

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.

IPR2024-00788
Patent 10,658,378 B2

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

CYGAN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. *Background and Summary*

Micron Technology, Inc. (“Petitioner”) filed a Petition requesting an *inter partes* review of claims 15–17, 19, and 20 of U.S. Patent No. 10,658,378 B2 (Ex. 1001, “the ’378 patent”). Paper 1 (“Pet.”). The Petition is supported by a declaration from Dr. Jack C. Lee. Ex. 1003 (“Lee Declaration”). Yangtze Memory Technologies Company, Ltd. (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 12 (“Prelim. Resp.”). On that record, we instituted an *inter partes* review as to all asserted claims of the ’378 patent, claims 15–17, 19, and 20, on all asserted grounds of unpatentability. Paper 13 (“Inst. Dec.”).

Patent Owner filed a Response accompanied by a declaration from Dr. Woodward Yang. Paper 17 (“PO Resp.”); Ex. 2005 (“Yang Dec.”). Patent Owner also filed a deposition of Dr. Lee. Ex. 2007 (“Lee Dep.”). Petitioner filed a Reply accompanied by a second declaration from Dr. Lee. Paper 20 (“Pet. Reply”); Ex. 1037 (“Lee Reply Dec.”). Patent Owner filed a Sur-reply. Paper 23 (“PO Sur-reply”). We held an oral hearing on September 4, 2025, and a transcript is included in the record. Paper 35 (“Tr.”).

B. *Real Parties-in-Interest*

Petitioner identifies itself and its subsidiaries, including Micron Consumer Products Group LLC, as real parties-in-interest. Pet. 5. Patent Owner identifies itself as a real party-in-interest. Paper 3, 2.

C. *Related Matters*

The parties represent that the ’378 patent is involved in *Yangtze Memory Technologies Company, Ltd. v. Micron Technology, Inc. and Micron Consumer Products Group, LLC*, Case No. 3:23-cv-05792-RFL

(N.D. Cal., filed November 9, 2023). Paper 3, 2; Pet. 5. The '378 patent is the subject of IPR2024-00909.

Petitioner also identifies a number of IPRs challenging other patents asserted in the district court case, namely U.S. Patent Nos. 10,950,623 (IPR2024-00794), 10,861,872 (IPR2024-00789), 10,868,031 (IPR2024-00790), 10,937,806 (IPR2024-00791), 11,501,822 (IPR2024-00795), 11,468,957 (IPR2024-00792), and 11,600,342 (IPR2024-00793). Pet. 5–6.

D. The '378 Patent

The '378 patent is titled “Through Array Contact (TAC) For Three-Dimensional Memory Devices.” Ex. 1001, code (54). The '378 patent issued from Application No. 16/047,182, filed on July 27, 2018, and is a continuation of PCT/CN2018/085421, filed on May 3, 2018. *Id.* at code (63). The '378 patent relates to “a channel hole plug structure of three-dimensional (3D) memory devices.” *Id.* at 1:32–33.

E. Illustrative Claim

Claim 15 is illustrative and recites as follows:¹

[15.PRE] A three-dimensional (3D) memory device, comprising:

[15.A] a substrate with an isolation structure;

[15.B] an alternating conductor/dielectric layer stack disposed on the substrate;

[15.C] a dielectric structure on the isolation structure and extending vertically through the alternating conductor/dielectric layer stack, wherein the alternating conductor/dielectric layer stack abuts a sidewall surface of the dielectric structure and the dielectric structure is formed of a dielectric material;

¹ Bracketed organization added as per the Petition.

[15.D] channel structures and slit structures extending vertically through the alternating conductor/dielectric layer stack;

[15.E] a staircase structure disposed in the alternating conductor/dielectric layer stack, wherein the staircase structure comprises levels with each level having a conductor layer thereon;

[15.F] a word line contact disposed on the conductor layer of the each level;

[15.G] local contacts disposed on the channel structures and the slit structures; and

[15.H] through array contacts (TACs) extending vertically through the dielectric and the isolation structures.

Ex. 1001, 24:45–67.

F. Evidence

Petitioner relies on the following patent document evidence.

Name	Patent Document	Exhibit
Toyama et al. (“Toyama”)	US 2017/0179026 A1	1005
Mushiga et al. (“Mushiga”)	US 10,354,980 B1	1006
Makala et al. (“Makala”)	US 10,262,945 B2	1007

G. Prior Art and Asserted Grounds

Petitioner asserts that claims 15–17, 19, and 20 would have been unpatentable on the following grounds (Pet. 6–7):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
15–17, 19, 20	103 ²	Toyama

² We apply AIA 35 U.S.C. §§ 102, 103 to the ’378 patent because it was filed after, and never claimed the benefit of an effective filing date before,

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
15–17, 19, 20	103	Mushiga
15–17, 19, 20	103	Mushiga, Makala

II. ANALYSIS

A. *Legal Standards*

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, “would have been obvious at the time the invention was made to a person having ordinary skill in the art [to which said subject matter pertains].” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of non-obviousness.³ *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. *Level of Ordinary Skill in the Art*

Petitioner asserts that a person of ordinary skill in the art (“POSITA”) at the critical time “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) NAND flash memory devices, or an equivalent level of skill, knowledge, and experience (e.g., an advanced degree may replace some of the professional experience).” Pet. 27 (citing Ex. 1003 ¶¶ 36–37). Petitioner further asserts

March 16, 2013. Petitioner also applies AIA §§ 102 and 103. *See* Pet. 2, 24–26.

³ Neither party presented evidence or arguments regarding objective evidence of non-obviousness during trial.

that a POSITA “would also have been aware of and generally knowledgeable about semiconductor manufacturing and 3D NAND’s structure, its component parts, how it operates, and how it is controlled.” *Id.* (emphasis omitted). Patent Owner does not object to this assessment. PO Resp. 12. We adopt Petitioner’s proposed level of ordinary skill, as it appears to be consistent with the specification of the ’378 patent and the prior art of record.

C. Claim Construction

In an *inter partes* review, we construe a patent claim “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).” 37 C.F.R. § 42.100(b). Under this standard, the words of a claim generally are given their “ordinary and customary meaning,” which is the meaning the term would have to a person of ordinary skill at the time of the invention, in the context of the entire patent including the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). In the Petition, Petitioner asserted that the claims should receive their plain and ordinary meaning. Pet. 27.

Patent Owner sets forth explicit claim construction of the following terms: “a dielectric structure on the isolation structure” (claim 15), “a substrate with an isolation structure” (claim 15), “the dielectric and the isolation structures” (claim 15), and “the dielectric structure comprises a through array contact region of the 3D memory device” (claim 17). PO Resp. 13–29.⁴ Petitioner disputes each of these constructions. Pet. Reply 5–

⁴ Patent Owner states that none of the claim constructions at issue in the parallel district court proceeding are at issue in this *inter partes* review proceeding. PO Resp. 11–12. Patent Owner did not, in its Response,

15. We did not expressly construe any terms in our Decision on Institution, except in regards to whether the prior art fell within the scope of some of those terms. Inst. Dec. 6–7. To the extent that any construction in this Final Written Decision varies from the Institution Decision, such variance is due to the arguments and evidence submitted by the parties during post-institution briefing. Patent Owner states that proposed claim constructions have been exchanged in the parallel district court proceeding, but those constructions do not impact the issues raised by Patent Owner. PO Resp. 13 (citing Exs. 2003–2004).

1. *“a dielectric structure on the isolation structure” (claim 15)*

Patent Owner proposes that “on” in the context of “a dielectric structure on the isolation structure” should be “construed to mean ‘above’ in the z-direction (the vertical direction) when the substrate is positioned in the lowest plane of the semiconductor device in the z-direction.” PO Resp. 13. Patent Owner cites the specification of the ’378 patent, which reads,

As used herein, whether one component (e.g., a layer or a device) is “on,” “above,” or “below” another component (e.g., a layer or a device) of a semiconductor device (e.g., 3D memory device 200) is determined relative to substrate 202 in the z-direction (the vertical direction) when the substrate is positioned in the lowest plane of the semiconductor device in the z-direction.

PO Resp. 14 (emphasis omitted); Ex. 1001, 7:37–43.

Petitioner does not dispute Patent Owner’s construction, asserting that its grounds render obvious this limitation under Patent Owner’s construction

propose construction of the term “through array contact,” which was at issue in the Preliminary Response and in the parallel district court proceeding. *Id.* Nor have the parties indicated, in response to Board inquiry, that any relevant construction has occurred. *See* Paper 34.

and that Patent Owner does not assert otherwise. Pet. Reply 5–6. We agree with Petitioner that Patent Owner does not dispute this aspect of the “a dielectric structure on the isolation structure” limitation in Petitioner’s assertions based on Toyama. PO Sur-reply 20–21. Patent Owner does dispute that Mushiga’s insulating spacer 586 is “on” the isolation structure. PO Resp. 70–72. However, because Petitioner relies upon a dielectric structure that includes other portions of Mushiga that Patent Owner does not dispute to be on the asserted isolation structure, the dispute is whether Petitioner is correct to include multiple components as part of a single dielectric structure, and not whether spacer 586 is on an isolation structure. *Id.*

Because Petitioner’s assertions and our determination would be unaffected by its proposed construction, we need not construe this term. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (noting that “we need only construe terms ‘that are in controversy, and only to the extent necessary to resolve the controversy’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

2. “a substrate with an isolation structure” (claim 15)

Patent Owner proposes that “a substrate with an isolation structure” should be construed as requiring that the isolation structure is part of the substrate. PO Resp. 19 (citing Ex. 2005 ¶ 57). Patent Owner contends that the isolation structure is recited in the claims only in reference to the recited substrate. *Id.* Patent Owner further contends that the ’378 patent consistently depicts the isolation structure in a shallow region in the upper portion of the substrate. *Id.* at 19–21 (citing Ex. 1001, Fig. 2, 12:54–66 (“According to some embodiments, substrate 202 includes isolation

regions”), 20:38–42 (“In some embodiments . . . a dielectric structure . . . on an isolation region of the substrate”), 21:7–13 (“In some embodiments . . . forming an isolation structure on a substrate”), 22:27–28 (“In some embodiments . . . a substrate with an isolation structure”)) (emphasis omitted).

Patent Owner’s citations to the Specification do not support its proposed construction. Patent Owner relies on multiple embodiments, only one of which describes a substrate “with” an isolation structure. PO Resp. 21 (citing Ex. 1001, 22:27–28). For example, one of Patent Owner’s cited embodiments recites “on” an isolation region, but Patent Owner specifically argues that the “on” embodiment does not apply to the claimed “with” embodiment. *Id.* at 22 (denying that “the ‘with’ relationship encompass[e]s the ‘on’ relationship”). Only one of the embodiments cited is clearly within the scope of the “with” claim language, and that embodiment describes no more than the claim language itself. Ex. 1001, 22:27–28. Moreover, Figure 2, cited by Patent Owner, is an illustration “according to some embodiments,” but is not described as depicting all embodiments. Ex. 1001, 3:35–36. These other embodiments need not be included in claim 15’s “with” language because other claims (not at issue in this proceeding) specifically recite language from other embodiments. Ex. 1001, 23:20–21 (“a dielectric structure on an isolation region of the substrate”), 23:58 (“forming an isolation structure on a substrate”). Thus, the specification of the ’378 patent does not limit “a substrate with an isolation structure” in claim 15 to “part of” an isolation structure, such as in a shallow region or other partial-depth portion of the substrate.

Because neither the language of claim 15 nor the Specification indicates a narrower meaning, we agree with Petitioner that the phrase “a

substrate with an isolation structure” should be given its plain meaning. Patent Owner argues that the plain meaning of “with” is “having” or “inclusive of.” PO Sur-reply 2 (citing Ex. 1038, 7). Citing the same dictionary, Petitioner argues that the plain meaning of “with” includes objects that are separate. Pet. Reply 3 (stating, “In the sentence ‘Alice went to school *with* Bob,’ it would be nonsensical to interpret that to mean that Bob is *part of* Alice.”) (citing Ex. 1038, 7). The cited definition of “with” states that it may indicate “accompaniment,” such as “went there [with] her,” as well as combination (“milk [with] honey”). Ex. 1038, 7. Based on the evidence and arguments presented, we determine that the phrase “a substrate with an isolation structure” should be given its plain meaning, which includes accompaniment (A is accompanied by B) as well as combination (A is part of B, or A and B are a part of C).

3. *“through array contacts (TACs) extending vertically through the dielectric and the isolation structures” (claim 15)*

We need not construe this term for purposes of this decision, because we find, and Patent Owner does not dispute, that Toyama’s First Exemplary Structure discloses this limitation. *Infra* § II.D.2; PO Resp. 51–52; Pet. 68–70 (citing Ex. 1005, Fig. 17A). Further, we determine that Petitioner’s assertions based upon Toyama’s First Exemplary Structure show, by a preponderance of evidence, the obviousness of the claims at issue. Thus, our construction does not affect our overall determination on unpatentability of claim 15 or any other claim. However, this construction is relevant to Petitioner’s alternative argument that the challenged claims would have been obvious over Toyama’s Second Modification. *See* PO Resp. 57–60. As such, we provide the following construction to promote compact decision making, including provision of a complete treatment of the issues in the

event of a Director Review decision or Federal Circuit appeal. “Final Written Decision Procedures for AIA Trial Proceedings,” <https://www.uspto.gov/sites/default/files/documents/20250729095727582.pdf>.

