

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

NANYA TECHNOLOGY CORP.,
Petitioner,

v.

NORTH STAR INNOVATIONS INC.,
Patent Owner.

Case IPR2016-00965
Patent 6,372,638 B1

Before J. JOHN LEE, CHARLES J. BOUDREAU, and
MICHELLE N. WORMMEESTER, *Administrative Patent Judges*.

WORMMEESTER, *Administrative Patent Judge*.

DECISION
Institution of *Inter Partes* Review
37 C.F.R. § 42.108

Nanya Technology Corp. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–11 of U.S. Patent No. 6,372,638 B1 (Ex. 1001, “the ’638 patent”). North Star Innovations Inc. (“Patent Owner”) did not file a Preliminary Response. We have jurisdiction under 35 U.S.C. § 314 and 37 C.F.R. 42.4(a). Under 35 U.S.C. § 314(a), 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 that follow, we institute an *inter partes* review as to claims 1–11 of the ’638 patent.

I. BACKGROUND

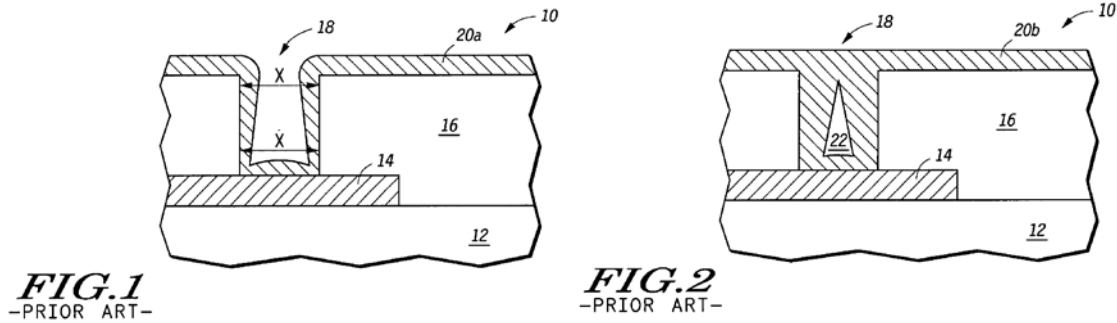
A. *Related Proceedings*

The parties identify the following related case: *North Star Innovations Inc. v. Nanya Technology Corp.*, Case No. 1:15-cv-01027-GMS (D. Del. Nov. 5, 2015). Pet. v; Paper 7, 2.

Patent Owner also identifies the following related request for *inter partes* review: IPR2016-01022. Paper 7, 2.

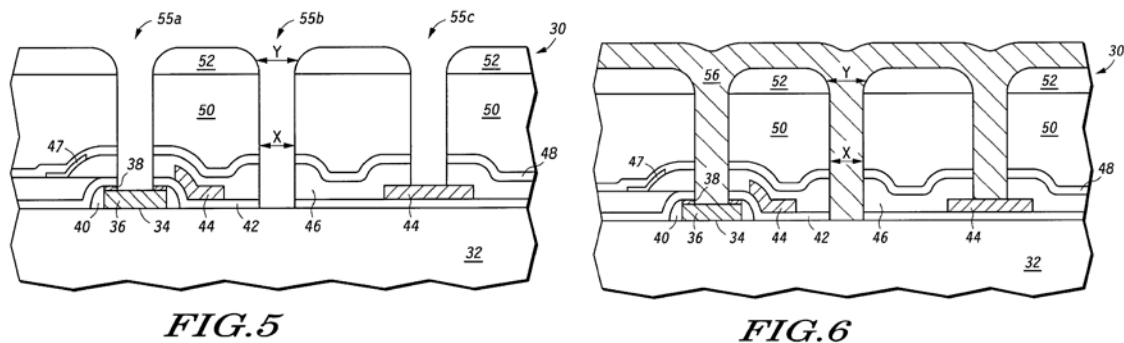
B. *The ’638 Patent*

The ’638 patent is titled “Method for Forming a Conductive Plug Between Conductive Layers of an Integrated Circuit.” Ex. 1001, at [54]. According to the ’638 patent, tungsten deposition in the integrated circuit industry has become highly nonconformal, resulting in the problem of inconsistent step coverage. *Id.* at 1:30–32. To illustrate this problem, Figures 1 and 2 of the ’638 patent are reproduced below.



Figures 1 and 2 show, in cross-sectional diagrams, a method for forming a contact structure. *Id.* at 2:16–18. The top surfaces of dielectric layer 16 accumulate tungsten material 20a at a much faster rate than the bottom corners of contact opening 18. *Id.* at 1:46–48, Fig. 1. Due to this nonconformal deposition, the contacts end up with keyholes or voids 22. *Id.* at 1:59–61, Fig. 2.

To address this problem, the '638 patent proposes a method for forming tungsten plug contacts that are free of keyholes or voids. *Id.* at 2:28–29. According to one embodiment of the '638 patent, the method alters the contact profile, tapering the sidewalls of the contact to form a “golf tee” profile. *Id.* at 2:37–39. Figures 5 and 6 of the '638 patent, which illustrate such a profile, are reproduced below.



