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Paper 13
Entered: March 4, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

STMICROELECTRONICS, INC.,
Petitioner,

v.

OCEAN SEMICONDUCTOR LLC,
Patent Owner.

IPR2021-01349
Patent 6,420,097 B1

Before KRISTINA M. KALAN, CHRISTOPHER M. KAISER, and DAVID COTTA, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

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

I. INTRODUCTION

STMicroelectronics, Inc. ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting *inter partes* review of claims 1–17 of U.S. Patent No. 6,420,097 B1 (Ex. 1001, "the '097 patent"). Ocean Semiconductor LLC ("Patent Owner") filed a Preliminary Response to the Petition (Paper 9, "Prelim. Resp."). Pursuant to Board authorization, Petitioner filed a Reply (Paper 10, "Reply") and Patent Owner filed a Sur-reply (Paper 12, "Sur-reply").

To institute *inter partes* review, we must determine that the information presented in the Petition shows "there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a). For the reasons discussed below, after considering the parties' submissions and the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one claim of the '097 patent. Thus, we institute *inter partes* review.

A. Related Proceedings

The parties identify a number of related matters, including: *Ocean Semiconductor LLC v. STMicroelectronics Inc.*, No. 6:20-cv-01215 (W.D. Tex.); *Ocean Semiconductor LLC v. NXP Semiconductors NV*, No. 6:20-cv-01212 (W.D. Tex.); *Ocean Semiconductor LLC v. Infineon Techs. AG*, No. 1:20-cv-12311 (D. Mass.); *Ocean Semiconductor LLC v. Western Digital Techs., Inc.*, No. 6:20-cv-01216 (W.D. Tex.); *Ocean Semiconductor LLC v. Silicon Labs. Inc.*, No. 6:20-cv-01214 (W.D. Tex.); *Ocean Semiconductor LLC v. Renesas Elecs. Corp.*, No. 6:20-cv-01213 (W.D. Tex.); *Ocean Semiconductor LLC v. NVIDIA Corp.*, No. 6:20-cv-01211

(W.D. Tex.); *Ocean Semiconductor LLC v. MediaTek Inc.*, No. 6:20-cv-01210 (W.D. Tex.); *Ocean Semiconductor LLC v. Huawei Device USA Inc.*, No. 4:20-cv-00991 (E.D. Tex.); and *Ocean Semiconductor LLC v. Analog Devices, Inc.*, No. 1:20-cv-12310 (D. Mass.). Pet. 2–3; Paper 4, 2.

B. Real Parties-In-Interest

Petitioner identifies itself and STMicroelectronics N.V. as real parties-in-interest. Pet. 2. Patent Owner identifies itself as a real party-in-interest. Paper 4, 2.

C. The '097 Patent

The '097 patent is titled "Hardmask Trim Process," and is directed to an "improved method of forming circuit structures having linewidths which are smaller than what is achievable by conventional UV lithographic techniques on ultra-thin resist layers." Ex. 1001, codes (54), (57). The '097 patent includes "a hardmask which is patterned using an ultra-thin resist layer and is then trimmed to reduce the width of the hardmask before etching the underlying gate conductive layer." *Id.* at code (57).

Figure 4b of the '097 patent, as annotated by Petitioner, is reproduced below.

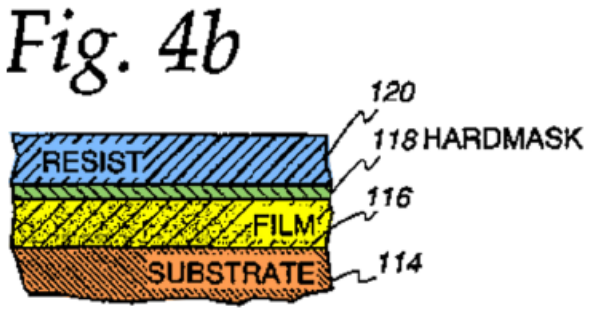

Figure 4b illustrates ultra-thin resist ("UTR") layer 120 (blue), hardmask layer 118 (green), gate conductive layer 116 (yellow), and substrate 114

(orange). Ex. 1001, 4:1–8; Pet. 6. Figure 4c, as annotated by Petitioner, is reproduced below.

