Method and Device for Bonding Substrates

This invention relates to a method for bonding a first contact surface of a first substrate with a second contact surface of a second substrate as well as a corresponding device.

Alignment systems are known in which the alignment of the substrates with one another takes place under a normal atmosphere. The substrates that are aligned with one another are still temporarily attached to one another in the alignment system and are subsequently transferred to a high-vacuum bonding system and permanently bonded there under vacuum, whereby the temperature that is necessary for bonding is produced by heat sources.

The heat sources together with corresponding pressure plates are located above or below the substrates that are to be bonded. The upper heat source and the upper pressure plate are designed to be movable. The lower heat source and the specimen holder on the bottom of the high-vacuum bonding system are designed statically.

In the alignment system, the two substrates that are to be aligned with one another are attached to a bond chuck (English: bond chuck). In this case, the attachment is carried out in most cases with mechanical clamps. The substrates that are received in the bond chuck and are aligned with one another are then transported to the high-vacuum bonding system. The bond chuck is laid down on the lower heat source.

Because of the structures that are becoming steadily smaller, deformations of the substrates that occur because of thermal action have a negative effect on the bonding result.

Embodiments of this invention disclose a method with which the bonding result is improved.

According to a first aspect of the present invention, there is provided a receiving system for accommodating a substrate stack, ~~characterized in that~~wherein the receiving system is configured such that the substrate stack is only fixed in a peripheral area of the substrate stack, wherein the receiving system comprises: mechanical clamps for clamping the sides of the substrate stack in the peripheral area of the substrate stack; and an attaching unit for temporarily prefixing substrates of the substrate stack, wherein the attaching unit is configured to temporarily prefix the substrates of the substrate stack by a tacking method, wherein the tacking is done with heat application; and wherein laser radiation is used for the heat application.

According to a second aspect of the present invention, there is provided a handling system for handling a substrate stack, including the receiving system of the first aspect.

According to a third aspect of the present invention, there is provided a device for aligning and bonding substrates, including at least an alignment unit, a bonding unit and a transfer section between the alignment unit and the bonding unit for transferring the substrates from the alignment unit to the bonding unit, wherein within the transfer section ~~there is~~comprising the handling system according to the second aspect.

According to a fourth aspect of the present invention, there is provided a method for accommodating a substrate stack, ~~characterized in that the substrate stack is accommodated only in a peripheral area of the substrate stack, wherein the substrate stack comprises mechanical clamps for clamping the sides of the substrate stack in the peripheral area of the substrate stack~~ clamping the sides of the substrate stack only in a peripheral area of the substrate stack using mechanical clamps; and temporarily prefixing substrates of the substrate stack using an attaching unit, wherein the prefixing comprises a tacking fixing method, wherein the tacking is done with heat application; and wherein laser radiation is used for the heat application.

According to a fifth aspect of the present invention, there is provided a method for transferring a substrate stack, ~~characterized in that the substrate stack is accommodated only in a peripheral area of the substrate stack, wherein the substrate stack comprises mechanical clamps for clamping the sides of the substrate stack in the peripheral area of the substrate stack~~, the method comprising the steps of: clamping the sides of the substrate stack only in a peripheral area of the substrate stack using mechanical clamps; and temporarily prefixing substrates of the substrate stack using an attaching unit, wherein the prefixing comprises a tacking fixing method, wherein the tacking is done with heat application; and wherein laser radiation is used for the heat application.

Also, all combinations that consist of at least two of the features indicated in the specification, the claims and/or the figures fall within the scope of the invention. In the indicated ranges of values, values lying within the above-mentioned limits are also to be disclosed as boundary values and can be claimed in any combination.

The basic idea of embodiments this invention is to heat the substrates of the substrate stack that is aligned at the contact surfaces of the substrates for the, in particular, permanent bonding in the bonding system gently and uniformly from two surfaces to be heated (the sides facing away from the contact surfaces) of the substrate in order to minimize or to completely avoid in particular different deformations of the two substrates.

Embodiments of the invention describe in particular a modularized device as well as a process chain, which makes it possible to implement an alignment system for alignment and for temporary connection of two or more substrates to a substrate stack. In this case, the substrates that are aligned herein are transferred to a bonding system taking into consideration an especially sensitive path over a high-vacuum transfer section (i.e.,

CLAIMS:

1. A receiving system for accommodating a substrate stack, ~~characterized in that~~ wherein the receiving system is configured such that the substrate stack is only fixed in a peripheral area of the substrate stack,

wherein the receiving system comprises:

mechanical clamps for clamping the sides of the substrate stack in the peripheral area of the substrate stack; and

an attaching unit for temporarily prefixing substrates of the substrate stack, wherein the attaching unit is configured to temporarily prefix the substrates of the substrate stack by a tacking method,

wherein the tacking is done with heat application; and

wherein laser radiation is used for the heat application.

~~2. The receiving system according to claim 1 or 2, wherein the receiving system further comprises an attaching unit for prefixing substrates of the substrate stack, wherein the attaching unit comprises one or more of the following fixing methods:~~
~~- magnetic fixing~~
~~- mechanical fixing~~
~~- electrostatic attraction force, or~~
~~- tacking.~~

~~3. The receiving system according to claim 2, where the tacking is done with~~
~~a) electricity, or~~
~~b) heat application~~

~~4. The receiving system according to claim 3, wherein laser radiation is used for the heat application.~~

~~5~~2. A handling system for handling a substrate stack, comprising the receiving system ~~according to one of the preceding claims~~of claim 1.

~~6~~3. The handling system according to claim ~~5~~3, wherein the handling system comprises a robot.

~~7~~4. A device for aligning and bonding substrates, comprising at least an alignment unit, a bonding unit and a transfer section between the alignment unit and the bonding unit for transferring the substrates from the alignment unit to the bonding unit, wherein within the transfer section ~~there is~~comprises the handling system according to claim ~~5~~2 or ~~6~~3 for transferring the substrates.

~~8~~5. The device according to claim ~~7~~4, wherein the transfer section comprises a vacuum transfer section.

~~9~~6. The device according to claims ~~7~~4 or ~~8~~5, wherein at least the alignment unit, the bonding unit and the transfer section are configured as independently controllable modules.

~~10~~7. A method for accommodating a substrate stack, ~~characterized in that~~ the method comprising the steps of:

~~the substrate stack is accommodated only in a peripheral area of the substrate stack,~~

~~wherein the substrate stack comprises mechanical clamps for~~ clamping the sides of the substrate stack only in ~~the~~a peripheral area of the substrate stack using mechanical clamps; and

temporarily prefixing substrates of the substrate stack using an attaching unit, wherein the prefixing comprises a tacking fixing method,

wherein the tacking is done with heat application; and

wherein laser radiation is used for the heat application.

~~11~~8. A method for transferring a substrate stack, ~~characterized in that~~ the method comprising the steps of:

~~the substrate stack is accommodated only in a peripheral area of the substrate stack,~~

~~wherein the substrate stack comprises mechanical clamps for~~ clamping the sides of the substrate stack only in ~~the~~a peripheral area of the substrate stack using mechanical clamps; and

temporarily prefixing substrates of the substrate stack using an attaching unit, wherein the prefixing comprises a tacking fixing method;

wherein the tacking is done with heat application; and

wherein laser radiation is used for the heat application.

~~12~~9. The method according to claim ~~11~~8, wherein the substrate stack is transferred from an alignment unit to a bonding unit.