

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.

PGR2025-00021
Patent 12,010,838 B2

Before JO-ANNE M. KOKOSKI, KIMBERLY McGRAW, and
MICHAEL T. CYGAN, *Administrative Patent Judges*.

McGRAW, *Administrative Patent Judge*.

DECISION
Granting Institution of Post-Grant Review
35 U.S.C. § 324(a)

I. INTRODUCTION

Micron Technology, Inc. (“Petitioner”) filed a Petition to institute a post-grant review of claims 1, 3–7, and 12–20 of U.S. Patent No. 12,010,838 B2 (“the ’838 patent,” Ex. 1001). Paper 1 (“Pet.”). Yangtze Memory Technologies Company, Ltd. (“Patent Owner”) filed a Preliminary Response. Paper 18 (“Prelim. Resp.”).

Institution of a post-grant review is authorized by statute when “the information presented in the petition . . . demonstrate[s] that it is more likely than not that at least 1 of the claims challenged in the petition is unpatentable.” 35 U.S.C. § 324(a) (2018); *see also* 37 C.F.R. § 42.4 (2023). Post-grant review is available for patents that issue from applications that at one point contained at least one claim with an effective filing date on or after March 16, 2013. *See* Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), §§ 3(n)(1), 6(f)(2)(A). For the reasons discussed below, we determine that Petitioner establishes they are more likely than not to prevail with respect to the unpatentability of at least one of the challenged claims. Accordingly, we institute a post-grant review of claims 1, 3–7, and 12–20 of the ’838 patent.

A. *Real Parties in Interest*

Petitioner identifies itself and its subsidiaries, including Micron Consumer Products Group LLC, as the real parties in interest. Pet. 5. Patent Owner identifies itself as the real party in interest. Paper 5 (Mandatory Notice), 1.

B. *Related Matters*

The parties indicate that the ’838 patent is asserted in *Yangtze Memory Techs. Co., Ltd. v. Micron Tech. Inc. and Micron Consumer Prods. Grp., LLC*, Case No. 3:23-cv-05792-RFL (N.D. Cal.). Pet. 5–6; Paper 5, 1.

Petitioner states it filed IPRs challenging other patents asserted in the district court cases. *See* Pet. 6–7.

C. The '838 Patent

The '838 patent, titled “Staircase Structure for Memory Device,” is “directed to a staircase structure for a memory device (e.g., 3D memory device)” that “provide[s] numerous benefits including, but not limiting to, yield and manufacturing cost improvements.” Ex. 1001, code (54), 1:41–45. Figure 8 of the '838 patent is reproduced below.

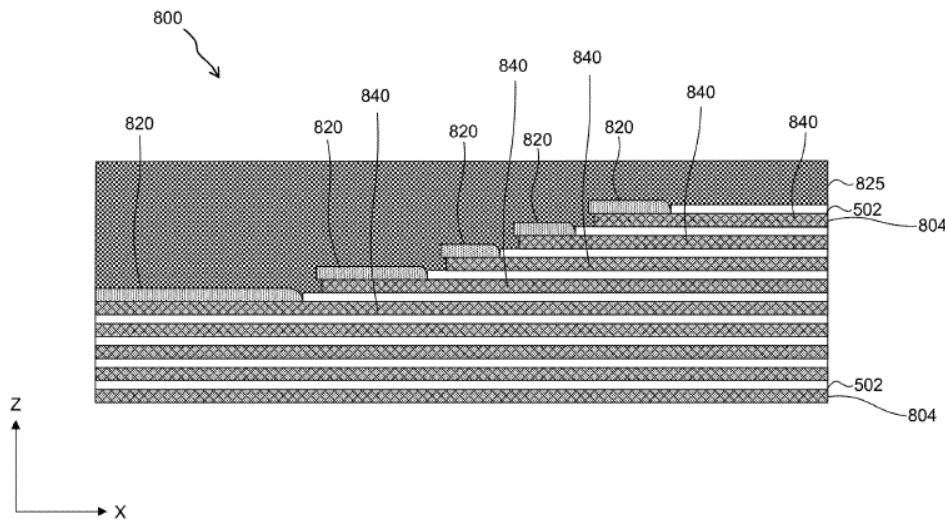


Figure 8 is a cross-sectional view of staircase structure 800 having dielectric layer 825, wordline layers 804, insulating layers 502, landing pads 820, and conductive layers 840. *Id.* at 9:40–53.

The '838 patent explains that each wordline layer 804 of a staircase (“SC”) layer is disposed over a portion of insulating layer 502 of another vertically adjacent SC layer. Ex. 1001, 9:53–55. Landing pad 820 is thicker than insulating layer 502 and is insulated from another landing pad 820 disposed on another vertically adjacent SC layer. *Id.* at 9:58–61. Each wordline layer 804, including landing pad 820 and conductive layer 840 can

control a portion of a memory string in the stacked storage region of a memory device. *Id.* at 9:62–68. The '838 patent further explains that each wordline layer 804 is a wordline of the memory device, where conductive layer 840 contacts a portion of a memory string of a memory device, and landing pad 820 contacts a portion of a side of insulating layer 502. *Id.* at 9:66–10:3. In some embodiments, landing pad 820 is thicker than conductive layer 840 of wordline layer 804. *Id.* at 10:3–6.

D. Illustrative Claim

Petitioner challenges claims 1, 3–7, and 12–20 of the '838 patent. Independent claim 1 is illustrative of the claimed subject matter and is reproduced below.

1. [1.PRE] A staircase structure of a memory device, comprising:

[1.A] a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and

[1.B] a landing pad disposed over a second portion of the second material layer,

[1.B.1] wherein the landing pad comprises a first side surface and a second side surface,

[1.B.2] wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

Ex. 1001, 13:46–56 (bracketed material added).

E. Asserted Grounds

Petitioner asserts that claims 1, 3–7, and 12–20 would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 4–7, 12–17, 19–20	103 ¹	Kim ²
3, 18	103	Kim, Yang ³
1, 4–7, 12, 16–17, 19–20	103	Lee ⁴
3, 18	103	Lee, Haller ⁵
13, 14, 15	103	Lee, Park ⁶

Pet. 10. Petitioner relies on the Declaration of Dr. Jack C. Lee (“Lee Declaration,” Ex. 1003) in support of its Petition. Patent Owner relies on the Declaration of Dr. Konstantinos Giapis (Ex. 2006) in support of its Preliminary Response.

II. ANALYSIS

A. *Level of Ordinary Skill in the Art*

Petitioner contends that a person of ordinary skill in the art (“POSITA”) would have had “a bachelor of science degree in electrical engineering or a similar discipline, along with 2–3 years of professional experience working with (e.g., researching, designing, or teaching) 3D memory devices, or an equivalent level of skill, knowledge, and experience (e.g., an advanced degree may substitute for professional experience).”

Pet. 21 (citing Ex. 1003 ¶¶ 36–37). Petitioner further contends that a

¹ The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284 (2011), revised 35 U.S.C. §§ 102 and 103 effective March 16, 2013. Because the ’838 patent has an effective filing date after March 16, 2013 (Ex. 1001, codes (22), (63)), we refer to the AIA version of Sections 102 and 103.

² US 10,229,929 B2, issued March 12, 2019 (“Kim,” Ex. 1005).

³ US 9,941,153 B1, issued April 10, 2018 (“Yang,” Ex. 1007).

⁴ US 2014/0191389 A1, published July 10, 2014 (“Lee,” Ex. 1006).

⁵ US 9,520,402, B1, issued December 13, 2016 (“Haller,” Ex. 1008).

⁶ US 10,297,543 B2, issued May 21, 2019 (“Park,” Ex. 1009).

