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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JUERGEN SCHWANDNER and MICHAEL KERSTAN

Appeal 2018-000868
Application 13/038,455
Technology Center 3700

Before GEORGE R. HOSKINS, SCOTT C. MOORE, and
LEE L. STEPINA, *Administrative Patent Judges*.

HOSKINS, *Administrative Patent Judge*.

DECISION ON APPEAL

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1–6 and 8–21 in this application, under 35 U.S.C. § 103(a), as unpatentable over Kozasa (US 7,540,800 B2, issued June 2, 2009) and Hishiki (US 2003/0109209 A1, published June 12, 2003). Claim 7 is canceled. *See* Appeal Br. 2, 10. The Board has jurisdiction over the appeal under 35 U.S.C. § 6(b).

We REVERSE.

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[1] We use the word "Appellant" to refer to "applicant" as defined in 37 C.F.R. § 1.42. Appellant identifies Siltronic AG as the real party in interest. Appeal Br. 1.

CLAIMED SUBJECT MATTER

Claim 1 is the sole independent claim on appeal, and it recites (with emphases added to the limitations at issue here):

> 1. A method of polishing a semiconductor wafer, the method comprising:
>
> polishing a surface of the semiconductor wafer using a polishing pad while supplying a polishing agent slurry containing abrasives during a first step, the polishing pad being free of abrasives and including a first surface that contacts the semiconductor wafer, the first surface having a surface structure including elevations, the structure of the first surface being structured by one of chemical etching, grinding, buffing, sintering or furrowing;
>
> subsequently ending the supply of polishing agent slurry; and
>
> *polishing* the surface of the semiconductor wafer *so as to decrease a surface roughness* of the wafer using the polishing pad in a second step while supplying a polishing agent solution having *a pH value of at least 12* that is free of solids.

Appeal Br. 10 (Claims App.) (emphases added).

OPINION

Claim 1

The issues presented on appeal center on the limitations in claim 1 reciting "*polishing* the surface of the semiconductor wafer *so as to decrease a surface roughness of the wafer* . . . while supplying a polishing agent solution having *a pH value of at least 12*." Appeal Br. 10 (Claims App.) (emphases added). The Examiner firstly finds Kozasa discloses this subject matter. The Examiner alternatively determines, if Kozasa does not disclose this subject matter, it would have been obvious to modify Kozasa to include

this subject matter. For the following reasons, we do not sustain either conclusion, so we do not sustain the rejection of claim 1.

a. Whether Kozasa discloses decreasing surface roughness while supplying a polishing solution having a pH value of at least 12

The Examiner finds Kozasa discloses using a polishing agent solution having a "high value of pH." Final Act. 2. In particular, according to the Examiner, Kozasa discloses "*the pH value is set within a range of 10–12* in the second polishing step" (Kozasa, 2:41–44 (emphasis added)), so "at least one value [i.e., 12] lies within the range recited [i.e., at least 12]" in claim 1. *Id.* at 4 (emphasis added); Ans. 5.

Appellant disputes the Examiner's finding. Appeal Br. 4–5. According to Appellant, Kozasa's Figure 4 "teaches that, at a pH of 12, the surface roughness of the wafer *increases*, which is opposite to the requirements of claim 1." *Id.* (emphasis by Appellant). Appellant points out Kozasa's Figure 4 shows surface roughness decreasing over time at pH values of 10 and 11, but those values are outside of the claimed pH range of at least 12. *Id*. Appellant further contends "Kozasa is silent" as to pH values above 12. *Id*.

The Examiner answers that "it is immaterial that the surface becomes slightly rougher" when applying Kozasa's second step polishing solution at a pH of 12, because Kozasa's overall process results in a wafer surface that "is smoother than an initial starting roughness." Ans. 6. The Examiner finds: "Even for pH of 12, the final roughness of 1.2 μm after 8 minutes *can still be lower if the initial starting roughness is, for example 1.4 μm*." *Id.* (emphases added)

We determine Kozasa does not disclose a second polishing step that "decreas[es] a surface roughness of the wafer . . . while supplying a polishing agent solution having a pH value of at least 12," as recited in claim 1. The Examiner correctly finds Kozasa discloses a second polishing step that supplies a polishing agent solution having a pH value of 12, which is at least 12 as required by claim 1. *See* Kozasa, 2:41–44, 6:16–17; *see also* Appeal Br. 5 (stating that in Kozasa, "the pH of 12 would only be used with one particular micro-roughness achieved in the first polishing step"). However, claim 1 requires more than that, in reciting that the second polishing step "decreas[es] a surface roughness of the wafer." Kozasa's only disclosure pertaining to the effect of supplying a polishing agent solution having a pH of 12 is that the solution increases, rather than decreases, the surface roughness of the wafer. *See* Kozasa, Fig. 4, 6:19–25 (Fig. 4 reflects that "the micro-roughness Rq degrades when the polishing time t becomes long at pH12 on account of too strong alkaline property," and "the micro-roughness Rq decreases in accordance with the polishing time t at pH11 and pH10 levels").

