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Paper 12
Entered: January 7, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MICRON TECHNOLOGY, INC.,
Petitioner,

v.

YANGTZE MEMORY TECHNOLOGIES COMPANY, LTD.,
Patent Owner.

IPR2024-00909
Patent 10,658,378 B2

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

CYGAN, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

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 on 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.").

We have authority to determine whether to institute an *inter partes* review. *See* 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2023). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted "unless . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." For the reasons given below, on this record, Petitioner has established a reasonable likelihood that it would prevail in showing the unpatentability of at least one of challenged claims 1–7 and 18 of the '378 patent. Accordingly, we institute an *inter partes* review as to 1–7 and 18 of the '378 patent on all asserted grounds of unpatentability.

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.

Micron Ex. 1039, p. 2
Micron v. YMTC
IPR2024-00788

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 (pending)), 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:[1]

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

[1.A] a semiconductor substrate;

[1] Bracketed organization added as per the Petition.

Micron Ex. 1039, p. 3
Micron v. YMTC
IPR2024-00788

[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.

F. Evidence

Petitioner relies on the following patent document evidence.

Name	Patent Document	Exhibit
Toyama et al. ("Toyama")	US 2017/0179026 A1	1005

Micron Ex. 1039, p. 4
Micron v. YMTC
IPR2024-00788

G. Prior Art and Asserted Ground

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

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–7, 18	103[2]	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.[3] *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

B. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art ("POSITA") at the critical time "would have had a bachelor of science degree in electrical engineering or a similar discipline, along with 2-3 years of professional

[2] We apply AIA 35 U.S.C. § 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.
[3] Neither party presents evidence or arguments regarding objective evidence of non-obviousness at this stage. Pet. 104; Prelim. Resp.

Micron Ex. 1039, p. 5
Micron v. YMTC
IPR2024-00788

experience working with (e.g., researching, designing, or teaching) NAND flash memory devices, or an equivalent level of skill, knowledge, and experience (e.g., an advanced degree may replace some of the professional experience)." Pet. 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 provide any such assessment in its Preliminary Response. For purposes of this Decision, 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 states that it "does not address Petitioner's proposed construction" because "it does not impact the issues raised in this [Preliminary Response]." Prelim. Resp. 13. We agree with Patent Owner that Petitioner's construction does not affect the determination for institution,

Micron Ex. 1039, p. 6
Micron v. YMTC
IPR2024-00788

and, as such, we need not construe this term for purposes of institution. *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))).

Although neither party provides an explicit construction, Petitioner and Patent Owner dispute whether "a substrate with an isolation structure" as set forth in limitation [1.A] requires that the isolation structure be part of the substrate or whether it may encompass a structure that fills an opening in the substrate. The parties also dispute whether the claim limitation "a dielectric structure" set forth in limitation [1.C] must be a single structure or whether it may encompass multiple structures. We address these construction issues *infra* at Section II.D.2 of this decision. For the remainder of the claim limitations, we do not need to determine a particular construction, and instead construe the claims pursuant to § 42.100(b).

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. Prelim. Resp. 27–47.

Upon consideration of Petitioner's explanations and the totality of evidence in this current record, we are persuaded that Petitioner demonstrates a reasonable likelihood of prevailing in showing that claims 1–7 and 18 are unpatentable under 35 U.S.C. § 103 as obvious over Toyama.

Micron Ex. 1039, p. 7
Micron v. YMTC
IPR2024-00788

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:

