

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
MICRON TECHNOLOGY, INC., and
SK HYNIX, INC.,
Petitioner,

v.

ELM 3DS INNOVATIONS, LLC,
Patent Owner.

Case IPR2016-00770
Patent 8,907,499 B2

Before GLENN J. PERRY, BARBARA A. BENOIT, and
FRANCES L. IPPOLITO, *Administrative Patent Judges*.

PERRY, *Administrative Patent Judge*.

DECISION
Final Written Decision
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

This *inter partes* review is closely related to IPR2016-00708 (“the ’708 review”) which addressed claim 1 of U.S. Patent No. 8,907,499 B2 (Ex. 1001, “the ’499 patent” or “the challenged patent”). In the ’708 review, our Final Written Decision was entered as Paper 48 and is fully adopted herein. In this ’770 review Petitioner applies the same references as applied in the ’708 review in substantially the same manner to claims 12, 13, 24, 36, 37, 38, 83, 86, 87, and 132 of the ’499 patent.

A. Procedural Posture

Samsung Electronics Co., Ltd.; Micron Technology, Inc.; and SK Hynix Inc. (collectively “Petitioner”) filed a Petition on March 17, 2016, requesting an *inter partes* review of claim 1 of “the ’499 patent”. Paper 4, “Pet.” Patent Owner, Elm 3DS Innovations, LLC, filed a Preliminary Response to the Petition on June 30, 2016. Paper 13 (“Prelim. Resp.”).

Based on these submissions, we instituted an *inter partes* review of claims 12, 13, 24, 36, 37, 38, 83, 86, 87, and 132 of the '499 patent on the following grounds:

Reference(s)	Basis	Claims Challenged
Hsu ¹ and Leedy '695 ²	§ 103	12, 13, 24, 36, 37, 38, 83, 86, 87, and 132
Bertin '945, ³ Poole ⁴ , and Leedy '695	§ 103	12, 13, 24, 36, 37, 38, 83, 86, 87, and 132
Bertin '945 and Leedy '695	§ 103	12, 13, 24, 36, 37, 38, 83, 86, 87, and 132

Paper 16 (“Dec. on Inst.”).

After institution, Patent Owner filed its Patent Owner Response on January 4, 2017 (Paper 40, “PO Resp.”), and Petitioner filed a Reply on March 2, 2017 (Paper 43, “Reply”).

This *inter partes* review pertains to one member of the “Elm 3DS family” of patents that share a common core of written description but have different claims (continuations and divisional applications of a common parent). Some of the patents being considered in *inter partes* reviews of patents in the Elm 3DS family have expired and others have not (*e.g.* the '499 patent). On April 5, 2017, we held a consolidated hearing in which we

¹ US Patent No. 5,627,106, issued May 6, 1997 (Ex. 1008, “Hsu”).

² US Patent No. 5,354,695, issued Oct. 11, 1994 (Ex. 1006, “Leedy '695”).

³ U.S. Patent No. 5,731,945, issued Mar. 24, 1998 (Ex. 1004, “Bertin et al. '945”).

⁴ US Patent No. 5,162,251, issued Nov. 10, 1992 (Ex. 1005, “Poole”).

heard argument on fourteen *inter partes* reviews (including this one and all having the same panel of Administrative Patent Judges) of Elm 3DS family patents. Although there are differences among these related *inter partes* reviews (different claims and different combinations of prior art references, different reasons to combine, and different arguments regarding reasonable expectation of success), there is a significant overlap of evidentiary records among the reviews. Each *inter partes* review has been decided on its own evidentiary record. A transcript of the oral hearing is included in the record of each proceeding, including this one. Paper 47 (“Tr.”).

This Decision relies upon analysis set forth in the combined Final Written Decision in IPR2016-00386, IPR2016-00387, and IPR2016-00388, particularly with regard to claim construction. It also relies upon and incorporates the analysis set forth in our Final Written Decision (Paper 48) of IPR2016-00708, which dealt with the same references applied to claim 1 of the ’499 patent. In particular, we rely upon the analysis related to our findings that Petitioner has not established by a preponderance of the evidence that the references teach or suggest the “substantially flexible” limitation or the proposed dielectric substitution. The evidentiary record of this review is substantially the same as the evidentiary record of IPR2016-00708. For example, the Franzone Declaration (Exhibit 1002 of IPR2016-00770) and the Franzone Declaration (Ex. 1002 of IPR2016-00770 are the same); and Petitioner’s argument set forth in the Petitioner of IPR2016-00770 (Paper 4) are substantially the same as those set forth in the Petition of IPR2016-00708 (Paper 4).

