

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INNOSCIENCE (ZHUHAI) TECHNOLOGY
COMPANY, LTD., AND
INNOSCIENCE AMERICA, INC.,
Petitioner,

v.

EFFICIENT POWER CONVERSION CORPORATION,
Patent Owner.

IPR2023-01381
U.S. Patent 8,350,294

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

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EXHIBITS LIST

Exhibit	Description
Ex. 1001	U.S. Patent No. 8,350,294 B2 (“the ’294 patent”)
Ex. 1002	Prosecution History of the ’294 Patent (“ <i>Prosecution History</i> ”)
Ex. 1003	Declaration of Dr. James Richard Shealy (“ <i>Shealy</i> ”)
Ex. 1004	Curriculum Vitae of Dr. James Richard Shealy
Ex. 1005	U.S. Patent Application Publication No. US 2007/0164315 A1 to Smith (“ <i>Smith</i> ”)
Ex. 1006	U.S. Patent Application Publication No. US 2008/0087915 A1 to Uemoto (“ <i>Uemoto</i> ”)
Ex. 1007	Japanese Patent Publication No. JP2006-253224 A to Kigami.
Ex. 1008	Certified English Translation of Japanese Patent Publication No. JP2006-253224 A (“ <i>Kigami</i> ”)
Ex. 1009	Translator’s Declaration for Certified English Translation of JP 2006-253224 A.
Ex. 1010	Umesh K. Mishra et al., <i>AlGaIn/GaN HEMTs—An Overview of Device Operation and Applications</i> , Proceedings of the IEEE, vol. 90, no. 6 (June 2002), pp. 1022-1031 (“ <i>Mishra</i> ”).
Ex. 1011	Excerpts of Rüdiger Quay, <i>Gallium Nitride Electronics</i> , vol. 96, Springer Science & Business Media (2008) (“ <i>Quay</i> ”).
Ex. 1012	Excerpts of Stephen J. Pearton et al., <i>Gallium Nitride Processing for Electronics, Sensors and Spintronics</i> , Springer Science & Business Media (2006) (“ <i>Pearton</i> ”).
Ex. 1013	U.S. Patent Application Publication No. US 2004/0012015 A1 to Saxler (“ <i>Saxler015</i> ”)

Exhibit	Description
Ex. 1014	X. Hu et al., <i>Enhancement mode AlGaIn/GaN HFET with selectively grown pn junction gate</i> , Electronics Letters, vol. 36, no. 8 (2000), pp. 753-754 (“Hu”).
Ex. 1015	Excerpts of Chang Soo Suh, Enhancement-Mode GaN-Based HEMTs for High-Voltage Switching Applications (Dec. 2008) (Ph.D. dissertation, University of California, Santa Barbara) (“Suh”).
Ex. 1016	U.S. Patent Application Publication No. US 2005/0145874 A1 to Saxler (“Saxler874”)
Ex. 1017	Chris G. Van de Walle et al., “Hydrogen in III-V Nitrides,” <i>Semiconductors and Semimetals</i> , vol. 57 (1998), pp. 157-184 (“Van de Walle”).
Ex. 1018	Shuji Nakamura et al., <i>Hole Compensation Mechanism of P-Type GaN Films</i> ,” Japanese Journal of Applied Physics, vol. 31 (1992), pp. 1258-1266 (“Nakamura”).
Ex. 1019	Complainant’s Proposed Constructions & Respondents’ Proposed Constructions in related International Trade Commission investigation: <i>In the Matter of Certain Semiconductor Devices, and Methods of Manufacturing Same and Products Containing the Same</i> , Inv. No. 337-TA-1366, dated September 5, 2023 (“ITC Constructions”).
Ex. 1020	U.S. Patent No. 5,985,687 (“Bowers”)
Ex. 1021	U.S. Patent Application Publication No. 2002/0167023 A1 to Chavarkar (“Chavarkar”)
Ex. 1022	U.S. Patent Application Publication No. 2003/0102482 A1 to Saxler (“Saxler482”)

Exhibit	Description
Ex. 1023	Shuji Nakamura – Biographical, NobelPrize.org, Nobel Prize Outreach AB 2023, www.nobelprize.org/prizes/physics/2014/nakamura/biographical/ (last visited Aug. 28, 2023) (“ <i>Biographical Nakamura</i> ”)
Ex. 1024	Excerpts of Vasco Matias, Defect characterization of Europium implanted Gallium Nitride (2008) (Ph.D. dissertation, KU University, Belgium) (“ <i>Matias</i> ”).
Ex. 1025	Email exchange between Petitioner and Board, Board email dated January 9, 2024.
Ex. 1026	<i>Merriam-Webster Dictionary</i> (excerpt) (2022)
Ex. 1027	Prepositions of Place in English Grammar, LanGeek.co, Prepositions and Conjunctions, https://langeek.co/en/grammar/course/69/prepositions-of-place (last visited Jan. 15, 2024)
Ex. 1028	Transcript of Conference Call with the Board, taken on August 6, 2024
Ex. 1029	Email exchange between Petitioner and Patent Owner, Petitioner email dated August 7, 2024.
Ex. 1030	Email exchange between Petitioner and Board, Board email dated August 8, 2024.
Ex. 1031	Exhibit 28 to Verified Complaint in International Trade Commission <i>Certain Semiconductor Devices, And methods Of Manufacturing Same And Products Containing the Same</i> . Inv. No. 337-TA-1366.
Ex. 1032	Exhibit RX-0255 in Inv. No. 337-TA-1366. Book: E. Fred Schubert. Doping in III-V semiconductors. AT&T Bell Laboratories, New Jersey. (1993)
Ex. 1033	Supplemental Reply Declaration of James Richard Shealy, Ph.D., Dated September 3, 2024.

I. INTRODUCTION

Patent Owner (“PO”)’s Response, Paper 18 (“POR”), primarily reiterates the arguments already rejected from its Preliminary Response, Paper 7 (“POPR”). The Board need not depart from its findings at Institution (Paper 11, “ID”).