Micron Ex. 1039, p. 8
Micron v. YMTC
IPR2024-00788

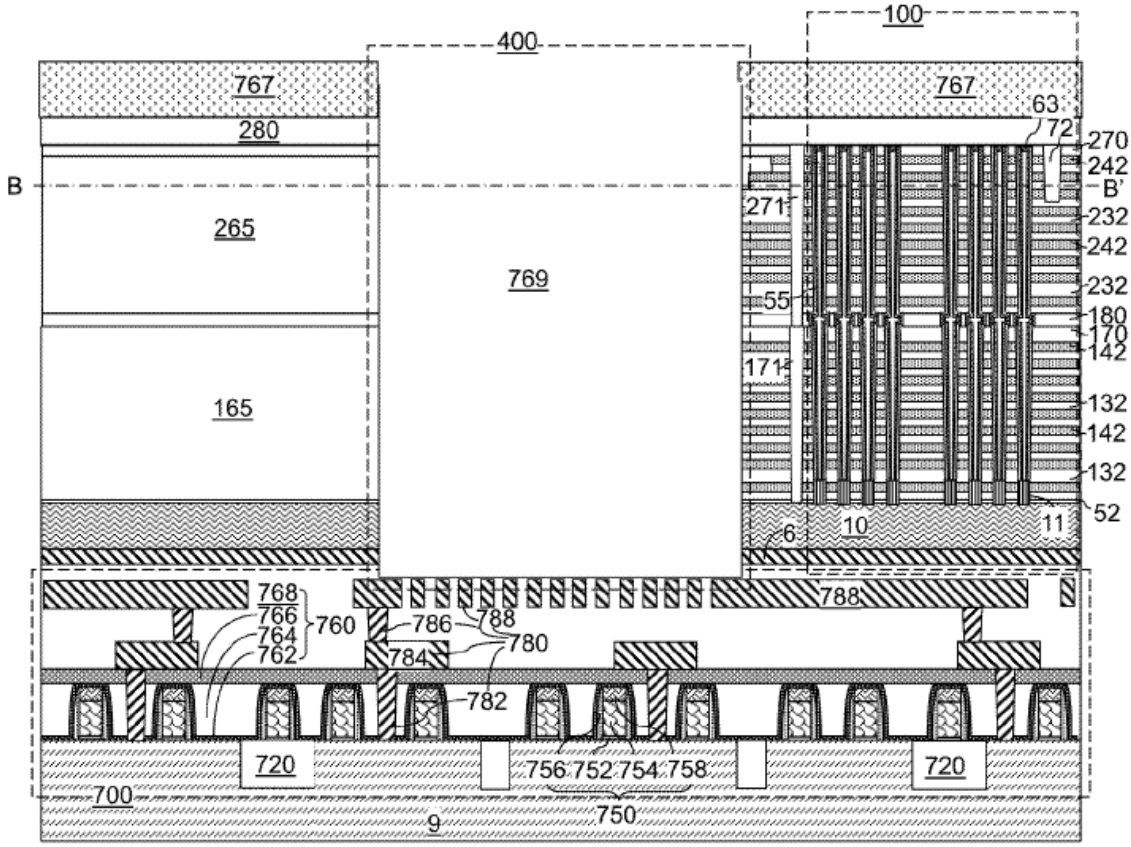

FIG. 11A

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:

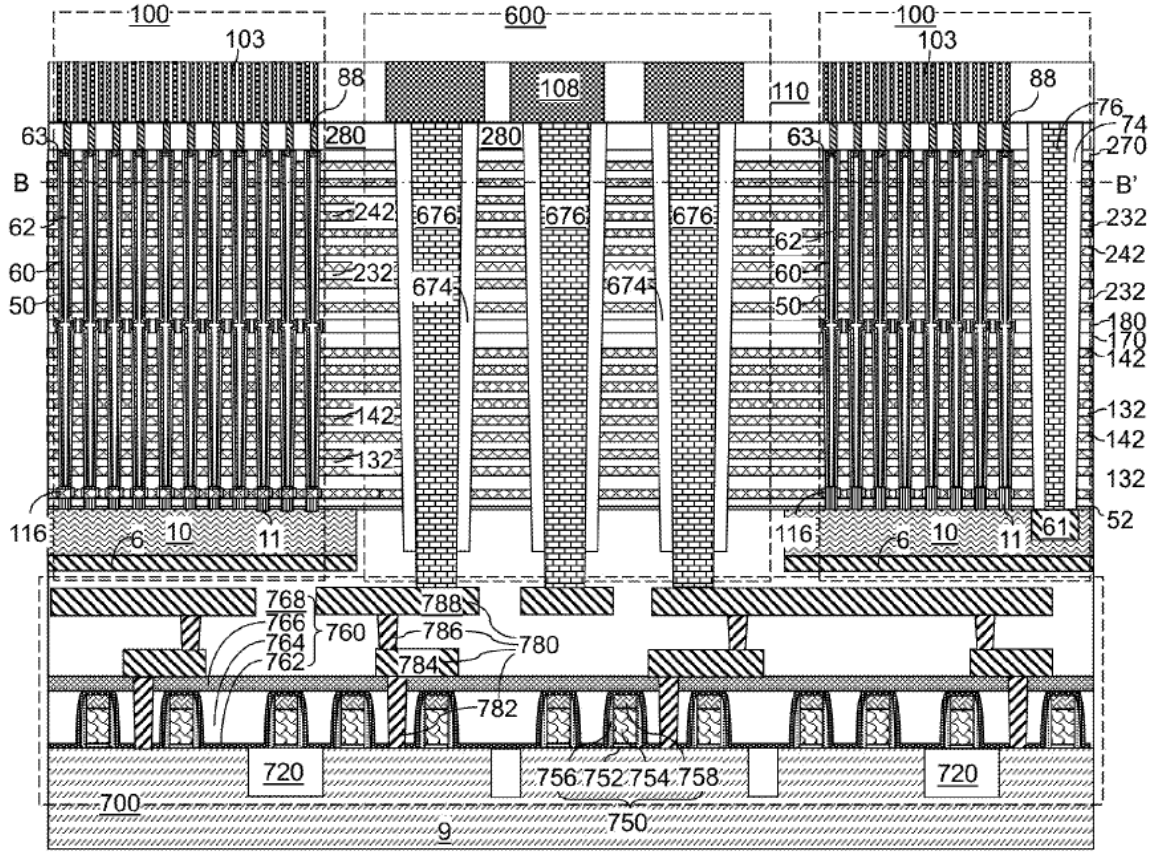

FIG. 49

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 at this stage of the proceeding. *See, e.g.*, Prelim. Resp. 42.

Upon review of the current record, we determine that Petitioner's assertions regarding limitations [1.PRE]–[1.B] are supported by the record in a manner sufficient for institution.[4]

[4] Because we determine that the preamble [1.PRE] is taught by Toyama for purposes of institution, we need not determine whether it is limiting.

Micron Ex. 1039, p. 11
Micron v. YMTC
IPR2024-00788

[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; the first based upon the "Second Modification" of Toyama's fourth exemplary structure, and the second based upon Toyama's "First Exemplary Structure." Patent Owner contests these assertions. Prelim. Resp. 39–43.[5]

a) "Second Modification" Alternative

In Petitioner's "Second Modification" alternative, Petitioner points to Toyama's description of a dielectric structure in the form of multiple dielectric insulating liners 674 on an isolation structure in the form of the insulating material filling opening 151. *Id.* at 39–44 (citing Ex. 1005 ¶¶ 233, 338–340, 381; Ex. 1003 ¶¶ 115–123). Petitioner asserts that Toyama's alternating conductor/dielectric stack abuts a sidewall surface of 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:

[5] Patent Owner references its arguments in section "VI.A.2.a," which appears to be a typo. We treat its support as instead from VII.A.2.a, which argues against Petitioner's assertions based upon Toyama's First Exemplary Structure.

