor layer 101. Pet. 31; Ex. 1042, Figs. 8, 11, ¶¶ 46–50; Ex. 1003 ¶¶ 66–71. Petitioner relies on the parent patent’s file history and cited references to argue that the presence of “a downward-sloping graded-dopant concentration creates an inherent built-in unidirectional electric drift field to aid the movement of minority carriers.” Pet. 33–34 (citing Ex.1003, ¶¶ 73; Pet. § VII.B).

Claim 7.6 recites “at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.” Ex. 1001, 4:63–67. Petitioner argues that Onoda discloses this element. Pet. 34–40. Petitioner argues that Onoda’s single drift layer (“SDL”), with a well region disposed within it, satisfies this claim limitation. *Id.* at 34–36 (citing Ex.

1042, Fig. 3, ¶¶ 42, 44, 46, 48–50). Petitioner also argues that Onoda’s Figure 11 depicts the gradient profile of cross-sectional B-B’ of Figure 8, which would aid the movement of minority carriers from the surface layer to the substrate for the same reasons as described in limitation 7.5. *Id.* at 36–38 (citing Ex. 1042, Figs. 8, 11, ¶ 52; Ex. 1003 ¶¶ 75–78; Pet. § VII.B). Relying on Patent Owner’s arguments during prosecution, Petitioner contends that the presence of this layer creates a second “static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.” Pet. 37–40; Ex. 1003 ¶¶ 72–83; Ex. 1042, Figs. 8, 13, ¶ 48, 87.

Patent Owner argues that, for “all of the asserted grounds,” Petitioner fails to show that any of the primary references disclose any of the claim elements requiring the limitation “aid the movement of minority carriers” as in claim 7.5 and 7.6. Prelim. Resp. 1–7, 9–10, 12–13. More particularly, Patent Owner faults Petitioner for relying “entirely on [Patent Owner’s] purported admissions” in prosecution, without analyzing “other parameters.” *Id.* at 6–7. Patent Owner argues that Dr. Campbell “does not offer an opinion regarding the strength of the force created by the dopant grading” in any of the prior art, and because he “offers no opinion about the strength of the force created by the dopant gradients,” he “cannot not compare it to other forces acting on carriers.” *Id.* at 11–12. Finally, Patent Owner faults Dr. Campbell for failing to “describe what forces these curves [in Onoda] exert on carriers” or “how those forces compare with other forces acting on carriers.” *Id.* at 13.

After considering the parties’ arguments and information on the present record, we determine that Petitioner has shown sufficiently, for

purposes of institution, that Onoda discloses or suggests the first and second “static unidirectional electric drift field to aid the movement of minority carriers” limitations of claim 7.

Contrary to Patent Owner’s assertions, Petitioner is not arguing or assuming that “*any* ‘graded dopant concentration’ would *necessarily* ‘aid the movement of minority carriers,’” nor is Petitioner attempting to read out the “aid the movement of minority carriers” element. Prelim. Resp. 1–2; Prelim. Reply 3–7. Instead, Petitioner presents evidence demonstrating that a graded dopant concentration results in an electric field, which exerts a force on charged particles that will move, or aid movement, of the carriers in a specific direction. Pet. 30–40. For example, Petitioner correctly indicates (Prelim. Reply 4–5) that during prosecution, Patent Owner stated that “the graded dopant concentration itself creates a ‘built-in’ electrical field that forces the movement of carriers into a particular direction,” and that this inherent ‘built-in’ unidirectional electric field is “the additional parameter for ensuring that all minority carriers are being moved in one direction.” Ex. 1002, 289–290.

Patent Owner attempts to explain away the statements made during prosecution, arguing that it “never said all graded dopant concentrations aid the movement of minority carriers” and that “Petitioner does not quote [Patent Owner’s] full statement.” Prelim. Resp. 2–3. Petitioner, however, has accurately quoted the statements made during prosecution, and those statements speak for themselves. *See* Pet. 10–12, 33–34, 38; Ex. 1002, 289–290.

As to Patent Owner’s argument that “Dr. Campbell’s declaration cannot make up for what is lacking in Petitioner’s references” (Prelim.

