

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

Case IPR2023-01381
U.S. Patent No. 8,350,294

PATENT OWNER'S SUR-REPLY

TABLE OF CONTENTS

	Page
I. INTRODUCTION	1
II. CLAIM CONSTRUCTION	2
A. “a gate contact above the compensated GaN layer”	4
B. “Compensated GaN Layer”	8
C. Claims 1-3 are Directed to an Enhancement Mode Transistor	10
III. GROUND 1A (SMITH ALONE)	11
A. Smith is Depletion Mode.....	11
B. Smith does not disclose compensation.....	14
IV. SMITH IN VIEW OF KIGAMI (GROUND 1B).....	17
V. SMITH IN VIEW OF UEMOTO (GROUND 1C)	18
VI. UEMOTO IN VIEW OF SMITH (GROUND 2).....	19
A. Uemoto’s gate electrode is not located above region 15b	19
B. Region 15b has a 2DEG below it and Uemoto cannot be enhancement mode	24
VII. CONCLUSION.....	25

TABLE OF AUTHORITIES

Page(s)

Cases

<i>Gemalto S.A. v. HTC Corp.</i> , 754 F.3d 1364 (Fed. Cir. 2014)	3
<i>In re Marosi</i> , 710 F.2d 799, 218 USPQ 289 (Fed. Cir. 1983)	5
<i>In re Okuzawa</i> , 537 F.2d 545 (CCPA 1976)	5
<i>Medicines Co. v. Mylan, Inc.</i> , 853 F.3d 1296 (Fed. Cir. 2017)	2
<i>Renishaw PLC v. Marposs Societa'</i> <i>per Azioni</i> , 158 F.3d 1243 (Fed. Cir. 1998)	3
<i>Retractable Techs., Inc. v. Becton, Dickenson & Co.</i> , 653 F.3d 1296 (Fed. Cir. 2011)	2, 7
<i>TriMed. Inc. v. Stryker Corp.</i> , 608 F.3d 1333 (Fed. Cir. 2010)	3, 24
<i>Wi-Fi One, LLC v. Broadcom Corp.</i> , 887 F.3d 1329 (Fed. Cir. 2018)	2

PATENT OWNER’S EXHIBIT LIST

Exhibit No.	Description
2001	Jorg Neugebauer et al., “Role of Hydrogen Complexes in Doping of GaN,” Material Research Society Symposium Proceedings, Vol. 423 (1996), pp. 619-24 (“Neugebauer-MRS1”)
2002	Jorg Neugebauer et al., “Theory of Point Defects and Complexes in GaN,” Material Research Society Symposium Proceedings, Vol. 395 (1996), pp. 645-56 (“Neugebauer-MRS2”)
2003	EPC’s Responsive Claim Construction Brief: Inv. No. 337-TA-1366, dated October 6, 2023
2004	IEEE Dictionary definition for “compensated”
2005	U.S. Patent No. 6,498,111 (“the ‘111 patent”)
2006	Translation of Innoscience’s Invalidation Request to the Chinese Patent Office for the Chinese Counterpart to the ‘294 Patent
2007	U.S. Patent App. No. 12/756, 906, filed on April 8, 2010
2008	U.S. Provisional App. No. 61/167,792, filed on April 8, 2009
2009	Declaration of Dr. E. Fred Schubert
2010	Respondents’ Post-Hearing Initial Brief (Inv. No. 337-TA-1366)
2011	Declaration of Dr. James Richard Shealy (IPR2023-01384)
2012	Deposition Transcript of Dr. Shealy (IPR2023-01381)
2013	Deposition Transcript of Dr. Shealy (IPR2023-01382, -01384)
2014	Evidentiary Hearing Transcript, pages 1-238 (Inv. No. 337-TA-1366) (Public)
2015	Evidentiary Hearing Transcript, pages 239-506 (Inv. No. 337-TA-1366) (Public)
2016	Evidentiary Hearing Transcript, pages 741-984 (Inv. No. 337-TA-1366) (Public)
2017	Evidentiary Hearing Transcript, pages 985-1270 (Inv. No. 337-TA-1366) (Public)
2018	Certified Translation of Innoscience’s Invalidation Request to the Chinese Patent Office for the Chinese Counterpart to the ‘294 Patent
2019	Certified Translation of Decision on Innoscience’s Invalidation Request to the Chinese Patent Office for the Chinese Counterpart to the ‘294 Patent
2020	“About Efficient Power Conversion Corporation,” https://epc-co.com/epc/about-epc , printed Mar. 2, 2023

2021	“SEMI Awards Honors Process and Technology Integration Achievements,” https://www.semi.org/en/semi-awards-honor-process-and-technology-integration-achievements , Jan. 13, 2016
2022	Public Initial Determination
2023	Complainant’s Responsive Post-Hearing Brief
2024	Supplemental Declaration of E. Fred Schubert, PhD., in Support of Patent Owner’s Reply to Petitioner’s Opposition to Patent Owner’s Motion to Amend
2025	Pre-Hearing Brief of the Commission Investigative Staff (Inv. No. 337-TA-1366) (Public)
2026	1999-Pankove-(MSE)- “GaN from fundamentals to applications”
2027	1998-Obloh-(JCG)- “Self-compensation in Mg doped p-type GaN grown by MOCVD”
2028	1999-Neugebauer-(SCSM)- “Theory of Hydrogen in GaN”

I. INTRODUCTION

At the outset, Patent Owner reiterates the important point that none of the prior art relied upon in the Petition even mentions the word “compensated” or remotely suggests a transistor with a compensated gate. This is because the compensated gate invention of the ‘294 patent, which achieves two technical effects having opposite requirements for electrical conductivity, was entirely unexpected and went in a direction completely contrary to conventional wisdom at the time of the invention.

