

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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MICRON TECHNOLOGY, INC.,

Petitioner,

v.

YANGTZE MEMORY TECHNOLOGIES COMPANY, LTD.,

Patent Owner.

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Case No. IPR2024-00909

Patent 10,658,378 B2

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**PATENT OWNER'S NOTICE OF APPEAL**

Director of the United States Patent and Trademark Office  
c/o Office of the General Counsel  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450

Pursuant to 35 U.S.C. §§ 141, 142, and 319, and 37 C.F.R. §§ 90.2-90.3, notice is hereby given that Patent Owner Yangtze Memory Technologies Company, Ltd. (“Patent Owner”) appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision of the Patent Trial and Appeal Board (“Board”) entered January 5, 2026 (Paper 34) in IPR2024-00909, and from all underlying orders, decisions, rulings, and opinions decided adversely to Patent Owner regarding this *inter partes* review of U.S. Patent No. 10,658,378 (“the ‘378 patent”). A copy of the Final Written Decision is attached.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Patent Owner further indicates that the issues on appeal include, but are not limited to, the following: (1) the Board’s determination that claims 1–7 and 18 of the ‘378 patent have been shown to be unpatentable; (2) the Board’s determination that Petitioner has demonstrated by a preponderance of the evidence that claims 1–7 and 18 of the ‘378 patent are unpatentable under 35 U.S.C. § 103; (3) the Board’s consideration of the expert testimony, prior art, and other evidence in the record; (4) the Board’s factual findings, conclusions of law or other determinations supporting or related to those issues; as well as (5) all other issues decided adversely to Patent Owner in any orders, decisions, rulings, and opinions.

Pursuant to 35 U.S.C. § 142 and 37 C.F.R. § 90.2(a), this Notice is being filed with the Director of the United States Patent and Trademark Office, and a copy of this Notice is being concurrently filed with the Patent Trial and Appeal Board. In addition, a copy of this Notice and the required docketing fees are being filed with the Clerk’s Office for the United States Court of Appeals for the Federal Circuit via CM/ECF.

Dated: March 4, 2026

By: /Andrew Radsch/  
Andrew Radsch  
Counsel for Patent Owner

**CERTIFICATE OF SERVICE**

The undersigned hereby certifies that, on March 4, 2026, the foregoing PATENT OWNER'S NOTICE OF APPEAL was:

(1) electronically filed through P-TACTS

(2) filed by Express Mail to The Director of the United States Patent and Trademark Office at the following address:

Director of the United States Patent and Trademark Office  
c/o Office of the General Counsel  
United States Patent and Trademark Office  
P.O. Box 1450  
Alexandria, VA 22313-1450

(3) filed in the U.S. Court of Appeal for the Federal Circuit using the Court's CM/ECF filing system and pay.gov to pay the filing fee electronically

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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICRON TECHNOLOGY, INC.,  
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Patent Owner.

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IPR2024-00909  
Patent 10,658,378 B2

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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 1–7 and 18 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”).

Petitioner filed a Notice of Ranking Papers, identifying that this is the second Petition challenging the ’378 Patent, and explaining why such a second Petition is needed. Paper 3. Yangtze Memory Technologies Company, Ltd. (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 11 (“Prelim. Resp.”). On that record, we instituted an *inter partes* review as to all asserted claims of the ’378 patent on all asserted grounds of unpatentability. Paper 12 (“Inst. Dec.”).

Patent Owner filed a Response accompanied by a declaration from Dr. Woodward Yang. Paper 15 (“PO Resp.”); Ex. 2005 (“Yang Dec.”). Patent Owner also filed a transcript of the deposition of Dr. Lee. Ex. 2007 (“Lee Dep.”). Petitioner filed a Reply accompanied by a second declaration from Dr. Lee. Paper 17 (“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 30 (“Tr.”).

### B. *Real Parties-in-Interest*

Petitioner identifies itself and its subsidiaries, including Micron Consumer Products Group LLC, as real parties-in-interest. Pet. 6. Patent Owner identifies itself as a real party-in-interest. Paper 5, 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 5, 2; Pet. 6.

Petitioner previously filed IPR2024-00788 challenging other claims (claims 15–17 and 19–20) in the '378 patent. Petitioner also filed 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 (instituted) and IPR2024-00910 (institution denied)), 10,868,031 (IPR2024-00790), 10,937,806 (IPR2024-00791 (instituted) and IPR2024-00911 (instituted)), 11,501,822 (IPR2024-00795), 11,468,957 (IPR2024-00792 (instituted), and 11,600,342 (IPR2024-00793 and IPR2024-00912) (institution denied). Pet. 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/CN/2018/085421, 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 1:14–16.

*E. Illustrative Claim*

Claim 1 is illustrative, and recites as follows:<sup>1</sup>

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

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<sup>1</sup> Bracketed organization added as per the Petition.

[1.A] a semiconductor substrate;

[1.B] an alternating layer stack disposed on the semiconductor substrate;

[1.C] a dielectric structure on an isolation region of the substrate and extending vertically through the alternating layer stack, wherein the alternating layer stack abuts a sidewall surface of the dielectric structure and the dielectric structure is formed of a dielectric material;

[1.D] one or more through array contacts (TACs) extending vertically through the dielectric structure and the isolation region;

[1.E] one or more channel structures extending vertically through the alternating layer stack;

[1.F] an epitaxial layer between the one or more channel structures and the semiconductor substrate;

[1.G] an etch stop plug on each of the one or more channel structures;

[1.H] a staircase structure in the alternating layer;

[1.I] slit structures extending vertically in the alternating layer stack; and

[1.J] one or more contact layers on the one or more TACs, the one or more channel structures, and the slit structures.

Ex. 1001, 23:16–38.

*F. Evidence*

Petitioner relies on the following patent document evidence.

| <b>Name</b>                 | <b>Patent Document</b> | <b>Exhibit</b> |
|-----------------------------|------------------------|----------------|
| Toyama et al.<br>("Toyama") | US 2017/0179026 A1     | 1005           |

*G. Prior Art and Asserted Ground*

Petitioner asserts that claims 1–7 and 18 would have been unpatentable on the following ground:

| <b>Claim(s) Challenged</b> | <b>35 U.S.C. §</b> | <b>Reference(s)/Basis</b> |
|----------------------------|--------------------|---------------------------|
| 1–7, 18                    | 103 <sup>2</sup>   | Toyama                    |

**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.<sup>3</sup> *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

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

<sup>3</sup> Neither party presents evidence or arguments regarding objective evidence of non-obviousness. Pet. 104; PO Resp.

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. 33 (citing Ex. 1003 ¶¶ 37–39). Petitioner further asserts 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.* Patent Owner does not object to such a definition. PO Resp. 13. 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).

Petitioner asserts that only the term “a staircase structure in the alternating layer” should be construed, and that the term should be construed as “a staircase structure in the alternating layer stack.” Pet. 32–33. Patent Owner does not dispute this construction, and our determination would be unaffected by Petitioner’s proposed construction. Therefore, we need not provide an express construction of 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))).

Petitioner asserted that all other terms should receive their plain and ordinary meaning. Pet. 33.

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. 14 (citing Exs. 2003–2004). Patent Owner proposes construction of three phrases, which we address in turn.

1. *“an isolation region of the substrate” (claim 1); “a substrate with an isolation structure” (claims 15/18)*

Patent Owner proposes that the term “an isolation region of the substrate” as recited in claim 1 and “a substrate with an isolation structure,” as recited in claim 15 and incorporated into its dependent claim 18, should be construed as requiring that the isolation region/structure is part of the substrate. PO Resp. 14 (citing Ex. 2005 ¶ 46); PO Sur-reply 2. Although claims 1 and 15 have slightly different language, Patent Owner treats the language as interchangeable. *Id.* at 14–22 (stating, e.g., that “the isolation [region/structure] is ‘part of’ the substrate”). Citing to both claims 1 and 15, Patent Owner contends that the isolation region/structure is recited in the claims only in reference to the recited substrate. PO Resp. 14. Patent Owner further contends that the ’378 patent consistently depicts the isolation region/structure in a shallow region in the upper portion of the substrate. *Id.* at 14–16 (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 asserts that the isolation region/structure must be “part of” the substrate, and if the isolation region/structure extends beyond the top or bottom surface of the substrate, then it is not part of the substrate. PO Resp. 16; PO Sur-reply 3.

Petitioner asserts that the Patent Owner improperly attempts to narrow the meaning of “with” and “of” to “part of.” Pet. Reply 2 (citing PO Resp. 14). We first address the construction of claim 15 and then address the construction of claim 1.