Resp. 12–13), we disagree. According to Patent Owner, “Dr. Campbell’s analysis fails to determine whether the force exerted by the specific dopant gradients would actually aid carrier movement, or be overwhelmed by other forces in the device.” *Id.* at 12–13. Patent Owner thus argues that Dr. Campbell’s declaration “merely observes the shape of the downward curves” in Onoda and “concludes that the claim limitation is met by anything having a ‘downward dopant gradient.’” *Id.* at 12–13 (quoting Ex. 1003 ¶¶ 72–73).

Patent Owner’s arguments, however, are inconsistent with the representations it made during prosecution. In particular, during prosecution, Patent Owner argued that a graded dopant concentration creates an electric field that forces the movement of carriers in a particular direction, without any discussion of the force exerted by the specific dopant gradients, whether any other forces are present, or the comparative magnitude of all forces present. *See* Ex. 1002, 289–290. Furthermore, although Patent Owner now directs us to the Examiner’s statement that “movement of minority carriers is affected by multiple forces and fields,” and “‘without knowing other parameters of the device’ one cannot say whether the field would aid the movement of minority carriers” to support its arguments (*see* Prelim. Resp. 4 (citing Ex. 1002, 270)), Patent Owner previously represented to the Patent Office that it disagreed with the Examiner’s position (Ex. 1002, 289).

Additionally, Patent Owner does not direct us to any discussion in the ’502 patent regarding a specific slope value that is necessary to “aid the movement of minority carriers,” either in isolation or in the presence of other forces that may act upon the carriers. Nor does Patent Owner direct us

to any authority suggesting we should demand more from the prior art disclosure in Onoda than is provided in the disclosure of the '502 patent.

In view of this, we determine Petitioner's assertion that Onoda discloses a first and second "static unidirectional electric drift field to aid the movement of minority carriers" because Onoda has a graded dopant concentration is reasonable and sufficient for purposes of institution. There is no evidence on this record that any other additional parameter is necessary, present, or acting upon the carriers in Onoda's system. Prelim. Reply 5 (citing Ex. 1002, 290); Sur-reply 2 (discussing, without disputing, Petitioner's statements regarding "other forces"). At this stage of the proceeding, we credit Dr. Campbell's testimony that Onoda discloses the limitations of element [7.5] and element [7.6]. Ex. 1003 ¶¶ 72–83, 160. Dr. Campbell's testimony is consistent with, and supported by, other evidence in the record, and disputed only by attorney argument.

For all of the foregoing reasons, Petitioner has shown sufficiently, at this stage of the proceeding, that Onoda teaches the "said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers" and "said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers" limitations of claim 7.

3. Dependent Claim 8

Petitioner presents additional arguments for obviousness of claim 8 based on Onoda alone. Pet. 40–43. Other than as explained above, Patent Owner does not dispute Petitioner's contention. See Prelim. Resp. 2–13.

In view of our determination that Petitioner establishes a reasonable likelihood for claim 7, and because Petitioner’s arguments and evidence for remaining claim 8 (Pet. 40–43) are similar to Petitioner’s arguments and evidence for claim 7 (*id.* at 17–40) and are unopposed at this stage by Patent Owner, we determine that it is unnecessary to provide an express analysis of Petitioner’s challenges to dependent claim 8 in order to provide guidance to the parties for the upcoming trial. Consolidated Trial Practice Guide November 2019 (“CTPG”)⁷ at 64; *see* 37 C.F.R. § 42.108(a) (“When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.”); *see also SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018) (holding that 35 U.S.C. § 314 forbids the Board’s prior “partial institution” practice).