Under Petitioner’s theory, at least with respect to the Smith reference, any GaN transistor that has a p-type dopant and is made by a MOVCD process is necessarily compensated by hydrogen. But the prior art at the time of the invention, such as Figure 1 in the ‘294 patent and the Uemoto reference, sought just the opposite, a conductive p-GaN gate material under the gate contact.

Lacking any disclosure in the prior art of a compensated gate, Petitioner’s Reply (Paper No. 26) essentially presents a series of anticipation arguments as part of an obviousness analysis in which it seeks to literally read the words of each limitation of the claims on the prior art, and ignores the fundamental issue - whether the invention as a whole would have been obvious to a POSITA over the Smith and Uemoto references. Yet all three grounds are based on obviousness, in

which the important functional differences between the invention and the prior art must be considered, as explained below.

II. CLAIM CONSTRUCTION

Petitioner asserts that the Board should reject Patent Owner’s constructions because they “apply an improper standard.” According to Petitioner, the “goals” of the invention are not relevant to claim construction. Petitioner is wrong.

Petitioner challenges the holding in *Retractable Techs., Inc. v. Becton, Dickinson & Co.*, 653 F.3d 1296, 1304 (Fed. Cir. 2011) that claims terms must be interpreted to “capture the scope of the actual invention,” rather than allowing the claim language to become “divorced from what the specification conveys is the invention.” According to Petitioner, the ‘294 patent “does not include any disavowal,” as in *Retractable*, Reply at 3. But disavowal is only one example of how the true scope of an invention can be determined. The other cases cited by Patent Owner, *not addressed by Petitioner*, demonstrate that the invention and its “goals” **as described in the specification**, i.e., the intrinsic evidence, is clearly relevant to claim construction. *Wi-Fi One, LLC v. Broadcom Corp.*, 887 F.3d 1329, 1346 (Fed. Cir. 2018) (“the claim must be read ... in order to be faithful to the invention disclosed in the specification”); *Medicines Co. v. Mylan, Inc.*, 853 F.3d 1296, 1305 (Fed. Cir. 2017) (restricting the claim to a specific process to avoid “the impermissible result of extending [the] monopoly beyond the invention

disclosed, and potentially to the prior art.”) (internal quotations omitted); *Gemalto S.A. v. HTC Corp.*, 754 F.3d 1364, 1369-71 (Fed. Cir. 2014) (affirming narrow construction based on purpose of invention and distinctions over prior art because “the claims cannot be of broader scope than the invention that is set forth in the specification.”) (internal quotations omitted); *Renishaw PLC v. Marposs Societa’ per Azioni*, 158 F.3d 1243, 1250 (Fed. Cir. 1998) (“construction that stays true to the claim language and most naturally aligns with the patent’s description of the invention will be, in the end, the correct construction.”).

Functional distinctions are highly relevant in an obviousness analysis and must be considered in claim construction. *TriMed, Inc. v. Stryker Corp.*, 608 F.3d 1333, 1339-43 (Fed. Cir. 2010) (reversing district court’s grant of summary judgment where the claimed element performed a different function in the prior art).

The specification of the ‘294 patent provides important context for interpreting claim 1. The specification provides a method of making the transistor depicted in Figure 2 and discloses the step of “etch[ing] away the compensated semiconductor layer 38), *except the portion beneath the gate contact layer 37.*” (emphasis added). Ex. 1001 at 3:35-38.

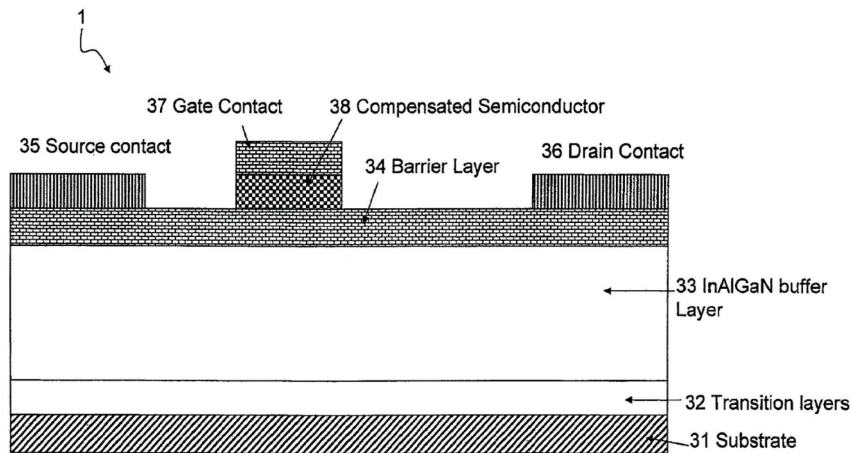


FIG. 2

As explained below, a POSITA reading claim 1 *in light of the specification* would clearly understand that the claimed “gate contact *above* the compensated GaN layer” is the structure that results from the etching step, i.e., a gate structure that includes a gate contact and compensated GaN layer.