Figures 5 and 6 show, in cross-sectional diagrams, a method for forming a contact structure without keyholes or voids. *Id.* at 2:19–21. The method tapers the upper portions of contact openings 55a–55c. *Id.* at 4:9–12. This tapering step enlarges the upper portions of contacts 55a–55c to radius Y, which is greater than radius X. *Id.* at 4:20–24. Radius X of Figure 5 and radius X of Figure 1 are the same. *Id.* at 4:24–25. As a result of the golf tee profiles, keyholes and voids within the contact openings are reduced or eliminated. *Id.* at 5:25–30.

C. Illustrative Claim

Petitioner challenges claims 1–11 of the '638 patent. Claims 1, 8, and 11 are independent. Claim 1 is illustrative of the claims under challenge:

1. A method for forming a contact structure, the method comprising the steps of:

forming a first conductive material overlying a semiconductor substrate;

forming a dielectric layer overlying the first conductive layer;

forming a resist layer over the dielectric layer;

patterning the resist layer to form an opening that exposes portions of the dielectric layer;

placing the semiconductor substrate into a reactive ion etching chamber and in-situ processing the semiconductor substrate as follows:

etching portions of the dielectric layer using a gas mixture that includes a fluorocarbon source gas to form an opening in the dielectric layer, the opening having a bottom portion and a sidewall portion;

etching a portion of the resist layer using a gas mixture that includes a fluorocarbon source gas and an oxygen source gas to remove the portion of the resist layer and

expose a top surface portion of the dielectric layer adjacent the sidewall portion;

etching the top surface portion of the dielectric layer adjacent the sidewall portion to form a taper that extends between a top surface of the dielectric layer and the sidewall portion, wherein the taper towards the top surface portion has a radius Y and the taper towards the sidewall portion has a radius X wherein $X < Y$; and

removing remaining portions of the resist layer;

depositing a second conductive material within the opening;

and

polishing away a top portion of the conductive material and a top portion of the dielectric layer to remove the taper.

D. Asserted Grounds of Unpatentability

Petitioner challenges claims 1–11 of the '638 patent on the following grounds. Pet. 2, 34–84.

Reference(s)	Basis	Claim(s) Challenged
Mathews ¹	§ 102	8–11
Mathews	§ 103	8–11
Mathews and Langley ²	§ 103	1–7 and 11
Mathews, Langley, and Wu ³	§ 103	1–7 ⁴

¹ Mathews, U.S. Patent No. 5,580,821, issued Dec. 3, 1996 (Ex. 1004).

² Langley, U.S. Patent No. 4,939,105, issued July 3, 1990 (Ex. 1005).

³ Wu, U.S. Patent No. 5,547,892, issued Aug. 20, 1996 (Ex. 1006).

⁴ For the ground based on Mathews, Langley, and Wu, Petitioner identifies claims 1–7 and 11 in its summary of the asserted grounds on page 2 of the Petition, but omits claim 11 from the heading on page 78 of the Petition. Given the substance of Petitioner's arguments, we presume the former to be a typographical error, and, therefore, we address only claims 1–7 with respect to this ground.

As additional support, Petitioner proffers the Declaration of Dr. Martin G. Walker (Ex. 1003). *See id.*

E. Claim Interpretation

We construe claims in an unexpired patent by applying the broadest reasonable interpretation in light of the specification of the patent in which they appear. *See* 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs. LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). Under this standard, claim terms are generally given their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *See In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). A “claim term will not receive its ordinary meaning if the patentee acted as his own lexicographer,” however, and clearly set forth a definition of the claim term in the specification. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002).

Petitioner provides proposed interpretations for various limitations of the claims. *See* Pet. 10–22. For purposes of this Decision, we conclude that no term requires interpretation at this time to resolve any controversy in this proceeding. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”).

II. DISCUSSION

A. Anticipation by Mathews

Petitioner argues that Mathews anticipates claims 8–11 of the '638 patent under 35 U.S.C. § 102. Pet. 2, 34–51. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on its asserted ground as to claims 8–10, but not as to claim 11.

1. Mathews

Mathews describes a method of forming an electrically conductive contact plug. Ex. 1004, 1:7–9. Figure 5 of Mathews is reproduced below.