“POSITA would also have been aware of and generally knowledgeable about 3D memory’s structure, its component parts, and how it operates.” *Id.*

At this stage of the proceeding, Patent Owner neither responds to Petitioner’s proposed definition, nor provides a definition of its own. *See* Prelim. Resp. 8–9. Petitioner’s proposed definition appears to be consistent with the cited prior art and the disclosure of the ’838 patent, and we adopt it for purposes of this Decision.

B. Claim Construction

We construe claims challenged in a post-grant review proceeding, “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b),” including construing the claims “in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” 37 C.F.R. § 42.100(b). Under this standard, claim terms are generally given their plain and ordinary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). Only those terms in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data LLC v. Iancu*, 912 F.3d 1348, 1375 (Fed. Cir. 2019).

Petitioner asserts that the ’838 patent specification includes a definition section that defines the terms “on,” “above,” and “over” in the broadest manner. Pet. 20 (citing Ex. 1001, 4:4–12). Petitioner additionally argues that the ’838 patent specification broadly defines “layer” as “a material portion including a region with a thickness.” *Id.* (citing Ex. 1001, 4:39–48). The ’838 patent specification further discloses:

a layer can be a region of a homogenous or inhomogeneous continuous structure that has a thickness less than the thickness of the continuous structure. For example, a layer can be located between any set of horizontal planes between, or at, a top surface and a bottom surface of a continuous structure. . . . A layer can include multiple layers.

Ex. 1001, 4:46–56. Petitioner contends “[a] POSITA would have recognized that none of this operates to the limit the ’838 patent’s claims.” Pet. 20 (citing Ex. 1003 ¶¶ 145–147, 161–162).

Patent Owner states that it does not believe any terms require construction. Prelim. Resp. 9. Based on the record before us, we determine that none of the claim terms discussed above require express construction for purposes of this Decision. To the extent the parties’ arguments raise additional claim construction issues, for efficiency, we address any such arguments in the context of our unpatentability analysis below.

C. Post-Grant Review Eligibility

As a threshold issue, we must determine whether the ’838 patent is eligible for post-grant review. There are two requirements that must be met for post-grant review to be available. First, post-grant review is only available if the petition is filed within nine months of the issuance of the challenged patent. 35 U.S.C. § 321(c). Here, the Petition was filed on January 6, 2025, which is within nine months of the ’838 patent’s June 11, 2024 issue date. Pet. 89; Ex. 1001, code (45).

Second, as noted above, post-grant review is available only for patents that issue from applications that at one point contained at least one claim with an effective filing date of March 16, 2013 or later. *See* AIA §§ 3(n)(1), 6(f)(2)(A). The “effective filing date” for a claim is either the application’s

actual filing date or the filing date of the earliest application that supports the claim. 35 U.S.C. § 100(i) (2018).

Petitioner has the burden of establishing eligibility for post-grant review. *See Mylan Pharms. Inc. v. Yeda Res. & Dev. Co.*, PGR2016-00010, Paper 9 at 10 (PTAB Aug. 15, 2016). Petitioner states that the '838 patent issued from U.S. App. 17/447,456 filed on September 13, 2021. Pet. 9 (citing Ex. 1001, code (21), code (22)). Petitioner further states that the '838 patent makes priority claims that date back to, at the earliest, an August 28, 2017 foreign filing, and it is assumed that the '838 patent is entitled to the benefit of the August 28, 2017 date. *Id.* (citing Ex. 1001, code (30)). Accordingly, at least one claim has an effective filing date of March 16, 2013 or later.

Patent Owner does not contest the '838 patent's eligibility for post-grant review. *See generally* Prelim. Resp.

For the foregoing reasons, and based on the current record, we are persuaded that Petitioner has satisfied its burden to prove that the '838 patent is eligible for post-grant review.

D. Ground 1 – Asserted Obviousness over Kim

Petitioner contends that claims 1, 4–7, 12–17, and 19–20 would have been obvious over Kim. Pet. 25–53.

1. Kim (Ex. 1005)

Kim is directed to “semiconductor memory devices having enhanced reliability.” Ex. 1005, 1:38–39. Kim teaches that the semiconductor memory device includes a substrate with a cell array region, a contact region, and stacking structure including a plurality of insulating layers and a plurality of gate electrodes alternately stacked on the substrate. *Id.* at 1:41–46. “The stacking structure may include a stepwise structure in the contact

region.” *Id.* at 1:46–47. Kim teaches that one of the plurality of gate electrodes “may include a respective pad unit that comprises a step of the stepwise structure,” and “[a]t least one of the pad units may include a base pad and a protrusion pad on the base pad.” *Id.* at 1:47–50. Kim further teaches that “[t]he protrusion pad may be between and spaced apart from two edges of a surface of the base pad that are perpendicular to an extension direction of the respective gate electrode.” *Id.* at 1:51–53.

Figure 4B is reproduced below.

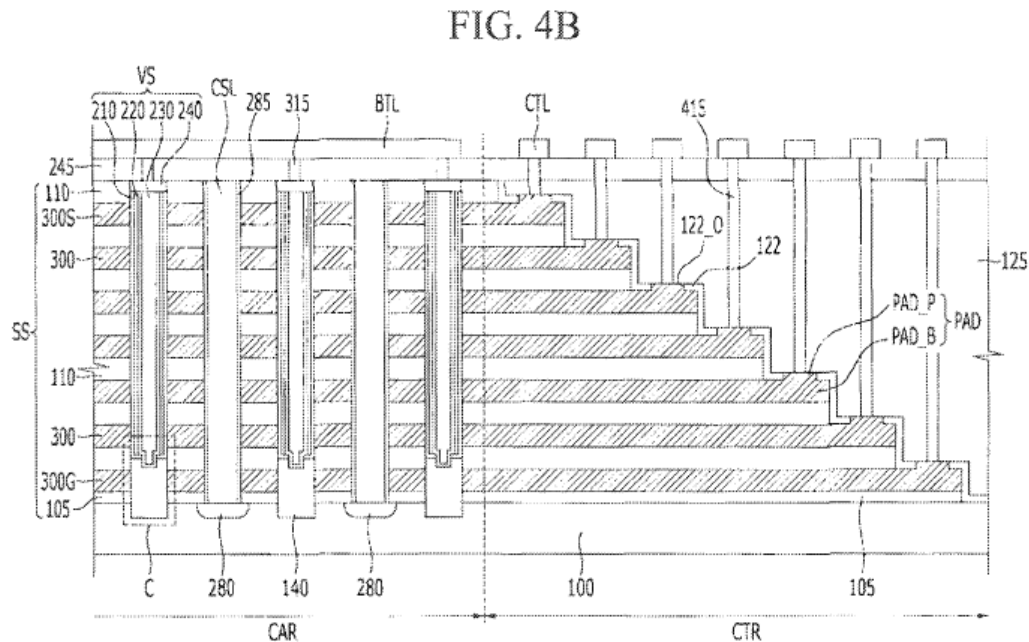


Figure 4B is a cross-sectional view of a partial region of a semiconductor device described in Kim. Ex. 1005, 2:41–42. Substrate 100 includes cell array region CAR, contact region CTR positioned on the periphery of cell array region CAR, and a plurality of common source regions 280. *Id.* at 5:33–37, 5:45–46. Vertical pattern structure VS, stacking structure SS, and bit line BTL may also be on substrate 100. *Id.* at 5:37–39. Stacking structure SS includes a plurality of insulating layers 110 and a plurality of gate electrodes 300 that are alternately stacked. *Id.* at 5:53–55. Common

source line CSL is between adjacent stacking structures SS and penetrates a plurality of gate electrodes 300 and a plurality of insulating layers 110 in a vertical direction that is perpendicular to the uppermost surface of substrate 100. *Id.* at 5:63–67. Trench spacer 285 between common source line CSL and gate electrode 300 electrically insulates common source line CSL and the gate electrode 300 adjacent in the y direction. *Id.* at 6:1–6.