Micron Ex. 1039, p. 12
Micron v. YMTC
IPR2024-00788

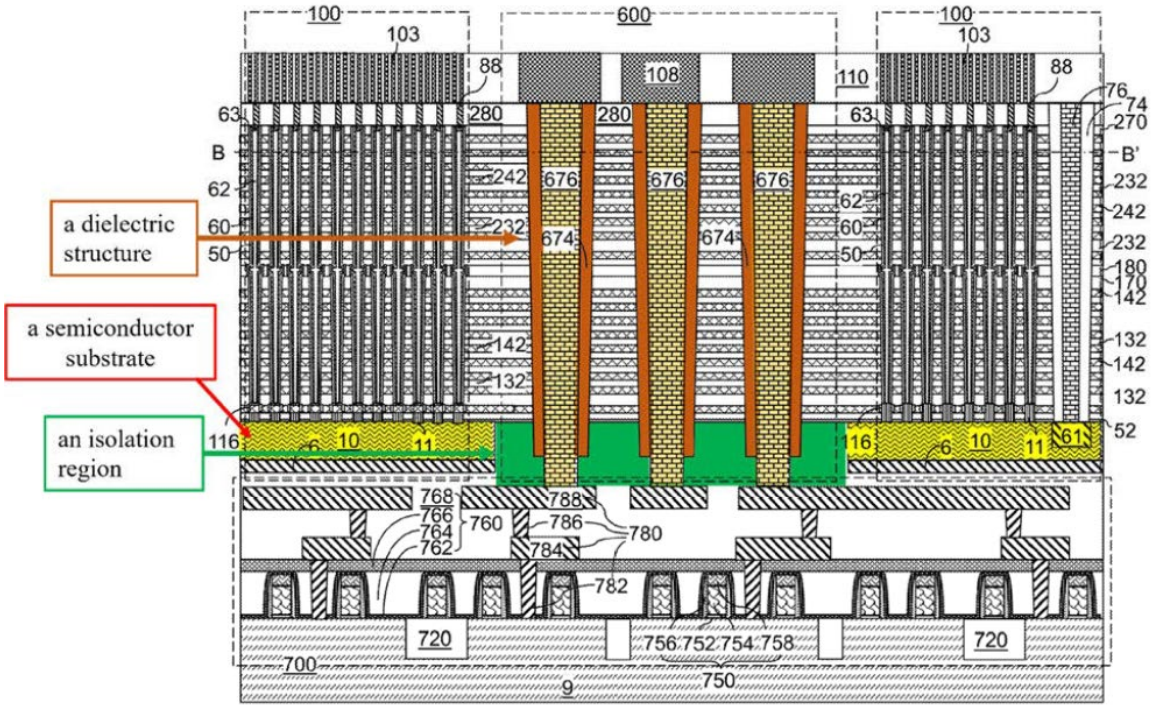

FIG. 49

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 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 the insulating liners 674 are collectively a single structure because "an indefinite article 'a' or 'an' in patent parlance carries the meaning of 'one or more' in open-ended claims containing the transitional phrase 'comprising.'" *Id.* at

41 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. Prelim. Resp. 40–43. 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 40. Patent Owner argues that the '378 patent, through its descriptions and depictions, requires the isolation structure to be part of the substrate. *Id.* at 40–41 (citing Ex. 1001, Figs. 2, 4–13, 12:54–66, 20:38–42). 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 42 (citing Ex 1005, Fig. 44A). Thus, Patent Owner argues, "there is no alleged substrate 'with' that 'insulating material layer 760.'" *Id.*

We determine that on the current record, Petitioner has shown Toyama's substrate having insulating layer 760 in an excavated portion of the substrate layer teaches the claimed "substrate with an isolation region." Patent Owner's argument is unavailing because it does not appear to be supported by the '378 patent specification. Figure 2 of the '378 patent, upon which Patent Owner's argument rests, describes its isolation structure on the substrate as "STI [Shallow Trench Isolation] structure is formed on a top portion of substrate 202 and filled with a dielectric material." Ex. 1001, 10:30–40; Prelim. Resp. 39–41. Patent Owner's annotated Figure 2 of the '378 patent is reproduced below:

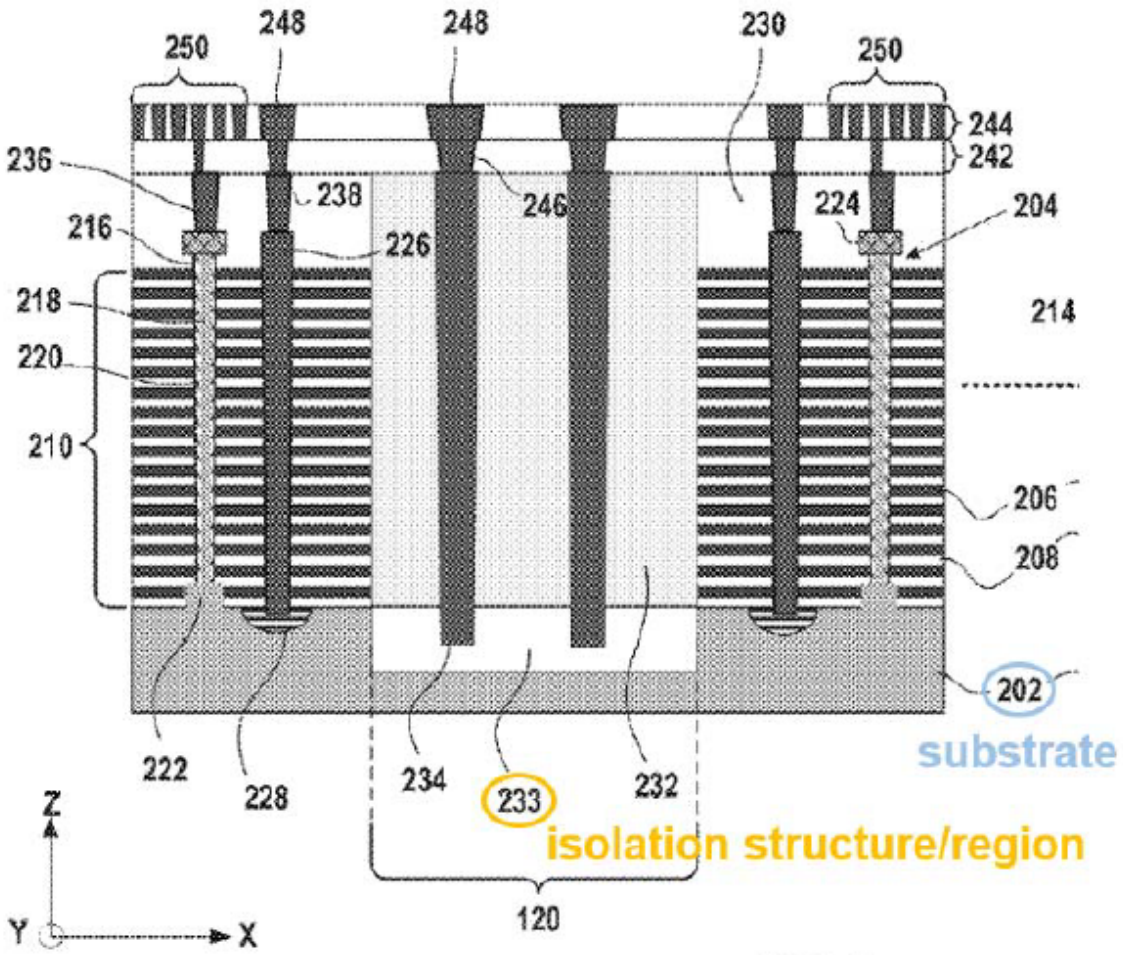

FIG. 2

Prelim. Resp. 41. Annotated Figure 2 shows, in pertinent part, a substrate 202 having an insulation-filled trench 233 in the top half of the center third of the substrate. Patent Owner characterizes the insulation formed in this manner as an "isolation region" of the substrate. *Id.* at 30.

Toyama's dielectric-filled substrate cavity and the dielectric-filled structure of Figure 2 of the '378 patent have the same structure except that Toyama's dielectric extends completely through the substrate whereas the dielectric of the '378 patent extends only partway through the substrate. However, for purposes of institution, this distinction is not determinative because the claim requires only "an isolation region of the substrate," which does not restrict the region from extending through the substrate.

Consequently, we are persuaded by Petitioner that Toyama's Second Modification teaches an isolation region of the substrate as set forth in limitation [1.C].

b) "First Exemplary Structure" Alternative

Petitioner also asserts that Toyama's "first exemplary structure" illustrated in Figure 15A teaches 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. *Id.* at 54–60 (citing Ex. 1005, Figs. 1C, 4, 15A, and 16B).

Regarding its division of the single fill material portion 430, 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 (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).

Micron Ex. 1039, p. 16
Micron v. YMTC
IPR2024-00788

Patent Owner argues that the '378 patent contemplates the isolation region as being part of the substrate, and that the dielectric structure is a separate structure from, and disposed on, the isolation region, unlike Toyama's unitary structure. Prelim. Resp. 34–37. 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. *Id.* at 37–38 (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.* Patent Owner further argues against Petitioner's assertions as being an arbitrary division of a single dielectric structure into two separate features of the challenged claims. *Id.* at 44–45.

Patent Owner's argument is unavailing at this stage of the proceeding. The court in *Retractable Technologies* analyzed the patent claims and specification to determine whether claimed elements need be separately formed structures. *Retractable Techs.*, 653 F.3d at 1303–1305. The court contrasted one pair of claim elements for which the claims and specification indicated that the elements "need not be separately molded pieces" with another "body" element that the specification indicated as a "one piece" body. *Compare id.* at 1303 ("These claims allow the [two elements] to structurally overlap prior to separation and indicate that the two limitations need not be separate pieces. The specifications also indicate that the [two elements] need not be separately molded pieces.") *with id.* at 1305 ("the specifications do not disclose a body that consists of multiple pieces or indicated that the body is anything other than a one-piece body").

Here, neither the claims nor the specification of the '378 patent indicate that the dielectric structure and isolation structure need be separately formed structures. First, the '378 patent indicates that both the dielectric structure and the isolation structure may be the same material; i.e., SiO_2. Ex. 1001, 10:37–40 (isolation structure 233 filled with SiO_2), 10:46–47 (dielectric structure can include SiO_2, and can include the same material as dielectric layer 230), 10:12–14 (dielectric layer 230 is formed of SiO_2). Second, the '378 patent indicates that the dielectric structure may be "aligned to" and "in contact with" the isolation structure. *Id.* at 10:30–36. Thus, the two structures of the '378 patent may appear as two aligned and contacting structures; e.g., a single column, of the same material.