A. “a gate contact above the compensated GaN layer”

Petitioner asserts that it is improper to construe “a gate contact above the compensated GaN layer” as a “a gate comprised of a gate contact and the compensated layer” because “claims cannot be limited to an embodiment.” Reply, 4. But the specification and drawings only describe the “gate contact above the compensated GaN layer” as being a “a gate comprised of a gate contact and the compensated layer” – no other possibilities or embodiments, and certainly not the device of Uemoto or Smith, could possibly be gleaned by a POSITA from the

specification and drawings of the ‘294 patent. Figure 2 is not “an embodiment” of the compensated GaN invention of the ‘294 patent – it is the invention.

Petitioner essentially asks the Board to construe “gate contact above the compensated GaN layer” in a vacuum, without reference to the title of the patent (“Compensated Gate MISFET”), the specification, the drawings or any intrinsic evidence. That clearly runs afoul of the law. *In re Marosi*, 710 F.2d 799, 802 (Fed. Cir. 1983) (“[C]laims are not to be read in a vacuum, and limitations therein are to be interpreted in light of the specification.” (quoting *In re Okuzawa*, 537 F.2d 545, 548 (CCPA 1976))).

As shown in Fig. 2 above, in the ‘294 patent, the compensated GaN layer is only present as being part of the gate, i.e., only under the gate contact. Figure 7, which Petitioner references, shows GaN layer in an intermediate manufacturing step, before etching, not in the actual finished device.

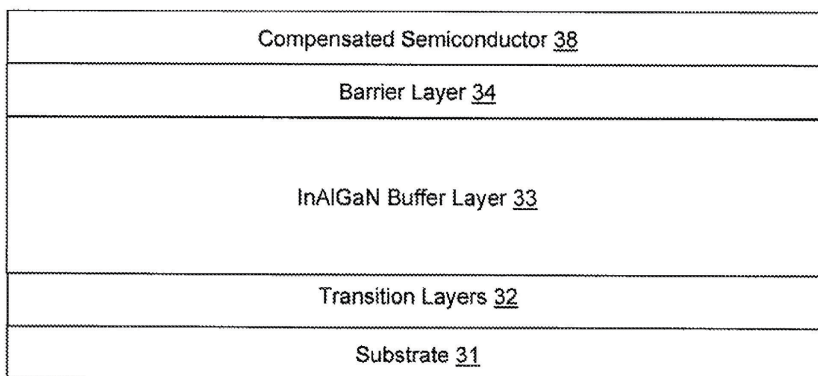


FIG. 7

Figure 8 shows the gate contact 37 above the compensated semiconductor layer 38, but, like Figure 7, does not depict the finished device.

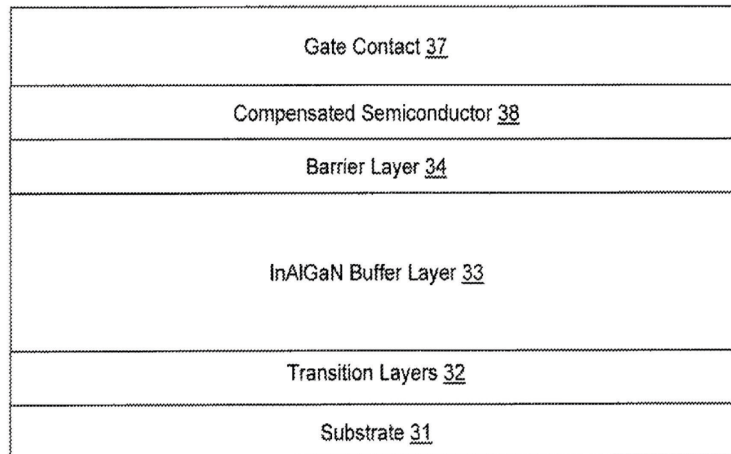


FIG. 8

Figure 9 shows the completed device.

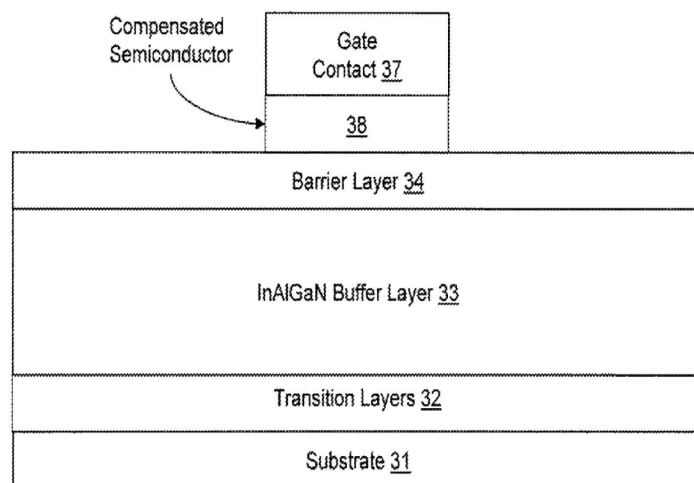


FIG. 9

A POSITA reading the claim in light of the specification and drawings would have understood the claimed “gate contact above the compensated GaN layer” to be referring to the finished structure that results from etching away the compensated GaN layer except the portion beneath the gate contact, as shown in Figure 9 (and Figure 2).

