

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICRON TECHNOLOGY, INC.,
Petitioner

v.

YANGTZE MEMORY TECHNOLOGIES COMPANY, LTD.,
Patent Owner

Case No.: IPR2025-00117
U.S. Patent No. 10,672,711

PETITIONER'S REPLY BRIEF

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LISTING OF EXHIBITS

EXHIBIT NO.	DESCRIPTION
1001	U.S. Patent No. 10,672,711 to Zhu et al. (“the ’711 patent”)
1002	File History of U.S. Patent No. 10,672,711 (“the ’711 FH”)
1003	Declaration of Dr. Sanjay Banerjee (“Banerjee”)
1004	<i>Curriculum Vitae</i> of Dr. Sanjay Banerjee
1005	U.S. Patent Publication No. 2012/0070944A1 to Kim et al. (“Kim”)
1006	Korean Patent No. 10-2015-0051841 to Park et al. (“Park”) including certified translation
1007	U.S. Patent Publication No. 2019/0067306A1 to Fang et al. (“Fang”)
1008	U.S. Patent Publication No. 2017/0294384A1 to Chen (“Chen”)
1009	Aritome, “NAND Flash Memory Technologies” (2016)
1010	Silvagni, “3D NAND Flash Based on Planar Cells,” Computers 2017
1011	Micheloni et al., “Inside Solid State Drives (SSDs)” (2nd Ed. 2018)
1012	U.S. Patent Publication No. 2017/0117222A1 to Kim et al.
1013	Chang and Sze, “ULSI Technology” (1996)
1014	Orlowski et al., <i>Si, SiGe, Ge, and III-V Semiconductor Nanomembranes and Nanowires Enabled by SiGe Epitaxy</i> , ECS Transactions Vol. 33, No. 6 (2010), 777-89
1015	U.S. Patent No. 9,728,547 to Ohsaki et al.
1016	U.S. Patent Publication No. 2017/0148677A1 to Shin

EXHIBIT NO.	DESCRIPTION
1017	U.S. Patent Publication No. 2013/0313627A1 to Lee et al.
1018	Minute Order (case schedule), Dkt. No. 141, dated September 18, 2024 in <i>Yangtze Memory Technologies Company, Ltd. v. Micron Technology, Inc. and Micron Consumer Products Group, LLC</i> , Case No. 3:23-cv-05792-RFL
1019	Combined Civil and Criminal Federal Court Management Statistics (December 31, 2023), available at https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distcomparison1231.2023.pdf
1020	Plaintiff and Counterclaim Defendant Yangtze Memory Technologies Company, LTD.'s Disclosure of YMTC II Asserted Claims and Infringement Contentions, dated October 2, 2024 in <i>Yangtze Memory Technologies Company, Ltd. v. Micron Technology, Inc. and Micron Consumer Products Group, LLC</i> , Case No. 3:23-cv-05792-RFL
1021	Docket from <i>Yangtze Memory Technologies Company, Ltd. v. Micron Technology, Inc. and Micron Consumer Products Group, LLC</i> , Case No. 3:24-cv-04223-RFL which has been consolidated with Case No. 3:23-cv-05792-RFL
1022	Declaration of Jared Bobrow in Support of Petitioner's Motion for Admission <i>Pro Hac Vice</i>
1023	Declaration from Mel DeSart, University of Washington regarding Chang and Sze, <i>ULSI Technology</i> (1996) (<i>served only – not filed</i>)
1024	Leibniz Information Centre for Science and Technology University Library accession confirmation regarding Chang and Sze, <i>ULSI Technology</i> (1996) (<i>served only – not filed</i>)

EXHIBIT NO.	DESCRIPTION
1025	Declaration of Jeremy Jason Lang regarding Orlowski et al., <i>Si, SiGe, Ge, and III-V Semiconductor Nanomembranes and Nanowires Enabled by SiGe Epitaxy</i> , ECS Transactions Vol. 33, No. 6 (2010), 777-89 (<i>served only – not filed</i>)
1026	Declaration of Mina Ching (Internet Archive) regarding Orlowski et al., <i>Si, SiGe, Ge, and III-V Semiconductor Nanomembranes and Nanowires Enabled by SiGe Epitaxy</i> , ECS Transactions Vol. 33, No. 6 (2010), 777-89 (<i>served only – not filed</i>)
1027	Transcript of November 7, 2025 deposition of Stephen Campbell, Ph.D.
1028	Reply Declaration of Dr. Sanjay Banerjee (“Banerjee2”)
1029	U.S. Patent Publication No. 2013/0228837A1 to Sukekawa et al. (“Sukekawa”)
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1032	Dhungana et al., <i>Combinatorial Survey of Fluorinated Plasma Etching in the Silicon-Oxygen-Carbon-Nitrogen-Hydrogen System</i> , Journal of Vacuum Science and Technology A (2016), 061302-1–18

I. INTRODUCTION

In attempting to salvage the '711 patent, Patent Owner's ("PO's") Response advances erroneous legal standards and mischaracterizes the '711 patent and the prior art.

Kim and Park render the claims obvious based on their clear disclosures of a gate-stack-on-top staircase. In Response, PO advances contradictory positions: on the one hand, it argues that the references disclose both orderings in different embodiments and that it wouldn't have been obvious to apply one embodiment to the other; on the other hand, it argues that the claimed ordering is a "missing limitation." As demonstrated in the Petition and below, both positions fail. Further, PO advances a legally erroneous standard in which a known substitute must offer a "benefit" to be obvious. This position cannot succeed because the record demonstrates that each ordering was a straightforward, predictable variation.

Turning to the dependent claims, PO argues that they are not obvious based on a legally erroneous claim construction of the word "on" that is contrary to the clear definition in the '711 patent.

PO also asserts that certain dependent claims are not obvious based on their recited etch-stop-layer thickness range—all while ignoring that the Examiner officially noticed that this range was notoriously well known and lacks criticality. PO then focuses on alleged differences between Kim and Park and the secondary

reference Fang. The alleged differences, however, are irrelevant, because the range at issue lacks criticality and is broad enough to cover different etch-stop materials, etch stops with different underlying layers, and other differences.