We have jurisdiction under 35 U.S.C. § 6. This Decision is a final written decision under 35 U.S.C. § 318(a) as to the patentability of the challenged claims. For the reasons discussed herein, Petitioner has not demonstrated by a preponderance of the evidence that claims 12, 13, 24, 36, 37, 38, 53, 83, 86, 87, and 132 of the '499 patent are unpatentable.

B. Related Proceedings

As required by 37 C.F.R. § 42.8(b)(2), each party identifies various judicial or administrative matters that would affect or be affected by a decision in this proceeding. Pet. 1–2; Paper 6 (Patent Owner’s Mandatory Notices). Petitioner indicates that Patent Owner has asserted the challenged patent against Petitioner in the following United States District Court proceedings: *Elm 3DS Innovations, LLC v. Samsung Elecs. Co.*, No. 1:14-cv-01430 (D. Del.); *Elm 3DS Innovations, LLC v. Micron Tech., Inc.*, No. 1:14-cv-01431 (D. Del.); and *Elm 3DS Innovations, LLC v. SK hynix Inc.*, No. 1:14-cv-01432 (D. Del.). Pet. 1–2.

Petitioner also indicates that Patent Owner has asserted related U.S. Patent Nos. 7,193,239; 7,474,004; 7,504,732; 8,035,233; 8,410,617; 8,653,672; 8,791,581; 8,629,542; 8,841,778; 8,496,862; 8,928,119; and 8,933,570 in one or more of these actions. Pet. 2

Petitioner further indicates that it has requested *inter partes* review of the following patents: 7,193,239 (IPR2016-00388 and IPR2016-00393); 7,504,732 (IPR2016-00395); 8,629,542 (IPR2016-00390); 8,035,233 (IPR2016-00389); 8,410,617 (IPR2016-00394); 8,653,672 (IPR2016-

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00386); 8,796,862 (IPR2016-00391); 8,841,778 (IPR2016-00387);
8,928,119 (IPR2016-00687); and 7,474,004 (IPR2016-00691). *Id.*

Petitioner also indicates that Micron Technology, Inc. and SK Hynix Inc. have requested *inter partes* review of U.S. Patent No. 8,791,581 (IPR2016-00703 and IPR2016-00706). *Id.*

IPR2016-00708 addresses claim 1 of the '499 patent.

C. The '499 Patent (the Challenged Patent)

The '499 patent relates generally to a three-dimensional structure (3DS) for integrated circuits that allows for physical separation of memory circuits and control logic circuits on different layers. Ex. 1001, Abstract. The use of three-dimensional stacked layers of integrated circuits increases performance and decreases cost of electronic circuits by increasing integration and decreasing physical size per equivalent number of circuit devices such as transistors or capacitors. *Id.* at 1:11–14.

Figure 1a is reproduced below.

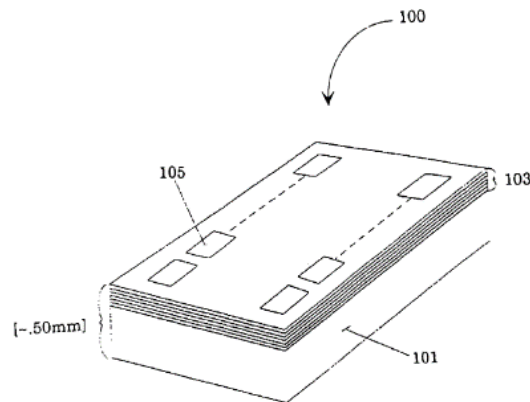


Figure 1a

Figure 1a shows three-dimensional memory device 100 having a stack of integrated circuit layers with a “fine-grain inter-layer vertical interconnect” between all circuit layers. *Id.* at 4:4–18. Layers shown include controller circuit layer 101 and memory array circuit layers 103. *Id.* at 4:25–27. The challenged patent discloses that “each memory array circuit layer is a thinned and substantially flexible circuit with net low stress, less than 50 [μm] and typically less than 10 [μm] in thickness.” *Id.* at 4:30–33. The challenged patent further discloses that the “thinned (substantially flexible) substrate circuit layers are preferably made with dielectrics in low stress (less than 5×10^8 dynes/cm²) such as low stress silicon dioxide and silicon nitride dielectrics as opposed to the more commonly used higher stress dielectrics of silicon oxide and silicon nitride used in conventional memory circuit fabrication.” *Id.* at 8:54–59.

Figure 1b is reproduced below.