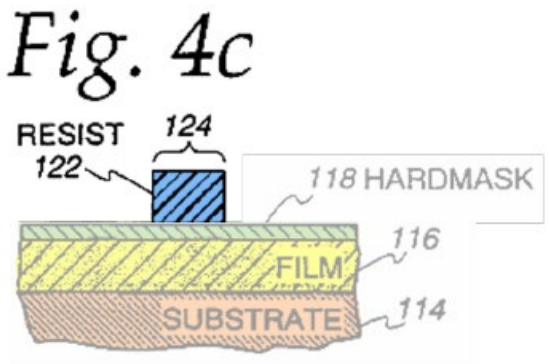

Figure 4c shows resist mask 122 being pattered to initial linewidth 124, which is the smallest dimension obtained by image transfer from the UTR layer in the lithographic equipment. Ex. 1001, 4:14–18; Pet. 6. Following this step, hardmask 118 is etched anisotropically (in the vertical direction) to remove the exposed portions of the hardmask 118 and leave the portion that lies underneath resist mask 122. Ex. 1001, 4:67–5:5. Next, hardmask 118 is isotropically (omnidirectionally) overetched to trim away portions of the layer underneath resist mask 122 to form hardmask 126. Ex. 1001, 4:19–26; Ex. 1002 ¶ 42. Figure 4d, as annotated by Petitioner, is reproduced below.

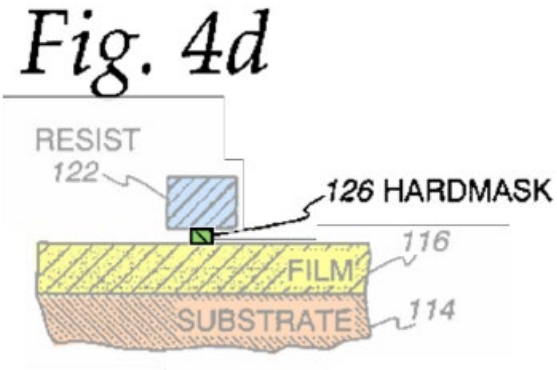

Figure 4d illustrates hardmask 126 following the isotropic overetch. Ex. 1001, 4:23–26; Pet. 7. Next, resist mask 122 may be removed so that

conductive layer 116 may be anisotropically etched to form gate 130. Ex. 1001, 4:34–38. Figure 4f, as annotated by Petitioner, is reproduced below.

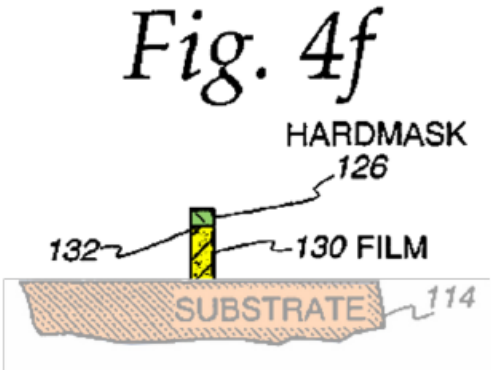

Figure 4f illustrates the removal of resist mask 122 and the subsequent anisotropic etch of conductive layer 116 using hardmask 126. Ex. 1001, 4:31–39; Pet. 7. The resulting gate has a width approximately equal to the hardmask but narrower than what would have been possible using conventional lithographic techniques. Ex. 1001, 2:18–21, 4:37–42, 5:9–16.

D. Illustrative Claim

Claim 1 is the sole independent claim of the challenged claims, and is reproduced below:

> 1. A method of forming circuit structures having linewidths which are smaller than what is achievable by conventional UV lithographic techniques on ultra-thin resist layers, said method comprising the steps of:
>
> providing a semiconductor wafer stack formed of a substrate and a device layer above the substrate;
>
> depositing a hardmask layer over the device layer;
>
> depositing an ultra-thin resist layer over the hardmask layer;
>
> forming a resist mask having an initial linewidth;
>
> anisotropically etching exposed portions of the hardmask layer;
>
> isotropically etching subsequently the hardmask layer underneath the resist mask to form a hardmask having a

final linewidth which is narrower than the initial line width of the resist mask and corresponds to a desired structure linewidth; and

anisotropically etching the device layer as defined by the hardmask to form a structure having a width substantially equal to the final linewidth of the hardmask.

Ex. 1001, 5:32–53.

E. The Asserted Grounds of Unpatentability

Petitioner contends that claims 1–17 of the '097 patent are unpatentable on the following grounds. Pet. 4.

Ground	References	Basis[1]	Claims Challenged
1	Chapman,[2] AAPA, Hause[3]	§ 103	1–9, 16, 17
2	Chapman, AAPA, Hause, Becker,[4] Jeoung,[5] Wong[6]	§ 103	10, 11

[1] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), amended 35 U.S.C. § 103. Because the '097 patent has an effective filing date prior to the effective date of the applicable AIA amendments, we refer to the pre-AIA versions of § 103.
[2] US 5,976,769, issued Nov. 2, 1999 (Ex. 1004).
[3] US 5,885,887, issued Mar. 23, 1999 (Ex. 1007).
[4] G. Becker et al., *A comparative study of resist stabilization techniques for metal etch processing*, Proc. SPIE 3678, Advances in Resist Technology and Processing XVI (March 1999) (Ex. 1008).
[5] US 6,358,672 B2, issued Mar. 19, 2002 (Ex. 1019).
[6] US 6,319,655 B1, issued Nov. 20, 2001 (Ex. 1020).