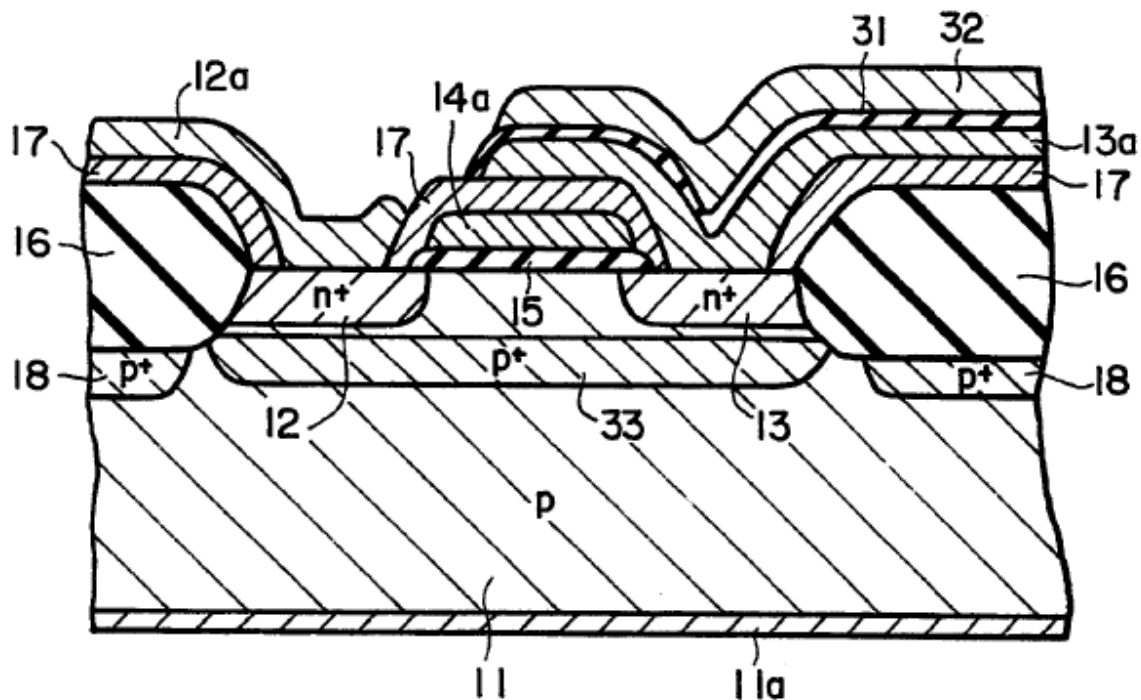
F. Ground II: Obviousness over Onoda and Nishizawa

Petitioner contends claims 7 and 8 would have been obvious based on Onoda and Nishizawa. Pet. 43–49.

1. Nishizawa

Nishizawa “relates to a semiconductor device, and more particularly to a semiconductor device such as an insulation-gate transistor which allows a high packing density integration and effects a good holding of memory contents and which does not make soft errors induced by alpha-particle irradiation.” Ex. 1046, 1:21–29. Figure 16 of Nishizawa, reproduced below, is a diagrammatic sectional view showing the structures of a dynamic random access memory (“d-RAM”) cell. *Id.* at 8:25–26.

⁷ Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.



Nishizawa's Figure 16 depicts a p-type substrate 11 and a substrate electrode 11a. The cell includes n⁺ type regions 12, n⁺ type storage region 13, and p⁺ type buried region 33a. *Id.* at 17:40–47. Numerals 12a and 13a represent a source electrode and a drain electrode, respectively, which are made of a metal such as aluminum. *Id.* at 2:7–10. Numeral 15 represents a gate oxide film, 16 a field oxide film, and 17 a PSG film. *Id.* at 2:6–7. Numeral 18 represents a p⁺ type region which serves as a channel-stopper region for inhibiting the tendency of formation of a current channel between the field oxide film 16 and p type substrate 11. *Id.* at 2:10–13. Numeral 14a represents a gate electrode made of p⁺ type polysilicon, 13a an n type polysilicon, 31 a thin oxide film, and 32 a metal electrode such as aluminum. *Id.* at 10:17–20.

2. Analysis of Claim 7

According to Petitioner, “Ground II takes Nishizawa’s teachings of minority carrier diffusion, and combines it with teachings from Onoda.”

Pet. 44. Regarding motivation to combine Onoda with Nishizawa, Petitioner argues that a POSITA “would have been motivated to apply Nishizawa’s teachings of minority carrier diffusion based on a downward sloping dopant gradient (e.g., Nishizawa at 18:46–67) to Onoda’s teachings of a downward sloping dopant gradient (e.g., Onoda at FIG. 11).” *Id.* at 45 (citing Ex. 1003 ¶¶ 91–92). Petitioner asserts that a “POSITA would have been motivated to combine teachings of Nishizawa’s explicit discussion of concepts to the structures described in Onoda” and “would have seen such combinations as yielding expected results with known prior art elements and would have moreover found it obvious to try.” *Id.* at 45–46 (citing Ex. 1003 ¶¶ 92–93).