The Board should reject PO’s proposed claim constructions because they violate the canons of construction and commit “one of the cardinal sins of patent law—reading a limitation from the written description into the claims.” *AIP Acquisition LLC v. Cisco Sys., Inc.*, 714 F.App’x 1010, 1016 (Fed. Cir. 2017). The Board should also disregard PO’s alleged distinctions between the claims and the prior art because PO applies its improper constructions, misinterpret the prior art, and misconstrue Petitioner’s obviousness combinations.

Finally, PO’s halfhearted secondary considerations allegations fail to meet PO’s burden and have no evidentiary support.

II. LEVEL OF SKILL IN THE ART

As PO concedes, while the parties’ proposed level of skill have minor differences, they do not impact the analysis. POR, 7; Petitioner’s Petition, Paper 1 (“Pet.”) §III; Ex. 1033 §II.

III. CLAIM CONSTRUCTION

The Board should reject PO's proposed constructions because they apply an improper standard, import limitations from the specification, and lack intrinsic support.

A. PO Fabricates a "Goals of the Invention" Standard

Instead of following *Phillips*, PO incorrectly argues that claims should be construed "consistent with the inventor's identified invention goals." POR, 8-10. But claims are **not** construed according to "invention goals." *Source Vagabond Sys. Ltd. v. Hydrapak, Inc.*, 753 F.3d 1291, 1301 (Fed. Cir. 2014) ("claim construction is a function of the words of the claim not the 'purpose' of the invention"); *E-Pass Techs., Inc. v. 3Com Corp.*, 343 F.3d 1364, 1370 (Fed. Cir. 2003) (explaining it's incorrect to construe claims based on "a perceived 'purpose' of the invention").

PO's cited cases to justify construing claims with PO's fabricated "invention goals" standard. POR, 9-10. But none of them support PO's constructions. For example, PO relies on *Retractable Techs., Inc. v. Becton, Dickinson & Co.*, 653 F.3d 1296 (Fed. Cir. 2011) to justify its construction. POR, 9. But *Retractable* **does not** permit construing claims according to "invention goals"; *Retractable* follows *Phillips* and requires disavowal or lexicography to reinterpret claim terms. 653 F.3d at 1306. In *Retractable*, the court limited a claim term when the specification disavowed the broader scope. 653 F.3d at 1305 (limiting "body" to a one-piece body

finding the patent disavowed multi-piece bodies); *Samsung Elecs. Co., Ltd. v. Promos Techs., Inc.*, No. IPR2017-01412, Paper 33, 26 (P.T.A.B. Oct. 22, 2018) (analyzing *Retractable* and rejecting a construction when the specification did not disavow claim scope). *Retractable* does not support PO’s “invention goals” standard.

And *Retractable* does not support PO’s constructions because, unlike in *Retractable*, the ’294 patent does not include any disavowal. Instead, the ’294 patent expressly states its descriptions and drawings do not disavow claim scope stating “embodiments of the invention are not considered as being limited by the foregoing description and drawings.” Ex. 1001, 5:3-6. *Retractable* and the other cases PO cited do not support PO’s made-up “invention goals” standard or PO’s constructions.

B. PO’s Construction For “Compensated GaN Layer” and “Gate Contact Above the Compensated GaN Layer” Are Wrong

With it “invention goals” standard, PO construes two terms: “a gate contact above the compensated GaN layer” ([1f]) and “compensated GaN layer” (in [1e]). POR §IV.A-B. PO’s proposed constructions apply an improper standard and have no support in the intrinsic record.

1. Rewriting element [1f] as “a gate comprised of a gate contact and the compensated GaN layer” has no support

PO seeks to rewrite [1f], arguing the specification “provides important context” about “a method of making the device depicted in Figure 2” that justifies

rewriting the limitation. POR, 10. PO contends that such method implies a structure where “‘above’ means more than merely ‘higher than.’” *Id.*, 11. But claims cannot be limited to an embodiment, much less an implied interpretation of one. *Hill-Rom Servs., Inc. v. Stryker Corp.*, 755 F.3d 1367, 1372 (Fed. Cir. 2014). That is the *Phillip*’s “cardinal sin[] of patent law.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1320 (Fed. Cir. 2005).

The specification also fails to support PO’s rewriting of [1f] with its “implied” interpretation because the specification describes Figure 2 is “an example method of manufacturing” (Ex. 1001, 3:22-23)—an example expressly optional because “[m]odifications and substitutions to specific process conditions can be made” (*id.*, 5:5-6). Ex. 1033 §III.A.

2. “Gate material” cannot be read into “compensated GaN layer” of [1e]

Neither the claim language nor the specification support PO’s “gate material” construction for “compensated GaN layer.”

As the ID concluded, the claim language “‘compensated GaN layer’ does not require a ‘compensated GaN gate material.’” ID, 12. Instead, the claim language counsels against PO’s construction because the claim recites a structure with a series of layers “above” each other with only two elements lacking the express “layer” recitation: “substrate” and “gate contact.” Ex. 1001, 5:12-18. The differences

between claim elements are “highly instructive.” *Phillips*, 415 F.3d at 1314. That the claim defines some elements as layers, but not others, counsels against interpreting layers to be inherently restricted to something other than a layer. *Id.*

Other claims also contradict PO’s construction. While claim 1 does not recite “compensated gate,” claim 10 does. PO’s construction would equate the “compensated GaN layer” in claim 1 with the “compensated gate” in claim 10. But that runs afoul the doctrine of claim differentiation. *Atl. Rsch. Mktg. Sys., Inc. v. Troy*, 659 F.3d 1345, 1354 (Fed. Cir. 2011).

The specification also refutes PO’s construction. Ex. 1033 §III.B. As the Board concluded, “the written description of the ’294 patent does not support construing ‘compensated GaN layer’ as a ‘compensated GaN gate material.’” ID, 14. The written description does not redefine any term as “gate material.” *See* Ex. 1001. Rather, the written description describes embodiments where the “compensated GaN layer” is distinct from the “gate material.” For example, Figure 7 illustrates a “compensated semiconductor layer 38” independent from any gate structure, but still identified as compensated GaN layer. Ex. 1001, 3:7-17.