The plurality of gate electrodes 300 and plurality of insulating layers 110 extending from the cell array region CAR into the contact region CTR have a stepwise structure. Ex. 1005, 7:47–52. Pad unit PAD is at an end of gate electrode 300 exposed through the stepwise structure. *Id.* at 7:58–59. Pad units PAD include base pad PAD_B and protrusion pad PAD_P contacting a surface of base pad PAD_B. *Id.* at 7:60–62. Base pad PAD_B may be part of gate electrode 300 in contact region CTR, and “may be exposed by an adjacent pad unit PAD that is stacked on the pad unit PAD.” *Id.* at 7:63–66. “The pad unit PAD and the adjacent pad unit PAD may not overlap with each other.” *Id.* at 7:66–67. Protrusion pad PAD_P may contact the uppermost surface of base pad PAD_B that is exposed by the adjacent base pad PAD_B. *Id.* at 8:3–10.

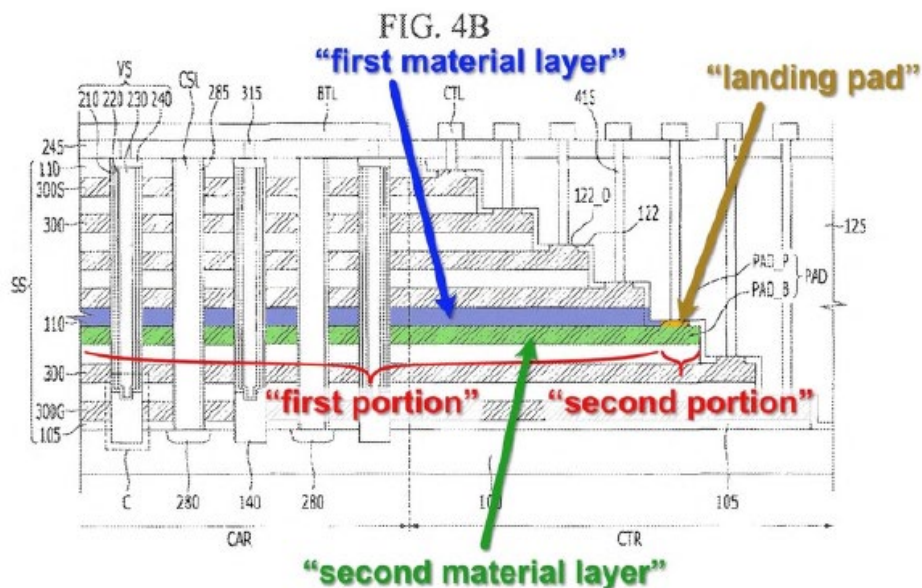
2. *Independent Claim 1*

(a) *Petitioner’s Contentions*

Petitioner asserts that Kim discloses or suggests each limitation of independent claim 1.⁷ Pet. 25–38. For example, Petitioner contends that, to

⁷ Petitioner asserts independent claim 1 and independent claim 12 are identical outside of their preamble, and thus argues them together. *See* Pet. 26. For the purposes of this Decision, we focus our analysis on claim 1.

the extent the preamble is limiting,⁸ Kim discloses a staircase structure of a memory device (memory device having a stepwise structure in its contact region). Pet. 26–27 (citing Ex. 1003 ¶¶ 137–143; Ex. 1005, 1:15–17, 1:26–30, 1:38–47, 3:43–44, 3:52–65, 5:33–39, 6:42–46, Fig. 4B). Petitioner also contends that—as shown in Petitioner’s annotations of Kim’s Figure 4B below—Kim discloses “a first material layer” (insulating layers 110 and a portion of adjacent auxiliary layer 122 (blue)) and “a second material layer” (gate electrodes 300 (green)), “wherein the first material layer is disposed over a first portion of the second material layer” (first and second portions labeled in red) as required by claim element 1A. Pet. 27–30 (citing Ex. 1003 ¶¶ 144–167; Ex. 1005, 1:41–46, 5:53–55, 6:31–36, 9:12–13, 9:29–38, 9:56–63, 12:34–37, 12:61–13:11, 13:51–14:17, Figs. 4B, 11, 13, 16, 17).



Kim’s Figure 4B above, with Petitioner’s color annotations added, depicts a cross-sectional view of a region of a semiconductor device having

⁸ Because Petitioner sufficiently shows at this stage of the proceeding that Kim discloses the preamble, we make no determination as to whether the preamble is limiting.

substrate 100, insulating layers 110, auxiliary insulating layer 122, gate electrode 300, and pad unit PAD that includes base pad PAD_B and protrusion pad PAD_P. Pet. 31; Ex. 1005, 2:39–41, 7:47–62. Petitioner labels protrusion PAD_P in orange and brown as the “landing pad,” insulating layer 110 and a portion of auxiliary insulating layer 122 to the left of protrusion pad PAD_P in blue as the “first material layer”, and gate electrode 300 and base pad PAD_B in green as the “second material layer”. Pet. 31. Petitioner also labels the first and the second portions of the second material layer in red wherein the first portion is to the left of the second portion. *Id.*

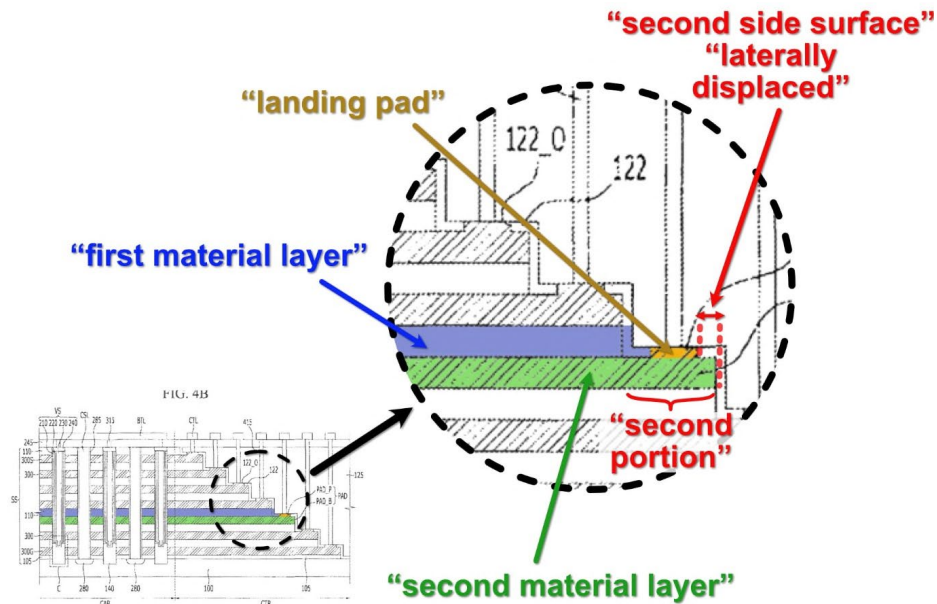
Petitioner explains that “auxiliary insulating layer 122 may include the same or similar material as the insulating layer 110” such that a “boundary between the auxiliary insulating layer 122 and the insulating layer 110 may not be distinguished and the auxiliary insulating layer 122 and the insulating layer 110 may form one structure.” Pet. 28 (quoting Ex. 1005, 9:29–38 and citing 12:34–37). Petitioner also asserts that gate electrode 300 includes “pad unit PAD” formed from a “base pad PAD_B” and a “protrusion pad PAD_P.” Pet. 22 (citing Ex. 1005, 7:58–62).

