PUBLIC VERSION

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC
Petitioner

v.

GREENTHREAD LLC
Patent Owner

Case IPR2024-00264
U.S. Patent No. 10,734,481

PETITIONER'S AUTHORIZED REPLY TO PATENT OWNER'S PRELIMINARY RESPONSE

Because the Petition establishes that every element of the challenged claims—including the "aid carrier movement" element—is obvious, and because Petitioner Semiconductor Component Industries, LLC (Petitioner) is not in privity with any prior litigants, Petitioner respectfully requests that the Board reject Patent Owner (PO) Greenthread LLC's arguments and institute this *inter partes* review.

I. DR. BLALOCK'S DEPOSITION TESTIMONY CONFIRMS THAT THE "AID CARRIER MOVEMENT" ELEMENTS ARE OBVIOUS

PO misinterprets Dr. Blalock's testimony taken in separate IPRs and during a delay PO sought in this matter due to pendency of Director Review Requests in those IPRs. Far from assuming "graded" means "aided," Dr. Blalock explained throughout his deposition why the prior art's graded dopant concentrations would generate electric fields that aid carrier movement. Testimony about hypothetical opposing forces and a "net" force is also irrelevant because the prior art does not include any such forces. And Dr. Blalock explained how Kawagoe's discussion of alpha ray strikes confirms that its graded dopant concentration will "aid carrier movement." Lastly, Dr. Blalock's interpretation of "aid carrier movement" is correctly informed by the relevant prosecution history and is consistent with PO's positions in other forums.

A. Dr. Blalock explained why the "graded dopant concentration" in the prior art "aid[s] carrier movement"

Contrary to PO's mischaracterizations, Dr. Blalock (and Petitioner) did ***not***

"assum[e] that 'graded dopant concentrations' equals 'aid carrier movement[.]'" *Contra* POPR, 2. Instead, a physical relationship exists between a "graded dopant concentration" and "aid[ing] carrier movement." As Dr. Blalock explained: "if you have a downward-sloping graded dopant concentration, we know from the basic physics that that will lead to an electric field and that will create a force, which tends to move the carriers." EX2058, 166:1-6.

The "basic physics" that Dr. Blalock referred to are relatively simple. A "graded dopant concentration" means that more dopants are added at different depths within a semiconductor device. This results in an electric field. The field then exerts a force on charged particles (including carriers) in the device, and said force will then move—or "aid movement" of—the carriers. EX2058, 72:3-9, 101:12-16. This is what the patent is referring to when it states that the "relative slope of the donor concentration […] creates a suitable aiding drift electric field" (EX1001, 3:6-9) and what applicant referred to in prosecution: "the graded dopant concentration <u>itself</u> creates a 'built-in' electrical field that forces the movement of carriers into a particular direction" (EX1016, 289-90, underlining in original).

That is not to say the "aid carrier movement" element is superfluous in view of the recited "graded dopant concentration." Requiring the graded concentration to "aid carrier movement" ***in a specific direction*** tells one of skill in the art how the

graded concentration must change going deeper into the device. If the dopant concentration increases over depth, the resulting electric field would move carriers in one direction; if the dopant concentration decreases over depth, the resulting electric field would move carriers in the opposite direction. So, "graded" does not mean "aided," but "graded" does mean "electric field," and an "electric field" means "aided" in one direction. This is why Dr. Blalock correctly focused on direction of the dopant concentration slope in Kawagoe and Wieczorek. *See e.g.*, EX2058, 73:20-76:5, 167:9-169:7, 189:18-193:14, 196:8-198:8.

Because Dr. Blalock consistently explained the scientific relationship between a graded dopant concentration and aiding the movement of carriers, PO has no basis to assert that "Dr. Blalock actually agrees that Petitioner's 'aided' means 'graded' theory is an artificial assumption that Petitioner created for this IPR." POPR, 7. PO's statement—which, tellingly, has no citation—is just false. *Id*. Instead of a direct cite, PO suggests this is established by Dr. Blalock's discussion of ***hypothetical*** unidentified forces acting against the electric field. *Id*., 7–8. PO is wrong. As explained below, these hypotheticals have nothing to do with the prior art, and do not show agreement between PO and Dr. Blalock.

B. Hypothetical opposing forces are not in the prior art and are irrelevant

PO wrongly emphasizes Dr. Blalock's testimony, incorrectly suggesting unidentified opposing forces prevent the prior art's graded dopant concentrations

from "aid[ing] carrier movement." POPR, 8-9. PO is misguided because the prior art does not contemplate any such opposing force. While Dr. Blalock appropriately considered and responded to PO's questions about ***hypothetical*** opposing forces, he was clear that such forces are not shown in the prior art. EX2058, 132:6-136:21. For example, PO asked "where could other [opposing] fields come from," and Dr. Blalock offered two hypothetical possibilities: "[e]xternally applied voltages" or "some environmental effect." *Id*., 132:9-13. When asked if "anything like that [is] described in […] Kawagoe," Dr. Blalock was clear: "none of that is." *Id*. at 132:14-17. The prior art is about "put[ting] in a gradient to create this electric field, which tends to move carriers down into the substrate," rendering PO's "net forces" discussion moot. *Id*., 132:17-21; *Contra* POPR, 11-12.