For the above reasons, contrary to Petitioner’s construction of the claim in a vacuum, “*above*” in the context of the ‘294 specification means more than merely “higher than”; rather, it implies a gate structure that includes a gate contact and the underlying compensated GaN layer. Ex. 2009, ¶ [91]. Thus, a person skilled in the art, reading claim 1 in light of the specification, would readily understand that “a gate contact above the compensated GaN layer” is defining a gate in which the compensated GaN layer is the gate material, as shown in Fig. 2 and in Fig. 9, the last step in the process in which the compensated GaN layer is etched away except under the gate contact.

Petitioner asserts that the ‘294 patent does not include any disavowal as in *Retractable*, pointing to a statement in the ‘294 specification that “embodiments of the invention are not limited by the foregoing description and drawings.” Reply, 3. First, although *Retractable* involved a disavowal, *Retractable* does not require an express disavowal. Second, this boilerplate language, present in most patents, cannot be read to mean that claim 1 would cover anything other than a gate

comprised of a gate contact and a compensated GaN layer. For example, there might be other ways to make the compensated GaN gate structure or to make the compensated GaN gate material which are not disclosed in the specification and would fall within the scope of claim 1, as properly construed. But all embodiments disclosed in the '294 patent relate to the gate, and particularly the gate material.

Contrary to Petitioner's assertion, the specification does not describe **Figure 2** as an "example method of manufacturing," Reply, 4. Rather, the specification refers to **Figures 3-9** as showing the process of making the transistor. Figure 2 is the finished device, as claimed. And while it is true that the specification states, at the end, that "modifications and embodiments to specific **process** conditions can be made" (emphasis added), this has no bearing on claim construction of claim 1, which is a device claim, not a process claim.

B. "Compensated GaN Layer"

Petitioner asserts that the neither the claim language nor the specification support Patent Owner's "gate material" construction for "compensated GaN layer." Reply, 4.

Petitioner first asserts that claim 1 recites a structure with a series of layers "above" each other, with only two elements - substrate and gate contact – lacking the "layer" recitation. Thus, according to Petitioner, compensated GaN layer must be a layer. Reply, 4-5. Patent Owner does not contest that the claimed GaN layer

is a “layer” – rather, as Patent Owner explained in the Response, the claimed GaN layer is the GaN gate material, based on the claim language itself, as confirmed by the specification (including the Summary of the Invention), the drawings (Figures 2 and 9) and the title of the patent. POR, 11-14.

Petitioner asserts that claim 10, which specifically recites the term “compensated gate” contradicts Patent Owner’s construction of claim 1 (claim differentiation). Reply, 5. Claim 10 is a separate independent claim with the term “compensated gate” recited in the preamble, and Petitioner does not establish that the preamble of claim 10 is limiting.¹ Accordingly, Petitioner’s claim differentiation argument fails.

Petitioner asserts that the specification does not define any claim term as gate material and that the specification describes embodiments where the compensated GaN layer is distinct from the gate material, pointing to Figure 7. Reply, 5. But, as explained above, Figure 7 shows an intermediate step of making the device and does not show the final device as claimed, with the compensated GaN layer outside the gate etched away.

¹ Claim 10 has been canceled in Patent Owner’s Motion to Amend (Paper No. 17), which is non-contingent, and has been replaced by new independent claim 14.

C. Claims 1-3 are Directed to an Enhancement Mode Transistor

As explained in Patent Owner's Response at 19-23, claims 1-3 are directed to an "enhancement mode" transistor. Petitioner asserts that the specification does not support Patent Owner's construction because "it expressly describes depletion-mode embodiments," citing column 4, lines 55-60 of the specification ("the device can be changed to a depletion mode device"). Reply, 8. But the portion of the specification, column 4, lines 55-60, that Petitioner references with respect to depletion mode relates to the third embodiment, **which does not include a compensated GaN layer**. If anything, Petitioner's reference to this language in the specification ("the device can be changed to a depletion mode device") establishes, contrary to Petitioner's assertion, that the first embodiment is enhancement mode.

Indeed, the specification nowhere discloses or suggests that the compensated GaN embodiment of the invention (Fig. 2) could be operated in depletion-mode. Patent Owner presented substantial evidence in the Response at 19-22 (citing testimony by Patent Owner's expert Dr. Schubert (Ex. 2015 at 436:5-17, 442:20-443:18) and Petitioner's expert in the ITC proceeding, Dr. Lebby (Ex. 2016 at 936:17-937:2) that the compensated GaN embodiment of claims 1-3, with p-doped GaN gate material, must be enhancement-mode.

Claims 2-3, which recite that the compensated GaN layer contains acceptor type (i.e., p-type) dopants, are unquestionably directed to enhancement mode. Both parties (and both experts), and the CNIPA agree that the ‘294 patent’s p-doped (acceptor type doped) GaN gate material under the gate contact results in enhancement mode operation. POR at 20-23. Tellingly, Petitioner does not respond to Patent Owner’s argument with respect to claim 2 and 3.

III. GROUND 1A (SMITH ALONE)

A. Smith is Depletion Mode

Petitioner ignores the determination of the CNIPA that Smith is depletion mode and asserts that Smith does not specify and could be either depletion mode or enhancement mode. Reply, 10. As Patent Owner explained, if cap layer 34 has p-type doping at zero voltage, the p-type doping would deplete the 2DEG the entire length between the ohmic contacts 30. POR, 26. Petitioner acknowledges this fact, but responds that Figure 2A of Smith is simply a “cartoon,” and that a POSITA would not have interpreted Figure 2A as an implemented device. Reply, 11.

