Method for Bonding Substrates

Specification

The invention relates to a method for bonding.

In the semiconductor industry, substrates are connected to one another permanently or temporarily by so-called bonding processes.

By a bonding process, for example, substrates with different functional units, for example substrates with memory chips and microcontrollers, can be stacked on top of one another. A substrate stack with more complex properties is obtained by the stacking and permanent attachment of multiple substrates with different properties. The thus produced substrate stacks have a thickness of a few hundred micrometers.

The bonding technology, however, can also be used for temporary attachment of a substrate and/or a substrate stack. In this case, a product substrate is attached under pressure and/or temperature by means of an adhesive to a carrier substrate. After the processing of the product substrate, the product substrate is detached again from the carrier substrate.

The greatest problem in the state of the art consists in the alignment and the permanent attachment of multiple extremely thin substrates. The stacking

of such thin substrates produces a substrate stack, a so-called "multi-stack." In order to avoid the difficult and cumbersome handling of thin substrates, the alignment and bonding process is performed on substrates with a defined standard thickness. After a second substrate was bonded to a first substrate, the back-thinning of the second substrate is carried out. By the back-thinning process, a thin substrate is produced from a formerly thick substrate. Optionally, another, third, thick substrate, whose thickness is reduced in another back-thinning process, is to be bonded on this second, back-thinned substrate. Substrate stacks of any functionality can thus be produced by the process that theoretically can be repeated often at will.

A technical problem consists in that a permanent bond cannot be reversed, so that in the case of a misalignment and/or damage, the entire substrate stack constructed up to that point is unusable. A substrate stack that consists of multiple substrates can be worth tens of thousands of Euros.

Embodiments of this invention disclose a method that at least partially, preferably predominantly, solves the above-mentioned problems. In addition, embodiments of this invention disclose a production of bonds that is economical and in particular as scrap-free as possible.

According to an aspect, there is provided a method for bonding a first substrate to a second substrate, the method comprising: thinning the first substrate and/or the second substrate; prior to or after the thinning, fixing the first substrate and/or the second substrate to surfaces of respective elastically deformable carriers; and after the fixing and the thinning, bonding the first substrate to the second substrate by deforming at least one of the carriers, wherein a frame is disposed on each of the carrier surfaces, wherein an upper surface of the frame defines a carrier attaching surface, wherein each of the fixed first and/or second substrates has a side that faces away the carrier surface, and wherein, relative to the carrier surface, a height of the side of the fixed first and/or second substrates is less than a height of the carrier attaching surface.

Falling within the scope of the invention are also all combinations of at least two of the features indicated in the specification, the

CLAIMS:

1. A method for bonding a first substrate to a second substrate, the method comprising:

thinning the first substrate and/or the second substrate;

prior to or after the thinning, fixing the first substrate and/or the second substrate to surfaces of respective elastically deformable carriers; and

after the fixing and the thinning, bonding the first substrate to the second substrate by deforming at least one of the carriers,

wherein a frame is disposed on each of the carrier surfaces,

wherein an upper surface of the frame defines a carrier attaching surface,

wherein each of the fixed first and/or second substrates has a side that faces away the carrier surface, and

wherein, relative to the carrier surface, a height of the side of the fixed first and/or second substrates is less than a height of the carrier attaching surface.

2. The method according to claim 1, wherein, during the thinning, the first substrate and/or the second substrate is/are thinned to a thickness of less than 1,000 µm.

3. The method according to claim 1, wherein the first substrate and the second substrate are at least partially congruent in shape and/or have similar geometric dimensions.

4. The method according to claim 1, further comprising:

aligning the first substrate and the second substrate with one another before the bonding, said aligning based on corresponding alignment markings of the first and second substrates; and

pre-attaching the first substrate to the second substrate after the aligning and before the bonding.

5. The method according to claim 1, wherein said elastically deformable carriers are respectively included in substrate attachments to which said first substrate and/or said second substrate are respectively attached prior to or after the thinning, and

wherein the substrate attachments respectively have substrate attaching surfaces, the substrate attaching surfaces being configured to respectively attach said first and/or second substrates, and

wherein said carrier attaching surfaces respectively surround the substrate attaching surfaces, said carrier attaching surfaces being configured to mutually attach the substrate attachments.

6. The method according to claim 1, wherein the carrier attaching surfaces are magnetized.

7. The method according to claim 1, wherein said carriers are respectively attached to ring-shaped frames.

8. The method according to claim 3, wherein the first substrate and the second substrate are congruent in shape at least in relation to a cross-sectional surface that is parallel to a bonding surface of each of the first and second substrates.

9. The method according to claim 4, wherein the aligning of the first and second substrates is to an alignment accuracy of greater than 100 μm.

10. The method according to claim 4, wherein the pre-attaching of the first substrate to the second substrate is performed magnetically.

11. The method according to claim 1, wherein the carriers are respectively stretched over frames of substrate attachments that respectively comprise said carriers.

12. The method according to claim 1, wherein the carriers are respectively comprised of elastic films.

13. The method according to claim 1, wherein the bonding comprises applying a centrically-oriented pressure to at least one of the carriers to respectively bring at least one of the thinned and fixed substrates toward another one of the thinned and fixed substrates, the applying of the pressure serving to deform the at least one of the carriers.

14. The method according to claim 13, wherein the centrically-oriented pressure is applied by pins.

15. The method according to claim 13, wherein the centrically-oriented pressure is applied by mandrels.