Regarding claims 15/18, Patent Owner’s citations to the Specification do not support its proposed construction. Patent Owner relies on multiple embodiments to support its proposed construction, only one of which describes a substrate “with” an isolation structure. PO Resp. 16 (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 17 (“the claim language . . . specifically invokes the term ‘with’ and ‘of’ (i.e., part of) rather than ‘on.’”), 22. 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,” and 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, 8). 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).<sup>4</sup>

Patent Owner also argues that the “isolation region of the substrate” as recited in claim 1 should be construed as requiring that the isolation region is part of the substrate. PO Resp. 14. We further determine that the “isolation region of the substrate” language of claim 1, argued on the same reasoning, should similarly be given its plain meaning, because the ’378 patent is not

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<sup>4</sup> Patent Owner’s further arguments against a construction of “on” the substrate; i.e., that “on” requires a horizontal and not lateral spatial relationship, are moot because we do not apply such a construction. PO Resp. 17–22.

limited to an isolation region that is “part of” an isolation structure, such as in a shallow region or other partial-depth portion of the substrate.

Regarding plain meaning, Patent Owner argues that “of” is a “function word to indicate the whole that includes the part,” citing to a dictionary definition. PO Sur-reply 2 (citing Ex. 1038, 6). Petitioner points to an example from that same dictionary of “a friend of mine,” arguing that this “does not imply that the speaker is part of the friend.” Pet. Reply 3 (citing Ex. 1038, 6).

Patent Owner’s characterization of the region as “part of” the substrate is not based on any usage of the term “part of” in the ’378 Patent. Instead, Patent Owner relies on the description of some embodiments in which the substrate includes isolation regions, and upon one example of the “region” of substrate 202 as shallow trench isolation 233. PO Resp. 15 (citing Ex. 1001, Fig. 2, 12:54–66); Ex. 2005 ¶ 47. Dr. Yang states that the shallow trench isolation region may be formed by etching out a single crystal silicon substrate and filling it with oxide. Ex. 1040, 96:14–17, 112:6–11, 117:17–22. Dr. Yang acknowledges that the substrate of the ’378 patent is one “onto which subsequent material layers are added or otherwise ‘disposed.’” Ex. 2005 ¶ 90 (quoting Ex. 1001, 4:41–43). This testimony, which is supported by Dr. Yang’s cited section of the ’378 patent, indicates that the isolation region of the substrate is formed separately from the substrate, and may be formed of a different material than the substrate. Thus, Patent Owner is not arguing that the claimed region must be integral with, or made from the same materials as, the claimed substrate.

Instead, Patent Owner’s proposed construction of a “region of the substrate” is primarily based on an interpretation as a “shallow region” excavated from the substrate, excluding a region that “extend[s] vertically

through the full depth of the substrate,” or is “next to” the substrate. PO Resp. 15–16 (citing Ex. 1001, Fig. 2, 10:30–43, 12:64–13:3, 14:46–15:32). Although Figure 2 of the patent illustrates a “shallow trench” isolation region, it is described as an illustration “according to some embodiments,” not as depicting all embodiments. Ex. 1001, 3:35–36. To the contrary, the ’378 patent states, “STI structure 233 is exemplary and is not limiting. As such, other isolation structures can be used.” *Id.* at 10:33–35. Patent Owner’s argument that claim 1 must be limited to the exemplary embodiments is therefore unavailing.

With respect to the region being part of, and not next to, the substrate, Dr. Yang attests:

The specification nowhere discloses an isolation region/structure through a cut entirely through the substrate. This at most is creating a structure that is next to or abuts the substrate, but is not “with” or “of” the substrate.

Ex. 2005 ¶ 49. However, Dr. Yang’s statement is based a lack of an explicit supporting example in the ’378 patent, and is undermined by the ’378 patent’s statement that other isolation structures can be used. Ex. 1001, 10:33–35; *see Phillips*, 415 F.3d at 1323 (“although the specification often describes very specific embodiments of the invention, we have repeatedly warned against confining the claims to those embodiments”). Dr. Yang does not otherwise explain why a region extending from top to bottom of the substrate would not be a region of the substrate. Therefore, we do not find support for limiting the plain meaning of a “region of the substrate” to a “shallow region in the upper portion of the substrate.” Thus, the record does not provide support for Patent Owner’s construction of a region of the substrate as being a region that is part of the substrate.

In summary, we determine that the phrase “a substrate with an isolation structure” should be given its plain meaning, which includes accompaniment as well as combination, and is not limited to an isolation structure that is part of a substrate under the construction provided by Patent Owner.

2. “*through array contacts (TACs) extending vertically through the dielectric and the isolation structures*” (claims 15/18)

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 argues that claim 15 permits, but does not require, multiple dielectric structures or multiple isolation structures. PO Resp. 23–24 (citing Ex. 1001, Fig. 2; Ex. 2005 ¶ 64). Patent Owner contends that the limitation “through array contacts (TACs) extending vertically through the dielectric and the isolation structures” requires that the plurality of TACs extend through *at least one particular* dielectric structure and one particular isolation structure—i.e., the previously recited dielectric structure and isolation structure—regardless of whether additional dielectric structure or isolation structures are also present in the device. *See id.* (citing Ex. 2005 ¶ 64). In other words, Patent Owner asserts that the claimed multiple TACs must, *inter alia*, extend through the *same* dielectric structure. PO Sur-reply 7–10 (citing, *inter alia*, Ex. 1001, Fig. 2). Petitioner asserts that claim 15 requires that the TACs extend vertically through multiple dielectric structures but does not require that each of the multiple TACs extend through the same dielectric structure. *See* Pet. Reply 5–9 (citing, *inter alia*, Ex. 1001, 21:17–25).

We need not resolve this dispute 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; Pet. 63–64 (citing Ex. 1005, Fig. 17A); PO Resp. 54–55 (arguing only that Toyama does not teach the claimed isolation region/structure or the claimed dielectric structure on the isolation region/structure). Because 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, our construction does not affect our overall determination on unpatentability of claim 15 or any other claim. However, 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>.

Patent Owner contends that “the dielectric and the isolation structures” in “through array contacts (TACs) extending vertically through the dielectric and the isolation structures” recited in claim element [15.H] should be construed as “the dielectric structure and the isolation structure.” PO Resp. 23. 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 ¶ 62). 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 (citing Ex. 2005 ¶ 64).

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 ¶ 64. 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.4<sup>th</sup> 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 ¶ 64. Thus, claim 15 requires multiple TACs, and permits multiple dielectric structures and multiple isolation structures,<sup>5</sup> 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 only this embodiment describes a single TAC 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 6 (citing Ex. 1037 ¶ 20).

Patent Owner relies on Figure 2 of the '378 patent as an example of two TACs extending through a single dielectric structure and a single isolation structure. PO Resp. 24. 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 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

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<sup>5</sup> 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.

15 is not limited to the embodiment of Figure 2 merely because it depicts multiple TACs.

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 6 (citing Ex. 1001, 21:7–25). 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, 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 scope of claim 15 (and by extension, claim 18) to Patent Owner’s preferred configuration despite the broader claim language. *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 (multiple TACS through a single pair of dielectric/isolation structures) but also Petitioner’s broader construction (multiple TACs, with a

single TAC extending through corresponding pairs of dielectric/isolation structures). Because Patent Owner’s proposed construction is narrower than that supported by the ’378 patent, 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.

3. “each local contact of the local contacts” (claim 18)

Claim 18 recites, in pertinent part, “an etch stop plug interposed between each local contact of the local contacts and each channel structure of the channel structures.” Ex. 1001, 25:9–12. Neither party presented a construction prior to institution. Prelim. Resp. 12–13; Pet. 32–33. Patent Owner asserted that no claim construction set forth in the parallel district court proceeding impacts the issues raised in its Preliminary Response. Prelim. Resp. 13.

a) *Parties’ contentions*

Subsequent to institution, Patent Owner argues that the plain and ordinary meaning of “each local contact of the local contacts” refers to the

local contacts disposed on both of the channel structures and the slit structures recited in claim 15, from which claim 18 depends. PO Resp. 27. Patent Owner argues that this antecedent basis clearly shows that each of the local contacts recited in claim 15 must have an etch stop plug interposed between itself and each channel structure. *Id.* at 27–28.

Patent Owner points to the following description of “local contact” in the ’378 patent:

The contacts are referred to herein as “local contacts” because they are in direct contact with the memory array structures, and further because they are formed within dielectric layer 230. ... As used herein, the term “contact” can broadly include any suitable types of interconnects including vertical interconnect access (via) lines and lateral lines (interconnect lines).

