

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HAMAMATSU CORPORATION,
Petitioner,

v.

PRESIDENT & FELLOWS OF HARVARD COLLEGE
Patent Owner.

Case IPR2016-01143
Patent 7,884,446 B2

Before JONI Y. CHANG, JENNIFER S. BISK, and
JACQUELINE T. HARLOW, *Administrative Patent Judges*.

HARLOW, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
Determining Claims 1–6 and 11 Have Been Shown To Be Unpatentable
35 U.S.C. § 318(a) and 37 C.F.R. § 42.73

I. INTRODUCTION

Hamamatsu Corporation (“Petitioner”), filed a Petition requesting an *inter partes* review of claims 1–11 of U.S. Patent No. 7,884,446 B2 (Ex. 1001, “the ’446 patent”). Paper 1 (“Pet.”). President & Fellows of Harvard College, (“Patent Owner”), filed a Preliminary Response to the Petition. Paper 6 (“Prelim. Resp.”). We determined that the information presented in the Petition demonstrated that there was a reasonable likelihood that Petitioner would prevail in challenging claims 1, 2, 4–6 and 11 as unpatentable under 35 U.S.C. § 102(b), and in challenging claim 3 as unpatentable under 35 U.S.C. § 103(a). Pursuant to 35 U.S.C. § 314, the Board instituted trial on November 22, 2016, as to those claims of the ’446 patent. Paper 7 (“Institution Decision” or “Inst. Dec.”).

Following our institution, Patent Owner filed a Response to the Petition (Paper 10, “PO Resp.”) and Petitioner filed a Reply to the Patent Owner Response (Paper 13, “Reply”). An oral hearing was held on July 17, 2017. The transcript of the hearing has been entered into the record. Paper 25 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. Based on the record before us, we conclude that Petitioner has demonstrated by a preponderance of the evidence that claims 1–6 and 11 of the ’446 patent are unpatentable.

A. Related Matter

The '446 patent is asserted against Petitioner in *SiOnyx LLC, et al. v. Hamamatsu Photonics K.K., et al.*, Case No. 1:15-cv-13488-FDS (D. Mass.). Pet. 1.

B. The '446 Patent

The '446 patent is titled “Femtosecond Laser-Induced Formation of Submicrometer Spikes on a Semiconductor Substrate.” Ex. 1001, [54]. The '446 patent is a division of U.S. Patent Application No. 11/196,929, filed on August 4, 2005, now U.S. Patent No. 7,442,629, which is a continuation-in-part of U.S. Patent Application Nos. 10/950,248 and 10/950,230, now U.S. Patent Nos. 7,354,792 and 7,057,256, respectively, each of which was filed on September 24, 2004. *Id.* [60].

The '446 patent describes “methods for generating submicron-sized features on a semiconductor surface by irradiating the surface with short laser pulses” and devices produced by such methods. *Id.* 1:50–52. In discussing the advantages of the claimed invention, the '446 patent explains that although techniques for generating micrometer-sized structures on silicon surfaces are well-known, the claimed invention satisfies the need “for enhanced methods that allow generating even smaller structures on semiconductor surfaces, and particularly on silicon surfaces.” *Id.* at 1:38–46, 1:50–52.

The '446 patent describes the generated features as substantially columnar spikes, that extend from a base to a tip, and “protrude above the surface.” *Id.* at 1:58–60.

In many embodiments, the average height of the spikes (i.e., the average separation between the base and the tip) can be less than about 1 micron, and the spikes can have an average width—defined, for example, as the average of the largest dimensions of cross-sections of the spikes at half way between the base and the tip—that ranges from about 100 nm to about 500 nm (e.g., in a range of about 100 nm to about 300 nm).

Id. at 1:60–67.

Figures 5A and 5B of the '446 patent are reproduced below.

FIG. 5A

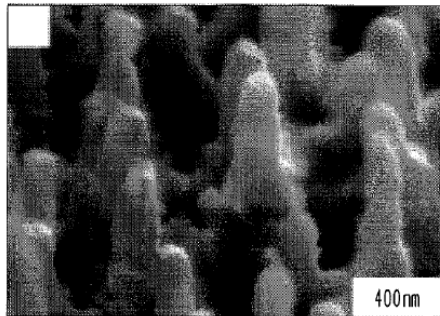
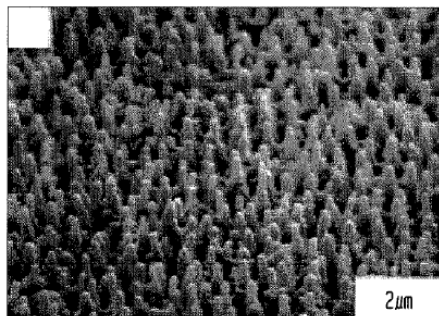


FIG. 5B



Figures 5A and 5B “are scanning electron micrographs of silicon spikes formed on a silicon surface viewed at 45° angle relative to a normal to the surface, formed by placing the surface in contact with distilled water and irradiating it with 100-fs, 400-nm, 60-μJ laser pulses[.]” *Id.* at 3:38–43. The '446 patent explains that the spikes depicted in Figures 5A and 5B “have a substantially columnar shape with a typical height of about 500 nm and a typical diameter of about 200 nm. They protrude up to about 100 nm above the original surface of the wafer.” *Id.* at 6:8–14.

C. Illustrative Claim

Claim 1, reproduced below, is the sole independent challenged claim, and is illustrative of the claimed subject matter.

1. A semiconductor substrate, comprising
a surface layer having at least a portion exhibiting an undulating topography characterized by a plurality of submicron-sized features having an average height less than about 1 micrometer and an average width in a range of about 100 nm to about 500 nm.

Ex. 1001, 8:31–36.

D. Instituted Grounds of Unpatentability

We instituted *inter partes* review in this proceeding based on the following patentability challenges:

Claim(s)	Basis	Reference(s)
1, 2, 4–6, and 11	§ 102(b)	Uematsu ¹
3	§ 103(a)	Uematsu

Petitioner relies on the Declaration of Shukri J. Sourì, Ph.D. (“Sourì Declaration,” Ex. 1007) to support its Petition and Reply.