Ground	References	Basis[1]	Claims Challenged
3	Chapman, AAPA, Hause, Lin,[7] Cirelli[8]	§ 103	12–15
4	Laaksonen,[9] AAPA, Hause	§ 103	1, 2, 4–9, 12–15, 17
5	Laaksonen, AAPA, Hause, Chapman	§ 103	3, 16
6	Laaksonen, AAPA, Hause, Chapman, Becker, Jeoung, Wong	§ 103	10, 11

In support of its unpatentability arguments, Petitioner relies on the declaration of Dr. John Bravman. Ex. 1002.

II. ANALYSIS

A. Claim Construction

We apply the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). 37 C.F.R. § 42.100(b) (2020). Under *Phillips*, claim terms are afforded "their ordinary and customary meaning." *Phillips*, 415 F.3d at 1312. The "ordinary and customary meaning of a claim term 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." *Id.* at 1313. Only terms that are in controversy need to be construed, and then

[7] Q. Lin et al., *Dual-layer inorganic SiON bottom ARC for 0.25-μm DUV hard mask applications*, Proc. SPIE 3678, Advances in Resist Technology and Processing XVI (June 11, 1999) (Ex. 1009).
[8] R.A. Cirelli et al., *A multilayer inorganic antireflective system for use in 248 nm deep ultraviolet lithography*, J. Vac. Sci. Technology B 14(6), Nov/Dec 1996 (Ex. 1021).
[9] US 6,362,111 B1, issued Mar. 26, 2002 (Ex. 1006)

only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner "does not propose any express claim constructions because none is necessary for the Board to determine whether to institute review and cancel the challenged claims." Pet. 10. Patent Owner does not appear to propose any express claim constructions. *See generally* Prelim. Resp. On this record, we determine that no claim terms require express construction.

B. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art

> would have had (i) a Bachelor's degree in chemical engineering, materials science, electrical engineering, physics, chemistry, or a similar field, and three or four years of work experience in integrated circuit fabrication or related fields; or (ii) a Master's degree in the technical areas listed above, and two or three years of work experience in semiconductor manufacturing or related fields; or (iii) a Ph.D. in the technical areas listed above.

Pet. 9–10 (citing Ex. 1002 ¶ 22). Patent Owner does not propose a definition of one of ordinary skill in the art. *See generally* Prelim. Resp.

In light of the record before us, we adopt Petitioner's proposal regarding the level of one of ordinary skill in the art. The level of ordinary skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Discretion Under 35 U.S.C. § 314(a) Due to Parallel Proceedings

Patent Owner contends the Board should exercise its discretion under 35 U.S.C. § 314(a) and deny institution in light of the advanced stage of the parallel district court proceedings involving the '097 patent. Prelim. Resp. 1–2, 7–35; Sur-reply 1–5. Petitioner contends that the circumstances

here support institution, including events that occurred after the Petition was filed. Pet. 68–73; Reply 1–5.

In assessing whether to exercise such discretion, the Board weighs six non-exclusive factors, known as the *Fintiv* factors. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 6 (PTAB Mar. 20, 2020) (precedential) ("*Fintiv*"). Recognizing that "there is some overlap among these factors" and that "[s]ome facts may be relevant to more than one factor," the Board "takes a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review." *Id.* We have considered Patent Owner's arguments in light of the *Fintiv* factors, together with Petitioner's opposition, and we decline to exercise our discretion to deny the Petition as explained further below.

1. Factor 1: Whether a Stay Exists or Is Likely to Be Granted if a Proceeding Is Instituted

The '097 patent is asserted in various district court proceedings. For instance, Patent Owner filed seven lawsuits in the Western District of Texas ("WDTex litigation"). Prelim. Resp. 9. Patent Owner also filed one lawsuit in the Eastern District of Texas (*id.* at 10 ("EDTex litigation")) and two lawsuits in the Massachusetts District Court ("Massachusetts litigation")). *Id.*; Paper 4, 2. The WDTex litigation and the EDTex litigation have not been stayed. Reply 1 (citing Ex. 1027, identifying only the Massachusetts litigation as stayed). Patent Owner argues that this factor favors denial because Petitioner has not filed any motion to stay in the WDTex litigation. Prelim. Resp. 10. Petitioner argues that this factor favors institution, in part because of the stay in the Massachusetts litigation. Reply 1.

There is no evidence in the record that a stay has been requested in the WDTex litigation. We decline to speculate on how the court in the WDTex litigation would rule on a stay, if one were requested. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 15 at 12 (PTAB May 13, 2020) (informative) (explaining that factor 1 generally "does not weigh for or against discretionary denial" when neither party has requested a stay). Accordingly, this factor is neutral.

