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UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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*Ex parte* NAOKI MATSUMOTO and YASUHIRO OTSUKA

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Appeal 2018-004590  
Application 13/542,068  
Technology Center 1700

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Before MARK NAGUMO, KAREN M. HASTINGS, and  
DONNA M. PRAISS, *Administrative Patent Judges*.

PRAISS, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellant<sup>1</sup> appeals under 35 U.S.C. § 134(a) from the Examiner's decision<sup>2</sup> finally rejecting claims 1 and 3. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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<sup>1</sup> We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Tokyo Electron Limited is identified as the real party in interest. Appeal Brief, filed July 13, 2017 ("Appeal Br.") 3.

<sup>2</sup> Final Office Action, dated March 30, 2017 ("Final Act.").

## STATEMENT OF THE CASE

### *Background*

The subject matter on appeal relates to “a plasma processing apparatus capable of preventing generation of an extraneous material.” Substitute Specification, filed July 10, 2012 (“Spec.”) 2:5–6. According to the Specification, an object to be processed is held by a holding member as a focus ring surrounds an outer circumferential wall surface of the holding member such that a gap equal to or less than 350  $\mu\text{m}$  is defined between the inner circumference of the focus ring and the outer circumferential wall surface of the holding member. *Id.* at 2:7–15, 2:27–31. The Specification discloses an equation for computing a Debye length, defined as “an order of a length blocking the electric field.” *Id.* at 12:24–13:5. Under an electron density of  $6 \times 10^9 \text{ cm}^{-3}$  and an electron temperature of 1.5eV, the range of less than 350  $\mu\text{m}$  for the gap is correlated to less than three times the Debye length. *Id.* at 13:13–16. The Specification explains that “an electrical neutrality of plasma is not obtained in a space smaller than the Debye length  $\lambda_D$ .” *Id.* at 13:5–6. In other words, a plasma cannot exist in such a small gap, *id.* at 13:6–9, and if a gap is “equal to or less than two or three times the Debye length  $\lambda_D$ , plasma is prevented from entering the gap.” *Id.* at 13:10–11.

In addition to the structure of a particular gap size preventing plasma from entering the gap, thereby preventing generation of minute particles, the Specification discloses the gap being covered by the object to be processed as also preventing plasma from entering the gap and thereby preventing generation of minute particles. *Id.* at 2:27–31, 3:8–12.

Of the appealed claims, claim 1 is independent. Claim 1 is representative of the subject matter on appeal, and reproduced below (disputed limitations italicized):

1. A plasma processing apparatus comprising:
  - a processing container which defines a processing space;
  - a gas supplying unit which supplies a processing gas to the processing space;
  - an introducing unit which introduces energy for generating plasma of the processing gas;
  - a holding member disposed in the processing space, having a top surface on which an object to be processed can be held, and comprising an electrode such that the object can be held by using electrostatic force, the holding member having an outer circumferential wall surface,
    - wherein *the outer circumferential wall surface has a portion which is substantially straight* and a remainder is an approximately circular shape when viewed from a top; and
    - a focus ring disposed around the holding member and having an inner wall surface facing the outer circumferential wall surface of the holding member, wherein, when viewed from a top, the *inner wall surface of the focus ring has substantially a same shape as the outer circumferential wall surface of the holding member*, and the straight portion of the outer circumferential wall surface and a straight portion of the inner wall surface is parallel to each other,
    - wherein a first gap is defined between the straight portion of the outer circumferential wall surface and the straight portion of the inner wall surface, a second gap is defined between the remainder of the outer circumferential wall surface and a remainder of the inner wall surface, and *each of the first gap and the second gap has a size equal to or less than three times of debye length ( $\lambda_D$ )* presented by an equation below,

$$\lambda_D(cm) = 7.43 \times 10^2 \sqrt{\frac{T_e(eV)}{n_0(cm^{-3})}}$$

wherein  $T_e$  represents an electronic temperature and  $n_0$  represents an electronic density,

wherein the focus ring comprises an inner top surface comprising an inner circumference, and an outer top surface around the inner top surface,

wherein the inner top surface has a level substantially the same as the top surface of the holding member such that the first gap, the second gap and a portion of the inner top surface are *covered by the object without a vertical gap* between the portion of the inner top surface and the object for prevention of accumulation or adherence of minute particles, and

wherein the outer top surface has a level higher than the top surface of the holding member.

