

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LAM RESEARCH CORP.,
Petitioner,

v.

DANIEL L. FLAMM,
Patent Owner.

Case IPR2016-00469
Patent RE40,264 E

Before MICHAEL R. ZECHER, CHRISTOPHER L. CRUMBLEY, and
JO-ANNE M. KOKOSKI, *Administrative Patent Judges*.

ZECHER, *Administrative Patent Judge*.

DECISION

Denying Institution of *Inter Partes* Review
35 U.S.C. § 314(a) and 37 C.F.R. § 42.108

I. INTRODUCTION

Petitioner, Lam Research Corporation (“Lam”), filed a Petition requesting an *inter partes* review of claims 51–63 and 68–71 (“the challenged claims”) of U.S. Patent No. RE40,264 E (Ex. 1001, “the ’264 patent”). Paper 1 (“Pet.”). Patent Owner, Daniel L. Flamm (“Flamm”), filed a Preliminary Response. Paper 5 (“Prelim. Resp.”).

Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted unless the information presented in the Petition shows “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” Taking into account the arguments presented in Flamm’s Preliminary Response, we conclude that the information presented in the Petition does not establish that there is a reasonable likelihood that Lam would prevail in challenging any of claims 51–63 and 68–71 of the ’264 patent as unpatentable under 35 U.S.C. § 103(a). We, therefore, *deny* the Petition.

A. Related Matters

The parties represent that the ’264 patent is presently at issue in a declaratory judgment action captioned *Lam Research Corp. v. Daniel L. Flamm*, No. 5:15-cv-01277-BLF (N.D. Cal.), and in an infringement action captioned *Daniel L. Flamm v. Samsung Electronics Co.*, No. 1:15-cv-00613-LY (W.D. Tex.). Pet. 2; Paper 4, 1.

In addition to this Petition, Lam also filed other petitions challenging the patentability of certain subsets of claims of the ’264 patent in the following cases: (1) Case IPR2015-01759; (2) Case IPR2015-01764; (3) Case IPR2015-01766; (4) Case IPR2015-01768; (5) Case IPR2016-00468;

(chamber 12 of plasma etch apparatus 10). *Id.* at 3:24–25, 3:32–33, 3:40–41.

Figures 6 and 7, reproduced below, depict a temperature-controlled substrate holder and temperature control systems.