*Id.* at 30 (citing Ex. 1001, 11:20–30). Patent Owner argues that other structures, including TACs 234, are described as local contacts. *Id.* at 30–31 (citing Ex. 1001, 11:26–27). Patent Owner further argues that in the ’378 patent, bit lines 250 are local contacts because they are interconnect contacts that are “electrically connected to NAND strings[] (channel structures) in the NAND string region.” *Id.* at 31 (citing Ex. 1001, 12:4–9). Patent Owner argues that the bit lines, which extend laterally, are disposed on channel structures as well as slit structures, providing annotated Figure 1A:

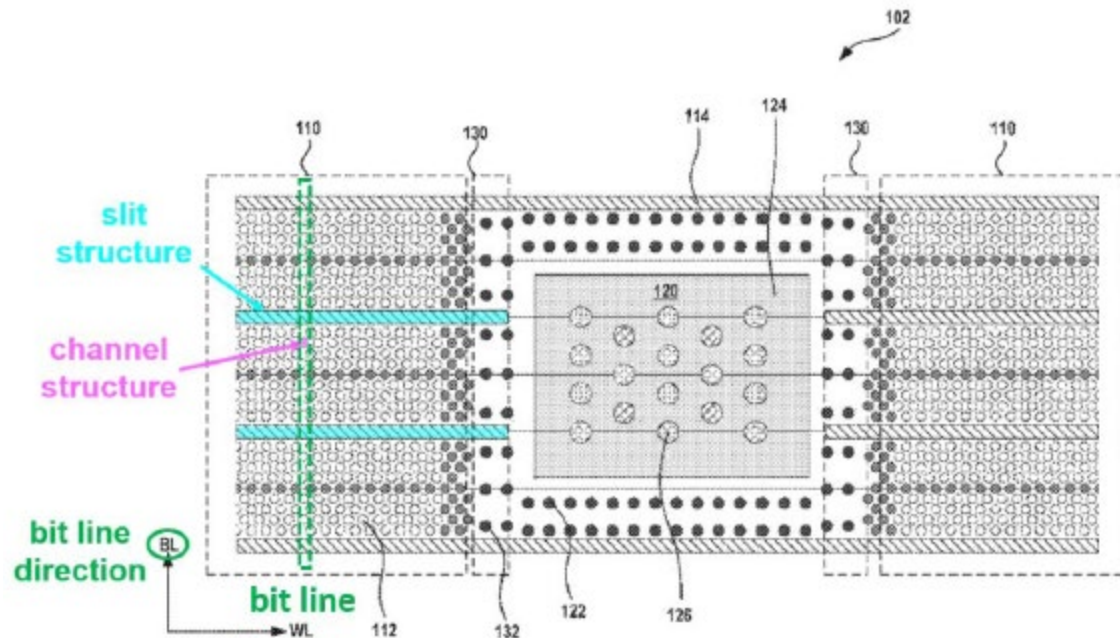


FIG. 1A

*Id.* at 32. Annotated Figure 1A shows a slit structure (teal), channel structure (pink arrow), and a bit line green dotted box added to Figure 1A, for which Patent Owner states, “The precise placement of the bit line in the NAND string region does not matter because the location of the slit structures and channel structures means that the bit lines will be disposed over both.” *Id.*

Petitioner argues that Patent Owner’s construction is incorrect because it “reads out every embodiment of the specification.” Pet. Reply 10–11. Petitioner argues that the ’378 patent’s etch stop plugs are always described as being between channel structure local contacts 236 and channel structures 216. *Id.* at 11 (citing Ex. 1001, 11:37–39). Petitioner argues that “the point of an ‘etch stop’ is to protect *channel* structures,” and that both parties’ declarants agree that an etch stop plug on a slit structure is unnecessary. *Id.*(citing Ex. 1040, 121:14–16; Ex. 1037 ¶ 31; Ex. 1001, 9:44–46). Petitioner further argues that bit lines 250 are not local contacts because they

are not in physical or electrical contact with slit structures 226. *Id.* at 11–12 (citing Ex. 1001, Fig. 2). Petitioner argues that the ’378 patent instead describes the bit lines as “interconnect contacts” in the “top interconnect layer.” *Id.* at 12–13 (citing Ex. 1001, 11:56–59, 5:40–45). Petitioner further argues that dependent claim 18, by referring to the local contact-channel structure configuration, is limited to local contacts on channel structures, not slit structures. *Id.* at 13.

*b) Analysis*

Claim 15 requires that there be “local contacts disposed on the channel structures and the slit structures that extend vertically through an alternating conductor/dielectric stack.” Ex. 1001, 24:56–64. Claim 18 further requires “an etch stop plug interposed between each local contact of the local contacts and each channel structure of the channel structures.” Ex. 1001, 25:9–12.

To construe claim 18, we look to “the words of the claims themselves, the remainder of the specification, the prosecution history, and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art.” *Innova/Pure Water, Inc. v. Safari Water Filtration Sys., Inc.*, 381 F.3d 1111, 1116 (Fed. Cir. 2004).

As summarized above, Patent Owner essentially argues that there is a single way to read claim 18, which requires “each local contact” to refer to each of the local contacts in claim 15, including those on the channel structures and those on the slit structures. Petitioner essentially argues that there is a different way to read claim 18, and that a person having ordinary skill in the art would understand “each local contact” as being limited to the local contacts associated with respective channel structures.

With respect to the plain language of the claim, we agree with Petitioner that the express language of claim 18, considered alone, does not provide an unambiguous construction of “each local contact.” Where the express language of the claim is subject only to a single, unambiguous construction, that construction will be maintained. *Chef America, Inc. v. Lamb-Weston, Inc.*, 358 F.3d 1371, 1374 (Fed. Cir. 2004). Here, claim 15 describes two sets of local contacts: one set disposed on the channel structures and one set disposed on the slit structures. Claim 18 refers to a relationship between local contacts and channel structures, requiring an etch stop plug to be interposed therebetween. Claim 18 does not mention slit structures in relation to etch stop plugs. Claim 18 addresses only the relationship of etch stop plugs to channel structures, and does not require that etch stop plugs be placed in any relationship to slit structures. Because the express language of claim 18 does not address the relationship of etch stop plugs to the slit structures of claim 15, the express language of claim 18 does not unambiguously address interposition of etch stop plugs relative to the local contacts on those slit structures as recited in claim 15. Because claim 18 does not unambiguously refer to local contacts on both channel and slit structures, the plain language of the claim does not resolve the claim construction (unlike in *Chef America*). Thus, we consider the evidence of record to determine how a person having ordinary skill in the art would understand claim 18.

As noted by Petitioner, when the ’378 patent mentions etch stop plugs, it does so only in the context of a plug between the channel structure local contacts and the channel structures. Pet. Reply 11; Ex 1001, 11:24–26, 11:35–40. Dr. Lee states that in the ’378 patent, “[t]here are etch stops (224) only between the channel local contacts and the channel structures.”



interposed between the local contacts and the slit structures that they are disposed upon.

However, Patent Owner argues that there is a different set of local contacts, bit lines 250, that are over both the channel structures and the slit structures. PO Resp. 29–30. Patent Owner argues that a bit line disposed over both structures, with an etch stop plug only between each bit line and each channel structure, would read on claim 18. *Id.* at 30 (citing Ex. 2005 ¶ 73).

Patent Owner’s construction requires a determination that a person having ordinary skill in the art would recognize bit lines as local contacts within the meaning of claims 15 and 18. Patent Owner points to the ’378 patent as indicating that “contacts” can be “lateral lines (interconnect lines)” and “interconnect contacts 248” may be “bit lines 250.” PO Resp. 30–31 (citing Ex. 1001, 11:20–30, 12:4–9). Yet this only indicates that bit lines are contacts, not that bit lines are “local” contacts.

As argued by Petitioner, the ’378 patent clearly distinguishes interconnect contacts from local contacts. Ex. 1001, 11:48–51 (“*in addition to the local contacts*, 3D memory device 200 can further include a contact layer 242 and an interconnect layer 244 as part of its interconnect structures.”) (emphasis added); Pet. Reply 12–13 (citing Ex. 1001, 11:56–59; Ex. 1037 ¶ 33). Thus, a person having ordinary skill would recognize that bit lines are not local contacts.

Further, as acknowledged by Patent Owner, the ’378 patent states that “[t]he contacts are referred to herein as ‘local contacts because they are in direct contact with the memory array structures.” *Id.* at 30 (quoting Ex. 1001, 11:20–30). Yet the bit lines 250 are not in “direct” contact with either the channel structures or the slit structures, which are described by Patent

Owner as memory array structures. Ex. 1001, Fig. 2; PO Resp. 31.

Although Patent Owner describes the bit lines as being “over” the channel and slit structures, and are electrically connected to channel structures, Patent Owner does not state that they are directly connected to either. PO Resp. 30–31. Patent Owner states that the bit lines 250 are electrically connected to different memory array structures, NAND strings (channel structures) in the NAND string region. PO Resp. 31 (citing Ex. 1001, 12:4–9). However, this cited section shows that bit lines 250 are not directly connected to NAND strings 204, but that NAND string contacts 236 are interposed therebetween. Ex. 1001, 12:4–7.

Further, Patent Owner acknowledges that the ’378 patent describes local contacts as being formed within dielectric layer 230. PO Resp. 30 (citing Ex. 1001, 11:20–30). Patent Owner states that this is not limiting because the ’378 patent describes its TACs 234 as being local contacts despite not being within dielectric layer 230. *Id.* at 30–31 (citing Ex. 1001, Fig. 2, 11:26–27). While we credit this distinction, the TACs are located at the same vertical level as contacts 236. Ex. 1001, Fig. 2. That the TACs are in their own dielectric layer 232, rather than the surrounding dielectric layer 230, does not tend to indicate that contacts in the top interconnect layer, such as bit line 250, would also be considered local contacts.