Appeal Br. 23 (Claims Appendix).

#### *The References*

Sato	US 2011/0116207 A1	May 19, 2011
Huang	US 6,117,349	Sept. 12, 2000
Morikage	US 2003/0066484 A1	Apr. 10, 2003

#### *The Rejection*

The Examiner maintains the following rejection on appeal: Claims 1 and 3 are rejected under 35 U.S.C § 103(a) over Sato, Huang, and Morikage. Final Act. 3–10.

#### OPINION

After having considered the evidence presented in this Appeal and each of Appellant's contentions, we are not persuaded the Examiner erred harmfully.

In rejecting claim 1, the Examiner finds that Sato teaches the elements of claim 1 except Sato does not teach that the gap defined between the outer circumferential wall surface and the inner wall surface of the focus ring has a substantially straight portion with the remainder approximately circular shape. Final Act. 3–5. The Examiner determines that it would have been obvious to optimize the gaps between the holding member and the focus ring to be equal to or less than a few Debye lengths as well as the vertical gap between the object and the inner top surface of the focus ring in view of Sato’s teaching that (1) gap C between the outer circumferential wall surface and the inner wall surface of the focus ring has a size of 0.05mm to 0.4 mm to prevent plasma from entering the gap and to prevent damage due to edge contact between the holding member and the focus ring and (2) gap B between the object W and inner top surface of the focus ring is optimized (equal to or smaller than 0.4 mm) to prevent plasma from reaching the surface of the holding member and arcing, and particle generation. *Id.* at 4 (citing Sato ¶¶ 59, 61: Fig. 2). The Examiner also finds that it would have been obvious to optimize Sato’s gaps to be equal to or less than three times the Debye length as required by claim 1 in view of Huang’s teaching gaps in a process chamber that are larger than a few Debye lengths may either cause a gas breakdown, or the plasma may be extracted into the sufficiently large gaps. *Id.* at 6 (citing Huang 2:13–58).

The Examiner finds that although Sato in view of Huang discloses optimizing gaps B and C, the combination does not explicitly teach the first gap, the second gap, and a portion of the inner top surface are covered by the object. *Id.* at 7. The Examiner determines it would have been obvious to provide a holding member with outer circumferential wall surface having a

substantially straight portion and the remainder approximately circular shape in view of Morikage's teaching that it is a known structure of a holding member and surrounding focus ring in a plasma process apparatus. *Id.* at 8–9 (citing Morikage Figs. 4–6).

Appellant argues the rejection of claim 1 and points out that claim 3 depends from claim 1. Appeal Br. 21. Accordingly, claim 3 stands or falls with claim 1. 37 C.F.R. § 41.37(c)(1)(iv).

Appellant asserts that the Examiner erred harmfully in combining the teachings of Huang with Sato because Huang discloses an ideal or theoretical solution of limiting gaps to less than several Debye lengths that is not practically possible to maintain. Appeal Br. 13–14. Appellant contends that because Huang recognizes it is not practically possible to main the interval between the electrostatic chuck and the shadow ring as several Debye lengths, Huang alternatively teaches contacting the end portion of the wafer with the inner end portion of the shadow ring to isolate the upper and lower portions of the chamber. *Id.* at 13. Appellant also contends that the Examiner erred in combining Morikage with Sato or Huang because there is no motivation to do so since the flat portions of the holding member and the focus ring have no intended purpose to block plasma infiltration. *Id.* at 15. According to Appellant, Morikage does not block plasma infiltration because Morikage's wafer does not touch a focus ring surface. *Id.* Appellant also argues that the effect of the claimed invention is accomplished with the simultaneous combination of claimed features (1) no vertical gap between the object and the focus ring top surface, (2) a gap of three times the Debye length or less between the holding member and the focus ring, and (3) a straight portion in the holding member and the focus ring. *Id.* at 10, 15.

