this way the lower substrate is not subjected to boundary conditions and can bond freely to the upper substrate during the bonding process. An important feature in the prior art is primarily the flat fixing of a substrate, generally by means of a vacuum device.

The run-out faults which arise are more dramatic in most cases radially symmetrically around the contact site, therefore increase from the contact site to the periphery. In most cases it is a linearly increasing intensification of the run-out faults. Under special conditions the run-out faults can also increase nonlinearly.

Under especially optimum conditions the run-out faults can be determined not only by corresponding measuring devices (EP2463892), but can also be described by mathematical functions. Since the run-out faults constitute translations and/or rotations and/or scalings between well defined points, they are preferably described by vector functions. Generally this vector function is a function $f:R^2 \rightarrow R^2$, therefore am imaging standard which images the two-dimensional definition region of the local coordinates onto the two- dimensional value range of run-out vectors. Although an exact mathematical analysis of the corresponding vector fields could not be done, assumptions are made with respect to the function properties. The vector functions are with great probability c^n $n>=1$ functions, therefore they are continuously differentiable at least once. Since the run-out faults increase from the contact-making point toward the edge, the divergence of the vector function will probably be different from zero. The vector field is therefore with great probability a source field.

Embodiments of this invention provide a device and a method for bonding of two substrates with which the bond precision, especially on the edge of the substrates, is increased.

According to a first aspect of the present invention, there is provided a method for bonding a first substrate to a second substrate on respective contact surfaces of the substrates, the method including the steps of: accommodating the first substrate on a first mounting surface of a first mounting apparatus, accommodating the second substrate on a second mounting surface of a second mounting apparatus, fixing the first substrate and/or the second substrate solely in a region of side edges of the substrates on the first and/or second mounting surfaces, contact-making for bringing the contact surface of the first substrate into contact with the contact surface of the second substrate at a bond initiation site, and deforming the first substrate and/or the second substrate for alignment of the contact surfaces outside the bond initiation site before and/or during the bonding, wherein, when the step of contact-making for bringing the contact surface of the first substrate into contact with the contact surface of the second substrate at the bond initiation site, the fixing step releases the first substrate and/or the second substrate from being fixed to the first mounting surface and/or second mounting surface to propagate a radially symmetrically traveling bonding wave from the bond initiation site to the side edges of the substrates to bond the substrates, and wherein the radii of curvature of the two substrates are marginally different on the bond front of the substates.

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

including: a first mounting apparatus configured to accommodate the first substrate on a first mounting surface; a second mounting apparatus configured to accommodate the second substrate on a second mounting surface, fixing means for fixing the first substrate and/or the second substrate solely in a region of side edges of the substrates on the first and/or second mounting surfaces, contact means for bringing the contact surface of the first substrate into contact with the contact surface of the second substrate at a bond initiation site, deformation means for deforming the first substrate and/or the second substrate for alignment of the contact surfaces outside the bond initiation site before and/or during the bonding, wherein, when the contact means bring the contact surface of the first substrate into contact with the contact surface of the second substrate at the bond initiation site, the fixing means are configured to release the first substrate and/or the second substrate from being fixed to the first mounting surface and/or second mounting surface to propagate a radially symmetrically traveling bonding wave from the bond initiation site to the side edges of the substrates to bond the substrates, and wherein the radii of curvature of the two substrates are marginally different on the bond front of the substates.

All combinations of at least two of the features given in the specification, the claims and/or in the figures fall within the scope of the invention. For given values ranges, values which lie within the indicated limits should be considered disclosed as boundary values and able to be claimed in any combination.

Embodiments of the invention are based on the idea that at least one of the two substrates, preferably the second and/or lower substrate, is deformed for alignment of the contact surfaces, especially solely, outside the bond initiation site before and/or during the bonding, especially during the travel of a bonding wave, preferably in fusion bonding. Deformation means especially a state which deviates from an initial state, especially initial geometry of the substrates. As per embodiments of the invention the bonding is initiated after contact-making of the contact surfaces especially by allowing the first/upper substrate to fall or by detaching it. Corresponding bonding means are provided especially according to the device.

In the initial state the substrates are generally, especially on one contact surface, more or less flat, aside from any structures which project above the contact surface (microchips, functional components) and substrate tolerance such as bending and/or thickness fluctuations. In the initial state, but in most cases the substrates have a curvature different from zero. For a 300 mm wafer curvatures of less than 50 µm are common. Viewed mathematically, a curvature can be regarded as a measure for the local deviation of a curve from its planar state. In the specific case substrates are examined whose thicknesses are small compared to the diameter. Therefore in a good approximation the curvature of a plane can be addressed. In the case of a plane the initially mentioned flat state is the tangential plane of the curve at the point at which the curvature is being examined. Generally a body, in the special case the substrate, does not have a homogeneous

CLAIMS:

1. A method for bonding a first substrate (3) to a second substrate (8) on respective contact surfaces (3k, 8k) of the substrates (3, 8), the method comprising the steps of:

accommodating the first substrate (3) on a first mounting surface (2o) of a first mounting apparatus (1),

accommodating the second substrate (8) on a second mounting surface (2o') of a second mounting apparatus (4),

fixing the first substrate (3) and/or the second substrate (8) solely in a region of side edges (3s, 8s) of the substrates (3, 8) on the first and/or second mounting surfaces (2o, 2o'),

contact-making for bringing the contact surface of the first substrate (3) into contact with the contact surface of the second substrate (8) at a bond initiation site (20), and

deforming the first substrate (3) and/or the second substrate (8) for alignment of the contact surfaces (3k, 8k) outside the bond initiation site (20) before and/or during the bonding,

wherein, when the step of contact-making for bringing the contact surface of the first substrate (3k) into contact with the contact surface of the second substrate (8k) at the bond initiation site (8k), the fixing step releases the first substrate (3) and/or the second substrate (8) from being fixed to the first mounting surface (3k) and/or second mounting surface (8k) to propagate a radially symmetrically traveling bonding wave from the bond initiation site (20) to the side edges (3s, 8s) of the substrates (3, 8) to bond the substrates (3, 8), and

wherein the radii of curvature of the two substrates (3, 8) are marginally different on the bond front of the substates (3, 8).

