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KUSNER & JAFFE
Paragon Center II
6150 Parkland Boulevard
Suite 105
Mayfield Heights, OH 44124

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PHAM, THOMAS T	

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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte THOMAS PLACH, KURT HINGERL,
MARKUS WIMPLINGER, and CHRISTOPH FLÖTGEN

Appeal 2019-006343
Application 14/414,795
Technology Center 1700

Before CATHERINE Q. TIMM, MICHAEL P. COLAIANNI, and JEFFREY R. SNAY, *Administrative Patent Judges.*

TIMM, *Administrative Patent Judge.*

DECISION ON APPEAL

STATEMENT OF THE CASE

Pursuant to 35 U.S.C. § 134(a), Appellant[1] appeals from the Examiner's decision to reject claims 1, 3, 4, 15–17, 23–29, 31–33, and 35. *See* Non-Final Act. 1. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM.

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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 the real party in interest as EV GROUP E. THALLNER GMBH. Appeal Br. 3.

CLAIMED SUBJECT MATTER

The claims are directed to a method for bonding substrates with a bond force as high as possible at a temperature that is as low as possible. Spec. ¶ 7. The method involves receiving a first substrate and a second substrate into a plasma chamber and generating a plasma of ionized gas that forms a reservoir (e.g., reservoir 5 of pores and channels in Figures 1a and 1b) by plasma treatment in at least the first substrate. Spec. ¶¶ 79–90. After plasma treatment, the reservoir is at least partially filled with a first educt (e.g., water) and the contact areas of the first and second substrates are brought together to form a hydrophilic pre-bond as shown in Figures 1a and 1b. Spec. ¶¶ 78, 92, 95. The second substrate has a growth layer (growth layer 8 shown in Figures 1a and 1b), which may be a thin layer of native oxide. Spec. ¶¶ 55, 91. A permanent bond is formed by reacting the first educt (e.g., water) with the growth layer (termed a second educt in claim 1). Spec. ¶¶ 55, 91. Claim 1, reproduced below, is illustrative of the claimed subject matter:

> 1. A method for bonding of a first contact area of a first substrate to a second contact area of a second substrate, the second substrate or each of the substrates having at least one reaction layer, said method comprising the steps of:
>
> receiving the first and second substrates into a plasma chamber, the plasma chamber having at least first and second generators,
>
> generating alternating current or alternating voltage at a first electrode with a first frequency (f21) with the first generator to produce plasma for forming a first reservoir in a first reservoir formation layer on the first contact area of the first substrate,
>
> generating alternating current or alternating voltage at a second electrode with a second frequency (f22) with the second

generator, the second frequency (f22) being different from the first frequency (f21),

at least partially filling the first reservoir with a first educt or a first group of educts,

forming a pre-bond interconnection between the first and second contact areas, the forming comprising bringing first portions of the first contact area of the first substrate into contact with first portions of the second contact area of the second substrate such that gaps are formed between second portions of the first contact area of the first substrate and second portions of the second contact area of the second substrate that are not brought into contact with each other, and

forming a permanent bond between the first and second contact areas, the permanent bond being at least partially strengthened by a reaction of the first educt filled in the first reservoir with a second educt contained in the at least one reaction layer of the second substrate, the reaction comprising deforming a growth layer provided between the second contact area and the at least one reaction layer of the second substrate, the deforming of the growth layer serving to reduce a distance between the second portions of the first contact areas of the first substrate and the second portions of the second contact area of the second substrate by bulging the second portions of the second contact area of the second substrate toward the second portions of the first contact area of the first substrate to close the gaps and at least partially strengthen the permanent bond.

Appeal Br. 20–21.

REFERENCES

The prior art relied upon by the Examiner is:

Name	Reference	Date
Koshiishi	US 2006/0037701 A1	Feb. 23, 2006
Kerdiles ’642	US 2006/0240642 A1	Oct. 26, 2006
Kerdiles ’072	US 2009/0294072 A1	Dec. 3, 2009

REJECTION

Claims 1, 3, 4, 15–17, 23–29, 31–33, and 35 are rejected under pre-AIA 35 U.S.C. § 103(a) as being unpatentable over Kerdiles ’642 and Kerdiles ’072, and Koshiishi. Non-Final Act. 3.