In response to Appellant's arguments, the Examiner finds that it is Sato that teaches it is desirable for the gap between the end portion of the wafer and the inner end portion of the focus ring to be equal to or smaller than 0.4 mm, which includes no gap. Ans. 3 (citing Sato ¶ 58, Fig. 2). Sato's Figure 2 is reproduced below.

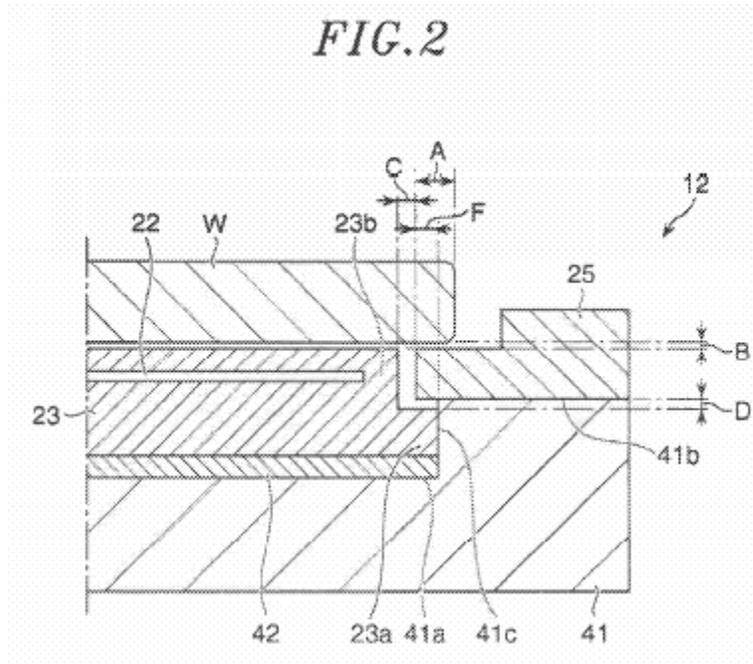


Figure 2 is a partial cross-sectional view of a substrate mounting table depicting electrostatic chuck 23, focus ring 25, wafer W, and vertical gap B. Sato ¶¶ 32, 57, 58.

The Examiner points out that due to realistic issues, namely, the inevitable non-uniformity of the wafer's bottom surface and the top surface, which Appellant acknowledges exist, plasma is not perfectly blocked from entering near the gaps. Ans. at 3-4 (citing Appeal Br. 12 "claimed feature 1 does not perfectly block the plasma from entering near gaps"). Appellant's annotated Figure 4 is shown below.



asserts that the Examiner relies upon Huang rather than Sato for the claimed configurations of (1) the object covering the gap between the inner top surface of the focus ring and the holding member and (2) the gap between the holding member and the focus ring being three times Debye length or less. Reply Br. 4. However, the Examiner relies on Sato's disclosure for disclosing the object covering the gap as well as for disclosing a gap range encompassing the claimed range. Ans. 3. Appellant does not dispute the Examiner's finding that three times the Debye length disclosed in the Specification is encompassed by Sato's disclosed range of 0.05 mm to 0.4 mm. Sato ¶ 59; Fig. 2; gap C.

Appellant also does not dispute Huang discloses gaps surrounding the holder should not exceed several Debye lengths. Huang 2:13–58. Instead, Appellant argues that the gap length disclosed by Huang is not achievable in practice. Reply Br. 4–5; Appeal Br. 13–14. Specifically, Appellant contends Huang's statement, "ideal equipment conditions cannot be achieved in a manufacturing environment" means that the reference "recognizes that the minute adjustment . . . using the debye length is actually NOT possible" and instead only covers the gap with the object. Reply Br. 4–5.

