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Datasheet for the decision of 6 March 2018

Case Number: T 1213/14 - 3.4.03

Application Number: 10008732.9

Publication Number: 2398041

IPC: H01L21/00, H01L21/687, H01L21/68

Language of the proceedings: EN

Title of invention:
Method and apparatus for removing a reversibly mounted device wafer from a carrier substrate

Applicant:
Brewer Science Inc.

Headword:

Relevant legal provisions:
EPC Art. 52(1), 56, 123(2)

Keyword:
Inventive step - after amendment - (yes)

Decisions cited:

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It can be changed at any time and without notice.

Catchword:

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Beschwerdekammern

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Case Number: T 1213/14 - 3.4.03

D E C I S I O N
of Technical Board of Appeal 3.4.03
of 6 March 2018

Appellant: (Applicant)	Brewer Science Inc. 2401 Brewer Drive Rolla, MO 65401 (US)
Representative:	Uexküll & Stolberg Partnerschaft von Patent- und Rechtsanwälten mbB Beselerstraße 4 22607 Hamburg (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 3 January 2014 refusing European patent application No. 10008732.9 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	G. Eliasson
Members:	S. Ward
	C. Schmidt

Summary of Facts and Submissions

I. The appeal is against the decision of the Examining Division refusing European patent application No. 10 008 732 on the grounds that the subject-matter of claim 1 (of all requests) was not new within the meaning of Articles 52(1) and 54 EPC. Furthermore, the claimed subject-matter failed to meet the requirements of Article 123(2) EPC (first, second and third auxiliary requests), and failed to meet the requirements of Article 84 EPC (second and third auxiliary requests).

II. At the end of the oral proceedings held before the Board the appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of:
- claims 1 to 5 of the main request labeled "14:15" and filed at the oral proceedings before the Board;
- description: pages 1 to 5, 5a, 5b and 6 to 42 as filed at the oral proceedings before the Board; and
- figures: sheets 1/11 to 11/11 as originally filed.

III. The following document is referred to:

D1: US 2009/0218560 A1

IV. Claim 1 reads as follows:

"A method of forming a temporary wafer bonding structure (10), said method comprising:
- providing a first substrate (12) having front (14) and back (16) surfaces;
and

- forming a bonding layer (40) formed of bonding material on said front surface (14) of said first substrate (12);
further characterized by:
- said bonding layer (40) being on and across said front surface (14) of said first substrate (12);
- providing a second substrate (22) having front (24) and back (26) surfaces, said front surface (24) of said second substrate (22) having a central region (30) and a peripheral region (28);
- applying a protective material to said peripheral region (28) of said front surface (24) of the second substrate (22) to form a layer of a mask (36) adjacent said peripheral region (28);
- depositing a surface modifying composition in said central region (30) to yield a surface-modified region having a surface to which said bonding material cannot strongly adhere, wherein said protective material used to form the mask (36) does not react with said surface modifying composition; said front surface (24) having
- said surface-modified region at said central region (30) having a surface to which said bonding material cannot strongly adhere, and
- a non-modified region at said peripheral region (28) which is coated with the mask (36);
- contacting said front surface (24) of said second substrate (22) with said bonding layer (40) on said first substrate (12) under heat and pressure, said mask (36) reflowing into said bonding layer (40) to create a uniform bonding layer, to thereby form said temporary bonding structure (10), said bonding layer (40):
- being distributed substantially uniformly along the front surface (14) of said first substrate (12) and along the front surface (24) of said second substrate (22), contacting the surface-modified region at said central region (30), and being bonded with said mask

(36) at said peripheral region (28), said protective material used to form the mask (36) being of the same material, or of a similar or compatible material, as the bonding material, so that said mask (36) and said bonding layer (40) reflow together to form a uniform bonding layer (40)."

Reasons for the Decision

1. The appeal is admissible.

2. *Article 123(2) EPC*

Claim 1 is based in part on claims 1, 4 and 6-8 as originally filed. The claim is now restricted to, and includes features of, the embodiment depicted in Fig. 2 and described on page 19, line 15 to page 23, line 8. Claims 2-5 are based on claims 2, 3, 10 and 11 as originally filed. The description has been adapted to the current set of claims. The present request is therefore considered to meet the requirements of Article 123(2) EPC.

3. *Inventive Step*

3.1 Document D1 discloses numerous temporary wafer bonding structures and methods for their production. The disclosed structures generally comprise two substrates bonded to each other, the bonding strength being weak in a central region (to facilitate subsequent separation) and strong in a peripheral region (to provide sufficient strength to allow backside

processing), as is also the case for the structures described in the present application.