The testimony of the declarants is not to the contrary. Dr. Yang describes that contacts 236 and 246 are “the contacts from the etch stop plug all the way up to the bit line,” indicating both a lack of direct connection of the bit line to, and significant distance from, the etch stop plug. Ex. 1040, 107:2–5. Although Dr. Lee describes the function of the local contact basically as “an interconnect to connect the memory array structure to . . . external input, outputs,” this describes the “contact” function of the local

contact, but does not address the required location of such contacts or the requirement that they be directly connected to the memory array structure elements, or the context in which “local contact” is used in claims 15 and 18. Ex. 2007, 66:1–14.

Based upon the entirety of this evidence we do not agree that a person having ordinary skill in the art would understand bit lines 250 to be “local contacts” in the context of the ’378 patent.

Furthermore, Patent Owner’s proposed construction does not accord with the “disposed on” limitation of claim 15. Claim 15 sets forth channel and slit structures, with local contacts “disposed on” each. Ex. 1001, 24:56–65. Patent Owner does not contest that one requirement of local contacts is that they be “in direct contact with” the memory structures. PO Resp. 30; Ex. 1001, 20–22. Thus, the local contacts are those in direct contact with both the channel and slit structures. Patent Owner’s proposed construction is instead based on interconnect contacts located over, not in direct contact with, channel and slit structures. Further, in order to meet the requirement of claim 18 that an etch stop plug be interposed between “each” local contact, Patent Owner’s construction would cause contacts 236 and 238, described in the ’378 patent as “local contacts,” to not be considered local contacts, because the slit structure contacts 238 would not have an etch stop plug interposed between them and the channel structures, and the NAND string contacts 236 do not extend over the slit structures.

Similarly, Patent Owner’s construction is in tension with its statement that TACs 234 are described as local contacts. PO Resp. 30–31 (citing Ex. 1001, 11:26–27). Although TACs are recited in claim 15, and Patent Owner asserts that those may be local contacts, Patent Owner does not indicate that those TAC local contacts should be treated as part of the “each local

contacts” in claim 18. Nor does Patent Owner point to explanation of how its construction of claim 18 would be consistent with “local contacts” including TACs. To the contrary, Patent Owner’s annotated Figure 1A appears to indicate that its bit lines would not be located over its TACs that are in area 120. PO Resp. 32.

Based on the foregoing, we construe the phrase “each local contact of the local contacts” as referring to those local contacts disposed on the channel structures for which an etch stop plug may be interposed therebetween.

#### *D. Obviousness over Toyama*

Petitioner asserts that claims 1–7 and 18 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. 34–103. Patent Owner argues against this assertion. PO Resp. 38–76.

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 1–7 and 18 are unpatentable under 35 U.S.C. §103 as obvious over Toyama.

##### *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; Prelim. Resp. 13. Petitioner’s assertions rely primarily upon two structures of Toyama, namely the “First Exemplary Structure” and a Second Modification of the fourth exemplary structure (the “Second Modification”).

a) *Toyama's First Exemplary Structure*

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:

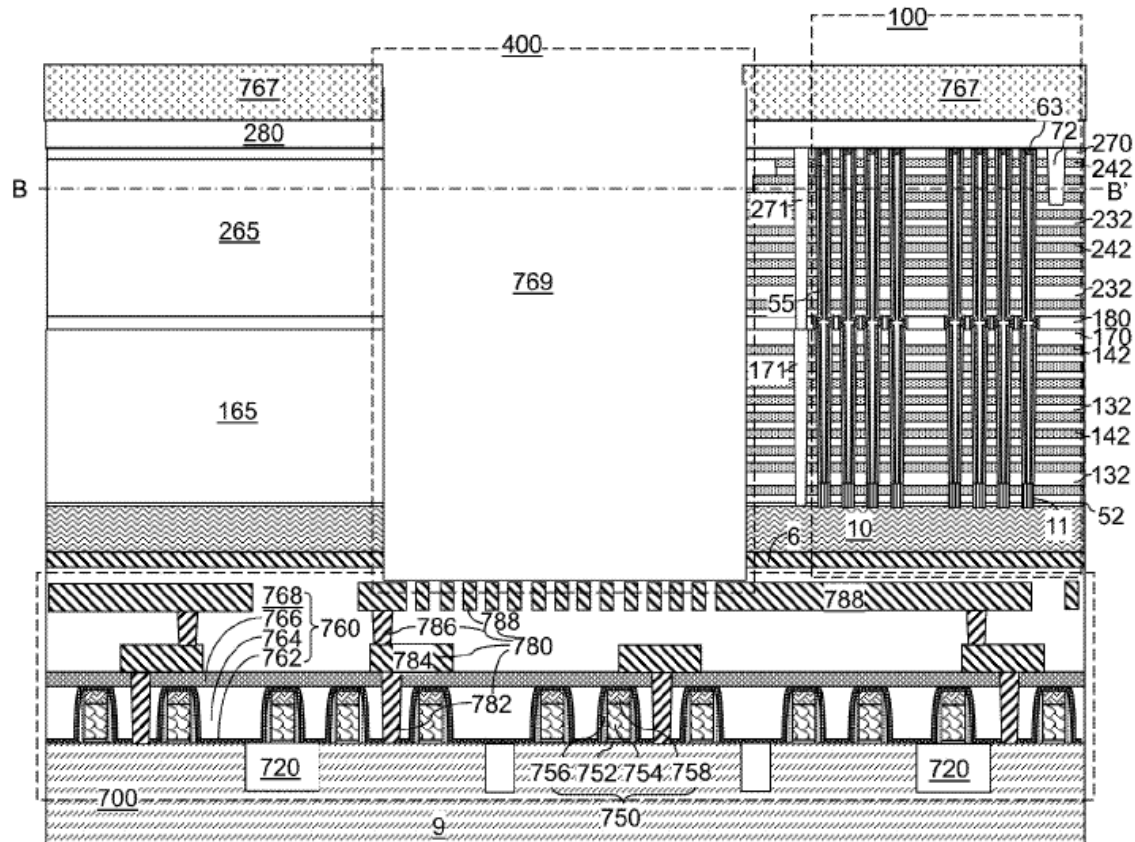


FIG. 11A

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 (those having numbers in the 700s), a planar semiconductive layer 10 is formed. *Id.* ¶ 169. 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.

*b) Toyama's Second Modification*

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:

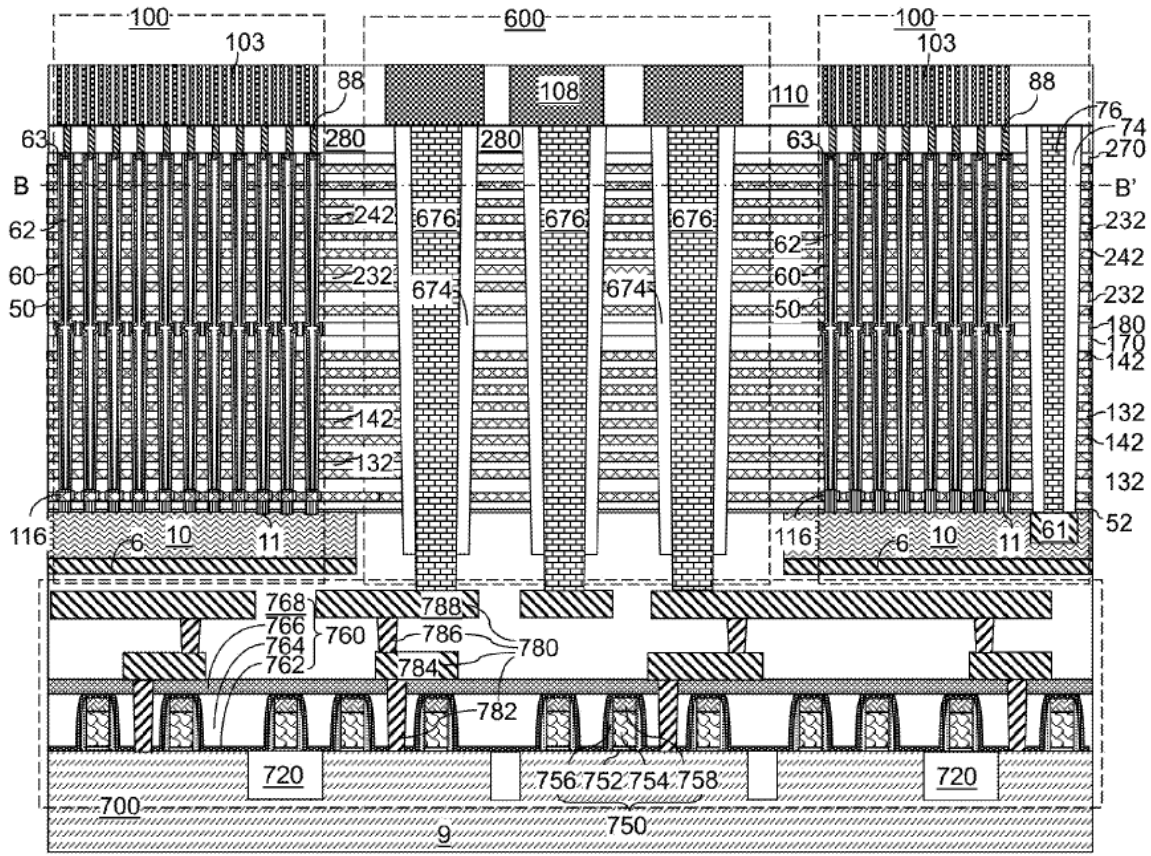


FIG. 49

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 1

We begin our analysis of Petitioner's obviousness contentions with Petitioner's assertions as to claim 1.