Petitioner relies on its Onoda-based Ground I arguments for limitations 7.1–7.4. *Id.* at 47. For limitation 7.5, Petitioner argues that “Nishizawa makes these elements explicit.” *Id.* at 47–49 (citing Ex. 1046, 18:9–18, 18:35–59, 19:1–9, 20:23–27, Fig. 16; Ex. 1003 ¶¶ 89, 96–97). For limitation 7.6, Petitioner argues that the “Onoda-Nishizawa combination makes clear that this well region in Onoda provides a second static unidirectional electric drift field” for the same reasons for limitation 7.5. *Id.* at 49 (citing Ex. 1003 ¶ 98). Petitioner does not provide separate arguments for claim 8. *See id.* at 43–49.

Patent Owner presents the same arguments of general applicability related to Onoda, as discussed above at Section II.E.2. Prelim. Resp. 1–8, 12–13. With respect to Nishizawa in particular, Patent Owner argues that “Nishizawa’s dopant gradient is explicitly ‘to prevent [the] flow of electrons.’” *Id.* at 7 (citing Ex. 1046, 28). Patent Owner also argues that Nishizawa “expressly states that such carriers can be ‘disregarded.’” *Id.* at 7–8.

Petitioner replies that Nishizawa “identifies the problem that electrons migrate into the n+ type region 13 . . . from the p+ type region” and that Nishizawa’s solution is to apply “an impurity concentration in the p+ type region that decreases downward.” Prelim. Reply 6–7. Petitioner argues: “That Nishizawa states that the probability that an electron causing memory errors is small does not mean that its downward gradient does not migrate electrons downwards.” *Id.* at 7.

In view of our determination that Petitioner establishes a reasonable likelihood of prevailing on its challenges based on Onoda alone (Petitioner’s Ground I), we institute *inter partes* review. Because we find some grounds sufficient for institution, we institute on all grounds in the Petition. 37 C.F.R. § 42.108(a); *SAS*, 138 S. Ct. at 1353 (“The agency cannot curate the claims at issue but must decide them all.”); *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (interpreting the statute as requiring “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”).

G. Ground III: Obviousness over Kawagoe

Petitioner contends claims 7 and 8 would have been obvious over Kawagoe. Pet. 49–78.

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,” as well as

“drastically reduc[ing] the defect density of the gate insulating film” of a semiconductor integrated device. *Id.* at 1:33–40.

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

Kawagoe describes seven embodiments, including Embodiment 1 (Ex. 1007, 6:41–12:40, Figs. 1–8) and Embodiment 4 (*id.* at 14:46–19:64, Figs. 16–25). According to Embodiment 1, a semiconductor integrated circuit device includes semiconductor substrate body 2S, epitaxial layer 2E, and gettering layer 2G. *Id.* at 6:51–56, Fig. 1. Substrate body 2S and epitaxial layer 2E are doped with p-type impurity in equal concentrations. *Id.* at 6:60–7:3, 10:51–55, 11:12–16. Embodiment 1 includes n-channel MOS.FET (“nMOS”) 4N and p-channel MOS.FET (“pMOS”) 4P, the latter being formed in n-well 6, which is doped with n-type impurity and extends below the epitaxial layer. *Id.* at 8:46–52, 9:32–40, 11:18–24, 11:43–50, Figs. 1, 5, 7.

According to Embodiment 4, substrate body 2S and epitaxial layer 2E are doped with p-type impurity, and the impurity concentration of substrate body 2S is higher than that of epitaxial layer 2E “to improve the resistance to the latchup.” Ex. 1007, 14:64–15:6, 15:13–17, 16:16–21, 19:59–63, Fig. 17. Embodiment 4 includes p-well 6p formed with nMOS 4N and n-well 6n formed with pMOS 4P. *Id.* at 15:26–40, 17:40–18:35, Figs. 16, 21–23. In Embodiment 4, the impurity concentration in p-well 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 primarily on Kawagoe Figures 16 and 17, which are reproduced below and illustrate Embodiment 4 and its properties.