With respect to claim element [1.B], Petitioner asserts that Kim discloses “a landing pad” (protrusion pad PAD_P labeled in orange and brown in Figure 4B above) “disposed over a second portion of the second material layer” (base pad PAD_B at the end of gate electrode 300 (green)). Pet 30–31 (citing Ex. 1003 ¶¶ 168–175; Ex. 1005, 6:31–35, 7:58–62, 7:61–62, 8:3–10, 9:64–66, 10:23–25, 14:12–17, Fig. 4B).

With respect to claim element [1.B.1], which recites “wherein the landing pad comprises a first side surface and a second side surface,” Petitioner asserts that Kim’s “protrusion pad PAD_P” has a first and second

side surface because PAD_P has either an “island shape” or a “rectangular parallel[] shape.” *Id.* at 32–33 (citing Ex. 1005, 7:58–62, 8:23–34; Ex. 1003 ¶¶ 176–182).

Claim Element [1.B.2] recites “wherein the first side surface [of the landing pad] is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.” For this element, Petitioner contends Kim’s teaching of protrusion PAD_P inside the opening 122_O of auxiliary insulating layer 122 renders this element obvious. Pet. 33–34 (citing, *inter alia*, Ex. 1005, 9:21–23, 9:29–38, 12:34–37, 13:51–14:17, Figs. 11, 16–17; Ex. 1003 ¶¶ 185–187). Petitioner asserts that because protrusion PAD_P fills opening 122_O, “a POSITA would have understood that there is ‘contact’ between the ‘first side surface’ of Kim’s ‘landing pad’ (protrusion pad PAD_P) and its ‘first material layer’ (auxiliary insulating layer 122 adjacent to insulating layer 110).” *Id.* at 34 (citing, *inter alia*, Ex. 1003 ¶¶ 188–190; Ex. 1005, Fig. 4B). Petitioner further argues, as shown in annotated Kim’s Figure 4B below, that Kim’s landing pad (protrusion pad PAD_P) is displaced inward and back from the edge of the underlying conductive layer, and is therefore, laterally displaced from a side surface of the second portion of the second material layer. Pet. 34–38 (citing, *inter alia*, Ex. 1001, 5:6–8; Ex. 1003 ¶¶ 191–202; Ex. 1005, 8:11–22, 8:35–59, Fig. 4B, 5–7).



“second portion of the second material layer.” *See, e.g.*, Prelim. Resp. 10–11, 15; *see also id.* at 11 (stating that the claimed first and second portions “are defined by the interface of the landing pad and the first material layer” and citing Ex. 2006 ¶¶ 32, 39–42, 49). Patent Owner also states that the “second side surface” of the landing pad must be “laterally displaced from a side surface of the second portion of the second material layer,” that the “first portion” and the “second portion” do not overlap and are distinct, and that “first material layer” and the “landing pad” are over the respective portions of the “second material layer.” *Id.* at 16.

Patent Owner asserts that claim 1’s “specific arrangement” is shown in, for example, Figure 8 of the ’838 patent reproduced below with Patent Owner’s annotations added. Prelim. Resp. 10–11, 16 (citing Ex. 1001, Fig. 8; Ex. 2006 ¶ 39).

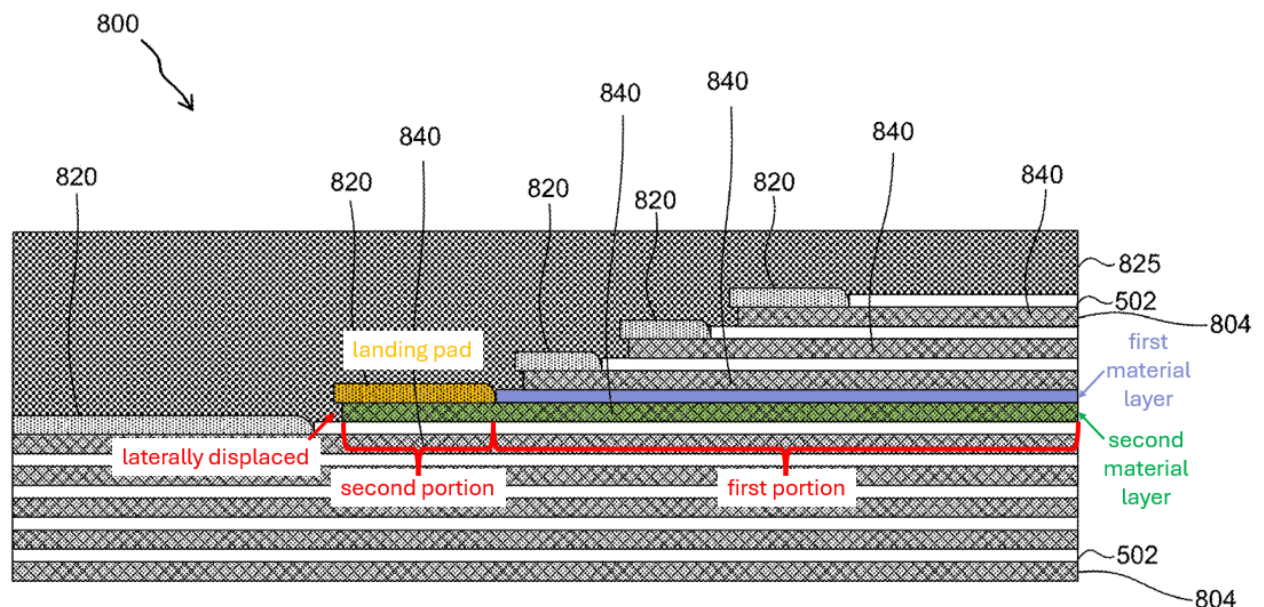


Figure 8 of the ’838 patent illustrates a cross-sectional view of a staircase structure having insulating layer 502 and wordline layer 804, which includes conductive layer 840 and landing pad 820. Prelim. Resp. 14; Ex. 1001, 3:27–29, 9:51–53, Fig. 8. Patent Owner adds color highlighting

and labels identifying the first material layer (blue), second material layer (green), landing pad (orange), and first and second portions of the second material layer (red). *Id.*

Patent Owner asserts that this “specific arrangement” shown in annotated Figure 8 of the ’838 patent above is consistent with the claim language and Specification. *Id.* at 10–12 (citing Ex. 1001, 1:47–54, Figs. 4, 5; Ex. 2006 ¶¶ 32, 39–44, 49). Patent Owner further asserts that “the interface between the landing pad and the first material layer (blue) defines the boundary between the claimed first portion and second portion of the second material layer.” *Id.* at 12–13 (citing Ex. 2006 ¶¶ 33, 41–42; Ex. 1001, Figs. 7, 8); *see also id.* at 12–14 (discussing the process steps disclosed in the ’838 patent). Patent Owner also states that the above understanding of the meaning of the “first portion” and “second portion” is confirmed by similar usage throughout the Specification and the understanding of the Examiner during prosecution. *Id.* at 14 (citing Ex. 2006 ¶¶ 44–49).

Patent Owner asserts that Petitioner has not shown claim 1 is unpatentable because the Petition misrepresents Kim’s structure and ignores that Kim’s first material layer (auxiliary layer 122) surrounds the landing pad on all four sides and extends to the end of the second material layer. Prelim. Resp. 1; *see also id.* at 15 (stating Petitioner ignores the claimed the “specific arrangement” and misrepresents Kim’s teachings), 16 (stating Petitioner’s expert relies on an “island shaped” landing pad, PAD_P, but ignores how “Kim’s stacking structure is formed” and uses “hindsight-driven and arbitrary labels in an attempt to mimic” the claimed arrangement); *see also id.* (stating that Petitioner’s expert only relies on Kim’s Figures 4B and 6 when mapping Kim to the claimed first and second

material layers and the landing pad and citing Ex. 1003 ¶¶ 144–202; Ex. 2006 ¶ 55; Pet. 27–38).

As reproduced below, Patent Owner provides its own color annotations of a portion of Kim Figure 4B. Prelim. Resp. 3–4.