II. CLAIM CONSTRUCTION

PO's argument that "on a side/top surface" in claim 14 means "directly contacting a side/top surface" fails on multiple counts. POR, 8–10.

First, the '711 patent defines "on" "in the broadest manner" "[to] not only mean[] 'directly on' ... but also include[] the meaning of 'on' [as] something with an intermediate feature or a layer therebetween." Ex. 1001, 4:1–6; Banerjee2 ¶¶11–15. PO's lexicography is binding. *Thorner v. Sony Comput. Entm't. Am. LLC*, 669 F.3d 1362, 1366 (Fed. Cir. 2012).

Second, the claims use "directly contacts" when such contact is required. Ex. 1001, claim 13; Banerjee2 ¶¶16–18. Thus, PO is wrong to construe a different term ("on") in the same claim as "directly contacting," conflating the meaning of two different claim terms. *Cf. SIPCO, LLC v. Emerson Elec. Co.*, 794 F. App'x 946, 949 (Fed. Cir. 2019) (different terms presumed to have different meanings).

Nevertheless, PO argues that "on a surface" requires direct contact because the '711 patent embodiments consistently use "on a surface" to mean "directly contacting a surface." POR, 9; Banerjee2 ¶19. Consistent usage, however, does not trump lexicography. Instead, "the patentee must 'clearly express an intent' to

redefine the term.” *Thorner*, 669 F.3d at 1365. The ’711 patent expresses no such clear intent. Indeed, the patent states that its embodiments are merely “exemplary” and do not limit claim scope. Ex. 1001, 14:64–67; *Aventis Pharma S.A. v. Hospira, Inc.*, 675 F.3d 1324, 1331 (Fed. Cir. 2012).

Next, PO asserts that Petitioner’s position “is inconsistent with the specification equating ‘on’ with ‘above’ and ‘over.’” POR, 10. That the specification defines all three terms to apply whether or not an intermediate layer is present demonstrates that the patent’s lexicography means that “on,” “above,” and “over” do not require direct contact. Ex. 1001, 4:1–10.

PO further argues that the lexicography of “on” “renders the term ‘surface’ superfluous....” POR, 14. It does not. The terms “side/top surface” provide a reference point to the *exterior* of the step. Were the claims to just recite “top” or “side” of the step, the claim scope would be ambiguous as to whether, for example, the etch-stop layer may be in contact with the step’s interior. Regardless, the superfluous-language rule does not “supersede[] all other principles of claim construction.” *SimpleAir, Inc. v. Sony Ericsson Mobile Commc’ns AB*, 820 F.3d 419, 429 (Fed. Cir. 2016). Indeed, “the patentee’s lexicography *must* govern the

claim construction analysis.” *Braintree Labs., Inc. v. Novel Labs., Inc.*, 749 F.3d 1349, 1356 (Fed. Cir. 2014);¹ Banerjee² ¶¶20–22.

III. GROUND 1

A. Kim Renders Obvious “Each Step Comprises a Gate Stack Disposed Over a Dielectric Layer”

1. Kim’s embodiments are properly combined

Despite PO later making a “missing limitation” argument (*see infra*, §III.A.2), PO does not dispute that Kim itself discloses inverting the order of the alternating layers (*i.e.*, each gate stack above *or* below a corresponding dielectric layer) in the staircase. POR, 17. Nor does PO dispute that the Petition demonstrates with additional prior art that either order was a well-known, suitable option. Pet., 32–33. PO merely disputes whether there was motivation to invert the ordering in the Figure 17A–22B embodiment or a reasonable expectation of success to do so. PO is wrong on both the law and the facts.²

To start, PO’s “motivation” arguments fail because their premise is that Petitioner must show the gate-stack-on-top alternative has a “benefit.” POR, 18.

¹ Emphases are added unless otherwise noted.

² If necessary, these arguments apply equally to Park, which in fact discloses a gate-stack-on-top variation for the embodiment the Petition relies on. POR, 21 n.4; 44–48 (cross-referencing Ground 1 arguments); *infra* §V.A.

But “motivation” does not require showing of benefit. In *Intel*, the petitioner suggested that a POSITA would have replaced a prior-art element with another from a secondary reference that “address[ed] the same problem”—“just through a different mechanism.” *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023). The Board there reasoned that no motivation existed because the substitution resulted in no “obvious improvement.” *Id.* The Federal Circuit reversed, explaining that the fact that the secondary reference provided a “known way to address [the same problem] is precisely the reason that there’s a motivation to combine under *KSR*....” *Id.* The petitioner “never had to show that replacing” one known mechanism for addressing the same problem (here, constructing a staircase structure using one gate-stack-dielectric order) with another known mechanism (the alternative order) “was an ‘improvement’ in a categorical sense”; petitioner needed only to show that it was a “suitable option.” *Id.* at 1381.

Here, Kim, Park, and Chen independently demonstrate that both orders were well-known, predictable variations, and thus obvious. Banerjee² ¶¶23–25; *Smith & Nephew, Inc. v. Hologic, Inc.*, 721 F. App’x 943, 948 (Fed. Cir. 2018) (holding that substituting a predictable variation with another provided motivation). Moreover, here, both suitable options are shown in the very same primary reference. Because PO does not dispute that Kim discloses all limitations including both layer orders across two embodiments, these claims are unpatentable. *KSR Int’l Co. v. Teleflex*

Inc., 550 U.S. 398, 417 (2007) (a combination that simply arranges old elements to perform the conventional function and yields expected results is obvious).

The fact that Kim (and Park) discloses both orders is notable. In *Boston Sci. Scimed, Inc. v. Cordis Corp.*, 554 F.3d 982 (Fed. Cir. 2009), the Wolff reference disclosed embodiments with two types of stents that used identical numerals for elements, and optional coatings for **only one type** of stent. *Id.* at 990–92. Finding it obvious to apply that optional coating to the other stent, *Boston Sci.* recognized that obviousness does not require the prior-art reference itself to “have recognized” the benefits, highlighting “the predictable variation” based on identical numerals. *Id.* at 991. Indeed, “[c]ombining two embodiments disclosed adjacent to each other in a prior art patent does not require a leap of inventiveness.” *Id.* Like Wolff, Kim discloses closely related embodiments with shared numerals. *See also Paice LLC v. Ford Motor Co.*, 681 F. App’x 904, 917 (Fed. Cir. 2017) (finding a “predictable variation” on similar facts).