3. PO’s construction of “compensated” is incorrect, but ultimately irrelevant to the outcome of the case

PO’s construction of “compensated” is incorrect for ignoring the intrinsic record. Nonetheless, as the ID correctly concluded, the construction of the term is

ultimately inapposite because the asserted prior art discloses a “compensated” layer under any construction. ID, 10-11.

PO updated the construction it initially presented in the related ITC matter by modifying the IEEE dictionary definition PO previously relied on. POR, 11, 14. But PO’s modified construction remains incorrect because it prioritizes extrinsic over intrinsic evidence and creates ambiguities. Pet., 16-17; *Seabed Geosolutions (US) Inc. v. Magseis FF LLC*, 8 F.4th 1285, 1287 (Fed. Cir. 2021) (“we still ‘give [] primacy’ to intrinsic evidence, and we resort to extrinsic evidence to construe claims only if it is consistent with the intrinsic evidence”).

PO’s revised construction sidelined the specification and started from the IEEE dictionary. POR, 14. That is an error. Claim construction necessarily “starts with the intrinsic record, including the specification, and not with a dictionary definition” *Power Integrations, Inc. v. Fairchild Semiconductor Int’l, Inc.*, 711 F.3d 1348, 1362 (Fed. Cir. 2013). PO’s construction is “relying on dictionary definitions at the expense of a fair reading of the claims” and “breed[s] unnecessary uncertainty.” *Interval Licensing LLC v. AOL, Inc.*, 766 F.3d 1364, 1377 (Fed. Cir. 2014).

PO attempts to justify its construction arguing it is “consistent with the plain and ordinary meaning of ‘compensated.’” POR, 14. But the fact that PO could not adopt a dictionary definition and had to arbitrarily modify it, belies PO’s claim of an

accepted “ordinary” meaning. PO’s modifications to the dictionary definition highlight an ordinary meaning is **not** readily apparent. *See Tessera, Inc. v. Micron Tech., Inc.*, 423 F.Supp.2d 624, 632 (E.D. Tex. 2006) (“In addition to being unhelpful and possibly confusing, [Plaintiff] construction is simply a modified dictionary definition, which after *Phillips*, is suspect in cases where the ordinary meaning of the claim language is not readily apparent ...”).

Nonetheless, the construction of “compensated” is not relevant to the outcome of this proceeding. All Petitioner grounds teach the “compensated GaN layer” under both Petitioner’s and PO’s constructions. Pet., 39-42; Ex. 1033 §III.C. As Dr. Shealy notes, PO’s updated construction does not alter his conclusion that all grounds meet the “compensated GaN layer.” Ex. 1033 §III.C. In grounds 1A-1C, *Smith*’s cap layer meets PO’s updated construction because it has “one type of impurity (for example, donor)”—the hydrogen—that “cancels electrical effects of other type of impurity (for example, acceptor)”—the passivated p-type dopants. Ex. 1033 §III.C.1-3. In ground 2, *Uemoto*’s region 15b has “one type of impurity”—the hydrogen—that “cancels the electrical effects of the other type of impurity”—the inactivated magnesium. *Id.* §III.C.4

Accordingly, express construction of “compensated” is not needed to determine the validity of the claims. *PNC Bank, N.A. v. United Servs. Auto. Ass’n*, No. IPR2021-01073, Paper 72, 13 (P.T.A.B. Jan. 19, 2023).

**C. PO's Construction Requiring "Enhancement-mode"
Contradicts the Intrinsic Record**

PO seeks a construction that limit claims 1-3 to an "enhancement-mode transistor." POR, 19-22. This is unsupported.

The claim language does not support PO's "enhancement-mode" interpretation because, as the Board noted, claims 1-3 are more broadly directed to a "column III Nitride transistor." ID, 13. PO's proposal to narrow the claim is so divorced from the claim language that PO does not even identify the term being construed for the "enhancement-mode" interpretation. POR, 19-21. Violating all the canons of claim construction, PO ignores the claim language and advances a construction based only on descriptions in the specification. *Id.*

Yet, not even the specification supports PO's interpretation. Ex. 1033 §III.D. While PO argues that the patent's "Field of the Invention" justify enhancement-mode interpretation (POR, 19), the '294 patent "present invention" is broad, without limitation to enhancement- or depletion-mode operation. Ex. 1001, 2:13-19. And the specification is not limited to enhancement-mode, it expressly describes depletion-mode embodiments. Ex. 1001, 4:55-60 ("the device can be changed to a depletion mode device"). Even EPC's expert admits, the '294 patent is not limited to "enhancement mode" stating "[t]he '294 Patent describes improvements to conventional E-mode and D-mode GaN transistors." Ex. 2009, ¶48.

IV. STATEMENT OF FACTS

PO contends Petitioner's Statement of Facts "should be ignored" because "Petitioner failed to include any citations." POR, 23. But 37 C.F.R. § 42.22(c) does not require citations, they are only "preferabl[e]." Petitioner's Statements of Facts are supported by the record, e.g., by Dr. Shealy's first declaration and the patent's admitted prior art. Ex. 1001, 1:55-2:2; Ex. 1003 §VIII (citing Exs. 1010-1018). They comply with 37 C.F.R. § 42.22(c).

While alleging no citations, PO does not deny Petitioner's Statement of Facts. Because "[a]ny material fact not specifically denied may be considered admitted" (*id.* §42.23(a)), Petitioner's Statement of Facts should be admitted.

V. GROUNDS 1A-1C INVALIDATE THE CLAIMS

PO disputes for Grounds 1A-1C focuses on two elements: "compensated GaN layer" ([1f]) and "semi-insulating III-N layer" ([7e]). POR §§VI-VIII. PO's arguments against these elements are based on PO's incorrect construction and misinterpretations of the prior art and Petitioner's grounds.