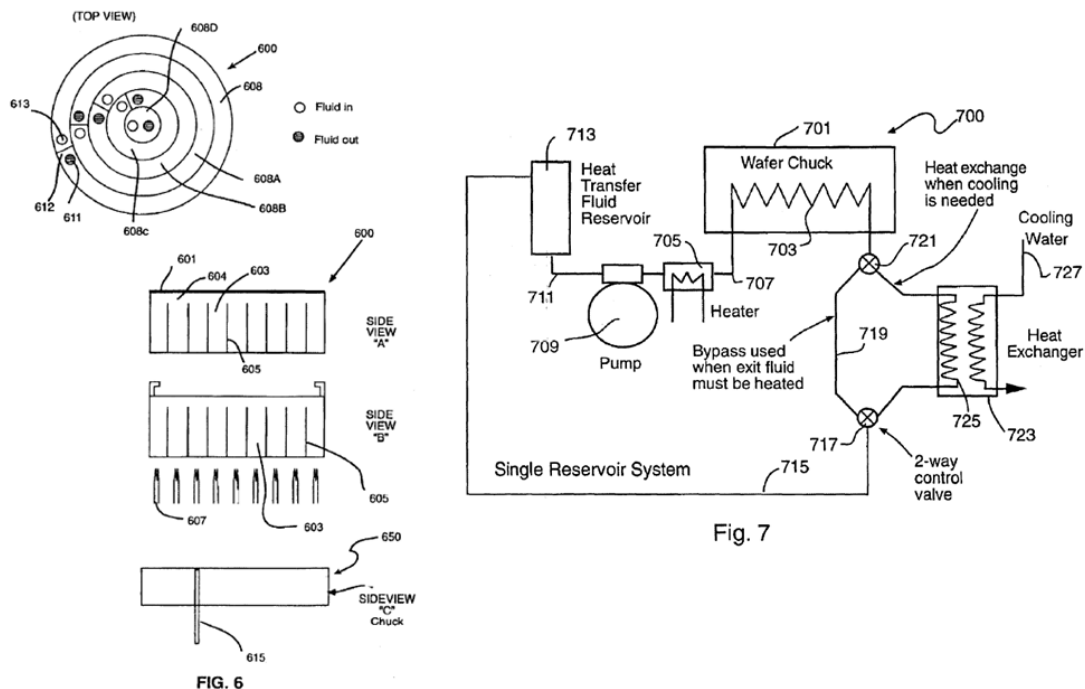


Fig. 7

Figures 6 and 7 depict temperature-controlled fluid flowing through substrate holder (600, 701), guided by baffles 605, where “[t]he fluid [is] used to heat or cool the upper surface of the substrate holder.” Ex. 1001, 14:28–63, 16:5–67. Figure 6 also depicts heating elements 607 underneath the substrate holder, where “[t]he heating elements can selectively heat one or more zones in a desirable manner.” *Id.* at 15:10–26. Referring to Figure 7, the operation of the temperature control system is described as follows:

The desired fluid temperature is determined by comparing the desired wafer or wafer chuck set point temperature to a measured wafer or wafer chuck temperature The heat exchanger, fluid flow rate, coolant-side fluid temperature, heater power, chuck, etc. should be designed using conventional means to permit the

heater to bring the fluid to a setpoint temperature and bring the temperature of the chuck and wafer to predetermined temperatures within specified time intervals and within specified uniformity limits.

Id. at 16:36–39, 16:50–67.

An example of a semiconductor substrate to be patterned is shown in Figure 9, reproduced below.

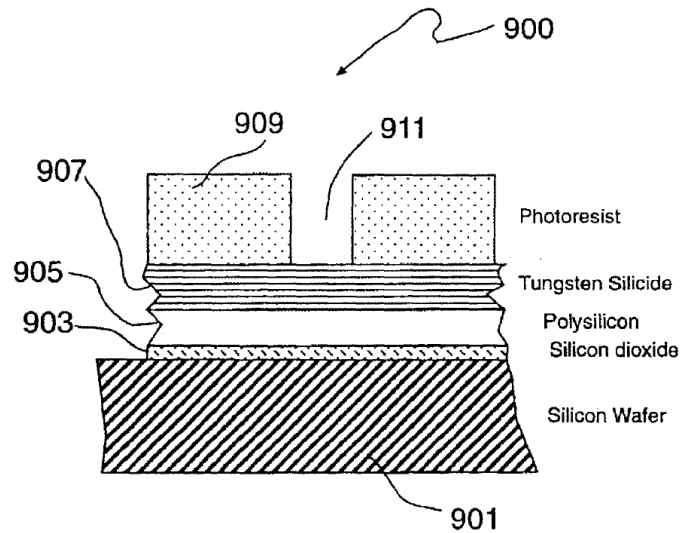


Figure 9 depicts substrate 901 having a stack of layers including oxide layer 903, polysilicon layer 905, tungsten silicide layer 907, and photoresist masking layer 909 with opening 911, from the treatment method shown in Figure 10, reproduced below. Ex. 1001, 17:58–18:57.