2. Factor 2: Proximity of the Court's Trial Date to the Board's Projected Statutory Deadline

The projected statutory deadline for this proceeding would be, at the latest, March 2023. Patent Owner asserts that the jury trial in the WDTex litigation is set for December 7, 2022. Prelim. Resp. 14. This deadline sets the trial dates in district court to fall about three months before the projected statutory deadline. Petitioner argues that the trial dates are more fluid than what they appear, and the "court will stagger the trials across several months after December 7, 2022." Reply 1–2 (citing Ex. 1028, 25:6–10).

We typically take courts' trial schedules at "face value." *Fintiv*, IPR2020-00019, Paper 15 at 13. Accordingly, for now, we assume trial will begin in the WDTex litigation on December 7, 2022, but we acknowledge Petitioner's representation that "court will stagger" the trial dates in the WDTEx litigation.

Given that our final written decision in this case may issue after trial begins in the WDTex litigation, but considering that the trial date may move, we determine that this factor weighs marginally in favor of exercising our discretion to deny institution.

3. Factor 3: Investment in the Parallel Proceeding by the Court and Parties

Patent Owner identifies work that has been completed in the WDTex litigation to argue that "immense resources" have been expended. Prelim. Resp. 20–24. In particular, Patent Owner notes that the WDTex district court has issued a Markman order. Sur-reply 3. The parties have exchanged preliminary infringement and invalidity contentions. Prelim. Resp. 22–23; Reply 3; Sur-reply 3. However, expert and fact discovery are ongoing. Prelim. Resp. 22–23.

Petitioner argues that it filed the Petition four months before its statutory bar date and less than two months after receiving infringement contentions. Pet. 71–72. Petitioner also points out that the work expended thus far are "investments regarding other issues" not related to invalidity, and that the recent claim construction proceedings in the WDTex litigation "addressed just one term for the '097 patent, which the district court held to be definite." Reply 3. Petitioner also argues that "final invalidity contentions and invalidity-related fact discovery and expert reports all remain in the future." *Id.* Thus, Petitioner argues that this factor weighs against exercising discretion. Pet. 71–72.

We agree with Petitioner. In particular, we acknowledge Petitioner's diligence in filing the Petition and that the resources and effort expended by the district court in the pending litigations thus far have not been shown to have any substantial relation to the unpatentability issues presented in the Petition. Accordingly, we determine that this factor weighs slightly against exercising our discretion to deny institution.

4. Factor 4: Overlap Between Issues Raised in the Petition and in the Parallel Proceeding

Patent Owner argues there is "complete overlap" between issues raised in the Petition and in the pending litigations, while Petitioner argues that there is no substantial overlap. Prelim. Resp. 25–31; Reply 4; Sur-reply 4. We agree with Petitioner that there is a "difference in scope." Reply 4. This proceeding involves all issued claims of the '097 patent (claims 1–17), while the underlying litigation involves a subset of the claims. Reply 4. The ground asserted here also does not seem to "completely" overlap with the district court invalidity contentions. Patent Owner argues that the prior art is the same, merely because the references relied on in this Petition are listed in the invalidity contentions. Prelim. Resp. 26–28. But that is not enough to support Patent Owner's conclusion that the overlap of the issues is "complete," when the grounds asserted here are a specific combination of the references relied on in this Petition, or other specific combinations not identified in any of the invalidity contentions.

Accordingly, we determine that this factor weighs marginally against exercising discretion.

5. Factor 5: Whether the Petitioner and the Defendant in the Parallel Proceeding Are the Same Party

Petitioner states that the "district court case and the IPR proceeding involve the same parties." Pet. 73. Patent Owner states that "Petitioner is a defendant in one of the parallel proceedings in the WDTX." Prelim. Resp. 32. The same parties involved in the present proceeding are also involved in the WDTex litigation and, thus, this factor weighs marginally in favor of

exercising our discretion to deny institution under § 314(a). *Fintiv*, Paper 11 at 13–14.

6. Factor 6: Other Circumstances that Impact the Board's Exercise of Discretion, Including the Merits

Patent Owner contends that the merits of the case are "not strong." Prelim. Resp. 33–34; Sur-reply 4–5. Petitioner asserts that the merits warrant institution and the "quantity and quality of the cited prior art in this Petition support institution." Pet. 73; Reply 4–5.

As the Board explained in *Fintiv*, we consider this factor as "part of a balanced assessment of all the relevant circumstances in the case." *Fintiv*, Paper 11 at 14. The assessment requires consideration of the "strengths or weaknesses regarding the merits," but this "is not to suggest that a full merits analysis is necessary to evaluate this factor." *Id.* at 15–16.