A. *Smith* Discloses Both Enhancement- and Depletion-mode Devices

PO wrongly alleges *Smith* "does not disclose an enhancement mode transistor." POR §VI.A. Preliminarily, this is irrelevant because claim 1 does not require an "enhancement mode transistor." *Supra* §III.A. Additionally PO's

interpretation of *Smith* is wrong, *Smith* covers enhancement-mode devices. Ex. 1033 §IV.A.

Smith does not specify depletion- or enhancement-mode operation. *Id.*; Ex. 1005. Contrary to PO's allegations, *Smith* does not describe **any** of its devices as "depletion-mode." Ex. 1005. Instead, *Smith* describes its transistors broadly with multiple embodiments and alternative implementations. Ex. 1033, [047]-[049]. A POSITA would have found it to be "quite obvious that [Smith] could cover enhancement mode devices." Ex. 2012, 36:6-7.

Without anything in *Smith* limiting it to depletion-mode or foreclosing enhancement-mode, PO grasps at straws and resorts to vague comparisons with drawings in other publications to argue *Smith* could not operate in enhancement-mode. POR, 24-30. But PO's challenge to *Smith*'s operability is both irrelevant and incorrect. Ex. 1033 §IV.A.2. Irrelevant because "a prior art reference asserted under §103 does not necessarily have to enable its own disclosure." *Raytheon Techs. Corp. v. Gen. Elec. Co.*, 993 F.3d 1374, 1380 (Fed. Cir. 2021). Incorrect because it misunderstands *Smith*'s disclosure, *Smith* would operate in enhancement-mode. Ex. 1033, [050]-[053].

PO's operability argument centers on *Smith*'s FIG. 2A, which shows cap layer is "in direct contact with both ohmic contacts." POR, 25. Based on this feature, PO argues *Smith* could not work in enhancement-mode. *Id.*, 25-26. But PO's analysis of

Smith is fundamentally flawed because *Smith* is not limited to FIG. 2A. Ex. 1033, [054]-[060]. *Smith* states that “embodiments of the present invention should not be construed as limited to structures having ohmic contacts recessed through the cap layer,” as shown in FIG. 2A. *Smith*, [0121]. As Dr. Shealy explained, FIG. 2A is a “schematic drawing[]” (*Smith*, [0041]), an “idealized cartoon” (Ex. 2013, 53:9-54:1), that cannot be interpreted as an exact design (Ex. 1033, [060]-[061]). PO’s analysis of *Smith*’s operability based on FIG. 2A ignores *Smith*’s written descriptions and POSITA’s ability to interpret the schematic and adjust variables (like doping, thicknesses, or voltages) for a working device. Ex. 1033, [064]-[067].

PO also cites testimony from Dr. Shealy in a different proceeding where he explained that having a conductive cap layer connecting ohmic contacts “would be a disaster.” POR, 29. But far from undermining *Smith*’s operability, Dr. Shealy’s testimony shows that PO’s analysis of *Smith*’s based only on FIG. 2A, ignoring *Smith*’s teachings, is absurd. Dr. Shealy’s testimony, which Dr. Schubert relied on in his declaration, confirms a POSITA would not have interpreted FIG. 2A as an implemented device. Ex. 1033, [068]-[072]. Rather, a POSITA would have understood FIG. 2A as a schematic and would have known how to control factors like doping, thickness, and applied voltage to have *Smith* operate in enhancement-mode. *Acorda Therapeutics, Inc. v. Roxane Labs., Inc.*, 903 F.3d 1310 (Fed. Cir. 2018) (prior art is interpreted to “take account of the inferences and creative steps

that a person of ordinary skill in the art would employ”); Ex. 1033, [051]-[071]; Ex. 2012, 33:8-34:13.

B. *Smith* Renders the “Compensated GaN Layer” of [1e] Obvious

PO argues that *Smith* does not disclose the “compensated GaN layer” alleging that “mere presence of hydrogen is not enough.” POR, 32. PO also alleges that “there are processes which remove hydrogen” and contends that “finding that hydrogen is necessarily present is improper.” POR, 33-36. PO’s arguments fail because they do not apply any of the proposed constructions and misinterpret Petitioner’s grounds and *Smith*’s disclosure.

First, PO’s criticisms of *Smith* are divorced from the claim language and the constructions. *Smith* meets the “compensated GaN layer” under Petitioner’s construction. Pet., 38-41. *Smith* also meets “compensated GaN layer” under PO’s revised construction by disclosing the formation of a nonconductive cap layer with p-type dopants and MOCVD. Pet., 42-43; Ex. 1033 §III.C.1. To a POSITA it would have been obvious that *Smith*’s cap includes hydrogen that inactivates p-type dopants making *Smith*’s cap a layer “in which one type of impurity”—hydrogen from MOCVD—“cancels the electrical effects of the other type of impurity”—passivated p-type dopants—meeting PO’s construction. *Id.*

PO’s arguments regarding the layer’s conductivity, tentative additional processing, and other layers in *Smith* (POR, 30-36) are irrelevant because they are

divorced from the claim language or the constructions (e.g., neither of the constructions require a specific conductivity).

Second, PO's criticisms of *Smith* misinterpret Ground 1A. PO argues that "Petitioner is applying Smith as an anticipatory reference." POR, 30. That is not correct. Ground 1A is obviousness. Pet., 11, 26-27.

Third, PO's allegations that Petitioner relies on the "mere presence of hydrogen" are also wrong. POR, 31. Petitioner does not rely on mere presence of hydrogen as resulting in "compensated GaN." Pet., 26-27, 38-43. Instead, Petitioner identifies *Smith*'s description of the formation and characteristics of cap layer as making "compensated GaN layer" obvious. *Id.* *Smith*'s cap layer is grown with an epitaxy process (like MOCVD), has p-type dopants (like Mg), and is nonconductive. Ex. 1033 §IV.C; *Smith*, [0085]-[0087]. A POSITA would have therefore understood *Smith*'s cap layer is a "compensated GaN layer" under both constructions. Pet., 38-42; Ex. 1033 §III.C.

