

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC,
Petitioner,
v.

GREENTHREAD, LLC,
Patent Owner

IPR2024-00265
U.S. Patent No. 9,190,502

**PETITIONER'S AUTHORIZED RESPONSE TO
DIRECTOR REVIEW REQUEST**

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Patent Owner Greenthread, LLC’s two arguments regarding the phrase “to aid the movement of minority carriers” do not warrant disturbing the Board’s thorough Final Written Decision (Paper 82, “FWD”).

First, across more than a dozen IPRs on patents in the same family, the Board has consistently concluded that the challenged claims only require a graded dopant concentration that is **capable** of aiding carrier movement in the recited direction. The claims do not recite and do not require affirmatively moving any specific carrier. And regardless, the active language in Kawagoe—that electrons “are attracted to the substrate body”—confirms that the graded dopant concentration in Kawagoe would actually move carriers. EX1007, 16:7-9. The verb tense is key: Kawagoe does not say that electrons “may be,” “could be,” or “sometimes are” attracted; Kawagoe says the electrons **are** attracted to the substrate. So, even if the Board’s construction was mistaken (and it was not), Kawagoe still renders the claims obvious.

Second, Patent Owner’s argument regarding “minority carriers”—which was improperly raised for the first time on Sur-Reply—is disconnected from both the plain language of the claims and the evidence of record. Paper 85 (“Request”), 12-15. Here, Patent Owner asserts an interpretation of “minority carriers” that wrongly defines “minority” with respect to the active region (e.g., the channel) of a semiconductor device, when the claims refer to minority carriers **in the drift layer**. EX1001, 4:52-67. Patent Owner’s own expert repeatedly confirmed that whether a

carrier is a “minority carrier” in a given region (e.g., Kawagoe’s p-well), depends on the doping type of that region—there is no one single “minority carrier” for an entire semiconductor device. See EX1063, 120:11-17; EX2064, ¶55.

I. BACKGROUND

A. The Parties’ Arguments

To show a “static unidirectional electric drift field to aid the movement of minority carriers,” the Petition identifies semiconductor devices where the concentration of dopants decreases along the depth of the device. Paper 1 (“Petition”), 26-35 and 60-62. As explained by Petitioner’s expert, these decreasing (e.g., “graded”) concentrations of dopants result in forces that push electrons towards the substrate, as claimed. See EX1003, ¶¶99-113 and ¶¶150-71; EX2058 (Pet. Expert Dep.), 77:7-9 (“[T]he concentration gradient leads to a force on the carriers that moves them toward the substrate.”). Later in the IPR, Patent Owner’s **own expert agreed** that such a graded dopant concentration would generate an electric field “pushing electrons down.” EX1063 (Patent Owner Expert Dep.), 113:12-16.

Because the experts both agreed that graded dopant concentrations result in a force pushing in the claimed direction, Patent Owner instead attempted to distinguish the prior art by presenting a narrow interpretation of “aid the movement of minority carriers.” Paper 32 (“POR”), 10-11. Specifically, according to Patent Owner, a device only has graded dopant concentration that generates “a first static

unidirectional electric drift field to aid the movement of minorities carriers,” if a carrier is actually moved by the field. *Id.*; *see also* Request, 6. Relying on this narrow construction, Patent Owner argued that Petitioner needed to compare the magnitude of the prior art graded dopant concentrations to other unspecified forces and resistances that could interfere with the motion of actual carriers. *See* POR, 16-17. Having not done this analysis, Patent Owner contended that Petitioner “fail[ed] to establish that the disclosed gradients would ‘aid carrier movement.’” *Id.*

Patent Owner also stated in its POR that “Kawagoe’s electrons are not minority carriers in the p-well.” POR, 1 and 24. But Patent Owner did not present this as an issue of carrier type (e.g., “holes” versus “electrons”) — Patent Owner presented this as an issue regarding the **location** of the electrons in Kawagoe. *Id.*, 25 (“Kawagoe’s carriers are nowhere near what Petitioner identifies as the ‘surface’ or first/second ‘active regions[.]’”). The only discussion in the POR of what type of carrier would be a minority carrier is in a footnote, specifically discussing the channel region of a semiconductor, not p-wells. *Id.* 8. And the POR never suggests that Petitioner identified the incorrect carriers for Payne.

