

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.

IPR2023-01382
U.S. Patent 9,748,347

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

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*Emphasis added unless otherwise noted.

I. Introduction

The Patent Owner Response contradicts the disclosure of the references. Patent Owner implausibly argues modifying *Saxler* by removing the gate recess—a modification expressly taught by *Saxler*—renders the device inoperable. Paper No. 17 (“POR”), 16-22. And Patent Owner contends this modification does not result in an enhancement mode device when Patent Owner agrees a HEMT with a p-type gate—like *Saxler*—is enhancement mode. POR, 10, 16-22.

Patent Owner also contends that a POSITA would not have sought to improve gate alignment because *Saxler* does not requires “precise positioning” of its gate element. POR, 34-35 (citing Petition, 24). But *Saxler*’s need for precision is self-evident because its gate resides above a cap layer with relevant dimensions on the order of angstroms or nanometers (*Saxler*, [0062], [0065]), and because *Saxler* incorporates *Smith* for its fabrication methods (*Saxler*, [0046]), which addresses gate misalignment (*Smith*, [0041]-[0044]; Petition, 26). Imprecise gate positioning would obviously lead to manufacturing defects, so a POSITA would have been motivated to improve gate alignment and positioning.

Patent Owner similar mischaracterizes *Yoshida* as having an unalterable fabrication method. The POR asserts *Yoshida* required a “gate-last” approach. POR, 55-56, 59. Patent Owner also illogically contends a POSITA would not have changed its fabrication method to improve *Yoshida*’s gate alignment because

Yoshida's schematic already shows symmetry. POR, 65-66. But Petitioners show a POSITA would have formed *Yoshida*'s gate "in any order" because a POSITA would have possessed ordinary creativity and would have sought to improve *Yoshida*'s fabrication process, including to prevent misalignment. Ex. 2004, 76:24-77:1; Shealy, [204]-[205]; *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 401-402 (2007).

II. Level of Skill in Art

Although the parties disagree on the level of ordinary skill, the differences do not impact the analysis. POR, 11; Paper No. 1 ("Petition") at 19.

III. Statement of Facts

Patent Owner did not deny any fact in the Statement of Material Facts, which are thus all admitted. POR, 10; *AVX Corp. v. Presidio Components, Inc.*, IPR2018-00292, Paper No. 16 at 9 (P.T.A.B. May 15, 2019). Instead, Patent Owner sidestepped the merits by asking the Board to "ignore[]" the Statement because it did not cite the record. POR, 10. This misunderstands the law. A Statement "*preferably*" cites the record, but the law does not require citations. 37 C.F.R. § 42.22(c).

Regardless, the Petition *did* identify that the '347 patent itself admits facts 1.a-1.h and 2.a. *Compare* Petition, 8-11 with *id.*, 18; *see* Ex. 1001, patent claims. Ex. 1001, 1:17-2:25, Figures 1-2, 3A-3B; Ex. 1003 ("Shealy"), [044]-[046]. The

Petition also found numerous prior art reference disclosed facts 2.b-c. Petition, 2-8. And the Petition noted self-aligned gate structures were common, discussing *Beach* and *Smith* and citing Dr. Shealy, for example, as evidence of fact 3. *Compare* Petition, 6-7, 26, 28-29, 32-33 with *id.*, 18. Patent Owner did not—and cannot—dispute these facts.

IV. *Saxler* in view of *Beach* and *Shenoy* renders obvious an enhancement mode GaN transistor based on Figure 1A (Ground 1)

A. It would have been obvious to remove the recess of Figure 1A to achieve an enhancement mode device

The Petition presented *Saxler*'s Figure 1A without a gate recess, as *Saxler* describes in its specification, which is an enhancement mode transistor when the GaN layer is doped p-type. Petition, 24-28, 35-36; Shealy, [080]-[085], [099]-[100]. Patent Owner agrees a HEMT with a p-type gate—like *Saxler*—is enhancement mode. POR, 7-8.

Saxler states “[e]xemplary devices ... are schematically illustrated in FIGS. 1A through 6,” and “while embodiments of the present invention are described herein with reference to a recessed gate structure or a non-recessed gate structure, other embodiments of the present invention *may include or not include* a gate recess.” *Saxler*, [0052]. *Saxler* tells a POSITA that some embodiments based on Figure 1A *would not* include a gate recess. Petition, 25-26; Shealy, [090]-[091], [108]; Ex. 2004, 31:1-20, 37:7-21. A POSITA would have had good reason to

remove the recess: “to turn *Saxler*’s device into an enhancement mode device, thus realizing the benefits of reduced power consumption and suitability for high power applications.” Petition, 55-56; Shealy, [146]-[148] (citing Ex. 1029 at 1).¹

Patent Owner wrongly contends *Saxler* discloses distinct embodiments, one with a gate recess (Fig. 1A) and one without (Fig. 1B). POR, 11-12, 23-28; Ex. 2005, ¶¶81-104. But, describing alleged differences between *Saxler*’s recessed and non-recessed embodiments, Patent Owner actually identifies many similarities. POR, 24-26. The POR identifies overlapping thickness ranges of *Saxler*’s cap layers, doped regions, and regions of increased Al concentration between recessed and non-recessed embodiments. *Id.* (e.g., cap layer thickness of 5 to 20Å found in recessed and non-recessed embodiments). Patent Owner also irrelevantly cites example *n*-type dopant concentrations of “ 10^{18} to about 10^{21} cm⁻³” in recessed embodiments and exceeding 10^{21} cm⁻³ in non-recessed embodiments. POR, 24-25; *Saxler* [0012]. For *p*-type dopants, concentrations range from “ 10^{16} to about 10^{22} cm⁻³” for both recessed and non-recessed caps. *Saxler*, [0013], [0071].

¹ The declaration at [146] mistakenly cited “*Suh*, 1” (Ex. 1017) to refer to *Suh2006* (Ex. 1029). Either reference supports the motivation. *Compare* Ex. 1017, [0002], [0005] (discussing benefits of enhancement mode) *with* Ex. 1029, 1 (same).