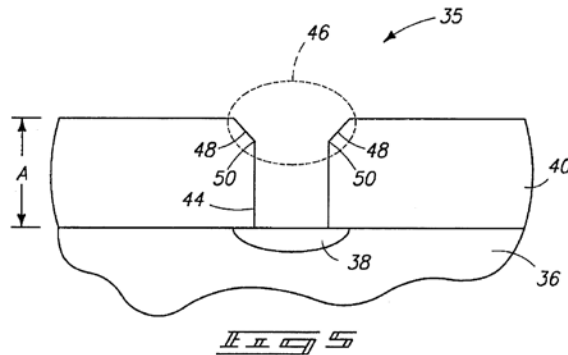
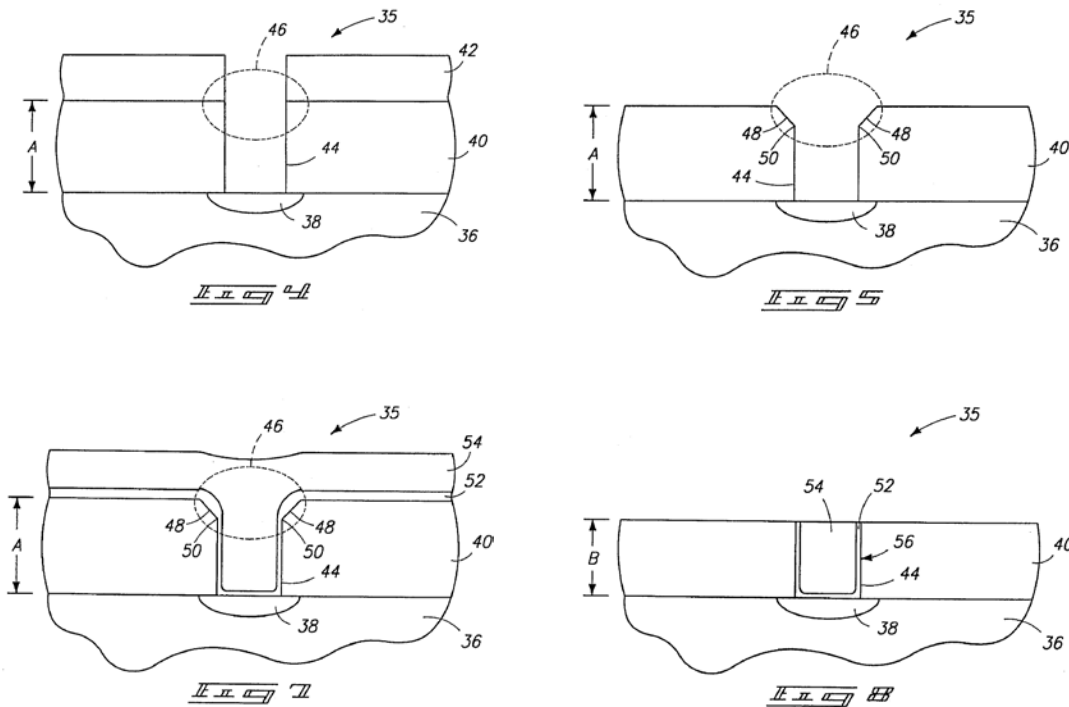


Figure 5 shows a wafer during a processing step, namely a facet sputter etching step. *Id.* at 2:34–35, 3:40–41. This step provides contact opening 44 with outwardly angled sidewalls 48 that effectively widen the contact opening at its outermost region 46. *Id.* at 3:40–43. As a result, undesired keyholes or voids that typically form when depositing a conductive material within the contact can be avoided. *See id.* at 1:44–45; 2:7–9.

2. Claims 8–10

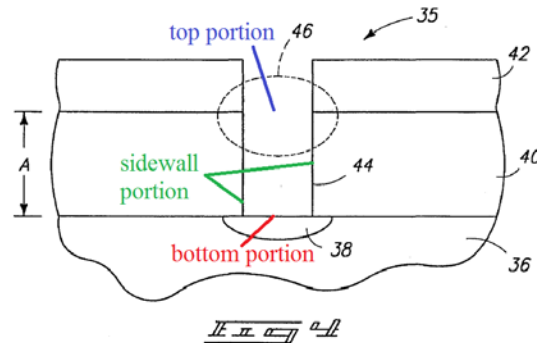
Petitioner explains in its Petition how Mathews discloses all the elements of independent claim 8. *See* Pet. 34–45. For example, Petitioner directs us to Figures 4, 5, 7, and 8 of Mathews, which are reproduced below. *Id.* at 35, 37–38, 40, 42–44.



Figures 4, 5, 7, and 8 show a wafer during various processing steps. Ex. 1004, 2:30–41. Petitioner identifies Mathews’ electrically insulative material 40 as a “dielectric layer” and Mathews’ photoresist 42 as a “resist layer,” which is formed over insulative material 40. Pet. 35–36; Ex. 1004, Fig. 4.

Petitioner points out that Figure 4 illustrates the step of etching insulative material 40 to form contact opening 44, which Petitioner identifies as an “opening.” Pet. 36. Petitioner argues that such etching is anisotropic because it is carried out in the vertical direction only. *Id.* at 37. Referring to an annotated version of Figure 4 of Mathews, which is reproduced below,

Petitioner further argues that contact opening 44 includes a “top portion,” “a bottom portion,” and a “sidewall portion,” as recited in claim 8. *Id.* at 38.



As discussed above, Figure 4 shows a wafer during a processing step.

Petitioner also points out that Figures 4 and 5 illustrate the step of removing photoresist 42 after contact opening 44 is formed. *Id.* at 39 (citing Ex. 1004, 3:39–40). Petitioner points out that Figure 5 further illustrates the step of facet sputter etching after removing the photoresist in order to provide contact opening 44 with outwardly angled sidewalls 48. *Id.* at 40–41 (citing Ex. 1004, 3:39–43). Petitioner identifies this latter step as “tapering the top portion of the opening.” *Id.* Petitioner further argues that sputter etching is anisotropic because it is highly directional. *Id.* at 41.

Petitioner additionally points out that Figure 7 illustrates the step of depositing conductive materials 52 and 54 over the top surface of insulative material 40 as well as within contact opening 44. *Id.* at 42.

Finally, Petitioner points out that Figure 8 illustrates the step of removing the conductive and insulative materials “down to the point where the outwardly angled sidewalls (48) meet the vertical sidewalls (50).” *Id.* at 44. As Petitioner asserts, Mathews uses chemical-mechanical polishing for this step. *Id.*; Ex. 1004, 4:33–34.