Claim 15 recites, *inter alia*, “a dielectric structure on the isolation structure” and “through array contacts (TACs) extending vertically through the dielectric and the isolation structures.” Patent Owner contends that “the dielectric and the isolation structures” in “through array contacts (TACs) extending vertically through the dielectric and the isolation structures” should be construed as “the dielectric structure and the isolation structure.” PO Resp. 23. Patent Owner further asserts that under this construction, claim 15 requires that multiple TACs extend through a single dielectric structure. *Id.* at 26. Petitioner disagrees and asserts that the claim encompasses multiple through array contacts that each extend through a separate dielectric structure. *See* Pet. 66–68; Reply 8; Ex. 1037 ¶ 26.

We begin with Patent Owner’s arguments based upon the express language of claim 15. Patent Owner argues that the antecedent basis for “the dielectric and the isolation structures” of element [15.H] is found in “a dielectric structure” and “an isolation structure” from limitations [15.A] and [15.C], which is the only reason why “structures” in limitation [15.H] is plural. *Id.* at 23–24 (citing Ex. 2005 ¶ 67). In other words, Patent Owner asserts that antecedent basis for “the dielectric and the isolation structures” is “a dielectric structure” and “an isolation structure,” not multiple dielectric structures or multiple isolation structures, as these are not recited earlier in the claim. *Id.* at 23 (citing Ex. 2005 ¶ 69). Patent Owner admits that “the claims do not preclude multiple dielectric structures or multiple isolation structures,” so long as the plurality of TACs extend through one of each. *Id.* at 24–25 (citing Ex. 2005 ¶ 69).

We do not agree that the express language of claim 15 clearly requires multiple TACs that each extend through at least one dielectric structure and at least one isolation structure. Although the dielectric and isolation structures are singly described in limitations [15.A] and [15.C], Dr. Yang admits that the claim may include multiple dielectric structures and multiple isolation structures. Ex. 2005 ¶ 69. Because claim 15 requires multiple TACs and permits multiple dielectric structures and multiple isolation structures, claim 15 does not bar, for example, two TACs and two dielectric/isolation structures, in which a single TAC extends through one dielectric structure and isolation structure and the other single TAC extends through another dielectric structure and isolation structure. Dr. Yang provides no reasoned explanation of why the language of claim 15 requires that multiple TACs must go through a single dielectric structure and a single isolation structure, providing only a conclusory statement. *Id.*

Patent Owner argues that “even if the claims cover ‘one or more’ of an element, there must still be at least one instance of the element . . . that meets all of the requirements of the claim for that element.” PO Resp. 26–27 (citing *Finjan LLC v. SonicWall, Inc.*, 84 F.4th 963, 974–75 (Fed. Cir. 2023)). It is true that when determining whether claim limitations are restrictive as to number, “context matters.” *In re Varma*, 816 F.3d 1352, 1362 (Fed. Cir. 2016). But this is not a situation in which “a dog that rolls over and fetches sticks” is read as permitting “two dogs, each able to perform just one of the tasks.” *Id.* at 1363. Here, Dr. Yang testified that claim 15 is not restricted to a single dielectric structure and a single isolation structure. Ex. 2005 ¶ 69. Thus, claim 15 requires multiple TACs, and

permits multiple dielectric structures and multiple isolation structures,⁵ and the express language of claim 15 does not specify how many TACs must pass through each of the multiple dielectric structures and multiple isolation structures.

Turning to the description in the '378 patent, the parties dispute the relevance of a single-TAC embodiment to the interpretation of claim 15. Patent Owner argues that this embodiment describes “formation of a single TAC, not a plurality of TACs extending through a single dielectric structure and a single isolation structure. PO Resp. 25–26 (citing Ex. 1001, 21:17–25). Patent Owner argues that claim 15 does not, and does not need to, encompass this description of a single TAC extending through a dielectric structure and an isolation structure, because claim 15 recites, and is limited to, multiple TACs. *Id.* at 25. Petitioner argues that Patent Owner’s construction improperly excludes this embodiment. Pet. Reply 8–9 (citing Ex. 1037 ¶ 27).

Patent Owner relies on Figure 2 of the '378 patent to support its argument that claim 15’s “structures” refers to both the isolation structure and the dielectric structure, not to multiple dielectric structures or multiple isolation structures. PO Resp. 24 (stating that Figure 2 depicts two TACs extending through a single dielectric structure and a single isolation structure). *Id.* However, Figure 2 is described as illustrating “some embodiments,” not every embodiment, of the '378 patent. Ex. 1001, 3:35–36; *see also id.* at 4:2–3 (“every embodiment may not necessarily include the particular feature”). An exemplary described embodiment, even if it is the

⁵ To continue *Varma*’s analogy, here there are multiple dogs (TACs) fetching sticks (dielectric/isolation structures), with no limitation as to how many dogs fetch each stick.

sole embodiment, is not limiting on the claims where the claims do not recite such limitations. *See Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004). Thus, claim 15 is not limited to the embodiment of Figure 2.

We acknowledge Patent Owner’s argument that the single-TAC embodiment is “irrelevant, since it does not include the claimed plurality of TACs.” PO Sur-reply 11. But Petitioner provides an explanation of relevance; i.e., that the single-TAC embodiment is a description of a relationship between each TAC and each of the device’s dielectric structures, which would be understood to describe the individual TAC configuration of a multiple-TAC device. Pet. Reply 8–9 (citing Ex. 1001, 21:7–25; Ex. 1037 ¶ 27). Petitioner’s explanation is consistent with Patent Owner’s description of the single-TAC embodiment as a method of forming both individual TACs and multiple TACs. PO Resp. 26 (citing Ex. 1001, 21:17–25 as “the formation of a single TAC”); *id.* at 2 (citing Ex. 1001, 10:30–33, 21:17–25 as describing that “the lower portions of the TACs extend” through an isolation structure having a dielectric structure thereon). Because Patent Owner discusses the single-TAC embodiment of the ’378 patent as a method for forming the multiple TACs of claim 15, we agree with Petitioner that the single-TAC embodiment should be considered when evaluating the scope of claim 15.

Based on the arguments and evidence, we determine that the ’378 patent does not “provide[] a clear expression of intent to limit” the broad scope of claim 15 to Patent Owner’s preferred configuration. *Info-Hold, Inc. v. Applied Media Techs. Corp.*, 783 F.3d 1262, 1266 (Fed. Cir. 2015). The ’378 patent’s description supports not only Patent Owner’s narrow construction of claim 15 (that requires the claimed TACs to extend through

the same dielectric structure) but also Petitioner’s broader construction (that also encompasses the claimed TACs extending vertically through multiple, separate dielectric structure) Because Patent Owner’s proposed construction is narrower than the plain language of the claim, we do not adopt it.

Patent Owner also argues that we have determined, in another *inter partes* review proceeding on “a related patent that shares the same specification,” that the claim language “requires multiple TACs to extend vertically through a single dielectric structure.” PO Sur-reply 12 (citing Ex. 2006 (IPR2024-00791, Institution Decision), 17–18). However, the claim at issue in that proceeding recites, “a plurality of through array contacts (TACs) extending vertically through the dielectric structure,” language that is not present in claim 15. Ex. 2006, 8. Thus, our determination here is not inconsistent with our preliminary determination in the related proceeding.

For the foregoing reasons, we determine that the scope of claim 15 encompasses multiple instances of a single TAC extending through a dielectric structure and an isolation structure.

4. *“the dielectric structure comprises a through array contact region of the 3D memory device” (claim 17)*

In the Petition, Petitioner submitted this language should receive its plain and ordinary meaning. Pet. 27. Patent Owner submits that this language “should be construed as ‘a region that is within or defined by the dielectric structure and which includes the through array contacts extending through the dielectric structure.’” PO Resp. 27. Patent Owner emphasizes that the claim language states that the dielectric structure “comprises”; i.e., includes therein, the TAC region. *Id.* at 27–28. Therefore, Patent Owner reasons, claim 17 requires the TAC region to be part of the dielectric

structure. *Id.* (citing *CIAS, Inc. v. All. Gaming Corp.*, 504 F.3d 1356, 1360 (Fed. Cir. 2007) (“In the patent claim context the term ‘comprising’ is well understood to mean ‘including but not limited to.’”)). Patent Owner cites to consistent use in the ’378 patent of the TAC region as a region exclusively containing dielectric material having TACs therein. *Id.* at 28–29 (citing Ex. 1001, 6:11–16, 10:21–24; Ex. 2005 ¶¶ 76–77).

Petitioner replies that the ’378 patent uses the term “TAC region” to describe regions that are not nested or coextensive within a dielectric structure, and therefore requires only a region that includes at least one TAC. Pet. Reply 12, 14 (citing Ex. 1001, Figs. 1A–1C (TAC regions 102, 104, 106)). Petitioner points to description in the ’378 patent of “an exemplary TAC region 102” that “includes NAND string regions 110, a TAC region 120, and top selective gate (TSG) staircase regions 130.” Pet. Reply 12–13; Ex. 1001, 5:65–67. Petitioner further notes that although TAC region 120 may be “defined by a single-material dielectric structure,” TAC region 102 extends beyond the dielectric material and includes other materials and components, such as NAND string regions and TSG staircase regions. Pet. Reply 12–13; Ex. 1001, 5:65–67, 6:13–14. As asserted by Petitioner, the ’378 patent describes two regions, region 102 and region 120 nested therein, as TAC regions, and both meet its definition of a region that includes at least one TAC.

Nevertheless, we agree with Patent Owner that because claim 17 refers to a *dielectric structure that comprises* a TAC region, claim 17 is represented by description of regions such as TAC region 120, which is a dielectric structure 124 that contains TACs 126. Ex. 1001, 6:11–16. The term “comprising” means that the named elements are “essential” or “included,” although other elements may also exist therein. *See Genentech*,

Inc. v. Chiron Corp., 112 F.3d 495, 501 (Fed. Cir. 1997); *Mars, Inc. v. H.J. Heinz Co., L.P.*, 377 F.3d 1369, 1376 (Fed. Cir. 2004). Claim 17 requires a dielectric structure to comprise a TAC region, and does not encompass TAC region 102, which is a *region that comprises a dielectric structure* 120 and TACs 126. Ex. 1001, 5:65–67. Although the ’378 patent uses the term “TAC region” to describe two different regions in the memory device, only one region, TAC region 120, meets the express language of claim 17. Consequently, we adopt Patent Owner’s proposed construction, and construe “the dielectric structure comprises a through array contact region of the 3D memory device” as recited in claim 17 to mean “a region that is within or defined by the dielectric structure and which includes the through array contacts extending through the dielectric structure.”⁶

D. Obviousness over Toyama

Petitioner asserts that claims 15–17, 19, and 20 are unpatentable under 35 U.S.C. §103 as obvious over Toyama in view of the knowledge of a person of ordinary skill in the art. Pet. 28–77. Patent Owner argues against this assertion. PO Resp. 37–63.

Upon consideration of Petitioner’s explanations and the totality of evidence in this current record, we are persuaded that Petitioner has shown, by a preponderance of the evidence, that claims 15–17, 19, and 20 are unpatentable under 35 U.S.C. § 103 as obvious over Toyama.

⁶ Our construction of claim 17 addresses each individual dielectric structure of claim 15, and preserves our construction that encompasses multiple instances of a single TAC extending through a dielectric structure and an isolation structure. Patent Owner similarly recognizes multiple instances of TAC regions 120 at regions 102, 104, and 106 of the ’378 patent. PO Sur-reply 16.