We discuss the merits of this case below, finding Petitioner's evidence and arguments persuasive on this preliminary record and sufficient to meet our standard for instituting *inter partes* review, and, thus, determine that factor six is neutral.

7. Balancing the Fintiv Factors

We have considered the circumstances and facts before us in view of the *Fintiv* factors. We take "a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review" when evaluating these factors. *Fintiv*, Paper 11 at 6. Having evaluated all of the factors on this record, we determine that the circumstances presented here do not support exercising our discretion under § 314(a) to deny institution of *inter partes* review.

D. Asserted Obviousness over Chapman, AAPA, and Hause (Ground 1)

Petitioner argues that Chapman, AAPA, and Hause would have rendered obvious claims 1–9, 16, and 17. Pet. 23–39.

1. Chapman

Chapman is a patent titled "Intermediate Layer Lithography," and is directed to "electronic semiconductor devices, and, more particularly, to fabrication methods for such devices." Ex. 1004, code (54), 1:10–12. Chapman's annotated Figures 8d and 8e are reproduced below.

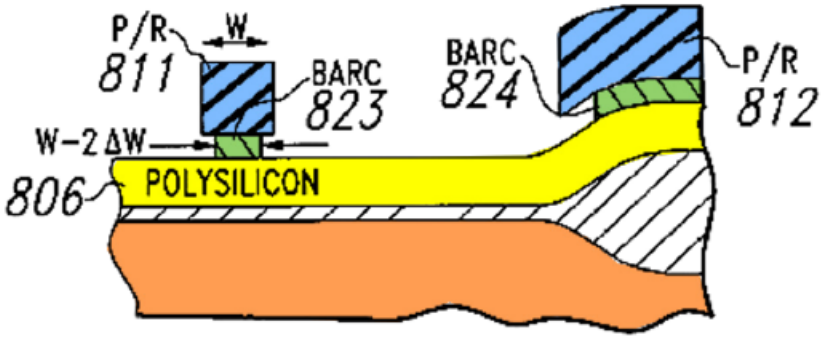

Fig. 8d

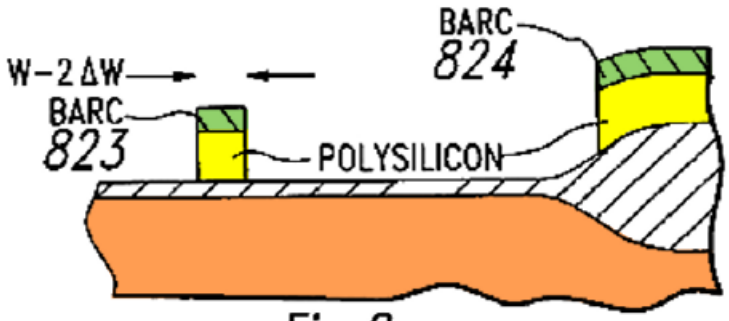

Fig. 8e

Figures 8d and 8e are cross sections of one embodiment of photoresist patterning. *Id.* at 2:18–19; Pet. 13. As annotated by Petitioner, Figures 8d and 8e show resist 811 or 812 (blue), hardmask 823 or 824 (green), polysilicon 806 (yellow) and substrate (orange) materials. Pet. 13.

2. Hause

Hause is a patent titled "Method of Making an IGFET with Selectively Doped Multilevel Polysilicon Gate,", and is directed to "integrated circuit manufacturing, and more particularly to insulated-gate field-effect transistors" with a "multilevel polysilicon gate that includes upper and lower polysilicon gate levels." Ex. 1007, code (54), 1:6–8, 2:35–40. Hause teaches a UTR layer having a thickness of 2000Å, and explains that this is beneficial because it "replicates an image pattern more accurately than thicker photoresist layers." Ex. 1007, 2:40–50, 4:14–17, 4:24–26.

3. Laaksonen

Laaksonen is a patent titled "Tunable Gate Linewidth Reduction Process." Ex. 1006, code (54). Laaksonen is directed to a process for forming a polysilicon line having linewidths below 0.23 μm. *Id.* at code (57). In Laaksonen, a "layer of polysilicon is deposited over a semiconductor body," then a "layer of bottom anti-reflective coating (BARC) is deposited over the polysilicon layer," then a "resist pattern is formed over the BARC layer using conventional lithography." *Id.* at 1:52–57. Laaksonen's annotated Figure 1 is reproduced below.