Based on the record before us, at this stage of the proceeding, we determine that Petitioner has demonstrated a reasonable likelihood of

prevailing on its assertion that Mathews anticipates claim 8. Having reviewed Petitioner's arguments asserting that Mathews anticipates dependent claims 9 and 10 (*see* Pet. 45–46), we also determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion as to these claims on the basis of Petitioner's contentions.

3. Claim 11

Claim 11 recites the step of “tapering the top portion of the opening using an anisotropic etch process *while* removing the resist layer” (emphasis added). For this limitation, Petitioner directs us to where Mathews describes the step of facet sputter etching, which Petitioner identifies as a “tapering” step. Pet. 48–49. Mathews discloses first using an oxygen etch to “move the resist back away from the contact, and not to necessarily fully strip the resist,” and then using an argon etch “to produce the desired facet.” Ex. 1004, 3:46–55. Given this disclosure, Petitioner contends that photoresist remains after moving the resist back away from the contact. Pet. 48. Petitioner further contends that “sputter etching will remove any material the sputter ions collide with, including the remaining photoresist layer,” because such etching is a non-selective physical process. *Id.* at 50. That is, according to Petitioner, “the (facet) sputter etching *necessarily* removes the photoresist layer as well as the exposed dielectric layer while the taper is being formed.” *Id.* Thus, Petitioner contends this limitation is disclosed inherently.

Petitioner's contentions are not persuasive. As Petitioner acknowledges in its discussion of claim 8, Mathews' “photoresist layer (42) is partially or completely removed before creating the outwardly angled

sidewalls.” *Id.* at 40. Moreover, in the case of partial removal, Mathews does not specify how far back away from the contact to move the photoresist. Nor does Petitioner proffer persuasive evidence showing how far back away to move the photoresist. Based on the record before us, we are not persuaded that Mathews’ disclosure of partially or completely removing photoresist before creating outwardly angled sidewalls necessarily discloses the recited tapering step *while* removing the resist layer. *See Continental Can Co. USA v. Monsanto Co.*, 948 F.2d 1264, 1269 (Fed. Cir. 1991) (“Inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient.”).

In view of the foregoing, we determine that Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that Mathews anticipates claim 11.

B. Obviousness over Mathews

Petitioner argues that claims 8–11 of the ’638 patent would have been obvious over Mathews under 35 U.S.C. § 103. Pet. 2, 51–53. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this asserted ground as to claim 11, but not as to claims 8–10.

1. Claims 8–10

As discussed above, Petitioner argues that Mathews anticipates claims 8–10. Petitioner alternatively argues that, to the extent that we are not persuaded by its anticipation arguments, “*Mathews* nevertheless renders

Claims 8–10 obvious because they would have been obvious to a skilled artisan in light of *Mathews*.” Pet. 51. Petitioner relies on Dr. Walker’s declaration testimony to support its contention. *Id.* (citing Ex. 1003 ¶¶ 113–115). In his declaration, Dr. Walker only testifies conclusorily that claims 8–10 would have been obvious for the same reasons Mathews anticipates those claims. Ex. 1003 ¶¶ 90–104, 113–115. Neither Petitioner nor Dr. Walker provides further explanation as to how claims 8–10 would have been obvious over Mathews if they are not anticipated. Under 35 U.S.C. § 312(a)(3), a petition must identify, “with particularity, each claim challenged, the grounds on which the challenge to each claim is based, and the evidence that supports the grounds for the challenge to each claim.” Our rules further require that a petition must identify “[h]ow the construed claim is unpatentable under the statutory grounds identified” and “where each element of the claim is found in the prior art,” and must explain the “relevance of the evidence to the challenge raised. 37 C.F.R. § 42.104(b); *see also* 37 C.F.R. § 42.22(a)(2) (requiring a petition to include a “full statement of the reasons for the relief requested, including a detailed explanation of the significance of the evidence”). The Petition fails to meet these requirements sufficiently for this asserted ground of unpatentability. As Petitioner does not explain sufficiently how any of claims 8–10 would have been obvious in light of Mathews, we determine that Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claims 8–10 would have been obvious over Mathews if we ultimately determine those claims are not anticipated.

2. Claim 11

As discussed above, claim 11 recites the step of “tapering the top portion of the opening using an anisotropic etch process *while* removing the resist layer” (emphasis added). For this limitation, Petitioner directs us to where Mathews teaches complete or partial removal of photoresist (i.e., “resist layer”) before⁵ facet sputter etching (i.e., “tapering”). Pet. 52 (citing Ex. 1004, 3:44–50). Petitioner explains that sputter etching is a nonselective process, which would remove any remaining photoresist. *Id.* Petitioner also explains that, “[i]f the photoresist were completely removed prior to the facet etch, it would take longer to obtain the same amount of tapering since the flat portions of the dielectric would be receding at the same time the edges are being tapered.” *Id.*; *see also id.* at 52–53 (stating that “exposing the edges would permit the tapering of the via faster since the flat portions of the dielectric are not etched until the remaining photoresist is removed completely”). Thus, Petitioner contends, “it would have been obvious for a person of ordinary skill in the art to not remove the photoresist layer completely prior to the sputter etching process, and instead retain portions of the photoresist layer and remove them simultaneously during the facet sputter etching step.” *Id.* at 53. Petitioner relies on Dr. Walker’s declaration

⁵ In arguing that claim 11 would have been obvious over Mathews, Petitioner asserts that Mathews discloses “complete or partial removal of the photoresist *during* the tapering etch.” Pet. 52 (emphasis added). In arguing that Mathews anticipates claim 8, however, Petitioner asserts that Mathews’ “photoresist layer (42) is partially or completely removed *before* creating the outwardly angled sidewalls.” *Id.* at 40 (emphasis added). Given the cited disclosures in Mathews (*see* Ex. 1004, 3:38–60), as well as the substance of Petitioner’s arguments, we presume the former to be a typographical error.

testimony to support its contention. *Id.* at 52–53 (citing Ex. 1003 ¶¶ 120–121).