Petitioner essentially seeks to rely solely on the alleged optional p-type doping under the gate contact 32 in Smith Figure 2A, and ignores the rest of Figure 2A of Smith as a “cartoon.” According to Petitioner, a POSITA would be able “to interpret the schematic and adjust variables (like doping, thicknesses, or voltages)

for a working device.” Reply, 11. Ex. 1033, 19-21. This defies logic. Ex. 2009, 51-52; Ex. 1033, 19-21. Petitioner’s arguments, that a POSITA would “interpret” the schematic shown in the patent (which could not represent an operable enhancement mode device, see POR, 22-30) and “adjust variables” to try to make it work as an enhancement device is nothing more than a hindsight reconstruction of the invention without any motivation other than to attempt to meet the claim.

Moreover, the averments in Dr. Shealy’s Supplemental Reply Declaration, Ex. 1033, [048]-[049] are directly *contrary* to his deposition testimony that if the cap layer were p-doped (as required for enhancement mode operation) and contacted both ohmic contacts, “it would be a disaster,” due to its conductivity because “[i]f you have a conducting layer in 1B, there would always be current flowing from source to – or electron flow or current from source to drain...” Ex. 2013 at 62:12-63:12; *see also id.* at 65:3-5 (noting that p-doping the cap layer “is the primary difference between a depletion and enhancement mode device.”). Dr. Shealy further testified at his deposition that it was not possible to fabricate a device in which the cap layer abutted both ohmic contacts, stating: “I just don’t know how you build something like that.” *Id.* at 57:8-12. A POSITA would have no motivation to struggle to convert a depletion mode device to a very poor enhancement mode device, if even possible. Notably, in paragraph [0087], the

portion of Smith relied upon by Petitioner for the doping levels, i.e., Petitioner’s “sweet spot”, is **region 40 at the surface**, not cap layer 34.

In other embodiments, the doped **region 40** is a region doped with p-type dopants. In particular embodiments of the present invention without a gate recess, the doped **region 40** extends into the **cap layer 34** from about 2.5 Å to about 100 Å. In particular embodiments of the present invention with a gate recess, the doped **region 40** extends into the **cap layer 34'** from about 30 Å to about 5000 Å. With p-type dopants, the doped **region 40** may provide a dopant concentration of from about 10^{16} to about 10^{22} cm^{-3} .

Cap region 34, in this embodiment, is not disclosed as being p-doped and therefore the device **cannot** be enhancement mode, as there is no p-type dopant adjacent the barrier layer to deplete the 2DEG.

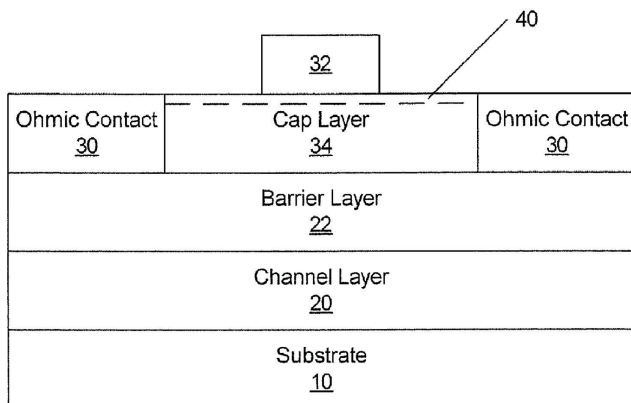


Figure 2A

For these reasons, and for the reasons set forth in Patent Owner’s Response at 23-30, it is clear that Smith is only operable as a depletion mode device.

B. Smith does not disclose compensation

Petitioner asserts that Smith also meets “compensated GaN layer” under PO’s revised construction “by disclosing the formation of a nonconductive cap layer with p-type dopants.” Reply, 12.

But Smith never discloses compensation. Petitioner’s entire argument on compensation in Smith is that compensation is inherent if Smith’s cap layer is grown with an epitaxy process (like MOCVD) or that it would be obvious to intentionally hydrogenate cap layer 34. Petition, 24, 40.

Importantly, Smith specifically discloses active, rather than compensated, p-type dopants: “P-type dopants may be used to screen the channel region from surface states, pin the surface energy level and a predictable and desired level to reduce and or minimize trapping effects.” Ex. 1005 at ¶ [0072]. Although hydrogen passivation of GaN, in general, was known at the time of its disclosure, Smith does not describe any such inactivation of the p-type dopants in doped region 40, or elsewhere. A POSITA would readily understand that Smith’s decision to exclude any mention of compensation/passivation of p-type dopants is thus a deliberate choice. Indeed, it is consistent with conventional knowledge at the time, which taught away from compensating p-type dopants and **is specifically highlighted by Smith**. Ex. 2005 at 2:1-3 (U.S. Patent No. 6,498,111 (“the ‘111 patent”), incorporated by reference in Smith ¶ [0083]. Given Smith’s teaching

requiring active p-type dopants in region 40, a POSITA would not contemplate doing the opposite and inactivating the very dopants that Smith requires for its devices. Ex. 2009 at [141]. Paper 11 (“ID”) at 24.