Patent Owner nonsensically argues *Saxler* at [0052] does not mean what it says because the “other embodiments” without a recess refer to Figure 1B. *Id.*, 27. EPC’s expert Dr. Schubert further contends without basis paragraph [0052] does not mean what it says because it was “written by a patent attorney.” Ex. 2005, ¶101. No reasonable reading of [0052] restricts the “other embodiments” to those shown in Figures 1A to 6. This passage expressly acknowledges *Saxler*’s recess is optional in every figure. In view of this statement and the knowledge of a POSITA, it would have been obvious to remove Figure 1A’s recess to make an enhancement mode device. Petition, 35-36; Shealy, [081], [099]-[100]; Saxler, [0052], [0066], [0071], [0087].

Patent Owner is wrong that the Petition engaged in hindsight when modifying Figure 1A. POR, 2-3, 27. Patent Owner relies on Dr. Shealy’s testimony that a POSITA would “take all the embodiments and bring in which ones you want, depending on what you’re trying to accomplish.” POR, 26-27 (citing Ex. 2004, 38:12-39:5). But ***Saxler itself*** tells a POSITA to remove Figure 1A’s recess. *Saxler*, [0052]. Following its guidance is not hindsight. *B.F. Goodrich Co. v. Aircraft Braking Sys. Corp.*, 72 F.3d 1577, 1583 (Fed. Cir. 1998) (upholding single-reference obviousness for explicit suggestion to modify); *Boston Sci. Scimed, Inc. v. Cordis Corp.*, 554 F.3d 982, 991 (Fed. Cir. 2009).

Dr. Shealy’s testimony accurately reflects obviousness law. His statement a POSITA “could take all the embodiments” accords with the principle that prior art must be considered for “everything it teaches.” *EXP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985). His statement a POSITA would “bring in which [embodiments] you want, *depending on what you’re trying to accomplish*,” acknowledges one may combine the teachings of the prior art with reason to do so. *KSR*, 550 U.S. at 401-402; *Boston Sci.*, 554 F.3d at 991. Dr. Shealy provided a reason to remove Figure 1A’s recess: to accomplish the benefits of enhancement mode. Shealy, [103]. The benefits of enhancement mode were well known, and Dr. Shealy’s analysis adheres to *KSR*.

Patent Owner, in contrast, lacks legal support for its position that one cannot mix and match *Saxler*’s embodiments—it cites no legal authority for this proposition. POR, 2, 22, 50, 52.

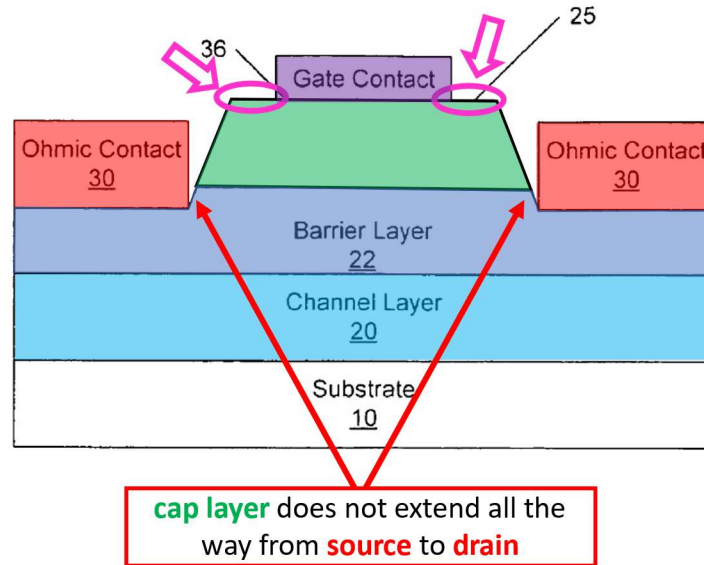
Dr. Schubert also contradicts the law. He opined “it is only reasonable to consider that the disclosure of *Saxler* must be ‘limited’ to what is actually disclosed” and because *Saxler* allegedly never combines recessed and non-recessed embodiments, a POSITA would not have removed *Saxler*’s recess to achieve enhancement mode. Ex. 2005, ¶102; *see id.* ¶¶101-112. *KSR* rejected Dr. Schubert’s rigid understanding. 550 U.S. at 418 (obviousness accounts for “inferences and

creative steps”), 422 (A POSITA “is also a person of ordinary creativity, not an automaton.”).

Petitioners’ proposed modification simplifies *Saxler*’s Figure 1A by removing steps to form a recess in its gate. *Saxler*, [0065] (describing additional steps to form recess); Petition, 25, 27, 31-32, 45, 47; Shealy, [080]-[098], [120], [123], [125]. It does to require undisclosed “additional process steps ... to get from Figure 1B to the modified figure” as Patent Owner contends (POR, 28), because Petition and Dr. Shealy never proposed starting from Figure 1B. The modification starts with Figure 1A.

B. The proposed modification of *Saxler* would operate as an enhancement mode device

Patent Owner incorrectly contends *Saxler*’s modified Figure 1A would be inoperable in enhancement mode because its **cap layer** purportedly extends from **source** to **drain**. POR, 28-34. The proposed modification, highlighted below, plainly shows otherwise. The **barrier layer** separates the **cap layer** from **source** and **drain**.