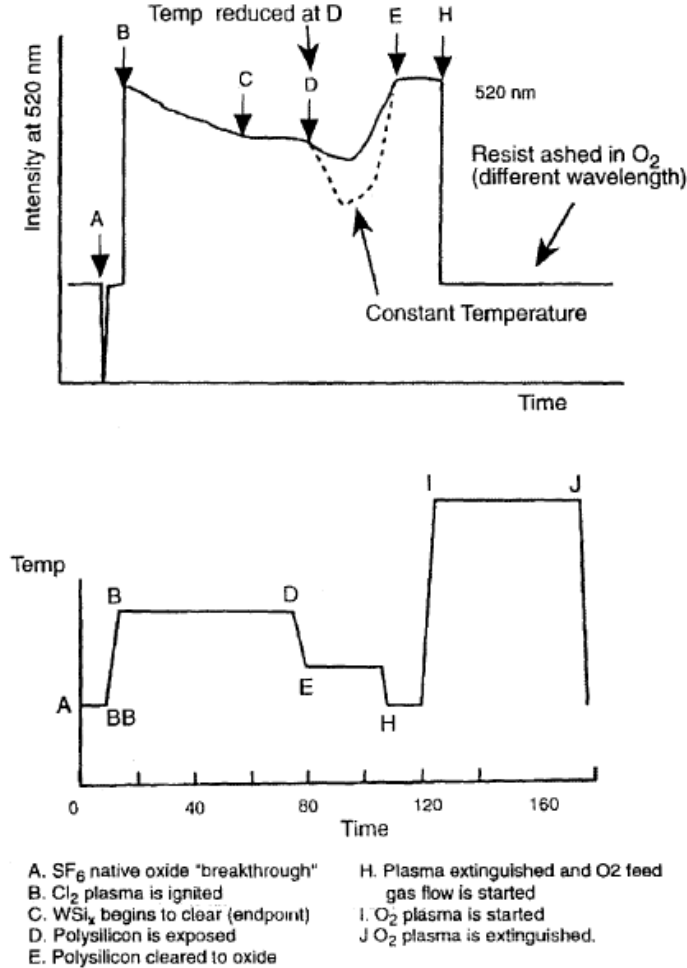


Fig. 10

Figure 10 depicts the tungsten silicide layer being etched between points B and D at a constant temperature; the polysilicon layer being exposed between Points D and E; the polysilicon layer being etched at a constant temperature beyond point E; and the resist being ashed beyond Point I. Ex. 1001, 18:58–19:64. The plasma's optical emission at 530 nanometers is monitored to determine when there is breakthrough to the polysilicon layer (Point D) and a lower etch temperature is required to etch the polysilicon layer (Point E). *Id.* at 19:8–24, 19:45–52.

C. Illustrative Claim

Of the challenged claims, claims 51, 56, and 60 are the only independent claims at issue. Independent claim 51 is directed to a method of processing a substrate in the manufacture of a device; independent claim 56 is directed to a method for processing layers that are included in a stack of layers positioned on a substrate; and independent claim 61 is directed to a method for manufacturing a device comprising an integrated circuit. Claims 52–55, 68, and 69 directly depend from independent claim 51; claims 57–59 directly depend from independent claim 56; and claims 61–63, 70, and 71 directly depend from independent claim 60. Independent claim 51 is illustrative of the challenged claims and is reproduced below:

51. A method of processing a substrate in the manufacture of a device, the method comprising:
- placing a substrate having a film thereon on a substrate holder in a processing chamber; the processing chamber comprising the substrate holder, a substrate control circuit operable to adjust the substrate temperature, a substrate holder temperature sensor, and a substrate holder control circuit operable to maintain the substrate holder temperature;
 - performing a first etching of a first portion of the film at a selected first substrate temperature;
 - performing a second etching of a second portion of the film at a selected second substrate temperature, the second temperature being different from the first temperature;
 - wherein at least one of the film portions is etched while heat is being transferred to the substrate holder with the substrate holder control circuit; and
 - the substrate temperature control circuit effectuates the change from the first substrate temperature to the second substrate temperature within a preselected time period.

Ex. 1001, 24:4–26 (italics omitted).

D. Prior Art Relied Upon

Lam relies upon the following prior art references:

Inventor¹ or Applicant	Patent or Publication No.	Relevant Dates	Exhibit No.
Thomas	U.S. Patent No. 4,680,086	issued July 14, 1987, filed Mar. 20, 1986	1009
Narita	U.S. Patent No. 4,913,790	issued Apr. 3, 1990, filed Mar. 21, 1989	1007
Wang (“Wang ’391”)	U.S. Patent No. 4,992,391	issued Feb. 12, 1991, filed Nov. 29, 1989	1008
Hwang	U.S. Patent No. 5,174,856	issued Dec. 29, 1992, filed Aug. 26, 1991	1010
Wang (“Wang ’485”)	U.S. Patent No. 5,219,485	issued June 15, 1993, filed Oct. 17, 1991	1003
Kawamura	U.S. Patent No. 5,892,207	issued Apr. 6, 1999, filed Nov. 27, 1996	1004
Kadomura	U.S. Patent No. 6,063,710	issued May 16, 2000, filed Feb. 21, 1997	1002
Tegal	EP Patent Pub. No. 0 399 676 A1	published Nov. 28, 1990, filed May 1, 1990	1006

Printed Publication	Exhibit No.
D.S. Fischl et al., <i>Etching of Tungsten and Tungsten Silicide Films by Chlorine Atoms</i> , 135 J. ELECTROCHEM. SOC., 2016–19 (Aug. 1988) (“Fischl”)	1005

E. Asserted Grounds of Unpatentability

Lam challenges claims 51–63 and 68–71 of the ’264 patent based on the asserted grounds of unpatentability (“grounds”) set forth in the table below. Pet. 15–60.