1. Toyama

Toyama is titled “Through-Memory-Level Via Structures For a Three-Dimensional Memory Device.” Ex. 1005, code (54). Toyama relates to three-dimensional NAND memory devices, such as vertical NAND strings, and describes four exemplary structures and modifications thereof. Ex. 1005 ¶¶ 4, 14–155. Pertinent to the instant proceeding, Toyama describes a “first exemplary structure,” illustrated in Figures 1 through 17. *Id.* ¶¶ 14–48. The First Exemplary Structure is illustrated by Figure 11A:

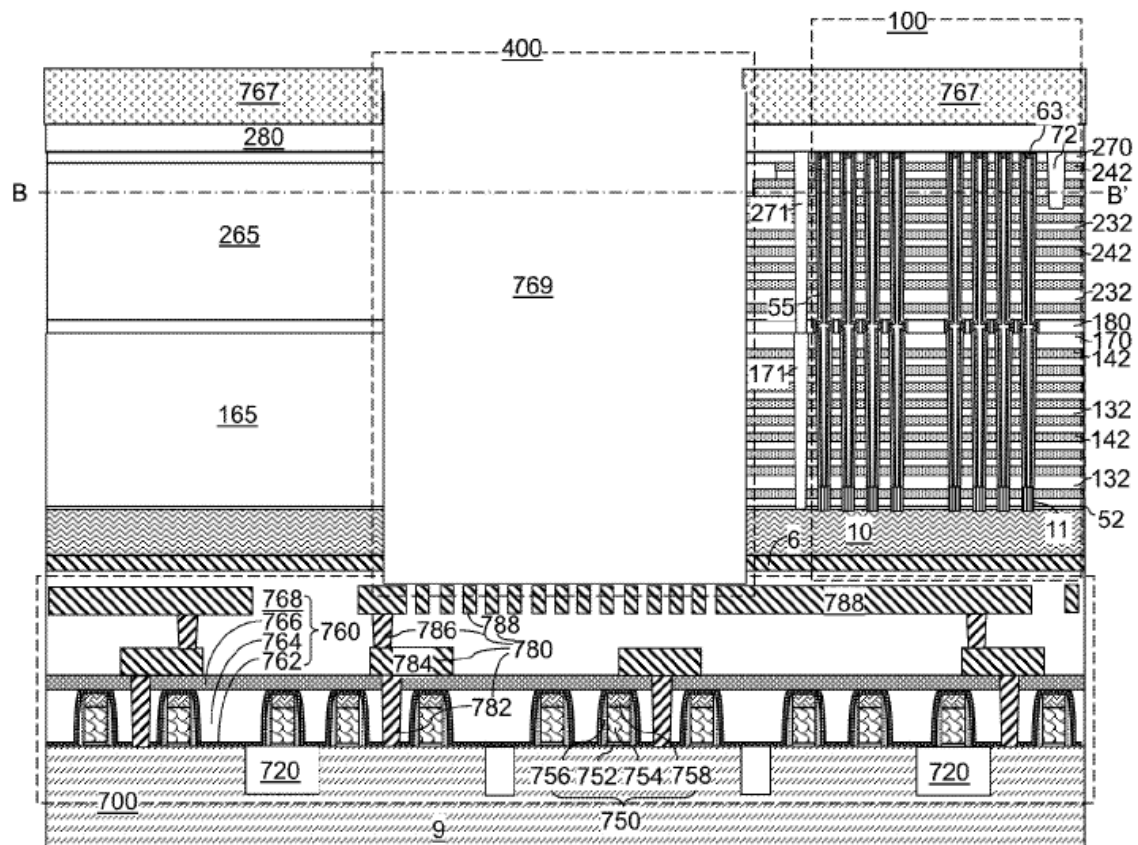


FIG. 11A

Figure 11A depicts semiconductor substrate 9 having semiconductor devices 710 formed thereon, with shallow trench isolation structures 720 providing electrical isolation therebetween. *Id.* ¶ 162. At least one dielectric layer 760 is formed over the semiconductor devices, and lower

level metal interconnect structures 780 formed thereon to function as landing pads for through-memory-level via structures. *Id.* ¶ 164. Upon these structures in underlying peripheral region 700, a planar semiconductive layer 10 is formed. On semiconductor layer 10 is an alternating stack of conductive layers 146, 246 (replacing sacrificial material layers 142, 242) and insulating layers 132, 232. *Id.* ¶¶ 172, 196, 228. In portions of the alternating stack, supporting pillar structures 171 are formed, and other portions of the dielectric stack appear as a stepped region. *Id.* ¶182, Fig. 4B. In the stepped region, a through-memory-level opening 769 can extend from the top of the device down to the lower level metal interconnect structures 780 in peripheral region 700. *Id.* ¶ 213. A dielectric fill material portion is formed within each through-memory-level opening 769. *Id.* ¶ 216.

Toyama further describes a “second modification of [a] fourth exemplary structure,” illustrated in Figures 44A through 49. Ex. 1005 ¶¶93–103. The “second modification” is illustrated by Figure 49:

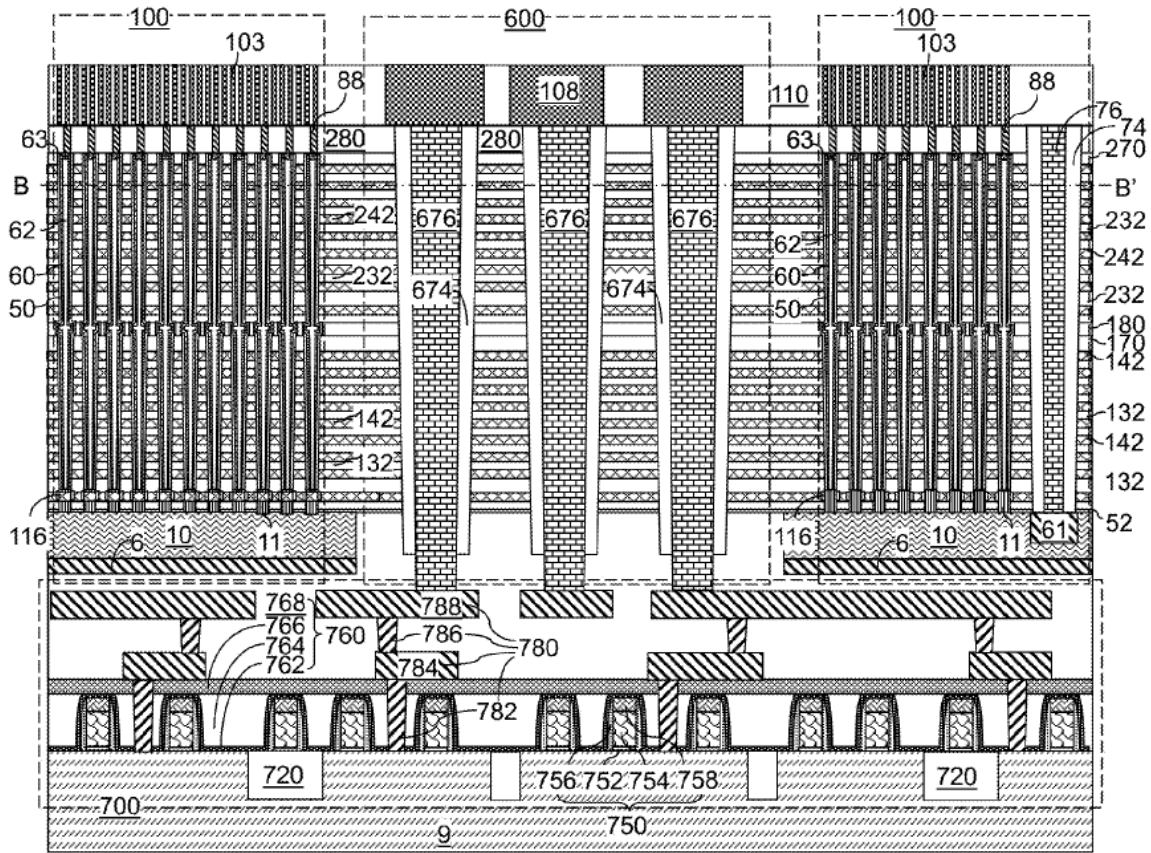


FIG. 49

Figure 49 depicts semiconductor substrate 9 having peripheral region 700, upon which planar semiconductive layer 10 is formed having an alternating stack of conductive layers 146, 246 (replacing sacrificial material layers 142, 242) and insulating layers 132, 232. *Id.* ¶¶ 310–311, 332. Multiple through-memory-level openings 676, surrounded by insulating liners 674, are created within the alternating stack. *Id.* ¶¶ 339–341.

2. Analysis of Claim 15

We begin our analysis of Petitioner's obviousness contentions with Petitioner's assertions as to claim 15.

a) [15.PRE] A three-dimensional (3D) memory device,
comprising: [15.A] a substrate with an isolation structure;

Petitioner asserts that limitations [15.PRE]–[15.A] are taught by Toyama, providing two alternate theories; the first based upon the “Second Modification” of Toyama’s fourth exemplary structure, and the second based upon Toyama’s “First Exemplary Structure.”

(1) “Second Modification” Alternative

In Petitioner’s “Second Modification” alternative, Petitioner points to Toyama’s description of a “3D memory device” that includes “substrate 10” that has an isolation structure in the form of insulating material filling opening 151. Pet. 28–31 (citing Ex. 1005, Fig. 44A, ¶¶ 173, 196, 277, 332; Ex. 1003 ¶¶ 93–94, 99–100). Petitioner annotates Figure 44A to illustrate:

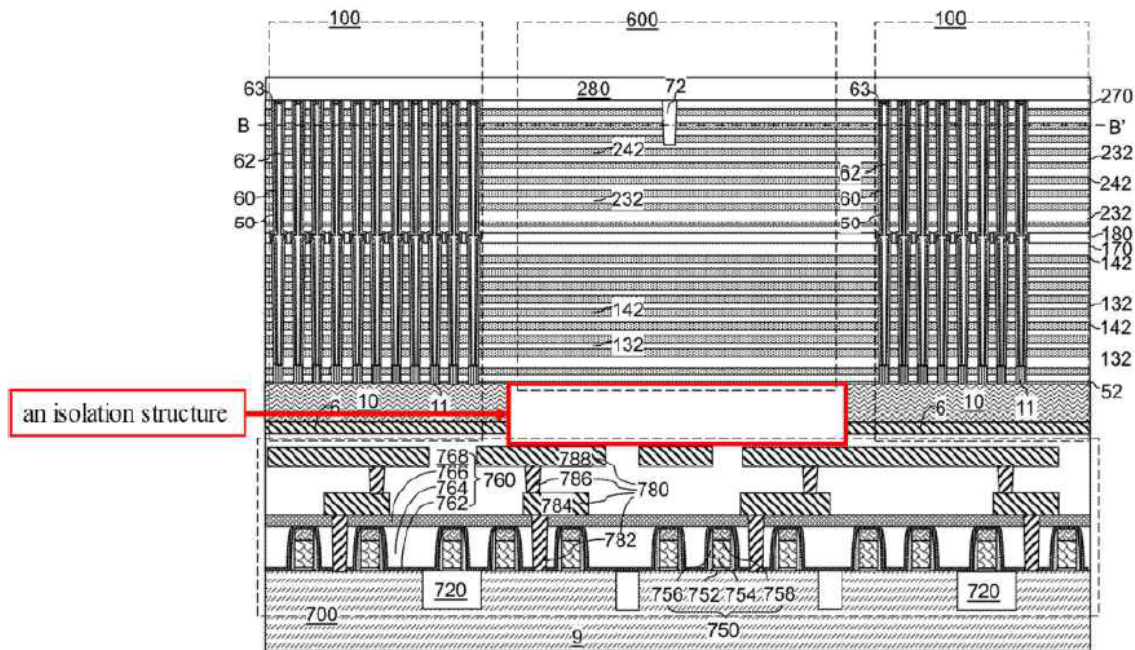


FIG. 44A

Petitioner’s annotated Figure 44A displays a vertical cross-sectional view of a structure having an alternating stack of insulating layers and dielectric spacer layers formed over semiconductor substrate 9, with an annotated red

box captioned as “an isolation structure” situated in the middle of layers 10 and 11. Ex. 1005 ¶ 332.

Patent Owner argues that Toyama’s Second Modification does not teach a substrate with an isolation structure. PO Resp. 53–56. Specifically, Patent Owner argues that the region of Toyama mapped by Petitioner to the “isolation structure” is located in a region of a cut through the alleged substrate, and is not part of the substrate required by Patent Owner’s construction of claim 15. *Id.* at 53–54. Patent Owner argues that Toyama’s insulating material layer 760 is not part of Toyama’s substrate, but instead, exists in a “through-opening” in the substrate, which has been completely removed in the relevant region, causing layer 760 to be in “a region outside and merely abutting the alleged substrate.” *Id.* at 54–55 (citing Ex 1004, Fig. 44A). Thus, Patent Owner argues, “there is no alleged substrate ‘with’ that ‘insulating material layer 760.’” *Id.* at 55.

Patent Owner’s argument is unavailing because it rests on a claim construction that we have not adopted. We have determined that “a substrate with an isolation structure” is not limited to an isolation structure that is part of the substrate, but includes a substrate accompanied by an isolation structure, such as Toyama’s substrate 10 having an opening “filled with” insulating layer 760. *Supra* § II.C.2; Ex. 1005 ¶ 277, Fig. 44A; Pet. 30–31.

For the above reasons, Petitioner has shown that claim elements [15.PRE]–[15.A] are taught by Toyama’s Second Modification.

(2) “*First Exemplary Structure*” *Alternative*

Alternately, Petitioner asserts that Toyama’s “first exemplary structure” teaches an isolation structure in the form of dielectric fill material portion 430 “level with and below the top of” semiconductor material layer

Petitioner's annotated Figure 13A depicts a dielectric fill material portion 430 formed within a through-memory opening 769 formed in through-memory level via regions 400, adjacent to memory array region 100 and word line contact via regions 200. Ex. 1005 ¶¶ 214, 216.

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“with” that dielectric fill material.” *Id.* at 42 (citing Ex. 1005, Figs. 12A, 13A, 14A, ¶¶213–215). Patent Owner points to Toyama’s Figure 12B as illustrating that the substrate is not divided into isolated portions, but remains connected, and therefore does not isolate portions of the substrate from one another as asserted by Petitioner. *Id.* at 42.

Patent Owner’s argument is unavailing because it rests on a claim construction that we did not adopt. We have determined that “a substrate with an isolation structure” is not limited to an isolation structure that is part of the substrate, but includes a substrate accompanied by an isolation structure, such as Toyama’s insulating layer 430 “formed within” opening 769 of semiconductor 10. *Supra* § II.C.2; Ex. 1005 ¶ 216, Figs. 10A–12B; Pet. 33–36.