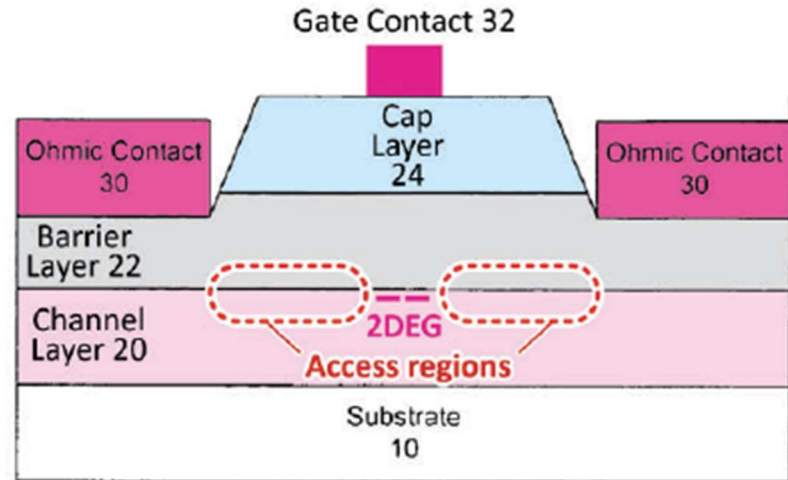
Petition, 30-31; Shealy [089].

For this argument, Patent Owner conducts an irrelevant analysis of Figure **1B**, not 1A, whose cap layer abuts source and drain. POR, 28-29, 32-33 (*Saxler* Fig. 2A, also with cap layer contacting source and drain). This misunderstands the proposed modification, which removes the recess of Figure 1A. Petition, 30-31, 41, 45, 48. As Dr. Shealy testified, Figure 1B could not be fabricated as drawn and “would be a disaster” if the **cap layer** was conductive because “there would always be current flowing ... from drain to source that would be going through the cap layer that wouldn’t be affected, necessarily, by the gate,” and “you never want a parallel

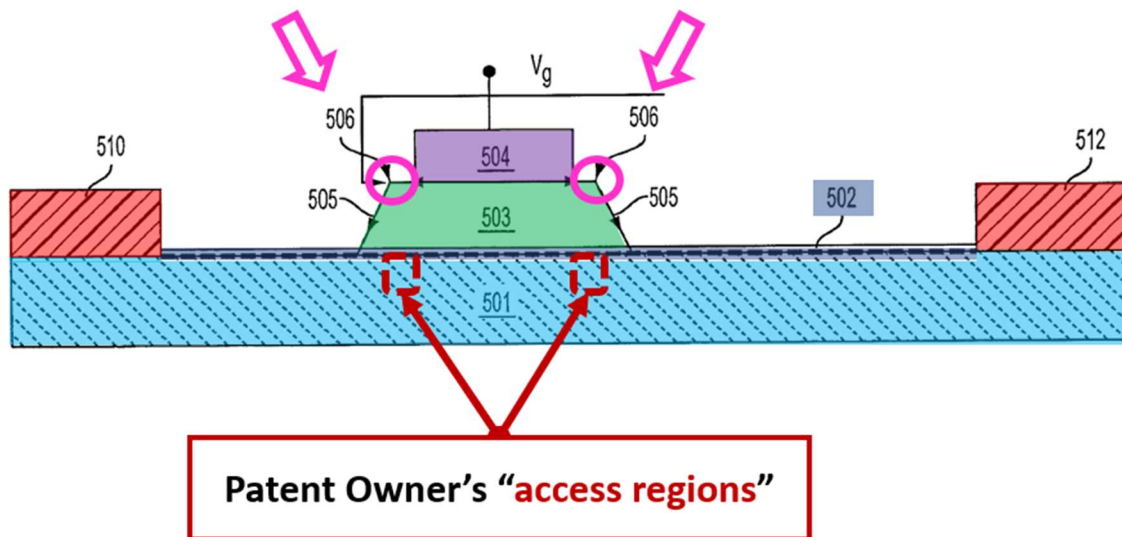
conduction path to the [2DEG].” Ex. 2204, 63:12-12, 65:16-18.² The Petition and Dr. Shealy never suggested Figure 1A’s **cap layer** extends from **source** to **drain**.

Patent Owner’s argument that “a POSA would not produce an enhancement-mode circuit” by “apply[ing] a sufficiently high voltage to replenish the electrons in the access regions” contradicts the ’347 patent. POR, 30. The patent has the same “access regions” as modified Figure 1A (shown below), and it purports to operate in enhancement mode. Ex. 1001, Fig. 5, claims 1-7. Patent Owner and Dr. Schubert do not explain this contradiction. POR, 30; Ex. 2005, ¶124.

² Patent Owner alleges Dr. Shealy “contradicted himself” in testifying Figure 1B could be an enhancement mode device. POR, 28. Responding to Patent Owner’s questions, he explained it would be enhancement mode when “separat[ing] the Ohmics from the cap layer,” which avoids parallel conduction paths. Figure 1A. Ex. 2004, 65:12-18. This is no contradiction.