Fourth, PO speculates that a POSITA would "likely have included an anneal/activation step to remove hydrogen" in *Smith*. POR, 33. PO's speculation is unsupported. *Smith* **does not** describe any **requirement** for removing hydrogen from cap layer. *Smith* [0085]-[0089]. As the Board correctly found, *Smith* specifies hydrogen removing steps are optional. ID, 19; *Smith*, [0083].

Fifth, PO wrongly alleges that Petitioner relies on *Smith*'s "passivation" in ¶[0083] for the "compensated GaN layer." POR, 34-36. Petitioner never identified *Smith*'s "passivation layer 100" as the "compensated GaN." Pet., 38-49. Petitioner identified *Smith*'s "passivation layer 100" as disclosing the *confinement layer* in [7f]. Pet., 50-52. Petitioner relied on *Smith*'s cap layer as the "compensated GaN layer." Pet., 38-43.

C. *Smith* Motivates Compensating Dopants in its Cap Layer, Specifying the Level of Doping Should Be in a "Sweet Spot"

PO argues that "[t]here is no motivation to compensate or passivate *Smith*'s cap layer" and alleges that it would be "completely counter to *Smith*'s stated intentions." POR, §VI.B.4. But *Smith* and the prior art directly contradict PO's assertions. Ex. 1033, [075]-[076], [092]-[096].

Smith motivates compensating dopants in its cap layer because *Smith* explains the level of doping needs to be in a "sweet spot": "[S]ufficiently high ... but not so high." *Smith* [0087]; Ex. 1033 §IV.B. As Dr. Shealy explained—and evident in the evidence of record—a POSITA "knew that hydrogen passivation, and hydrogenation processes, adjusted the doping level." Ex. 1003, [0125]. Dopant passivation was a well-known tool to adjust the "level of doping" *Smith* describes, particularly to prevent a doped layer from becoming conductive. Ex. 1018, 10 (Nobel prize Nakamura explaining in 1992 that "[t]he formation of acceptor-H neutral complexes

causes high resistivity”); Ex. 1003, [110]. In seeking *Smith*’s doping “sweet spot,” a POSITA would have been motivated to tailor the level of doping by passivating dopants in *Smith*’s cap layer. Pet., 38-42; Ex. 1003, 123-127.

PO contends that Petitioner confuses “level of doping” with “level of compensation of dopants” alleging that “level of doping ... is based on the concentration of dopants in the layer.” POR, 37. But PO ignores *Smith*’s description of level of doping. *Smith*’s associates the “level of doping” with the doping effects, like the resulting conductivity, not their mere concentration. *Smith*, [0087]; Ex. 1033, [074]-[075]. A POSITA would not have understood *Smith*’s “level of doping” as mere concentration of dopant” because *Smith*’s associates the “level of doping” with dopant conductivity and a POSITA knew conductivity hinged on dopant activation/passivation, not merely their concentration. Ex. 1033, [075]-[087]; Ex. 1003, [0110]-[0127].

Further, *Smith* contradicts PO’s interpretation of “level of doping” as merely dopant concentration because *Smith* distinguishes with different terms: “dopant concentration,” related to concentration, distinguishing from “level of doping,” related to dopant effects like conductivity. *Smith*, [0087]. *Smith*’s terminology confirm “level of doping” is not “dopant concentration.” Ex. 1033, [078].

PO alleges “Smith makes it clear that the dopants themselves cause desirable effects” and that “[c]ompensating those dopants would cancel the electrical

characteristics causing those desirable effects.” PO, 39. But PO focuses on the benefits of the dopants (one side of the “sweet spot”) while ignoring their adverse effects (the other side). *Smith*’s states:

The level of doping should be sufficiently high so as to reduce leakage current in embodiments without a recessed gate and be the dominant ‘surface’ state ***but not so high as to provide introduce traps or leakage paths by becoming a conductive layer.***

Smith, [0087] (emphasis added). *Smith* explains that some doping causes desirable effects, but too much doping make the layer conductive causing undesirable effects. *Id.* A POSITA seeking that “sweet spot” doping, would have found it obvious to passivate dopants to reduce doping level keeping the cap layer nonconductive. Pet., 38-40; Ex. 1033, [075]-[079]. Tailoring the level of doping in the cap layer (e.g., through dopant passivation) would be consistent with *Smith*. Ex. 1033, [072], [090]. As even PO’s expert admitted in his book, using hydrogen to tailor doping levels in III-V semiconductors, like GaN, was “widely used” and a technique that “provides high flexibility to tailor the electrical properties of thin films.” Ex. 1029, 402; Ex. 1033, [096].

D. *Smith*’s Cap Layer is Formed With “Co-doping,” Resulting in a “Semi-insulating Group III Nitride Layer”

Smith teaches cap layer 34 being doped with any of p-type, n-type, and deep dopants. *Smith*, [0085]; Pet., 46-47. *Smith* describes multiple doping schemes for cap

layer including doping: only region 40, “throughout the cap layer,” and with “techniques for co-doping.” *Id. Smith* specifies embodiments using co-doping make cap layer “semi-insulating,” as in [7e]. Pet., 46-47; ID, 20-21.

PO alleges that “Smith at most teaches regions of different dopant concentrations.” POR, 41. But PO’s interpretation contradicts *Smith*’s disclosure and its incorporation of *Saxler*⁴⁸⁷. Undisputedly *Smith* describes cap layer being formed with “co-doping.” *Smith*, [0085]. As PO acknowledges, *Saxler*⁸⁷⁴ discloses the “co-doping” forms a semi-insulating layer. POR, 41 (agreeing *Saxler*⁸⁷⁴ “would result in the semi-insulating layer”). PO, however, incongruently argues that *Smith*’s layer would still not be semi-insulating alleging no “motivation as to why a POSA would use that type of co-doping in *Smith*.” POR, 42. But no motivation is needed. *Smith* and *Saxler*⁸⁷⁴ are not independent—*Saxler*⁸⁷⁴ is unambiguously incorporated by reference in *Smith* making *Saxler*⁸⁷⁴ “effectively part of [*Smith*] as if [*Saxler*⁸⁷⁴] were explicitly contained therein.” *Paice LLC v. Ford Motor Co.*, 881 F.3d 894, 906–07 (Fed. Cir. 2018).