Based on the record before us, at this stage of the proceeding, we are persuaded by Petitioner’s proffered reasoning for partially removing the photoresist in Mathews in order to carry out the facet sputter etching while removing remaining portions of the photoresist. *See In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) (“[T]here must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.”). Accordingly, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claim 11 would have been obvious over Mathews.

C. Obviousness over Mathews and Langley

Petitioner argues that claims 1–7 and 11 of the ’638 patent would have been obvious over Mathews and Langley under 35 U.S.C. § 103. Pet. 2, 53–78. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on its asserted ground as to claims 1–4 and 11, but not as to claims 5–7.

1. Langley

Langley describes a method of contact etching. Ex. 1005, 1:6–10. Figures 4–7 of Langley, which illustrate the method, are reproduced below.

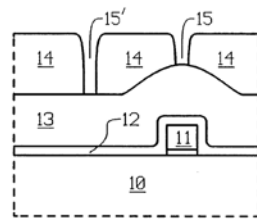


FIG. 4

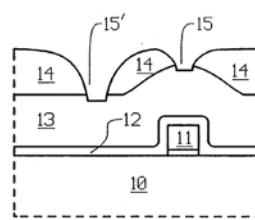


FIG. 5

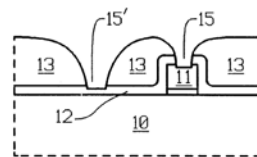


FIG. 6

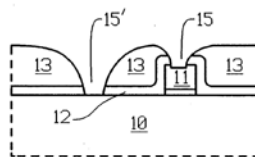


FIG. 7

Figures 4–7 show an oxide layer with an overlying mask during various etching steps. *Id.* at 2:60–68. The mask is a layer of resist 14, which is patterned for contacts 15 and 15'. *Id.* at 3:9–10, Fig. 4. The first step involves forming slopes in the contacts by eroding resist 14. *Id.* at 3:36–38, Fig. 5. The second step involves etching oxides 12, 13 as well as remaining resist 14. *Id.* at 3:48–50, Fig. 6. The contacts are essentially complete at this point. *Id.* at 3:57–58. The third step involves etching most of the remaining oxide out of the contacts. *Id.* at 3:62–65. The final step involves etching the rest of the oxide out of contacts 15' down to substrate 10. *Id.* at 4:9–12, Fig. 7. The contacts are well sloped at their tops, and deeper contacts 15' have vertical walls. *Id.* at 4:21–24.

2. Claims 1–4

For claim 1, Petitioner relies primarily on Mathews. *See* Pet. 56–74. For example, claim 1 recites “forming a first conductive material overlying a semiconductor substrate.” As to this limitation, Petitioner directs us to Figure 4 of Mathews, which is reproduced below. *Id.* at 57.

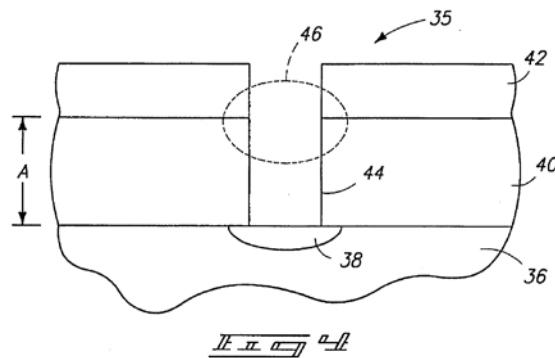


Figure 4 shows a wafer during a processing step. Ex. 1004, 2:30–32. Petitioner identifies Mathews’ active area 38 as a “first conductive material” and Mathews’ bulk substrate 36 as a “semiconductor substrate.” Pet. 58. Petitioner argues that active area 38 *overlies* bulk substrate 36, even though Figure 4 shows active area 38 being formed *within* the top surface of bulk substrate 36. *Id.* at 57. In support of this argument, Petitioner points out that claim 7, which depends from claim 1, recites “forming the first conductive layer as a doped current electrode for a transistor within a substrate.” *Id.* at 58. Given the dependency of claim 7 from claim 1, Petitioner explains that the term “overlying a semiconductor substrate” in claim 1 encompasses the term “within a substrate” in claim 7. *Id.* On this record, we are persuaded that Mathews teaches the recited “forming” limitation for the reasons outlined by Petitioner.

Claim 1 further recites “placing the semiconductor substrate into a reactive ion etching chamber and in-situ processing the semiconductor substrate.” For this limitation, Petitioner directs us to where Mathews teaches that all mask removal and etching are conducted in the same chamber, where etching can be carried out in a reactive manner. *Id.* at 62–63 (citing Ex. 1004, 3:44–46, 3:55–57). On this record, we are persuaded that Mathews teaches the recited “placing” and “processing” limitations.