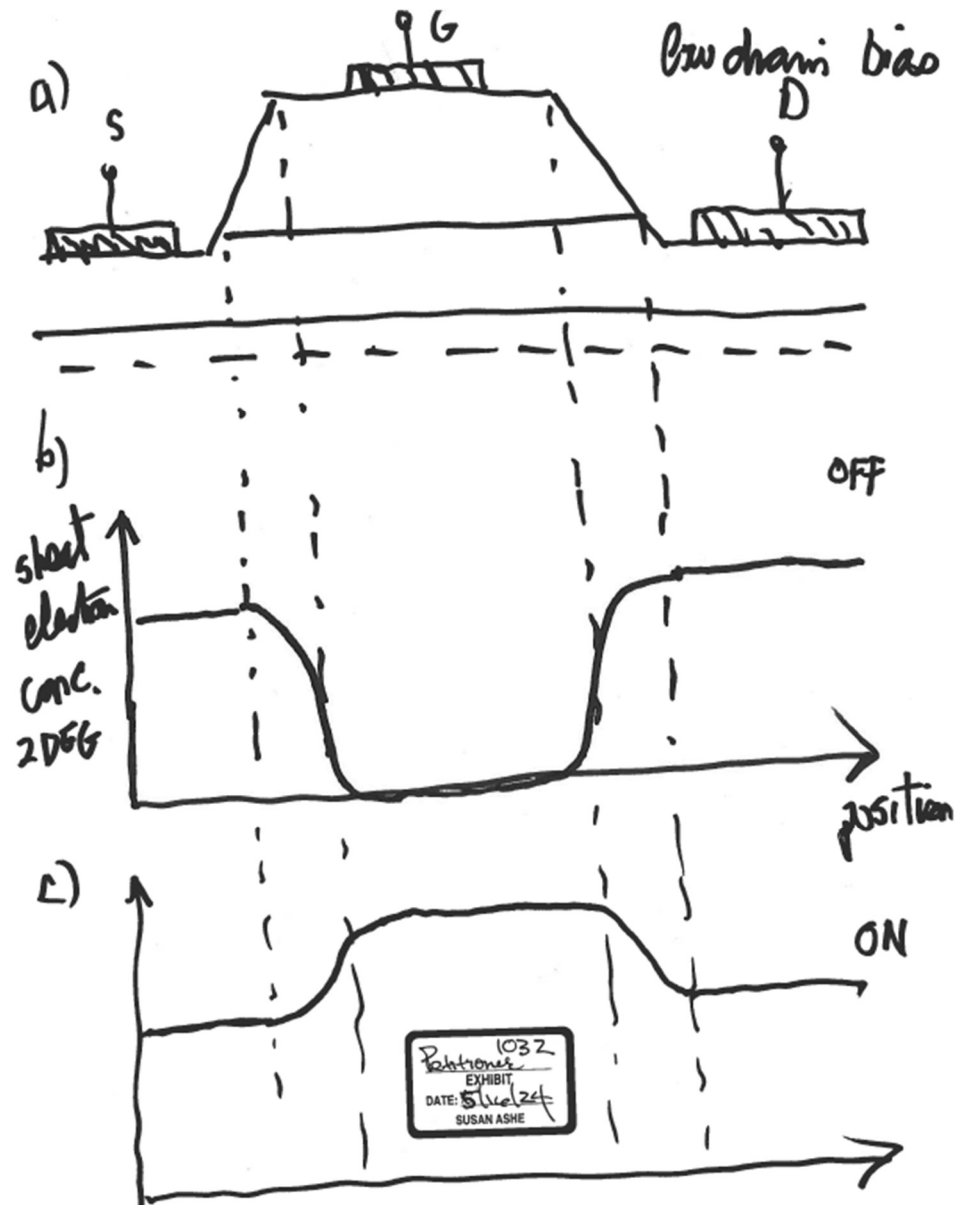
*Id.*³



Petition, 1 (showing Ex. 1001, Fig. 5).

³ Patent Owner modifies Figure 1A to shrink gate metal. *Compare* Ex. 2005, ¶122 (here) with Shealy, [089] (above).

Patent Owner ignores Dr. Shealy's detailed explanation and drawing describing how Figure 1A is in enhancement mode when "the recess is removed and p-dopants are added to the capping layer." Ex. 2004, 104:9-105:19; Ex. 1032.



Ex. 1032. In the "off" condition, a 2DEG forms under source and drain but is depleted gradually in the cap's sloped region until fully depleted under the horizontal

ledges. Ex. 2004, 104:2-18; Ex. 1032 (“b”). In the “on” condition, when voltage is “a reasonable level,” a 2DEG forms under the cap at concentrations exceeding electron concentration below source and drain. Ex. 2004, 104:19-105:10; Ex. 1032 (“c”). Patent Owner and its expert do not address this analysis, instead referencing irrelevant testimony of a different expert in a different proceeding on a different prior art reference with a different “geometry.” POR, 29-30; Ex 2004, ¶¶123-127.¶

Patent Owner’s contorted argument that *Saxler*’s p-type dopants may function as “deep level dopants” when they “segregate to dislocations” does not save the claims. POR, 33-34; Ex. 2005, ¶128. This analysis relies on *Saxler* [0049], which describes “particular embodiments” where the cap layer has a higher concentration at its outer surface. Ex. 1007, ¶49. In these embodiments, “dopants at the outer surface may segregate to dislocations in the cap layer and, thereby reduce gate leakage along the dislocations,” and “may have characteristics of a deep level when at a dislocation.” *Id.* But *Saxler* never says p-type dopants do not function as shallow dopants at *other* locations. *Id.* *Saxler* specifically clarifies its “references to p-type ... dopants refer[] to the characteristics of the dopants *in the bulk crystal rather than when at a dislocation.*” *Id.* When *Saxler* describes p-typed doping in a sub-region or when doped throughout its cap layer (e.g., *Saxler*, [0013], [0069] [0071]), it describes shallow dopants in the bulk crystal, capable of depleting the 2DEG when the recess is removed. Petition, 25, 35-36; Shealy, [081], [099]-[100].

V. A POSITA would have combined *Saxler* with *Beach* and *Shenoy* (Ground 1)

A. The Petition provided a motivation to combine the references

Patent Owner’s arguments against the motivation to combine *Saxler*, *Yoshida*, *Beach*, and *Shenoy* misapprehend the combination and the law. POR, 37-48.

The Petition explained a POSITA would have used the techniques of *Beach* and *Shenoy* to simplify *Saxler-Yoshida*’s process with “fewer masking steps” and to “improve alignment and symmetry between layers and reduce steps and costs” as suggested by *Smith* (incorporated by reference). Petition, 30-35. The Petition reasoned the combination was a simple substitution of known elements predictably yielding *Saxler*’s non-recessed structure. *Id.* “The ’347 patent was allowed without disclosing any particular method to etch the gate metal and obtain the claimed ledges because such methods were well within a POSITA’s ability.” Petition, 35; Shealy, [057]-[063], [098]. Self-alignment is not required in claim 1, it appears in claim 3. Ex. 1001.