Third, the '378 patent specification describes that the dielectric structure and a top portion of the isolation structure may be formed in the same deposition step. When etching the opening 600 that is to be filled with dielectric structure 232, "opening 600 may extend partially into STI structure 233;" i.e., "the etch process used to form opening 600 may also remove (recess) portion of the top surface of STI structure 233." *Id.* at 15:12–20. Then, "opening 600 can be filled with a dielectric layer 702," which may be the same SiO_2 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, with the same material, its isolation structure. The '378 patent does not mention whether this results in a dielectric structure that extends into the isolation structure or an isolation structure re-filled to its original height, and it would not appear to matter because both structures may be composed of the same material. The '378 patent's indifference to the exact boundary between dielectric structure 232 and isolation structure 233 during formation from the same

material indicates that these need not be distinct elements. Such connectivity of separate elements was also relied upon in *Retractable Technologies* that its elements may be taught by different portions of an integral structure. *See Retractable Techs.*, 653 F.3d at 1304 (finding the two elements need not be separately molded because "the specifications disclose forming a 'bridging portion' that connects" the two elements by welding them together).

Finally, dielectric fill material portion 430 performs the isolation functions common to both the isolation structure and the dielectric structure. Pet. 46–47; *see* Prelim. Resp. 44–48; Ex. 1005 ¶ 160 ("As used herein, an 'insulating material' or a 'dielectric material' refers to a material having electrical conductivity less than 1.0×10^{-6} S/cm"). Thus, Petitioner sufficiently shows at this stage of the proceeding that dielectric fill material portion 430 can be considered as both the isolation structure and the dielectric structure thereon. Consequently, we are persuaded that Petitioner has shown limitation [1.C] to be taught by Toyama for purposes of institution.

Alternate to its *Retractable* argument, Petitioner further points to another embodiment in Toyama that describes forming the isolation structure and dielectric structure separately. *Id.* at 54 (citing "Toyama's third exemplary structure"); Ex. 1003 ¶ 135 (citing Ex. 1005 ¶ 277). Petitioner further asserts that such a separate formation of the two portions of the dielectric fill material portion 430 would constitute the mere substitution of a known process ("Toyama's third exemplary structure" formation) for another process ("Toyama's first exemplary structure" formation) to obtain predictable results (the insulating material layer filling

opening 151 to electrically isolate the conductors embedded within). *Id.* (citing Ex. 1003 ¶ 135).

With respect to Petitioner's asserted combination of embodiments from Toyama, Patent Owner argues that the Toyama's other relied-upon embodiment "lacks additional limitations." Prelim. Resp. 38 (referencing its arguments for the second modification at §§ VI[I].A.1.a–VII.A.2.a). We have found these arguments unavailing. *Supra* §II(D)(2)(a).

We are persuaded by Petitioner's alternate argument based upon Toyama's teachings in the third exemplary structure for purposes of institution. Toyama states that the third exemplary structure can be derived from the first exemplary structure by performing the processing steps up to formation of the first-tier alternating stack (132, 142), represented by Figure 2. Ex. 1005 ¶¶ 169–170, 277. In this structure, the semiconductor layers "may be patterned to form an opening 151" that is filled with another insulating material layer 760. *Id.* ¶ 277. Dr. Lee testifies that a person having ordinary skill in the art would have found it obvious to use isolation regions on a substrate to electrically isolate components, and separate formation of the two dielectric regions to be a known process with predictable results. Ex. 1003 ¶ 135. Because Petitioner has shown that Toyama contemplates that its third exemplary embodiment, having separately-formed dielectric and isolation structures, may be combined with its first exemplary embodiment, and its third exemplary embodiment describes a step of filling a substrate-level opening 151 with dielectric material, we determine for purposes of institution 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.

For the foregoing reasons and upon review of the current record, we determine that Petitioner's assertions regarding limitation [1.C] are supported by the record in a manner sufficient for institution.

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

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 against Petitioner's assertions for [1.D] for the same reasons it raised against Petitioner's assertions for [1.C], which we have found unavailing as discussed *supra*. Prelim. Resp. 44.

We are persuaded by Petitioner's Second Modification assertions that limitation [1.D] is taught by at least one via structure 676 extending vertically through an insulating liner 674 ("individually and collectively the dielectric structure") and the insulating material layer filling opening 151.

In its "First Exemplary Structure" assertions, Petitioner asserts that Toyama's "through-memory-level via structures 488" are through array contacts (TACs), and that they extend vertically through dielectric material fill portion 430 (dielectric structure and isolation structure). Pet. 63–64 (citing Ex. 1005 ¶ 239; Ex. 1003 ¶¶ 147–148).

Micron Ex. 1039, p. 21
Micron v. YMTC
IPR2024-00788

Patent Owner argues that Petitioner has not shown Toyama teaches or renders obvious the isolation structure or a dielectric structure on the isolation structure, referring to its earlier arguments. Prelim. Resp. 38–39.

Patent Owner's argument is unavailing for the same reasons explained with respect to limitation [1.C]. Upon review of the current record, we determine that Petitioner's assertions regarding limitation [1.D] based upon Toyama's first exemplary structure are supported by the record in a manner sufficient for institution.

> *[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 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), local contacts ("drain contact via structures 88") disposed on channel structures ("memory stack structures 55"), and local contacts ("source connection via structures 91") disposed on the slit structures

(Figure 17A). Pet. 64–85. Petitioner asserts that Toyama's second modification teaches these limitations for the same reasons. Pet. 56 (citing Ex. 1005, Fig. 49; Ex. 1003 ¶ 132), 59 (citing Ex. 1005, Fig. 49; Ex. 1003 ¶ 136), 60–61 (citing Ex. 1005 ¶¶ 243, 322, ¶ 322; Ex. 1003 ¶ 138), 62–63 (citing Ex. 1005 ¶ 322; Ex. 1003 ¶¶ 141–142).