For the first time in its Sur-Reply, Patent Owner asserted that Petitioner had misidentified what type of carrier is a “minority carrier” in each of Payne and Kawagoe. Paper 44 (“Sur-Reply”), 15. Specifically, Patent Owner argued that the relevant minority carrier should be based on the doping type of the active regions in

the devices. *Id.*, 16-17. But focusing on the doping type of the active region is wrong; the claims do not require “aid[ing] the movement of minority carriers” in an active region. Instead, the claims refer to the movement of minority carriers *in a drift layer*, which is consistent with how the Petition identified minority carriers. Paper 1 (“Petition”), 32 n.5.

B. The Board’s Claim Construction

The Board correctly rejected Patent Owner’s construction of “aid the movement of minority carriers,” recognizing that the claims only require a graded dopant concentration that is capable of moving a carrier in the claimed direction. FWD, 39-41. To reach this conclusion, the Board considered the plain language of the claims, the prosecution history, and statements made by district courts concerning related claims. *Id.* The Board also recognized that the ’502 patent itself does not provide any details “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.” *Id.*, 54.

Regarding the claims themselves, the Board recognized that the challenged claims are **not** method claims, with active steps—these are apparatus claims. *Id.*, 40-41. And as the Federal Circuit has instructed, “claims directed to devices ‘cover what a device *is*, not what a device *does*.” *Id.*(emphasis by Board, quoting *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018)). As

such, the Board recognized that “Petitioner need only show ‘a graded concentration of dopants’ that is *capable* of “aid[ing] the movement of minority carriers from said surface layer to said substrate.’” *Id.* (alterations and emphasis in original).

The Board also cited statements made by Patent Owner during prosecution of a related earlier patent, confirming it was unnecessary to compare the graded dopant concentration to other hypothetical forces. *Id.*, 39-40. In particular, the Board found that Patent Owner’s statements confirmed “the mere presence of a graded dopant concentration creating ‘a unidirectional drift field,’ facing in the appropriate direction, will ‘aid the movement of minority carriers.’” *Id.*, 40 (quoting EX1040, 270, 289-290). “The public was entitled to rely on these clear and unambiguous statements when considering the scope of the challenged claims.” *Id.* (citing *Hockerson-Halberstadt v. Avia Group Int’l*, 222 F.3d 951, 957 (Fed. Cir. 2000)).

The Board also rejected Patent Owner’s arguments about prior district court claim construction orders. FWD, 34-37. The Board recognized that each of the district court orders that Patent Owner cited—which did not involve Petitioner—did not address the meaning of “to aid carrier movement.” *Id.* The Western District of Texas decision cited by Patent Owner instead addressed whether “graded dopant concentration” was indefinite. *Id.*, 36-37. The Eastern District of Texas decision addressed the phrase “single drift layer . . . having a graded concentration of dopants . . . said drift layer further having a first static unidirectional electric drift field.”

Id., 35. Neither of these decisions involved a determination that the phrase “aid the movement of minority carriers” requires actually moving a specific carrier.

C. The Board’s Analysis of the Prior Art.

After rejecting Patent Owner’s claim construction, the Board also agreed with Petitioner that the prior art discloses “a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers.” FWD, 52-55 and 74-75. For Payne, the Board rejected arguments that Petitioner needed to calculate a specific slope, and credited the testimony of Petitioner’s expert that “the graded dopant concentration led to an electric field, which assisted, aided, actually put a little force on the carriers to help them move[.]” *Id.*, 55 (quoting EX2058, 72:3–9). For the Kawagoe-Sakai combination, the Board noted that the testimony of **Patent Owner’s** expert “confirms Petitioner’s position that Kawagoe discloses a concentration gradient through the depth of Kawagoe’s device along the sloping line depicted in Kawagoe’s Figure 17 which ‘should result in a field’ which ‘[p]ush[es] electrons downward.’” FWD, 74-75 (quoting EX1063, 112:8–20, 113:4–11); Ex. 1007, Fig. 17. Notably Patent Owner’s Request for Director Review does not challenge the Board’s conclusion that—under the Board’s claim construction—the prior art discloses the required feature.

The Board also recognized that Kawagoe specifically states that carriers are “attracted to the substrate body . . . by that concentration gradient.” FWD, 75

(quoting EX1007, 16:7–9). This active language means that the dopant concentration in Kawagoe is graded such that electrons would affirmatively move, notwithstanding any unstated external forces. So, even if the graded dopant concentration must be sufficiently strong to overpower unidentified other forces—as Patent Owner argues now—Kawagoe discloses a graded dopant concentration that is sufficiently strong.