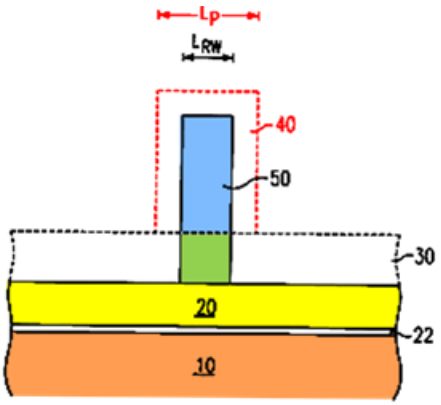

FIG. 1

Figure 1 is a cross-sectional diagram of a semiconductor body before and after the line width reduction. *Id.* at 2:13–15; Pet. 15. As annotated by Petitioner, Figure 1 shows resist 50 (blue), hardmask 30 (green), polysilicon 20 (yellow) and substrate 10 (orange) materials. Pet. 15.

Petitioner argues that Laaksonen is prior art because it is entitled to the December 9, 1998 filing date of its priority application, and Petitioner presents a claim chart arguing that the priority application provides support for claim 9 of Laaksonen. Pet. 13–14, 20–23. Patent Owner does not appear to contest this assertion. *See generally* Prelim. Resp. On this record, Petitioner appears to have shown adequately that Laaksonen is prior art.

4. Petitioner's Arguments – Chapman Grounds

Petitioner asserts that every element of claim 1 is found in the combination of Chapman, AAPA, and Hause, as follows:

1[pre] *A method of forming circuit structures having linewidths which are smaller than what is achievable by conventional UV lithographic techniques on ultra-thin resist layers, said method comprising the steps of*: (Pet. 23–26 (relying on Ex. 1004, 1:10–12, 1:57–67, 1:27–34, 1:57–61; Ex. 1001, 1:43–45; Ex. 1007, 4:14–17, 5:30–33, 6:64–66, 2:22–25, 2:40–44, 4:25–27; Ex. 1002 ¶¶ 32–34, 38–43, 102–107));[10]

[1a] *providing a semiconductor wafer stack formed of a substrate and a device layer above the substrate*; (Pet. 26–29 (relying on Ex. 1004, 5:17–20, 2:52–55, 5:15–20; Ex. 1002 ¶¶ 108–109));

[1b] *depositing a hardmask layer over the device layer;* (Pet. 28 (relying on Ex. 1004, 5:23–29, 5:59–62; Ex. 1002 ¶¶ 110–111));

[10] We express no opinion on whether the preamble is limiting.

[1c] *depositing an ultra-thin resist layer over the hardmask layer;* (Pet. 28 (relying on Ex. 1004, 5:30–33; Ex. 1002 ¶¶ 112–113));

[1d] *forming a resist mask having an initial linewidth;* (Pet. 28–29 (relying on Ex. 1004, 5:36–41; Ex. 1002 ¶ 114));

[1e] *anisotropically etching exposed portions of the hardmask layer;* (Pet. 29 (relying on Ex. 1004, 5:40–45; Ex. 1002 ¶ 115));

[1f] *isotropically etching subsequently the hardmask layer underneath the resist mask to form a hardmask having a final linewidth which is narrower than the initial line width of the resist mask and corresponds to a desired structure linewidth; and* (Pet. 30 (relying on Ex. 1004, 5:38–39, 5:49–52, 5:59–62; Ex. 1002 ¶¶ 116–118));

[1g] *anisotropically etching the device layer as defined by the hardmask to form a structure having a width substantially equal to the final linewidth of the hardmask*. Pet. 31 (relying on Ex. 1004, 5:63–65; Ex. 1002 ¶ 119)).

Petitioner argues that the '097 patent itself "describes that UTR layers, and the benefits associated with them, were generally known in the art at the time of the alleged invention." Pet. 24 (citing Ex. 1001, Fig. 2a). Petitioner also argues that because Chapman suggests that its "layer thicknesses . . . could all be varied," and because Hause explains that using a UTR layer would have been beneficial by replicating "an image pattern more accurately than thicker photoresist layers," one of ordinary skill in the art "would have combined Chapman and Hause to improve Chapman's photoresist by obtaining the accuracy advantages of the UTR layer taught in Hause." *Id.* at 26 (citing Ex. 1004, 6:64–66; Ex. 1007, 2:40–44; Ex. 1002 ¶¶ 106–107).

The remaining challenged claims in Ground 1 all depend from claim 1, and Petitioner presents additional arguments that the combination of Chapman, AAPA and Hause discloses all the limitations of those dependent challenged claims. Pet. 31–39. For Ground 2 (additionally relying on Becker or Jeoung or Wong) and Ground 3 (additionally relying on Lin or Cirelli), Petitioner argues that the proposed combinations disclose all of the challenged dependent claim limitations. Pet. 39–44.