The difficulty with Appellant's argument is that in a determination of obviousness, a reference may be relied upon for all that it would have reasonably suggested to one having ordinary skill in the art. *Merck & Co. v. Biocraft Labs.*, 874 F.2d 804, 807 (Fed. Cir. 1989) ("That the [prior art] patent discloses a multitude of effective combinations does not render any particular formulation less obvious."). Moreover, "a reference is not limited to the disclosure of specific working examples." *In re Mills*, 470 F.2d 649,

651 (CCPA 1972) (citation omitted). Here, Huang describes the “ideal situation” as one in which “plasma can be prevented from being generated in the gaps or being extracted into the gaps,” which Appellant likewise acknowledges is an ideal situation and not reality. Appeal Br. 12. Rather than stating, that a gap size measured in Debye lengths cannot be achieved in the apparatus as Appellant suggests, Huang states that “a quartz shadow ring would only survive about one preventive maintenance cycle or about 2,000 wafers.” Huang 2:65–3:1. That is, in a manufacturing environment, plasma is not completely prevented from being generated and affecting the ring. Regarding both features of gap size and object covering the gap being present in an apparatus, the Examiner relies on Sato for a processing apparatus configuration that has both the object covering the gap as well as a gap range that encompasses three Debye lengths or less. Ans. 3. The Examiner’s findings are supported by the record. Sato ¶¶ 56–59; Fig. 2.

Finally, Appellant’s assertion that the Examiner’s modification of Sato with the teachings of Morikage lacks a reason for combining and is based on improper hindsight (Reply Br. 11; Appeal Br. 15) is not persuasive of harmful error because the Examiner has provided a reason for replacing Sato’s structure with Morikage’s holding member and focus ring having flat portions. The Examiner finds not only that Morikage discloses a known holding member and surrounding focus ring structure for use in a plasma processing apparatus, but also that the flat portion of the structure allows for proper fit of the focus ring. Final Act. 9; Ans. 5. Thus the Examiner has provided ““some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”” over the combination of prior art references. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007)

(quoting *In re Kahn*, 441 F.3d at 977, 988 (Fed. Cir. 2006)). Appellant does not adequately rebut the Examiner's findings. Appellant's assertion that Morikage's flat portion configuration is not for the purpose of blocking plasma filtration (Appeal Br. 15) does not negate the Examiner's finding that it is a known configuration for a holding member and surrounding focus ring in a plasma processing apparatus. "The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Leapfrog Enters., Inc. v. Fisher-Price, Inc.*, 485 F.3d 1157, 1161 (Fed. Cir. 2007) (quoting *KSR*, 550 U.S. at 416). Nor does Appellant's argument address the Examiner's finding that the flat portion configuration taught by Morikage serves the purpose of obtaining proper fit of the focus ring. "One of the ways in which a patent's subject matter can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims." *KSR*, 550 U.S. at 419–20. The reason for providing a flat portion to the holder member and surrounding focus ring need not be for the same purpose as the inventors as Appellant argues. *See In re Kemps*, 97 F.3d 1427, 1430 (Fed. Cir. 1996) (Archer) ("Although the motivation to combine here differs from that of the applicant, the motivation in the prior art to combine the references does not have to be identical to that of the applicant to establish obviousness.")

Accordingly, we affirm the Examiner's rejection of claims 1 and 3 under § 103(a) over Sato, Huang, and Morikage.

For these reasons and those the Examiner provides, we uphold the Examiner's rejections of claims 1 and 3 under 35 U.S.C. § 103 as obvious over the cited prior art references.

**CONCLUSION**

The Examiner's rejection of claims 1 and 3 under 35 U.S.C. § 103(a) is affirmed.

In summary:

<b>Claim(s) Rejected</b>	<b>35 U.S.C. §</b>	<b>References/Basis</b>	<b>Affirmed</b>	<b>Reversed</b>
1, 3	103(a)	Sato, Huang, Morikage	1, 3	

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

**AFFIRMED**