¹ For clarity and ease of reference, we only list the first named inventor.

References	Basis	Challenged Claim(s)
Kadomura, Wang '485, and Kawamura	§ 103(a)	51–58, 68, and 69
Kadomura, Wang '485, Kawamura, Wang '391, and Thomas	§ 103(a)	59
Kadomura, Wang '485, Kawamura, and Fischl	§ 103(a)	60, 61, and 71
Kadomura, Wang '485, Kawamura, Fischl, and Tegal	§ 103(a)	62
Kadomura, Wang '485, Kawamura, Fischl, and Narita	§ 103(a)	63
Kadomura, Wang '485, Kawamura, Fischl, and Hwang	§ 103(a)	70

II. ANALYSIS

A. Claim Construction

As an initial matter, we determine the proper standard of construction to apply. The term of a patent grant begins on the date on which the patent issues and ends twenty (20) years from the date on which the application for the patent was filed in the United States, “or, if the application contains a specific reference to an earlier filed application or applications under section 120, 121, 365(c), or 386(c), from the date on which the earliest such application was filed.” 35 U.S.C. § 154(a)(2) (2002). The earliest patent application referenced for the benefit of priority under 35 U.S.C. § 120, for the '264 patent, was filed on December 4, 1995, and the patent has no term extensions. The term of the '264 patent, therefore, expired no later than December 4, 2015.

Because, on this record, we conclude that the term of the '264 patent expired prior to the filing of the Petition, for purposes of this Decision we

construe the claims of the '264 patent under the standard applicable to expired patents. For claims of an expired patent, our claim interpretation is similar to that of a district court. *See In re Rambus Inc.*, 694 F.3d 42, 46 (Fed. Cir. 2012). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005 (en banc))). There is, however, a “heavy presumption” that a claim term carries its ordinary and customary meaning. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002) (internal quotations and citation omitted).

The parties do not propose constructions for any claim terms recited in the challenged claims of the '264 patent. *See generally* Pet. 13–16, Prelim. Resp. 1–12. Because there is no dispute between the parties regarding claim construction, we need not construe explicitly any claim term of the '264 patent at this time. *See, e.g., Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (explaining that only those claim terms or phrases that are in controversy need to be construed, and only to the extent necessary to resolve the controversy).

B. Priority Date for the Challenged Claims of the '264 Patent

As explained previously, the '264 patent reissued from the '245 application, filed on May 14, 2003. Ex. 1001, at [21], [22]. The '245 application is a reissue of the '776 patent, which issued May 15, 2001, from the '163 application, which was filed September 10, 1998. *Id.* at [64]. The '163 application is a continuation-in-part of the following two applications:

(1) the U.S. Provisional Application No. 60/058,650 (“the ’650 provisional application”), filed on September 11, 1997; and (2) U.S. Patent Application No. 08/567,224 (“the ’224 application”), filed on December 4, 1995. *Id.* at [60], [63], 1:11–15.

Lam contends that Flamm may only claim the benefit of the filing date of the ’650 provisional application, i.e., September 11, 1997, because this is the earliest filed application in the priority chain that includes sufficient written description support for certain limitations recited in the challenged claims. Pet. 4. Relying upon the testimony of its Declarant Dr. Joseph L. Cecchi, Lam explains how the ’224 application fails to disclose etching the film at the selected first temperature and etching a second portion of the film at a selected second temperature while on the same substrate holder, using a substrate temperature control circuit, and using a substrate holder temperature sensor, as required by independent claims 51, 56, and 60. *Id.* at 9–13 (citing Ex. 1012, 45, 46;² Ex. 1013 ¶¶ 43–50). Consequently, Lam asserts that, because the ’224 application does not provide sufficient written description support for these limitations, the challenged claims only are entitled to the priority date of the ’650 provisional application, i.e., September 11, 1997. *Id.* at 13. Flamm does not present arguments as to whether the ’264 patent is entitled to claim a priority date earlier than September 11, 1997.

² All references to the page numbers in the ’224 application refer to page numbers inserted by Lam at the bottom, right-hand corner of each page in Exhibit 1012.

On this record, we are persuaded by Lam's argument that the '224 application does not provide sufficient written description support for etching the film at the selected first temperature and etching a second portion of the film at a selected second temperature while on the same substrate holder, using a substrate temperature control circuit, and using a substrate holder temperature sensor, as required by independent claims 51, 56, and 60. For purposes of this Decision, Lam has presented sufficient evidence indicating that the challenged claims of the '264 patent only are entitled to claim the benefit of the filing date of the '650 provisional application, i.e., September 11, 1997. Consequently, on this record, it appears that both Kadomura and Kawamura qualify as prior art to the challenged claims of the '264 patent.