The POR incorrectly contends the Petition did not provide the “specific process sequence” for the proposed combination. POR, 46. But the Petition identified *Saxler*’s steps to form a gate structure using two masks (Petition, 24) and the steps used in *Beach* and *Shenoy* to simplify this process with one mask (Petition, 31-35). The combination is simple, and the Petition explained it was well within the

level of ordinary skill. Petition, 31-35. Instead of using two masks to separately etch *Saxler*'s cap layer and gate metal, the combination uses Beach's method of using one mask. Petition, 31-35. The combination uses *Saxler*'s etching technique to create sloped sidewalls when using *Beach*'s one-mask approach, which is like *Smith*'s approach (incorporated by reference). Petition, 24, 31-35. The combination then uses *Shenoy*'s approach to undercut the photomask and etch the gate metal to achieve the structure shown in modified Figure 1A. *Id.*

Patent Owner's caselaw does not apply. POR, 2-3 (discussing *In re Dembiczak*, 175 F.3d 994, 999 (Fed. Cir. 1999), *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015), *InTouch Techs., Inc. v. VGo Commc'ns, Inc.*, 751 F.3d 1327, 1348-49 (Fed. Cir. 2014)⁴, 47 (citing *ActiveVideo Networks, Inc., v. Verizon Commc'n, Inc.*, 694 F.3d 1312, 1327 (Fed. Cir. 2012)), 48 (citing *In re Gorman*, 933 F.2d 982, 987 (Fed. Cir. 1991))).

First, Patent Owner cites bad law. *In re Dembiczak* applied reasoning that *KSR* firmly rejected. 175 F.3d at 999 (obviousness requires "a suggestion, teaching, or motivation to combine the prior art references ... as a matter of law."); *KSR*, 550 U.S.

⁴ Patent Owner did not provide a full citation to "*InTouch*," only an *id.* cite, or list it in the Table of Authorities. Petitioners assume this refers to the *InTouch* decision discussed herein.

at 415-419 (rejecting teaching, suggestion, motivation test). *In re Gorman*, applied the same rejected teaching, suggestion, motivation test. 933 F.2d at 987.

Second, Patent Owner cites cases with non-analogous facts. *InTouch* faulted the expert for providing vague testimony and not articulating a reason to combine other than that the references involved “doing things over the internet,” finding she “simply opined what a skilled artisan could accomplish.” *InTouch*, 751 F.3d at 1351-52. *ActiveVideo* similarly involved conclusory assertions without articulating “why a person of ordinary skill in the art would have combined elements from specific references *in the way the claimed invention does*.” *ActiveVideo*, at 1327-28. Dr. Shealy, in contrast to experts in *InTouch* and *ActiveVideo*, provided reasons to combine the references and how perform the steps to achieve the method of the ’347 patent. Petition, 24, 31-35.

In *Belden*, the Federal Circuit relied on *InTouch* for the principle that Patent Owner quotes: obviousness addresses not what a POSITA “could have” done but “would have been motivated” to do. 805 F.3d at 1073 (citing *InTouch*, 761 F.3d at 1352). The *Belden* court ultimately decided the Board satisfied this requirement and upheld a finding of obviousness. *Id.* Petitioners likewise address what a POSITA would have been motivated to do when combining *Saxler*, *Beach*, and *Shenoy*. Petition, 24, 31-35.

B. *Saxler* uses a photomask for “precise positioning” of its gate (Grounds 1-3)

Patent Owner argues “precise positioning” of gate elements is no motivation to modify or combine references. POR, 34-36. The POR surprisingly questions whether *Saxler* requires “precise positioning” of its gate element in GaN semiconductor devices. POR, 34-35 (citing Petition, 24). *Saxler*’s need for precision is self-evident when its gate resides above a cap layer with relevant dimensions on the order of angstroms or nanometers (*Saxler*, [0062], [0065]) and when *Saxler* incorporates *Smith* for fabrication (*Saxler*, [0046]), which addresses gate misalignment (*Smith*, [0041]-[0044]; Petition, 26). Imprecise gate positioning would obviously lead to manufacturing defects.

The Petition discusses *Saxler*’s “precise positioning” to support the seemingly uncontroversial notion that *Saxler* uses a photomask to position its gate:

Saxler masks and etches the p-type gate material and gate metal to form the gate structure. Although not explicitly disclosed, a POSITA would have understood that Saxler uses a photomask to etch the gate because Saxler requires ***precise positioning*** achievable using this conventional approach.

Petition, 24, 26, 42-43. Patent Owner does not explain how a POSITA would position *Saxler*’s gate without such precision (e.g., without a photomask). POR, 34-35.

Patent Owner also misapplies *Hockerson-Halberstadt, Inc. v. Avia Group, Int’l, Inc.*, 222 F.3d 951 (Fed. Cir. 2000) when alleging use of *Saxler*’s drawings for “precise positioning” is improper. POR, 34. First, *Hockerson* does not apply because

it addresses whether a drawing discloses a claim element, 222 F.3d at 956, but “precise positioning” is not a claim term. Second, Patent Owner does not dispute that *Saxler*’s drawings show a center-aligned gate. IPR2023-01384, Paper No. 17 at 3 (“Uemoto, like Saxler and Yoshida, represents the transistor with schematics illustrating a gate with a *centrally aligned* electrode contact.”). Third, the Petition references *Saxler*’s figures *and text* (including *Smith*), incorporated by reference, for the notion that *Saxler* used a photomask. Petition, 24, 26, 42.

Uemoto is irrelevant and does not show *Saxler* does not require precise positioning. POR, 35-36. The Petition did not assert *Uemoto* in any ground. The fact that it happens to draw a centered gate and build an offset gate does not mean the ’335 patent does not disclose a symmetric gate structure. Moreover, Uemoto’s disclosure of unequal ledges in TEM images does not diminish its concurrent disclosure of symmetric ledges in a schematic nor diminish *Saxler*’s and *Yoshida*’s symmetric ledges.