By incorporating *Saxler*⁸⁷⁴ in its description of cap layer doping, *Smith* itself discloses cap layer 34 being formed with the co-doping that, PO agrees, results in the “a semi-insulating Group III nitride layer.” Ex. 1016 ¶[0005]; POR, 40-41. *Smith* thus discloses cap layer as a “semi-insulating layer” and Grounds 1A-1C meet [7e].

E. A POSITA Would Have Found it Obvious to Apply *Kigami*'s Hydrogenation to Smith Seeking Smith's "Sweet spot" Level of Doping

For Ground 1B, PO does not dispute *Kigami* describes a method for the formation of the "compensated GaN layer," under both constructions. POR §VII.A. Instead, PO challenges the location of the compensated layer in *Kigami* and the motivation to combine. *Id.* PO contends that in *Kigami* the compensated layer "corresponds to a buffer and/or a transition layer." POR, 43. PO also alleges *Kigami* "discloses a different device" and repeats the argument that doping followed by passivation would be "counterintuitive." POR, 43-44. PO's arguments misunderstand the combination and ignore *Smith*'s goal of a doping "sweet spot." *Smith*, [0087].

First, PO misunderstand the combination in Ground 1B. PO mistakenly argues that *Kigami* does not teach "its hydrogen-treated p-type GaN layer would be suitable below the gate contact or that a compensated GaN layer including Mg dopants and hydrogen would be acceptable or functional *in place of* the cap layer." POR, 43 (emphasis added). But Ground 1B ***does not*** propose substituting any of *Kigami*'s layers "in place of the cap layer." *Id.* Ground 1B is the application of a known technique (*Kigami*'s hydrogenation) to a known device (*Smith*'s transistor) ready for improvement (reducing leakage by controlling level of doping) to yield

predictable results (the reduction of cap layer's conductivity). Pet., 28-31; Ex. 1033 §V.A.

Second, PO's allegation that the combination is "counterintuitive" contradicts *Smith*'s disclosure motivating control of the "level of doping" to achieve the doping "sweet spot." *Smith*, [0087]; §V.C. Applying *Kigami*'s hydrogenation *process* to *Smith*'s *device* would not be "counterintuitive" because *Kigami*'s technique furthers *Smith*'s objectives. Pet. 28-30, 38-43. *Kigami*'s hydrogenation allows the tailoring of the "level of doping" *Smith* desires. Ex. 1033 §V.B.

PO argues that passivating dopants in *Smith* "would void their purpose ... rendering the Smith device inoperable." POR 44. Far from it, *Smith* asks to control the dopants in cap layer because too many "introduce traps or leakage paths by becoming a conductive layer." *Smith*, [0087]; Ex. 1033, [090]. Passivating dopants in *Smith*'s cap layer would not "void their purpose," it would control their level, preventing the layer from "becoming a conductive layer," and minimizing the harmful effects of too much doping resulting in a conductive layer. *Smith*, [0087]; Ex. 1033 §V.B. *Kigami*'s hydrogenation is a convenient technique, applicable post-fabrication, to control doping levels seeking *Smith*'s "sweet spot." Ex. 1003, [0132]; Ex. 1033, [090]-[092]. Additionally, a POSITA would have been motivated to use *Kigami*'s technique in *Smith* because *Kagami* states that its technique improves

devices that, like *Smith*'s, have magnesium dopants by providing "stabilized threshold voltage, increased switching speed." *Kigami*, [0029]; Ex. 1033, [090].

Moreover, evidence of record directly refutes PO's allegations that doping followed by passivation in Ground 1B would be "counterintuitive." For example, *Kigami* describes doping followed by passivation, showing the process is not "counterintuitive" but desirable to increase resistance and improve transistor operation. Ex. 1033, [093]-[094]; *Kigami*, [0024]-[0029]. Similarly, *Uemoto* describes the fabrication of a transistor with magnesium-doping followed by dopant inactivation, again demonstrating the process was not "counterintuitive" but desirable to reduce leakage. Ex. 1033, [095]; *Uemoto*, [0063]. Even PO's expert has contradicted the allegations that passivation of dopants is "counterintuitive"; he wrote in a book from 1993 that dopants passivation with hydrogen is "widely used to render III-V semiconductors highly resistive" and provides "high flexibility to tailor the electrical properties." Ex. 1029, 402-406; Ex. 1033, [096].

**F. A POSITA Would Have Been Motivated to Incorporate
Uemoto's High-resistivity Region 15b Into *Smith* to Reduce
Leakage**

For Ground 1C, PO challenges the *Smith/Uemoto* combination alleging "no motivation as to why, given *Smith*'s concern with doping level adjustments, a POSA would seek to inactivate impurities in *Smith*." POR, 46. But PO again improperly limits *Smith*.

While *Smith* is concerned with adjusting doping, which motivates applying doping adjustment techniques like *Kigami*'s, *Smith* is also concerned with reducing leakage. *Smith*, [0087], [0064]. *Uemoto* addresses the same leakage problem identified in *Smith* disclosing that with “high resistive region 15b ... a greater amount of leakage current between the gate and the drain can be reduced.” *Uemoto*, [0059]. That the two references address *the same problem* is “precisely the reason that there’s a motivation to combine.” *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023).