3.2 According to the embodiment of Fig. 4 of D1, a suitable distribution of bonding strengths may be achieved by providing a strongly adhesive edge bond (46) between the substrates at the peripheral region, and a layer (50) on one of the substrates in the central region which "can be a low adhesive strength layer such as an anti-stick coating" (paragraph [0063]), or alternatively "could also represent an area on the front surface 14 of the first substrate 12 that has been chemically modified to obtain a permanent non-stick surface layer or a surface layer to which a fill material cannot strongly bond" (paragraph [0064]). Suitable chemical modification may include treatment of a silicon surface with a hydrophobic organosilane (as also described in the present application).

Paragraph [0064] does not disclose the full details of a manufacturing method, and in particular how the chemical modification is confined to the central area of the front surface, as depicted in Fig. 4.

3.3 A more detailed account of the manufacture of such a chemically modified embodiment is provided in Example 1 (entitled "Edge Surface Adhesively Bonded and Center Surface Chemically Modified") in paragraphs [0075]-[0076]. In this example, a layer of epoxy-based photoresist dispensed onto the outer edge of a silicon wafer protects the surface of the wafer during chemical modification, "leaving the edge untreated from the fluorinated silane solution".

The layer of epoxy-based photoresist therefore serves as a mask (although the term is not expressly employed

in D1) within the meaning of claim 1 of the present application. The method disclosed in Example 1 of D1 (together with the associated disclosure of paragraph [0064] and Fig. 4) is therefore seen as representing the closest prior art. The Board notes that Example 2 of D1 describes a very similar method involving chemical modification, and would represent an alternative, and equally good, starting point.

3.4 The following features of claim 1 of the present request are not disclosed in the closest prior art:

(a) "said protective material used to form the mask (36) does not react with said surface modifying composition";

(b) "said mask (36) reflowing into said bonding layer (40) to create a uniform bonding layer, to thereby form said temporary bonding structure (10)";

(c) "said bonding layer (40) being bonded with said mask (36) at said peripheral region (28)"; and

(d) "said protective material used to form the mask (36) being of the same material, or of a similar or compatible material, as the bonding material, so that said mask (36) and said bonding layer (40) reflow together to form a uniform bonding layer (40)."

It is clear from all of the above features that the mask remains in place not only during the chemical modification phase, but also during the subsequent bonding phase, so that the mask forms part of the final temporary wafer bonding structure. By contrast, in Example 1 of D1, following the chemical modification

treatment and prior to the bonding phase, the "epoxy-based photoresist was removed using acetone in a spin coater".

3.5 The problem solved by the distinguishing features may be regarded as providing a simpler manufacturing method without compromising the strength with which the substrates are bonded together.

3.6 The claimed method represents a simplification of the method of the closest prior art in that the step of removing the mask is omitted.

Moreover, the protective material of which the mask is made is selected such that strong bonding in the peripheral region is guaranteed despite the mask being left in place in the final product. According to the claimed invention, this is achieved in two ways.

3.7 Firstly, according to feature (a), the protective material used to form the mask does not react with the surface modifying composition. This ensures that the exposed surfaces of the mask are not rendered non-stick or capable of only weakly adhering to the bonding material as a result of the chemical modification treatment.

3.8 Secondly, according to feature (d), the protective material used to form the mask is of the same material, or of a similar or compatible material, as the bonding material, so that, under heat and pressure, the mask and the bonding layer reflow together to form a uniform bonding layer. As a result, the bonding layer in the peripheral region strongly adheres to both substrates.

3.9 There is no suggestion in the examples of D1 of the possibility of retaining the epoxy-based photoresist in the final bonded product.

In the contested decision it was argued that the edge bond (46) in Fig. 4 (which is certainly present in the final product) could be identified with the claimed mask. It is not necessary for the Board to judge whether this identification was reasonable in relation to the claims then on file; it is sufficient to note that such an identification cannot be made in relation to the current claims. Neither in Fig. 4, nor in paragraph [0064] is it disclosed or suggested that the edge bond acts as a mask in the sense defined in present claim 1, i.e. ensuring that during the application of a surface modification composition, the peripheral region, which is coated with the mask, is not chemically modified.

3.10 The Board sees nothing in D1 or the other available prior art which would lead the skilled person, in an obvious manner, to the claimed solution of the problem posed above. Consequently, the subject-matter of claim 1 involves an inventive step within the meaning of Articles 52(1) and 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to grant a patent in the following version:

   - claims 1 to 5 of the main request labeled "14:15" and filed at the oral proceedings before the Board;

   - description: pages 1 to 5, 5a, 5b and 6 to 42 as filed at the oral proceedings before the Board; and

   - figures: sheets 1/11 to 11/11 as originally filed.

The Registrar: The Chairman:

S. Sánchez Chiquero G. Eliasson

Decision electronically authenticated