Patent Owner does not specifically contest these limitations. Prelim. Resp. Upon review of the current record, we determine that Petitioner's assertions regarding limitations [1.E]–[1.J] are supported by the record in a manner sufficient for institution.

Conclusion

For the foregoing reasons, Petitioner has demonstrated a reasonable likelihood that it will prevail on showing that claim 1 is obvious over Toyama.

3. Analysis of Claims 2–7

At this stage of the proceeding, Patent Owner does not specifically contest Petitioner's assertions as to claims 2–7. *See, e.g.*, Prelim. Resp. i–ii. 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 demonstrated, by a reasonable likelihood, the unpatentability of claims 2–7 over Toyama.

4. Claim 18

Claim 18 depends from claim 15, which is not challenged in this Petition.[6] However, Petitioner must show all of the limitations of claim 18,

[6] Claim 15 is challenged in IPR2024–00788, instituted on November 7, 2024, filed by the same Petitioner.

Micron Ex. 1039, p. 23
Micron v. YMTC
IPR2024-00788

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. Patent Owner's arguments against those limitations (specifically, [15.A], [15.C], and [15.H]) are based on the same reasoning as its arguments against limitations [1.C] and [1.D], which we have found unavailing. Prelim. Resp. 27–47.

With respect to limitation [15.F], Petitioner points to Toyama's word line contact via structures 86 disposed on electrically conductive layers 146, 246. Pet. 96–98. With respect to limitation [15.G], 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. 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. For purposes of institution, we agree that Petitioner's assertions for these limitations are persuasive and supported by the record.

With respect to the additional limitations of claim 18, of an etch stop plug interposed between each local contact and each channel structure, and an epitaxial layer disposed between the channel structures and the substrate, Petitioner points to its assertions against the similar limitations [1.F] and [1.G], which we have found persuasive. *Supra* § II(D)(2).

Micron Ex. 1039, p. 24
Micron v. YMTC
IPR2024-00788

Conclusion

For the above described reasons, we are persuaded, for purposes of institution, that Petitioner has shown a reasonable likelihood that claim 18 is unpatentable as obvious over Toyama.

III. DISCRETION UNDER 35 U.S.C. § 325(d)

Patent Owner argues that the Board should exercise its discretion to deny institution under 35 U.S.C. § 325(d). Prelim. Resp. 17. Patent Owner argues that Toyama was previously presented to the Office and the Examiner did not err in declining to issue a patent over it. *Id.* at 19–25.

A. Parties' Arguments

Patent Owner argues that Toyama was previously presented to the USPTO during prosecution. Prelim. Resp. 19 (citing Ex. 1002, 555). Patent Owner points to the Examiner's consideration of Toyama as indicated by the Examiner's signature on an information disclosure statement listing Toyama. *Id.* (citing Ex. 1002, 593). Patent Owner points out that Toyama was the only reference cited on that particular information disclosure statement. *Id.*

Petitioner admits that the Examiner previously considered Toyama, but erred by overlooking Toyama's disclosures and failing to reject the claims in light of Toyama. Pet. 11. Petitioner notes that the Examiner never discussed Toyama or its teachings. *Id.* at 12. Petitioner assigns significance to the fact that the Examiner received Toyama only after the Examiner indicated allowability and that the Patent Owner never notified the Examiner of a rejection that was issued by the Chinese Patent Office based upon Toyama. *Id.* at 11–12. Petitioner further asserts that the Chinese Patent

Micron Ex. 1039, p. 25
Micron v. YMTC
IPR2024-00788

Office's rejection of claim 17[7], and the reasoning in support of that rejection, was not provided to the Examiner. *Id.* at 12–15. Petitioner argues that its ground in this proceeding relies upon Toyama for the same structures that the Chinese Patent Office found Toyama teaches with respect to claim 17. *Id.* at 13–15. Petitioner argues that this lack of disclosure, and the determination by the Chinese Patent Office (confirmed upon internal appeal), indicates that the Examiner erred in overlooking those teachings when issuing the '378 patent. *Id.* at 15.

In response, Patent Owner argues that Toyama's deficiencies are not limited to those claim limitations addressed by Petitioner in its assertions. Prelim. Resp. 20–21. Patent Owner argues that Toyama discloses a "fabrication technique that the '378 criticizes and improves upon," including the formation of TACs "in a dielectric structure that is formed on an isolation structure of a substrate." *Id.* at 21–24 (citing Ex. 1001, Fig. 2, 5:35–39, 10:59–66, 18:27–41, 20:9–16). With respect to the determination of unpatentability by the Chinese Patent Office, Patent Owner argues that Chinese law applies a different legal standard than that applied in U.S. examination, and the Chinese Patent Office did, in fact, find the claims had "distinguishing features" from Toyama that relate to having TACs that extend through a dielectric structure that is on an isolation structure of a substrate. *Id.* at 24–25 (citing Exs. 1012, 1014). Patent Owner argues that the evidence in the record indicates that Toyama's teachings lack key

[7] Petitioner asserts that the claim rejected by the Chinese Patent Office was "materially identical" to original U.S. claim 17, and "the Examiner only allowed now-challenged claim 18 after Patent Owner rewrote the independent claim upon which it depends (claim 15) to incorporate the limitations of original claim 17." Pet. 13.

Micron Ex. 1039, p. 26
Micron v. YMTC
IPR2024-00788

inventive features of the '378 patent application, and that the Examiner recognized this fact. *Id.* at 25.