Moreover, Smith only discloses that layer 40, not cap layer 34, is doped with p-type dopants and is non-conductive. Ex. 1005 at [0085] – [0089]. And layer 40 is only at the surface of cap layer 34, as discussed above, and cannot deplete the 2DEG under the gate. In contrast to Smith, in the invention of the ‘294 patent, the p-type gate material 38 is formed over the barrier layer 34 and under the gate contact 37 to deplete the 2DEG, and is intentionally compensated to render the gate material semi-insulating. Ex. 2009 at [54]-[76]. These two opposite effects were entirely unexpected according to the conventional wisdom. Ex. 2009 at [36].

Petitioner assumes or speculates that the p-type dopants in region 40 of Smith are passivated by hydrogen to achieve Petitioner’s “sweet spot.” Reply, 14. But unlike the present invention, which is directed to a completely different objective, Smith contains absolutely no disclosure that the p-dopants are compensated, intentionally or not.

Petitioner posits that the p-type dopants in Smith region 40 are passivated with hydrogen to tailor the activation to achieve a supposed “sweet spot.” *Id.* But that would require a very controlled passivation. If hydrogen was present during epitaxial growth in the particular “conventional growth technique” chosen by a

skilled person seeking to produce a device according to Smith’s teachings, a carefully tailored anneal/activation step would have been necessary to remove some, but not all, of the hydrogen in order for the dopants intentionally added in layer 40 “to screen the channel region from surface states, pin the surface energy level at a predictable and desired level to reduce and/or minimize trapping effects and to reduce leakage currents.” Ex 1005, ¶87.

Importantly, if the p-type dopants were added in a MOCVD process with hydrogen present, as Petitioner supposes, they would be completely passivated by hydrogen, and their desired electrical effects would be cancelled, regardless of any “sweet spot” doping levels postulated by Petitioner. Compensating *Smith*’s dopant layer 40 would negate the effects of the doping of that layer. Ex. 2009 at ¶ [0143]. *Smith* would not dope layer 40 and then subsequently compensate the doping. *Id.* Doing so would be completely counterintuitive and runs completely counter to Smith’s stated intentions. *Id.* See also Preliminary Guidance Patent Owner’s Motion to Amend (Paper 29) at 11. Smith’s disclosure thus goes in the exact opposite direction of the claimed compensation of the ‘294 patent.

Thus, just as with the Kigami and Uemoto combinations discussed below, Petitioner’s new sweet spot theory involving tailoring of doping and passivation is counterintuitive and is inconsistent with Petitioner’s inherent MOCVD process compensation theory.

IV. SMITH IN VIEW OF KIGAMI (GROUND 1B)

Petitioner asserts that applying Kigami's hydrogenation process to Smith's device would not be "counterintuitive" because Kigami's technique "furthers Smith's objectives," and Kigami's hydrogenation "allows the tailoring of the 'level of doping' Smith desires." Reply, 19. But Kigami does not teach "tailoring" the magnesium doping to create a "sweet spot." Rather, as the ID correctly noted, in the embodiment depicted in Figure 2A of Smith, dopants are added to cap layer 34 to form doped region 40, in which the concentration of dopants is higher than in the rest of cap layer 34, and "this increased concentration of dopants is "used to screen the channel region from surface states, pin the surface energy level at a predictable and desired level to reduce and/or minimize trapping effects and to reduce leakage currents." Smith ¶ 87. And as the ID also correctly reasoned, Petitioner's proposed combination is counterintuitive, as it would intentionally passivate the very dopants that Smith seeks to add to form region 40 to alter its electrical characteristics. ID at 24.

Petitioner responds that passivating dopants in Smith's layer would not void their purpose, but rather 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." Reply, 19. But this strategy, of controlling the doping level in Smith, and then passivating the doped GaN in

Smith, per Kigami, “to tailor their level,” is completely absent from the teachings of Smith and Kigami. Smith only discloses using the **level of doping** to “reduce leakage current in embodiments without a recessed gate” (to allegedly achieve Petitioner’s “sweet spot”) and is completely absent about compensating the p-type GaN or “passivating with hydrogen,” as required by the claims 1 and 2 of the ‘294 patent. Kigami, in its hydrogenation, does not seek to “tailor” the doping level, but rather sets “the concentration of the hydrogen atoms higher than the concentration of the p-type impurity,” so that “substantially all of the p-type impurity ... is inactivated.” Ex. 1008 ¶[0011]. The combination of Smith with Kigami is classic hindsight reconstruction, counterintuitive, and is nowhere taught or suggested in the references. Moreover, it is inconsistent with Petitioner’s position with respect to Ground 1, that passivation is inherent in an MOCVD process.

V. SMITH IN VIEW OF UEMOTO (GROUND 1C)

For the same reason as in Ground 1B, it would be counterintuitive to modify Smith with Uemoto. Given Smith’s concern with doping level adjustments, a POSITA would not seek to inactivate those carefully tailored impurities introduced in region 40 of Smith to create Petitioner’s alleged “sweet spot”. Moreover, like Kigami, Uemoto does not disclose or even remotely suggest “tailoring” the doping level of the p-type dopant with hydrogenation, but rather provides a hydrogen diffusion barrier film 16 so that no hydrogen desorbs from the Mg to create a “high

resistive region 15b in which the p-type impurity is not activated.” Ex 1006, ¶[0051].

Petitioner replies that both Smith and Uemoto seek to reduce leakage current, and that since the two references address the same problem is “precisely the reason that there’s a motivation to combine.” Reply, 21. The argument is incorrect - the references are addressing two different leakage currents, neither of which relates to the gate leakage current that the ‘294 patent reduces via the compensated gate.