We disagree with the Examiner's conclusion that "it is immaterial" whether Kozasa's second polishing step decreases the wafer's surface roughness, so long as Kozasa's overall process decreases the wafer's surface roughness. This conclusion overlooks the final clause of claim 1, which specifically requires that the second polishing step decreases the wafer's surface roughness. *See* Appeal Br. 10 (Claims App.). Further, the Examiner's speculation that a pH of 12 can decrease the wafer's surface roughness if the initial starting roughness is 1.4 μm is not supported by Kozasa's disclosure. *See, e.g.*, Kozasa, Fig. 4 (not reflecting what happens

when applying a pH 12 solution to a wafer surface having a roughness of 1.4 μm).

Further, to the extent the Examiner relies upon the mere *capability of Kozasa's apparatus* to supply a pH of at least 12, this overlooks that claim 1 is directed to a method of polishing not an apparatus for polishing. Thus, capability alone is insufficient to establish anticipation here.

For the foregoing reasons, we do not sustain the Examiner's finding that Kozasa discloses decreasing the surface roughness of a wafer while supplying a polishing solution having a pH value of at least 12.

b. Whether it would have been obvious to modify Kozasa to decrease surface roughness while supplying a polishing solution having a pH value of at least 12

The Examiner determines, if Kozasa does not disclose decreasing the surface roughness of a wafer while supplying a polishing solution having a pH value of at least 12, then it would have been obvious to modify Kozasa to do so. *See* Final Act. 2–5. The Examiner concludes "[t]he pH value chosen is seen as one of design choice depending upon the conditions of polishing and desired end result." *Id.* at 2–3. The Examiner acknowledges Kozasa's Figure 4 shows roughness "increasing with time during polishing" using a pH of 12, but notes Figure 4 "also shows other curves in which the roughness decreases with time." *Id.* at 3. Further according to the Examiner, "Figure 4 is representative of only one particular set of polishing parameters," and "whether the ultimate roughness of the wafer surface increases or decreases as a result of the polishing, would depend upon the initial roughness of the wafer prior to polishing." *Id.* For example, the Examiner determines "a highly roughened initial wafer surface would

necessarily be rendered less rough after polishing, *regardless of the pH of the polishing solution*." *Id.* at 3–4 (emphases added).

The Examiner further determines "the pH range of the polishing slurry is a recognized results effective variable which would be arrived at by mere routine experimentation" by a person of ordinary skill in the art. Final Act. 4. In support, the Examiner concludes Kozasa's disclosed pH range of 10–12 is only "a 'preferred' range, and is not assigned criticality, as evidenced by the omission of a pH range" in Kozasa's claim 1. *Id.* Further according to the Examiner, Kozasa teaches "to alter the pH level in dependence upon" several different considerations, such as "the applied load current from the first polishing step." *Id.* (citing Kozasa, 3:1–67).

Appellant disputes the foregoing analyses. *See* Appeal Br. 3–5. According to Appellant, Kozasa's Figure 4 "teaches that, at a pH of 12, the surface roughness of the wafer *increases*, which is opposite to the requirements of claim 1." *Id.* at 4 (emphasis by Appellant). Appellant contends the Examiner errs in relying on the other curves of Kozasa's Figure 4 to support the rejection, because the other curves concern pH values of 10 and 11, which are outside the claimed pH range of "at least 12." *Id.* Appellant asserts "Kozasa is silent to any set of polishing conditions by which a decrease in surface roughness could be achieved using a pH of at least 12." *Id.* at 4–5. Further in Appellant's view, "the pH is not recognized as being a results-effective variable," and "[i]f anything, based on the teachings of [Kozasa], one would expect that using the pH recited in the claims of the present application would achieve the opposite result to the one claimed." *Id.* at 3.

The Examiner responds that Appellant erroneously concludes Kozasa "indicates a roughening of the surface rather than a smoothing of the surface." Final Act. 4–5 (citing Kozasa, 1:21–22, 2:1–13); Ans. 5–6. In particular, according to the Examiner, "depending upon the original state of the wafer surface prior to performing the method, the surface can be either of higher or lower roughness." Ans. 6. Thus, the Examiner takes "the position that those of ordinary skill in the art would have recognized that the pH value of the alkali agent may be adjusted to provide a desired final surface roughness for the wafer, depending upon the composition of the wafer and [its] initial surface condition." *Id.* The Examiner additionally finds Kozasa "offers several of the same suitable examples (KOH, NaOH, ammonium hydroxide)" as are disclosed in Appellant's Specification to be appropriate alkaline agents for use in the second polishing step. *Id.* (emphasis omitted) (citing Kozasa, 2:28–30).