Consequently, Petitioner has shown that limitation [15.PRE], to the extent limiting, and limitation [15.A] are taught by Toyama’s First Exemplary Structure.

b) *[15.B] an alternating conductor/dielectric layer stack disposed on the substrate;*

Petitioner asserts that Toyama teaches an alternating conductor (146, 246)/dielectric (132, 232) stack disposed on substrate 10. Pet. 36–38 (citing Ex. 1005, Fig. 17A; Ex. 1003 ¶¶ 106–107). Patent Owner does not dispute this assertion. Upon review of the complete record, we determine that Petitioner establishes, by a preponderance of the evidence, that Toyama teaches limitation [15.B].

c) [15.C] a dielectric structure on the isolation structure and extending vertically through the alternating conductor/dielectric layer stack, wherein the alternating conductor/dielectric layer stack abuts a sidewall surface of the dielectric structure and the dielectric structure is formed of a dielectric material;

Petitioner asserts that Toyama teaches the claimed alternating conductor/dielectric stack of limitation [15.C] through Toyama's description of alternating layers of conductive layers (146, 246) and insulating layers (132, 232) which rest on semiconductor layer 10. Pet. 36–38 (citing Ex. 1005, Fig. 17A, ¶¶ 172, 190, 228, 232, 337; Ex. 1003 ¶¶ 106–108). Regarding the claimed “a dielectric structure on the isolation structure,” Petitioner provides two alternative theories, based on Toyama's “Second Modification” and “First Exemplary Structure,” respectively.

(1) “Second Modification” Alternative

Petitioner asserts that Toyama teaches a dielectric structure in the form of multiple insulating liners 674, made of a dielectric material, on an isolation structure in the form of the insulating material filling opening 151. *Id.* at 39–42 (citing Ex. 1005 ¶¶ 338–340, 233, 381, Fig. 49; Ex. 1003 ¶ 111). Petitioner asserts that Toyama's alternating conductor/dielectric stack abuts a sidewall surface of dielectric liners 674, and provides an annotated version of Figure 49 to illustrate this relationship:

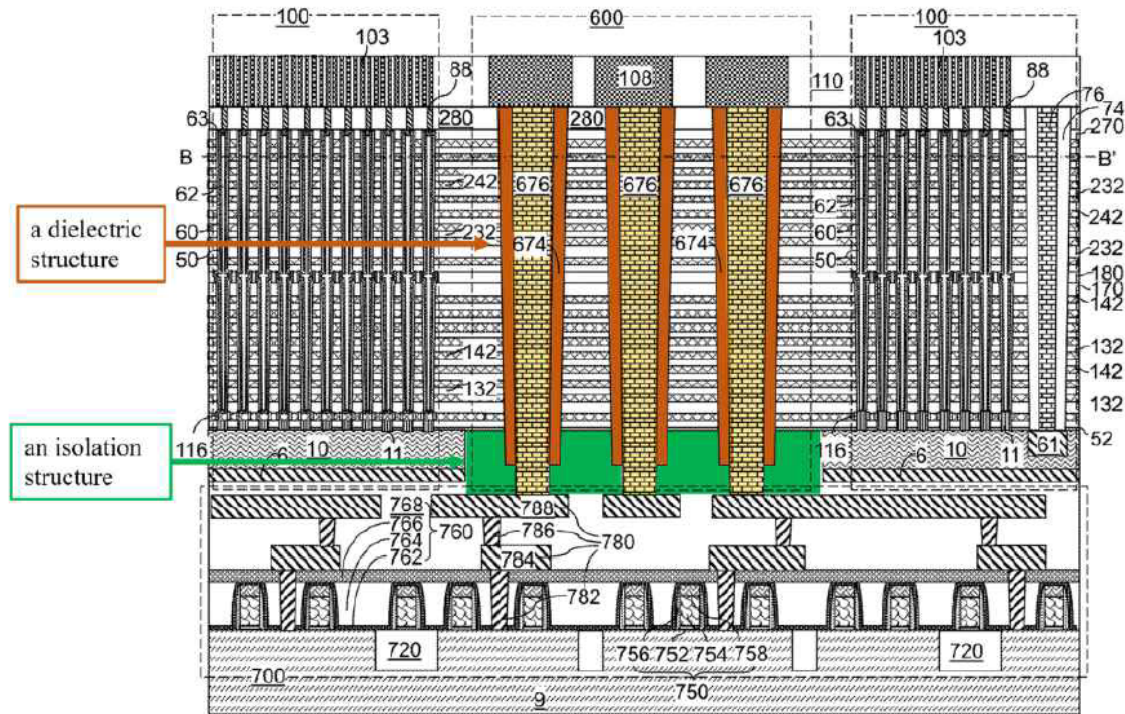


FIG. 49

Annotated Figure 49 depicts through-memory-level via structures 676 that are each laterally electrically isolated from electrically conductive layers (146, 246) by respective insulating liners 674. Ex. 1005 ¶ 380.

Petitioner asserts that limitation [15.C] may be met by Toyama’s individual dielectric liners. Pet. 42 (“A POSITA would thus have understood “insulating liners 674” are individually and collectively *a dielectric structure.*”) (citing Ex. 1003 ¶¶ 110–114), 41 n.7. Patent Owner does not contest that each individual liner is a dielectric structure. We agree that each liner is a dielectric structure because it is an individual construction of a dielectric material. Consequently, Petitioner is persuasive as to its assertion that limitation [15.C] may be met by any of Toyama’s individual dielectric liners in its Second Modification.

Patent Owner also argues that Toyama’s Second Modification does not disclose or render obvious an isolation structure, referring to its

arguments against Petitioner's assertions for limitation [15.A]. PO Resp. 56. However, for the same reasons discussed for limitation [15.A], we do not agree with Patent Owner's arguments with respect to limitation [15.C].

Further, we determine that Petitioner's uncontested assertions for limitation [1.C] are sufficiently supported by the above-cited sections of Toyama. Consequently, we are persuaded by Petitioner that Toyama's Second Modification teaches each and every limitation, including an isolation region of the substrate, as set forth in limitation [1.C].

Although that resolves the issue for limitation [15.C] for Petitioner's assertions based upon Toyama's Second Modification, we acknowledge the presence of an alternative claim construction issue that we resolve to promote compact decision making, including provision of a complete treatment of the issues in the event of a Director Review decision or Federal Circuit appeal. "Final Written Decision Procedures for AIA Trial Proceedings," <https://www.uspto.gov/sites/default/files/documents/20250729095727582.pdf>.

Relying on an alternate construction, Petitioner asserts that the claim limitation "a dielectric structure" may also be taught collectively by Toyama's multiple structures 674 of its Second Modification. Pet. 40–42. Petitioner argues that because all of the dielectric liners 674 were constructed together and have the same function, they meet a dictionary definition of "structure" as "something (as a building) that is constructed." *Id.* at 40–41 (citing Ex. 1005 ¶¶ 338–340; Ex. 1022, 5 (dictionary)). Petitioner further argues that the insulating liners 674 are collectively a single structure because "an indefinite article 'a' or 'an' in patent parlance carries the meaning of 'one or more' in open-ended claims containing the transitional phrase 'comprising.'" *Id.* at 41 (citing *KCJ Corp. v. Kinetic*

Concepts, Inc., 223 F.3d 1351, 1356 (Fed. Cir. 2000)). After institution, Petitioner provided an alternate definition of a structure as “something arranged in a definite pattern of organization.” Pet. Reply 22 (citing Ex. 1022, 5). Petitioner asserted that such a structure need not be contiguous. *Id.* at 21.

As a part of Patent Owner’s arguments relating to limitation [15.H], Patent Owner argues against Petitioner’s assertion that multiple dielectric liners can be considered a single structure. PO Resp. 58–60. Patent Owner argues that the claims and specification of the ’378 patent do not define a “structure” to be anything that is constructed. *Id.* at 60 (citing Ex. 2005 ¶ 149).

Petitioner does not persuade us that merely because the three insulating liners are each constructed, that three constructed liners together constitute a single dielectric structure. Every component of Toyama’s memory device is something that is constructed. The dictionary definition “something . . . that is constructed” relied upon by Petitioner uses the context of “a building”; i.e., a single thing, that is constructed. Ex. 1022, 5. Petitioner’s later-provided definition, “something arranged in a definite pattern of organization,” is used in the context of “a rigid totalitarian structure,” which is not relevant to the language here, and in the context of “leaves and other plant structures,” which implies parts of a single contiguous thing. *Id.*

Dr. Yang’s deposition testimony does not support Petitioner’s over-inclusive definition. Ex. 1040, 45:3–4, 47:3–6. Dr. Yang agreed that a row of stakes could be considered a wall, and a set of stairs connected only on the wall side could be a staircase. *Id.* at 47:3–13. However, Dr. Yang stated that “you have to be careful about whether a structure is one thing or

whether it’s multiple things.” *Id.* at 42:24–32:1. For example, he stated, “if I look at a house, you can say it’s the structure of a house. But if now I was looking at an entire neighborhood and I was looking at how that neighborhood had been damaged by a tornado, I would say multiple house structures were damaged, right? So it’s not just the one structure.” *Id.* at 42:18–23.

Critically, Petitioner does not sufficiently explain why Toyama’s three liners should be considered a single structure, rather than multiple structures. Dr. Lee states that “it is common for a structure to be referred to functionally or collectively even if it includes multiple components or substructures, particularly when they work together to perform a shared role such as electrical isolation.” Ex. 1037 ¶ 33. Yet Dr. Lee does not refer to the three liners collectively as a “liner,” despite the fact that each perform the same role, nor explain how they work together rather than individually. *See* Ex. 1037 ¶ 31 (referring to “multiple noncontiguous liners, each electrically isolating one through array contact”).

KCJ Corp. does not instruct us otherwise. The court in *KCJ Corp.* determined that “a . . . continuous . . . chamber” covers one or more continuous chambers. *KCJ Corp.*, 223 F.3d at 1357. However, these chambers were claimed as part of a single mattress that was “at no point restrict[ed] . . . to only one chamber.” *Id.* at 1353, 1357. Petitioner does not point to any description in the ’378 patent that permits any of its structures to be composed of multiple unconnected parts. Our review of the ’378 patent indicates that a structure may be made of multiple materials, but not that a structure may be made of discontinuous sub-structures. *See* Ex. 1001, 5:50–59 (describing the use of “single-material” dielectric structures in some embodiments, rather than dielectric structures made of “a stack of alternating

dielectric layers”). Because the Petition lacks “an examination of the written description and the prosecution history to ascertain whether to limit the meaning of ‘a’ or ‘an,’” Petitioner fails to apply persuasive force to *KCJ Corp.* *KCJ Corp.*, 223 F.3d at 1356. Although we agree (as does Dr. Lee) that limitation [15.H] may refer to multiple dielectric structures and multiple isolation structures, Petitioner does not persuade us that any particular structure may be composed of noncontiguous components. Consequently, we are not persuaded that Petitioner sufficiently establishes that Toyama’s Second Modification having multiple dielectric liners, considered collectively as a dielectric structure, teaches limitation [15.C].

(2) *“First Exemplary Structure” Alternative*

Petitioner also asserts that Toyama’s “first exemplary structure” illustrated in Figure 15A teaches limitation [15.C]. Pet. 45–54. Petitioner points to dielectric fill material portion 430 as represented in Figure 15A. Pet. 45. Petitioner asserts that a lower portion of dielectric fill material portion 430 teaches the claimed isolation structure and the upper portion of dielectric fill material portion 430 teaches the claimed dielectric structure. *Id.* at 46.

Patent Owner argues that Petitioner has not shown Toyama to teach the claimed isolation structure, referencing its arguments for limitation [15.A]. PO Resp. 46. We find this argument unavailing for the same reasons explained with respect to limitation [15.A]. *Supra* at § II.D.2.

(a) *Toyama’s unitary structure*

Petitioner asserts that “[n]othing in the language of the claim requires forming the structures in different steps or of different materials, nor is there a clear disavowal of such in the specification. On the contrary, the 378 Patent’s disclosure expressly broadens ‘isolation structure’ beyond the

disclosed embodiment.” Pet. 46 (citing Ex. 1001, 10:34–35). Petitioner asserts that the dielectric structure in both Toyama and the ’378 patent have the same purpose; i.e., “to electrically insulate a ‘through array contact’ as it extends through” a device portion. *Id.* at 46–47 (citing Ex. 1001, 11:12–14; Ex. 1003 ¶ 120). Petitioner cites to *Retractable Technologies, Inc. v. Becton, Dickinson & Co.* for the proposition that different parts of the same structure can meet distinct claim elements. *Id.* at 47 (citing *Retractable Techs., Inc. v. Becton, Dickinson & Co.*, 653 F.3d 1296, 1303–04 (Fed. Cir. 2011)).