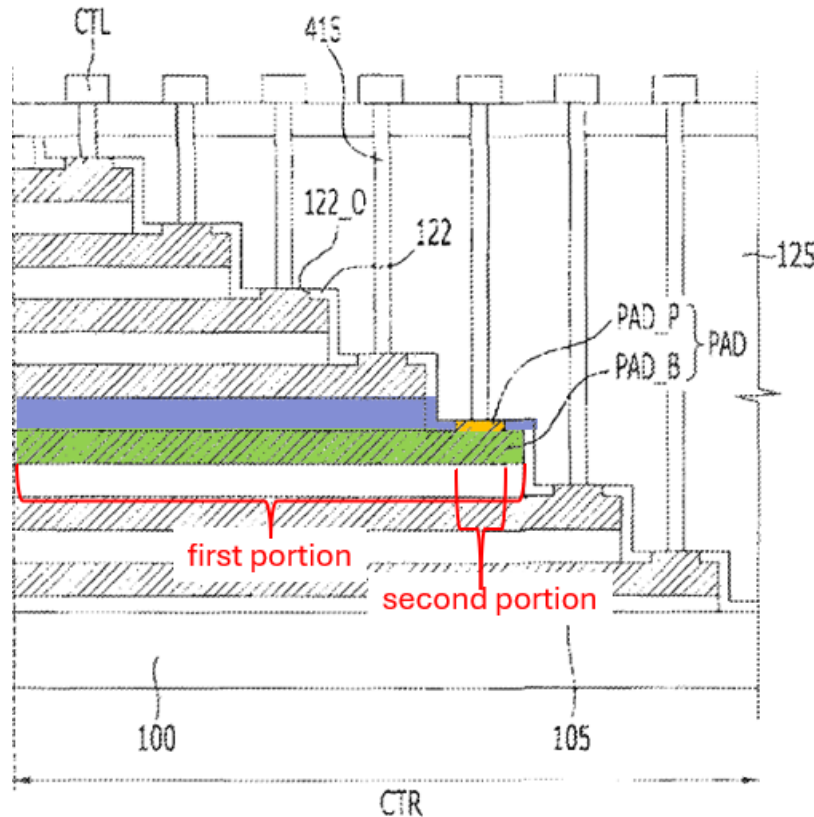


Figure 4B above, with Patent Owner’s color annotations added, depicts a cross-sectional view of a region of a semiconductor device with the first material with a region in the staircase structure enlarged that labels the first material layer in blue, the second material layer in green, the landing pad in orange, and labels the first and second portions of the second material layer in red. Prelim. Resp. 4; Ex. 1005, Fig. 4B.

Patent Owner’s labeling of Kim Figure 4B differs from Petitioner’s labeling in that Patent Owner’s labeling maps the first material layer (blue) as also including the auxiliary layer 122 that is to the right of the PAD_P, the first portion of the second material layer (red) as extending to the right

edge of gate electrode 300 (green), and the second portion of the second material layer (red) as being only underneath PAD_P (orange). *Compare* Prelim. Resp. 4 *with* Pet. 31.

Patent Owner asserts that “Kim, at best, shows only [an] arrangement where landing pad (orange) cannot be laterally displaced from the second portion of the second material layer because the landing pad is tightly surrounded by the first material layer (blue), leaving the second portion coextensive with the landing pad.” *Id.* at 3, 21 (stating if “auxiliary layer 122 forms one structure with insulating layer 110, as Petitioner’s expert opines, then it forms one structure all the way around the PAD_P”); *see also id.* at 19–20 (stating that auxiliary insulating layer 122 is used to form the contact pads by creating opening 122_O that will correspond to the pads, which will result in an island shaped PAD_P and citing Ex. 1003 ¶ 158; Ex. 2006 ¶¶ 52–54, 60–66).

Patent Owner further asserts that because Kim’s first material layer completely surrounds the island shaped landing pad, the second portion of the second material layer is an island shaped portion underneath the landing pad, with the boundary between the “first portion” and “second portion” at the interface between the first material layer and the landing pad. Prelim. Resp. 24 (citing Ex. 2006 ¶ 64). Consequently, Patent Owner asserts, Kim does not teach a landing pad having a second side surface that is laterally displaced from a side surface of the second portion of the material layer. *Id.* at 24–25.

(c) *Analysis*

We have reviewed and considered both parties’ arguments and evidence and determine that Petitioner has sufficiently shown that Kim discloses or suggests the limitations of claim 1. We disagree with Patent

Owner's argument that Petitioner only relies on embodiments in Kim having an "island" shaped landing pad that is surrounded on all four sides by auxiliary layer 122. Based on the present record, we do not understand the Petition to rely solely on the "island" landing pad embodiment of Kim because the Petition also refers to an embodiment in Kim that is not island shaped. *See, e.g.*, Pet. 34–35 (citing, *inter alia*, Ex. 1005, Fig. 5). In this embodiment, the sides of protrusion pad PAD_P are "coplanar" with 2 of the edges of PAD_B (i.e., E3, E4). *See, e.g.*, Ex. 1005, Fig. 5. We understand that, in this embodiment, PAD_P is not an "island" landing pad because the auxiliary layer would not surround the landing pad on the sides of the landing pad coplanar to edges E3 and E4. *See, e.g.*, Ex. 1005, Fig. 5. Thus, in this embodiment, the asserted first material layer (i.e., insulating layer 110 and the portion of the auxiliary layer to the left of the landing pad) would not form one structure all the way around PAD_P, as contended by Patent Owner. Prelim. Resp. 21 (citing Ex. 2006 ¶ 61). Rather, the asserted first material layer would end as depicted by Petitioner. *See, e.g.*, Pet. 34–35 (citing Ex. 1005, Fig. 4B).

We acknowledge Patent Owner's contention that Petitioner's expert does not cite to Figure 5 of Kim. However, as noted above, the Petition itself does cite to this Figure in its discussion of the landing pad, and is thus considered in our analysis. *See* Pet. 35–36. As such, on the present record, we disagree that the Petition misrepresents Kim's structure and ignores that Kim's first material layer (auxiliary layer 122) surrounds the landing pad on all four sides and extends to the end of the second material layer.

Because we determine, on the present record, that Kim (*e.g.*, Ex. 1006, Fig. 5) discloses embodiments in which the first material layer would end as depicted by Petitioner (*see, e.g.*, Pet. 31, 34–35), we need not

determine at this stage of the proceeding whether Petitioner has sufficiently shown that Kim's other embodiments—in which the auxiliary layer does surround the landing pad on all four sides—meets the “first material layer” requirements of claim 1. The parties are invited to address this issue if they choose.

Additionally, at this stage of the proceeding, we disagree with Patent Owner's argument that the first portion of the second material layer is defined by the first material layer and that the second portion of the second material layer is defined by the landing pad. The plain language of the claim merely recites how the first material layer and the landing pad are disposed in relation to portions of the second material layer, without defining first or second portions. The portions of the Specification cited by Patent Owner relate to the process for manufacturing embodiments and do not define the first or second portions of the second material layer by that process. The parties are invited to address this issue if they choose. At this stage of the proceeding, Patent Owner does not present any additional arguments regarding the remaining limitations of claim 1. We have reviewed Petitioner's arguments and supporting evidence, and determine that Petitioner's contentions, as set forth and addressed above, sufficiently show Kim discloses or suggests each of the limitations of claim 1. *See* Pet. 26–30. For example, as shown in Petitioner's annotations of Kim Figure 4B, and as discussed above, Petitioner sufficiently shows that Kim discloses or suggests a staircase structure of a memory device comprising a first material layer (insulating layers 110 and a portion auxiliary insulating layer 122) and a second material layer (gate electrodes 300), wherein the first material layer is disposed over a first portion of the second material layer. *See, e.g.*, Pet. 31. As shown in Petitioner's annotations of Kim Figure 4B, and as

discussed above, Petitioner also sufficiently shows that Kim discloses or suggests a landing pad (protrusion PAD_P) disposed over a second portion of the second material layer (gate electrode 300). *See, e.g.*, Pet. 31. As shown in Petitioner's annotations of Kim Figure 4B (*see e.g.*, Pet. 33), and as discussed above, Petitioner sufficiently shows that Kim teaches or suggests a first side surface of landing pad (left side of landing pad in Kim Fig. 4B) that is in contact with the first material layer (auxiliary insulating layer 122) and a second side surface of a landing pad (right side of landing pad in Kim Fig. 4B) that is laterally displaced (located inward) from a side surface of the second portion of the second material layer (the right end of gate electrode 300).