1. Analysis under Becton, Dickinson factors

In evaluating whether to exercise our discretion under § 325(d), we weigh the following non-exclusive factors: (a) the similarities and material differences between the asserted art and the prior art involved during examination; (b) the cumulative nature of the asserted art and the prior art evaluated during examination; (c) the extent to which the asserted art was evaluated during examination, including whether the prior art was the basis for rejection; (d) the extent of the overlap between the arguments made during examination and the manner in which Petitioner relies on the prior art or Patent Owner distinguishes the prior art; (e) whether Petitioner has pointed out sufficiently how the Examiner erred in its evaluation of the asserted prior art; and (f) the extent to which additional evidence and facts presented in the Petition warrant reconsideration of prior art or arguments. *Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17–18 (PTAB Dec. 15, 2017) (precedential).

As discussed above, it is undisputed that Toyama was submitted to the examiner, thus satisfying factors (a) and (b) in favor of exercising our discretion to deny institution. The parties differ on the extent to which Toyama was evaluated during examination, but both agree that (1) Toyama was indicated by the Examiner on an Information Disclosure Statement as having been considered and (2) the Examiner did not detail any such consideration, in a rejection or otherwise in an Office action or other document of record. Thus, factor (c) weighs somewhat, but less than fully, in favor of exercising our discretion to deny institution.

Micron Ex. 1039, p. 27
Micron v. YMTC
IPR2024-00788

Regarding factor (d), it is undisputed that no arguments regarding Toyama were presented during prosecution. Thus, the arguments made by the parties in the Petition and Preliminary Response were not presented previously to the Office, and factor (d) weighs against exercising our discretion to deny institution.

Regarding factor (e), Petitioner argues that during prosecution, the Examiner had indicated allowability of dependent claim 17 over the references applied to reject its independent claim. Pet. 12. Petitioner argues that the limitations of claim 17 were incorporated into the independent claims so as to secure allowance of the application and issuance of the '378 patent. *Id.* at 12–13. Petitioner argues that these limitations added to secure allowance are "a staircase structure, a word line contact, and a local contact disposed on each channel structure and slit structure." *Id.* at 12 (emphasis omitted). Petitioner asserts that Toyama teaches each of these limitations. *Id.* at 15–16. Petitioner asserts that the claimed "staircase structure disposed in the alternating conductor/dielectric layer stack wherein the staircase structure comprises levels with each level having a conductor layer thereon" is taught by Toyama's alternating stack (132, 146, 232, 246) having electrically conductive layers (146, 246). *Id.* Petitioner asserts that the claimed "a word line contact disposed on each conductor layer of the staircase structure" is taught by Toyama's word line contact via structures 86 disposed on first and second conductive layers (146, 246). *Id.* Petitioner asserts that the claimed "a local contact disposed on each channel structure" is taught by Toyama's drain contact via structures 88 disposed on memory stack structures 55. *Id.* Petitioner asserts that the claimed "a local contact disposed on each slit structure" is taught by Toyama's source connection via structures 91 disposed on laterally-elongated contact via structures 76. *Id.*

Micron Ex. 1039, p. 28
Micron v. YMTC
IPR2024-00788

Patent Owner argues that Petitioner's argument focuses only on the limitations incorporated from dependent claim 17 but fails to discuss other limitations that are missing from Toyama. Prelim. Resp. 20–21. Patent Owner argues that Toyama lacks a teaching of TACs formed in a dielectric structure that is formed on an isolation structure of a substrate, which results in a less complex and less costly fabrication technique. *Id.* at 21–24 (citing Ex. 1001, 5:35–39, 10:59–66, 18:27–41, 20:9–16).

Based on the arguments presented, we determine that Petitioner sufficiently shows the Office erred in its evaluation of Toyama. Patent Owner argues that Toyama lacks teaching of TACs formed in a dielectric structure that is formed in an isolation structure of a substrate. Prelim. Resp. 21–24. However, Patent Owner does not argue that the Office did not find such a teaching present in the prior art applied during prosecution. Prelim. Resp. Patent Owner does not dispute Petitioner's argument that the features indicated by the Office as providing allowability were the "staircase structure, a word line contact, and a local contact disposed on each channel structure and slit structure." Pet. 12. Nor does Patent Owner dispute Petitioner's assertions that Toyama teaches these limitations that, during prosecution, the Office found the applied prior art not to teach. Prelim. Resp. Because the record indicates that Toyama teaches limitations that the Office indicated as not being taught by the prior art and thereby conferring allowability, Petitioner sufficiently points out how the Examiner erred in its evaluation of the asserted prior art. Accordingly, factor (e) weighs against exercising our discretion to deny institution.

Regarding factor (f), it is uncontested that a communication from the Chinese Patent Office detailed the manner in which Toyama would render unpatentable at least one claim at issue during prosecution before the

Chinese Patent Office, and that this discussion was not presented to the Examiner during U.S. prosecution. Such discussion, however, involved Chinese patent law, and we agree with Patent Owner that the Chinese Patent Office communication does not necessarily show error by the Office. However, a discussion of how a submitted reference may be relevant to the patentability of a claim during prosecution weighs on our determination under § 325(d). *Cultec, Inc. v. Stormtech LLC*, Case IPR2017-00777, Paper 7 at 10–11 (August 22, 2017)(informative)(denying institution under § 325(d) where a submitted reference was accompanied by a "*detailed identification* of the relevant portions of" the reference). Here, no such identification of the relevant portions of Toyama was provided to the Office during prosecution. Thus, some evidence exists under factor (f) that warrants reconsideration of Toyama. Accordingly, factor (f) weighs slightly against exercising our discretion to deny institution.