C. Dr. Blalock's interpretation of "aid carrier movement" aligns with prosecution history and PO's district court position

Dr. Blalock correctly relied on related prosecution history where PO explained how a downward-sloping graded concentration creates electric fields that aid carrier movement, without any need to numerically calculate the slope magnitude. *See* EX1003, ¶¶99-101 (citing EX1016, 289-290 and 237-238); EX2058, 152:16-153:7. While PO emphasizes that the prosecution history of the parent '195 patent also referred to "the particular slope," in context, this does not mean a numerical calculation is necessary. POPR, 2; EX1016, 254–255. Without

any numerical assessment of the slope, the applicant identified Figures 5(b) and 5(c) as having a "particular slope" such that "all minority carriers are either swept 'down' (from the surface layer to the substrate) or 'up' (from the substrate to the surfacer layer)." EX1016, 255, 289–90. This confirms that "particular slope" refers to the slope's direction only—not the slope magnitude.

PO's insistence that the "aid carrier movement" element requires calculating a numerical slope is also contrary to PO's statements in district court, including a statement that PO quotes to the Board in the POPR. PO has consistently represented that "[w]hether the carrier movement has a particular speed or acceleration is beyond the scope of the claim[.]" POPR, 4 (quoting EX1020, 38). If the "particular speed or acceleration" of the carriers is irrelevant, then the strength of the electric field does not matter, meaning the magnitude of the slope does not matter.

Even ignoring PO's district court statements, PO's attempts to read a specific (and undefined) slope into the "aid carrier movement" element should be rejected as a matter of claim construction. The claims do not discuss how strong the force aiding carriers must be. Indeed, nowhere in the patent is there any discussion of a specific slope necessary to "aid carrier movement." The only discussion of slope in the patent is a general statement that relative slope "creates a suitable aiding drift electric field" and that the slope (or "gradient") "can be linear, quasi linear, exponential or

complimentary error function." EX1001, 3:5-9. Consistent with the prosecution history addressed above, this leaves no reason to read a specific slope into the claims.

D. Dr. Blalock's testimony undercuts PO's misreading of Kawagoe

Kawagoe's description of the graded dopant concentration as preventing electrons from entering the p-well is perfectly consistent with Dr. Blalock's (and Petitioner's) position that the graded concentration in Kawagoe aids carrier movement. *Contra* POPR, 12-14; *see also* EX1003, ¶ 91 and n.7. As Dr. Blalock said when asked about the modified quotation from Kawagoe: "there's no conspiracy here." EX2058, 150:5–151:3. Kawagoe discloses a "gradient creating a force that tends to move carriers deeper into the substrate[,]" ***and*** "if [an electron] happens to be generated below the concentration gradient, the concentration gradient is still helpful because […] it [the electron] will be repelled by the field coming from the concentration gradient." EX2058, 150:11–151:3.

Put simply, because the downward slope generates an electric field that always pushes in one direction—from the surface down towards the substrate—whether that force is aiding movement or preventing movement depends on which direction a carrier is trying to move. This can be thought of like boats in a strong wind; the wind both aids boats moving in one direction, and also prevents movement in the opposite direction. Just so, the electric field in Kawagoe ***both*** helps carriers move from the active regions to the substrate (as in the challenged claims), ***and***

prevents carriers moving from the substrate to the p-well (as called out in Kawagoe). This is how electric fields work; PO's ignorance of this fact is not a basis for PO to question Petitioner's candor to the Board. *See* POPR, 12–13 (falsely accusing Petitioner of "strategically us[ing] ellipses to conceal" aspects of Kawagoe).

PO's suggestion that Kawagoe does not have carriers in the active region also is not understandable. POPR at 14-15. Although the specific quote in Kawagoe about preventing movement into the p-well refers to a carrier in the substrate, that does not mean the only carriers (electrons) in Kawagoe are in the substrate. Electrons are everywhere. For a semiconductor device as in Kawagoe to operate, there must be carriers in the active region. And the electric field from Kawagoe's graded concentration would impact carriers both in the substrate and anywhere in the graded dopant region.