*[1.PRE] A three-dimensional (3D) memory device, comprising:  
[1.A] a semiconductor substrate; [1.B] an alternating layer  
stack disposed on the semiconductor substrate*

To the extent the preamble [1.PRE] is limiting, Petitioner asserts that it is taught by Toyama's description of three dimensional memory devices as the subject of its disclosure. *Id.* at 34 (citing Ex. 1005 ¶156). Petitioner asserts that limitations [1.A]–[1.B] are taught by Toyama's planar semiconductor material 10 (as the semiconductor substrate) and Toyama's alternating stack 132, 146, 232, 246 (as the alternating layer stack disposed on the semiconductor substrate). Pet. 34–38 (citing Ex. 1005, Figs. 17A, 49, ¶¶172, 190, 228, 232, 337). Patent Owner does not contest these assertions. *See, e.g.*, PO Resp. 38–39, 61.

Upon review of the current record, we determine that Petitioner's assertions regarding limitations [1.PRE]–[1.B] are supported by the record.<sup>6</sup>

*[1.C] a dielectric structure on an isolation region of the substrate and extending vertically through the alternating layer stack, wherein the alternating layer stack abuts a sidewall surface of the dielectric structure and the dielectric structure is formed of a dielectric material*

Petitioner asserts that limitation [1C] is taught by Toyama, providing two alternate theories; one based upon Toyama's "First Exemplary Structure," and the other based upon the "Second Modification" of Toyama's fourth exemplary structure. Pet. 38–60. Patent Owner contests these assertions. PO Resp. 38–54, 61–65.

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<sup>6</sup> Because we determine that the preamble [1.PRE] is taught, we need not determine whether it is limiting.

a) “*First Exemplary Structure*” *Alternative*

Petitioner asserts that Toyama’s “First Exemplary Structure” illustrated in Figure 15A teaches or suggests limitation [1.C]. Pet. 47–60. Petitioner points to dielectric fill material portion 430 as represented in Figure 15A. *Id.* at 47–50. Petitioner asserts that a lower portion of dielectric fill material portion 430 teaches the claimed isolation region of the substrate and the upper portion of dielectric fill material portion 430 teaches the claimed dielectric structure. *Id.* at 50–51. Petitioner asserts that the upper portion of the dielectric fill material portion extends through and abuts the alternating stack as required by claim limitation [1.C]. *Id.* at 54–60 (citing Ex. 1005, Figs. 1C, 4, 15A, and 16B).

Regarding its mapping of two portions of dielectric fill material portion 430 to both the dielectric structure and the isolation region recited in claim 1, 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.* (citing *Retractable Techs., Inc. v. Becton, Dickinson & Co.*, 653 F.3d 1296, 1303–04 (Fed. Cir. 2011)). 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.” *Id.* at 52–53 (citing Ex. 1001, 10:34–35). Petitioner asserts that the dielectric structure in both Toyama and the ’378 patent have the same purpose – “to electrically insulate a ‘through array contact’ as it extends through” a device portion. *Id.* at 53 (citing Ex. 1001, 11:12–14; Ex. 1003 ¶¶ 133–35).

Patent Owner argues that Toyama’s First Exemplary Structure does not render obvious (1) the “isolation region of the substrate” (PO Resp. 39–46) or (2) “a dielectric structure on an isolation region” as recited in claim limitation [1.C]. PO Resp. 46–53.

(1) “*isolation region of the substrate*”

Patent Owner argues that Toyama’s dielectric fill material portion 430 is not an “isolation region *of* the substrate” because the substrate is completely removed in that portion such that portion 430 is merely adjacent to, and not part of, the substrate. *See, e.g.*, PO Resp. 38–44.<sup>7</sup> Patent Owner’s argument relies upon its construction that excludes a structure that extends all the way through the substrate because such a structure is adjacent to but not “part of” the substrate. PO Resp. 14–16. As explained in more detail above, we do not adopt this construction. *Supra* § II.C.1. Consequently, that Toyama’s region extends the entire depth of the substrate, or that Toyama’s region is not surrounded by the substrate, does not detract from its teaching of an isolation region of a substrate.

Patent Owner further argues against Petitioner’s characterization of Toyama’s portion 530 as isolating portions of the substrate from one another. PO Resp. 43–44. PO argues that the substrate remains connected. *Id.* at 33. However, Patent Owner does not contest Petitioner’s assertion that Toyama’s portion 430 is an isolation region “because it electrically isolates electrical conductors from each other and from electrical interference from” semiconductor layer 10. Pet. 51. Based on the foregoing discussion, we

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<sup>7</sup> Patent Owner argues that portion 430 in Toyama is not surrounded by the substrate, but indicates that even if it were, it would be adjacent to, and not part of, the substrate. PO Resp. 41–43.

determine that Petitioner has sufficiently shown that Toyama's portion 430 teaches an isolation region of the substrate.

(2) “a dielectric structure on an isolation region”

(a) *Toyama's unitary structure*

Patent Owner argues that Toyama's First Exemplary Structure does not disclose or suggest “a dielectric structure on an isolation region” as required by claim limitation [1.C] because Petitioner improperly maps different portions of a single structure to multiple claim limitations. PO Resp. 46–53. In particular, Patent Owner argues that Toyama's unitary structure (i.e., dielectric fill material portion 430) cannot be arbitrarily divided to teach the separately claimed dielectric structure and isolation region. PO Resp. 46–53. Patent Owner argues that “the '378 [patent] consistently claims, describes, and depicts the isolation structure and the dielectric structure to be separate structures with a specific spatial relationship,” even where they are made of the same material. *Id.* at 49–52 (citing Ex. 1001, 10:30–43, Figs. 2–13; Ex. 2005 ¶ 99). Patent Owner asserts that there must be a “defined” boundary between the dielectric structure and the isolation region. PO Sur-reply 17. 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. 51–53 (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.*

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., SiO<sub>2</sub>. Ex. 1001, 10:37–40 (isolation structure 233 filled with SiO<sub>2</sub>), 10:46–47 (dielectric structure can include SiO<sub>2</sub>, and can include the same material as dielectric layer 230), 10:12–14 (dielectric layer 230 is formed of SiO<sub>2</sub>). 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; Fig. 6. Then, “opening 600 can be filled with a dielectric layer 702,” which may be the same SiO<sub>2</sub> 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 structures 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. 51; PO Sur-reply 16–18. *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 Resp. 52–53; PO Sur-reply 18; *Supra* at 34. 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. 47–50; PO Sur-reply 16–17) 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  $1.0 \times 10^{-6}$  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). Although Patent Owner points to an etch stop function of the STI structure, other embodiments permit the etch to continue into the STI structure. PO Resp. 53 (citing Ex. 1001, 15:6–14); Ex. 1001, 15:16–20. Consequently, we determine that Petitioner establishes by a preponderance of the evidence that that Toyama’s unitary First Exemplary Structure teaches limitation [1.C].

*(b) Toyama’s combination of embodiments*

Petitioner alternately asserts that it would have been obvious to modify Toyama’s First Exemplary Embodiment to form the isolation region and the dielectric structure separately. Pet. 53–54 (citing Ex. 1005 ¶ 277,

Fig. 24A). Petitioner asserts that it would have been obvious, as a mere substitution of a well-known process, which is taught by Toyama's Third Exemplary Structure, to separately form the isolation region and the dielectric structure and arrive at the same result. *Id.* (citing Ex. 1005 ¶ 277, Fig. 24A; Ex. 1003 ¶ 135).

With respect to Petitioner's asserted combination of embodiments from Toyama, Patent Owner argues that Toyama's other relied-upon embodiment is not an isolation region that is part of the substrate. PO Resp. 53–54 (referencing its arguments at §§VII.A.1,VIII.A.1). We have found these arguments unavailing because we do not adopt Patent Owner's construction of "part of." *Supra* § II(D)(2)(a).