Accordingly, based on the record before us, we are persuaded that Petitioner sufficiently shows a greater likelihood than not that at least claim 1 would have been obvious in view of Kim. Because Petitioner demonstrates that at least one claim of the '838 patent meets the threshold for institution, we institute a post-grant review for all claims as challenged in the Petition based on all alternative arguments. *See* 37 C.F.R. §§ 42.208(a), (c); *SAS Inst. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018).

3. *Claims 4–7, 12–17, and 19–20*

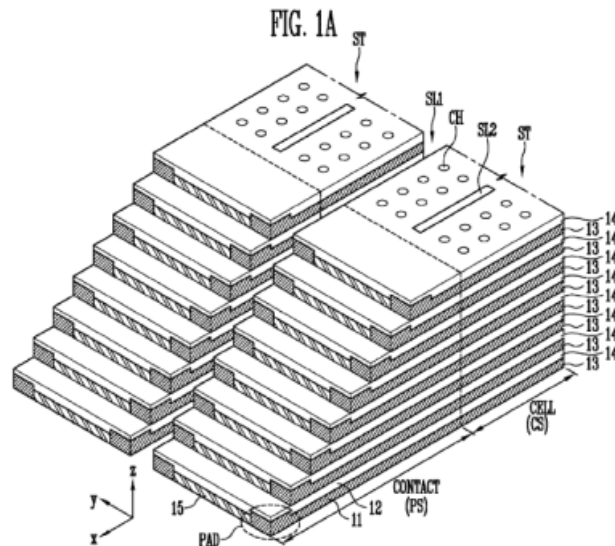
Petitioner also contends that claims 4–7, 12–17, and 19–20 would have been obvious over Kim. Pet. 25–53. At this stage of the proceeding, Patent Owner does not make any additional arguments directed to these claims, other than the arguments discussed above. Because Petitioner demonstrates that at least one claim of the '838 patent meets the threshold for institution, we institute a post-grant review for all claims as challenged in the Petition based on all alternative arguments, including the asserted unpatentability of claims 4–7, 12–17, and 19–20 over Kim.

E. Ground 3 – Asserted Obviousness over Lee

Petitioner contends that claims 1, 4–7, 12, 16–17, and 19–20 would have been obvious over Lee. Pet. 60–77. Having already determined that Petitioner shows a greater likelihood than not that claim 1 would have been obvious over Kim as discussed above, we need not address this ground in full. We offer the following comments in response to the parties’ arguments and evidence to provide guidance to the parties.

1. Lee (Ex. 1006)

Lee relates “to a semiconductor device capable of easily forming a pad portion and a method of manufacturing the same.” Ex. 1006 ¶ 8. Lee’s Figure 1A is reproduced below.



Lee Figure 1A is a perspective view of the structure of a semiconductor device described in Lee. *Id.* ¶¶ 11, 21–23. Lee’s semiconductor device includes cell region CELL and contact region CONTACT defined in a substrate (not shown). *Id.* ¶ 20. Stacked structures ST include conductive layers 11, 13 and insulating layers 12, 14 that are formed alternately with each other on the substrate. *Id.* First slit SL1

separates neighboring stacked structures ST from each other. *Id.* An end of stacked structures ST is patterned stepwise, with each step including at least one conductive layer 11 or 13 and at least one insulating layer 12 or 14. *Id.* ¶ 21. Stacked structure ST also includes pad structure PS located in contact region CONTACT, and cell structure CS located in cell region CELL. *Id.* ¶ 22. Pad structure PS includes first conductive layers 11 and first insulating layers 12 that are alternately formed in contact region CONTACT, with an end of pad structure PS being patterned stepwise. *Id.* ¶ 23. Pad portions PAD are defined as portions of first conductive layers 11 that are exposed along the stepped end of pad structures PS. *Id.* Pad structures PS further include sacrificial layers 15 that are coupled to first conductive layers 11. *Id.* at ¶ 24. Lee teaches that, for example, first conductive layers 11 are stacked on side walls along the z-axis of pad structure PS exposed through first slit SL1, i.e., in the side regions thereof. *Id.* Sacrificial layers 15 are stacked along the z-axis in a central region of pad structure PS. *Id.* Lee further states that pad portion PAD may have a greater thickness than other unexposed portions of first conductive layer 11, and may have a greater thickness than second conductive layer 13 and sacrificial layer 15, such that “the thickness of the pad portion PAD may be selectively increased without increasing the height of the stacked structure ST.” *Id.* ¶ 27.

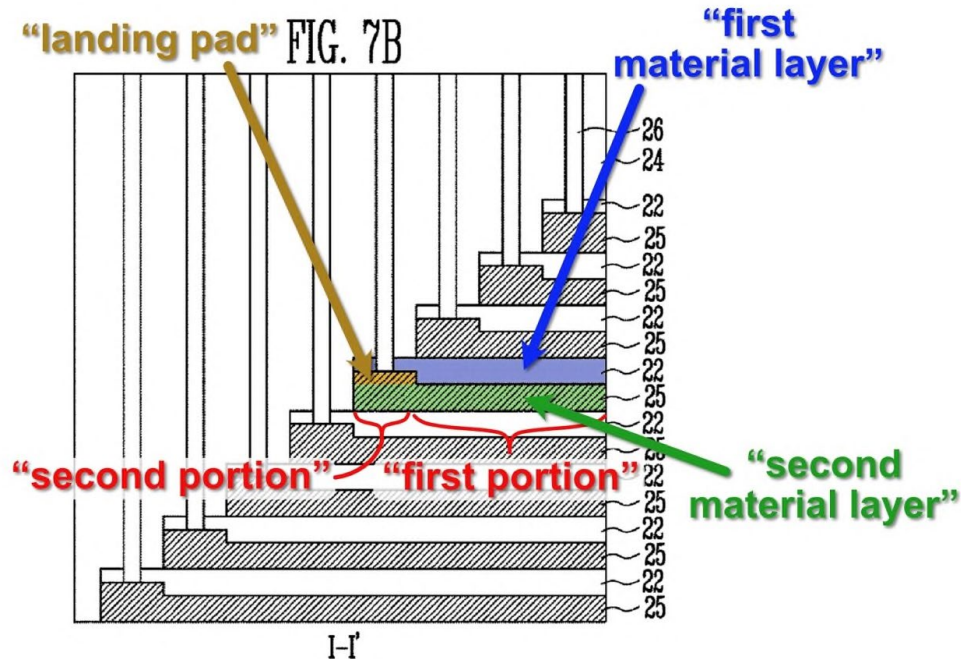
Cell structure CS includes second conductive layers 13 and second insulating layers 14 formed alternately with each other in cell region CELL. Ex. 1006 ¶ 25. First conductive layers 11 and second conductive layers 13 that are formed on the same level are coupled to each other, and first insulating layers 12 and second conductive layers 14 that are formed on the same level are coupled to each other. *Id.* The semiconductor device further

includes channel layers CH that penetrate cell structure CS and at least one second slit SL2 that penetrates cell structure CS. *Id.* ¶ 26.