C. Obviousness Over Kadomura, Wang '485, and Kawamura

Lam contends that claims 51–58, 68, and 69 are unpatentable under § 103(a) over the combination of Kadomura, Wang '485, and Kawamura. Pet. 16–38. Lam explains how this proffered combination purportedly teaches the subject matter of each challenged claim, and asserts that a person of ordinary skill in the art would have had reason to combine or modify the references. *Id.* Lam also relies upon the Declaration of Dr. Cecchi to support its positions. Ex. 1013 ¶¶ 63–97. On this record, we are not persuaded that Lam properly accounts for “a preselected time period,” as recited in independent claims 51 and 56.

We begin our analysis with the principles of law that generally apply to a ground based on obviousness, followed by brief overviews of

Kadomura, Wang '485, and Kawamura, and then we address the parties' contentions with respect to independent claims 51 and 56.

1. Principles of Law

A claim is unpatentable under § 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 skill in the art;³ and (4) when in evidence, so-called secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We analyze this asserted ground based on obviousness with the principles identified above in mind.

2. Kadomura Overview

Kadomura generally relates to a dry etching method used primarily for the production of semiconductor devices and, in particular, to a dry etching method and apparatus that provides compatibility for anisotropic fabrication and high selectivity. Ex. 1002, 1:6–10. According to Kadomura, one objective of the disclosed dry etching method is to apply an etching

³ Relying upon the testimony of Dr. Cecchi, Lam offers an assessment as to the level of skill in the art. Pet. 15–16 (citing Ex. 1013 ¶¶ 27–30). Flamm does not challenge this assessment of the level of skill in the art or propose an alternative. For purposes of this Decision, and to the extent necessary, we accept the assessment offered by Lam and Dr. Cecchi.

treatment that includes a plurality of steps to a specimen within the same processing apparatus, wherein the temperature of the specimen is changed between etching in a first step and etching in a second step. *Id.* at 2:65–3:5. Because the disclosed dry etching method conducts each of the etching treatments in the same processing apparatus, the time for changing the specimen temperature between the steps may be shortened. *Id.* at 4:46–49. Moreover, by conducting the change of specimen temperature within a short period of time, dry etching treatment may be applied without deteriorating the throughput. *Id.* at 4:49–54.

Kadomura discloses three embodiments, each of which applies its dry etching method in a different manner. Ex. 1002, 5:44–56, Figs. 1A–1C, 2A–2C, 3A–3C. Of particular importance to this case is the first embodiment discussed in relation to Figures 1A–1C. This embodiment applies the dry etching method to a method of fabricating a W polycide using a two-step etching treatment. *Id.* at 6:1–7:18. The main etching in the first step is applied at a normal temperature (20°Celsius (“C”)), whereas the overetching in the second step is applied at a much cooler temperature (-30°C). *Id.* at 6:17–28, 6:63–7:7. According to Kadomura, it is possible in this embodiment to attain both high selectivity and assurance for the anisotropic shape, as well as change the temperature of the specimen in a short period of time, by conducting each of the steps in the same etching device. *Id.* at 7:19–23.

3. Wang ’485 Overview

Wang ’485 generally relates to a process for etching conductive layers used in semiconductor integrated circuits and, in particular, to a method for

etching metal silicides, polycrystalline silicon, and composite silicide-polysilicon structures, as well as reactive plasma gas chemistry for use in such methods. Ex. 1003, 1:13–19. Of particular importance to this case are Figures 20 and 21, reproduced below, that depict the effect of hexode temperature on polysilicon etch rate and on molybdenum silicide etch rate for etching gases that are devoid of and contain a small volume percentage of additive gas, respectively. *Id.* at 6:1–5.