The cases on which PO relies are inapposite because none involves prior-art references in which two well-known, predictable variations are set forth in the primary reference itself and in other references. *In re Stepan* is further distinguishable because the petitioner did not offer evidence supporting motivation to combine or expectation of success until the appeal. 868 F.3d 1342, 1347 (Fed. Cir. 2017); *see also Intuit Inc. v. Samesurf, Inc.*, IPR2023-00342, Paper 51 at 78–79

(P.T.A.B. June 25, 2024) (distinguishing *Stepan* on the facts). *In re Kotzab* is a pre-*KSR* case that applied the rigid TSM test that *KSR* rejected. 217 F.3d 1365, 1370 (Fed. Cir. 2000). *InTouch Techs., Inc. v. VGO Commc'ns, Inc.* involved a combination of two “disparate” secondary references to arrive at the claimed invention. 751 F.3d 1327, 1332–33, 1351–52 (Fed. Cir. 2014). *BlephEx, LLC v. Myco Indus., Inc.* addressed anticipation, and the disclosure relied on to modify the embodiment expressly excluded that modification. 24 F.4th 1391, 1401 (Fed. Cir. 2022).

PO’s assertion that Petitioner is “cherry pick[ing]” an element from a different embodiment using “hindsight” is groundless. POR, 18, 20. Kim (and Park) itself discloses the gate-stack-on-top order, demonstrating that either layer ordering was common. Pet., 28–31. Chen’s side-by-side depiction confirms that each ordering was a well-known alternative. Chen, Figs. 9A–11B, [0054]–[0057].

PO further suggests that differences between the embodiments cut against motivation and reasonable expectation of success. POR, 19–21. This argument fails because the record demonstrates that each layer ordering was straightforward to implement and well within a POSITA’s knowledge. Pet., 33; Banerjee2 ¶¶23–28. Kim and Park’s brief disclosures about layer-order reversal and Chen’s side-by-side figures demonstrate that both orders were routine. Kim, [0090]; Park, [0102]; Chen, [0046]. *Epistar Corp. v. ITC*, 566 F.3d 1321, 1336 (Fed. Cir. 2009) (“a patent need

not teach, and preferably omits, what is well known in the art”). Indeed, after Chen discloses forming *each* ordering, it then discloses forming etch-stop layers, etching, and forming the conductive staircase contact for both orderings without any differentiation between them. Chen, Figs. 9A–11B, [0054]–[0057]. Similarly, PO’s expert Dr. Campbell admits that the ’711 patent omits these routine implementation details. Ex. 1027, 58:20–59:11, 105:23–107:10, 110:14–111:5. What these references and the ’711 patent omit are details known to a POSITA. *Engel Indus., Inc. v. Lockformer Co.*, 946 F.2d 1528, 1532 (Fed. Cir. 1991) (“technical details apparent to a [POSITA] need not be included....”). Consistent with that, Dr. Campbell testified that “every time you do any deposition and etching, you have to” “experiment to make [it] work.” Ex. 1027, 106:23–107:10. “[A] POSITA would certainly know that’s what you have to do. [There is] not[hing] unique to this process.” *Id.*; Banerjee2 ¶¶23–28. Thus, the prior art and the ’711 patent undermine PO’s assertion that it would be technically difficult to reverse the ordering in a given embodiment. *See Chiron Corp. v. Genentech, Inc.*, 363 F.3d 1247, 1253 (Fed. Cir. 2004) (a specification need not disclose “itself . . . how to make and use every possible variant of the claimed invention, for the artisan's knowledge of the prior art and routine experimentation can often fill gaps, *interpolate between embodiments*”). A POSITA has a reasonable expectation of success for that which is routine. *Salix Pharms., Ltd. v. Norwich Pharms. Inc.*, 98 F.4th 1056, 1066 (Fed. Cir. 2024)

(affirming a finding of a reasonable expectation of success based on “routine, conventional methods and skill”), *cert. denied*, 145 S. Ct. 567, 983 (2024).

In sum, Dr. Campbell acknowledged that reversing the layer ordering simply involves placing the insulating layers beneath each corresponding sacrificial layer during staircase formation. Ex. 1027, 93:12–18; 95:13–25. Dr. Banerjee’s undergraduate students could implement either order. Ex. 2008, 72:4–74:9. Their testimony is consistent with Kim, Park, and Chen: reversing layer order was routine fabrication modification. *Apple Inc. v. Corephotonics, Ltd.*, 861 F. App’x 443, 449 (Fed. Cir. 2021); Banerjee2 ¶¶29–30.

2. Kim has no missing limitation and Ground 1 does not rely on another source to supply a limitation

PO incorrectly argues that Petitioner improperly relies on references that are not part of the Ground to supply a “missing limitation” and “motivation” (POR, 20–22). First, there is no “missing limitation”: Kim expressly discloses both orderings. Pet., 28, 32–33. Second, it is black-letter law that citing other references to show that either layer ordering was a well-known, suitable option (thus supporting a motivation under *Intel*) is permissible. *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1362 (Fed. Cir. 2007) (noting that motivation “may be found in ... common knowledge, the prior art as a whole, or the nature of the problem itself”). Banerjee2 ¶31.