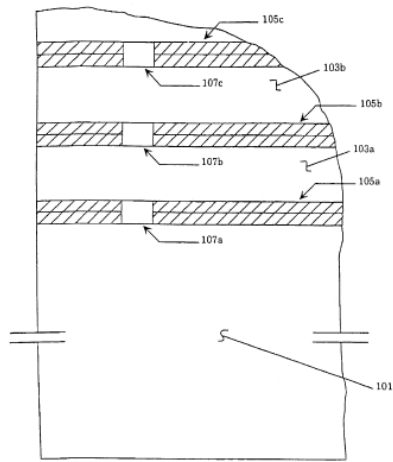


Figure 1b

Figure 1b of the challenged patent shows a cross-section of a three-dimensional integrated circuit with metal bonding interconnect between thinned circuit layers. *Id.* at 3:45–47. Bond and interconnect layers 105a, 105b, 105c are shown between circuit layers 103a and 103b. *Id.* at Fig. 1b. The challenged patent discloses that pattern 107a, 107b, 107c in the bond and interconnect layers 105a, 105b, 105c “defines the vertical interconnect contacts between the integrated circuit layers and serves to electrically isolate these contacts from each other and the remaining bond material.” *Id.* at 4:19–24. Additionally, the challenged patent teaches that the “pattern takes the form of voids or dielectric filled spaces in the bond layers.” *Id.* at 4:22–24.

Further, the challenged patent teaches that the “term fine-grain inter-layer vertical interconnect is used to mean electrical conductors that pass through a circuit layer with or without an intervening device element and have a pitch of nominally less than 100 [μm]. . . .” *Id.* at 4:7–10. The fine-

grain inter-layer vertical interconnect functions to bond together various circuit layers. *Id.* at 4:13–14.

D. Illustrative Claim

Of the challenged claims, claims 12, 24, 53, 83, and 132 are independent. Claim 24 is illustrative of the claimed subject matter:

24. A thin and *substantially flexible* integrated circuit comprising:

a thin, *substantially flexible* monocrystalline semiconductor layer of one piece comprising integrated circuit devices; and

a silicon-based dielectric layer formed on the thin semiconductor layer and having a stress of less than 5×10^8 dynes/cm² tensile. (emphasis added)

Ex. 1001, 14:57–64. Each of the claims at issue in this review requires at least one “substantially flexible” circuit or layer and a low tensile stress dielectric.

II. DISCUSSION

In our Final Written Decision in the ’708 review, we concluded that Petitioner did not establish by a preponderance of the evidence that claim 1 of the ’499 patent was unpatentable. We adopt the analysis set forth in that Final Written Decision; and focus on the claims at issue herein. The evidentiary records of the two reviews are substantially the same.

A. Principles of Claim Construction

Members of the Elm 3DS family share a common core of written description but have different claims (continuations and divisional

applications of a common parent). Some of the patents being considered have expired and others have not.

The '499 patent has not yet expired. Accordingly, here, we interpret claims of an unexpired patent using the “broadest reasonable construction in light of the specification of the patent in which [the claims] appear[.]” 37 C.F.R. § 42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144 (2016) (concluding the broadest reasonable construction “regulation represents a reasonable exercise of the rulemaking authority that Congress delegated to the Patent Office”).

Under this standard, the Board may not “construe claims during IPR so broadly that its constructions are unreasonable under general claim construction principles. . . . ‘[T]he protocol of giving claims their broadest reasonable interpretation . . . does not include giving claims a legally incorrect interpretation.’” *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1298 (Fed. Cir. 2016). “Rather, ‘claims should always be read in light of the specification and teachings in the underlying patent’” and “[e]ven under the broadest reasonable interpretation, the Board’s construction ‘cannot be divorced from the specification and the record evidence.’” *Id.* (citations omitted).

B. Principles of Law Concerning Demonstrating Unpatentability

To prevail in challenging Patent Owner’s claims, Petitioner must demonstrate by a preponderance of the evidence that the claims are unpatentable. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). “In an [*inter partes* review], the petitioner has the burden from the onset to show with

particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). The burden of persuasion never shifts to Patent Owner. See *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015). Furthermore, Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

Petitioner asserts that certain claims of the challenged patents are unpatentable under 35 U.S.C. § 103(a) as obvious over various combinations of references. A claim is unpatentable under 35 U.S.C. § 103(a) 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 of the invention to a person having ordinary skill in the art. *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 nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Consideration of the *Graham* factors helps inform the ultimate obviousness determination.” *Apple v. Samsung Elecs. Co.*, 839 F.3d 1034, 1048 (Fed. Cir. 2016) (en banc).

C. Level of Ordinary Skill

In determining whether an invention would have been obvious at the time it was made, 35 U.S.C. § 103 requires us to resolve the level of ordinary skill in the pertinent art at the time of the invention. *Graham*, 383 U.S. at 17. “The importance of resolving the level of ordinary skill in the art lies in the necessity of maintaining objectivity in the obviousness inquiry.” *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991). The person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). Factors that may be considered in determining the level of ordinary skill in the art include, but are not limited to, the types of problems encountered in the art, the sophistication of the technology, and educational level of active workers in the field. *Id.* In a given case, one or more factors may predominate. *Id.* Generally, it is easier to establish obviousness under a higher level of ordinary skill in the art. *Innovation Toys, LLC v. MGA Entm’t, Inc.*, 637 F.3d 1314, 1323 (Fed. Cir. 2011) (“A less sophisticated level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.”).