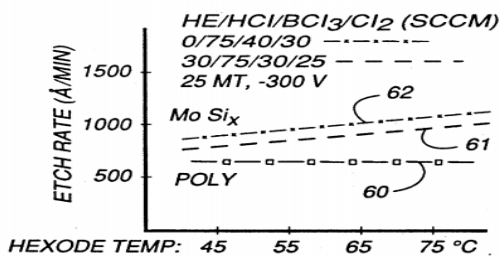


Figure 20

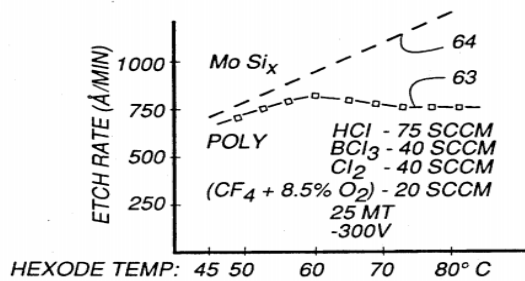


Figure 21

Figures 20 and 21 each show an increase of silicide etch rates over a range from 45°C to 75°C for the substrate holder temperature. *Id.* at 10:14–30.

4. Kawamura Overview

Kawamura generally relates to a treatment unit and, in particular, to a temperature control apparatus for controlling the temperature of a support for a substance to be treated, such as a semiconductor wafer. Ex. 1004, 1:6–10. According to Kawamura, the treatment unit includes at least one temperature sensor for measuring the temperature of the support. *Id.* at 1:47–51.

5. Claims 51 and 56

Our analysis focuses on the following limitation recited in independent claim 51, and similarly recited in independent claim 56:

“effectuat[ing] the change from the first substrate temperature to the second substrate temperature within *a preselected time period*.” Ex. 1001, 24:23–26, 24:55–61 (emphasis added). We view the parties’ arguments regarding “a preselected time period” as dispositive to Lam’s Petition.

In its Petition, Lam relies on Kadomura’s first embodiment, particularly its disclosure of adjusting the temperature of the specimen between etching steps in a short time period of about thirty (30) seconds, to teach “a preselected time period,” as recited in independent claims 51 and 56. Pet. 22, 25, (citing Ex. 1002, 6:18–62, 7:19–30; Ex. 1013 ¶ 77); *see also id.* at 33–34 (arguing the same). In response, Flamm contends that Lam only relies upon Kadomura to teach this particular limitation required by independent claims 51 and 56. Prelim. Resp. 5; *see also id.* at 10 (arguing the same). Flamm argues that, although Kadomura discloses a short time period of about 30 seconds, there is no disclosure in Kadomura that this time period was preselected. *Id.* at 5. According to Flamm, this time period disclosed in Kadomura merely teaches what the time period would be or likely would be—not what it was “preselected” to be. *Id.*

We agree with Flamm that Lam does not account properly for “a preselected time period,” as recited in independent claims 51 and 56. Kadomura discloses that, in its first embodiment, the temperature of the specimen is cooled rapidly between etching steps “within a short period of time of about 30 [seconds].” Ex. 1002, 6:52–55. Kadomura further discloses that, by conducting the etching steps in the same etching device, the temperature of the specimen may be adjusted in “a short period of time.” *Id.* at 7:22–24. Lam, however, does not direct us to, nor can we find, a disclosure in Kadomura indicating that its control device is capable of pre-

selecting the time period for adjusting the temperature of the specimen between etching steps. In other words, Kadomura is silent with respect to the control device adjusting the temperature of the specimen between etching steps to a certain temperature within a pre-selected time period.

We also do not find Dr. Cecchi's supporting testimony on this particular issue to be persuasive. Ex. 1013 ¶ 77. Dr. Cecchi's analysis essentially repeats the arguments advanced in the Petition, and does not explain adequately how Kadomura's short time period of about 30 seconds amounts to "a preselected time period," as recited in independent claims 51 and 56. For these reasons, we do not credit his testimony that the combined teachings of Kadomura, Wang '485, and Kawamura properly account for all the limitations recited in independent claims 51 and 56.

In summary, based on the record before us, Lam has not demonstrated a reasonable likelihood that it would prevail on its assertion that independent claims 51 and 56 would have been obvious over the combination of Kadomura, Wang '485, and Kawamura.

6. Claim 52–55, 57, 58, 68, 69

By virtue of their dependency, claims 52–55, 57, 58, 68, and 69 each include the same limitations as one of independent claims 51 and 56. Therefore, for the same reasons discussed above with respect to independent claims 51 and 56, Lam has not demonstrated a reasonable likelihood that it will prevail on its assertion that dependent claims 52–55, 57, 58, 68, and 69 would have been obvious over the combination of Kadomura, Wang '485, and Kawamura.