5. Petitioner's Arguments – Laaksonen Grounds

Petitioner asserts that every element of claim 1 is found in the combination of Laaksonen, AAPA, and Hause, as follows:

1[pre] *A method of forming circuit structures having linewidths which are smaller than what is achievable by conventional UV lithographic techniques on ultra-thin resist layers, said method comprising the steps of*: (Pet. 45–47 (relying on Ex. 1006, 1:9–11, 1:52–53, 2:1–5, 2:67–3:1, 3:8–10, 3:12–15; Ex. 1007, 4:14–17, 2:22–25, 4:25–27, 2:40–44; Ex. 1002 ¶¶ 177–182));

[1a] *providing a semiconductor wafer stack formed of a substrate and a device layer above the substrate*; (Pet. 47 (relying on Ex. 1006, 2:54–3:3, 5:3–4; Ex. 1001, 3:63–65; Ex. 1002 ¶ 183));

[1b] *depositing a hardmask layer over the device layer;* (Pet. 48 (relying on Ex. 1006, 2:64–65, 4:17–26; Ex. 1001, 4:4–8; Ex. 1002 ¶ 187));

[1c] *depositing an ultra-thin resist layer over the hardmask layer;* (Pet. 48 (relying on Ex. 1006, 2:67–3:1; Ex. 1002 ¶ 189));

[1d] *forming a resist mask having an initial linewidth;* (Pet. 48–49 (relying on Ex. 1006, 3:24–28, 3:30–33; Fig. 3; Ex. 1002 ¶ 191));

[1e] *anisotropically etching exposed portions of the hardmask layer;* (Pet. 49 (relying on Ex. 1006, 3:30–66; Ex. 1002 ¶¶ 192–193));

[1f] *isotropically etching subsequently the hardmask layer underneath the resist mask to form a hardmask having a final linewidth which is narrower than the initial line width of the resist mask and corresponds to a desired structure linewidth; and* (Pet. 50–51 (relying on Ex. 1006, 3:33–66, 2:38–40, 2:45–51, Figs. 1, 5; Ex. 1002 ¶¶ 194–198));

[1g] *anisotropically etching the device layer as defined by the hardmask to form a structure having a width substantially equal to the final linewidth of the hardmask*. Pet. 52–53 (relying on Ex. 1006, 4:18–19, 4:21–25, 4:33–35, Fig. 6; Ex. 1002 ¶¶ 199–201)).

Petitioner argues that the '097 patent itself "discloses UTR layers as AAPA and establishes that UTR layers and the benefits they provide were general knowledge to skilled artisans at the time of the alleged invention." Pet. 45–46. Thus, argues Petitioner, for "the same reasons described above regarding Chapman's method, a skilled person would have incorporated a UTR layer into Laaksonen's process based on the general knowledge reflected in the disclosures of the '097 patent." *Id.* at 46 (citing Ex. 1002 ¶ 177). Petitioner also argues that because Laaksonen describes a resist with a thickness of 7700Å, but also suggests that "many other thickness variations are possible," and because Hause explains that using a UTR layer "replicates the first image pattern with a high degree of accuracy," "more accurately than thicker photoresist layers," one of ordinary skill in the art "would have pursued the combination" because "implementing Hause's UTR layer as part of Laaksonen's process would have improved patterning

accuracy." *Id.* (citing Ex. 1006, 3:8–10, 3:12–15; Ex. 1007, 2:40–44, 4:25–27; Ex. 1002 ¶¶ 181–182).

The remaining challenged claims in Ground 4 all depend from claim 1, and Petitioner presents additional arguments that the combination of Laaksonen, AAPA and Hause discloses all the limitations of those dependent challenged claims. Pet. 53–60. For Ground 5 (additionally relying on Chapman) and Ground 6 (additionally relying on Becker or Jeoung or Wong), Petitioner argues that the proposed combinations disclose all of the challenged dependent claim limitations. Pet. 60–66.

6. Patent Owner's Arguments

Patent Owner argues Petitioner has failed to show a reasonable likelihood that it would prevail in proving the obviousness of any challenged claim. Prelim. Resp. 35.

First, Patent Owner argues that Hause teaches away from combining its teachings with those of Chapman or Laaksonen. *Id.* at 35. More particularly, Patent Owner argues that "Hause specifically teaches that photoresist layers were required to be on the order of *four times thicker* than polysilicon layers." *Id.* at 36 (citing Ex. 1007, 2:11–16). "Consistently, Hause *only* describes the use of UTR layers when the underlying layer is a mere 500 angstroms." *Id.* at 37 (citing Ex. 1007, 4:16–18). Chapman, Patent Owner argues, "generally adheres to these teachings of Hause in having photoresist layers that are multiple times as thick as the underlying polysilicon layer." *Id.* (citing Ex. 1004, 2:53, 2:66 (teaching a polysilicon layer of 3000 to 5000 angstroms and a photoresist layer of 10,000 angstroms)). Laaksonen, Patent Owner argues, teaches a photoresist layer of 7700 angstroms over a BARC layer of 1200-1600 angstroms. *Id.* (citing

Ex. 1006, 3:8–11). This teaching that "photoresist layers need to be several multiples as thick as the underlying layer," Patent Owner argues, teaches away from combining the devices of Chapman or Laaksonen with Hause's UTR layers. *Id.* at 38.