2. The method as claimed in claim 1, wherein the difference of the two radii of curvature on the bond front/bond line of the substrates (3, 8) is smaller than 10 m, preferably smaller than 1 m, more preferably smaller than 1 cm, most preferably smaller than 1 mm, still more preferably smaller than 0.01 mm, most preferably of all smaller than 1 µm.

3. The method as claimed in claim 1, wherein the substrates (3, 8) are deformed in mirror symmetry, wherein the curvature radius of the first mounting apparatus (1) is the same size,

especially within the same order of magnitude of one power of ten, as the radius of curvature of the second substrate (8).

4. The method as claimed in claim 1, wherein the substrates (3, 8) are only partly supported by the mounting surfaces (2o, 2o'), respectively, and the first substrate (3) bonds to the opposite second substrate (8) controlled automatically based on its prestress.

5. The method as claimed in claim 1, wherein the deformation of the first substrate (3) and/or of the second substrate (8) takes place depending on given factors which influence the travel of the bonding wave,

wherein the given factors include one or more of ambient pressure of atmosphere surrounding the substrates (3, 8), type of gas/gas mixture present in the atmosphere, temperature, distance between the substrates (3, 8) outside the bond initiation site (20), bond strength of the substrates (3, 8), any pretreatment steps, composition of the surfaces (2o, 2o'), surface roughness, materials on the surface (2o, 2o') and wafer thickness/bending strength.

6. The method as claimed in one of the preceding claims, wherein the bond initiation site (20) is located in the center of the contact surfaces (3k, 8k).

7. The method as claimed in one of the preceding claims, wherein the deformation of the first substrate (3) and/or of the second substrate (8) takes place in the lateral direction and/or convexly and/or concavely.

8. The method as claimed in one of the preceding claims, wherein the deformation takes place by expansion or compression or curving of the first substrate (3) and/or of the second substrate (8).

9. The method as claimed in one of the preceding claims, wherein diameters (d1, d2) of the substrates (3, 8) deviate from one another by less than 5 mm, in particular less than 3 mm, preferably less than 1 mm.

10. The method as claimed in one of the preceding claims, wherein the deformation takes place by mechanical actuation means and/or by temperature control of the first and/or second mounting apparatus (1, 4).

11. A device for bonding of a first substrate (3) to a second substrate (8) on respective contact surfaces (3k, 8k) of the substrates (3, 8), the device comprising:

a first mounting apparatus (1) configured to accommodate the first substrate (3) on a first mounting surface (2o);

a second mounting apparatus (4) configured to accommodate the second substrate (8) on a second mounting surface (2o'),

fixing means for fixing the first substrate (3) and/or the second substrate (8) solely in a region of side edges (3s, 8s) of the substrates (3, 8) on the first and/or second mounting surfaces (2o, 2o'),

contact means for bringing the contact surface of the first substrate (3) into contact with the contact surface of the second substrate (8) at a bond initiation site (20),

deformation means for deforming the first substrate (3) and/or the second substrate (8) for alignment of the contact surfaces (3k, 8k) outside the bond initiation site (20) before and/or during the bonding,

wherein, when the contact means bring the contact surface of the first substrate (3k) into contact with the contact surface of the second substrate (8k) at the bond initiation site (8k), the fixing means are configured to release the first substrate (3) and/or the second substrate (8) from being fixed to the first mounting surface (3k) and/or second mounting surface (8k) to propagate a radially symmetrically traveling bonding wave from the bond initiation site (20) to the side edges (3s, 8s) of the substrates (3, 8) to bond the substrates (3, 8), and

wherein the radii of curvature of the two substrates (3, 8) are marginally different on the bond front of the substates (3, 8).

12. The device as claimed in claim 11, wherein the difference of the two radii of curvature on the bond front/bond line of the substrates (3, 8) is smaller than 10 m, preferably smaller than 1 m, more preferably smaller than 1 cm, most preferably smaller than 1 mm, still more preferably smaller

than 0.01 mm, most preferably of all smaller than 1 µm.

13. The device as claimed in claim 11, wherein the substrates are deformed in mirror symmetry, wherein the curvature radius of the first mounting apparatus (1) is the same size, especially within the same order of magnitude of one power of ten, as the radius of curvature of the second substrate (8).

14. The device as claimed in claim 11, wherein the substrates (3, 8) are only partly supported by the mounting surfaces (2o, 2o'), respectively, and the first substrate (3) bonds to the opposite second substrate (8) controlled automatically based on its prestress.

15. The device as claimed in claim 11, wherein the deformation means encompass the first mounting apparatus (1) which is deformable in particular on the first mounting surface (2o) in the lateral direction and/or is deformable convexly or concavely.

16. The device as claimed in claim 11, wherein the deformation means encompass the second mounting apparatus (4) which is deformable in particular on the second mounting surface (2o') in the lateral direction and/or is deformable convexly or concavely.

17. The device as claimed in one of claims 11 to 16, wherein the deformation means have mechanical actuating means and/or temperature control means for temperature control of the first and/or second mounting apparatus (1, 4).