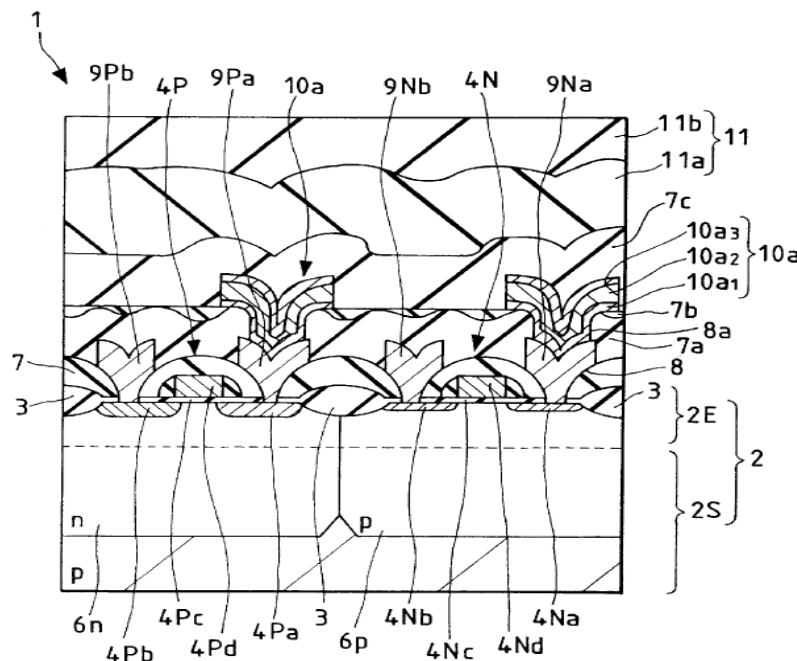


Figure 16 is a section showing an essential portion of a semiconductor integrated circuit device 1. *Id.* at 5:38–40. Figure 16 shows a “relatively

lightly doped semiconductor substrate body 2S of the semiconductor integrated circuit device 1 of the present embodiment 4 is made of a p-type Si single crystal or the like.” *Id.* at 14:61–64. Substrate body 2S and epitaxial layer 2E are doped with p-type impurity, and the impurity concentration of substrate body 2S is higher than that of epitaxial layer 2E “to improve the resistance to the latchup.” *Id.* at 14:64–15:6, 15:13–17, 16:16–21, 19:59–63. In Embodiment 4, 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.

Kawagoe Figure 17, which is reproduced below, illustrates properties of the semiconductor device of Embodiment 4.

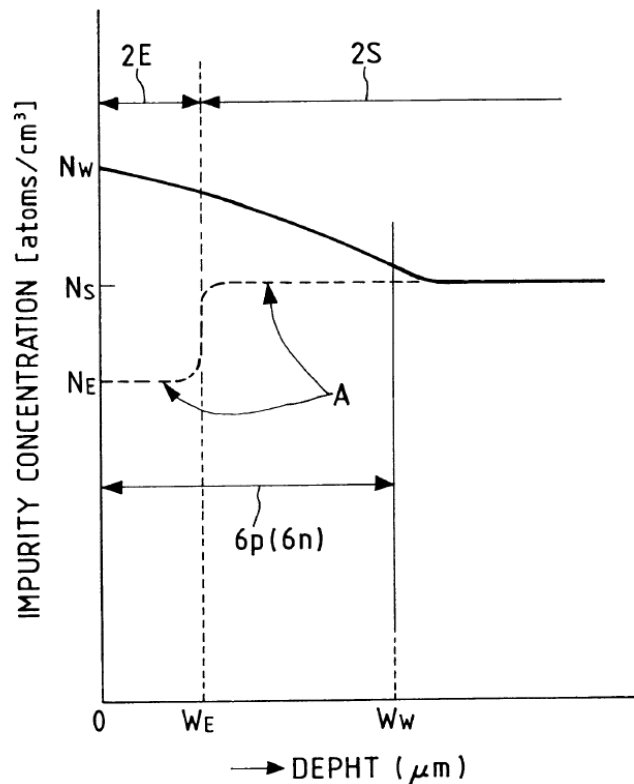


Figure 17 is a plot of impurity concentration as a function of depth in a semiconductor integrated circuit device, which shows “the p-well $6p$ and n-well $6n$ have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_w) of the epitaxial layer 2E.” Ex. 1007, 5:41–45, 15:62–16:40.