Patent Owner argues, “Petitioner arbitrarily and improperly divides Toyama’s single dielectric structure into two regions and maps different regions to two separate features of the Challenged Claims: the ‘dielectric structure’ and the ‘isolation structure.’” PO Resp. 45–48. Patent Owner argues that the ’378 patent describes “the dielectric structure [a]s a separate structure on the isolation structure,” unlike Toyama’s unitary structure. *Id.* at 46–48 (citing Ex. 1001, Fig. 2; Ex. 2005 ¶ 103). Patent Owner argues that “the ’378 [patent] teaches forming the isolation structure in the substrate and then depositing the dielectric structure on the isolation structure, resulting in two distinct, identifiable structures” which have “a claimed spatial relationship.” *Id.* at 49 (citing Ex. 2005 ¶¶ 105–106).

Patent Owner argues that *Retractable Technologies* is inapposite because that case involved clear claim language conveying that the structures could be part of one another, and the specification in that case suggested that they could be formed integrally. PO Resp. 50 (citing *Retractable Techs.*, 653 F.3d at 1303). Patent Owner argues that no such statements suggesting integral formation are present in the ’378 patent’s

claims or specification. *Id.*; PO Sur-reply 9. Patent Owner further argues that “there is a boundary” between the two structures. *Id.*

We are persuaded by Petitioner that the lower volume of Toyama’s dielectric fill portion teaches the isolation structure and the upper volume of Toyama’s dielectric fill portion teaches the dielectric structure. First, the ’378 patent indicates that both the dielectric structure and the isolation structure may be the same material; i.e., SiO₂. Ex. 1001, 10:37–40 (isolation structure 233 filled with SiO₂), 10:46–47 (dielectric structure can include SiO₂, and can include the same material as dielectric layer 230), 10:12–14 (dielectric layer 230 is formed of SiO₂). Second, the ’378 patent indicates that the dielectric structure may be “aligned to” and “in contact with” the isolation structure. *Id.* at 10:30–36. Thus, the two structures of the ’378 patent may appear as two aligned and contacting structures; e.g., a single column, of the same material.

Third, the ’378 patent specification describes that the dielectric structure and a top portion of the isolation structure may be formed in the same deposition step. When etching the opening 600 that is to be filled with dielectric structure 232, “opening 600 may extend partially into STI structure 233;” i.e., “the etch process used to form opening 600 may also remove (recess) portion of the top surface of STI structure 233.” *Id.* at 15:12–20. Then, “opening 600 can be filled with a dielectric layer 702,” which may be the same SiO₂ material as the isolation structure, and “[a]s a result, dielectric structure 232 is formed.” *Id.* at 15:42–54. Thus, the ’378 patent describes a dielectric structure that partially replaces or re-forms, with the same material, its isolation structure. The ’378 patent does not mention whether this results in a dielectric structure that extends into the isolation structure or an isolation structure re-filled to its original height, and it would

not appear to matter because both structures may be composed of the same material. The '378 patent's indifference to the exact boundary between dielectric structure 232 and isolation structure 233 during formation from the same material indicates that these need not be taught by distinct elements.

We do not agree with Patent Owner that *Retractable Techs.* is applicable only if the '378 patent describes that the isolation region and dielectric structure were formed as a single unitary structure. PO Resp. 50; PO Sur-reply 9. *Retractable Techs.* focuses on whether the two elements at issue “*could* be formed as an integral structure in the first instance,” not whether they *were* formed integrally. *Retractable Techs.*, 653 F.3d at 1304. (“The specifications further disclose a method to couple the two structures . . . to allow some diffusion or insipient melting to occur where they touch This passage suggests that [the structures] could be formed as an integral structure in the first instance”). *Retractable Techs.* looks to whether the specification suggests that the claim terms require separate structures. *Powell v. Home Depot U.S.A., Inc.*, 663 F.3d 1221, 1232 (Fed. Cir. 2011). Patent Owner’s focus on whether the claimed structures were disclosed as being separately formed disregards the issue of whether the separately claimed structures require specific methods of forming those structures. Here, as in *Retractable Techs.* and *Powell*, the Specification does not indicate any particular structure or function for the structures that results from their separate steps of deposition. Thus, as held in *Retractable Techs.* and *Powell*, the two portions of Toyama “need not be two separate parts” to teach two separate claim limitations. *Retractable Techs.*, 635 F.3d at 1303–04. Consequently, we determine that the claim language does not support a requirement that these structures be separate and distinct.

Patent Owner's further arguments are not availing. Contrary to Patent Owner's argument, in our "Third" point, *supra*, we do not state that the isolation structure and the dielectric structure are formed in the same deposition step. PO Sur-reply 10; *Supra* at 32. We only state that the top layer of the isolation structure may be re-formed during the deposition of the dielectric structure.

For the same reason, Patent Owner's argument that a unitary structure cannot have one of its parts "on" another part (PO Resp. 48; PO Sur-reply 8) is unavailing because Patent Owner does not explain, nor do we discern, why the term "on" requires its structures to be separate despite being made of the same materials and having no distinct, structural boundary. *See Powell*, 663 F.3d at 1232 ("Nor are we convinced that the claim language 'in fluid communication' requires [two components] be wholly separate structures").

Here, Toyama's dielectric fill material portion 430 performs the isolation functions of both the isolation structure and the dielectric structure. Ex. 1005 ¶ 160 ("As used herein, an 'insulating material' or a 'dielectric material' refers to a material having electrical conductivity less than 1.0×10^{-6} S/cm"). The record does not indicate any structural or functional distinction between the lower volume of Toyama's dielectric fill portion (the claimed isolation structure) and the upper volume of Toyama's dielectric fill portion (the claimed dielectric structure). Consequently, we determine that Petitioner establishes by a preponderance of the evidence that that Toyama's unitary First Exemplary Structure teaches limitation [15.C].

(b) Toyama's combination of embodiments

Petitioner further asserts that it would have been obvious to modify Toyama's First Exemplary Embodiment with a separate embodiment in

Toyama that describes forming the isolation structure and dielectric structure separately. Pet. 47 (citing “Toyama’s third exemplary structure”); Ex. 1003 ¶ 99 (citing Ex. 1005 ¶ 277). Petitioner further asserts that such a separate formation of the two portions of the dielectric fill material portion 430 would constitute the mere substitution of a known process (“Toyama’s third exemplary structure” formation) for another process (“Toyama’s first exemplary structure” formation) to obtain predictable results (the insulating material layer filling opening 151 to electrically isolate the conductors embedded within). *Id.* at 47–48 (citing Ex. 1003 ¶ 121).

Patent Owner argues that Petitioner has not shown a motivation for combining the separate deposition of isolation and dielectric structures taught by Toyama’s third exemplary structure with Toyama’s First Exemplary Structure. PO Resp. 51; PO Sur-reply 20. Patent Owner argues that such proposed changes are motivated purely by hindsight, and do not address the needed changes to the processing steps of the First Exemplary Structure. PO Resp. 51; PO Sur-reply 20–21.

We disagree with Patent Owner. We agree with Petitioner that Toyama’s third exemplary embodiment, having separately-formed dielectric and isolation structures, may be combined with its first exemplary embodiment. Pet. 47–48. In particular, Toyama expressly states that its Second Modification “can be formed concurrently with the formation of any of the first, second, and third exemplary structures.” Ex. 1005 ¶ 332. We also agree with Dr. Lee’s persuasive testimony that:

Using isolation structures on a substrate to electrically isolate components was well-known and commonplace prior to the effective filing date of the ’378 patent priority date. . . . [F]orming the *isolation structure* and the *dielectric structure* separately would be no more than the mere substitution of a

known process (forming an isolation structure in “opening 151” before forming the dielectric structure, as in Toyama’s third exemplary structure) for another process (forming the isolation and dielectric structures at the same time, as in Toyama’s first exemplary structure) to obtain predictable results (the insulating material layer that fills “opening 151” electrically isolates the conductors embedded within).

Ex. 1003 ¶ 121.

Dr. Yang attests that Petitioner has not addressed the changes to processing steps, including the etching for the dielectric structure, that would be required to arrive at such a combination. Ex. 2005 ¶ 111.

We are not persuaded by Dr. Yang’s testimony. Toyama’s Third Exemplary Structure describes a step of filling a substrate-level opening 151 with dielectric material. Although Dr. Yang raises questions as to the technical aspects of processing for such a combination (Ex. 2005 ¶ 111), the explicit description in Toyama that its embodiments may be combined indicates that a person having ordinary skill in the art would recognize Toyama to teach that such a combination would have advantages despite such aspects. Such description amounts to a clear teaching in Toyama of each of the described combinations of embodiments and structures therein, which supports Petitioner’s assertion that combining the First and Third Structures would have been a known substitution. Thus, we determine that Petitioner sufficiently shows that Toyama teaches separate portions of its dielectric fill, corresponding to an isolation structure within and abutting the substrate, and a dielectric structure formed thereon.

Consequently, we determine that Petitioner establishes by a preponderance of the evidence that Toyama’s combination of embodiments teaches limitation [15.C].

d) *[15.D] channel structures and slit structures extending vertically through the alternating conductor/dielectric layer stack; [15.E] a staircase structure disposed in the alternating conductor/dielectric layer stack, wherein the staircase structure comprises levels with each level having a conductor layer thereon; [15.F] a word line contact disposed on the conductor layer of the each level; [15.G] local contacts disposed on the channel structures and the slit structures;*

Petitioner asserts that Toyama's First Exemplary Structure teaches channel structures ("memory stack structures 55") extending vertically through the alternating conductor/dielectric stack, slit structures ("laterally-elongated contact via structures 76") in the alternating conductor/dielectric stack (Fig. 17A), a staircase structure in the alternating stack having levels with each level having a conductive layer (146, 246) thereon (Fig. 17C), word line contact ("word line contact via structures 86") disposed on conductive layers (146, 246) (Fig. 17C), local contacts ("drain contact via structures 88") disposed on channel structures ("memory stack structures 55"), and local contacts ("source connection via structures 91") disposed on the slit structures (Figure 17A). Pet. 55–62. Petitioner asserts that Toyama's Second Modification teaches these limitations for the same reasons. Pet. 56 (citing Ex. 1005, Fig. 49; Ex. 1003 ¶ 132), 59 (citing Ex. 1005, Fig. 49; Ex. 1003 ¶ 136), 60–61 (citing Ex. 1005 ¶¶ 243, 232, 322; Ex. 1003 ¶ 138), 62–63 (citing Ex. 1005 ¶ 322; Ex. 1003 ¶¶ 141–142). Patent Owner does not contest these assertions. *See* PO Resp.

Having reviewed the parties' arguments and evidence, we are persuaded that Petitioner's discussion of the particular structures in Toyama, and the explanations in the Petition and the Lee Declaration, shows that Toyama teaches limitations [15.D], [15.E], [15.F], and [15.G].

- e) *[15.H] through array contacts (TACs) extending vertically through the dielectric and the isolation structures.*

In its First Exemplary Structure assertions, Petitioner asserts that Toyama's "through-memory-level via structures 488" are through array contacts (TACs), and that they extend vertically through dielectric material fill portion 430 (dielectric structure and isolation structure). Pet. 68–70.

Patent Owner does not provide any arguments specific to Petitioner's First Exemplary Structure assertions for limitation [15.H] beyond those presented for limitations [15.A] and [15.C], which we have found unavailing. PO Resp. 51–52. Consequently, the record supports Petitioner's assertions that Toyama's First Exemplary Structure teaches limitation [15.H].

In its Second Modification theory, Petitioner asserts that Toyama's through-memory-level via structures 676 teach the claimed TACs, and that they extend vertically through insulating liners 674 (isolation structures) and the insulating material layer filling opening 151. Pet. 66–68 (citing Ex. 1005, Fig. 49, ¶¶ 341–342; Ex. 1003 ¶ 149). Petitioner provides the following illustration of its theory:

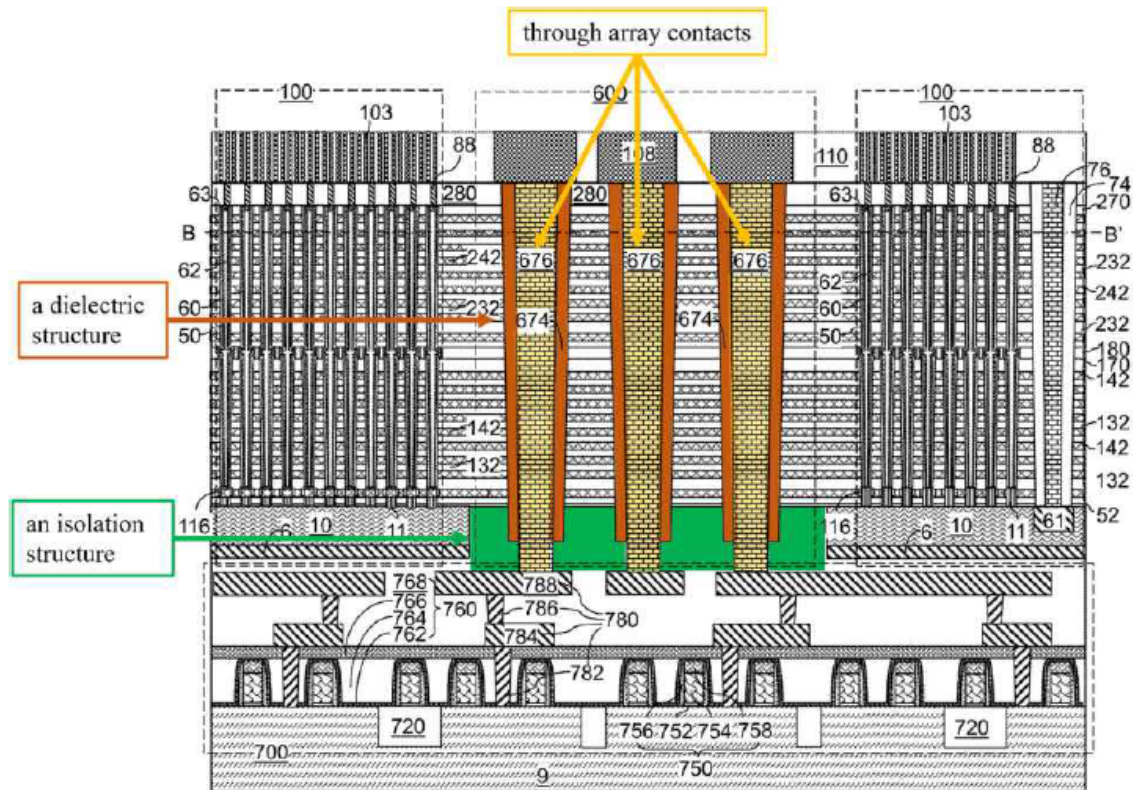


FIG. 49

Petitioner’s illustration of Figure 49 highlights its proposed through array contacts 676 (three vertical structures in yellow, with sidewalls in blue), its proposed dielectric structure 674 (three insulating liners in orange), and its proposed isolation structure (single insulating material layer in green). Pet. 66–67. Petitioner asserts that its insulating liners are “individually and collectively the dielectric structure.” *Id.* at 67 (emphasis omitted); Tr. 26:18–21.