Patent Owner further argues that Petitioner has not shown sufficient reason for incorporating Toyama's two-step processing into Toyama's First Exemplary Structure, and that such a change would "involve a longer and more complicated manufacturing process with more opportunities for defects and failure." PO Resp. 53–54.

We agree with Petitioner that Toyama's Third Exemplary Structure, 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. This express statement provides express reason why a person having ordinary skill in the art would find it obvious to combine the First and Third Exemplary Structures. We also accord weight to Dr. Lee's testimony that:

Using isolation region[s] 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 ¶ 135.

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 ¶ 107. However, Dr. Yang’s testimony does not account for the presence of such an embodiment in Toyama. 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 ¶ 107), 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 processing changes. 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.

(c) *Determination*

For the foregoing reason, we determine that Petitioner’s sufficiently shows that Toyama’s First Exemplary Structure teaches claim limitation [1.C].

b) *“Second Modification” Alternative*

As noted above, claim element [1.C] recites “a dielectric structure on an isolation region of the substrate and extending vertically through the alternating layer stack, wherein the alternating layer stack abuts a sidewall surface of the dielectric structure and the dielectric structure is formed of a dielectric material.” In Petitioner’s “Second Modification” alternative, Petitioner points to Toyama’s description of a dielectric structure in the form of multiple insulating liners 674, made of a dielectric material, on an isolation region in the form of the insulating material filling opening 151. Pet. at 39–44 (citing Ex. 1005 ¶¶ 233, 277 (“The opening 151 is located under region 400 and may be filled with another insulating material layer (e.g., a silicon oxide or doped silicate glass) 760”), 338–340, 381, Fig. 49; Ex. 1003 ¶¶ 115–123); *see also id.* at 42, 46 (stating that “insulating liners 674” are individually and collectively a dielectric structure). Petitioner asserts that Toyama’s alternating conductor/dielectric stack abuts a sidewall surface of insulating (dielectric) liners 674, such that the liners 674 extend vertically through the alternating stack (132, 146, 232, 246). *Id.* at 44–46. Petitioner provides an annotated version of Figure 49 to illustrate this relationship:

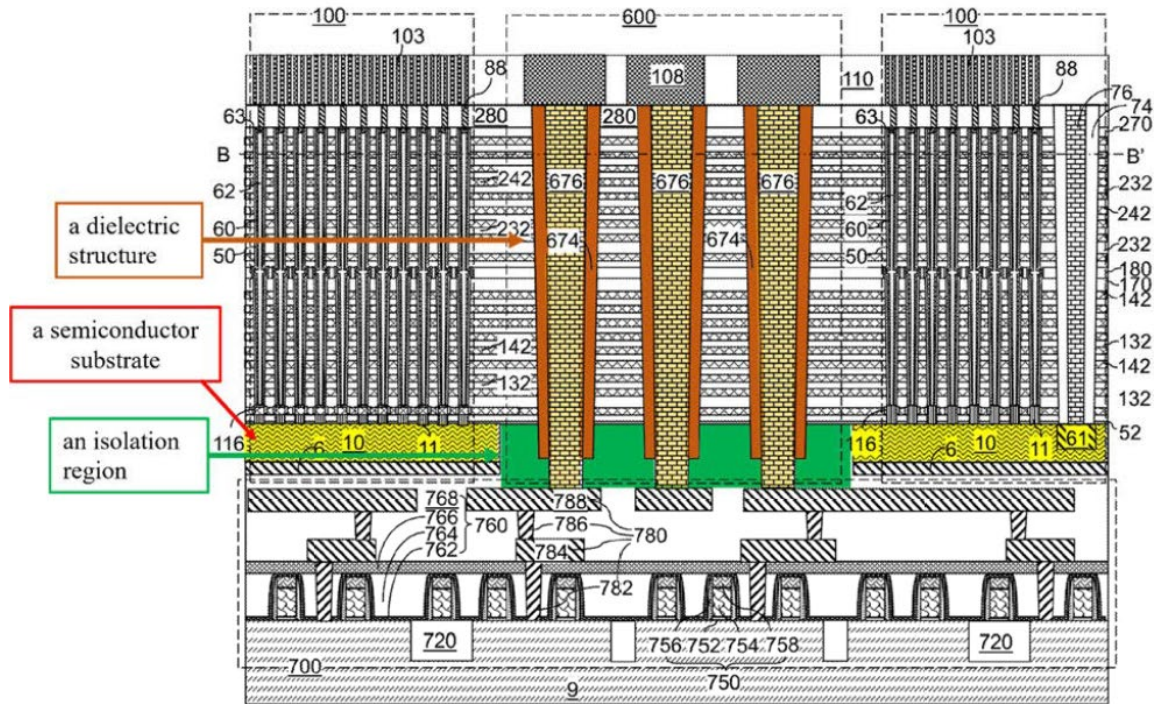


FIG. 49

*Id.* at 43–44. 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 the claim limitation “a dielectric structure” is taught by Toyama’s multiple structures 674. Pet. 40–42. Petitioner argues that dielectric liners 674 are “individually and collectively a dielectric structure.” *Id.* at 42 (emphasis omitted). Petitioner also 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 41 (citing Ex. 1005 ¶¶ 338–340; Ex. 1022, 5 (dictionary)). Petitioner further argues that “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

n. 11 (citing *KCJ Corp. v. Kinetic Concepts, Inc.*, 223 F.3d 1351, 1356 (Fed. Cir. 2000)).

Patent Owner argues that Toyama does not teach a substrate with an isolation region. PO Resp. 60–64. Specifically, Patent Owner argues that the region of Toyama mapped by Petitioner to the “isolation region” is located in a region of a cut through the alleged substrate, and is not part of the substrate required by claim 1. *Id.* at 62. Patent Owner argues that the ’378 patent requires the isolation structure to be part of the substrate. *Id.* (citing Ex. 2005 ¶ 121). Patent Owner argues that Toyama’s insulating material layer 760 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 63–64 (citing Ex 1005, Fig. 44A). Thus, Patent Owner argues, Toyama’s Second Modification does not describe or teach an isolation region of the substrate under its construction. *Id.* at 64.

Patent Owner’s argument is unavailing because it rests on a claim construction that we have not adopted. We have determined that “an isolation region of the substrate” includes a physically and chemically distinct part of the substrate, and may be a region that extends from top to bottom of the substrate, such as Toyama’s substrate 10 having an opening “filled with” insulating layer 760. *Supra* § II.C.1; Ex. 1005 ¶ 277, Fig. 44A; Pet. 30–31.

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 Petitioner’s Second Modification of Toyama assertions for limitation [1.C], 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. 39–42 (citing, *inter alia*, Ex. 1005 ¶¶ 233, 338–340, 381, Fig. 49; Ex. 1003 ¶¶ 115–118) . 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 41 (citing Ex. 1005 ¶¶ 338–340; Ex. 1022, 5 (dictionary)). After institution, Petitioner provided an alternate definition of a structure as “something arranged in a definite pattern of organization.” Pet. Reply 22–23 (citing Ex. 1022, 5). Petitioner asserted that such a structure need not be contiguous. *Id.* at 22.

As a part of Patent Owner’s arguments relating to limitation [1.D], Patent Owner argues against Petitioner’s assertion that multiple dielectric liners can be considered a single structure. PO Resp. 65–69. 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 69 (citing Ex. 2005 ¶132).

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 ¶ 26. 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 [1.D] 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 [1.C].

In summary, Petitioner has sufficiently shown limitation [1.C] to be taught by Toyama under its First Exemplary Structure assertion. Petitioner has also sufficiently shown limitation [1.C] to be met under its Second

Modification assertion in which dielectric liners 674 are individually a dielectric structure.

*[1.D] one or more through array contacts (TACs) extending vertically through the dielectric structure and the isolation region*

In its “First Exemplary Structure” theory, Petitioner asserts that Toyama teaches one or more through array contacts (“through-memory-level via structures 488) extending vertically through the dielectric structure (upper portion of 430) and isolation region (lower portion of 430). Pet. 63–64 (citing Ex. 1005, Fig. 17A, ¶ 239). Patent Owner does not contest this assertion beyond its arguments for limitation [1.C], with which we did not agree. PO Resp. 54–55; *Supra* § II.D.2.a. Because Petitioner’s assertions are sufficiently supported by the sections of Toyama cited for support, we determine that Petitioner has sufficiently shown limitation [1.D] to be taught by Toyama under Petitioner’s First Exemplary Structure assertions.

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 (“individually and collectively the dielectric structure”) and the insulating material layer filling opening 151. Pet. 61–62 (citing Ex. 1005, Fig. 49, ¶¶ 340–342; Ex. 1003 ¶¶ 143–145) (emphasis omitted). Petitioner asserts that (as explained with respect to limitation [1.C]) “a dielectric structure” includes “one or more dielectric structures,” and accordingly, limitation [1.D] “encompasses embodiments in which each through array contact extends vertically through a different dielectric structure.” *Id.* at 62 n.14 (emphasis omitted).