D. Obviousness Over Kadomura, Wang '485, Kawamura, and Fischl

Lam contends that claims 60, 61, and 71 are unpatentable under § 103(a) over the combination of Kadomura, Wang '485, Kawamura, and Fischl. Pet. 45–55. Lam explains how this proffered combination purportedly teaches the subject matter of each challenged claim, and asserts that a person of ordinary skill in the art would have had reason to combine or modify the references. *Id.* Lam also relies upon the Declaration of Dr. Cecchi to support its positions. Ex. 1013 ¶¶ 111–31. On this record, we are not persuaded that Lam properly accounts for “a preselected time,” as recited in independent claim 60.

Fischl generally relates to a method of patterning tungsten and tungsten silicide for microelectronics circuits using a halogen-based dry processing etching technique that relies upon chlorine atoms discharged upstream. Ex. 1005, 1.⁴ According to Fischl, a silicon dioxide layer forms on tungsten silicide when it is exposed to air. *Id.* at 3, 4.

1. Claim 60

Similar to independent claims 51 and 56, independent claim 60 recites that “the first substrate temperature is changed to the second substrate temperature with a substrate temperature control circuit within *a preselected time* to etch the silicide layer.” Ex. 1001, 25:28–31 (emphasis added). Lam relies upon essentially the same contentions with respect to independent claims 51 and 56 discussed above in the context of the asserted ground based on the combination of Kadomura, Wang '485, and Kawamura to support its

⁴ All references to the page numbers in Fischl refer to page numbers inserted by Lam at the bottom, right-hand corner of each page in Exhibit 1005.

assertion that this particular limitation recited in independent claim 60 would have been taught by Kadomura. *Compare* Pet. 22, 25, 33–34 *with id.* at 51–52. For the same reasons discussed above, Lam does not account properly for “a preselected time,” as recited in independent 60. Based on the record before us, Lam has not demonstrated a reasonable likelihood that it would prevail on its assertion that independent claim 60 would have been obvious over the combination of Kadomura, Wang ’485, Kawamura, and Fischl.

2. Claim 61 and 71

By virtue of their dependency, claims 61 and 71 each include the same limitations as independent claim 60. Therefore, for the same reasons discussed above with respect to independent claim 60, Lam has not demonstrated a reasonable likelihood that it will prevail on its assertion that dependent claims 61 and 71 would have been obvious over the combination of Kadomura, Wang ’485, Kawamura, and Fischl.

E. Remaining Grounds

Lam also contends that (1) claim 59 is unpatentable under § 103(a) over the combination of Kadomura, Wang ’485, Kawamura, Wang ’391, and Thomas; (2) claim 62 is unpatentable under § 103(a) over combination of Kadomura, Wang ’485, Kawamura, Fischl, and Tegal; (3) claim 63 is unpatentable under § 103(a) over the combination of Kadomura, Wang ’485, Kawamura, Fischl, and Narita; and (4) claim 70 is unpatentable under § 103(a) over the combination of Kadomura, Wang ’485, Kawamura, Fischl, and Hwang. Pet. 38–45, 56–60. By virtue of their dependency, each of claims 59, 62, 63, and 70 include the same limitations as one of independent claims 56 and 60. As applied by Lam, Wang ’391, Thomas, Tegal, Narita,

and Hwang do not remedy the deficiencies in the combined teachings of Kadomura, Wang '485, and Kawamura, much less the combined teachings of Kadomura, Wang '485, Kawamura, and Fischl, identified above.

Consequently, Lam has not demonstrated a reasonable likelihood that it will prevail on its assertion that (1) claim 59 would have been obvious over the combination of Kadomura, Wang '485, Kawamura, Wang '391, and Thomas; (2) claim 62 would have been obvious over the combination of Kadomura, Wang '485, Kawamura, Fischl, and Tegal; (3) claim 63 would have been obvious over the combination of Kadomura, Wang '485, Kawamura, Fischl, and Narita; and (4) claim 70 would have been obvious over the combination of Kadomura, Wang '485, Kawamura, Fischl, and Hwang.

III. CONCLUSION

Taking into account the arguments presented in Flamm's Preliminary Response, we conclude that the information presented in the Petition does not establish that there is a reasonable likelihood that Lam will prevail in challenging any of claims 51–63 and 68–71 of the '264 patent as unpatentable under § 103(a).

IV. ORDER

In consideration of the foregoing, it is ORDERED that the Petition is DENIED and no trial is instituted.

IPR2016-00469
Patent RE40,264 E

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