

The opinion in support of the decision being entered today was not written for publication and is not binding precedent of the Board.

Paper No. 33

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte SHINJI YOSHIHARA, FUMIO OHARA and MASAO NAGAKUBO

Appeal No. 2001-2082
Application No. 08/943,146

HEARD: AUGUST 14, 2002

Before KRASS, LALL and SAADAT, Administrative Patent Judges.
SAADAT, Administrative Patent Judge.

DECISION ON APPEAL

This is a decision on appeal from the Examiner's final rejection of claims 1-3 and 18-25, which are all of the claims pending in this application.

We reverse and enter a new ground of rejection under 37 CFR § 1.196(b).

BACKGROUND

Appellants' invention is directed to bonding of two substrates in a semiconductor device using a gold-silicon

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eutectic portion (specification, page 4). A surface portion on the first substrate designates the location of bonding with the second substrate (specification, pages 9 & 10). Layers of titanium and gold are deposited on the second substrate wherein the titanium layer deoxidizes a naturally formed oxide layer on the surface portion of the first substrate while the gold layer forms the gold-silicon eutectic portion (specification, pages 22 & 23). By eliminating the naturally formed silicon oxide, a uniform and void-free eutectic layer can be formed that contacts the entire surface portion resulting in a stable and uniform bonding interface (specification, page 23).

Representative independent claims 1 and 21 are reproduced as follows:

1. A semiconductor device comprising:

a first substrate having a surface portion made of silicon;

a second substrate bonded to the first substrate;

an eutectic portion of silicon and gold interposed between the first and second substrates to directly contact the surface portion of the first substrate at a first surface thereof and containing an oxide of metal that has deoxidized silicon oxide, the oxide of metal existing in the eutectic portion apart from the first substrate; and

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a gold layer interposed between the eutectic portion and the second substrate and directly contacting a second surface of the eutectic portion on an opposite side of the first substrate.

21. A semiconductor device comprising:

a first substrate having a surface portion;

a second substrate bonded to the first substrate only at the surface portion of the first substrate; and

an eutectic portion made of silicon and gold and interposed between the first substrate and the second substrate, the eutectic portion contacting the entire surface portion of the first substrate.

The Examiner relies on the following reference in rejecting the claims:

Mikkor	4,701,424	Oct. 20, 1987
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Claims 1-3 and 18-25 stand rejected under 35 U.S.C. § 102(b) as being anticipated by Mikkor.¹

Rather than reiterate the viewpoints of the Examiner and Appellants, we make reference to the answer (Paper No. 28, mailed September 12, 2000) for the Examiner's complete reasoning in support of the rejection, the appeal brief (Paper No. 27, filed

¹ The 35 U.S.C. § 112 rejection of claim 18, as indicated in the final rejection (Paper No. 19, mailed August 19, 1999) was overcome by Appellants' amendment to the claim (Paper No. 21, filed January 19, 2000). In an Advisory Action (Paper No. 25, filed May 23, 2000), the Examiner indicated that the amendment would be entered upon filing a Notice of Appeal.

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July 18, 2000) and the reply brief (Paper No. 29, filed November 13, 2000) for Appellants' arguments thereagainst.

OPINION

With respect to the rejection of claim 1, Appellants point out that the eutectic portion of Mikkor is formed by transformation of gold layer 5 which migrates through polysilicon layer 4 in the direction of thermal gradient (oral hearing, brief, page 6 and reply brief, page 3). Appellants argue that even if a part of gold layer 5 remains after migration, it would be within the layer, not outside the layer to form the claimed gold layer between the eutectic portion and the substrate (id.). Appellants further assert that the titanium layer of Mikkor is formed between the silicon oxide and the eutectic layer and functions as a barrier to the eutectic layer. Appellants conclude that the titanium layer of Mikkor cannot be included in the eutectic portion as an oxide because the titanium layer contacts the silicon oxide on a side opposite to the side where the eutectic reaction occurs (oral hearing, brief, page 7 and reply brief, page 2).

In response to Appellants' arguments, the Examiner points out that the thickness of Mikkor's gold layer is more than the claimed thickness and thus, both will have a part of gold

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remaining between the eutectic portion and the substrate (answer, page 4). The Examiner also asserts that "the Ti layers of Mikkor are substantially the same as the claimed Ti layers and should function the same way" (answer, page 5).