In reply, concerning Kozasa's disclosure of the same alkali materials as disclosed in Appellant's Specification for the second polishing step, Appellant contends "the results of polishing depend on more than just a particular composition of a polishing agent." Reply Br. 3. According to Appellant, "Kozasa does not suggest how such a second polishing step could be performed so that roughness decreases when using a solution with a pH of 12 or more." *Id.*

Based on our review of the foregoing, we conclude the rejection presently before us is not sustainable. "A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant."

Polaris Indus., Inc. v. Arctic Cat, Inc., 882 F.3d 1056, 1069 (Fed. Cir. 2018) (quoting *Ricoh Co., Ltd. v. Quanta Computer Inc.*, 550 F.3d 1325, 1332 (Fed. Cir. 2008)). Further, "a reference 'must [be] considered for all it taught, disclosures that diverged and taught away from the invention at hand as well as disclosures that pointed towards and taught the invention at hand.'" *Id.* (quoting *Ashland Oil, Inc. v. Delta Resins & Refractories, Inc.*, 776 F.2d 281, 296 (Fed. Cir. 1985)). Thus, "even if a reference is not found to teach away, its statements regarding preferences are relevant to a finding regarding whether a skilled artisan would be motivated to" modify the reference in the manner claimed. *Id.* (citing *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1051 n.15 (Fed. Cir. 2016) (en banc)).

Here, we conclude the rejection presently before us errs in not considering Kozasa for everything that it teaches, including disclosures that diverge or teach away from Appellant's claimed invention. It is undisputed that the only disclosure in Kozasa concerning the effects of using a polishing solution having a pH of "at least 12," as recited in claim 1, is that using a polishing solution having a pH equal to 12 increases rather than decreases surface roughness. *See* Kozasa, Fig. 4, 2:41–44, 6:16–25. Kozasa therefore indicates that, while a PH of 12 may be used, "the second polishing step . . . is *preferably* conducted at a pH value from pH10 or more to *less than pH12*." *Id.* at 2:28–33 (emphasis added), 6:67–7:6, 9:1–5 (claim 2). Kozasa, also, is silent concerning pH values of greater than 12. Even if these disclosures in Kozasa do not rise to the level of teaching away from decreasing the surface roughness of a wafer while supplying a polishing solution having a pH value of at least 12, they nonetheless are relevant to

determining whether a skilled artisan would have been motivated to modify Kozasa in such a manner.

There is little evidence of record to support the Examiner's conclusion that it would have been obvious to decrease the surface roughness of a wafer while supplying a polishing solution having a pH value of at least 12, even though Kozasa teaches that such a pH would increase surface roughness. We agree with the Examiner's conclusion that Kozasa indicates the pH value of a polishing agent solution is a result-effective variable when polishing semiconductor wafers. *See, e.g.*, Kozasa, 2:59–3:18. However, that fact alone is insufficient to overcome Kozasa's expressly stated preference for using pH values of less than 12 to decrease the surface roughness of a wafer. The Examiner, additionally, finds that under some conditions it may be that using pH values of at least 12 will decrease the surface roughness of a wafer. *See* Final Act. 3–4 (pertinent factors include pH value of the polishing agent solution, the initial roughness of the wafer, and load current); Ans. 4–6 (same). There is, however, no evidence of record to support this finding. For example, the Examiner does not cite any evidence of record that reflects knowledge or experience in the prior art of using pH values of at least 12 to decrease the surface roughness of a wafer, regardless of other conditions applied. Thus, we give little weight to the Examiner's speculation as to what might occur under various such conditions.

For the foregoing reasons, we do not sustain the Examiner's determination that it would have been obvious to modify Kozasa to decrease the surface roughness of a wafer while supplying a polishing solution having a pH value of at least 12.

c. Conclusion regarding claim 1

The Examiner's additional consideration of Hishiki does not cure the foregoing deficiencies of Kozasa. *See* Final Act. 3 (citing Hishiki for polishing pad having elevations, not for pH of polishing solution); Ans. 2–3 (same). Therefore, for the reasons provided above, we do not sustain the Examiner's rejection of claim 1 as unpatentable over Kozasa and Hishiki.

Claims 2–6 and 8–21

The Examiner's additional consideration of dependent claims 2–6 and 8–21 does not cure the foregoing deficiencies of Kozasa in relation to claim 1. *See* Final Act. 2–5. Therefore, for the reasons provided above, we do not sustain the Examiner's rejection of claims 2–6 and 8–21 as unpatentable over Kozasa and Hishiki.

CONCLUSION

In summary:

Claims Rejected	**35 U.S.C. §**	**References**	**Affirmed**	**Reversed**
1–6, 8–21	103	Kozasa, Hishiki		1–6, 8–21

REVERSED