That Kim discloses all elements also moots PO’s remaining arguments in Section III.A.2, which are directed to using general knowledge to supply a *missing* claim limitation. POR, 22–26.³

Even if PO were correct that Petitioner relies on a background reference to supply a missing limitation (it does not), PO’s “general knowledge” arguments fail because PO ignores that the standard for assessing an “unusually simple” missing limitation is from a “skilled artisan[’s]” perspective. *FullView, Inc. v. Polycom, Inc.*, 2024 WL 1843686, at *5 (Fed. Cir. Apr. 29, 2024).⁴ The record demonstrates that the gate-stack-on-top implementation was straightforward and simple to a POSITA.⁵ *Supra* §III.A.1. PO’s argument that implementing the gate-stack-on-top

³ PO cites a memorandum that does not apply to this proceeding. Ex. 1031, 3. Further, this memorandum defines “general knowledge” to exclude patents, whereas Petitioner cites patents, *e.g.*, Chen, for general knowledge. *Id.*, 1.

⁴ PO’s “flexible mat” argument ignores this standard. POR, 23. *E.g.*, *Gen. Elec. Co. v. United Techs. Corp.*, IPR2018-01442, Paper 39, 38–40 (P.T.A.B. Feb. 20, 2020) (finding “an inlet of a first turbine vane” within POSITA’s general knowledge).

⁵ PO alleges the gate-stack-on-top configuration renders Kim’s lower-gate-insulating layer unnecessary, and its inclusion in the modified Kim figures shows

order would cascade into many other changes, including process variations, ignores that such changes have been dealt with for decades. POR, 24–25; Ex. 1027, 37:20–38:12, 40:12–22. For this reason, none of the prior art, *e.g.*, Chen, felt the need to even disclose such routine variations. In an obviousness analysis, “changing one component often requires the others to be modified,” but this does not render the change nonobvious. *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800 (Fed. Cir. 2021). For example, contrary to PO’s argument, changing the depth of word-line-contact holes based on the layer ordering was routine. Chen, Figs. 7A–7B, 11A–11B, [0044]–[0046], [0057]; Ex. 1027, 94:15–95:3; Banerjee2 ¶¶32–33.

PO’s repetitive cascading-effect argument against a POSITA’s reasonable expectation of success also fails. *Supra* §III.A.1. It was well known that the allegedly increased risk of over-etching a gate-stack-on-top staircase can be mitigated through the “[v]ery common[]” monitoring technique called end-pointing that has “been around for 20 ... [to] 30 years.” Ex. 1027, 56:15–57:25; Chen, Figs. 7A–7B, 11A–11B, [0044]–[0046], [0057]; Banerjee2 ¶¶34–38.

technical complexity. POR, 25. PO is wrong because Chen shows that extra insulation is simply a design choice. Chen, Figs. 9A–9B; Banerjee2 ¶38.

3. PO misreads the Institution Decision

PO incorrectly asserts that the Board was misled and applied the gate-stack-on-top description to Kim's unmodified Figure 22A. POR, 27 (citing ID, 9). In context, the Board was referring to the annotated Figure 22A reproduced immediately above the statement that PO cited, which is labeled "Gate-Stack-on-Top," as are all similarly modified figures in the Petition. ID, 8.

B. Kim Renders Obvious Claims 14–15 Under Both the Correct Claim Construction and PO's Incorrect Construction

PO argues that Kim does not render obvious claims 14–15 under its proposed claim construction. POR, 29. Because PO's construction erroneously requires direct contact, the argument is unavailing. *Supra* §II.

Should the Board adopt PO's construction, Kim still renders the claims obvious.⁶ Kim discloses a single-etch-stop variant of the Figure 17A–22B embodiment, which illustrates that the barrier layer is optional. This satisfies claims 14–15 under PO's construction because the etch-stop layer would *directly contact* each step's side and top surfaces. Kim, [0185]–[0186]; Banerjee2 ¶¶39–40.

⁶ "[P]etitioner must be afforded a reasonable opportunity in reply to present argument and evidence under [PO's] new construction." *Axionics, Inc. v. Medtronic, Inc.*, 75 F.4th 1374, 1383 (Fed. Cir. 2023), *dismissed*, 2025 WL 471226 (Fed. Cir. Feb. 12, 2025).

IV. GROUND 2

PO's thirteen-page argument against applying Fang's etch-stop-layer thickness to Kim has a gaping hole: PO failed to rebut the Examiner's official notice that "the claimed etch-stop layer thickness was notoriously well known in the art" and "lacks criticality." Pet., 62 (citation modified). Nor did PO respond to this official notice during prosecution. Ex. 1002, 149–158, 200–208. The fact that the claimed two-orders-of-magnitude 10-to-1000-nm thickness range "lacks criticality" is fatal to PO's arguments that alleged minor differences between Kim and Fang are meaningful. Pet., 62. Indeed, 1,000 nm can be about as thick as the staircase itself. Ex. 1027, 31:19–25. And the '711 patent confirms this lack of criticality because the range encompasses multiple, narrower ranges, and the broad range permits significant variations in materials and device structure. Ex. 1001, 7:58–64, 7:64–66, 8:10–14. The claimed range does not even restrict the etch-stop layer to the specification's exemplary materials or a specific staircase height. *See* Pet., 98–99; Ex. 1027, 86:1–4. And the identical range recited by claim 10, which includes a barrier layer, and claim 17, which does not, demonstrates that the range is insensitive to a significant structural difference. *See* Pet., 66; POR, 40. Consistent with all of this, Dr. Campbell testified that the thickness range "is [merely] a place to start doing experiments to determine the actual thickness that you would need." Ex. 1027, 105:23–106:10. "[I]t is not inventive to discover the optimum or workable ranges

by routine experimentation,” much less a broad range within which a workable range is to be found. *In re Aller*, 220 F.2d 454, 456 (C.C.P.A. 1955); Banerjee ¶¶41–47.

Fang’s etch-stop thickness similarly lacks criticality. Ex. 2008, 54:12–18. Fang specifies a wide thickness range, 5–100 nm, a factor of 20. Pet., 63. The range is suitable “for any material” “not substantially removed (e.g., etched)” with “the nitride materials of the staircase structure.” Fang, [0020] (numerals omitted). For example, the same range applies regardless of the carbon-doping composition. Ex. 2008, 53:8–54:2. Because Fang’s “range” limitation also lacks criticality, any minor differences between Kim and Fang are irrelevant to a POSITA’s motivation and expectation of success in applying Fang’s range to Kim. Banerjee2 ¶¶48–49.