Petitioner, with support of its declarant Paul D. Franzon, Ph.D., contends that one of ordinary skill in the art at the time of the inventions of the challenge patents “would have had at least a B.S. degree in electrical engineering, material science, or equivalent thereof, and at least 3–5 years of experience in the relevant field, e.g., semiconductor processing.” Pet. 7 (citing Ex. 1002 ¶¶ 52–53). Dr. Franzon’s testimony as to the level of

ordinary skill is based on “the type of problems encountered in the art, prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field.” Ex. 1002 ¶ 53. Patent Owner did not propose expressly a particular level of ordinary skill. *See generally* PO Resp. At the oral hearing, Petitioner indicated that there did not seem to be any dispute as to the correct level of ordinary skill. Tr. 112:11–14 (“I don’t think there was any dispute about whether [Dr. Franzon’s proposed level of ordinary skill] was the correct level of skill, although Patent Owner can correct me.”).

Having reviewed the prior art asserted in these proceedings (*see, e.g.*, Exs. 1004–07, 1009, 2160), we determine that the level of ordinary skill proposed by Petitioner’s declarant is consistent with the challenged patent and the referenced prior art, and we adopt Petitioner’s proposed definition of the level of ordinary skill in the art for the purposes of the analysis below.

*D. Construction of “Substantially Flexible”*⁵

For reasons stated in our final written decision for IPR2016-00386, we construe “substantially flexible” in the context of the related patents as “largely able to bend without breaking.” IPR2016-00386, Paper 68, pages

⁵ The term “substantially flexible” is at issue in thirteen of the Elm 3DS *inter partes* reviews: IPR2016-00386 (’672 patent), IPR2016-00387 (’778 patent), IPR2016-00388 (’239 patent), IPR2016-00390 (’542 patent), IPR2016-00391 (’862 patent), IPR2016-00393 (’239 patent), IPR2016-00394 (’617 patent), IPR2016-00395 (’732 patent), IPR2016-00687 (’119 patent), IPR2016-00691 (’004 patent), IPR2016-00708 (’499 patent), IPR2016-00770 (’499 patent), and IPR2016-00786 (’570 patent).

23–39. The ’499 patent, at issue here, has not yet expired; thus, the applicable construction is broadest reasonable interpretation. At Oral Hearing, Petitioner’s counsel asserted that the claim construction of “substantially flexible” would be the same under both claim construction standards. Tr. 12:2–4 (Petitioner’s counsel indicating that the “we don’t see there as being a difference, whether BRI or Phillips is applied.”); see *generally* Tr. 11:21–13:16. Similarly, Patent Owner’s counsel at Oral Hearing indicated that the same construction would apply under broadest reasonable construction standard or the standard under *Phillips*. Tr. 50:10–14 (Q: “[I]n terms of the different claim construction standards, I understood that your position is that the same construction would apply under BRI or in District Court for substantially flexible.” A: “That’s correct.”).

In the context of the Elm 3DS family, we find that the broadest reasonable interpretation of “substantially flexible” is the same as our construction under the *Phillips* standard, which was the standard applied in IPR2016-00386. Under the broadest reasonable construction standard, we presume a claim term carries its ordinary and customary meaning, which “is the meaning that the term would have to a person of ordinary skill in the art in question” at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). As discussed in detail in the Final Written Decisions in IPR2016-00386, IPR2016-00387, and IPR2016-00388, the ordinary and customary meaning of “substantially flexible” is “largely able to bend without breaking.” Also as discussed extensively in

those Final Written Decisions, the inventor did not give the term “substantially flexible” a particular meaning in the specification with “reasonable clarity, deliberateness, and precision.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

The claims at issue in this review use the term “substantially flexible” as a modifier of “circuit” (*see, e.g.*, preamble of claim 12), “monocrystalline semiconductor layer” (*see, e.g.*, body of claim 24), “structure” (*see, e.g.*, preamble of claim 53), in the preamble of the claim and as a modifier of “monocrystalline semiconductor layer” (*see, e.g.*, body of claim 24), and “integrated circuit” (*see, e.g.*, preamble of claim 36). In each case, we construe the structure modified by the phrase “substantially flexible” to be one that is largely able to bend without breaking. Thus, a “substantially flexible monocrystalline semiconductor layer” requires the prior art to include a monocrystalline semiconductor layer that is largely able to bend without breaking.