Patent Owner argues that Toyama does not teach multiple TACs extending through the same dielectric structure. PO Resp. 65–69. Patent

Owner argues that Petitioner mapped multiple insulating liners 674 to a single dielectric structure. *Id.* (citing Pet. 41).

We disagree with Patent Owner. As noted above, claim element [1.D] recites “*one or more* through array contacts (TACs) extending vertically through the dielectric structure and the isolation region.” Because the claim recites *one or more*” TACs, this claim element is met if a *single* TAC extends vertically through a dielectric structure and an isolation region. Petitioner has sufficiently shown that Toyama’s Second Modification discloses that each individual TAC (676) extends through a dielectric structure (674) and an isolation region, and therefore, discloses this claim element.

*[1.E]–[1.J]: [1.E] one or more channel structures extending vertically through the alternating layer stack; [1.F] an epitaxial layer between the one or more channel structures and the semiconductor substrate; [1.G] an etch stop plug on each of the one or more channel structures; [1.H] a staircase structure in the alternating layer; [1.I] slit structures extending vertically in the alternating layer stack; and [1.J] one or more contact layers on the one or more TACs, the one or more channel structures, and the slit structures.*

Petitioner asserts that Toyama’s First Exemplary Structure and its Second Modification teaches channel structures (“memory stack structures 55”) extending vertically through the alternating conductor/dielectric stack, an epitaxial layer (“pedestal channel portions 11”) between the channel structures 55 and semiconductor substrate 10 (Figure 17A), an etch stop plug (“drain region 63” that “serve[s] the purpose of stopping an etch” and “fill[s] the cavities in the memory openings”) on each of the channel structures 55, a staircase structure in the alternating stack having levels with each level having a conductive layer (146, 246) thereon (Fig. 17C), slit structures (“laterally-elongated contact via structures 76”) in the alternating

conductor/dielectric stack (Fig. 17A), a contact layer (“drain contact via structures 88”) disposed on channel structures (“memory stack structures 55”), and a contact layer (“source connection via structures 91”) disposed on the slit structures (Figure 17A), and a contact layer (“upper-level metal interconnect structures 108”) on the one or more TACs (and in the Second Modification, also on the slit structures). Pet. 64–85 (citing Ex. 1005 ¶¶ 202, 208–210, 232, 238–239, 241–243, 250–251, 322–323, 342, 388, Fig. 49).

Patent Owner does not specifically contest these limitations. PO Resp. Upon review of the complete trial record, we determine that Petitioner’s assertions under both its First Exemplary Structure and its Second Modification assertions regarding limitations [1.E]–[1.J] are supported by the record and persuasive.

### *Conclusion*

For the foregoing reasons, Petitioner has shown by a preponderance of the evidence claim 1 is obvious over Toyama, under both its First Exemplary Structure and its Second Modification assertions.

### *3. Claims 2–6*

Patent Owner does not specifically contest Petitioner’s assertions as to claims 2–6. *See, e.g.*, PO Resp. 38, 60. However, the burden of proving unpatentability rests solely upon Petitioner. We have reviewed Petitioner’s assertions for these claims. Pet. 85–92. 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, the unpatentability of claims 2–6 over Toyama.

4. *Claim 7*

Claim 7 recites, “The 3D memory device of claim 1, wherein the dielectric structure defines a through array contact region within the 3D memory device.” Ex. 1001, 23:50–53. Petitioner asserts that Toyama teaches this limitation in both its First Exemplary Structure and its Second Modification. Pet. 90.

Regarding Toyama’s First Exemplary Structure, Petitioner asserts that the through array contact region is taught by the upper part of portion 430. Pet. 92 (citing Ex. 1005, Fig. 17A, ¶¶ 165–167). Patent Owner does not contest this assertion beyond its assertions that Toyama does not teach the claimed dielectric structure. PO Resp. 55 (citing Ex. 2005 ¶ 110); PO Sur-reply 22.

We are persuaded by Petitioner’s reasoning that the portion of Toyama’s dielectric through which the TACs extend teaches a dielectric structure that defines a through array contact region. We do not agree with Patent Owner that Toyama does not teach the claimed dielectric structure. *Supra* § II.D.2. Consequently, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 7 is obvious over the teachings of Toyama.

We address Petitioner’s alternate arguments based on Toyama’s Second Modification for completeness of the record. Petitioner asserts that “Toyama discloses *the dielectric structure* (“insulating liners 674”) defines a through array contact region within the 3D memory device (part of the “through-memory-level via region 600”). Pet. 90–91 (citing Ex 1005, Fig. 49, ¶¶ 333, 340, 352; Ex. 1003 ¶¶ 196–197). Patent Owner asserts, *inter alia*, that Petitioner’s asserted dielectric structure (Toyama’s liners) does not

define a through array contact region because the through array contact region extends beyond the liners. PO Resp. 71; PO Sur-reply 22–26.

Petitioner’s Second Modification arguments rely on an assertion that Toyama’s three constructed liners together constitute a single dielectric structure. Unlike for claim 1, where Petitioner also asserts that each individual liner is a single dielectric structure, for claim 7, Petitioner only contends that the multiple lines *together* form a single dielectric structure:

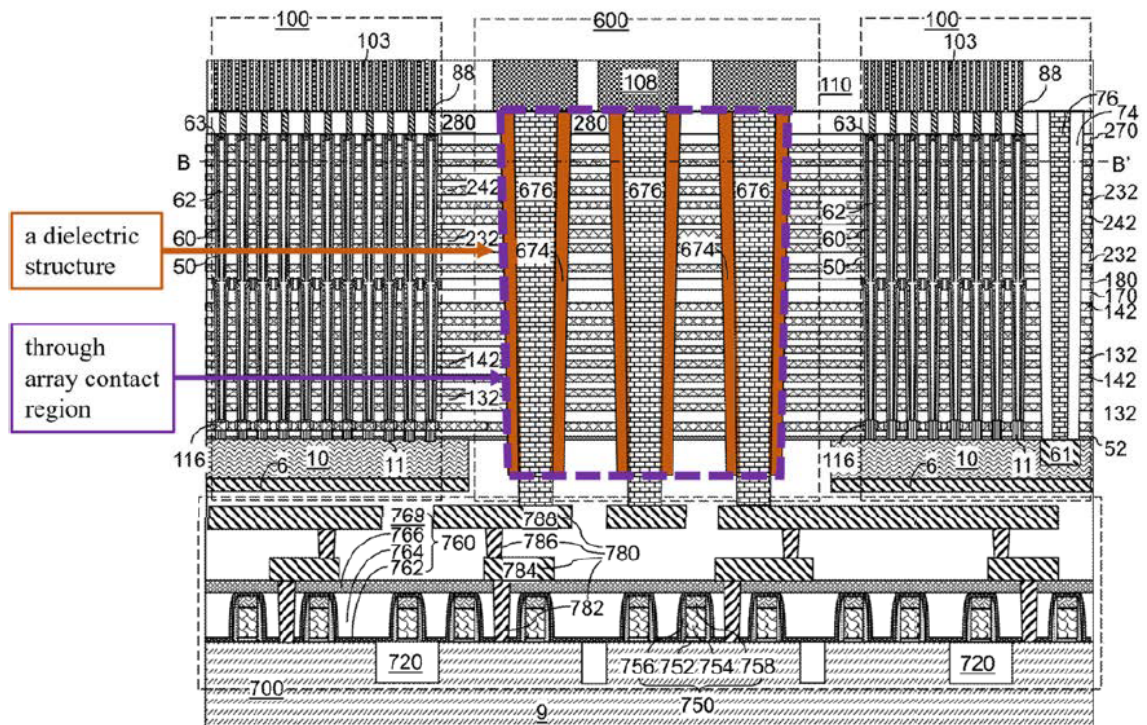


FIG. 49

Pet. 90–91 (providing an annotation of Figure 49). Petitioner’s annotated Figure 49 provides red shading to indicate three noncontiguous liners as the “a dielectric structure,” and provides a purple dashed rectangle around the outer edges of the outmost borders of the liners as the “through array contact region.” *Id.* at 91. There is no indication that Petitioner considers its dielectric structure to be each of the liners considered individually (as for claim 1), or how the through array contact region would appear under that

interpretation. 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 “the dielectric structure defines a through array contact region within the 3D memory device,” and has not shown that Toyama’s Second Modification would have rendered claim 7 obvious.

In summary, Petitioner’s First Exemplary Structure assertions show, by a preponderance of the evidence, that claim 7 is obvious over the teachings of Toyama.

### 5. *Claim 18*

Claim 18 depends from claim 15, which is not challenged in this Petition.<sup>8</sup> However, Petitioner must show all of the limitations of claim 18, including those of claim 15 incorporated by its dependency therefrom. Petitioner’s assertions for limitations [15.PRE]–[15.E] and [15.H] of claim 15 rely largely on its assertions for the corresponding limitations of claim 1. Pet. 93–96, 101–102. We determine that Toyama teaches limitations [15.PRE]–[15.E] and [15.H] of claim 15 for the reasons set forth in our discussion of the corresponding limitations of claim 1. We further determine that Toyama teaches the remaining limitations of claims 15 and 18 as detailed below.