2. *Analysis*

Petitioner presents arguments and evidence in support of its contention that Kawagoe discloses or suggests each limitation of claim 7, and that a person of ordinary skill in the art would have had reason to combine the teachings of the references. Pet. 49–78. At this stage, Patent Owner disputes only Petitioner’s contention that Kawagoe discloses or suggests the “aid the movement of minority carriers” and the “from the surface layer” claim limitations. Prelim. Resp. 1–5, 9–11.

As noted above, because we have determined we will institute *inter partes* review, we do not need to resolve this issue now. Nevertheless, we provide the following comments to guide the parties.

Petitioner contends that the teachings of Kawagoe disclose or suggest a single drift layer having a graded concentration of dopants, similar to what is shown in Kawagoe Figures 16 and 17. Pet. 57–66. Similar to its arguments regarding Onoda discussed above, Petitioner contends that in light of Patent Owner’s representations to the Patent Office, Kawagoe’s graded dopant concentration creates a static unidirectional electric drift field that aids the movement of minority carriers from the surface layer to the substrate. Pet. 66–76 (citing Ex. 1007, Fig. 17; Ex. 1003 ¶¶ 36, 117–126).

Petitioner also notes that Kawagoe teaches that its graded dopant profile causes carriers to move to the substrate. Pet. 76 (citing Ex. 1007, 16:7–11).

In addition to the arguments discussed above with regard to Onoda, Patent Owner argues that Kawagoe does not disclose aiding the movement of carriers, but rather impeding or preventing carrier movement, because Kawagoe states that the concentration gradient “prevent[s] [electrons] from entering the p-well.” Prelim. Resp. 5, 9–10 (quoting Ex. 1007, 28).

In response, Petitioner contends that “carrier movement is only impeded *upwards* towards the circuit because the dopant concentration migrates those carriers *downward*.” Prelim Reply 5. Additionally, Petitioner contends that “because electrons are moved down to the substrate body 2s” in Kawagoe, “they are prevented from going upwards into the conductive active region, thus reducing errors resulting from conduction.” *Id.* at 6. Petitioner presents testimony from Dr. Campbell in support of this position. *Id.* (citing Ex. 1003 ¶¶ 33–34).

Patent Owner does not seem to dispute that Kawagoe’s transistor has carriers in the active region. *See* Prelim. Sur-reply 6. Nor does Patent Owner meaningfully dispute that Kawagoe has a graded dopant concentration in the active region. *See generally* Prelim. Resp., Prelim. Sur-reply. In addition, Kawagoe states that carriers are “attracted to the substrate body . . . by that concentration gradient.” Ex. 1007, 16:7–9. Based on this undisputed evidence, coupled with Patent Owner’s statement during prosecution that a “graded dopant concentration itself creates a ‘built in’ electrical field that forces the movement of carriers into a particular direction,” and that “this inherent ‘built-in’ unidirectional electric field is the additional parameter for ensuring that all minority carriers are being moved

in one direction” (Ex. 1002, 289–290), we determine that the weight of the evidence on the present record favors Petitioner. The parties, however, are invited to further develop the evidence and arguments relevant to this issue during the course of this proceeding.

H. Conclusion as to Grounds I - III

In view of our determination that Petitioner establishes a reasonable likelihood of prevailing on its Onoda-based challenges (Petitioner’s Ground I), we institute *inter partes* review. Because we find some grounds sufficient for institution, we institute on all grounds in the Petition. 37 C.F.R. § 42.108(a); *SAS*, 138 S. Ct. at 1353 (“The agency cannot curate the claims at issue but must decide them all.”); *PGS Geophysical*, 891 F.3d at 1360.

III. CONCLUSION

Upon consideration of the Petition, the Preliminary Response, the Preliminary Reply, the Preliminary Sur-Reply, and the evidence presented, we determine that Petitioner has shown a reasonable likelihood that it will prevail in showing that at least one of the challenged claims is unpatentable. In addition, we are persuaded on the present record that the Petition is not time-barred under 35 U.S.C. § 315(b). Accordingly, we institute an *inter partes* review of all challenged claims based on the grounds asserted in the Petition.

IV. ORDER

For the reasons given, it is:

ORDERED that an *inter partes* review is instituted with respect to the grounds asserted in the Petition;

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which shall commence on the entry date of this Decision;

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

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

IPR2024-00469
Patent 9,190,502 B2

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