Dr. Blalock also addressed one specific source of electrons: alpha ray strikes on the device in Kawagoe. Here, he explained "[i]f you have a random alpha ray strike, you cannot predict where it will happen. […] Kawagoe teaches us that if it happens near the concentration gradient, it will experience the force and be attracted to the substrate body." EX2058, 147:7–148:5. PO disregards this testimony and suggests a POSITA would have been unaware or unconcerned by alpha ray strikes. The is wrong for multiple reasons. Kawagoe describes placing the graded dopant

beginning at "the surface of the epitaxial layer *2E*, so that the influence to be caused by the carriers (or electrons) due to the a-ray is lowered." EX1007, 16:4-7. Further, alpha rays are found in cosmic ray radiation—discovered over one hundred years ago—and it is difficult to envision cosmic rays, from outer space, being aimed precisely enough to only hit a substrate of a semiconductor device and not the active region. Moreover, because Petitioner is not arguing that Kawagoe must be modified by a POSITA to account for these alpha ray strikes, it does not matter if a POSITA is aware of or concerned about them. All that matters is how Kawagoe's disclosed electric field would interact with electrons/carriers, from any source. As described above and in the Petition, that electric field will uniformly push carriers down towards the substrate, *ergo*, aiding carrier movement as recited in the challenged claims.

II. THE PETITION IS TIMELY UNDER 35 U.S.C. §315(b)

PO parrots the same privity arguments that were already rejected by the Board and during Director review in IPR2023-01242, -01243, and -01244, but PO now alleges that Petitioner is in privity with [redacted] as well as [redacted] and Intel.[1]

[1] Despite raising identical [redacted] arguments in all four IPRs, PO acknowledged these arguments in IPR2024-00263 and -00264 are wrong. EX1055, 2. Further, PO

PO's arguments about the burden of proof are misplaced because PO has not come forward with *any* evidence showing that Intel or [redacted] and Petitioner are in privity. *See Worlds Inc. v. Bungie, Inc.,* 903 F.3d 1237, 1242–44 (Fed. Cir. 2018) ("[A] patent owner must produce some evidence that tends to show that a particular third party should be named a real party in interest."). The RPX Agreements—entered into without Petitioner's knowledge—are irrelevant to the relationship between Petitioner and Intel or [redacted] It is also well established that a standard manufacturer/customer relationship, even with indemnity provisions, does not establish privity. *See, e.g.*, *WesternGeco*, 889 F.3d at 1319-1322; *Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1340–41 (Fed. Cir. 2018); *Samsung Electronics Co. Ltd. v. Netlist Inc.*, IPR2022-00615, Paper 64 at 22-26 (PTAB, June 30, 2023).

PO's arguments about the same products being at issue in the prior cases and Petitioner's sales being both licensed and infringing is nonsensical. A licensed sale

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did not add [redacted] as a party to the Intel litigation until a second amended complaint dated January 23, 2023; thus, the Board need not address whether [redacted] is a privy. *Shark Ninja Operating LLC v. iRobot Corp.*, IPR2020-00734, Paper 11 at 18 (PTAB Oct. 6, 2020); EX2019, EX2032, EX2018. However, the same arguments for Intel and [redacted] would also apply to [redacted]

is not infringing. 35 U.S.C. § 271(a). Any license or exhaustion outcomes are the result of *PO's actions,* beginning when PO entered the RPX Agreements, followed by RPX later sublicensing Intel and [redacted] (if such a sublicense was in fact granted). PO itself created this situation, and PO cannot "ignore[] the practical consequences of its own actions." *Assa Abloy AB v. CPC Patent Tech. Pty., Ltd.*, IPR2022-01006, Paper 47 at 18, 42, 45-47 (PTAB Nov. 30, 2023). Nor does the bare supply of products create an agency relationship. *See In re Google LLC*, 949 F.3d 1338, 1345 (Fed. Cir. 2020) (quoting Restatement (Third) of Agency § 1.01). And, in a district court action involving the patents of IPR2023-01242, -01243, and 01244, PO has not pleaded any affirmative defense of *res judicata* or collateral estoppel in answer to Petitioner's invalidity counterclaims, further showing PO's privity argument is nothing but a red herring. *See* IPR2023-01242, Paper 31, 7-8.

At bottom, Petitioner's standard manufacturer/customer relationship with Intel and [redacted] did not provide Petitioner a "full and fair" opportunity to challenge the validity of any patents in any previous matter. Petitioner was a stranger to the Intel and [redacted] litigations, and it would be unjust and contrary to precedent to bind Petitioner as a privy to those cases. *Taylor*, 553 U.S. at 893-95; *WesternGeco*, 889 F.3d at 1319-22.

Dated: May 31, 2024

Respectfully submitted,

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CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. § 42.6(e), the undersigned certifies that on May 31, 2024, a complete and entire copy of the foregoing **PETITIONER'S AUTHORIZED REPLY TO PATENT OWNER'S PRELIMINARY RESPONSE** and supporting exhibits were served on Patent Owner via electronic mail at the below addresses:

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