Patent Owner argues that Toyama does not teach multiple TACs extending through the same dielectric structure. PO Resp. 57–60. Patent Owner argues that Petitioner mapped multiple insulating liners 674 to a single dielectric structure. *Id.* (citing Pet. 41).

As set forth above, we determined that the scope of claim 15 encompasses multiple instances of a single TAC extending through a

dielectric structure and an isolation structure. *Supra* § II.C.3. Patent Owner’s argument that multiple insulating liners cannot be a single insulating structure does not address the Petition’s assertion that the insulating liners are “individually” the dielectric structure. Pet. 67; PO Resp. 57–60. Thus, Toyama’s Figure 49, which shows multiple TACs, each of which extends through vertically respective dielectric structures (liners 674) and a single isolation structure (filler 151), meets the language of limitation [15.H]. Ex. 1005, Fig. 49. Consequently, we are persuaded that Petitioner shows that limitation [15.H] is be met by Toyama’s Second Modification, having multiple TACs, each of which passes through an individual dielectric liner and an individual insulating structure, so as to teach the claimed “through array contacts (TACs) extending vertically through the dielectric and the isolation structures.”

f) Conclusion

For the foregoing reasons, Petitioner has demonstrated by a preponderance of the evidence that claim 15 would have been obvious over Toyama.

3. Claim 17

Claim 17 depends from claim 15, and recites, “[t]he 3D memory device of claim 15, wherein the dielectric structure comprises a through array contact region of the 3D memory device.”

a) “Second Modification” Alternative

Petitioner asserts that Toyama’s insulating liners, taken together, provide a dielectric structure that comprises a through array contact region of the 3D memory device. Pet. 73–74. Petitioner provides the following annotated version of Figure 49:

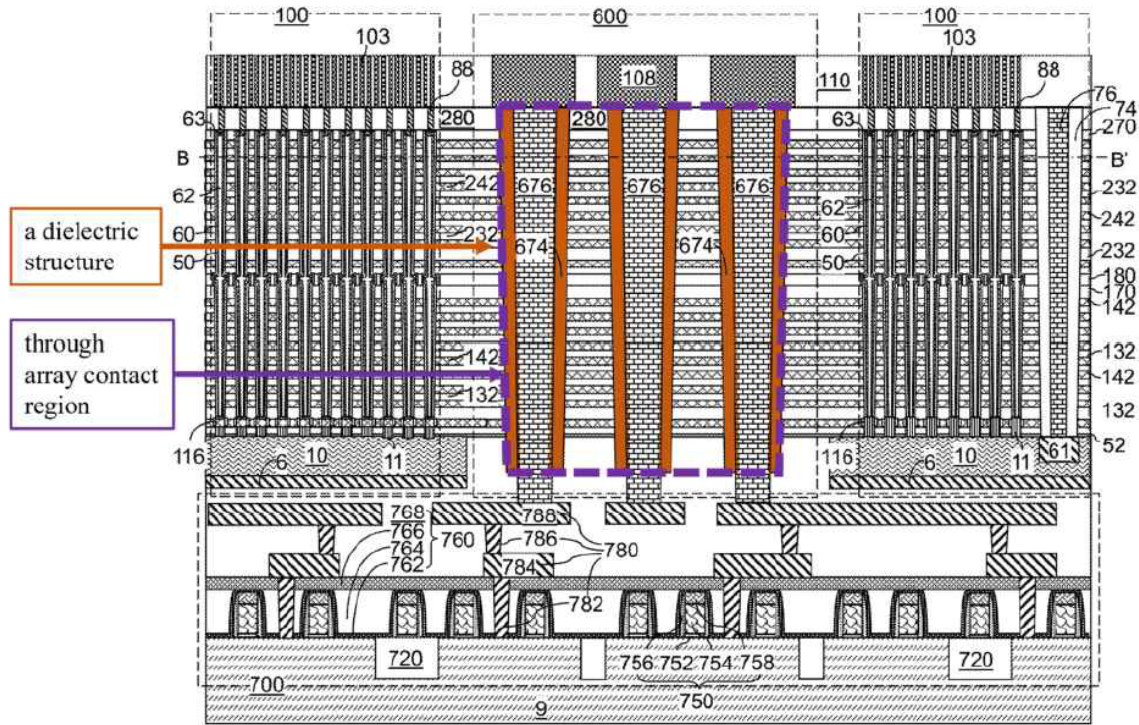


FIG. 49

Pet. 73. Annotated Figure 49 highlights a rectangular area (dashed purple) connecting the outer edges of dielectric liners 674 (orange) as a “through array contact region.” *Id.* Petitioner asserts that this region is a through array contact region because it is the region through which the through array contacts 676 extend. *Id.* at 73–74.

Petitioner’s argument relies on its assertion that Toyama’s three constructed liners together constitute a single dielectric structure. However, we determined that Toyama’s three constructed liners together do not constitute a single dielectric structure. *Supra* § II.D.2. Unlike for claim 15 where Petitioner asserts that each individual liner is a single dielectric structure, for claim 17, Petitioner contends that the multiple lines *together* form a single dielectric structure. We are not persuaded by Petitioner’s contentions. As noted above, we determine that Toyama’s three constructed liners together do not constitute a single dielectric structure. *Supra* § II.D.2.

Consequently, Petitioner has not shown that Toyama teaches a dielectric structure comprises a through array contact region of the 3D memory device, and has not shown that Toyama's Second Modification would have rendered claim 17 obvious.

b) *"First Exemplary Structure" Alternative*

Petitioner also asserts that Toyama's First Exemplary Structure discloses a dielectric structure having a through array contact region of the 3D memory device as required by claim 17 because Toyama's dielectric fill material portion is a dielectric structure that defines a dielectric region through which the TACs pass, as shown in annotated Figure 17A below:

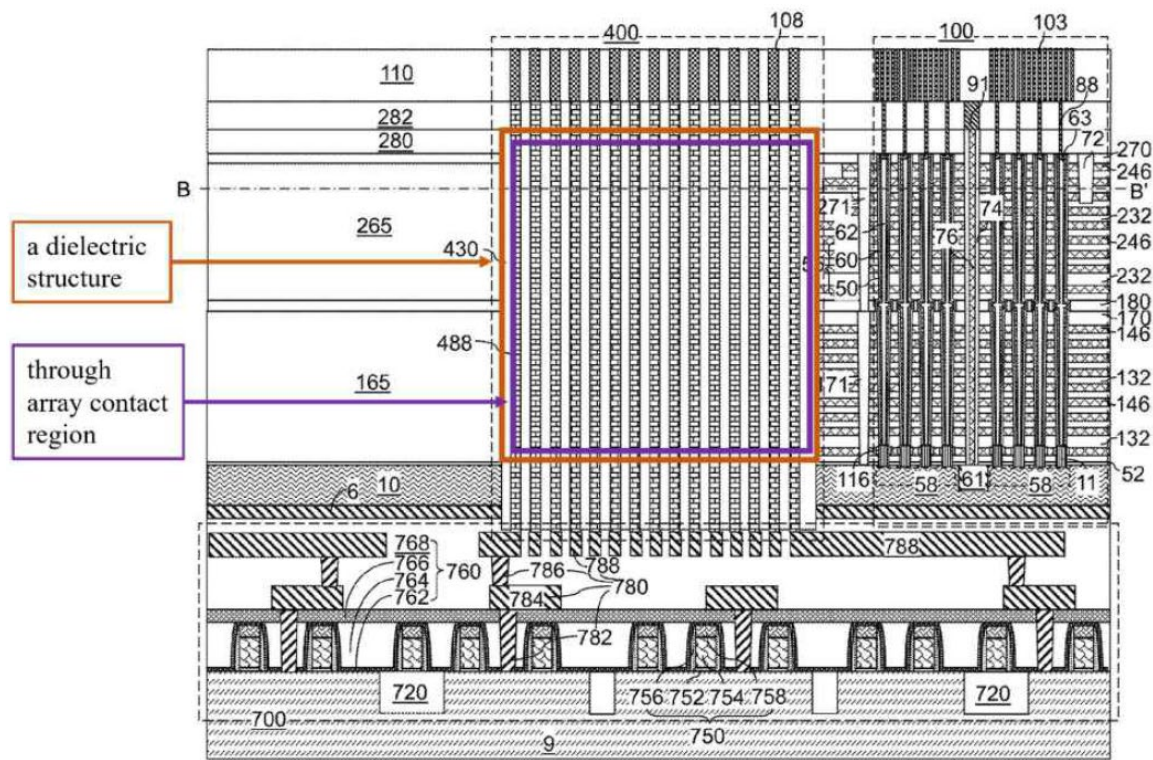


FIG. 17A

Pet. 74 (citing Ex. 1005 ¶¶ 165–167; Ex. 1003 ¶161). Annotated Figure 17A depicts an orange rectangle, labeled “a dielectric structure,” surrounding a smaller purple rectangle, labeled “through array contact region,” in the center portion of the Figure.

Patent Owner's sole argument is that Toyama does not teach the claimed dielectric structure, referencing its argument concerning limitation [15.C]. PO Resp. 52; PO Sur-reply 23. We disagree with this argument for the reasons stated above. *Supra* § II.D.2.

Patent Owner admits that other components are not precluded from also being present in the dielectric structure. PO Resp. 29; PO Sur-reply 23 n.5. Consequently, we are persuaded that Petitioner has shown a dielectric structure having a through array contact region, as illustrated in annotated Figure 17A. Petitioner's assertions based on Toyama's First Exemplary Structure have shown by a preponderance of the evidence that claim 17 would have been obvious over Toyama.

4. *Claims 16, 19, and 20*

Patent Owner does not specifically contest Petitioner's assertions as to claims 16, 19, and 20, which depend from claim 1; however, the burden of proving unpatentability rests solely upon Petitioner. We have reviewed Petitioner's assertions and supporting evidence for these claims. *See* Pet. 70–72, 75–77. As illustrated by Petitioner's annotated Figures 17A and 49, Toyama teaches that its dielectric structure abuts a sidewall of each TAC (claim 16). Toyama also teaches that its dielectric material comprises silicon oxide, because insulating liners 674 and dielectric fill material portion 430 are described as consisting of silicon oxide (claim 19). Ex. 1005 ¶¶ 216, 234, 381. Toyama also teaches that its TACs comprise a conductive material; i.e., a metal. Ex. 1005 ¶¶ 244, 341. Accordingly, we determine that Petitioner has demonstrated, by a preponderance of the evidence, the unpatentability of claims 16, 19, and 20 over Toyama.

E. Obviousness over Mushiga

Petitioner asserts that claims 15–17, 19, and 20 are obvious over Mushiga. Pet. 77–102. Patent Owner argues against these assertions. PO Resp. 63–82.

1. Mushiga

Mushiga is titled “Three-Dimensional Memory Device Containing Bonded Chip Assembly With Through-Substrate Via Structures and Method of Making Same.” Ex. 1006, code (54). Mushiga relates to bonded semiconductor chip assemblies for three-dimensional NAND flash memory that have through-substrate via structures. Ex. 1006, 1:9–20.