PO also reiterates a POSITA would not passivate dopants in *Smith*'s cap. POR, 47. That is incorrect. A POSITA would have been motivated to passivate dopants to achieve *Smith*'s level of doping “sweet spot” while keeping the layer nonconductive. §V.C. Further, as discussed in Ground 2, PO's criticism of the combination based on “gate material” construction and “2DEG” requirements are divorced from the claim language and contradicted by its expert.

VI. GROUND 2 INVALIDATES THE CLAIMS

For Ground 2, PO only disputes three elements: “compensated GaN layer” ([1e]), “semi-insulating layer” ([7e]), and the positional requirement of “gate contact above the compensated GaN layer” ([1f]). *Id.* However, PO's arguments against Ground 2 are divorced from the claim, based on PO's improper constructions, and misinterpretations of *Uemoto* and *Smith*.

A. Ground 2 Meets [1e] Because There is no Requirement That a “Compensated GaN Layer Has No 2DEG Beneath It”

PO argues *Uemoto*’s region 15b does not meet [1e] because “the 2DEG is present under *Uemoto*’s high resistive region 15b.” POR, 52. But PO’s 2DEG argument is completely irrelevant because [1e] has no “2DEG” requirements.

The claim is directed to a transistor structure. Ex. 1001, 5:11-18. It does not recite a particular operation or requires the “compensated GaN” to have an effect on a “2DEG.” *Id.* And none of the constructions for [1e] impose a 2DEG requirement; even PO’s construction fails to mention a “2DEG.” POR, 11-16.

Similarly, the specification does not require any “2DEG” functionality for the “compensated GaN layer.” Ex. 1001, 3:7-52. Indeed, the specification only mentions a “2DEG” in the background when describing a “polarization, which contributes to a conductive (2DEG),” not in relation to the compensated GaN layer. *Id.*, 1:34-50.

PO’s “2DEG” requirement is so completely divorced from the claims, the constructions, and the specification that it appears a desperate effort to retract its expert, Dr. Schubert, previous testimony. He testified *twice* that *Uemoto*’s layer 15b meets the “compensated GaN layer.” In ITC proceedings, Dr. Schubert admitted that “layer 15b is gallium nitride, contains magnesium and hydrogen, is passivated, and is non-conductive. So in that sense, **it meets the claim term ‘compensated gallium nitride.’**” Ex. 2017, 1033:21-1034:7 (emphasis added). He also admitted *Uemoto*’s

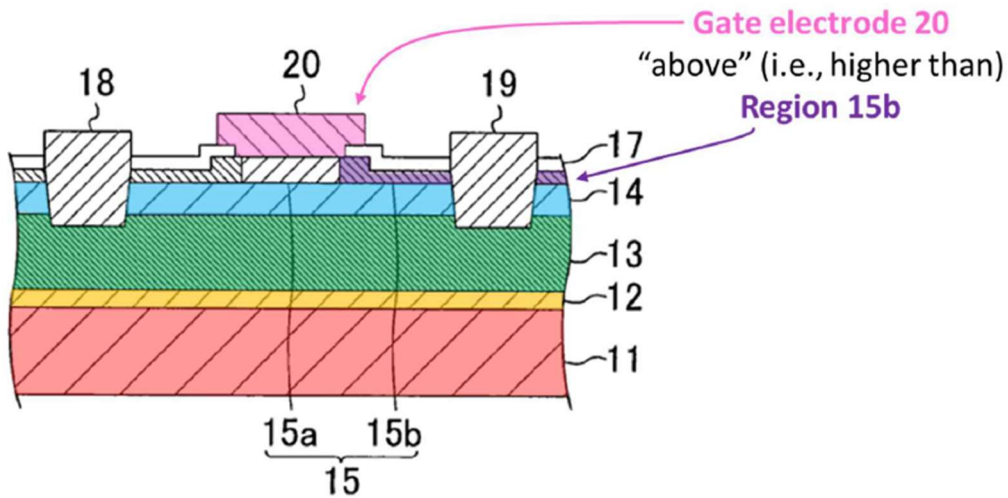
15b “is gallium nitride. It is doped with magnesium and it is passivated by hydrogen. So if we look at layer 15B in isolation then one could say **that’s the compensated gallium nitride layer.**” Ex. 2016, 964:1-7 (emphasis added).

PO’s bid to distinguish the claimed “compensated GaN layer” from *Uemoto*’s region 15b with a made-up “2DEG” requirement is meritless and contradicted by its expert.

B. Ground 2 Meets [1f] Because *Uemoto*’s Gate Electrode 20 is “Above” Region 15b

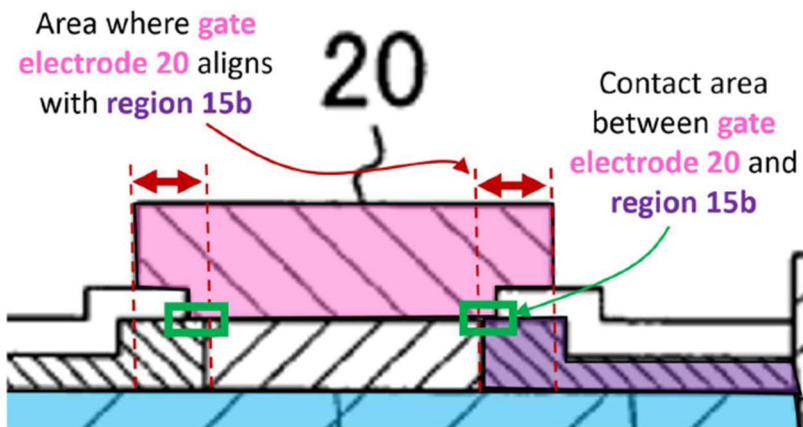
PO argues Ground 2 does not meet the positional requirement in [1f], which asks for the “gate contact [to be] above the compensated GaN layer,” arguing that 15b is not part of the “gate structure.” POR, 56-57. PO’s arguments are based on its improper “gate material” construction.

Element [1f] requires the gate contact to be “above” compensated GaN, it does not require any “gate material.” Ex. 1001, 5:11-18; Paper No. 8, 1-4; *supra* §III.B. As shown below, *Uemoto* plainly discloses its gate electrode is “above” region 15b. *Uemoto*, [0046], Fig. 7.