Before addressing the Examiner's rejection based on prior art, as pointed out by our reviewing court, we must first determine the scope of the claim. "[T]he name of the game is the claim." In re Hiniker Co., 150 F.3d 1362, 1369, 47 USPQ2d 1523, 1529 (Fed. Cir. 1998). Claims will be given their broadest reasonable interpretation consistent with the specification, and limitation appearing in the specification are not to be read into the claims. In re Etter, 756 F.2d 852, 858, 225 USPQ 1, 5 (Fed. Cir. 1985).

A review of claim 1 reveals that the claimed device requires that the eutectic portion of silicon and gold contain an oxide of metal that has deoxidized silicon oxide. The device is further required to include a gold layer between the eutectic portion and the second substrate. We find that Appellants' specification and figures 30-33 clearly describe the mechanism by which titanium from layer 114 diffuses through gold layer 115 to deoxidize the naturally oxidized silicon at the surface of silicon substrate 111 (specification, pages 22 & 23). Thus, by deoxidizing silicon

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oxide surface layer 113, gold-silicon eutectic portion 116e bonds the gold layer to the silicon substrate over the entire bonding area without voids in the bonding interface that may reduce the uniformity and strength of the bond (specification, page 23).

A rejection for anticipation under section 102 requires that the four corners of a single prior art document describe every element of the claimed invention, either expressly or inherently, such that a person of ordinary skill in the art could practice the invention without undue experimentation. See Atlas Powder Co. v. Ireco Inc., 190 F.3d 1342, 1347, 51 USPQ2d 1943, 1947 (Fed. Cir. 1999); In re Paulsen, 30 F.3d 1475, 1478-79, 31 USPQ2d 1671, 1673 (Fed. Cir. 1994).

Furthermore, to establish that the titanium layer and the eutectic portion of Mikkor must inherently function the same way as the metal in Appellants' claim 1, the evidence relied on by the Examiner "must make clear that the missing descriptive matter is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill." In re Robertson, 169 F.3d 743, 745, 49 USPQ2d 1949, 1950-1951 (Fed. Cir. 1999) citing Continental Can Co. V. Monsanto Co., 948 F.2d 1264, 1268, 20 USPQ2d 1746, 1749 (Fed. Cir. 1991).

"Inherency, however, may not be established by probabilities or

possibilities. The mere fact that a certain thing may result for a given set of circumstances is not sufficient." Id. 948 F.2d at 1269, 20 USPQ2d at 1749.

After a review of Mikkor, we agree with Appellants' assertion that the gold-silicon eutectic portion containing an oxide of metal that has deoxidized silicon oxide and the gold layer interposed between the eutectic portion and the second substrate are absent in the reference. As depicted in Fig. 1, Mikkor forms silicon oxide layer 2 over troughs in each of substrates 1A and 1B for preventing metal diffusion barrier 3 from reacting with the silicon substrate (col. 3, lines 27-34). Mikkor also forms a titanium/tungsten layer over the oxide layer as metal diffusion barrier 3 for blocking the diffusion of gold into the silicon substrate (col. 3, lines 35-43). The troughs are filled with polysilicon to the level of substrate surface and gold strip 5, having a width narrower than that of the trough, is formed on one of the substrates over the polysilicon-filled trough (col. 3, lines 44-51). Finally, the substrates are aligned, brought together and heated in a thermal gradient. As shown in Fig. 2, the gold layer and the silicon form eutectic droplet or line 6 which migrates through recrystallized silicon area 4 until it reaches barrier layer 3 and solidifies when the

temperature is reduced (col. 4, lines 1-17). Therefore, the silicon oxide and the titanium layers merely function as barrier layers and remain unchanged during the formation of the eutectic portion, i.e., the titanium layer neither deoxidizes the silicon oxide layer nor mixes with the eutectic portion. Furthermore, we find nothing in Mikkor related to any gold remaining after the migration and in particular, a gold layer left between eutectic line 6 and the substrate.

As discussed above, the Examiner provides no arguments to establish that the eutectic portion containing an oxide of titanium that deoxidized silicon oxide as well as the gold layer between the eutectic portion and the substrate are "necessarily present" in Mikkor's device and one of ordinary skill in the art would have recognized it. We find that the Examiner impermissibly relies on "probabilities or possibilities" to establish inherency. Accordingly, Mikkor cannot anticipate claim 1 and the rejection of independent claim 1 and claims 3, 18-20 and 25, which depend therefrom, under 35 U.S.C. § 102 over Mikkor cannot be sustained.