Patent Owner does not rely on expert testimony to support its Patent Owner Response to the Petition. Patent Owner does, however, rely on the Declaration of Dr. Ezekiel Kruglick, Ph.D. (“Kruglick Declaration,”

¹ Uematsu et al., JP H06 244444, published September 2, 1994 (Ex. 1004). Petitioner submitted a certified English translation of Uematsu as Ex. 1005. Our citations to Uematsu are to the English translation.

Ex. 2001) to support its Patent Owner Preliminary Response. See Tr. 21:14–22:15 (explaining that Patent Owner relies on the Kruglick Declaration in Patent Owner’s Preliminary Response, but not the Patent Owner Response).

II. DISCUSSION

A. *Level of Skill in the Art*

Petitioner contends that a person of ordinary skill in the art for the ’446 patent would have had “at least a bachelor’s degree in material science, physics, or electrical engineering, and at least one year of work experience in semiconductor processing.” Pet. 7–8 (citing Ex. 1007 ¶ 15). Patent Owner does not dispute Petitioner’s proposal, or otherwise address the level of skill in the art at the time of invention of the ’446 patent in its Response. See *generally*, PO Resp. In addition, in its Preliminary Response, Patent Owner applies the level of skill in the art set forth in the Petition. Prelim. Resp. 6; Ex. 2001 ¶¶ 11–12.

We agree with Petitioner that an artisan of ordinary skill at the time of invention of the ’446 patent would have had at least a bachelor’s degree in material science, physics, or electrical engineering, and at least one year of work experience in semiconductor processing, with the understanding that the level of skill is also reflected in the prior art of record. See *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). In addition, we have reviewed the credentials of Dr. Sourì (Ex. 1007), and we consider him to be qualified to provide his opinion on the level of skill and the knowledge of a person of ordinary skill in the art at the time of the invention.

B. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are given their broadest reasonable interpretation in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–45 (2016) (upholding the use of the broadest reasonable interpretation standard). Under the broadest reasonable interpretation standard, claim terms are presumed to have their ordinary and customary meaning, as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Under this standard, we may take into account definitions or other explanations provided in the written description of the specification. *In re Morris*, 127 F.3d 1048, 1054 (Fed. Cir. 1997). Any special definition for a claim term must be set forth in the specification with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). Only those terms that are in controversy need be construed, and only to the extent necessary to resolve the controversy. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co. Ltd.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

1. “undulating topography”

Independent claim 1 recites, in pertinent part, “a surface layer having at least a portion exhibiting an *undulating topography* characterized by a plurality of submicron-sized features having an average height less than about 1 micrometer and an average width in a range of about 100 nm to

about 500 nm.” Ex. 1001, 8:32–36 (emphasis added). Because the parties did not identify any dispute as to the meaning of the term “undulating topography” prior to institution, we did not provide an express construction of that term in the Institution Decision. Based on the full record in this proceeding, we afford the term “undulating topography” its plain and ordinary meaning, which encompasses a wavy surface, and permits, but does not require, the non-uniformity or irregularity of the individual features within that topography.

Petitioner contends that the term “undulating topography” is entitled to its “plain and ordinary meaning, and as such, no detailed construction[] [is] proposed therefor.” Pet. 9.

Patent Owner does not expressly propose a construction for “undulating topography” in the Patent Owner Response. See Tr. 22:7–9 (“These were not cited in the Patent Owner response. Patent Owner was not putting forth a construction for undulating.”). In arguing that Uematsu fails to disclose an undulating topography as required by claim 1, however, Patent Owner asserts that “[b]y it’s plain meaning, the term ‘undulating’ means ‘having a wavy surface, edge, or markings.’ MERRIAM-WEBSTER DICTIONARY, <https://www.merriam-webster.com/dictionary/undulate> (last visited Jan. 26, 2017). This is confirmed by the specification, which describes exemplary surface features as ‘wave-like.’ (Ex. 1001 at col. 7:16–19.).” PO Resp. 8.

In arguing that Petitioner has not shown that Uematsu teaches an “undulating topography,” Patent Owner additionally states that “Petitioner

has not provided any explanation or support to show that that [sic] these ‘pyramids having a regular width and largeness’ constitute an ‘undulating topography’”. *Id.* at 9. In this regard, Patent Owner contends that statements made by Petitioner’s parent company during the prosecution of its own patents in November 2013 demonstrate that “regular features can perform differently than irregular features.” *Id.* at 9–10, n.1.

In reply, Petitioner asserts that Patent Owner has not demonstrated that an ordinarily skilled artisan would have understood, at the time of invention, that “undulating topography” meant “a topography ‘having a wavy surface, edge, or markings’ or that is ‘wave-like.’” Reply 6–7. Petitioner further contends that “wavy” and “wave-like” each encompass “regularly-spaced pyramids.” *Id.* at 8. Petitioner additionally submits that Patent Owner’s discussion of Petitioner’s parent company’s statements in 2013 concerning patent applications that “do not utilize or define the term at issue” should be disregarded. *Id.* at 8, n.2.

During oral hearing, Patent Owner indicated that, although it had not previously provided a construction for “undulating topography,” if it were required to provide one, Patent Owner would propose that “undulating topography” be construed to mean “a plurality of non-uniform irregular features distributed to provide a wave-like topography.” Tr. 17:19–24. Patent Owner went on to identify the portions of the ’446 patent specification relating to Figures 5–7 as supporting a construction of “undulating topography” that requires that the claimed submicron-sized features be non-uniform and irregular. *See, e.g., id.* at 32:12–16. Patent

Owner additionally stated that certain portions of the Kruglick Declaration, relied on in its Preliminary Patent Owner Response, but not in its Patent Owner Response, support its proposed construction. *Id.* at 21:14–22:1.

On the record before us, we conclude that the term “undulating topography” should be afforded its plain and ordinary meaning, which encompasses a wavy surface, and permits, but does not require, the non-uniformity or irregularity of the individual features, within that topography.

As an initial matter, we observe that Patent Owner’s contention that “undulating topography” requires non-uniformity and/or irregularity of the claimed submicron-sized features, is improper, as it was impermissibly raised for the first time during oral hearing. *See* Office Patent Trial Practice Guide, 77 Fed. Reg. 48,756, 48,768 (Aug. 14, 2012) (“No new evidence or arguments may be presented at the oral argument.”). Accordingly, we need not address this contention. Nevertheless, for the reasons set forth below, we determine that even had Patent Owner timely raised this argument, the broadest reasonable interpretation of “undulating topography” does not require that the claimed submicron-sized features be non-uniform or irregular.