All the claims at issue also use the term “thin.” For example, the preamble of claim 12 refers to “a thin *and* substantially flexible circuit” (emphasis added). The body of claim 12 refers to “a thin monocrystalline semiconductor layer.” In this regard, the Petitioner has not persuasively explained why “substantially flexible” and “thin” are the same. In doing so, equating “thin” and “substantially flexible,” as argued by Petitioner, effectively reads “thin” out of the claims. Further, as discussed in greater detail in the Final Written Decisions in IPR2016-00386, IPR2016-00387, and IPR2016-00388, we regard “thin” and “substantially flexible” as

separate and distinct requirements, each of which must be met by Petitioner's proposed combinations of references in order to support a conclusion of unpatentability.

E. Summaries of the Prior Art Disclosures

The references applied by Petitioner in this review are identical to those applied in IPR2016-00708. They are fully summarized in our Final Decision (Paper 48) in the '708 review and are not repeated here. See IPR2016-00708, Paper 48, pages 14–17.

F. Challenge Based on Hsu and Leedy '695

Having considered the parties' arguments and weighed the parties' evidence cited therein, and for the reasons set forth below, we determine that Petitioner has *not* demonstrated by a preponderance of the evidence that claims 12, 13, 24, 36, 37, 38, 83, 86, 87, and 132 are unpatentable under 35 U.S.C. § 103 over Hsu and Leedy '695 for at least two separate and independent reasons, namely, 1) Petitioner fails to establish the claimed "substantial flexibility" requirement; and 2) Petitioner fails to demonstrate that one of ordinary skill would have made the proposed dielectric substitutions.

1. Petitioner's Contentions

Petitioner provides analysis of the combination of Hsu and Leedy '695 at Petition pages 19–35, supported with citations to the references and to declaration testimony of Dr. Franzon (Ex. 1002). Petitioner contends that "Hsu expressly discloses all but a few of the features recited in the [c]hallenged [c]laims." Pet. 19. Petitioner points to Hsu's

description of stacked chips each having a silicon dioxide film 18 formed on the entire surface of a substrate. *Id.*

Petitioner acknowledges that Hsu does not explicitly disclose that the dielectric layer 18 constitutes a “low stress” dielectric characterized by a tensile stress of about 5×10^8 dynes/cm² or less, as recited in the challenged claims; and argues that it would have been obvious to one of ordinary skill to modify the processes and device in Hsu such that the dielectric layer 18 constitutes a dielectric characterized by a tensile stress of about 5×10^8 dynes/cm² or less, based on the disclosure of Leedy ’695. Pet. 19-20 (citing Ex. 1002 ¶¶ 114–119). According to Petitioner, Leedy ’695 provides express motivations to incorporate low tensile stress dielectric into Hsu. Pet. 20–23.

As to each of the claims at issue, Petitioner argues that one or more of the references semiconductor substrates are “thin.” Pet. 23–35. Petitioner also argues as to each claim at issue, that one of ordinary skill would have used the Leedy ’695 dielectric in Hsu. *Id.* These arguments are the same as those made by Petitioner in IPR2016-00708. *Compare id.*, with IPR2016-00708, Paper 4 (Petition).

2. Patent Owner’s Contentions

Patent Owner argues, with regard to all of Petitioner’s challenges, that “substantially flexible” cannot be read out of the claims and that “thinned” does not mean “flexible.” PO Resp. 1. Each challenged claim explicitly requires one or more “substantially flexible” elements (layer or circuit). However, according to Patent Owner, none of the references disclose or

suggest a “substantially flexible” layer or circuit — and Petitioner does not attempt to prove otherwise. PO Resp. 1. Patent Owner notes that Petitioners argue that certain references disclose a “thinned” semiconductor layer, with no argument or evidence that the “thinned” semiconductor layer is in fact “substantially flexible.” *Id.*

Patent Owner argues (and has consistently argued in the related reviews) that “thinned” does not mean “flexible” and that something can be thinned yet not be flexible. According to Patent Owner, “[f]or example, a potato chip can be thin but still be rigid and break rather than flex.” *Id.*