C. *Beach*’s self-aligned approach is compatible with *Saxler* and would not eliminate *Saxler*’s sloped sidewalls

Patent Owner irrelevantly contends *Beach* etches n-type materials when *Saxler* uses p-type. POR, 39. *Beach*’s self-aligned method of making stacked gate structures in GaN HEMT devices using a single mask was a common approach that employed to different materials. Petition, 28-29, 32; Shealy, [086], [093].

The combinations would not “cut off” *Saxler-Yoshida*’s cap layer sidewalls. POR, 38-39. The combination uses *Saxler*’s etching technique to slope the sidewalls with *Beach*’s single mask, and it relies on *Shenoy* to undercut the gate metal of *Beach*’s self-aligned structure and arrive at the *Saxler* or *Saxler-Yoshida* structure with horizontal ledges. Petition, 31-35.

D. *Shenoy* would not have etched “the underlying ledges” of the p-type GaN

Dr. Shealy explained that *Shenoy* discloses symmetric, “isotropic etching through a photo resist window” because “symmetry is present in the [gate] structure,” the same symmetry present in *Saxler-Yoshida*. Ex. 2004, 96:17-98:9. This symmetric undercut was typical of many wet etches, not just the EMM *Shenoy* discloses (which would “work fine” for the Ground 3 combination). *Id.* at 96:17-98:9, 101:3-18. Dr. Shealy explained this approach would etch the gate metal, not the p-type GaN layer, which was more resistant to etching. *Id.*, 98:10-100:23.

Patent Owner’s expert disagreed. POR, 40-45; Ex. 2005, ¶¶157-174. But Dr. Schubert’s bases his opinion on the unsubstantiated belief that the GaN layer’s surface etches at the same rate as the gate metal. Ex. 2005, 174 (“the etching process proceeds in all directions at the same rate absent an insulator.”) And it is premised on the incorrect statement that *Saxler* does not disclose passivating GaN material. *Id.* at 170. In fact, *Saxler* repeatedly describes passivation techniques. *E.g.*, *Saxler*, title, [0023]-[0025], [0067]. Dr. Shealy explained why the p-GaN material etches

more slower than the gate metal, resulting in *Saxler-Yoshida*'s gate structure. Ex. 2004, 96:17-101:18.

VI. *Saxler* alone or in combination render obvious [1g] (Grounds 1-3)

Patent Owner quotes Dr. Shealy out of context to falsely contend he admitted *Saxler* alone does not disclose etching the gate metal and cap layer with the same photoresist, i.e., self-alignment. POR, 36-37, EX2004, 55:1-7. In context, Dr. Shealy noted *Saxler* incorporates *Shepard* and *Smith* to discuss fabrication. Ex. 2004, 55:21-56:2. His declaration notes the same and that *Smith* discloses “a ‘self-aligned’ technique.” Shealy, [083]-[084] (citing *Sheppard*, [0044]-[0051], Figs. 1A-1F; *Smith*, [0041], Figs. 4A-4C). [1g] is obvious over these disclosures. Petition, 43-44.

In addition, [1g] is obvious over *Saxler* and *Beach/Shenoy* (Petition, 43-44 (Ground 1)), *Saxler-Yoshida* and *Beach/Shenoy* (Petition, 58 (Ground 2)), and *Saxler* and *Ahn* (Petition, 66 (Ground 3)).

VII. A POSITA would have combined *Saxler* and *Yoshida*, which renders obvious an “enhancement mode” device, and made its gate structure using techniques of *Beach* and *Shenoy* (Ground 2)

Patent Owner advances the same flawed arguments that a POSITA would not have removed the recess of *Saxler*'s Figure 1A over *Yoshida*'s teachings it advanced for *Saxler* alone. POR, 48-50. For reasons given above, that is incorrect. *Supra* §IV. A POSITA would have “remove[d] the gate recess to turn *Saxler*'s device into an

enhancement-mode device, thus realizing the benefits of reduced power consumption and suitability for high power applications.” Petition, 55-56.

Patent Owner again mistakenly claims *Saxler* has “divergent parameters” for recessed and non-recessed embodiments. POR, 49. But as explained, *Saxler*’s layer thickness ranges *overlap* for the two embodiments, and *Saxler* has the same p-type doping for the two embodiments. *Supra* § IV.A. These passages thus do not show recessed and non-recessed embodiments are mutually exclusive, especially in view of *Saxler* at [0052]. *Supra* §IV.A.

Patent Owner also argues against the combination on the false premise that the proposed combination alters *Saxler*’s “principle of operation” by transforming a depletion-mode to an enhancement-mode device. POR, 49-50; Ex. 2005, ¶¶35, 185. But Dr. Shealy explained that the two devices have the same layer composition, and removing *Saxler*’s recess when its cap is doped p-type (as both references disclose), modified Figure 1A would function in enhancement mode. Shealy, [099]-[100]; Petition, 35-36. Dr. Shealy testified “they’re very compatible with each because they only differ by, you know, that one feature to go from a depletion mode to an enhancement mode” and the same POSITA “would be familiar with both” devices. Ex. 2004, 65:23-11; Ex. 1001, 1:23 (field of invention “relates generally to transistors.”). And a POSITA would have recognized the benefits of operating in enhancement mode. Petition, 55-56.

Patent Owner’s reliance on *In re Ratti* is inapposite. POR, 49-50; 270 F.2d 810, 813 (C.C.P.A. 1959). There, the C.C.P.A. declined to combine references that “require[d] a substantial reconstruction and redesign ... as well as a change in the basic principles” of operation. *In re Ratti*, 270 F.2d at 813. Here, a POSITA would have readily understood a simple substitution of *Saxler*’s recessed gate with *Yoshida*’s non-recessed gate in a p-type doped embodiment of Figure 1A would have predictably achieved enhancement mode. Petition, 24-36; Shealy, [080]-[100]. This does not change the “principle of operation”—*Saxler* teaches its recess is optional—and the Petition identified ample motivation to make the proposed combination, including simplifying manufacturing, decreasing costs, and receiving the benefits of a normally-off device suitable for high power applications. Petition, 24-36; Shealy, [080]-[100].