The subsections below address PO’s specific arguments, which fail for additional, independent reasons.

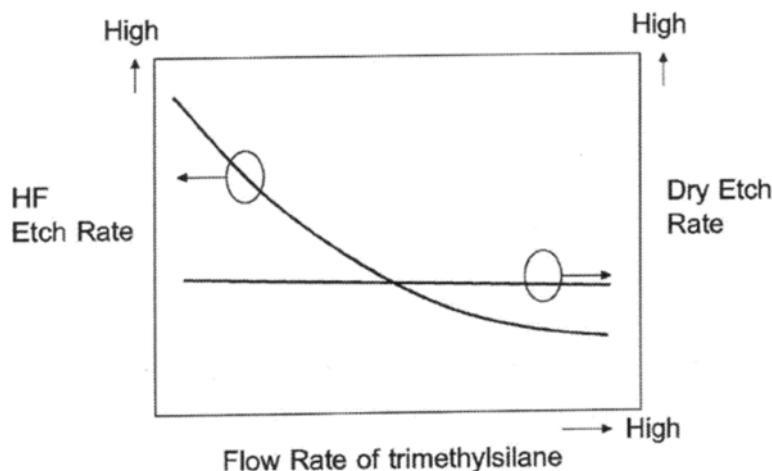
A. Fang’s Carbon Doping Is Optional and Immaterial to the Obviousness Analysis

PO argues that a POSITA would not have been motivated to adopt Fang’s thickness range because Kim and Fang use different etch-stop materials. POR, 31. PO’s argument fails on multiple counts.

First, Fang discloses the thickness range after it disclosed, “[b]y way of example only,”⁷ the etch-stop material. Fang, [0020]. Plainly, then, the range disclosure is not limited to a specific material (just like the ’711 patent’s range). A POSITA would have understood that the range applies broadly to any suitable etch-stop material. Banerjee2 ¶¶50–52.

Second, even if Fang’s range was specific to carbon-doped silicon nitride (it’s not), this is irrelevant to Kim. Kim employs a dry-etching process to etch the contact holes for staircase contacts. *See* Kim, [0070]; Ex. 1027, 24:2–25:18. Thus, the rate at which the etch-stop layer will be etched (and thus how thick the layer should be for a given margin of over-etch) is determined by the dry-etch rate of the etch-stop layer. As the flat line in the figure below shows, dry-etch rates of silicon nitride (as PO alleges Kim only discloses) are constant across varying carbon-doping levels (as PO alleges Fang only discloses):

⁷ PO argues that “Fang’s etch-stop-layer thicknesses are specific to carbon-doped silicon nitride.” POR, 33. Not so. Fang discloses this material as exemplary. Fang, [0008], [0020], [0025].



Ex. 1029, Fig. 19, [0035] (trimethylsilane flow rate representing carbon-doping amount), [0074] (“the same dry etch rates”). Thus, even assuming the addition of carbon-doping to Fang’s etch-stop layer, the thickness of Fang’s etch stop (and the corresponding margin it provides) is directly applicable to Kim, because carbon-doping has no impact on the dry-etch rate. Banerjee2 ¶¶53–54.

Finally, PO argues that Kim and Fang have different focuses that defeat motivation. POR, 34–38. But PO’s characterization of Kim’s etch-stop layer 125 as only protecting the contact pads is incorrect. If that were correct, Kim would only form the etch-stop layer over the staircase’s topmost step because CMP cannot damage any underlying layers. Ex. 1027, 61:23–62:2. In Dr. Campbell’s own words, “a POSITA would not want to add the time or material to include a non-functional component.” Campbell2 ¶41. But Kim’s etch-stop layer covers all staircase steps, that is, where staircase-contact etching penetrates the etch-stop layer.

Kim, Fig. 22A. That is the issue Fang addresses, as PO admits. POR, 37–38; Banerjee2 ¶¶55–56.

B. The Wide Etch-Stop Thickness Range and Etch-Chemistry Flexibility Render Kim and Fang’s Structural Differences Immaterial

PO argues that structural differences, *i.e.*, Kim’s high-k dielectric layer, extra etch-stop layer, and gate-stack-on-top configuration, would have dissuaded a POSITA from the combination with Fang. POR, 38–41. This argument fails on multiple counts.

First, Dr. Campbell contradicts PO’s argument that Kim’s high-k-dielectric layer affects the etch-stop thickness. He testified that the high-k dielectric layer does not serve as an etch stop during the etching of the etch-stop layer, much less the etching of the insulating layer, because there is an intervening barrier layer. Ex. 1027, 56:2–14; *see also* Ex. 2008, 48:2–19 (at best, providing minimal etch stop).

Second, PO argues that Kim’s extra lower etch-stop layer (*i.e.*, the barrier layer) reduces the required thickness for the (upper) etch-stop layer, rendering Fang’s range inapposite. POR, 40. PO admits, however, that a “range of thickness” (like the ’711 patent’s range) applies to a device regardless of whether the device includes an extra lower etch-stop layer. *Id.*; Pet., 66. Fang discloses a range, and thus is applicable to devices with or without an extra lower etch-stop layer. *Id.*, 63. Similarly, PO argues that “Kim’s *two* etch-stop layers ... would ... require different

etch processes than Fang.” POR, 40 (emphasis in original). This is incorrect, because an extra lower etch-stop layer and the associated, additional etch step are irrelevant to the thickness of the overlying etch-stop layer, which is set to slow down etching of the overlying insulating layer. Ex. 1027, 23:4–8. In contrast, the (lower) barrier layer provides over-etching protection during the *intentional* (and desirably speedy) etching of the etch-stop layer. *Id.*, 44:19–23; Banerjee2 ¶¶57–61.

Third, Chen contradicts PO’s argument that the inverted staircase-layer ordering changes the etch-stop-layer thickness. Chen discloses both gate-layer-on-top and dielectric-layer-on-top configurations. Chen, Figs. 7A–7B. Yet Chen discloses the same etch-stop thickness for both orderings. *Id.*, [0047]–[0053]; Banerjee2 ¶62.