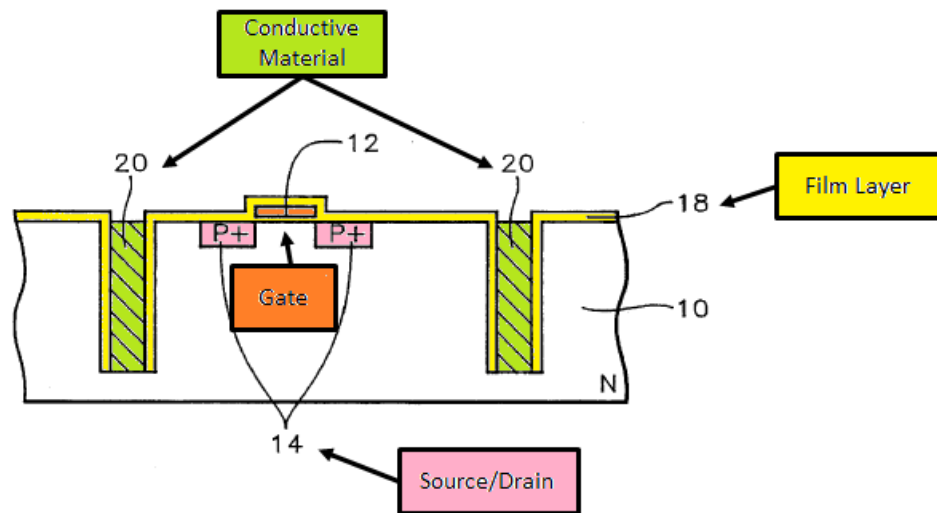
Patent Owner also argues that dielectrics are not fungible and that it would not have been obvious to utilize the Leedy ’695 dielectric in any of the primary references as proposed. PO Resp. 2–3.

In support of its argument against dielectric substitution, Patent Owner presents a tutorial explaining the complexity of semiconductor fabrication, with numerous citations to the prior art references and declaration testimony of its expert, Alexander D. Glew, Ph.D. (Ex. 2166).

The tutorial stresses the detailed planning and decisions required to establish a fabrication process for a semiconductor integrated circuit. PO Resp. 3–31. It explains four distinct stages: (1) material preparation; (2) wafer preparation; (3) wafer fabrication; and (4) packaging. PO Resp. 5 (citing Ex. 2166 ¶ 23; Ex. 2158, 13). In the second stage, the semiconductor material is first formed into a silicon crystal with specific electrical and structural parameters, and then sliced into thin disks called “wafers.” PO Resp. 6 (citing Ex. 2166 ¶ 25; Ex. 2158, 13–14). The tutorial explains

different techniques for producing and layering dielectrics (PO Resp. 16 – 30), including growing dielectrics using thermal oxidation (PO Resp. 18 – 19), depositing dielectrics (PO Resp. 19) and a comparison of thermal CVD (PO Resp. 20) with Plasma Enhanced CVD (PO Resp. 21); different kinds and uses of dielectrics (PO Resp. 22–29) including field oxide dielectrics, gate oxide dielectrics, pre-metal dielectrics, intermetal dielectrics, and passivation dielectrics.

Patent Owner also makes three arguments specific to the Hsu primary reference. First, Patent Owner argues that Hsu’s “silicon oxide film 18” (see Patent Owner’s annotated Figure 4 below) could not be produced and layered using plasma-enhanced CVD. PO Resp. 47–50.



This is an annotated version of Hsu Figure 4 provided by Patent Owner at page 48 of the Patent Owner Response.

Second, based on its proposed “ordinary meaning” construction of “substantially flexible,” Patent Owner argues that Hsu does not disclose or suggest a “substantially flexible” substrate. PO Resp. 50–61. Third, Patent Owner argues that Petitioner fails to prove that one of ordinary skill would have substituted the Leedy ’695 Leedy ’695 dielectric for that of Hsu. PO Resp. 60–65.

3. “Substantially Flexible” Claim Requirement

Each challenged claim explicitly requires one or more “substantially flexible” elements (circuit or layer). The Petition makes essentially the same arguments with regard to substantial flexibility as were made in the Petition (Paper 4) of IPR2016-00708.

For the same reasons as set forth in IPR2016-00708, Paper 48, which we fully adopt here, we are not persuaded by Petitioner’s argument that the “substantially flexible” limitation of each of the challenged claims is met by Hsu or Leedy ’695 individually or in combination. *See* IPR2016-00708, Paper 48, pages 21–24.

Petitioner’s arguments regarding substantial flexibility are all based on its proposed narrow construction of a semiconductor substrate that has been thinned to a thickness of less than 50 μm and subsequently polished or smoothed. *See, e.g.*, Pet. 8.

As noted in our claim construction section, above and as referenced in our Final Written Decision in IPR2016-00386, a preponderance of the evidence establishes that, in the context of semiconductor substrates, mere thinning is not the same as flexibility—being able to bend without breaking.

Although Petitioner presents arguments attempting to demonstrate thinning, there are no arguments that this thinning necessarily results in flexibility. Thus, we determine that Petitioner has not met its burden to demonstrate that the required “substantial flexibility.”