Further, the combination would have used *Beach* and *Shenoy* to make *Saxler-Yoshida*’s gate structure and “improve alignment and symmetry between layers and reduce steps and costs” as suggested by *Smith* (incorporated by reference) and discussed above for Ground 1. Petition, 24-36, 56; *supra* §V.

VIII. *Saxler* in view of *Ahn* (Ground 3)

Patent Owner advances similar flawed criticism of the motivation to combine *Saxler* and *Ahn* (Ground 3) as for *Saxler* or *Saxler/Yoshida* with *Beach* and *Shenoy* (Grounds 1-2): removing *Saxler*’s recess is allegedly not taught by the references

and would not result in enhancement mode. POR, 52. For the reasons given above, this is incorrect. *Supra* §§IV-VII.

Patent Owner's further criticisms that *Saxler* is not a "thin film transistor" and a POSITA would not look to *Ahn* are unavailing. POR, 53-54. The '347 patent broadly defines the pertinent field as "layered semiconductors that include various field effect transistors." '347 patent, 1:20-58 The patent "generally relates to transistors," including "heterojunction field effect transistors (HFET), high electron mobility transistors (HEMT), or modulation doped field effect transistors (MODFET)." *Id.* *Ahn* and *Saxler* both fall into this same field of endeavor. Petition, 60-64.

Patent Owner also incorrectly argues that one of skill would not look to *Ahn*'s fabrication techniques because its gate structure is "substantially different." POR, 53-55. But *Ahn*'s method of etching stacked gate structures is independent of the specific materials and applies to *Saxler*. Petition, 60-64. *Ahn* discloses dry etching both layers under a single mask, then wet etching to undercut the top layer. *Ahn*, 7:7-14; Shealy, [175]; Petition, 63-64. The same approach would work with *Saxler*'s device because its cap layer would dissolve more slowly than its gate metal. Petition, 63-64; Shealy [174]-[175]; Ex. 2004, 96:17-101:18. Patent Owner's assertion *Saxler*'s p-GaN layer would be "much thicker" than *Ahn*'s transistor and made from different materials reinforces Petitioners' position that a wet etch to undercut

Saxler's gate metal would predictably preserve the cap layer's sloped sidewalls. POR, 54.

IX. *Yoshida* in view of *Saxler*, *Beach*, and *Shenoy*

A. The Board correctly noted *Yoshida* has a flexible fabrication method

The Institution Decision correctly noted *Yoshida* has a “flexible” fabrication method. Paper No. 11, 50. Patent Owner rigidly reads *Yoshida* as employing a “gate-last” approach. POR, 55-56, 59. But *Yoshida* specifies no order of gate and ohmic contact formation (*Yoshida*, [0022]), and it teaches finishing the gate *before* the ohmic contacts. Ex. 2004, 76:1-80:16; Shealy, [204]. A POSITA would have formed *Yoshida*'s gate “in any order” because a POSITA would have possessed ordinary creativity. Ex. 2004, 76:24-77:1; Shealy, [204]-[205]; *KSR*, 550 U.S. at 418, 422.

Patent Owner's contention that *Yoshida* is specific and therefore a POSITA lacks motivation to change its methods is inconsistent with the law. POR, 55-56. *KSR* rejected this rigid understanding. 550 U.S. at 418 (obviousness accounts for “inferences and creative steps”), 422 (A POSITA “is also a person of ordinary creativity, not an automaton.”). Here, “a POSITA would have recognized *Saxler*'s sidewalls would have reliably reduced *Yoshida*'s gate” and combined the references. Petition, 73-76. *Saxler*'s sloped sidewalls were conventional and had a known gate leakage current path, as the '347 patent admits. *Id*; Ex. 1001, 1:28-2:26, Figs. 1-2, 3A-3B, 7A.

Yoshida does not teach away from using alternative methods of fabrication, as Patent Owner asserts. POR, 56-57. *Yoshida* teaches its improvements arise from its structure, not from its fabrication methods. *Yoshida*, [0009] (“Means for Solving the Problems”). While *Yoshida* mentions the prior art uses “conventional photolithography and etching,” it never disparages this “conventional” approach. *Id.*, [0006]. “[A] reference does not teach away if it ‘merely expresses a general preference for an alternative invention but does not criticize, discredit or otherwise discourage investigation into the invention claimed.’” *UCB, Inc. v. Actavis Laby's UT, Inc.*, 65 F.4th 679, 692 (Fed. Cir. 2023) (quoting *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 567 F.3d 1314, 1327 (2009)). Indeed, *Yoshida* uses the conventional methods it discussed. *Yoshida*, [0006], [0022].

B. A POSITA would have formed the claimed “ledges” in *Yoshida-Saxler* using *Beach* and *Shenoy*’s approach (Ground 4)

Using *Beach*’s and *Shenoy*’s techniques to form *Yoshida-Saxler*’s structure would have been a simple substitution that improved alignment and reduced steps. Petition, 76-80. Patent Owner alleges *Yoshida* is a gate-last approach, so the combination would have added steps. POR, 57-60. But *Yoshida* specifies no order of gate and ohmic contact formation, and it teaches finishing the gate *before* the ohmic contacts. Ex. 2004, 76:1-80:16. A POSITA would have formed *Yoshida*’s

gate “in any order” because a POSITA would have possessed ordinary creativity. Ex. 2004, 76:24-77:1; Shealy, [204]-[205]; *KSR*, 550 U.S. at 418, 422.

The POR argues *Shenoy*’s undercut decreases gate width, so it reduces voltage control. POR, 59-61. That runs contrary to *Yoshida*, which has a narrow gate and touts advantages of its voltage control with small carrier injection. *Yoshida*, [0017], Fig. 1.