Specifically, Smith adds dopants “to reduce leakage current” **in region 40 of the gate**, not in the underlying cap layer 34. Ex. 1005 ¶ [0047]. Uemoto provides high resistive layer 15b to allegedly reduce leakage current **between the gate and drain**. Ex. 1006 ¶ [0059]. Smith and Uemoto are directed to two different types of leakage current, and a POSITA would not be motivated to combine the two teachings, and would not arrive at the ‘294 patent if the teachings were combined.

VI. UEMOTO IN VIEW OF SMITH (GROUND 2)

A. Uemoto’s gate electrode is not located above region 15b

Petitioner asserts that Uemoto discloses a “compensated GaN layer” because Uemoto’s gate electrode 20 is “above” region 15b. Reply, 23.

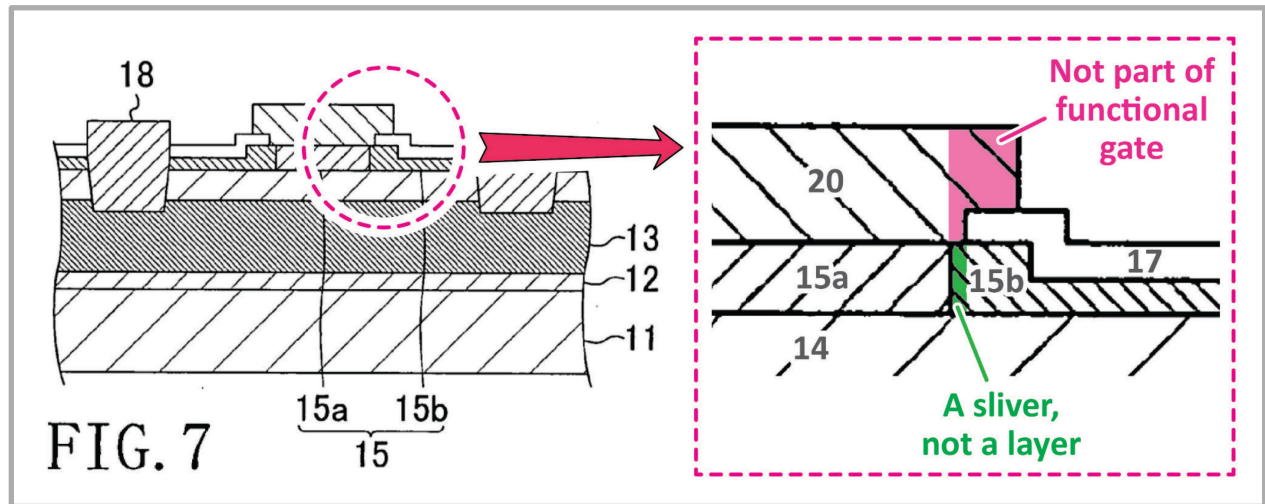
As discussed above with respect to claim construction, under an analysis that takes into account the intrinsic evidence and in which claim 1 is properly read in

light of the specification, the claim term “a gate contact above the compensated GaN layer” is properly construed as “a gate comprised of a gate contact and the compensated GaN layer” and the term “a compensated GaN layer” is properly construed as “a compensated GaN gate material.”

As Dr. Schubert testified, a POSITA would not consider high resistive region 15b to be a part of the gate structure because it is not under the gate electrode within the meaning of the ‘294 patent and is not part of the specifically identified control region 15a that is provided to deplete the 2DEG under the gate and obtain the normally-OFF characteristics of the Uemoto device. Ex. 2009 at ¶ 44.

In Uemoto, the gate is formed of a gate contact and a control region 15a (not region 15b), which is the “gate material.” Petitioner’s expert, Dr. Lebby, admitted that control region 15a, with activated GaN, not region 15b, is “in the path of the current.” Ex. 2016, 932:18-20. Most compellingly, Uemoto itself, throughout the disclosure, refers to region 15a as the “control region,” i.e., the gate region which controls the on/off state of the transistor. Region 15b, on which Petitioner relies to meet the claimed “compensated GaN layer,” is clearly not part of the functional gate. Likewise, the tiny part of gate contact that is directly “above” and contacts the sliver of 15b is likewise not a part of the functional gate.

The entire area in which Petitioner asserts that the gate contact extends “over” region 15b is not part of the functional gate. These areas of gate contact, shown in pink below, are not part of the gate because they do not overlay control region 15a.



Rather, per Uemoto, the purpose of these (pink) portions of the gate contact are to ensure that the opening in diffusion film 17 is covered and sealed. Uemoto states: “On the hydrogen diffusion barrier film 16, a gate electrode 20 is formed to cover the opening.” Ex. 1006, [0034]. That is, the gate contact is formed to “cover the opening” in the “hydrogen diffusion barrier film 16.” *Id.* The small overlap that Petitioner relies upon is present only to ensure that the opening is completely covered. In other words, the gate electrode is to be located where the hydrogen diffusion barrier film (and the underlying region 15b) is absent, the opposite of what Dr. Shealy claims it would teach.

This is critically important in an *obviousness* context. A POSITA viewing Uemoto would recognize that the tiny part of gate contact that is “above” the sliver of 15b is not a part of the gate.

Moreover, a POSITA would understand and consider from the disclosure of Uemoto that the function of high resistive region 15b is to reduce the leakage current **between the gate contact and the drain**, not leakage current through the gate material:

As the resistance of the high resistive region **15b** between the control region **15a** and the drain electrode **19** is higher, a greater amount of leakage current **between the gate and the drain** can be reduced.