C. PO’s Recycled Expectation-of-Success Argument Fails

PO recycles its motivation arguments (alleged differences between Kim and Fang) to argue that Petitioner has not shown a reasonable expectation of success. POR, 41–42. These arguments fail for the same reasons, *e.g.*, these *alleged* differences, even if taken as true, are immaterial to ranges that lack criticality. *Supra* §§IV–IV.B.

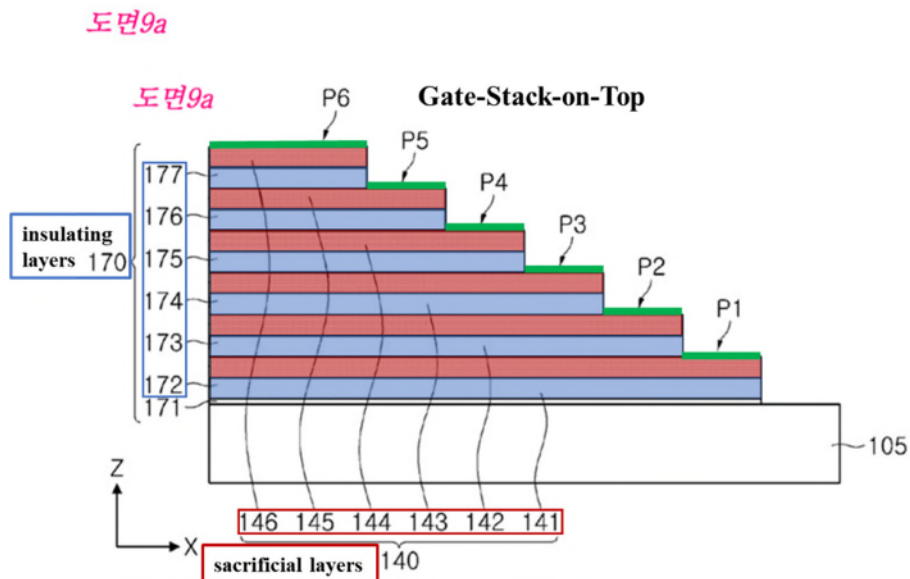
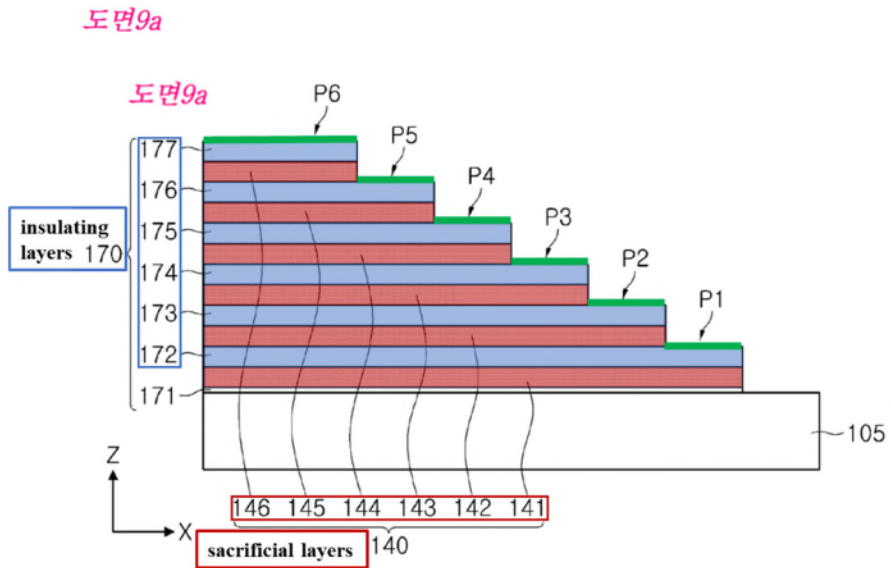
As sections IV.A–B demonstrate, Fang’s 20x thickness range accommodates a wide range of materials and conditions such that a POSITA would have a reasonable expectation of success in applying that range to Kim as a starting point

for subsequent optimization—just as the wide range of the ’771 patent applies to a wide range of materials and conditions. *See Intel*, 21 F.4th at 800 (requiring only “suitab[ility]”). *See Pet.*, 65–66; Banerjee2 ¶¶63–64.

V. GROUND 3

A. Park Renders Obvious “Each Step Comprises a Gate Stack Disposed Over a Dielectric Layer”

PO incorrectly argues that Park does not disclose layer-ordering reversal for Figure 9a. POR, 43–44. Park discloses that “a portion of the top surface of each *insulating layer (170)* may be exposed *by* the plurality of pad regions (P1-P6).” Park, [0102]. This describes Figure 9a and is shown via green lines in the first figure below. Park further discloses that “*unlike what is shown in FIG. 9a*, a portion of the top surface of each *sacrificial layer (140)* may be exposed *in* a plurality of pad regions (P1-P6).” *Id.* Except for the bold/italicized portions, these two statements mirror each other. Because it is undisputed that the staircase comprises alternating insulating and sacrificial layers in both configurations, the unmistakable interpretation of Park’s disclosure is the alternative configuration shown in the second figure below:

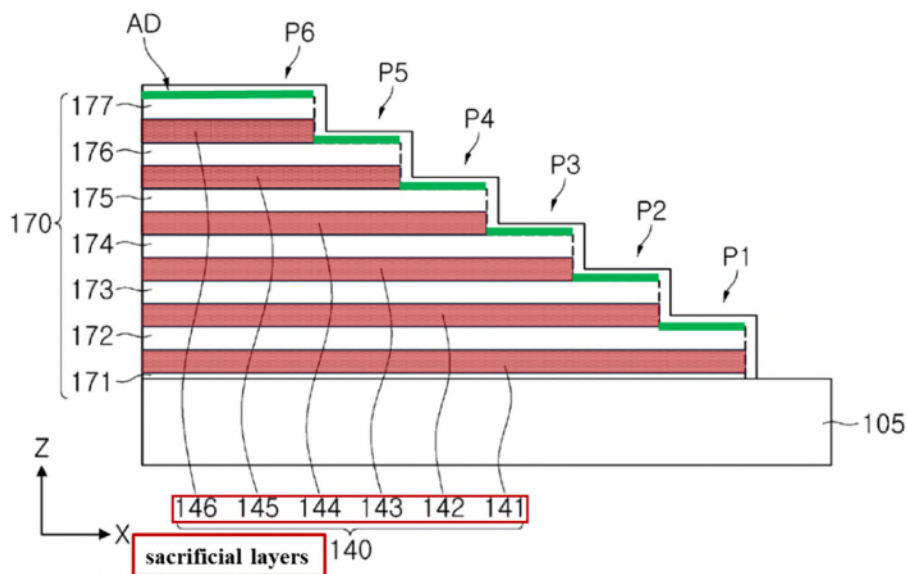


Id., Fig. 9a (original (top) and modified (bottom)). Thus, Park plainly discloses reversing the layer ordering for Figures 5/9.

PO argues that what Park’s reverse-ordering disclosure actually means is that “both insulating layers 170 and sacrificial layers 140 may be ‘exposed’ in the pad regions P1-P6 (as shown in **Figure 9b**).” POR, 44. Figure 9b, however, does not

show exposed sacrificial layers in the pad regions, and thus has no bearing on Park’s reverse ordering disclosure.

도면9b



Park, Fig. 9b. Banerjee2 ¶¶65–67.

1. Park’s embodiments are properly combined

PO recycles and cross-references its arguments from Kim (POR, 44–47), which fail for the same reasons. *Supra* §§III.A.1–2.

Specific to Park, PO argues that Petitioner cannot apply the re-ordering teaching in one embodiment (Figures 4/8a–8m, [0042]) to another embodiment (Figures 5/9a–9j), because PO alleges that Park explicitly states when its teachings from one embodiment apply to others. POR, 45–46. This argument directly contradicts Park’s express disclosure that “various embodiments may be combined.” Park, [0017]. Moreover, PO’s support for this argument is Park’s cross-reference to

forming channels in another embodiment (*id.*, [0104])), which clearly is shorthand to avoid repeating an identical description in the other embodiment (it has no relation to combining embodiments). Banerjee2 ¶¶68–71. Indeed, “[j]ust because an embodiment does not expressly disclose a feature does not mean that embodiment excludes that feature.” *Pacing Techs., LLC v. Garmin Int’l, Inc.*, 778 F.3d 1021, 1026 (Fed. Cir. 2015).

2. Park has no missing limitation and Ground 3 does not rely on another source to supply a limitation

PO repeats the exact same arguments it made against Kim (POR, 47–48, 21 n.4), which fail for the same reasons. *Supra* §III.A.2.

B. Park Renders Obvious Claims 14–15 Under the Correct Claim Construction and PO’s Incorrect Construction

Besides repeating the same flawed arguments that it made against Ground 1, PO argues that Park does not render obvious claims 14–15 because (1) Park allegedly does not have an etch-stop layer on the side surface of *each* step, and (2) Park (like Kim) fails to render the claims obvious under PO’s claim construction. POR, 48–49. PO’s arguments fail. *See also supra* §III.B.

PO’s first argument is based on Park’s figure showing that the etch-stop layer does not cover the side of the bottom step. But the claimed “each” step is not the same as “all” steps of the staircase structure. First, *each* “can also mean ‘each of a

subset.” Ex.1001, 5:6–8.⁸ Second, “a staircase structure comprising a plurality of steps” need not include all steps of the staircase because “comprising” is open-ended. *Genentech, Inc. v. Chiron Corp.*, 112 F.3d 495, 501 (Fed. Cir. 1997).

PO’s second argument fails because its proposed claim construction is legally erroneous. *Supra* §II. Regardless, Park’s Figures 4/8a–8m demonstrate that the barrier layer is optional. Park, [0049]. Thus, Park renders obvious claims 14–15 even under PO’s incorrect construction because, without a barrier layer, the etch-stop layer directly contacts the surfaces of the steps. Banerjee2 ¶¶72–74.

C. Park Renders Obvious Claim 15

PO argues that Park does not render claim 15 obvious for two additional reasons. Both arguments fail.⁹

First, PO alleges that Park does not disclose a uniform etch-stop-layer thickness as claim 15 requires. POR, 52–53. PO is wrong. “Park repeatedly refers to ‘*the* thickness of the etch-stop layer.’” Pet., 89. This is consistent with the uniform thickness shown in Park’s figures: “Patent drawings may be useful in

⁸ Consistent with this, the ’711 patent discloses that the etch-stop layer covers each step of the staircase “[i]n *some* embodiments.” Ex. 1001, 8:3–6.

⁹ PO also repeats its argument that Park does not disclose an etch-stop layer on the side surface of *each* step. This argument fails. *Supra* §V.B.

shedding light about the general shapes and relative sizes of elements of the claimed invention....” *Regents of Univ. of Cal. v. Satco Prods., Inc.*, 2024 WL 4972639, at *3 (Fed. Cir. Dec. 4, 2024). That satisfies the claim requirement for uniform thickness. The Petition uses a POSITA’s knowledge merely to further support that understanding of Park. Pet., 90. This moots the remainder of PO’s *missing*-limitation arguments.

Regardless, PO’s missing-limitation arguments fail on the merits. PO alleges that forming a uniformly thick etch-stop layer in Park is not unusually simple because Park uses a sacrificial-etch-stop-layer process. POR, 53–55. But these arguments ignore that the sacrificial etch-stop layers themselves are formed by depositing a layer on top of the staircase structure. *Id.*, 57–58 (describing Park’s process); Park, [0103]–[0104]. Because it would have been obvious to use ALD—a process Park already uses—to deposit sacrificial etch-stop layers 115a/115b with uniform thicknesses, the replacement etch-stop layers 110a/110b, which have the same shape as the sacrificial etch-stop layers 115a/115b, would also have uniform thicknesses. *Id.*, [0086]; POR, 58–59, Ex. 1003 ¶177; Ex. 1027, 66:17–24, 67:15–25, 117:9–22. In fact, ALD is used to form Park’s etch-stop layers 110a/110b according to Dr. Campbell. Campbell2 ¶75.