Turning to the rejection of claim 21, Appellants argue that Mikkor's substrates are bonded at the entire surface portion of titanium layer 3 whereas the gold eutectic layer contacts a

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portion of the surface portion (brief, page 8). Appellants conclude that Mikkor's disclosure lacks the claimed features of the substrates bonded only at a surface portion of the first substrate and the eutectic portion contacting the entire surface portion (id.). We note that the Examiner does not challenge these arguments and instead, dismisses the claimed features as process limitations (answer, pages 3 & 5).

A review of claim 21 confirms that the claim requires bonding the first and the second substrates only at a surface portion of the first substrate. The claim further recites a gold-silicon eutectic portion interposed between the two substrates contacting the entire surface portion on the first substrate. Therefore, the two substrates are bonded through a eutectic portion and only at the surface portion of the first substrate.

Based on our analysis of Mikkor above, we agree with Appellants that Mikkor's substrates are bonded at the surface of Titanium layer 3 relating to a surface portion of the first substrate. However, eutectic portion 6 of Mikkor contacts only a part of the surface of the titanium layer and cannot be equated with the eutectic portion "contacting the entire surface portion of the first substrate," as recited in claim 21. Therefore,

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based on the Examiner's failure to establish a prima facie case of anticipation with respect to claim 21, we do not sustain the 35 U.S.C. § 102 rejection of claims 21-24 over Mikkor.

CONCLUSION

In view of the foregoing, the decision of the Examiner rejecting claims 1-3 and 18-25 under 35 U.S.C. § 102 is reversed.

We make the following new ground of rejection for claims 21 and 22 under 35 U.S.C. § 102 as being anticipated by Shimbo² pursuant to 37 CFR § 1.196(b). We only consider independent claim 21 and dependent claim 22, but encourage the Examiner to consider other claims that depend from claim 21 for possible rejections over Shimbo alone or in combination with other prior art.

Claims 21 and 22 are rejected under 35 U.S.C. § 102(b) as being anticipated by Shimbo. Shimbo is related to a method of bonding two silicon bodies without an adhesive agent for improving the stress induced inaccuracies in measuring pressure. However, Shimbo discloses a conventional semiconductor pressure transducer that uses a gold-silicon eutectic alloy for bonding the two substrates (Figure 1 and col. 1, line 57 through col. 2,

² Shimbo et al. (Shimbo) 4,671,846
(a copy of which is attached to this decision)

June. 9, 1987

line 22). Shimbo discloses a semiconductor device (semiconductor pressure transducer) comprising a first substrate (single-crystal silicon plate 1) having a surface portion (the lower end of ring portion 1b) as recited in Appellants' claim 21. Shimbo further discloses the claimed second substrate (substrate 3) bonded to the first substrate only at the surface portion of the first substrate (thick ring portion 1b whose lower end is bonded to the upper surface of the substrate 3). Shimbo specifically discloses that a eutectic portion made of silicon and gold is interposed between the first substrate and the second substrate (Au-Si eutectic alloy layer 4) and contacts the entire surface portion of the first substrate (eutectic layer 4 directly contacts the entire lower end of ring portion 1b). With respect to claim 22, the reference also shows that the eutectic portion directly contacts the entire surface portion (eutectic layer 4 directly contacts the entire lower end of ring portion 1b without any other layer interposed in between).

As discussed above, Shimbo teaches all the limitations of independent claim 21 and dependent claim 22. Accordingly, claims 21 and 22 are rejected under 35 U.S.C. § 102 as being anticipated by Shimbo.

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In addition to reversing the Examiner's decision rejecting the claims, this decision contains a new ground of rejection pursuant to 37 CFR § 1.196(b). 37 CFR § 1.196(b) provides that "[a] new ground of rejection shall not be considered final for purposes of judicial review."

37 CFR § 1.196(b) also provides that the appellant, WITHIN TWO MONTHS FROM THE DATE OF THE DECISION, must exercise one of the following two options with respect to the new grounds of rejection to avoid termination of proceedings (37 CFR § 1.197(c)) as to the rejected claims:

(1) Submit an appropriate amendment of the claims so rejected or a showing of facts relating to the claims so rejected, or both, and have the matter reconsidered by the examiner, in which event the application will be remanded to the examiner. . . .

(2) Request that the application be reheard under § 1.197(b) by the Board of Patent Appeals and Interferences upon the same record. . . .

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

REVERSED
37 CFR § 1.196(b)

ERROL A. KRASS)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
PARSHOTAM S. LALL)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
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