Uemoto, Fig. 7 (annotated)

Uemoto not only discloses electrode 20 “above” region 15b, *Uemoto* describes electrode 20—at least partially—directly on top and in contact with region 15b.



Uemoto, Fig. 7 (annotated)

At the ITC Dr. Schubert also admitted that in *Uemoto* “the gate electrode *is above* a small region of layer 15B.” Ex. 2016, 965:3-19 (emphasis added); 966:21-24

(admitting a “sliver” is below the gate). Dr. Schubert contradicted PO’s arguments, he admitted gate electrode 20 is above region 15b (even if a small region).

With the reference *Uemoto* plainly showing [1f], as Dr. Schubert agrees, PO resorts to criticize *Uemoto*’s Fig. 7 arguing shown features are “not described in *Uemoto*’s specification that way.” POR, 57. However, it is well-settled that features shown in prior art drawings need not be described in the specification to be prior art disclosure. M.P.E.P. §2125 (citing *In re Aslanian*, 590 F.2d 911, 200 (CCPA 1979)); *In re Wagner*, 63 F.2d 987, 988 (CCPA 1933). *Uemoto* shows gate electrode not only above, but (at least partially) on top and contacting region 15b.

PO also argues that because *Uemoto* “has an activated p-GaN,” it is “similar” to the admitted prior art, and that region 15b “will not impact gate capacitance.” POR, 56. PO’s arguments about *Uemoto*’s operation and capacitance are irrelevant and incorrect. Irrelevant because the claims (and proposed constructions) do not include “gate capacitance” requirements. Ex. 1001, 5:11-18. Incorrect because *Uemoto* is not “similar” to the admitted prior art and *Uemoto*’s region 15b would impact the gate capacitance. Ex. 1033 §VI.A-B.

C. Ground 2 Meets [7f] Because *Smith* Discloses the “Semi-Insulating III-N Layer” as Explained for Ground 1

Like in Grounds 1A-1C, PO argues Ground 2 does not meet [7f] alleging “Smith never states or even remotely implies that the cap layer 34 is ‘semi-

insulating.” POR, 58. As explained above, however, *Smith* discloses its cap layer can be formed with co-doping techniques for “fabricating semi-insulating Group III nitride layers.” *Saxler874*, [0005]; *Smith*, [0085]; §V.D. PO’s allegation of “no motivation as to why a POSA would use [*Saxler874*] co-doping in *Smith*” is legally flawed because *Smith* and *Saxler874* are effectively the same document. *Paice*, 881 F.3d at 906–07.

It is undisputed, to a POSITA it would have been obvious to apply *Smith*’s semi-insulating teachings to *Uemoto*. Pet., 64-66. When *Uemoto* is modified with *Smith*, *Uemoto*’s layer 15 is semi-insulating. *Id.*

VII. PATENT OWNER’S SECONDARY CONSIDERATIONS FAIL

PO halfheartedly alleges that secondary considerations salvage the claims. POR §X. They do not.

PO’s secondary considerations evidence does not have the required nexus to the claims. *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019). PO alleges “the ’294 patent was a breakthrough” that “provided a significant improvement.” POR, 60. But PO makes no attempt to link the purported “improvement” to any of the secondary considerations or demonstrate they stem from unique characteristics of the claims. *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 33, 33 (P.T.A.B. Jan. 24, 2020).

PO only cites two documents: PO's website (Ex. 2020) and an article (Ex. 2021). These, however, highlight features completely independent from the claims. Ex. 2020 highlights "a mature, efficient, and low cost supply chain." *Id.*, 5. Ex. 2021 alludes solutions for "establishing a low-cost supply chain." *Id.*, 1. These exhibits do not support PO's secondary considerations, or the alleged "innovative breakthrough" because they are generic and untethered to the claims. PO's exhibits fail to even mention the purportedly innovative "compensated" or "semi-insulating" features of the claims. And PO's cited expert testimony is generic to enhancement-mode transistors, relies on features not specific to the claims, and also fails to establish nexus. Ex. 1033 §VII.; Ex. 2009, 91-93.

Without any evidence of nexus or demonstrating secondary considerations, PO failed to carry its burden. *Leapfrog Enterprises, Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1162 (Fed. Cir. 2007).

VIII. CONCLUSION

Petitioners request cancellation of the challenged claims.

Dated: September 4, 2024

/Lionel M. Lavenue/
Lionel M. Lavenue (Reg. No. 46,859)
Counsel for Petitioner

CERTIFICATION UNDER 37 CFR § 42.24(d)

Under the provisions of 37 CFR § 42.24(d), Petitioner certifies that the word count under §42.24(c)(1) for the foregoing Petitioner's Reply to Patent Owner's Response totals 5,571 words, less than 5,600, as measured by the word-processing system used to prepare this paper.

Dated: September 4, 2024

By: /Lionel M. Lavenue/

Lionel M. Lavenue

Reg. No. 46,859

CERTIFICATE OF SERVICE

Pursuant to 37 CFR § 42.6(e)(4), the undersigned certifies that on September 4, 2024, a complete and entire copy of this Petitioner's Reply to Patent Owner's Response and Exhibit 1033 was provided by email to the Patent Owner by serving the correspondence email address of record as follows:

Walter D. Davis, Jr.
walter.davis@blankrome.com

Dipu Doshi
dipu.doshi@blankrome.com

Mark Mashack
mark.mashack@blankrome.com

Stephen Soffen
stephen.soffen@blankrome.com

Cory R. Edwards
cory.edwards@blankrome.com

Ameya V. Paradkar
arun.paradkar@blankrome.com

Jonathan England
jonathan.england@blankrome.com

EPCC-Inno-IPRS@blankrome.com

Dated: September 4, 2024

By: /Daniel E. Doku/

Daniel E. Doku

Litigation Legal Assistant

FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, LLP