Claim 1 further recites “etching a portion of the resist layer using a gas mixture that includes a fluorocarbon source gas and an oxygen source gas to remove the portion of the resist layer and expose a top surface portion of the dielectric layer adjacent the sidewall portion.” For this limitation, Petitioner directs us to where Mathews teaches that “an oxygen etch is conducted to strip the resist.” *Id.* at 66 (citing Ex. 1004, 3:46–48). Relying on Dr. Walker’s declaration testimony, Petitioner further argues that “it would have been obvious for a skilled artisan to etch the photoresist layer without completely evacuating the fluorocarbon gas that was used in the previous step (of vertically etching the vias).” *Id.* (citing Ex. 1003 ¶ 148); *see also* Ex. 1004, 3:34–36 (“[a]n example etch of the BPSG oxide to form contact 44 would be a dry etch using a carbon/fluorine based chemistry”); *id.* at 3:39–40 (“masking layer 42 is removed after the etching which formed contact opening 44”). In his declaration, Dr. Walker testifies that it would have been simpler for a person of ordinary skill in the art to add oxygen to the fluorocarbon gas in the chamber than to completely evacuate the fluorocarbon gas. Ex. 1003 ¶ 148. Based on the record before us, we are persuaded that the recited “etching” step is taught by Mathews.

Claim 1 further recites “removing remaining portions of the resist layer.” As to this limitation, Petitioner refers to its argument that claim 11 is obvious over Mathews. Pet. 70. For the reasons discussed above, we are persuaded that this “removing” step would have been obvious over Mathews.

Petitioner also relies alternatively on Langley for certain of the limitations of claim 1. For example, Petitioner relies alternatively on Langley for the following “etching” step discussed above: “etching a

portion of the resist layer using a gas mixture that includes a fluorocarbon source gas and an oxygen source gas to remove the portion of the resist layer and expose a top surface portion of the dielectric layer adjacent the sidewall portion.” Pet. 66. In particular, Petitioner directs us to where Langley teaches that “a chamber atmosphere of O₂, He, CHF₃, and CF₄ is provided, widening, or forming slopes in, contacts 15 and 15’ by eroding resist.” *Id.* (citing Ex. 1005, 3:36–38). Petitioner also directs us to Figure 5 of Langley, which is reproduced below.

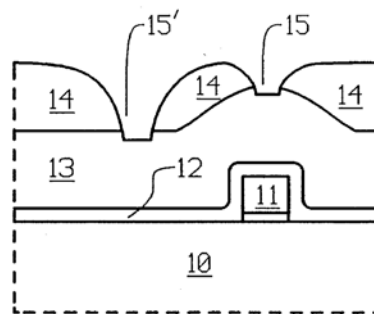


FIG.5

Figure 5 shows a cross-sectional view of the result of an etching step. Ex. 1005, 2:62–63. According to Petitioner, Figure 5 specifically shows that “the surface of a portion of the dielectric layer (13) is exposed where the photoresist layer (14) is etched back.” Pet. 66–67. Based on the record before us, we are persuaded that Langley also teaches the recited “etching” step.

In addition to showing that Langley teaches this “etching” step, Petitioner must provide “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *Kahn*, 441 F.3d at 988; *see KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). In that regard, Petitioner contends that, “[b]ecause of the significant overlap in the process environment, it would have been a simple substitution for a

person practicing the invention of *Mathews* to use a mixture of CHF_3 , CF_4 , and O_2 (as taught in *Langley*) during the photoresist removal step instead of using just O_2 as *Mathews* suggests.” Pet. 68. Petitioner relies on Dr. Walker’s declaration testimony to support its contention. *Id.* at 67–68 (citing Ex. 1003 ¶ 147 (referring to ¶ 127)). Based on the record before us, at this stage of the proceeding, we are persuaded that Petitioner has provided adequately articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claim 1 would have been obvious over *Mathews* and *Langley*. Having reviewed Petitioner’s arguments asserting that dependent claims 2–4 would have been obvious over *Mathews* and *Langley* (*see* Pet. 74–76), we also determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion as to these claims.

3. Claims 5–7

Petitioner asserts that “[c]laims 5–7 are directed to applying [c]laim 1 to various portions of an SRAM cell, that is forming a via over various elements of an SRAM transistor.” Pet. 77. Petitioner further argues that “it would have been obvious for a person of ordinary skill in the art to apply the inventions disclosed in *Mathews* and *Langley* to an SRAM cell.” *Id.* According to Petitioner, “[c]laims 5–7 simply recite characteristics of SRAM cells that were well-known at the time of the alleged invention,” and they “do not recite any elements that are particularly suited for or targeted at

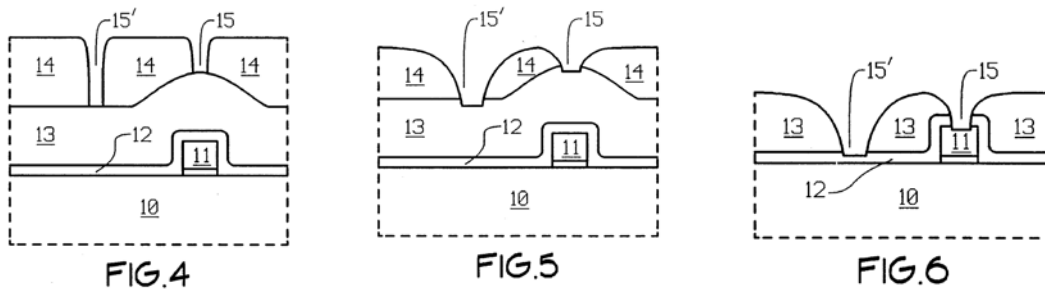
SRAM cells.” *Id.* at 77–78. Thus, Petitioner concludes, “[c]laims 5–7 are obvious over *Mathews* in view of *Langley*.” *Id.* at 78.