2. Analysis of Claim 15

We begin our analysis of Petitioner’s obviousness contentions with Petitioner’s assertions as to claim 15.

a) [15.PRE] A three-dimensional (3D) memory device, comprising: [15.A] a substrate with an isolation structure;

Petitioner asserts that elements [15.PRE]–[15.A] are taught by Mushiga’s “three-dimensional monolithic memory array devices,” including substrate 8 having an isolation structure in the form of insulating material liners 302 and backside insulating layer 306. Pet. 77–80. Petitioner asserts that the ’378 patent defines a “substrate” as “a material onto which subsequent material layers are added, or otherwise ‘disposed.’” *Id.* at 78 (citing Ex. 1001, 4:41–43). Petitioner asserts that insulating liners 302 and layer 306 isolate various conductive components from the substrate, and therefore, are an isolation structure. *Id.* at 79. Petitioner further asserts that the substrate is “with an isolation structure” because parts of the substrate were removed to form the liners 302 and layer 306. *Id.* at 80 (citing Ex. 1003 ¶¶ 173–174).

Referring to its reasoning in addressing Petitioner’s assertions for limitation [15.A] under the Toyama ground, Patent Owner argues that at least Mushiga’s liners 302 are not part of the substrate because they fill a cut through the substrate. PO Resp. 64–68. Patent Owner argues that liners 302 are thus “outside and merely abutting the alleged substrate.” *Id.* at 66–68.

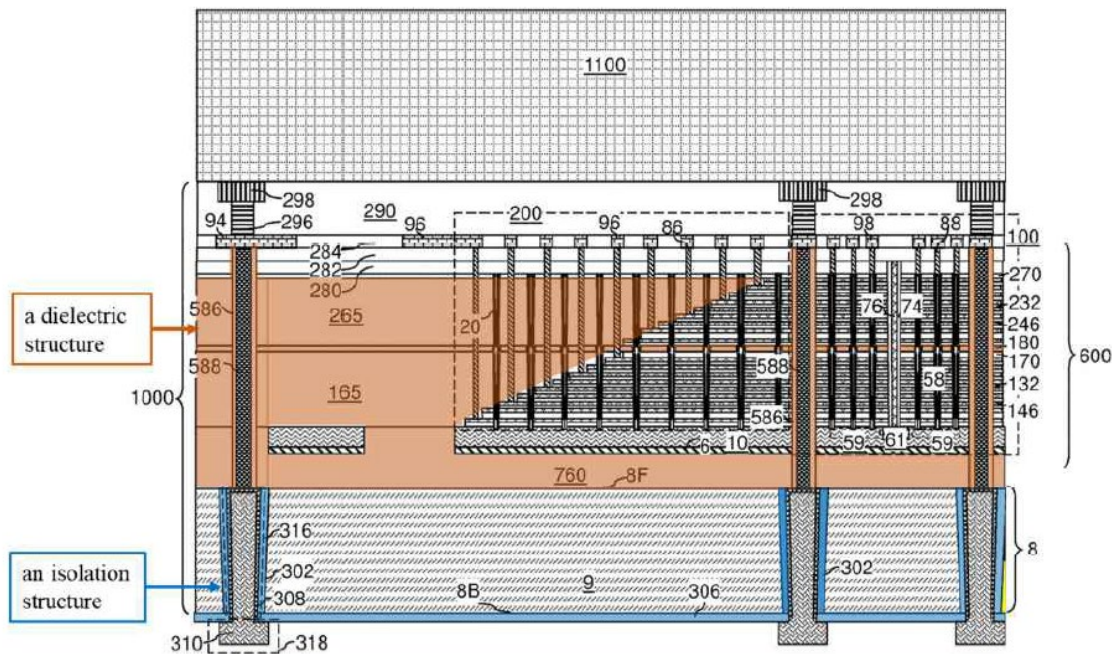
As discussed at § II(C)(2), we determine that the phrase “a substrate with an isolation structure” should be given its plain meaning, which includes accompaniment as well as combination. Under that construction Petitioner has shown that Toyama’s substrate 8 is accompanied by an isolation structure in the form of insulating material liners 302 and backside insulating layer 306. Consequently, Petitioner has shown that Mushiga teaches limitations [15.A], and to the extent limiting, limitation [15.PRE], notwithstanding Patent Owner’s arguments to the contrary.

b) *[15.B] an alternating conductor/dielectric layer stack disposed on the substrate;*

Petitioner asserts that limitation [15.B] is taught by Mushiga’s stack 600, which is composed of an “alternating stack of insulating layers (132, 232) and electrically conductive layers (146, 246)” disposed on substrate 9. Pet. 80 (citing Ex. 1006, Fig. 11, 8:67–9:2). Petitioner further asserts that the stack is “on” the substrate under the definition of “on” provided by the ’378 patent; i.e., that “‘on’ not only means ‘directly on’ something but also includes the meaning of ‘on’ something with an intermediate feature or a layer therebetween.” *Id.* at 80–81 (citing Ex. 1001, 4:20–25). Patent Owner does not explicitly contest this assertion. PO Resp.

We have reviewed the complete record and determine that Petitioner shows that Mushiga teaches limitation [15.B].

Petitioner asserts that the claimed dielectric structure is taught by Mushiga’s insulating material layer 760, dielectric material portion 165, dielectric layer 180, dielectric material portion 265, and insulating spacer 586, considered collectively. Pet. 81–82 (citing Ex. 1006, Fig. 11; Ex. 1003 ¶ 177). Petitioner provides the following annotated version of Figure 11:



Annotated Figure 11 depicts in orange a “dielectric structure” comprising insulating material layer 760, dielectric material portion 165, dielectric layer 180, dielectric material portion 265, and insulating spacer 586, and in blue, “an isolation structure” comprising insulating material liners 302 and backside insulating layer 306, with substrate 8 residing therebetween. *Id.* at 82.

Petitioner argues that “because these components together are something “that is constructed,” they are a structure. *Id.* at 82–83 (citing Ex. 1022, 5 (Merriam-Webster definition of “structure” as “something ([such] as a building) that is constructed”); Ex. 1003 ¶ 179). Petitioner asserts that at least one element of the structure, layer 760, is directly on the isolation structure (elements 302, 306). *Id.* at 83. Petitioner further points to the description in the ’378 patent that “on” includes “on something with an intermediate feature or layer therebetween.” *Id.* (citing Ex. 1001, 4:20–29, Ex. 1003 ¶ 180). Petitioner further asserts that Mushiga’s dielectric structure extends through the dielectric stack, and that the dielectric stack abuts a sidewall surface of the dielectric structure. *Id.* at 83–85 (citing Ex. 1006, Fig. 11; Ex. 1003 ¶ 181). Petitioner further asserts that Mushiga’s elements 760, 165, 180, 265, and 586 are described as being formed of a dielectric material, because Mushiga expressly discloses that each of these elements are insulating and/or dielectric. *Id.* at 85–86 (citing Ex. 1003 ¶184).

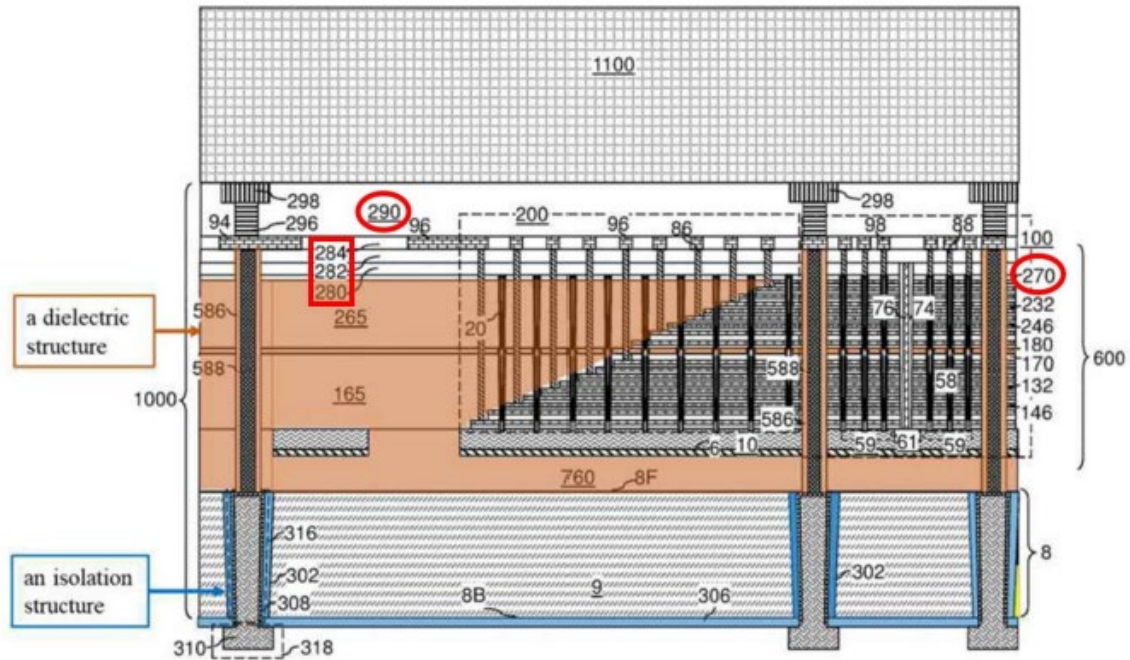
Patent Owner argues that the only alleged dielectric structure that extends through the stack; i.e., insulating spacers 586, is not “on” Petitioner’s alleged isolation structure of insulating layer 306 and insulating material liners 302. PO Resp. 69–71 (citing Ex. 1006, Fig. 11). However, this argument is unavailing because Petitioner does not assert that Mushiga’s dielectric structure is only spacers 586, but the entirety of dielectric elements 760, 165, 180, 265, and 586. Pet. 85–86.

Next, Patent Owner argues that Petitioner’s grouping of Mushiga’s components in its alleged dielectric structure “has no discernable logic” and that each of those components have “distinct locations and roles [compared to the ’378’s dielectric structure],” and “omitted other adjacent dielectric

elements [elements 270, 280, 282, 284, 290] that, if included, would have hurt its claim mapping.” PO Resp. 72–76 (citing Ex. 1006, Fig. 11; Ex. 2005 ¶ 152). Patent Owner emphasizes that Dr. Lee admits that his selection of what elements to include in determining whether Mushiga teaches claim 15’s dielectric structure were guided by the claim language. *Id.* at 77 (citing Ex. 2007, 53:21–57:17).

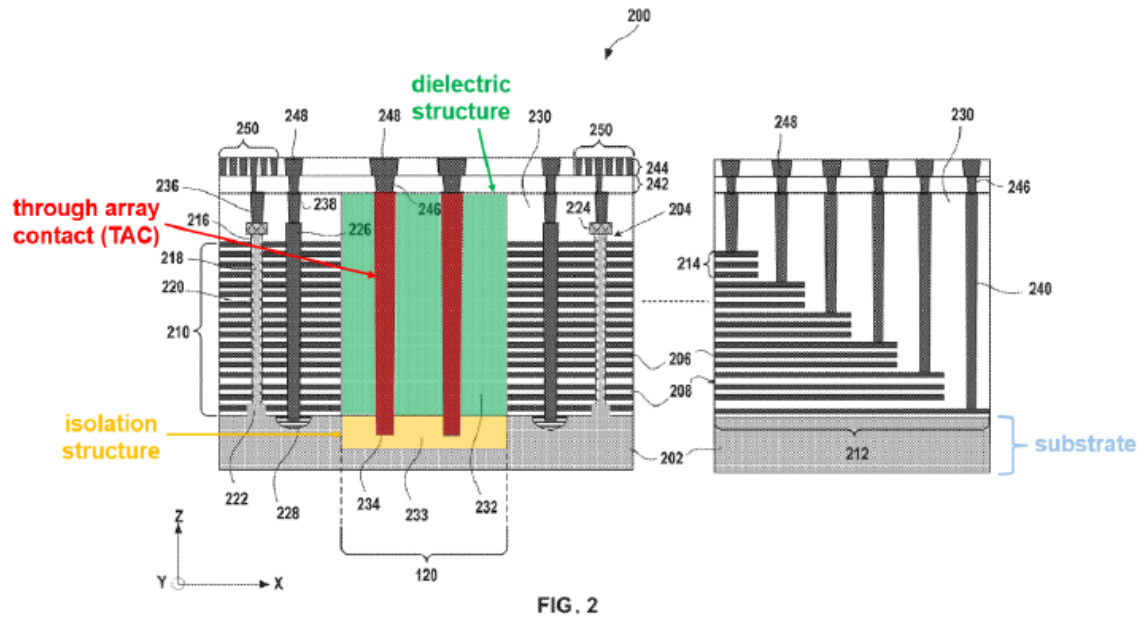
We do not agree with Patent Owner that the selection of only some elements to teach the claimed dielectric structure is impermissible hindsight. Our reviewing court has stated, “[a]ny judgment on obviousness is in a sense necessarily a reconstruction based on hindsight reasoning, but so long as it takes into account only knowledge which was within the level of ordinary skill in the art at the time the claimed invention was made and does not include knowledge gleaned only from applicant’s disclosure, such a reconstruction is proper.” *In re McLaughlin*, 443 F.2d 1392, 1395 (CCPA 1971). Here, Petitioner has referred to the ’378 patent claims, not its disclosure, to guide its assertions. Ex. 2007, 57:13–17 (“Q. Just to make sure I understand, you chose the particular dielectric structures in the Mushiga reference that you could combine to read on limitation 15.H of the ’378 patent? **A. That is correct.**”).