The Petition showed a POSTIA would use the methods of *Beach* and *Shenoy* to reduce masking steps and improve alignment when forming the *Yoshida-Saxler* gate structure. Petition, 76-80, 92-94. The POR claims this combination adds steps, referring to *Shenoy*’s etching step, but does not dispute the combination uses fewer masks and is more precise than a two-mask approach. POR, 60-61. Dr. Shealy explained the *Yoshida-Saxler* combination, which includes *Yoshida*’s ledges (also found in *Saxler*) and *Saxler*’s sloped sidewalls would increase leakage paths and result in lower leakage. Petition, 73-75; Shealy, [197], [201]. A POSITA would have made the simple substitution of using *Beach*’s and *Shenoy*’s techniques to obtain this same gate structure and receive the same benefits. Petition, 76-80; Shealy, [203]-[209].

The Petition properly relied on *Yoshida*’s drawing of a GaN gate structure with *Saxler*’s depiction of sloped cap layer as the target of the *Yoshida-Saxler*, *Beach*, and *Shenoy* combination. Petition, 76-80, 92-94. Patent Owner wrongly

contends *Hockerson* forbids this combination. POR, 62-63 (discussing *Hockerson*, 222 F.3d at 956). But the claims and combination do not require precise proportions or measurements, so *Hockerson* does not apply. 222 F.3d at 956.

C. A POSITA would have modified *Yoshida* to incorporate *Saxler*'s sloped sidewalls (Ground 4)

Patent Owner's arguments against incorporating *Saxler*'s sloped sidewalls into *Yoshida*'s cap layer rest on the flawed assumption the combination *extends* existing sidewalls and *Beach* would cut off these sidewalls. POR, 61-62. This overlooks the alternative—using *Saxler*'s etching technique (Petition, 74; Shealy, [199]) within the p-GaN's existing footprint also creates sloped sides and maintain the same (or less) width at the bottom of the p-GaN (Petition, 76-80). The combination does not require widening it.

X. A POSITA would have used *Ahn*'s methods to make *Yoshida*'s structure (Ground 5)

Patent Owner's criticisms the Petition did not specify how to combine *Yoshida* with *Ahn* are unfounded. POR, 63-66. The combination is simple, and the Petition explained it was well within the level of ordinary skill. Petition, 97-98. Rather than the process described in *Yoshida* at [0022] to etch the gate structure, the combination calls for using *Ahn*'s approach. *Id.* *Ahn* discloses dry etching both layers under a single mask, then wet etching to undercut the top layer. *Ahn*, 7:7-14; Shealy, [242]-

[243]; Petition, 98. This would form the same gate structure as *Yoshida* more efficiently and with sloped sidewalls on the gate layers.

Patent Owner's criticisms that *Saxler* is not a "thin film transistor" and a POSITA would not look to *Ahn* are unavailing. POR, 67-69. The '347 patent broadly defines the pertinent field as "layered semiconductors that include various field effect transistors." '347 patent, 1:20-58 The patent "generally relates to transistors," including "heterojunction field effect transistors (HFET), high electron mobility transistors (HEMT), or modulation doped field effect transistors (MODFET)." *Id.* *Ahn* and *Yoshida* both fall into this same field of endeavor.

Patent Owner also incorrectly argues that one of skill would not look to *Ahn*'s fabrication techniques because its gate structure is "substantially different." POR, 67-69. But *Ahn*'s method of etching stacked gate structures is independent of the specific materials and applies to *Yoshida*. Petition, 95-99. *Ahn* discloses dry etching both layers under a single mask, then wet etching to undercut the top layer. *Ahn*, 7:7-14; Shealy, [175], [251]-[253]; Petition, 63-64.

The same approach would work with *Yoshida*'s device because its cap layer would dissolve more slowly than its gate metal. Petition, 98-100; Shealy [241]-[244], [253]; see Ex. 2004, 96:17-101:18. Patent Owner attempts to dispute this (POR, 69-70), but Patent Owner's assertion *Yoshida*'s p-GaN layer would be "much thicker" than *Ahn*'s transistor and made from different materials reinforces

Petitioners' position that a wet etch to undercut *Yoshida*'s gate metal would predictably preserve the cap layer's sloped sidewalls in the *Yoshida-Ahn* combination. POR, 68.

The POR irrationally argues *Yoshida* already discloses symmetric ledges in its drawings so a POSITA would not be motivated to "improve alignment and precision" with *Ahn*'s known method. POR, 65-66. *Yoshida* has a flexible fabrication approach. *Supra* §IX.A. Using *Ahn*'s technique would lead to improvements in alignment when implementing *Yoshida*'s device. Petition, 98.

Further, the Petition properly relied on *Yoshida*'s drawing of a GaN gate structure as the target of the *Yoshida-Ahn* combination. Petition, 76-80, 92-94. Patent Owner wrongly contends *Hockerson* forbids this combination. POR, 65 (discussing *Hockerson*, 222 F.3d at 956). But the claims and combination do not require precise proportions or measurements, so *Hockerson* does not apply. 222 F.3d at 956.

XI. Conclusion

For the foregoing reasons and as explained in the Petition, the Board should find all claims of the '347 patent unpatentable.

Dated: September 10, 2024

/Lionel M. Lavenue/
Lionel M. Lavenue
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37 C.F.R. § 42.24(D) CERTIFICATION

Pursuant to 37 C.F.R. § 42.24(a)(1)(i), Petitioner certifies that this petition complies with the requirements of 37 C.F.R. § 42.24. Excluding parts of this Petition exempted under § 42.24(a), this Petition contains 5,564 words, as measured by the word-processing system used to prepare this paper.

Dated: September 10, 2024

By: Lionel M. Lavenue/

Lionel M. Lavenue

Reg. No. 46,859

CERTIFICATE OF SERVICE

The undersigned certifies that a copy of this Petitioner's Reply to Patent Owner's Response and Exhibit 1032 were served on September 10, 2024, via email directed to counsel of record for the Patent Owner at the following:

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