Turning to the parties’ arguments, we note that there is no genuine dispute that the plain and ordinary meaning of “undulating topography” encompasses a wavy surface. *See e.g.*, MERRIAM-WEBSTER DICTIONARY, <https://www.merriam-webster.com/dictionary/undulate> (last visited Jan. 26, 2017). Indeed, although Petitioner takes issue with certain

aspects of Patent Owner’s argument, Petitioner does not affirmatively dispute that the plain and ordinary meaning of “undulating topography” includes a wavy surface. *See* Reply 4–8. Moreover, because we find, as set forth below, that Uematsu discloses a wavy surface, we need not decide whether the claim term “undulating topography” requires that the surface in question be wavy; it is sufficient for our patentability determination in the instant proceeding to conclude that “undulating topography” encompasses such morphology. *See Nidec Motor*, 868 F.3d at 1017.

With regard to the plain language of the claims, we observe that the term “undulating topography” appears only in claim 1 of the ’446 patent, which states that the claimed “undulating topography [is] characterized by a plurality of submicron-sized features having an average height less than about 1 micrometer and an average width in a range of about 100 nm to about 500 nm.” The use of the term “undulating topography” in claim 1 is consistent with the plain and ordinary meaning of that term, which encompasses a wavy surface. Furthermore, through its use of the phrase “characterized by,” claim 1 identifies the necessary features of an “undulating topography,” namely, the presence of a plurality of submicron-sized features having certain average dimensions, without excluding additional, unrecited aspects of such a topography. *See Mars, Inc. v. H.J. Heinz Co., L.P.*, 377 F.3d 1369, 1375–76 (Fed. Cir. 2004) (explaining that “[t]he transitional term ‘comprising,’ . . . is synonymous with . . . ‘characterized by,’ [and] is open-ended and does not exclude additional,

unrecited elements or method steps.”) (citing the Manual of Patent Examining Procedure, 8th ed., rev. 1 § 2111.03 (2003)).

Notably absent from claim 1, however, is any indication that the recited submicron-sized features must be non-uniform or irregular. Indeed, although the limitations on the “average height” and “average width” of the submicron-sized features leave open the possibility that those features may be non-uniform or irregular, such limitations cannot be said to mandate that the submicron-sized features must be non-uniform or irregular.

The specification of the ’446 patent likewise includes only a single instance of the term “undulating topography.” In particular, the specification discloses:

In another aspect, the invention provides a semiconductor substrate that includes a surface layer having at least a portion that exhibits an undulating topography characterized by a plurality of submicron-sized features having an average height less than about 1 micrometer and an average width in a range of about 100 nm to about 500 nm.

Ex. 1001, 2:32–39. Notably, the specification uses the same language as claim 1 to describe the recited “undulating topography,” and is likewise consistent with the plain and ordinary meaning of the term, which encompasses a wavy surface. Furthermore, like claim 1, the specification is devoid of any suggestion that the submicron-sized features that comprise the undulating topography must be non-uniform or irregular.

In this regard, we observe that the specification expressly contemplates spikes that are uniform and regular in shape and size. For example, the specification discloses that “the submicron-sized features can

include a plurality of microstructured spikes, e.g., columnar structures” (Ex. 1001, 4:20–22), and elsewhere refers to embodiments in which the spikes are “substantially columnar” (*see, e.g., id.* at 1:58–60). Furthermore, the specification states that a given spike “has a height H defined as the separation between its base **20** and its tip **22**, and a width defined by a diameter D of a cross-section” (*id.* at 4:28–30), and describes an embodiment in which “[t]he spikes have a substantially columnar shape with a typical height of about 500 nm and a typical diameter of about 200 nm” (*id.* at 6:11–13). In contrast, the specification identifies “irregularly shaped spikes” as an exception, requiring a modified definition of width. Ex. 1001, 4:32–34.

With respect to the portions of the Kruglick Declaration identified by Patent Owner at the oral hearing (*see, e.g.,* Tr. 21:14–22:1), we observe that those portions do not address the meaning of the term “undulating topography,” or relate to claim 1, in which that term appears (*see* Ex. 2001 ¶¶ 17–19). Rather, the portions of the Kruglick Declaration on which Patent Owner now relies describe the purportedly “fundamentally different structural characteristics” of “submicron-sized features produced by irradiating the surface of the substrate with short laser pulses *as recited in claim 7* of the ’446 Patent.” Ex. 2001 ¶ 17 (emphasis added). Because Dr. Kruglick focuses his testimony on specification embodiments related to claim 7, which recites a particular process for generating the claimed semiconductor substrate, and does not address the term “undulating topography,” or contend that this testimony is relevant to other, broader

claims, such as claim 1 (*see id.* ¶¶ 17–19), we do not discern any basis for limiting the meaning of “undulating topography” in view of that testimony. Moreover, we note that we have considered the portions of the specification of the ’446 patent addressed by Dr. Kruglick, and, although we agree, as discussed further below, that those portions indicate that the construction of “undulating topography” should allow for submicron-sized features that are non-uniform or irregular, they do not support importing into the claims a requirement that such features be non-uniform or irregular.

Concerning the extrinsic evidence that Petitioner’s parent company, in November 2013, “acknowledged that regular features can perform differently than irregular features during prosecution of their own patents on textured silicon devices” (PO Resp. 9–10, n.1), we agree with Petitioner that because the statements in question were made years after both the filing date and priority date for the ’446 patent, and do not relate to the disputed claim term, such evidence is not pertinent to the construction of “undulating topography” as that term is used in the ’446 patent.

We also consider the district court’s construction of “undulating topography” as “arrangement of features of varying heights and widths” (Paper 23,² 22) in determining the broadest reasonable interpretation of that term.³ We observe, however, that we are “not generally bound by a prior

² Papers 23 and 24 each appear to be copies of the Claim Construction Memorandum and Order issued in the corresponding district court litigation. For convenience, we refer to Paper 23 throughout the Decision.

³ The district court’s Claim Construction Memorandum and Order issued on

judicial construction of a claim term.” *Power Integrations, Inc. v. Lee*, 797 F.3d 1318, 1326 (Fed. Cir. 2015). In this regard, we note that we are tasked to discern the broadest reasonable interpretation of disputed claim terms, and thus apply “a different claim construction standard than that applied by a district court.” *Id.* We also observe that the parties’ proposed constructions in the district court proceeding are different from those advanced here, and, thus, the record differs between the district court and instant *inter partes* review proceedings. Paper 23, 21–22.