With respect to limitation [15.PRE], “a three-dimensional (3D) memory device,” Petitioner refers to its assertions for limitation [1.PRE]. Pet. 92. Patent Owner does not contest this limitation. PO Resp. We need

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<sup>8</sup> Claim 15 is challenged in IPR2024–00788, instituted on November 7, 2024, filed by the same Petitioner. Claim 15 was determined to be unpatentable in a Final Written Decision entered concurrently with this Decision. IPR2024-00788, Paper 41.

not determine whether the preamble is limiting because we determine that Petitioner has shown that Toyama teaches this limitation. *See supra* § II.D.2.

With respect to limitation [15.A], “a substrate with an isolation structure,” Petitioner refers to its assertions for limitation [1.A], asserting that the difference from the “isolation region” language in limitation [1.A] is immaterial. Pet. 92–93. Patent Owner contests this limitation for the same reasons as argued with respect to limitation [1.A]. PO Resp 39–46, 62–64 (providing a combined analysis of limitations [1.A] and [15.A]). *See supra* § II.D.2. We have found those arguments unavailing, and determine that Petitioner has sufficiently shown that Toyama teaches this limitation. *See id.*

With respect to limitation [15.B], “an alternating conductor/dielectric layer stack disposed on the substrate,” Petitioner refers to its assertions for limitations [1.B]. Pet. 94. Patent Owner does not contest this limitation. PO Resp. For the same reasons discussed with respect to limitation [1.B], we determine that Petitioner has shown that Toyama teaches this limitation. *See supra* § II.D.2.

With respect to limitation [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 refers to its assertions for limitation [1.C]. Pet. 94-95. Patent Owner contests this limitation for the same reasons as argued with respect to limitation [1.C]. PO Resp 46–54, 65 (providing a combined analysis of limitations [1.C] and

[15.C]. *See supra* § II.D.2. We have found those arguments unavailing, except on Petitioner’s alternate assertion in which each of Toyama’s liners is considered together as a dielectric structure. *See id.* Patent Owner additionally argues that Toyama’s First Exemplary Structure does not teach “a substrate *with* an isolation structure” even if “with” is construed as encompassing “on.” PO Resp. 39, 45–46. However, our construction of “with” is not based upon such an “on” construction, but encompasses accompaniment in any orientation. *See id.* at § II.C.1. For the reasons set forth in our discussion of limitation [1.C], we determine that Petitioner has sufficiently shown that Toyama teaches this limitation. *See supra* § II.D.2.

With respect to limitation [15.D], “channel structures and slit structures extending vertically through the alternating conductor/dielectric layer stack,” Petitioner asserts that Toyama teaches channel structures (“memory stack structures 55”) and slit structures (“laterally-elongated contact via structures 76”), relying on its assertions for limitations [1.E] and [1.I]. Pet. 96. Patent Owner does not contest these assertions. PO Resp. For the reasons set forth in our discussion of limitations [1.E] and [1.I], we determine that Petitioner has sufficiently shown that Toyama teaches this limitation. *See supra* § II.D.2.

With respect to limitation [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,” Petitioner relies on its assertions for limitations [1.H] and [15.B]. Pet. 96. Patent Owner does not contest these assertions. PO Resp. For the reasons set forth in our discussion of limitations [1.H] and [15.B], we determine that

Petitioner has sufficiently shown that Toyama teaches this limitation. *See supra* § II.D.2.

With respect to limitation [15.F], “a word line contact disposed on the conductor layer of the each level,” in its First Exemplary Structure assertions, Petitioner points to Toyama’s word line contact via structures 86 disposed on electrically conductive layers 146, 246. Pet. 96–98 (citing Ex. 1005, Fig. 17C, ¶¶ 260, 322). With respect to limitation [15.G], “local contacts disposed on the channel structures and the slit structures,” Petitioner points to drain contacts 88 (the claimed “local contacts”) disposed on memory stack structures 55 (“channel structures”) and source connection via structures 91 (“local contacts”) disposed on via structures 76 (“slit structures”). Pet. 98–101 (citing Ex. 1005 ¶¶ 241, 251, Fig. 17A). For its alternative theory relying on Toyama’s Second Modification, Petitioner asserts that Toyama’s description of “metal interconnect structures [that] can include . . . source connection line structures” indicates, or would make obvious, that the via structures 76 would also include source connection via structures. *Id.* at 100–101 (citing Ex. 1005 ¶¶ 250, 342, 382, Fig. 49). Patent Owner does not contest these assertions. PO Resp. We agree that Petitioner’s assertions for these limitations are persuasive and supported by the complete trial record.

Claim limitation [15.H] recites “through array contacts (TACs) extending vertically through the dielectric and the isolation structures.” Ex. 1001, 24:66–67. Petitioner asserts that Toyama’s First Exemplary Structure teaches through array contacts (TACs) by its through-memory-level via structures 488, which extend vertically through the dielectric structure of the upper portion of dielectric fill material portion 430 and through the isolation structure of the lower part of dielectric fill material

portion 430. Pet. 102 (citing its assertions for limitations [1.D], [15.A.ii], and [15.C]). Patent Owner does not contest these assertions beyond its arguments for limitations [15.A] and [15.C], which we have determined to be unavailing. PO Resp. 54–55. We agree that Petitioner’s assertions based upon Toyama’s First Exemplary Structure are persuasive and supported by the complete trial record.

Petitioner also asserts that Toyama’s Second Modification, shown in Figure 49 shows multiple TACs, each of which extends through vertically respective dielectric structures (liners 674) and a single isolation structure (filler 151), teaches limitation [15.H]. Pet. 101–102 (citing its assertions for limitations [1.D], [15.A.ii], and [15.C]). Patent Owner argues that Petitioner’s Second Modification assertions for limitation [15.H] fail because they are based on Petitioner’s flawed assertions for limitations [15.A] and [15.C] (PO Resp. 65); however, we have found Patent Owner’s arguments regarding limitations [15.A] and [15.C] unavailing. *Supra* § II.D.5.

Patent Owner further argues that Toyama’s alleged TACs do not extend through the same structure (the claimed “dielectric structure”). PO Resp. 66. To the extent that Patent Owner argues that multiple noncontiguous liners may not be treated as a single dielectric structure, we agree as detailed in our discussion of limitation [1.C]. *See supra* § II.D.2.b. However, Petitioner also asserts that each of Toyama’s dielectric liners, considered individually, teach the claimed dielectric structure. Pet. 61. As detailed in our discussion of limitation [1.D], we determine that Toyama teaches multiple instances of a TAC extending through a dielectric structure and an isolation structure. *Supra* § II.D.2. Our claim construction supports an interpretation of limitation [1.D] of multiple TACs, with a single TAC

extending through corresponding pairs of dielectric/isolation structures.

*Supra* § II.C.2. Consequently, we determine that Petitioner’s Second Modification assertion, based upon Toyama’s liners considered individually as a dielectric structure, sufficiently shows Toyama to teach limitation 15.H.

Claim 18 further requires “an etch stop plug interposed between each local contact of the local contacts and each channel structure of the channel structures; and an epitaxial layer disposed between the channel structures and the substrate.” Ex. 1001, 25:9–13. Petitioner points to its assertions against limitations [1F] (“an epitaxial layer between the one or more channel structures and the semiconductor substrate”) and [1.G] (“an etch stop plug on each of the one or more channel structures”). Pet. 102–103. We have determined those assertions, which are uncontested, to be supported by the evidence and persuasive. *Supra* § II(D)(2).

However, Patent Owner argues, based on its construction, that the language of claim 18 requires more; i.e., that an etch stop plug be interposed not only on each channel structure, but between each local contact and between each channel structure. PO Resp. 55–56. However, we do not adopt such a construction, and instead adopt a construction of claim 18 in which the claimed “each local contacts” are each of the local contacts for which an etch stop plug is interposed between the channel structures for which claim 15 recites that each local contact is disposed on. *Supra* § II.C.3.b. Consequently, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 18 would have been obvious over Toyama.

### III. CONCLUSION<sup>9</sup>

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 1–7 and 18 are unpatentable.

In summary:

| <b>Claim(s)</b> | <b>35<br/>U.S.C.<br/>§</b> | <b>Reference(s)/Basis</b> | <b>Claims<br/>Shown<br/>Unpatentable</b> | <b>Claims Not<br/>Shown<br/>Unpatentable</b> |
|-----------------|----------------------------|---------------------------|------------------------------------------|----------------------------------------------|
| 1–7, 18         | 103                        | Toyama                    | 1–7, 18                                  |                                              |

### IV. ORDER

For the foregoing reasons, it is:

ORDERED that Petitioner has established by a preponderance of the evidence that claims 1–7 and 18 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.

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<sup>9</sup> 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).

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