2. Discussion

Petitioner contends that Lee discloses or suggests each limitation of the challenged claims, including claim 1.⁹ Pet. 60–77. For example, Petitioner contends that Lee discloses a memory device having a staircase structure (the stepped portion of the CONTACT region). Pet. 60–61 (citing Ex. 1006 ¶¶ 8–9, 17, 85–90, 20–21, Fig. 1A; Ex. 1003 ¶¶ 339–347). Petitioner also asserts that Lee discloses or suggests a “first material layer” (insulating layer 22), a “second material layer” (conductive layer 25), and a “landing pad” (pad portion PAD). Pet. 61–63 (citing Ex. 1006 ¶¶ 9, 23, 27, 41–43, 46, Figs. 1A, 6B, 7B; Ex 1003 ¶¶ 348–360). Petitioner asserts that, as shown in Lee Figure 7B below, with Petitioner’s annotations added, Lee’s first material layer (insulating layer 22 (blue)) is disposed over a first portion of the second material layer (conductive layer 25 (green)) and that Lee’s landing pad (a portion of pad portion PAD (brown)) is located over a second portion of Lee’s second material layer (conductive layer 25 (green)). Pet. 61–63 (citing Ex. 1006 ¶¶ 9, 23, 27, 42–43, Fig. 7A, 7B; Ex. 1003 ¶¶ 355–360).

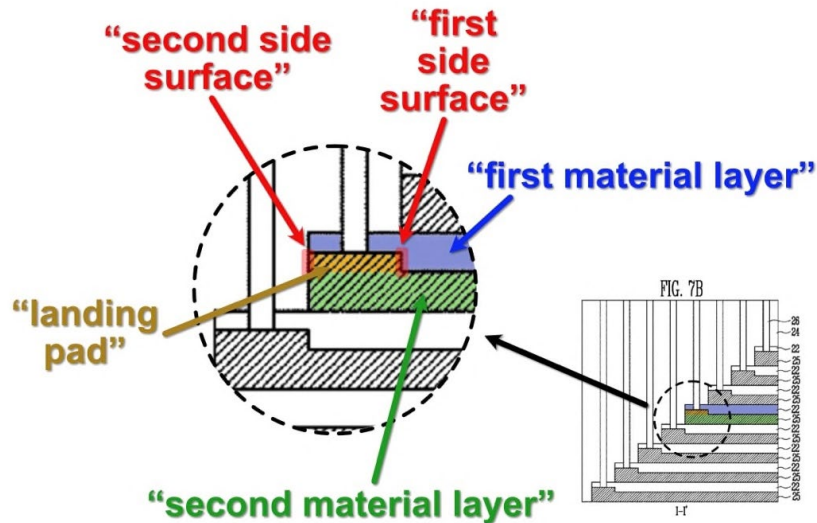
⁹ Petitioner asserts independent claim 1 and independent claim 12 are identical outside of their preamble, and thus argues them together. *See* Pet. 25, 60. For the purposes of this Decision, we focus our comments on claim 1.



Lee Figure 7B, with Petitioner's color annotations added, depicts a cross-sectional view of a portion of a semiconductor device during one step of the manufacturing process. Pet. 61, 63; Ex. 1006 ¶ 13, Fig. 1B.

Petitioner asserts that the claims only require that an insulating layer (first material layer) be disposed over a first portion of an underlying conductive layer (second material layer) and do not prohibit the insulating layer (first material layer) from also covering other portions of the same conductive layer (second material layer). Pet. 62.

Petitioner also asserts that Lee's pad portion PAD (landing pad) has a first side surface (side facing inwards towards insulation and conductive layers) and a second side surface (the side facing outwards) as required by claim element [1.B.1], as shown in Lee Figure 7B below. Pet. 64.

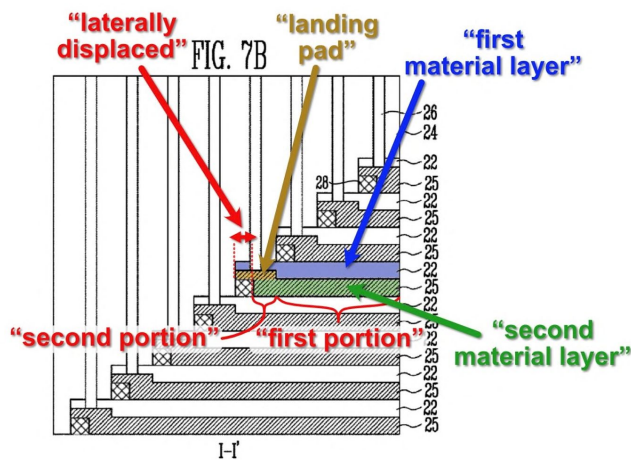


Lee Figure 7B is a cross-sectional view of a portion of a semiconductor device during one step of the manufacturing process, with the addition of a dotted circle around a portion of the stepped end pointing to an enlarged view of the circled area. Pet. 64. Petitioner also adds color annotations to label the first and second side surface (red), the first material layer (blue) and landing pad (orange and brown). *Id.*; Ex. 1006, Fig. 7B; Ex. 1003 ¶¶ 361–364.

Petitioner further contends that claim element [1.B.2] (“wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer”) would have been obvious over Lee. Pet. 64–70 (citing Ex. 1003 ¶¶ 365–393; Ex. 1006 ¶¶ 29–30, 34, 38–41, 47–50, Figs. 3B, 5B, 6B, 7B, 8B). Petitioner asserts that Lee discloses a method for manufacturing a memory device and that it would have been obvious to structure Lee’s device such that its landing pad (pad portion PAD) is laterally displaced from a side surface of the underlying conductive layer. *Id.* at 67.

To support this argument, Petitioner states Lee teaches that additional processes can be applied during the manufacturing process to produce a modified structure, such as by forming a plurality of barrier layers 28 “in order to ensure an etch margin when the ends of the recessed regions RC are extended.” Pet. 67–68 (citing Ex. 1006 ¶¶ 47–48 and quoting Ex. 1006 ¶ 49). Petitioner asserts that Lee Figure 8B shows barrier layer 28 during this process (i.e., after ion implantation but before etching). *Id.* at 68 (citing Ex. 1006 ¶ 50 (Fig. 8B)). Petitioner asserts that it would have been obvious to a person skilled in the art that, in this modified process, barrier layer 28 replaces a portion of the sacrificial layer 21 that serves as a precursor to conductive layer 25 which “causes the PAD in the finished device over the barrier layer 38 that—per Lee—remains behind.” *Id.* at 68–70 (citing Ex. 1006, Fig. 7B; Ex. 1003 ¶¶ 379–390).

Petitioner asserts that this modified structure, including barrier layer 28, is shown in modified Figure 7B of Lee, reproduced below. Pet. 70.



Modified Lee Figure 7B is a cross sectional view of a portion of a semiconductor device during one step of the manufacturing process, with Petitioner’s modification to include barrier layer 28, indicated by hatch marks. Pet. 70. Petitioner asserts that, as shown in the above modified

figure, the “first side surface” (the right side of the pad in Fig. 7B) of Lee’s “landing pad” (pad portion PAD) is still in contact with the first material layer (insulation layer 22), but the pad’s second side surface (the left side of the pad) is now laterally displaced from the side surface of the second portion of the second material layer (the end of conductive layer 25 that is adjacent to now included barrier layer 28). *Id.* (citing Ex. 1006, Fig. 7B; Ex. 1003 ¶¶ 391–393).