We further observe that the parties did not address whether “undulating topography” encompasses a wavy surface in the district court proceedings. Paper 23, 21 (“The parties dispute whether the term ‘undulating topography’ requires variation in both height and width, or variation in height alone” of the submicron-sized features). We note, however, that the district court’s construction of this term is consistent with our understanding that “undulating topography” encompasses a wavy surface. *See id.* at 21–22.

With respect to the district court’s determination that the specification of the ’446 patent discloses embodiments depicting variation in the height and/or width of certain submicron-sized features, we agree that the embodiments shown in Figures 5A–5C and 6A–6B include examples of

September 7, 2017 (Papers 23, 24), subsequent to the conclusion of briefing and oral hearing in the instant *inter partes* review. Patent Owner requested to file a copy of that order “without comment,” and we authorized that request. Ex. 3001.

such variation.⁴ Nevertheless, in view of the plain language of claim 1, as well as the portions of the specification discussed in detail above, we conclude that although the broadest reasonable interpretation of “undulating topography” permits that the recited submicron-sized features may vary in height and width, it does not affirmatively require such variation.

Accordingly, for the reasons set forth above, we conclude that the broadest reasonable interpretation of “undulating topography” encompasses a wavy surface, and permits, but does not require, non-uniformity or irregularity of the individual features within that topography.

2. *“protrude above the semiconductor surface
by a distance”*

Dependent claim 6 recites, in pertinent part, “wherein said spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm.” Ex. 1001, 8:48–50. In the Institution Decision, we conclude that the broadest reasonable interpretation of this claim term “encompasses spikes that measure from about 100 nm to about 300 nm from base to tip.” Inst. Dec. 8–9. We consider anew this claim construction based on the full record in this proceeding, and again conclude that the broadest reasonable interpretation of “wherein said spikes protrude above

⁴ Because Figures 7A–7J “are scanning electron micrographs of a silicon surface irradiated while in contact with distilled water by an increasing number of laser pulses” (Ex. 1001, 3:53–55) and not images of the final semiconductor substrate product, we are not persuaded that these figures depict spikes of varying height and width.

the semiconductor surface by a distance in a range of about 100 nm to about 300 nm” encompasses spikes that measure from about 100 nm to about 300 nm from base to tip.

Petitioner contends that claim 6 should be interpreted “as reducing the spike heights to a preferred feature size (*i.e.*, spikes 100–300 nm high).”

Pet. 21. In support of its position, Petitioner’s expert, Dr. Souri, testifies that an ordinarily skilled artisan would have understood the claim term “semiconductor surface” as referring to “any portion of the semiconductor that is in contact with the environment above it, where two different such portions may or may not be coplanar” (Ex. 1007 ¶ 70), and thus “may interpret the given range of 100 nm to 300 nm as a reduction of the spike heights to a preferred feature size” (*id.* ¶ 69). Dr. Souri identifies the following portion of the ’446 patent specification as supporting an interpretation of claim 6 as limiting the height of the spikes to a range of about 100 nm to about 300 nm:

the surface layer has a thickness in a range of about 100 nm to about 1 micrometer and the submicron-sized features comprise spikes each of which extends from a base to tip separated from the base by a distance that is less than about 1 micron. For example, the spikes can protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm.

Ex. 1001, 2:40–46.

Patent Owner responds that the claim 6 phrase “protrude above the semiconductor surface by a distance” should be construed to mean “extend above an original surface of the semiconductor,” rather than the actual surface of the claimed semiconductor substrate. PO Resp. 16. Patent Owner

contends that although they both refer to length measurements, “throughout the specification, the use of ‘height’ and ‘protrude’ is consistent with the presumption that they should be given different meanings.” *Id.* at 11.

In support of its position, Patent Owner points to the following passage of the ’446 patent (PO Resp. 12):

FIGS. 5A, 5B, and 5C present electron micrographs of the silicon surface after irradiation with one thousand laser pulses, showing formation of a plurality of spikes on the surface. The spikes have a substantially columnar shape with a typical height of about 500 nm and a typical diameter of about 200 nm. They protrude up to about 100 nm above the original surface of the wafer (FIG. 1C).

Ex. 1001, 6:8–14. Based on the discussion in the specification of the above-described embodiment, Patent Owner asserts that “[i]f ‘height’ and the extent by which a feature ‘protrude[s] above the semiconductor surface’ were to be interpreted as coextensive, . . . this recitation in claim 6 would contain a logical fallacy: spikes cannot both be 500 nm and 100 nm in height.” PO Resp. 12. Patent Owner surmises that “[b]ecause the ‘protrusion’ refers to a portion of the spike as a whole, it typically has a smaller value than the height of the spike.” *Id.*

Patent Owner additionally contends that discussion of spike size set forth in column 2 of the ’446 patent demonstrates that spike height and spike protrusion are distinct measurements taken from different reference points. *Id.* at 13. In particular, Patent Owner identifies the following excerpt from column 2 as supporting its proposed claim interpretation (*id.*):

the submicron-sized features comprise spikes each of which extends from a base to a tip separated from the base by a distance

that is less than about 1 micron. For example, the spikes can protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm.

Ex. 1001, 2:40–46. Patent Owner contends that this passage discloses that spike “‘height’ – measured as the separation from base to tip – is less than about 1 micron, while the amount by which those less-than-1-micron-sized features protrude – measured as the amount by which the features extend above the original surface of the semiconductor – is between 100 nm and 300 nm.” PO Resp. 13.

Patent Owner further asserts that if the applicant had “intended to define different ranges for the same attribute it would have used the same term.” *Id.* at 14. To illustrate this point, Patent Owner highlights that the ’446 patent teaches that “the spikes can have an average width . . . that ranges from about 100 nm to about 500 nm (*e.g.*, in a range of about 100 nm to about 300 nm).” *Id.* at 14 (quoting Ex. 1001, 1:63–67) (emphasis omitted).