Even though it was presented for the first time in the Sur-Reply, the Board also rejected Patent Owner’s argument that holes (not electrons) are the minority carriers that must be affected by the graded dopant concentration. FWD, 52.

II. ARGUMENT

A. The Board Correctly Interpreted the Claim Language

The logic from the Federal Circuit’s *ParkerVision* decision that the Board cited is sound and applicable: “apparatus claims cover what a device *is*, not what a device *does*.” 903 F.3d at 1361 (emphasis original); FWD, 41 (quoting same). Following this precedent, the Board was correct to recognize that the phrase “to aid the movement” is not used as a verb, requiring action. *Id.* The phrase is used as an adjective, describing a characteristic of the electric field generated by the claimed “graded dopant concentration.” None of Patent Owner’s arguments overcome this plain reality: the claims recite a thing (a graded dopant concentration) that is *suitable* for an action (to aid the movement of minority carriers); the claims do not recite actually performing that action.

Patent Owner’s contrary arguments relying on *INVT SPE LLC v. Int’l Trade Comm’n*, are misguided. Request 5-6; 46 F.4th 1361, 1371(Fed. Cir. 2022). The Federal Circuit in *INVT* did not create a categorical analysis requiring actual operation to practice types of apparatus claims. *Contra* Request, 6-7 (citing *INVT SPE LLC v. Int’l Trade Comm’n*, 46 F.4th 1361, 1371 (Fed. Cir. 2022)). The Federal Circuit in *INVT* specifically determined that the claims at issue **did not** require actual performance to be practiced. *INVT*, 46 F.4th at 1374. So, any statement in *INVT* about different hypothetical claims that might require actual performance is dicta. Moreover, the Federal Circuit in *INVT* continued to emphasize that “whether infringement requires actual performance of the recited functions by the accused device depends on the claim language.” *Id.* at 1371. This focus on the actual claim language contradicts the categorical rule for “mechanical apparatus claims” that Patent Owner advances. *Contra* Request, 6.

Looking at the actual claim language (as instructed in *INVT*), the Board was correct that the claims do not require actually moving any specific carrier. There is an important linguistic difference between “aiding” movement and “generating” movement. The phrase used in the claims—“to aid the movement of minority carriers”—assumes that carriers may already be moving in the recited direction. This makes sense for describing the capability of the graded dopant concentration: describing the direction in which the graded dopant concentration would “aid the

movement” tells a POSITA the required orientation of the graded dopant concentration. In contrast, the verb “aid” does not suggest that the graded dopant concentration must accelerate a specific carrier from a stop into active movement.

The specification also does not help Patent Owner. *Contra* Request, 6-7. As the Board pointed out, the ’502 patent does not include any discussion of a specific slope needed “to aid the movement of minority carriers.” FWD, 54. Because the patent specification never discusses a slope magnitude—or any other feature—that is needed to move a hypothetical carrier, Patent Owner cannot claim that such details are fundamental to the claimed invention. Instead of addressing slope magnitude, the specification treats carrier movement as a directional issue, just like the prosecution history, and just like the Board’s construction.

B. The Board Correctly Analyzed Prior Claim Construction Orders

The Board also correctly rejected Greenthread’s arguments based on prior district court claim constructions.¹ FWD, 34-37. The claim construction orders cited by Greenthread do not actually construe the phrase “to aid carrier movement.”

¹ In other proceedings involving related patents, the Director recently denied requests for Director Review based on this issue (*inter alia*). See e.g., *Semiconductor Components Industries, LLC et al. v. Greenthread, LLC*, IPR2023-01242, Paper 138 (February 3, 2026) and Paper 129 (November 10, 2025) at 9-11.

Instead, the decisions involved (1) a conclusion by the Western District of Texas that “graded” was not indefinite (*id.* 36-37), and (2) a construction by the Eastern District of Texas of the term “single drift layer . . . having a graded concentration of dopants . . . said drift layer further having a first static unidirectional electric drift field”. (*id.* 35-36). Neither court construed “to aid carrier movement” to require affirmatively moving a carrier.