OPINION

Appellant does not argue any claim apart from the others. Appeal Br. 13–19. We select claim 1 as representative for deciding the issues on appeal.

Because Appellant has not identified a reversible error in the Examiner’s well-supported rejection, we affirm. In doing so, we adopt the findings of fact, analysis, and conclusions stated by the Examiner in the Office Action appealed from (Non-Final Act. of Nov. 19, 2018 at 3–8) as well as the Examiner’s well-reasoned responses to Appellant’s arguments (Ans. 6–10). We add the following primarily for emphasis.

At the heart of the Examiner’s rejection is the finding that the process suggested by Kerdiles ’642 as modified by Kerdiles ’072 is identical to the process recited in claim 1. Ans. 7. Based on this finding of identity, the Examiner finds that the method steps the ordinary artisan would perform using the method of the combination would inherently result in the formation of the various structures and bonds recited in claim 1. We determine the Examiner has provided a reasonable basis to conclude that, based on the similarities of the methods of the prior art, the formation of reservoirs, pre-bonds with gaps, growth layer deformation and bulging would inherently take place and the burden was shifted to Appellant to show that these results would not, in fact, necessarily occur in the method suggested by the prior art. Where an examiner has reason to believe that a characteristic or functional limitation in a claim may, in fact, be an inherent characteristic of the prior art, the examiner possesses the authority to require the applicant to prove that the subject matter shown to be in the prior art does not possess the characteristic the applicant is relying on for patentability. *In re Best*, 562 F.2d 1252, 1254–55 (CCPA 1977) (quoting *In re Swinehart*, 439 F.2d 210 (CCPA 1971). An examiner's belief is reasonable where starting materials and processing of the prior art are so similar to those disclosed by the applicant that it appears that the claimed function or property would naturally result when conducting the process as taught in the prior art. *See In re Spada*, 911 F.2d 705, 708 (Fed. Cir. 1990); *In re King*, 801 F.2d 1324, 1326 (Fed. Cir. 1986); *Best*, at 1255. In making this determination we are cognizant of the fact that the Examiner's finding is based on a combination of steps in two references. Thus, the burden for establishing inherency is high and must be carefully circumscribed in the context of obviousness. *Persion Pharm. LLC v. Alvogen Malta Operations Ltd.*, 945 F.3d 1184, 1191 (Fed. Cir. 2019). But it remains true that "'inherency may supply a missing claim limitation in an obviousness analysis' where the limitation at issue is 'the natural result of the *combination of prior art elements*'." *Id.* (quoting *PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1194 (Fed. Cir. 2014).

Before we can consider the inherency aspect of Appellant's arguments, we must first determine whether Appellant has identified a reversible error in the Examiner's finding of a suggestion to perform the method steps of the Kerdiles references together. We determine that Appellant has not identified such an error.

Both Kerdiles ’642 and Kerdiles ’072 are, like Appellant, concerned with bonding two semiconductor wafers together. Kerdiles’642 ¶ 7; Kerdiles’072 ¶ 39; Spec. ¶ 7. Both Kerdiles ’642 and Kerdiles ’072 describe their methods as useful in a Smart-Cut process. Kerdiles ’642 ¶ 10, 103; Kerdiles ’072 ¶ 111. Like Appellant, Kerdiles ’642 seeks to enhance the bonding of two semiconductor wafers using a temperature as low as possible. *Compare* Kerdiles ’642 ¶ 9, *with* Spec. ¶ 7. Kerdiles ’072 also describes this as a conventional technique. Kerdiles ’072 ¶ 17. While Kerdiles ’642 focuses on improvements to the plasma activation step of the bonding process (Kerdiles ’642 ¶¶ 10, 11), Kerdiles ’072 is concerned with other surface modification steps such as controlling the quantity of water absorbed at the surface. Kerdiles ’072 ¶¶ 30, 71.

The Examiner acknowledges that Kerdiles ’642 is silent as to the step of at least partially filling the first reservoir with a first educt, but relies on Kerdiles ’072 to support a finding for including such a step. Appellant couches the arguments in terms of a lack of a suggestion to combine the teachings of the Kerdiles references (Appeal Br. 13–16), but Appellant fails to address the specific factual support offered by the Examiner. Specifically, that each of the Kerdiles references disclose the use of their steps in a Smart-Cut process. A preponderance of the evidence supports the Examiner’s finding that the Kerdiles references suggest using the combination of steps together in a Smart-Cut process.