Lastly, Patent Owner argues that Petitioner’s proposed construction “rests on Petitioner’s implicit construction of the term ‘semiconductor surface,’ for which Petitioner provides no support.” *Id.* at 15. Instead, asserts Patent Owner, “protrudes” ought to be constructed to mean “extend above the **original surface** of the semiconductor” because such construction “is consistent with the exemplary embodiments on the specification.” *Id.*

In reply, Petitioner contends that the ’446 patent specification equates the concepts of “‘height,’ a ‘separation [or distance] between the base and the tip,’ and ‘protrud[ing] above the semiconductor surface by a distance,’”

thereby rebutting the presumption that the claim 6 term “protrude above the semiconductor surface by a distance” must mean something different than “height” as recited in claim 1 (Ex. 1001, 8:34), or “extending from a base to a tip separated from the base by a distance” as recited in claim 5 (*id.* at 8:45–46). Reply 9.

Petitioner additionally asserts that the above-described excerpt from column 6 of the specification on which Patent Owner relies “is the *only* instance where the term ‘original’ appears within the ’446 patent (including the claims).” *Id.* at 11. Petitioner notes that the spike protrusion range described in that excerpt is “virtually exclusive” of that recited in claim 6, and, therefore, contends that it “does not support claim 6.” *Id.* Petitioner further argues that the column 6 excerpt confirms that “protrude above the semiconductor surface” and “protrude . . . above the original surface of the wafer” are distinct measurements, and illustrates that the applicant for the ’446 patent knew how to claim the measurement intended. *Id.*

Petitioner characterizes Patent Owner’s position as an argument that “Petitioner’s and the Board’s understanding of claim 6 reads ‘original’ out of the specification,” and responds that “[t]here is no dispute that the ’446 patent contains a disclosure of a measurement for spikes that is taken from an ‘original’ surface of the substrate. Rather, the issue is that claim 6 recites a different measurement having no bearing on the ‘original’ surface measurement.” *Id.* at 12.

On the record before us, we conclude that the broadest reasonable interpretation of the claim phrase “wherein said spikes protrude above the

semiconductor surface by a distance in a range of about 100 nm to about 300 nm” encompasses spikes that measure from about 100 nm to about 300 nm from base to tip. In reaching this conclusion, we determine, for the reasons set forth below, that the presumption that different claim terms have different meanings is rebutted by the plain language of the claims, as well as by the specification. *See CAE Screenplates, Inc. v. Heinrich Fiedler GmbH & Co. Kg*, 224 F.3d 1308, 1317 (Fed. Cir. 2000) (“In the absence of any evidence to the contrary, we must presume that the use of these different terms in the claims connotes different meanings”).

Each of the claims in the chain of dependency from claim 1 to claim 6 successively limits the shape or size of the claimed “submicron-sized features”: claim 1 recites “*submicron-sized features* having an *average height* less than about 1 micrometer” (Ex. 1001, 8:33–35 (emphasis added)); claim 5 specifies that “said submicron-sized features comprise *spikes* extending from a base to *a tip separated from the base by a distance* of less than about 1 micrometer” (*id.* at 8:44–47 (emphasis added)); and claim 6 adds the refinement that “said *spikes protrude above the semiconductor surface by a distance* in a range of about 100 nm to about 300 nm” (*id.* at 8:48–50 (emphasis added)). Thus, the claims themselves initially articulate a broad concept, i.e., submicron-sized features having an average height of less than 1 micrometer, and then proceed to narrow that concept to a particular embodiment by limiting feature shape and defining a narrowed range for feature height, i.e., spikes that protrude above the semiconductor surface by a distance of about 100 nm to about 300 nm.

The recitation in claim 6 that the “spikes protrude above the *semiconductor surface* by a distance” (Ex. 1001, 8:49–50 (emphasis added)) further clarifies that the distance in question is the distance from the base of the spike, i.e., the semiconductor surface, to the tip of the spike. The challenged claims are apparatus claims directed to a “semiconductor substrate.” *See, e.g.*, Ex. 1001, 8:31. As such, those claims are agnostic as to how the recited semiconductor substrate is formed. Thus, an ordinarily skilled artisan reading the challenged claims would understand the term “semiconductor surface” as referring to the actual surface of the claimed semiconductor substrate, and not the original surface of the semiconductor as it existed prior to formation of the claimed product. *See* Ex. 1007 ¶ 70 (“This is consistent with how one of ordinary skill in the art would interpret semiconductor surface: any portion of the semiconductor that is in contact with the environment above it, where two different such portions may or may not be coplanar.”).

Therefore, the claims themselves indicate that the terms “height” (Ex. 1001, 8:34), “tip separated from the base by a distance” (*id.* at 8:46), and “protrude above the semiconductor surface by a distance” (*id.* at 8:49–50) each refer to the measurement, from base to tip, of the feature claimed. In addition, we observe, contrary to Patent Owner’s suggestion (PO Resp. 12), that our construction of “wherein said spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm” as encompassing spikes that measure from about 100 nm to about 300 nm from base to tip does not simultaneously require the recited spikes to

have distinct, non-overlapping heights. Rather, claim 6 simply narrows the claim 5 requirement that the “spikes extend[] from a base to a tip separated from the base by a distance less than about 1 micrometer” (Ex. 1001, 8:45–47) (which itself imposes limitation on the “submicron-sized features having an average height less than about 1 micrometer” of claim 1 (*id.* at 8:33–35)), to require that spike height fall within the range of “about 100 nm to about 300 nm” (*id.* at 8:49–50).

The specification of the ’446 patent likewise discloses determining the distance by which a spike protrudes above the semiconductor surface by measuring the distance from the base to the tip of the spike:

the submicron-sized features comprise spikes each of which extends from a base to tip separated from the base by a distance that is less than about 1 micron. For example, the spikes can protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm.

Ex. 1001, 2:40–46. Congruent with the structure of the claims, the specification initially identifies a broad range within which spike heights may fall, i.e., “less than about 1 micron,” and then goes on to describe a narrower exemplary embodiment in which the spikes measure “about 100 nm to about 300 nm” from semiconductor surface to tip. In addition, the specification elsewhere describes the “submicron-sized features” as including “a plurality of microstructured spikes, e.g., columnar structures extending from the surface to a height above the surface.” Ex. 1001, 4:20–23; *see also* 1:58–60 (“The generated features can be, for example, in the form of substantially columnar spikes, each of which extends from a base to a tip, that protrude above the surface.”).

That “semiconductor surface” and “original semiconductor surface” have distinct meanings in the context of the claimed semiconductor substrate is further underscored by the express recognition in the specification that the topography of a semiconductor surface can change during processing. See Ex. 1001, 3:31–34 (the ’446 patent discloses a method “for changing [the] topography of a semiconductor surface”), 4:58–67 (“so as to cause a change in topography of that portion”).