Based on the record before us, we are not persuaded that Petitioner has provided adequately articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988. Petitioner does not explain persuasively *why* one of ordinary skill in the art would have considered combining elements of *Mathews* with elements of *Langley*, or *why* one of ordinary skill in the art would have considered modifying the teachings of *Mathews* in view of the teachings of *Langley* to arrive at the claimed invention. For example, Petitioner does not direct us to any portion of *Mathews* or *Langley* that describes an SRAM cell. Moreover, contrary to Petitioner’s assertion that claims 5–7 “do not recite any elements that are particularly suited for or targeted at SRAM cells,” each of these claims expressly recites “an SRAM cell.”

In view of the foregoing, we determine that Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claims 5–7 would have been obvious over *Mathews* and *Langley*.

4. Claim 11

As discussed above, Petitioner argues that *Mathews* anticipates or renders obvious claim 11. Petitioner further argues that, “[t]o the extent, however, that PTAB determines *Mathews* does not anticipate or render obvious Claim 11, it is nevertheless obvious over *Mathews* in view of *Langley*.” Pet. 53. Focusing on the recited step of “tapering the top portion of the opening . . . while removing the resist layer,” Petitioner directs us to Figures 4–6 of *Langley*, which are reproduced below. Pet. 54–55.



Figures 4–6 illustrate etching steps. Ex. 1005, 2:60–64. Referring to Figures 4 and 5, Petitioner points out that Langley teaches that “a chamber atmosphere of O₂, He, CHF₃, and CF₄ is provided, widening, or forming slopes in, contacts 15 and 15’ by eroding resist.” *Id.* at 53–54 (citing Ex. 1005, 3:36–38). Referring to Figures 5 and 6, Petitioner also points out that Langley further teaches that, “[a]fter the proper contact slope is obtained, a second etch is performed . . . in order to etch oxides 13 and 12 and remaining resist 14.” *Id.* at 54 (citing Ex. 1005, 3:48–52). Based on the record before us, we are persuaded that Langley teaches the recited step of “tapering the top portion of the opening . . . while removing the resist layer.”

As mentioned above, Petitioner must also provide “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *Kahn*, 441 F.3d at 988; *see KSR*, 550 U.S. at 418. In that regard, Petitioner contends that “a skilled artisan would have been motivated to combine the specific teachings of *Langley* (*i.e.*, simultaneously etching the dielectric and the photoresist) with *Mathews*” because, “[i]n light of the overlap in the etch type, chemical, and environment, it would have been simple for a skilled artisan to substitute one or more etching steps disclosed in *Langley* for the etching steps disclosed in *Mathews*.” Pet. 30, 56. Petitioner relies on Dr. Walker’s declaration testimony to support its contention. *Id.* (citing Ex. 1003 ¶ 127). On this record, at this stage of the

proceeding, we are persuaded that Petitioner has provided adequately articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claim 11 would have been obvious over Mathews and Langley.

D. Obviousness over Mathews, Langley, and Wu

Petitioner argues that claims 1–7 of the '638 patent would have been obvious over Mathews, Langley, and Wu under 35 U.S.C. § 103. Pet. 2, 78–84. For the reasons explained below, we are persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on its asserted ground as to claims 1 and 5–7, but not as to claims 2–4.

1. Wu

Wu describes a method of fabricating a plug structure and metal contacts on the latch portion of a static random access memory (SRAM) circuit including thin film transistors. Ex. 1006, 1:9–12, 4:53–57.

2. Claims 1 and 5–7

Claim 1 recites “forming a first conductive material overlying a semiconductor substrate.” Each of claims 5–7 depends directly from claim 1 and further limits the step of forming a first conductive layer. As discussed above, Petitioner argues that claims 1 and 5–7 would have been obvious over Mathews and Langley. For the reasons given above, we are persuaded by Petitioner’s argument as to claim 1, but not as to claims 5–7. Under an

alternative theory, however, Petitioner argues that “[c]laims 5–7 are nevertheless obvious over *Mathews* in view of *Langley* and *Wuu* because *Wuu* discloses Claims 5–7 and because skilled artisans would have been motivated to combine the specific teachings of *Mathews* and *Langley* with *Wuu*.” Pet. 79. We agree with Petitioner in this regard.

Claim 5 recites “forming the first conductive layer as a gate electrode which gates a transistor in an SRAM cell,” and claim 6 recites forming the first conductive layer as “a polysilicon layer which is coupled to a storage node of an SRAM cell.” For these limitations, Petitioner directs us to Figure 9 of Wu, which is reproduced below. *Id.* at 80–81.