Second, Patent Owner argues that Petitioner and its expert engage in impermissible hindsight reconstruction. Prelim. Resp. 35. More particularly, Patent Owner argues that Petitioner's reliance on seven separate resources and unsupported declaration testimony in its obviousness grounds results in a "hodge-podge collection of alleged knowledge tidbits." *Id.* at 42. Patent Owner provides allegedly conclusory examples of where Petitioner asserts that there was inherently some motivation to combine. *Id.* at 44–45.

Third, Patent Owner argues that Petitioner's expert relies on conclusory statements to make legal conclusions. Prelim. Resp. 35. More particularly, Patent Owner argues that Petitioner's expert "also relies on hindsight reconstruction in many of the same ways Petitioner does," to "cobble together multiple disparate tidbits of information from multiple unrelated references." *Id.* at 46–47. Patent Owner also faults the declaration as being "couched as a legal obviousness opinion." *Id.* at 46.

7. Analysis

On this record, Petitioner demonstrates a reasonable likelihood of prevailing on its argument that the challenged claims would have been obvious over Chapman, AAPA, and Hause, or Laaksonen, AAPA, and Hause, along with the additional combinations of prior art.

Regarding Patent Owner's teaching away argument, the portions of Hause on which Petitioner relies, when combined with Chapman and Laaksonen, appear on this record to teach the required UTR layers.

Petitioner demonstrates persuasively, on this preliminary record, that Chapman discloses the elements of claim 1 apart from the UTR layers. Pet. 23–31. Petitioner also demonstrates persuasively, on this preliminary record, that Laaksonen discloses the elements of the claim 1 apart from the UTR layers. Pet. 45–53. Petitioner relies on AAPA to demonstrate that UTR layers were known in the prior art, and on Hause to demonstrate actual use of UTR layers in a similar system; Petitioner also relies on its declarant's supporting testimony, which we find persuasive at this stage in the proceeding. Pet. 23–26, 45–47; Ex. 1002 ¶¶ 100–107, 176–182.

As Petitioner points out, Patent Owner's argument about ratios and teaching away "relies on the premise that the prior art establishes a rule requiring that a photoresist be at least four times thicker than an underlying layer" but the "prior art provides no such rule." Reply 5. Also, as noted by Petitioner, Hause teaches a 4:1 thickness ratio in the examples but does not prohibit or discourage other ratios, and Chapman and Laaksonen "described their layer thicknesses as examples and taught varying them." *Id.* (citing Ex. 1004, 6:64–66; Ex. 1006, 3:4–15). When supported by the declarant's testimony regarding the combinability of the cited references, and the motivation of one of ordinary skill in the art to make the combination (*see, e.g.,* Ex. 1002 ¶¶ 98–107, 175–182), Petitioner's argument is sufficient at this stage in the proceeding.

Regarding Patent Owner's hindsight reconstruction argument, we have reviewed the record before us and do not perceive that Petitioner's arguments are impermissibly based in hindsight. Petitioner provides sufficient reasoning, on this record, why one of ordinary skill in the art would have been motivated to combine the references with a reasonable

expectation of success, supported by expert testimony. Accordingly, Petitioner has provided "some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness," without impermissibly resorting to hindsight. *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006).

Regarding Patent Owner's assertions about expert testimony being unsupported, we have reviewed Dr. Bravman's testimony and do not find that Patent Owner's assertions demonstrate anything lacking in the testimony. At this stage in the proceeding, this testimony is uncontroverted by anything but attorney argument. Having reviewed Petitioner's obviousness arguments and supporting testimony, and Patent Owner's counterarguments, we are persuaded at this point in the proceeding that Petitioner has demonstrated a reasonable likelihood of prevailing on its obviousness contentions.

III. CONCLUSION

For the reasons set forth above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one challenged claim of the '097 patent. Thus, we institute *inter partes* review on all challenged claims and on all grounds presented.

At this preliminary stage of the proceeding, we have not made a final determination as to the patentability of any challenged claim or any factual or legal issue underlying the patentability inquiry. Any final determination will be based on the record developed during trial. We place Patent Owner on express notice that any argument not asserted in a timely-filed Response to the Petition, or in another manner permitted during trial, shall be deemed waived, even if that argument was presented in the Preliminary Response.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that *inter partes* review is instituted on each of the grounds asserted in the Petition; and

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, which shall commence on the entry date of this decision.

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