Thus, rather than distinguishing spike height and spike protrusion as non-overlapping measurements taken from different reference points, an ordinarily skilled artisan would have understood the specification of the ’446 patent as teaching that spikes measuring about 100 nm to about 300 nm from the semiconductor surface to their tip are one embodiment of the invention claimed. See Ex. 1007 ¶ 69 (“[o]ne of ordinary skill in the art may interpret the given range of 100 nm to 300 nm as a reduction of the spike heights to a preferred feature size”). Indeed, we note that the broader spike height range, i.e., up to less than about 1 micron, and the narrower spike protrusion above the semiconductor surface range, i.e., about 100 nm to about 300 nm set forth in the above excerpt from column 2 of the ’446 patent specification precisely mirror the average height range of claim 1 and the spike protrusion distance range of claim 6, respectively.

The portion of the specification describing the embodiment depicted in Figures 5A–5C of the ’446 patent on which Patent Owner relies in its Response (PO Resp. 12), and in particular, the statement that the spikes “protrude up to about 100 nm above the original surface of the wafer”

(Ex. 1001, 6:13–14), lends additional support to our claim interpretation. That statement—the only instance in which the ’446 patent refers to the distance spikes protrude above the “original surface” of a semiconductor—indicates that the claimed distance above the “semiconductor surface” and the distance above the “original surface of the wafer” discussed in different portions of the specification are distinct measurements.

Moreover, reference in the specification to an embodiment in which protrusion is measured from the “original surface of the wafer” indicates that the applicant for the ’446 patent knew how to claim a protrusion above an “original surface” of the semiconductor and could have recited as much in claim 6, if that was the intent. In this regard, we note that it is not apparent how an embodiment in which the spikes “protrude *up to about 100 nm* above the *original surface* of the wafer” (Ex. 1001, 6:13–14 (emphasis added)), sheds light on the correct interpretation of claim 6, which recites a virtually non-overlapping range of protrusion distances, “about 100 nm to about 300 nm,” and identifies the “semiconductor surface” as the reference point for measurement (*id.* at 8:49–50). This is especially so in view of the fact, discussed above, that the specification elsewhere exemplifies spikes that “protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm” (*id.* at 2:44–46)—the precise language of claim 6 (*id.* at 8:49–50)—as one embodiment of the submicron-sized features of the claimed invention.

Neither do we find persuasive Patent Owner’s contention that its proposed construction is consistent with the mechanism for formation of

submicron-sized features proposed by the '446 patent. *See* PO Resp. 15–16. Even assuming, *arguendo*, the mechanism proposed in the specification is correct, that mechanism is also consistent with the claim interpretation that we adopt, as there is nothing in our interpretation that precludes the spikes from protruding above the original surface of the wafer.

We also consider the district court's construction of "protrude above the semiconductor surface" as meaning "extend above the original surface of the semiconductor" (Paper 23, 19) in determining the broadest reasonable interpretation of the phrase "wherein said spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm." As explained above, however, we apply a different standard than the district court, and are not generally bound by the district court's construction. *Power Integrations*, 797 F.3d at 1326. We additionally observe that the record differs between the district court and instant *inter partes* review proceedings. *See, e.g.*, Paper 23, 19 (citing to the transcript of the district court proceeding).

We have considered the district court's construction of "protrude above the semiconductor surface," but, for the reasons articulated above, arrive at a different construction of "wherein said spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm" under the applicable broadest reasonable interpretation standard. In this regard, we note that our analysis considers aspects of the claims and specification of the '446 patent not addressed in the district court's construction. *See* Paper 23, 18–19. Moreover, as set forth in detail above,

applying the standard relevant to *inter partes* review proceedings, we determine that the same portions of the specification addressed by the district court (*see id.*) support a broad, but reasonable, interpretation of “wherein said spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm” as encompassing spikes that measure from about 100 nm to about 300 nm from base to tip.

C. Principles of Law

To establish anticipation, each and every element in a claim, arranged as recited in the claim, must be found in a single prior art reference. *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008).

“A reference anticipates a claim if it discloses the claimed invention ‘such that a skilled artisan could take its teachings in combination with his own knowledge of the particular art and be in possession of the invention.’”

In re Graves, 69 F.3d 1147, 1152 (Fed. Cir. 1995) (emphasis omitted) (quoting *In re LeGrice*, 301 F.2d 929, 936 (CCPA 1962)).

A patent 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 the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art;

(3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).⁵

*D. Prior Art Relied Upon:
Overview of Uematsu*

Petitioner relies on the teachings of Uematsu as the basis for its patentability challenges in this proceeding.

Uematsu describes a “light-confining structure which can reduce surface reflection and effectively confine light” (Ex. 1005, Summary), useful in “light-receiving devices, such as light sensors and photoelectric transducers” (*id.* [0001]). Uematsu explains that the disclosed device comprises “a substrate and a transition layer having depressions and projections and provided to the front surface of the substrate,” and teaches that “the repeating width of these depressions and projections are equal to or less than the wavelength of a main light to be confined.” *Id.* [0006].

Figure 8 of Uematsu is reproduced below.

Figure 8



3: substrate; 11: pyramid

⁵ Neither party introduces objective evidence of non-obviousness or argues that the existence of secondary considerations impacts this Decision’s obviousness analysis. Accordingly, our analysis is based upon the first three of the four *Graham* factors.

Figure 8 is a schematic diagram depicting Working Example 1 of the light-confining structure of Uematsu. *Id.*, Brief Description of the Drawings, [0019]. Uematsu discloses that pyramids 11, which have a regular width and largeness, make up a transition layer formed on silicon substrate 3, which itself has a front surface with a (100) plane. *Id.* [0019]. Uematsu teaches that “pyramids 11 of 1 μm or less can be easily formed by etching using a heated aqueous solution composed mainly of ammonia and hydrazine as the etchant.” *Id.* Uematsu further discloses that “[t]he average size of the pyramids 11 on the front surface of the silicon substrate 3 obtained by the above process was approximately 0.3 μm according to a measurement using a scanning electron microscope (SEM).” *Id.* [0020].