This reason alone sufficiently supports our conclusion. However, we also conclude, as set forth below that for a second, independent reason, Petitioner has not established that the challenged claims are unpatentable. Petitioner has not sufficiently established that one of ordinary skill would have substituted the dielectric material of Leedy '695 for the various layers proposed for substitution in Hsu. Therefore we do not credit Leedy '695 as providing any potential “substantial flexibility” to Hsu.

4. Low Tensile Stress Dielectric Substitution

Petitioner's arguments regarding dielectric substitution are also the same as set forth in IPR2016-00708. Each of the challenged claims in this review require the use of a dielectric having a stress of less than 5×10^8 dynes/cm² tensile.

The evidentiary record in this case with regard to dielectric substitution adds nothing further to the evidentiary record established in IPR2016-00708. For the same reasons set forth in our Final Written Decision in IPR2016-00708, we determine that Petitioner has not met its burden to demonstrate by a preponderance of the evidence that a person of ordinary skill in the art would have made the proposed dielectric substitution.

5. Conclusion

For the above separate and independent reasons, we conclude that the preponderance of evidence does not support a finding of unpatentability of claims 12, 13, 24, 36, 37, 38, 53, 83, 86, 87, and 132 based on Hsu and Leedy '695.

G. Challenge Based on Bertin '945, Poole, and Leedy '695

1. Petitioner's Contentions

Petitioner provides analysis of the combination of Bertin '945 (as modified by Poole) and Leedy '695 at Petition pages 35–55, making reference to the Franzon Declaration. Petitioner notes that Bertin '945 discloses stacked chips each having a “dielectric layer 60” and through-silicon metal interconnects insulated by dielectrics. Pet. 35 (citing Ex. 1002 ¶¶ 95–101).

Petitioner acknowledges that Bertin '945's dielectric layer 60 and interconnect dielectrics are not described as “low stress” characterized by a stress of 5×10^8 dynes/cm² tensile or less. Pet. 35. However, according to Petitioner, it would have been obvious to one of ordinary skill to modify the processes and device in Bertin such that each of the dielectric layer 60 and interconnect insulators constitute a dielectric characterized by a tensile stress of about 5×10^8 dynes/cm² or less, based on Leedy '695. Pet. 35 (citing Ex. 1002 ¶¶ 114–119). Petitioner argues that both Bertin '945 and Leedy '695 are directed to the improvement of integrated circuits and recognize the central role the fabrication process plays in facilitating this improvement. Pet. 36. Further, Petitioner argues that Leedy '695 provides “express

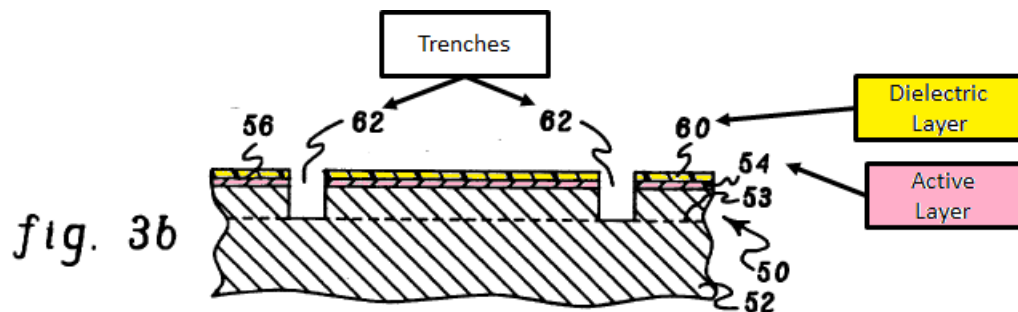
motivation” for modifying Bertin’s processes and devices to incorporate Leedy ’695’s low tensile stress dielectric material. Pet. 36–38 (citing Ex. 1006, Abstract, 1:53–62, 2:9–31, 2:66–3:3, 3:56–4:13, 5:63–6:5, 11:33–37, 30:36–42, 45:49–46:26, 46:52–47:33, Figs. 32a–32d; Ex. 1002 ¶¶ 109–114).

Petitioner also argues that it would have been obvious to modify Bertin ’945 to replace its wet etching process with another well-known thinning process that involves polishing to obtain a substrate that is thinned to less than 50 μm and then polished or smoothed, such as disclosed in Poole. Pet. 38–41 (citing Ex. 1002 ¶¶ 103–105).

2. Patent Owner’s Contentions

In addition to its universal arguments regarding “substantially flexible” and “dielectric substitution,” discussed already with respect to Hsu and Leedy ’695, above, Patent Owner argues specifically with regard to the combination of Bertin ’945, Leedy ’695, and Poole. PO Resp. 43–47.