Patent Owner responds that Petitioner ignores the claimed “specific arrangement” required by claim 1 and improperly reads “first portion” and “second portion” out of the claims. Prelim. Resp. 9–15, 26–32. Patent Owner asserts that the specific arrangement required by claim 1 is shown, for example, in Figure 8 of the ’838 patent, reproduced below with Patent Owner’s color annotations added. *See id.* at 26–31 (citing *id.* at 9–15); *see also id.* at 11 (citing Ex. 1001, Fig. 8).

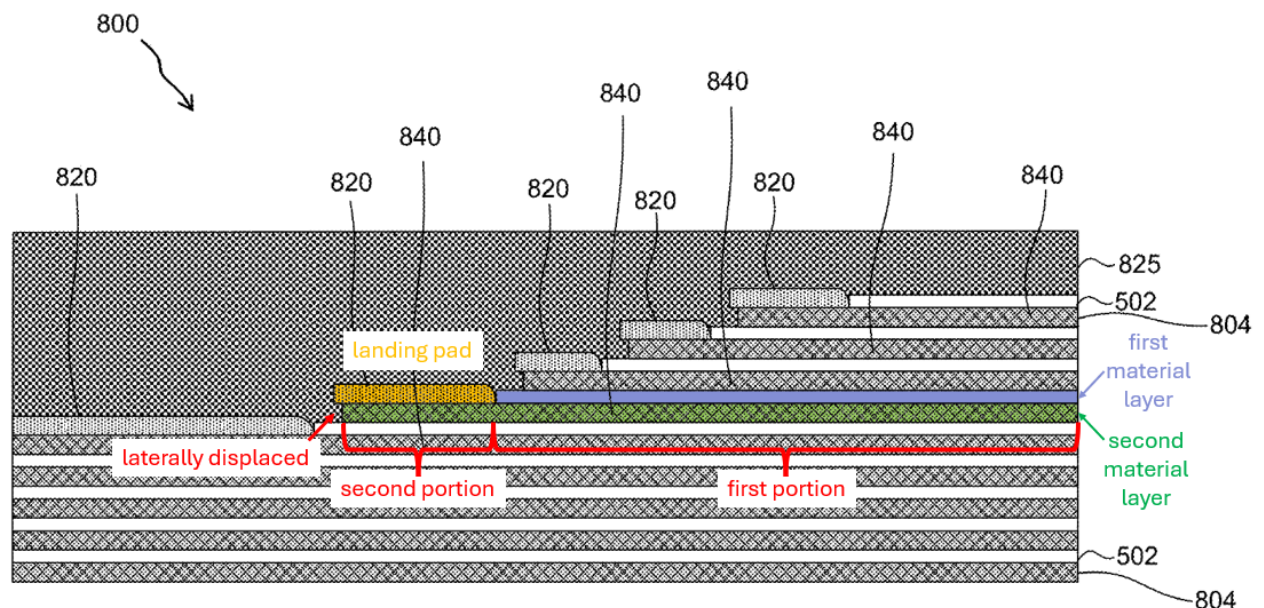


Figure 8 of the ’838 patent illustrates a cross-sectional view of a staircase structure having insulating layer 502 and wordline layer 804, which includes conductive layer 840 and landing pad 820. Prelim. Resp. 11;

Ex. 1001, 3:27–29, 9:51–53, Fig. 8. Patent Owner adds color highlighting and labels identifying the first material layer (blue), second material layer (green), landing pad (orange), and first and second portions of the second material layer (red). Prelim. Resp. 11.

Patent Owner states that claim 1 requires that the “first material layer” is over the “first portion of the second material layer,” and the “landing pad” is over the “second portion of the second material layer.” Prelim. Resp. 26 (citing *id.* at 9–15). Patent Owner also argues that the “first portion” and the “second portion” do not overlap and are distinct, and the “first material layer” and “landing pad” are over the respective portions of the “second material layer.” *Id.*

On this record, we are persuaded that Petitioner sufficiently shows that Lee teaches or suggests the limitations of claim 1 and provides adequate reasons why a POSITA would have modified Lee to arrive at the subject matter of claim 1. *See* Pet. 60–70 (and evidence cited therein).

We acknowledge that Patent Owner disagrees, but find that we either have concerns about Patent Owner’s arguments, or that Patent Owner’s arguments raise issues that are best resolved on a full record.

For example, we have concerns about Patent Owner’s arguments that appear to limit the construction of claim 1 to the embodiment of Figure 8 of the ’838 patent. Neither the plain claim language itself, nor the Specification, clearly require that the first and second portions of the second material not overlap with each other, that the “first material layer defines the ‘first portion’ of the second material layer,” or that the “landing pad defines the ‘second portion’ of the second material layer.” Significantly, the portions of the ’838 patent cited by Patent Owner relate to embodiments of the invention. *See* Pet. 11–15 (citing Ex. 1001, 1:47–54, 3:5–32, Figs. 4, 5,

7, 8); *see also* Ex. 1001, 1:47–54 (discussing “some embodiments” of the invention), 9:40–57 (discussing the embodiment of Fig. 8), 3:5–32 (stating figures 1–9 illustrate views of structure or a flowchart according to “some embodiments” of the invention).

Additionally, the ’838 patent itself states that the invention is not limited to the specific embodiments or configurations disclosed in the Specification. *See, e.g.*, Ex. 1001, 3:36–43 (stating that although “specific configurations and arrangements are discussed, it should be understood that this is done for illustrative purposes only,” that “other configurations and arrangements” are possible); *see also id.* at 3:44–56 (stating that references to an embodiment or to “some embodiments” indicate that “the embodiment described can include a particular feature, structure, or characteristic, but every embodiment can not necessarily include the particular feature, structure, or characteristic”). As such, at this stage of the proceeding, we do not understand claim 1 to be limited to the “specific arrangement” that is shown in Figure 8 of the ’838 patent. *See Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004) (stating “a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment”).

Additionally, whether or not Lee’s layer 22 (the asserted first material layer) can be disposed over the entirety of the second material layer (layer 25), and not just over the first portion of the second material layer, is an issue best resolved on a full record. *See, e.g.*, Pet. 62 (stating the claims do not prohibit the first material layer (insulating layer 22) from also covering other portions of the second material layer (conductive layer 25) beyond the first portion of the second material layer); Prelim. Resp. 9–15, 27–31 (presenting counter argument).

Because Petitioner demonstrates that at least one claim of the '838 patent meets the threshold for institution, we institute a post-grant review for all claims as challenged in the Petition based on all alternative arguments, including Petitioner's argument that challenged claims would have been obvious over Lee. *See* 37 C.F.R. §§ 42.208(a), (c); *SAS Inst. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018).

F. Grounds 2, 4, 5

Petitioner asserts that claims 3 and 18 would have been obvious over Kim and Yang (ground 2), that claims 3 and 13 would have been obvious over Lee and Haller (ground 4), and that claims 13–15 would have been obvious over Lee and Park (ground 5). Pet. 54–59, 77–88. Patent Owner does not specifically challenge Petitioner's contentions as to these dependent claims. *See* Prelim. Resp. 32. Because Petitioner demonstrates that at least one claim of the '838 patent meets the threshold for institution, we institute a post-grant review for all claims as challenged in the Petition based on all alternative arguments, including the claims challenged in grounds 2, 4, and 5. *See* 37 C.F.R. §§ 42.208(a), (c); *SAS Inst.*, 138 S. Ct. at 1359–60.

III. CONCLUSION

Based on the arguments in the Petition, and the evidence of record, we determine that Petitioner has sufficiently demonstrated that the '838 patent is eligible for post-grant review. Additionally, we determine that Petitioner has demonstrated, on the current record, that it is more likely than not that at least one claim of the '838 patent is unpatentable. Thus, we institute a post-grant review of all challenged claims on all the grounds presented.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that that that a post-grant review is instituted with respect to all of the grounds asserted in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 324(d) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which shall commence on the entry date of this Decision.

PGR2025-00021
Patent 12,010,838 B2

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