Moreover, we disagree with Patent Owner that including additional adjacent features would have “hurt its claim mapping.” PO Resp. 75. Dr. Yang testifies if Petitioner would have included all of the adjacent dielectric structures, then Mushiga’s TACs would not extend through such a dielectric structure, but instead, terminate within the dielectric structure between layers 282 and 284. Ex. 2005 ¶ 153. Dr. Yang illustrates the dielectric structure resulting from inclusion of all adjacent dielectric structures in annotated Figure 11, reproduced below:



Id. Annotated Figure 11 reproduces Petitioner’s color scheme and annotations, and highlights additional layers 270, 280, 282, 284, and 290.
Id.

However, this is inconsistent with Dr. Yang’s testimony describing “through” in the ’378 patent. Dr. Yang describes Figure 2 of the ’378 patent illustrating “‘TACs 234’ extending vertically through ‘dielectric structure 232’ and ‘isolation structure 233.’” Ex. 2005 ¶ 34 (citing Ex. 1001, 10:57-59, 20:45-48) (emphasis omitted). Dr. Yang provides the following annotated Figure 2:



Id. Annotated Figure 2 depicts a dielectric structure (green) atop an isolation structure (yellow) and two through array contacts (brown) extending from the top of the green portion downward to terminate in the yellow portion. Clearly, TACs 234 do not extend completely through isolation structure 233, instead terminating within. Dr. Yang’s testimony indicates that claim 15’s recitation, “through array contacts (TACs) extending vertically through the dielectric and the isolation structures” does not require the TACs to extend completely through and terminate beyond those structures. Even if Petitioner had included Dr. Yang’s additional layers in Mushiga, it would not have “hurt” Petitioner’s mapping for limitation [15.H].

Therefore, we discern no use of the disclosure of the ’378 patent that would constitute impermissible hindsight.

Finally, Patent Owner argues that Petitioner does not sufficiently explain how these separate components can be considered a single structure (the claimed “dielectric structure”) in view of the Board’s preliminary decision in IPR2024-00791 that three noncontiguous liners do not constitute a single dielectric structure. PO Resp. 77–78 (citing Ex. 2006, 17).

During our analysis of Petitioner's Toyama assertions, we determined that the claim term "structure" could not be taught by an assemblage of noncontiguous components, consistent with the determination in IPR2024-00791. *Supra* § II.D.2.c.2 (determining that Toyama's three separate liners did not constitute a single dielectric structure). However, for its Mushiga assertions, Petitioner's "structure" is composed of a contiguous mass of dielectric elements. Moreover, the '378 patent broadly defines "layer" as a "material portion including a region with a thickness" that may have a "homogeneous or inhomogeneous continuous structure." Ex. 1001, 4:51–58. Thus, although Petitioner's selected disparate elements in its asserted dielectric structure have an inhomogeneous continuous structure, in view of the description in the '378 patent and the provided dictionary description, we agree with Petitioner that they teach the claimed dielectric structure. Further, the components of Petitioner's alleged dielectric structure each possess a dielectric quality that underlies their selection as a "dielectric structure."

Consequently, we determine that Petitioner shows that Mushiga teaches limitation [15.C].

d) *[15.D] channel structures and slit structures extending vertically through the alternating conductor/dielectric layer stack; [15.E] a staircase structure disposed in the alternating conductor/dielectric layer stack, wherein the staircase structure comprises levels with each level having a conductor layer thereon; [15.F] a word line contact disposed on the conductor layer of the each level; [15.G] local contacts disposed on the channel structures and the slit structures;*

Petitioner asserts that the claimed channel structures and slit structures are taught by Mushiga's memory stack structures 58 and backside contact via structures 76, respectively. Pet. 86–90 (citing Ex. 1006, Fig. 11, 9:2–5,

10:1–18; Ex. 1003 ¶¶ 186–193; Ex. 1022, 4). Petitioner asserts that the claimed staircase structure is taught by the stepped surfaces of Mushiga’s alternating conductor/dielectric layer stack. *Id.* at 91–92 (citing Ex. 1006, Fig. 11; Ex. 1003 ¶194). Petitioner asserts that Mushiga teaches the claimed word line contact by its word line contact via structures 86 disposed on electrically conductive layers 146, 246. *Id.* at 92–93 (citing Ex. 1006, Fig. 11, 10:21–27; Ex. 1003 ¶ 196). Petitioner asserts that Mushiga teaches the claimed local contacts disposed on the channel structures and the slit structures by its drain contact via structures 88 in contact with and extending above memory stack structures 58. *Id.* at 94 (citing Ex. 1006, Fig. 11, 10:21–27). Petitioner further asserts that it would have been obvious to dispose contacts on the backside contact via (slit) structures 76 because they serve as the source connection for memory stack structures, and would obviously find useful local contacts to provide a top-level electrical connection to the source. *Id.* at 95–98 (citing Ex. 1006, 10:16–18; Ex. 1003 ¶¶199–203; Ex. 1015, 110, 150; Ex. 1016, 275, 288).

Patent Owner does not contest Petitioner’s assertions on these limitations. PO Resp. 63–80. Having reviewed the parties’ arguments and evidence, we determine that Petitioner shows that Mushiga teaches limitations [15.D], [15.E], [15.F], and [15.G].

- e) *[15.H] through array contacts (TACs) extending vertically through the dielectric and the isolation structures.*

Petitioner asserts that Mushiga teaches limitation [15.H] as illustrated in its annotated Figure 11 of Mushiga, reproduced below:

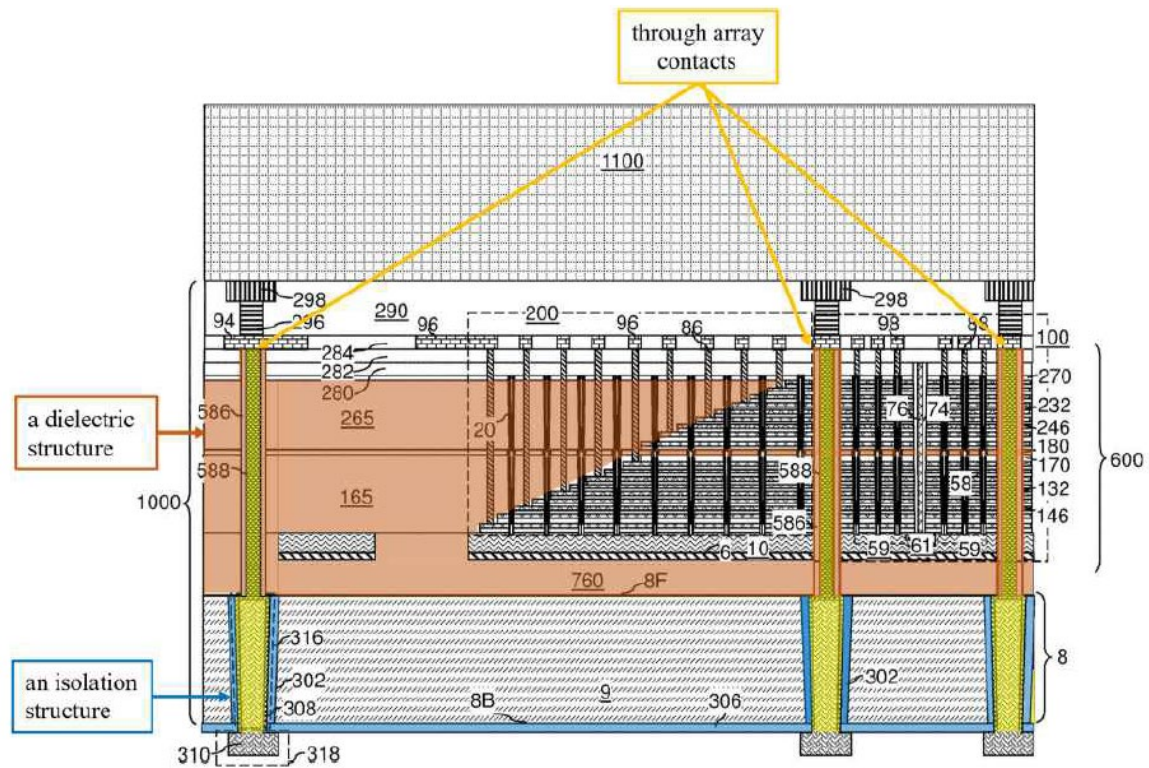


FIG. 11

Figure 11 depicts three through-memory-level via structures 588 and three adjoining through-substrate via structures 316, colored yellow and labeled “through array contacts,” elements 760, 165, 180, 265, and 586, colored orange and labeled “a dielectric structure,” and elements 302, 316, colored blue and labeled “an isolation structure.” Pet. 98 (citing Ex. 1006, Fig. 11, 10:31–57; Ex. 1003 ¶ 204.

Patent Owner argues that Petitioner’s dielectric structure is the result of an improper combination, and that if only the insulating spacers 586 are considered, Mushiga’s alleged TACs do not extend through the same dielectric structure. PO Resp. 79. However, Patent Owner’s argument is unavailing for the reasons discussed with respect to Patent Owner’s argument with respect to limitation [15.C]; i.e., that Petitioner’s dielectric

structure is not an improper combination and is not limited to insulating spacers 586. *Supra* § II(E)(2)(c).

We note that Mushiga teaches limitation [15.H] even under Patent Owner's construction, because it teaches multiple TACs extending through (the same pair of) dielectric and isolation structures. Patent Owner does not argue otherwise. PO Resp. 79–80.

f) Conclusion

For the foregoing reasons, Petitioner has shown, by a preponderance of the evidence, that claim 15 would have been obvious over Mushiga.

3. Analysis of Claims 16, 19, and 20

Patent Owner does not specifically contest Petitioner's obviousness assertions as to claims 16, 19, and 20; however, the burden of proving unpatentability rests solely upon Petitioner. We have reviewed Petitioner's assertions and supporting evidence for these claims. *See* Pet. 99–102. As illustrated by Petitioner's annotated Figure 11, Mushiga teaches that the dielectric structure abuts a sidewall of each TAC (claim 16). Mushiga also teaches that its dielectric material comprises silicon oxide, because insulating material 760 therein is described as consisting of silicon oxide (claim 19). Ex. 1006, 9:8–10. Mushiga also teaches that its TACs comprise a conductive material; i.e., a metal. Ex. 1006, 10:42–46. Upon review of these assertions, we determine that they are supported by the record such that Petitioner has shown, by a preponderance of the evidence, that claims 16, 19, and 20 would have been obvious over Mushiga.

4. Analysis of Claim 17

Petitioner contends that its asserted dielectric structure of Mushiga teaches claim 17. Petitioner provides the following annotated Figure 11 of Mushiga:



Patent Owner, drawing on its construction of “through array contact region” that it argued with respect to Petitioner’s Toyama-based assertions for claim 17, argues that Mushiga does not teach a through array contact region. PO Resp. 80–82. Patent Owner argues that Petitioner’s alleged region includes not only dielectric structure and TACs, but also, portions of metal structures 94 and bonding pad connection via structures 296. *Id.* at 82.

Claim 17 recites that “the dielectric structure comprises a through array contact region of the 3D memory device.” Patent Owner admits that other components are not precluded from also being present in the dielectric structure. PO Sur-reply 23 n.5. Patent Owner further admits that the TAC region need not be coextensive with the dielectric structure. *Id.* In light of

these admissions, we determine that Petitioner demonstrates that Petitioner's indicated region of Mushiga's Figure 11 showing a dielectric structure through which a TAC extends, and other TACs extending through that same dielectric structure, teaches claim 17.

F. Obviousness over Mushiga and Makala

Petitioner advances its obviousness assertions in this ground by adding Makala to teach local contacts disposed on the slit structures. Pet. 102–103. Patent Owner does not dispute any aspect of the Mushiga-Makala combination beyond its arguments regarding Petitioner's Mushiga-only ground. PO Resp. 82–83. We have considered each of those arguments and found them unavailing. *Supra* § II.E.

We have reviewed Petitioner's proposed combination and determine that Petitioner's reliance on Makala's local contacts ("source connection via structures 91") disposed on (in contact with and extending above) the slit structures ("laterally elongated contact via structures 76") is supported by the record. Pet. 104; Ex. 1007, Fig. 16, 34:27–33. We further determine that Petitioner has shown sufficient reason to combine those teachings of Makala with Mushiga; i.e., to provide connections to a source line that permit electrical operability for Mushiga's via structures 76. *Id.* at 105. Accordingly, we determine that Petitioner shows, by a preponderance of the evidence, that claims 15–17, 19, and 20 would have been obvious over the combined teachings of Mushiga and Makala.

III. CONCLUSION⁷

After reviewing the record and weighing the evidence proffered by both parties, we determine that Petitioner has shown by a preponderance of the evidence that claims 15–17, 19, and 20 are unpatentable.

In summary:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
15–17, 19, 20	103	Toyama	15–17, 19, 20	
15–17, 19, 20	103	Mushiga	15–17, 19, 20	
15–17, 19, 20	103	Mushiga, Makala	15–17, 19, 20	
Overall Outcome			15–17, 19, 20	

⁷ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner’s attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

IV. ORDER

For the foregoing reasons, it is:

ORDERED that Petitioner has established by a preponderance of the evidence that claims 15–17, 19, and 20 of the '378 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the Decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2024-00788
Patent 10,658,378 B2

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