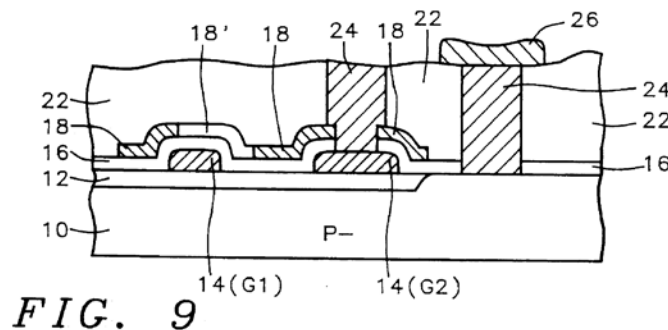


FIG. 9

Figure 9 shows a cross-sectional view of a portion of an SRAM cell with a P-channel thin film transistor. Ex. 1006, 3:65–67. Petitioner identifies Wu’s gate electrode G2 as the “first conductive layer.” Pet. 80–81. We note that Wu describes gate electrode G2 as a part of transistor P2. Ex. 1006, 4:61–62, Fig. 6. Petitioner further points out that gate electrode G2 is formed from polysilicon layer 14. Pet. 81 (citing Ex. 1006, 2:5–7, 5:4–8). In addition, Petitioner points out that gate electrode G2 is connected to node Q2, which Petitioner identifies as a “storage node.” *Id.* at 82 (citing Ex. 1006, Fig. 1); *see also* Ex. 1006, 1:42–48 (“The voltage at the nodes Q1 and Q2 between the two pairs of CMOS transistor P1, N1 and P2, N2, are sensed on the bit lines BL1 and BL2 during the read cycle to determine the

state of the SRAM latch.”). Based on the record before us, we are persuaded that Wu teaches the recited steps of forming the first conductive layer in claims 5 and 6.

Claim 7 recites “forming the first conductive layer as a doped current electrode for a transistor within a substrate, the transistor being coupled in an SRAM cell.” For this limitation, Petitioner directs us again to Figure 9 of Wu (reproduced above). Petitioner identifies Wu’s amorphous silicon layer 18 as the “first conductive layer.” *Id.* at 83. As Petitioner points out, Wu teaches that amorphous silicon layer 18 is “subjected to an ion implantation using a P type dopant.” *Id.* at 84 (citing Ex. 1006, 6:3–6). Wu also teaches that the “ion implant forms the source/drain doped regions of the P-channel TFTs [thin film transistors], and also provide a conducting layer elsewhere on the substrate.” *Id.* (citing Ex. 1006, 6:6–8). Based on the record before us, we are persuaded that Wu teaches the recited step of forming the first conductive layer in claim 7.

As discussed above, Petitioner must also provide “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *Kahn*, 441 F.3d at 988; *see KSR*, 550 U.S. at 418. In that regard, for each of claims 5–7, Petitioner contends that it would have been obvious to a skilled artisan to combine the teachings of Mathews, Langley, and Wu in order “to solve the problem of keyhole formation in vias.” *Id.* at 81–84. Petitioner relies on Dr. Walker’s declaration testimony to support its contention. *Id.* (citing Ex. 1003 ¶¶ 165–167). On this record, at this stage of the proceeding, we are persuaded that Petitioner has provided adequately articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988.

In view of the foregoing, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing on its assertion that claims 1 and 5–7 would have been obvious over Mathews, Langley, and Wu. *See Ormco Corp. v. Align Tech., Inc.*, 498 F.3d 1307, 1319 (Fed. Cir. 2007) (finding that independent claims would have been obvious because dependent claims were found to have been obvious).

3. Claims 2–4

Petitioner argues that claims 2–4 would have been obvious over Mathews, Langley, and Wu for the same reasons Petitioner argues that these claims would have been obvious over Mathews and Langley. Pet. 78–79. Petitioner relies on Dr. Walker’s declaration testimony to support its argument. *Id.* (citing Ex. 1003 ¶¶ 147–149, 169). Neither Petitioner nor Dr. Walker provides persuasive explanation, however, as to *why* one of ordinary skill in the art would have considered combining Mathews, Langley, *and* Wu to arrive at the claimed invention. Based on the record before us, we are not persuaded that Petitioner has provided adequately articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *See Kahn*, 441 F.3d at 988. Accordingly, we determine that Petitioner has not demonstrated a reasonable likelihood of prevailing on its assertion that claims 2–4 would have been obvious over Mathews, Langley, and Wu.

III. CONCLUSION

For the foregoing reasons, we are persuaded that Petitioner has demonstrated a reasonable likelihood that it would prevail in showing that

claims 1–11 of the '638 patent are unpatentable. We have not, however, made a final determination with respect to the patentability of these claims.

IV. ORDER

For the reasons given, it is

ORDERED that *inter partes* review is instituted as to claims 1–11 of the '638 patent based on the following grounds:

- A. Anticipation of claims 8–10 by Mathews under 35 U.S.C. § 102;
- B. Obviousness of claim 11 over Mathews under 35 U.S.C. § 103;
- C. Obviousness of claims 1–4 and 11 over Mathews and Langley under 35 U.S.C. § 103;
- D. Obviousness of claims 1 and 5–7 over Mathews, Langley, and Wu under 35 U.S.C. § 103;

FURTHER ORDERED that no other grounds of unpatentability are authorized for an *inter partes* review as to any claim of the '638 patent; 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; the trial will commence on the entry date of this decision.

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