Moreover, the Western District of Texas equated “graded” and “aided,” in a manner that contradicts Patent Owner’s view of the claims. Patent Owner wrongly suggests that by saying a concentration must be “sufficiently graded,” the Court found some graded dopant concentrations aid carrier movement and some do not. Request, 8. That is not an accurate characterization of the Court’s conclusion. The Court held that “graded dopant concentration” was not indefinite because the phrase “to aid carrier movement” defined the minimum amount of grading needed ***to qualify as*** a “graded dopant concentration.” EX2080, 39-40. In other words, the Court held that everything that qualifies as a “graded dopant concentration” (as that term is used in the claims) must necessarily “aid carrier movement.” To be clear, Petitioner has not adopted the WDTX Court’s interpretation (which, again, was not a construction of “to aid carrier movement”). But it remains wrong for Patent Owner to suggest the WDTX Court’s position contradicts the Board’s construction. If

anything, the WDTX Court’s conclusion contradicts Patent Owner’s position that some graded dopant concentrations do not “aid carrier movement.”

Lastly, Patent Owner’s reference to *Revvo Techs., Inc. v. Cerebrum Sensor Techs., Inc.*, is erroneous. Request, 4 (citing IPR2025-00632, Paper 20 (PTAB Nov. 3, 2025) (precedential) (“*Revvo*”). *Revvo* addresses circumstances where a petitioner advances potentially contradictory claim constructions in district court litigation and before the PTAB. See *Revvo*, 4-5. That concern has no application to this matter because Petitioner was not involved in the Texas district court cases that Patent Owner cites. Patent Owner has never identified any inconsistency between Petitioner’s positions in these IPRs and Petitioner’s district court litigation.

C. The Board Correctly Recognized that Kawagoe Meets Patent Owner’s Narrow Construction

Patent Owner’s allegation that Petitioner “has not pointed to any teachings or disclosure that demonstrate the claimed limitations” is incorrect. Request, 11-12. Petitioner has consistently maintained that even under Patent Owner’s narrow construction, Kawagoe discloses a graded dopant concentration that generates an electric field “to aid the movement of minority carriers.” “Specifically, Kawagoe says that ‘the impurity [or dopant] concentration is given such a gradient’ so that certain electrons ‘*are attracted*’ to the substrate body 2S by that concentration gradient and prevented from entering the p-well[.]” Paper 39 (“Reply”), 7 (alterations and emphasis in Reply, quoting EX1007, 16:2-11); see also FWD, 75

(quoting same). This gradient extends from the surface layer, through the active region, to the substrate. *Id.*; EX1007, 16:2-11, Fig. 17; EX1063, 112:8-113:16. Because Kawagoe says that electrons **are** attracted—not “might be” attracted, or “sometimes” attracted—a POSITA would understand that the graded dopant concentration in Kawagoe actually moves carriers.

The further confirmation in Kawagoe that electrons in the substrate are “prevented from entering the p-well” strengthens this conclusion. *Contra*, Request 10. Logically, if there were any stronger forces in Kawagoe, pushing in the opposite direction from the graded dopant concentration, then electrons would not be “prevented from entering the p-well.” This “prevention” thus confirms that the electric field from the graded dopant concentration in Kawagoe must be stronger than any other (unspecified) forces.

Moreover, Patent Owner’s arguments about the location of the graded dopant concentration and location of the carriers in Kawagoe are undermined by testimony from Patent Owner’s own expert. *Contra* Request, 10. Patent Owner’s expert agreed that Figure 17 of Kawagoe shows “a p-well, so it is substantially holes. There are electrons as minority species.” EX1063, 120:11-17. Patent Owner’s expert also confirmed that the graded dopant concentration shown in Figure 17 of Kawagoe extends to the surface of the device, through the active region. *See* EX1063, 113:12-16 (confirming graded dopant concentration “from 0 [the surface] past WW [the

depth of the well].”). In view of these admissions, there can be no dispute that Kawagoe has electrons (i.e., minority carriers) in a graded dopant concentration that corresponds to the location of the claimed drift layer (the p-well).

Thus, it does not matter that Kawagoe describes the activity of the graded dopant concentration with respect to preventing electrons generated by alpha ray strikes from moving “up” into the well. The alpha ray strike is just an illustration; the configuration of the graded dopant concentration does not change based on the presence (or absence) of an alpha ray strike. And as a matter of physics—confirmed by Patent Owner’s expert—an electric field that “impedes” electron movement up also “aids” movement down. *See* EX1063, 109:6-14. This aligns perfectly with what Kawagoe says: electrons “are attracted to the substrate” (aided going down), and “prevented from entering the p-well” (impeded going up). EX1007, 16:2-11.

