

Device and method for Bonding substrates

The present invention relates to a method for Bonding a first substrate to a second substrate and a corresponding device according to the coordinate claims.

In the prior art, a great many methods exist in order to bond two substrates to one another. Independently of the fundamental bonding process, it is almost always the case that at least one first substrate is convexly curved and centrally brought into contact with a second substrate. The whole-surface bond then comes about due to a continuous contacting from the centre to the edge of the substrates. This type of contacting is found again in the case of fusion and metal bonding, but also in the case of temporary bonding. Other options for contacting exist, particularly in the case of the fixing of a substrate on a film. Thus, a film is very often laminated onto a substrate. In this case, the contacting process predominantly takes place by means of a manipulation of the film. The substrate is fixed and held flat in this case. A special device, what is known as a laminator, subsequently pulls a film over the substrate. The film may be fixed on the substrate by means of mechanical elements, particularly rollers, or simply only by lowering.

Embodiments of the present invention provide a device and a method for bonding two substrates, using which the bonding accuracy is increased.

All combinations of at least two features specified in the description, the claims and/or the drawings also fall within the scope of the invention. When value ranges are given, values lying inside the limits mentioned should also be considered as disclosed as limit values and claimable in any desired combination.

According to a first aspect of the present invention, there is provided a method for bonding a first substrate to a second substrate at contact surfaces of the substrates, with the following steps, particularly the following procedure:

- mounting the first substrate on a first mounting surface of a first substrate holder and mounting the second substrate on a second mounting surface of a second substrate holder, wherein the substrate holders are arranged in a chamber, which can be closed in a vacuum-tight manner in particular,

- contacting the contact surfaces at an, in particular annular, bond initiation surface, wherein a circular contacting is conducted,
- bonding the first substrate to the second substrate from the bond initiation surface to the centre of the substrates.

In an embodiment of the above aspect, after contacting and/or during bonding, a chamber pressure in the chamber is increased.

In an embodiment of the above aspect, the bond initiation surface is arranged at the circumferential edge of at least one of the contact surfaces.

In an embodiment of the above aspect, prior to contacting, a concave deformation of the first substrate takes place with respect to the second substrate, particularly by mounting the first substrate on the correspondingly concavely curved first mounting surface.

In an embodiment of the above aspect, the, particularly closed-circumference, bond initiation surface is constructed to run in an annular, particularly circular manner, preferably concentrically to the centre of the substrates.

In an embodiment of the above aspect, the first substrate and/or the second substrate are fixed at the rear on the first and/or second mounting surfaces, exclusively in the region of side edges of the contact surfaces.

According to a second aspect of the present invention, there is provided a device for bonding a first substrate to a second substrate at contact surfaces of the substrates, having:

- a first mounting surface of a first substrate holder (10) for mounting the first substrate,
- a second mounting surface of a second substrate holder for mounting the second substrate,
- a chamber, which can be closed in a vacuum-tight manner in particular, and in which the substrate holders are arranged,
- means for contacting the contact surfaces at an, in particular annular, bond initiation surface, wherein a circular contacting is conducted,

- means for bonding the first substrate to the second substrate from the bond initiation surface to the centre of the substrates.

Embodiments of the invention are based on the idea that bonding of the substrates takes place from an annular bond initiation surface to a centre of the contact surfaces. Preferably, at least one of the two substrates, preferably the second and/or upper substrate, is concavely deformed with respect to the other substrate prior to contacting, for aligning the contact surfaces. Deformation in particular means a state deviating from an initial state, particularly initial geometry, of the substrates. The bonding is preferably initiated after contacting the contact surfaces, particularly by dropping/releasing the first/upper substrate, preferably supported by means of a pressure increase. Corresponding bonding means are provided in accordance with the device.

Embodiments of the invention relate to a method and a device for bonding/laminating a second substrate, particularly wafers, to a second substrate, particularly another wafer or a film. The second substrate can also be termed a support in particular. In this case, the idea is based on the thought of fixing the substrate in a concave shape on a concavely shaped substrate holder, concavely contacting, particularly prefixing, with a different substrate at a bond initiation surface and subsequently utilizing a pressure difference for generating a homogeneous pressure on the surface of the substrate to be bonded, in order to create the whole-surface bond. The pressure difference is generated between a cavity formed by the contacted contact surfaces of the substrates and the chamber space. It is also conceivable that the substrate holder can curve its surface, particularly concavely, by means of control elements.

A homogeneous pressure distribution advantageously ensures a uniform contact force of the second substrate onto the first substrate, as due to the use of a homogeneous pressure, a uniform application of pressure takes place over the entire surface of the substrate. Furthermore, a pressure difference, which can easily be generated, can be used and it is possible to dispense with the use of pins or other mechanical elements which only act with a local force.

Embodiments of the invention consist in the use of an isostatic pressure, in order to fix one, particularly rigid, substrate on a different substrate, which may also be rigid. The substrate to be fixed is in this case curved in a concave manner prior to generating the pressure difference and therefore only rests by way of the boundary surface (bond initiation surface). The idea according to embodiments of the invention is not only limited to the bonding or laminating of a film to a substrate, but rather preferably relates to two, in particular rigid, substrates. The idea according to embodiments of the invention can in particular also be used for fusion or metal bonding. Preferably, the method according to embodiments of the invention and the device according to embodiments of the invention are used for the temporary bonding, however. The thickness of a film used according to embodiments of the invention lies between 1 μm and 4000 μm , preferably between 1 μm and 3500 μm , more preferably between 1 μm and 3000 μm , most preferably between 1 μm and 2500 μm , most preferably of all between 1 μm and 2000 μm .

Substrates

Different types of substrates are mentioned, wherein (particularly structured) wafers, particularly with an adhesive layer, and frames with film come into question. Substrates of this type are known per se to the person skilled in the art. The substrates may have an adhesive layer. The thickness of the adhesive layer lies between 1 μm and 250 μm , preferably between 2 μm and 200 μm , more preferably between 3 μm and 100 μm , most preferably between 3 μm and 50 μm , most preferably of all between 3 μm and 10 μm .

Substrate holder

Substrate holders with a planar mounting surface or a concavely curved mounting surface in particular come into question as substrate holders. The substrate holders preferably have fixings for retaining/fixing/mounting the substrates. The fixings may in particular be

1. mechanical fixings, particularly clamps, and/or
2. vacuum fixings, particularly with individually controllable and/or mutually connected vacuum tracks, and/or
3. electrical fixings, particularly electrostatic fixings, and/or
4. magnetic fixings, and/or