Uemoto ¶[0059].

A POSITA would understand from the specification of the ‘294 patent that reducing **gate** leakage (i.e., the leakage **in the path of the gate current**) is a key feature of the ‘294 patent that results from the compensated GaN layer 38 (Ex. 1001, 3:16-19 and 4:21-23) and could not be achieved with the high conductivity of region 15a, which is not compensated. A literal reading of “above” is not proper in an **obviousness** context, where a POSITA would consider the intrinsic evidence (the disclosure of Uemoto) in the determination of whether the invention as a whole is obvious over the prior art. Petitioner does not assert that Uemoto anticipates the ‘294 patent, and the patentability analysis should not be based upon a literal reading of the claim elements, but rather a reading that takes into account

the intrinsic evidence, most notably the specification. The specification of Uemoto nowhere discloses or even remotely suggests that the gate contact is above region 15b.

A POSITA would also understand that region 15b could not reduce gate capacitance, a key goal of the '294 patent (Ex. 1001, 3:50-52) because region 15b is not part of the gate. Dr. Shealy's testimony in his Supplemental Reply Declaration that Uemoto's region 15b would impact the gate capacitance in the manner described in the '294 patent – i.e., because it is part of the gate structure -- is wrong (see the above discussion), and is scientifically inaccurate. The “fringing capacitance” that Dr. Shealy references, Ex. 1033 ¶[0102], has nothing to do with the **gate** capacitance, because region 15b is not in the gate.

Even under an improper claim construction in which the compensated GaN layer is not considered to be part of the gate, a POSITA, interpreting FIG. 7 in light of the '294 specification, would consider the gate contact of Uemoto to be above control region 15a, not region 15b.

Uemoto never characterizes the gate contact as being above layer 15b. Rather, Uemoto states in the specification: “A region of the third nitride semiconductor layer 15a located below the gate electrode is formed with a control region having a p-type conductivity, and a region of the third nitride semiconductor layer 15b located between the gate electrode and each of the source electrode and

the drain electrode is formed with a high resistive region having a higher resistance than that of the control region.”

A POSITA reading and interpreting Uemoto would identify the tiny part of the region 15 located below the gate electrode as a sliver (a miniscule feature) of a region, not “a layer,” as required by claim 1. And the sliver of region 15b does not exert any control function because most of it is below layer 17, and the remainder is too small to exert any meaningful control. Ex. 2009 ¶ 101.

B. Region 15b has a 2DEG below it and Uemoto cannot be enhancement mode

Petitioner asserts that the presence of a 2DEG under region 15b is irrelevant because the claim has no 2DEG requirements, even under Patent Owner’s construction, and the specification does not mention 2DEG in connection with the compensated GaN layer limitation. Reply, 22-23. In response, functional distinctions of the claimed invention over the prior art need not be claimed and are highly relevant in an obviousness analysis. *TriMed. Inc.*, 608 F.3d at 1339-43 (Fed. Cir. 2010). Again, Petitioner is not asserting that Uemoto anticipates claims 1-3, but rather that Uemoto in view of Smith, renders the claims obvious.

And the presence of a 2DEG below region 15b is relevant because, as discussed above, claim 1, properly construed, is directed to an enhancement mode transistor, and claims 2 and 3 are unquestionably enhancement mode limitations.

See supra §II.C.

Petitioner asserts that Dr. Schubert twice admitted that region 15b meets the “compensated GaN layer” limitation. Reply, 22-23. In fact, Dr. Schubert specifically testified to the contrary, that region 15b does *not* meet the compensated GaN layer limitation of claim 1, i.e., that it is not in the gate and that it does not deplete the 2DEG, as it must under a proper interpretation of claim 1. Ex. 2017, 1034:4-25; Ex. 2016, 963:9-964:16.

VII. CONCLUSION

For the foregoing reasons, Petitioner’s challenge is deficient and no claim should be held unpatentable.

Dated: October 16, 2024

Respectfully submitted,

/s/ Walter D. Davis, Jr.
Walter D. Davis, Jr. (Reg. No. 45,137)
walter.davis@blankrome.com
Blank Rome LLP
1825 Eye St NW
Washington, DC 20006
Tel: 202-420-2200

Counsel for Patent Owner

CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing PATENT OWNER'S SUR-
REPLY complies with the type-volume limitation in 37 C.F.R. § 42.24(b)(1).
According to the word count tool in Microsoft Word, the brief contains 5,127
words, excluding the parts of the document that are exempted by 37 C.F.R. §
42.24(a).

Dated: October 16, 2024

Respectfully submitted,

/s/ Walter D. Davis, Jr.

Walter D. Davis, Jr. (Reg. No. 45,137)

Counsel for Patent Owner

CERTIFICATE OF SERVICE

The undersigned certifies that a true and correct copy of the foregoing
PATENT OWNER’S SUR-REPLY is being served on counsel of record by filing
this document through the Patent Review Processing System, with a copy served
via electronic mail to the following email address, as authorized in the Petition:

Innoscence-EPC-IPRs@finnegan.com

Dated: October 16, 2024

Respectfully submitted,

/s/ Walter D. Davis, Jr.

Walter D. Davis, Jr. (Reg. No. 45,137)

Counsel for Patent Owner