*E. Anticipation Ground of Unpatentability
Based on Uematsu*

Petitioner asserts that claims 1, 2, 4–6, and 11 are anticipated under § 102(b) by Uematsu. Pet. 14–22. Each of claims 2, 4–6, and 11 depends, directly or indirectly, from claim 1. In support of its assertion, Petitioner provides detailed explanations as to how Uematsu discloses each claim limitation (*id.*), and relies upon the Souri Declaration (Ex. 1007) to support its positions.

Upon review of Petitioner’s contentions and supporting evidence, as well as Patent Owner’s Response and supporting evidence, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that claims 1, 2, 4–6, and 11 of the ’446 patent are unpatentable over Uematsu.

1. Claim 1

We have reviewed the Petition and the supporting evidence to which we are directed as to how Uematsu anticipates claim 1. We are persuaded that Uematsu discloses a semiconductor substrate. Pet. 18; Ex. 1007 ¶ 37. We are additionally persuaded by Petitioner’s showing, and adopt it as our own, that Uematsu teaches “a surface layer having at least a portion exhibiting an undulating topography characterized by a plurality of submicron-sized features.” Pet. 18; Ex. 1007 ¶ 39. In particular, we credit Dr. Sourì’s testimony that:

Uematsu teaches the use of a “transition layer 2 having depressions and projections” that is “provided to the surface of a substrate” (Uematsu, [Constitution]). In addition, Uematsu specifically claims such undulating topography in claim 1, which reads “A light-confining structure characterized by a substrate and a transition layer having depressions and projections and is provided to the front surface of said substrate . . .” Furthermore, working example 1 (see Uematsu, ¶¶[0019]–[0020]) describes an undulating topography composed of pyramids that are “formed on a silicon substrate 3 having a front surface with a (100) plane.” Ex. 1007 ¶ 39.

We further determine that Petitioner has established that the pyramids disclosed by Uematsu have an average height of less than about 1 µm, and an average width in a range of about 100 nm to about 500 nm. Pet. 14–19; Ex. 1007 ¶¶ 37–53. For example, Uematsu teaches that “[t]he average size of the pyramids 11 on the front surface of the silicon substrate 3 obtained by the above process was approximately 0.3 µm [300 nm] according to a measurement using a scanning electron microscope (SEM).” Ex. 1005,

[0020]. We also find persuasive Dr. Sourì's testimony that although Uematsu does not explicitly identify the dimension of the pyramids to which the 300 nm size applies, "regardless of how this is interpreted, the limitations of the relevant claim element from the '446 patent are disclosed by working example 1 of Uematsu." Ex. 1007 ¶ 42.

In this regard, we credit Dr. Sourì's calculations, which demonstrate that Uematsu's pyramids necessarily satisfy the claim 1 requirement for a plurality of submicron-sized features having an average height of less than about 1 μm and an average width of about 100 nm to about 500 nm. *Id.* ¶¶ 47–51. In particular, Dr. Sourì observes that the anisotropic etching method of Uematsu would yield pyramids having a known angle of 54.7° between the base of the pyramids and their sidewalls (*id.* ¶¶ 44–46), and uses that known angle, in conjunction with the disclosed 300 nm size of the pyramids, to determine, depending upon which dimension the 300 nm size pertains to, that Uematsu's pyramids measure either 210 nm in height and 300 nm in width, or 150 nm in height and 210 nm or 300 nm in width, and thus, necessarily fall within the average height and average width ranges of claim 1 (*id.* ¶¶ 46–51).

Patent Owner contends that "Petitioner presents no evidence that Uematsu discloses a 'surface layer having at least a portion exhibiting an undulating topography.'" PO Resp. 8 (quoting Ex. 1001, 8:32) (emphasis omitted). In this regard, Patent Owner asserts that "[b]y its plain meaning, the term 'undulating' means 'having a wavy surface, edge, or markings.'" *Id.*

Patent Owner acknowledges Petitioner's allegation that the pyramids having a regular width and largeness taught by Uematsu disclose the claimed "undulating topography," but asserts that Petitioner does not adequately describe how the claim limitation reads on those pyramids. *Id.* at 8–9. Patent Owner further contends that Petitioner's reliance on Figure 8 of Uematsu as supporting its position is unavailing, because Figure 8 "is just an artist's conception of the 'pyramids 11 having a regular width and largeness' described in paragraphs [0019] and [0020] of Uematsu." *Id.* at 9. Patent Owner argues, therefore, that Petitioner has not fulfilled the requirement under 35 U.S.C. § 312(a)(3) to identify, with particularity, the evidence supporting this asserted ground of unpatentability, or the requirement under 37 C.F.R. § 42.104(b) to identify how the challenged claim is unpatentable, specify where each claim element is disclosed in the prior art, and explain the relevance of the evidence cited to the challenge raised. PO Resp. 10.

Patent Owner additionally asserts, in a footnote, that "[t]he fact that the only portions of Uematsu relied on by Petitioner teach[] 'pyramids 11 having regular width and largeness' is material" because Petitioner's parent company "acknowledged that regular features can perform differently than irregular features during prosecution of their own patents on textured silicon devices." *Id.* at 9–10, n.1.

We are not persuaded by Patent Owner's arguments. As explained above, we conclude that the broadest reasonable interpretation of "undulating topography" encompasses a wavy surface, and permits, but does not require, non-uniformity or irregularity of the claimed submicron-sized

features. Furthermore, for the reasons set forth above, we find that Uematsu's disclosure of a transition layer including "pyramids 11 having a regular width and largeness" formed on a silicon substrate (Ex. 1005, [0019]) satisfies the "undulating topography" requirement of claim 1. In particular, we find that the depiction of Uematsu's pyramids in Figure 8 establishes that Uematsu teaches a wavy surface. *Id.* at Fig. 8. We also find, in accord with Dr. Sourì's testimony, that Working Example 1 of Uematsu "describes an undulating topography composed of pyramids that are 'formed on a silicon substrate 3 having a front surface with a (100) plane.'" Ex. 1007 ¶ 39 (quoting Ex. 1005, [0019]).