Second, PO argues that contact-hole etching renders obvious uniform thickness only of the top surface, not the side surface. POR, 54. This argument fails,

because the same ALD process used to form the uniform layer on top also forms the uniform layer along the staircase. Ex. 1027, 117:9–22; Ex. 1003 ¶177; Banerjee2 ¶¶75–77.

VI. GROUND 4

A. The Petition Shows Motivation to Combine Park and Fang

PO asserts that differences between Park and Fang defeat obviousness. POR, 55–56. PO’s arguments fail.

1. Dependent claim 7

PO argues that a coplanar top surface would not have been obvious because the portion of Park that the Petition proposes to CMP is necessary to form the etch-stop layer. POR, 56–65. PO’s argument hinges on the assumption that CMP cannot occur after forming the etch-stop layer due to risk of damaging the protruding conductive layer 195 that already exists at this step in Park’s fabrication. *Id.*, 63–64. PO is incorrect. Prior art shows repetitive CMP applications that result in protruding elements above a planarized surface:

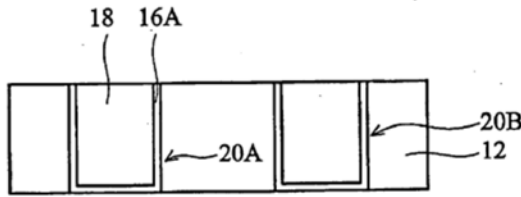


FIG. 1D

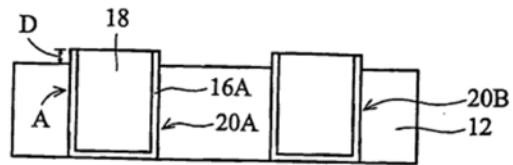


FIG. 1E

Ex. 1030, Figs. 1D–1E, [0018]–[0019]. This illustrates that a POSITA would have known how to planarize a top surface without damaging adjacent protruding structures.

Further, Park itself suggests two CMP steps, before and after forming the conductive layer.¹⁰ Park, [0089]; [0110], Fig. 9j; Banerjee2 ¶79. Indeed, it was routine to protect vulnerable elements during CMP processes. Banerjee2 ¶¶78–81.

2. Dependent claims 10 and 17

PO regurgitates the arguments it made against Ground 2, which fail for the same reasons. POR, 66–69; *supra* §IV.

¹⁰ PO makes much ado about Dr. Banerjee’s supposed misstatements. POR, 60–61. But PO misses the key to his testimony. Dr. Banerjee testified about “correspond[ing]” elements. Ex. 2008, 75:22–76:7. Thus, properly understood, his testimony was not incorrect as PO alleges. For example, Park’s layers 115a–115b *do* respectively “correspond[]” to the ’711 patent’s barrier layer and etch-stop layer. *Id.*, 69:1–11; *compare* Park, Figs. 9c–9d with Ex. 1001, Figs. 3–4; Banerjee2 ¶82.

Additionally, Park discloses that “the thickness of the etch-stop layer is less than or equal to two times the thickness of the gate insulating films.” Park, cl. 3. Dr. Campbell testified that the gate insulating films (the high-k dielectric layer) are 5–15 nm thick. Ex. 1027, 100:21–101:2. Twice that equals 10–30 nm, right within Fang’s range, further illustrating that Fang’s range is applicable to Park.

Petitioner explained that Park does not disclose a different etch-stop thickness for single-layer and multi-layer etch stops. Pet., 102. PO counters by arguing that is the case because “Park does not specify *any* etch-stop layer thickness.” POR, 67–68 (emphasis in original). PO is incorrect. *See, e.g.*, Park, [0060], [0067]. This further demonstrates that Fang’s range (even if for a single-layer etch stop) is applicable to Park. *See id.*, cls. 1, 3; Banerjee2 ¶¶83–85.

3. Dependent claim 15

PO merely cross-references the arguments it made with respect to claims 10 and 17 in Ground 4 and claim 15 in Ground 3. POR, 69–71. Those arguments fail. *Supra* §§VI.A.2, V.C; Banerjee2 ¶86.

VII. DR. CAMPBELL IS NOT A POSITA AND DID NOT TESTIFY AS ONE

PO did not dispute the qualifications of a POSITA, which require “2-3 years of professional experience working with (*e.g.*, researching, designing, or teaching) monolithic 3D structures and NAND memory devices....” POR, 7. Dr. Campbell admitted that he did not have experience in 3D memories as of the priority date. Ex.

1027, 33:5–8, 19:17–22. He admitted that he is not a semiconductor designer. *Id.*, 32:1–13, 32:23–25, 33:22. He conceded that he is **not** qualified to opine on the design aspects in his declaration. *Id.*, 134:9–16, 149:5–10. Instead, he relied on his expertise in fabrication. *Id.*, 32:1–13. He repeatedly testified as a fabrication expert, not as a POSITA. *Id.*, 32:23–25, 129:16–20, 130:19–131:3, 133:21–24, 134:17–135:3, 146:25–147:10, 148:23–149:1. But obviousness must be determined from a POSITA’s viewpoint. *In re Ona*, 62 F.3d 1433 (Fed. Cir. 1995).

VIII. CONCLUSION

Petitioner respectfully requests a final written decision finding the Challenged Claims unpatentable.

Dated: November 25, 2025

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

The undersigned certifies that the foregoing Petitioner's Reply Brief complies with the word count limits set forth in 37 C.F.R. §42.24(a)(1)(i). Excluding the parts of the Petition exempted by 37 C.F.R. §42.24(a)(1), this Reply contains 5,600 words as determined using the word count feature in Microsoft Word, which was used to prepare this Reply.

Dated: November 25, 2025

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CERTIFICATE OF SERVICE

The undersigned hereby confirms that the foregoing paper was caused to be served on November 25, 2025 via electronic mail, upon the following attorneys of record for the Patent Owner

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