Given Appellant has not identified a reversible error in the Examiner’s finding of a reason to use the steps of the Kerdiles references together, the next question is whether Appellant has identified a reversible error in the Examiner’s finding that the resulting process is so similar to Appellant’s process that it is reasonable to believe it inherently creates the structures and performs the acts as recited in claim 1.

Appellant has not identified reversible error in the Examiner's inherency findings.

Like Appellant, Kerdiles '642 subjects the surface of at least one of the wafers to plasma activation. *Compare* Kerdiles '642 ¶ 66, *with* Spec. ¶ 23. Kerdiles '642 performs plasma activation "so as to create a disturbed region." Kerdiles '642. The Examiner finds that this disturbed region "acts as a reservoir suitable for receiving the gases and other elements on the surfaces to enhance subsequent bonding." Non-Final Act. 3–4. Kerdiles '642 supports this finding. Kerdiles '642 ¶ 75. Thus, a preponderance of the evidence supports the Examiner's finding that Kerdiles '642 forms the reservoirs required by claim 1.

As to the step of "at least at least partially filling the first reservoir with a first educt or a first group of educts," Appellant's Specification indicates that this limitation is met by applying water or exposing the reservoir to ambient atmosphere or atmospheric humidity. Spec. ¶¶ 43, 59. As found by the Examiner, Kerdiles '072 discloses applying water so it is absorbed at the surface of the wafer to a thickness that is controlled. Kerdiles '072 ¶ 71. Indeed, we disagree with Appellant that "the monolayers of Kerdiles '072 are not filled in reservoirs in the substrate, but are <u>*on the surface* of the substrate</u>." Appeal Br. 14. Kerdiles '072 specifically uses the term "absorbed." Kerdiles '072 ¶ 71. The water is absorbed at the surface, it is not *on* the surface. It is absorbed to a thickness albeit to a thickness less than that of the earlier prior art. *Id.* Kerdiles '072 also provides evidence that it was known in the art to provide several monolayers of absorbed water. Kerdiles '072 ¶ 20 ("As a function of their degree of hydrophily, the surfaces of the substrates have, after drying, several monolayers of adsorbed water, with these monolayers being at the origin of the intermolecular forces responsible for adhesion during contacting of the surfaces."); *see also* ¶ 71.

Nor can we agree with Appellant that the evidence supports a finding that "a monolayer of educt is <u>not sufficient to induce a reaction</u> that closes gaps by <u>*bulging*</u> the second portions of the second contact area of the second substrate toward the second portions of the first contact area" or that the disturbed and undisturbed regions of the substrate would react in a different manner than claimed. Appeal Br. 14–15. As pointed out by the Examiner (Ans. 8–9), this argument contradicts Appellant's Specification, which states that "[t]he reaction is suitable for allowing the growth layer to grow by 0.1 to 0.3 nm for a conventional wafer surface of a circular wafer with a diameter from 200 to 300 mm with 1 monolayer (ML) of water." Spec. ¶ 19. And even if true, Kerdiles '072 suggests using several monolayers and that substrates having several monolayers absorbed were conventional. Kerdiles '072 ¶¶ 20, 71. Native oxide on the Kerdiles's silicon wafers would be thin as well and Appellant provides no persuasive evidence or technical argument indicating that the process parameters of the Kerdiles's processes would not result in the transformations recited in claim 1. A preponderance of the evidence supports the Examiner's finding of inherency given the similarities in the materials and processes.

Appellant's arguments against the Examiner's interpretation of paragraphs 88 and 89 of Kerdiles '642 (Appeal Br. 17–18) are unpersuasive for the reasons given by the Examiner. Ans. 9–10.

CONCLUSION

The Examiner's decision to reject claims 1, 3, 4, 15–17, 23–29, 31–33, and 35 is affirmed.

DECISION SUMMARY

Claim(s) Rejected	**35 U.S.C. §**	**Reference(s)/Basis**	**Affirmed**	**Reversed**
1, 3, 4, 15–17, 23–29, 31–33, 35	103(a)	Kerdiles '642, Kerdiles '072, Koshiishi	1, 3, 4, 15–17, 23–29, 31–33, 35	

TIME PERIOD FOR RESPONSE

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

AFFIRMED