In addition, we determine that the Petition adequately sets forth Petitioner's contention that the pyramids taught by Uematsu disclose a surface layer having an "undulating topography." As Patent Owner acknowledges, the Petition explicitly identifies Uematsu's pyramids as disclosing "a surface layer having at least a portion exhibiting an undulating topography characterized by a plurality of submicron-sized features" (Ex. 1001, 8:32–34), and points to paragraphs [0019] and [0020], and Figure 8 of Uematsu as supporting this position. Pet. 14, 18. The Petition also repeatedly identifies paragraph 39 of the Sourì Declaration as supporting the contention that the "undulating topography" requirement reads on Uematsu's pyramids. Pet. 14, 18. Indeed, the Institution Decision expressly relies on, and quotes from that paragraph in its explanation of Petitioner's contentions concerning the anticipation of claim 1 by Uematsu. Inst. Dec. 13.

With respect to Patent Owner's contention that the regularity of Uematsu's pyramids is "material" in view of Petitioner's parent company's patent prosecution activities, because those activities took place years after both the filing date and priority date for the '446 patent, and did not pertain to the question of whether pyramids of regular width and largeness exhibit an "undulating topography," we determine that such evidence is not pertinent to the instant dispute. Moreover, to the extent Patent Owner contends that the term "undulating topography" includes a requirement that the claimed submicron-sized features must be non-uniform or irregular, we disagree, for the reasons set forth in Part II.B.1, above.

Accordingly, based on the complete record before us, we conclude that Petitioner has demonstrated by a preponderance of the evidence that Uematsu anticipates the device of claim 1.

2. Claim 6

Claim 6 recites "[t]he semiconductor substrate of claim 5, wherein said spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm." Ex. 1001, 8:48–50.

We have reviewed the Petition and the supporting evidence to which we are directed as to how Uematsu anticipates claim 6. We are persuaded that "the pyramids 11 (spikes) in Uematsu's Working Example 1 have an average height [of] 150[nm or]210 nm, depending on how one applies the 0.3 μ m dimension to the pyramid base" (Pet. 21; Ex. 1007 ¶ 71), and, thus, meet the claim 6 requirement that the "spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about

300 nm” (Ex. 1001, 8:48–50). As explained above with regard to claim 1, we credit Dr. Souri’s calculations demonstrating that Uematsu’s pyramids have an average height of either 150 nm or 210 nm. Ex. 1007 ¶¶ 46–51.

Patent Owner disputes neither the accuracy of Dr. Souri’s calculations, nor the conclusion that Uematsu discloses pyramids having an average height of 150 nm or 210 nm. See PO Resp. 11–16. Rather, Patent Owner contends that claim 6 should be interpreted to require that the submicron-sized features “extend above an *original* surface of the semiconductor.” *Id.* at 16 (emphasis added). For the reasons set forth in Part II.B.2 above, however, we do not agree with Patent Owner’s proposed construction. Therefore, because Uematsu’s disclosure of pyramids having an average height of 150 nm or 210 nm satisfies the requirement that the claimed “spikes protrude above the semiconductor surface by a distance in a range of about 100 nm to about 300 nm” as we construe that term, for the reasons set forth above, we find that Uematsu discloses that claim requirement.

Accordingly, based on the complete record before us, we conclude that Petitioner has demonstrated by a preponderance of the evidence that Uematsu anticipates the device of claim 6.

3. Conclusion

Patent Owner does not separately argue the patentability of claims 2, 4, 5, and 11. See PO Resp. 11 (“Having failed to show that Uematsu anticipates claim 1, Petitioner has also failed to show that Uematsu anticipates or renders obvious claims 2–6 and 11, which depend from claim

1.”). We have reviewed Petitioner’s evidence and argument as to those claims, and, based on the evidence, find that Petitioner has established by a preponderance of the evidence that those claims are anticipated by Uematsu. Pet. 19–22; Ex. 1007 ¶¶ 54–56, 64–74.

For the foregoing reasons, therefore, we determine Petitioner has demonstrated, by a preponderance of the evidence, that claims 1, 2, 4–6, and 11 are unpatentable under § 102(b) as anticipated by Uematsu.

*F. Obviousness Ground of Unpatentability
Based on Uematsu*

Petitioner asserts that claim 3 is unpatentable under § 103(a) as obvious in view of Uematsu. Pet. 22–25. Claim 3 depends directly from claim 1. In support of its assertion, Petitioner provides detailed explanations as to how Uematsu discloses each claim limitation (*id.*), and relies upon the Souri Declaration (Ex. 1007) to support its positions.

Claim 3 recites “[t]he semiconductor substrate of claim 1, wherein said substrate comprises an n-doped silicon wafer.” Ex. 1001, 8:39–40.

We have reviewed the Petition and the supporting evidence to which we are directed as to how Uematsu renders obvious claim 3. We are persuaded that an ordinarily skilled artisan in possession of Uematsu would have sought, based on Uematsu’s disclosure of a silicon substrate, i.e., wafer in Working Example 1 (Ex. 1005, [0019]–[0020], Uematsu’s disclosure of using a textured transition layer on a p-type wafer to reduce surface reflectance in a light-receiving element in Working Example 5 (*id.* at [0024]–[0026])), and the recognition that many photodetecting devices

include an n-doped substrate (Ex. 1007 ¶¶ 60–61), to use an n-doped wafer in Working Example 1 of Uematsu. Pet. 23–24; Ex. 1007 ¶¶ 57–63.

Patent Owner does not separately address this asserted ground of unpatentability, or dispute the adequacy of Petitioner’s showing with regard to any of the limitations added by claim 3. See PO Resp. 11 (“Having failed to show that Uematsu anticipates claim 1, Petitioner has also failed to show that Uematsu anticipates or renders obvious claims 2–6 and 11, which depend from claim 1.”).

We have reviewed Petitioner’s evidence and argument as to claim 3, and, based on the evidence, including the reasons set forth above, find that Petitioner has established by a preponderance of the evidence that claim 3 is rendered obvious by Uematsu. Pet. 22–25; Ex. 1007 ¶¶ 57–63.

For the foregoing reasons, therefore, we determine Petitioner has demonstrated, by a preponderance of the evidence, that claim 3 is unpatentable under § 103(a) as obvious in view of Uematsu.

G. Motion to Exclude

Petitioner has filed a Motion to Exclude Exhibits 2003 and 2004. Paper 15. Because we have not relied upon the evidence sought to be excluded in this Final Written Decision, we dismiss Petitioner’s Motion to Exclude as moot.

III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–6, and 11 of the '446 patent are unpatentable.

IV. ORDER

It is

ORDERED that claims 1–6, and 11 of the '446 patent are unpatentable;

FURTHER ORDERED that Petitioner's Motion to Exclude Evidence is dismissed; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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