D. The Board Correctly Rejected Patent Owner’s Untimely Argument About Minority Carriers

Patent Owner did not raise its argument about minority carriers in the drift layer being defined by the doping type of the channel region until the Sur-Reply, and thus the Board had no obligation to consider it. *See* 37 C.F.R. § 42.23(b). However, despite being procedurally improper, the Board still considered—and rejected—this argument. *See* FWD 52 (“Patent Owner asserts that it is the holes that are the minority carrier...” and “After considering the parties’ arguments...”).

Nowhere in the POR does Patent Owner argue that all minority carriers are defined by the doping type of the channel. The footnote that Patent Owner cites only states that minority carriers *in the channel* are defined by the doping type *in the channel*. Request, 12-13 (citing EX2064, ¶36 n.4); *see also* POR, 8 n.6. This footnote does not say *all* minority carriers in a device are defined by the doping type in the channel. That difference is critical because the claims do not refer to “aid[ing] the movement of minority carriers” in the channel. The claims refer to “minority carriers” in the drift layer and well.

Further, nowhere in the POR does Patent Owner suggest that Petitioner misidentified the minority carriers in Payne. And while Patent Owner stated in the POR that “Kawagoe’s electrons are not minority carriers in the p-well,” this is presented as an argument about the **location** of Kawagoe’s carriers, not the type. *See* POR, 23 (Heading: “The electrons Kawagoe describes never enter the p-well—much less the surface or active region.”). Because Patent Owner made no substantive arguments in its POR about what constitutes a “minority carrier” in the prior art, the background footnote about minority carriers is not enough to preserve this issue.

Regardless, Patent Owner’s “minority carrier” argument also fails on its merits. Patent Owner’s expert repeatedly confirmed that the minority carrier in a region depends on the doping type *of that region*. Specifically, when asked whether there would be electrons present in the area described in Figure 17 of Kawagoe

Patent Owner's expert testified: "This is a p-well, so it is substantially holes. ***There are electrons as minority species.***" EX1063, 120:11-17 (emphasis added). This testimony aligns with the declaration of Patent Owner's expert, which similarly characterizes electrons as "the minority carriers in a p-well" of Kawagoe. EX2064, ¶55. Consistent with Patent Owner's expert, Petitioner's expert also correctly focused on the doping type of the specific region to identify minority carriers, that is "holes in N-wells, electrons in P-wells." EX1003, ¶110. Because the experts both agree that the "minority carriers" in a well are defined by the doping type of the well, Patent Owner's arguments based on the doping type of channel regions are meritless. *Contra* Request, 12-15.

III. Conclusion

The Board's Final Written Decision should not be disturbed.

Dated: March 13, 2026

Respectfully submitted,

/Roger Fulghum/

Roger Fulghum

Reg. No. 39,678

Counsel for Petitioner

Semiconductor Components

Industries, LLC

CERTIFICATE OF COMPLIANCE

I hereby certify that this **PETITIONER’S AUTHORIZED RESPONSE TO DIRECTOR REVIEW REQUEST**, excluding the parts of the brief exempted by 37 C.F.R. § 42.24, complies with the page limits provided by the Director’s email on March 6, 2026, which stated: “Petitioner is authorized to submit a response limited to the issues raised in the Director Review request, of no more than 15 pages, to be filed within five business days of this email. Any such response must be filed in P-TACTS, i.e., by selecting the ‘Other: Other’ paper type and the paper must be titled ‘Authorized Response to Director Review Request’ or it may not be considered. No new evidence is permitted. No further briefing is authorized at this time.” EX3100.

Dated: March 13, 2026

/Roger Fulghum/

Roger Fulghum

Reg. No. 39,678

Counsel for Petitioner

Semiconductor Components

Industries, LLC

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), I certify that on this 13th day of March 2026,
**PETITIONER'S AUTHORIZED RESPONSE TO DIRECTOR REVIEW
REQUEST** was served by email on the following counsel for Patent Owner and the
Joined Petitioner:

Greenthread-OnSemi-MS@mckoolsmith.com

awhitehurst@mckoolsmith.com

ajairam@mckoolsmith.com

nozarkar@mckoolsmith.com

shejny@mckoolsmith.com

Dated: March 13, 2026

/Roger Fulghum/

Roger Fulghum

Reg. No. 39,678

Counsel for Petitioner

Semiconductor Components

Industries, LLC