With regard to the specific structures of Bertin ’945, Patent Owner focuses on dielectric layer 60 and argues that it was grown using thermal oxidation and could not be produced and layered using plasma-enhanced CVD, as shown in Patent Owner’s annotated version of Bertin ’945’s Figure 3b, reproduced below. PO Resp. 44.



This is an annotated version of Bertin 945's Figure 3b provided by Patent Owner at page 44 of the Patent Owner Response.

Patent Owner argues that one of ordinary skill would understand that layer 60 is a high-purity silicon dioxide grown by thermal oxidation at high temperatures during a “front end” (prior to metallization) phase of fabrication. PO Resp. 44 (citing Ex. 2166 ¶ 127). It would have been directly grown over active silicon components (source, gate, or drain). PO Resp. 45 (citing Ex. 2166 ¶128; Ex. 1004 at 3:60–4:3; Ex. 2158 at 68–70; Ex. 2159 at 54, 139). Therefore, according to Patent Owner, that dielectric could not be deposited using plasma-enhanced CVD as described in Leedy '695. Id. at 46 (citing Ex. 2166 ¶¶ 129, 130; Ex. 2169 at 29–30; Ex. 2159 at 139).

Patent Owner also notes that Bertin '945's dielectric layer 60 is removed during subsequent processing and is not part of the final integrated circuit. PO Resp. 46–47.

In support of its argument against dielectric substitution, Patent Owner relies in part on the tutorial discussed above with respect to Hsu and makes reference to declaration testimony of its expert, Alexander D. Glew, Ph.D. (Ex. 2166).

3. “Substantially Flexible” Integrated Circuit Layer

Each challenged claim explicitly requires one or more “substantially flexible” elements (circuit or layer). The Petition makes essentially the same arguments with regard to substantial flexibility as were made in the Petition (Paper 4) of IPR2016-00708.

For the same reasons as set forth in our discussion of claim 1 in IPR2016-00798, Paper 48, which we fully adopt here, we are not persuaded by Petitioner's argument that the "substantially flexible" limitation of each of the challenged claims is met by Bertin '945, Poole, or Leedy '695 individually or in combination. See IPR2016-00708, Paper 48, pp 28–36.

This reason alone sufficiently supports our conclusion as to claims 12, 13, 24, 36, 37, 38, 53, 83, 86, 87, and 132. However, we also conclude, as set forth below that for a second, independent reason, Petitioner has not established that claims 12, 13, 24, 36, 37, 38, 53, 83, 86, 87, and 132 are unpatentable. Petitioner has not sufficiently established that one of ordinary skill would have substituted the dielectric material of Leedy '695 for the various layers proposed for substitution in Bertin '945. Therefore we do not credit Leedy '695 as providing any potential "substantial flexibility" to Bertin '945.

4. Low Tensile Stress Dielectric Substitution

Each of claims 12, 13, 24, 36, 37, 38, 53, 83, 86, 87, and 132 explicitly requires a dielectric having a stress of less than 5×10^8 dynes/cm² tensile. The Petition makes essentially the same arguments with regard to dielectric substitution as were made in the Petition (Paper 4) of IPR2016-00708.

For the same reasons as set forth in our discussion of claim 1 in IPR2016-00708, Paper 48, which we fully adopt here, we are not persuaded by Petitioner's argument that one of ordinary skill would have modified the

Bertin '945 process and device to utilize the Leedy '695 dielectric. See IPR2016-00708, Paper 48, pp 28–36.

H. Challenge Based on Bertin '945 and Leedy '695

Petitioner's challenge based on Bertin '945 and Leedy '695 was included to deal with a potential alternative claim construction of “substantially flexible.” Pet. 58. In the event of such an alternative construction, Petitioner would not have to rely on Poole for its teaching of thinning and polishing.

However, based on our finally adopted construction of “substantially flexible,” this challenge is moot.

III. SUMMARY OF CONCLUSIONS

We now summarize our determinations and conclusions.

“Substantially flexible” is construed to mean “largely able to bend without breaking.” A “thinned substantially flexible integrated circuit layer” requires that at least one integrated circuit layer be both “thinned” and “substantially flexible.”

Petitioner has not demonstrated sufficiently that any of the references, singly or taken in combinations as proposed would meet the “substantially flexible” requirement of the claims.

Petitioner has not demonstrated sufficiently that one of ordinary skill would have substituted the dielectric of Leedy '695 into Hsu or Bertin '945.

We conclude, based on a preponderance of the evidence, that Petitioner has not established that claims 12, 13, 24, 36, 37, 38, 83, 86, 87, and 132 of the '499 patent are unpatentable.

IV. ORDER

Accordingly, it is:

ORDERED that claims 12, 13, 24, 36, 37, 38, 83, 86, 87, and 132 of U.S. Patent No. 8,907,499 have not been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to the proceedings 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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