In summary, we determine that although Toyama was presented to, and considered by, the Office during prosecution, Petitioner has sufficiently shown on the current record that the Office erred in its evaluation such that the prior consideration does not justify exercising our discretion to deny institution on that basis.

IV. EXPLANATION OF MULTIPLE PETITIONS

Petitioner states that this is the second petition they have filed on the '378 patent and that both petitions are needed. Paper 3, 1. Petitioner states that each petition addresses different claims. *Id.* Petitioner states that the second petition is required in view of Patent Owner's amendment of its infringement contentions, after the first petition was filed, to include claims 1–7 and 18. *Id.* at 1–2. Petitioner asserts that the number of asserted claims filed in such a staggered fashion in a parallel district court proceedings

justify the filing of a second petition to address the later-added claims. *Id.* at 2. Petitioner asserts that the additional burden on the Board and Patent Owner will be minimized because the second Petition relies on no new prior art and the same expert witness. *Id.* at 3. Patent Owner does not oppose Petitioner's claim that it needed a second Petition. Prelim. Resp. 1 n2.

In *General Plastic*, the Board discussed the "potential for abuse" due to multiple, staggered petitions "challenging the same patent and same claims." *General Plastic* at 17. The Board said, "The absence of any restrictions on follow-on petitions would allow petitioners the opportunity to strategically stage their prior art and arguments in multiple petitions, using our decisions as a roadmap, until a ground is found that results in the grant of review." *Id.*

In *General Plastic*, the Board identified the following nonexclusive factors to consider when deciding whether to exercise discretion under § 314(a) to deny institution based on a follow-on petition:

> 1) whether the same petitioner previously filed a petition directed to the same claims of the same patent;
> 2) whether at the time of filing of the first petition the petitioner knew of the prior art asserted in the second petition or should have known of it;
> 3) whether at the time of filing of the second petition the petitioner already received the patent owner's preliminary response to the first petition or received the Board's decision on whether to institute review in the first petition;
> 4) the length of time that elapsed between the time the petitioner learned of the prior art asserted in the second petition and the filing of the second petition;
> 5) whether the petitioner provides adequate explanation for the time elapsed between the filings of multiple petitions directed to the same claims of the same patent;
> 6) the finite resources of the Board; and

7) the requirement under 35 U.S.C. § 316(a)(11) to issue a final determination not later than 1 year after the date on which the Director notices institution of review.

Gen. Plastic, 16.

Here, *General Plastic* factors 1, 3, and 5 weigh strongly against exercising our discretion to deny institution. Regarding factor 1, Petitioner's first petition did not address any claim addressed in the instant petition. Paper 3, 1. Regarding factor 3, the second Petition was filed on May 19, 2024, which is before both the Patent Owner's Preliminary Response in the first proceeding (IPR2024-00788, filed on August 12, 2024) and the Board's Decision on Institution in that proceeding (November 7, 2024). Regarding factor 5, Petitioner explained that the time between filings of petitions was due to the timing of the amended infringement claims that newly addressed the asserted claims in the second petition. *Id.* at 2–3.

Factors 2 and 4 weigh towards exercising our discretion, because the sole Toyama reference applied in the instant petition appeared in the prior-filed petition. *Id.* at 2. Considering factors 1–6 as a whole, the fact that the same art was earlier known is outweighed by (1) its application to different claims, and (2) Petitioner's explanation that the additional "epitaxial layer" and "etch stop plug" limitations set forth in each of the later-asserted claims had not yet been alleged to be infringed.

Factor 7 weighs slightly towards exercising our discretion, because this decision instituting the later-filed proceeding occurs two months after the decision instituting the prior-filed proceeding. We have considered the available resources and determined that such a two month delay in the present circumstance does not significantly affect the balance of factors 1–6 so as to justify exercising our discretion to deny the later-filed petition.

Micron Ex. 1039, p. 32
Micron v. YMTC
IPR2024-00788

Consequently, based upon consideration of the *General Plastic* factors, we decline to exercise our discretion not to institute the instant proceeding. We also note that the present proceeding and the IPR2024-00788 proceeding on the same '378 patent can be coordinated and that a similar or common schedule can be adopted, thus decreasing the inconvenience to the Patent Owner. The parties may seek to consolidate the two proceedings, including requesting a consolidated briefing schedule, and/or oral hearing, which would result in even more efficiencies for the parties.

V. CONCLUSION

For the reasons discussed above, we conclude Petitioner has shown a reasonable likelihood of prevailing with respect to at least one of claims 1–7 and 18. We determine that the record supports institution. Accordingly, we institute an *inter partes* review of all challenged claims under all grounds set forth in the Petition. 37 C.F.R. § 42.108(a) ("When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim."); *see SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1355 (2018) (noting that the language of 35 U.S.C. § 314(b) "indicates a binary choice—either institute review or don't"); *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (interpreting the statute as requiring "a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition").

Our determination at this stage of the proceeding is based on the evidentiary record currently before us. This decision to institute trial is not a final decision as to patentability of any claim for which an *inter partes*

review has been instituted. Our final decision will be based on the full record developed during trial.

VI. ORDER

For the foregoing reasons, it is:

ORDERED that pursuant to 35 U.S.C. § 314(a), an *inter partes* review is hereby instituted for all asserted grounds on all asserted claims, i.e.:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–7, 18	103	Toyama

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; the trial will commence on the entry date of this Decision.

Micron Ex. 1039, p. 34
Micron v. YMTC
IPR2024-00788

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Micron Ex. 1039, p. 35
Micron v. YMTC
IPR2024-00788