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 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 and accommodating the second substrate on a second mounting surface of a second mounting apparatus, contact-making of the contact surfaces at a bond initiation site, bonding the first substrate to the second substrate along a bonding wave which is travelling from the bond initiation site to the side edges of the substrates, wherein the first substrate and/or the second substrate is/are deformed for alignment of the contact surfaces outside the bond initiation site before and/or during the bonding, wherein detachment of the second substrate from the second mounting apparatus is controlled for increasing the bond precision on the edge of the substrates.

According to a second aspect of the present invention, there is provided a method for bonding a first substrate to a second substrate on 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 and accommodating the second substrate on a second mounting surface of a second mounting apparatus, contact-making of the contact surfaces at a bond initiation site, bonding the first substrate to the second substrate along a bonding wave which is travelling from the bond initiation site to the side edges of the substrates, wherein the first substrate and/or the second substrate is/are deformed for alignment of the contact surfaces outside the bond initiation site before and/or during the bonding, wherein the substrates are fixed before a heating and/or cooling step for increasing the bond precision on the edge of the substrates.

According to a third aspect of the present invention, there is provided a device for bonding of a first substrate to a second substrate on contact surfaces of the substrates, the device including: a first mounting apparatus for accommodating the first substrate on a first mounting surface and a

second mounting apparatus for accommodating the second substrate on a second mounting surface, contact means for making contact of the contact surfaces at a bond initiation site, bonding means for bonding the first substrate to the second substrate along a bonding wave which is travelling from the bond initiation site to the side edges of the substrates, wherein the first substrate and/or the second substrate is/are deformed by deformation means for deformation of the first substrate and/or of the second substrate for alignment of the contact surfaces outside the bond initiation site before and/or during the bonding, and control means for controlling detachment of the second substrate from the second mounting apparatus for increasing the bond precision on the edge of the substrates.

According to a fourth aspect of the present invention, there is provided a device for bonding of a first substrate to a second substrate on contact surfaces of the substrates, the device including: a first mounting apparatus for accommodating the first substrate on a first mounting surface and a second mounting apparatus for accommodating the second substrate on a second mounting surface, contact means for making contact of the contact surfaces at a bond initiation site, bonding means for bonding the first substrate to the second substrate along a bonding wave which is travelling from the bond initiation site to the side edges of the substrates, wherein the first substrate and/or the second substrate is/are deformed by deformation means for deformation of the first substrate and/or of the second substrate for alignment of the contact surfaces outside the bond initiation site before and/or during the bonding, and fixing means for fixing the substrates before a heating and/or cooling step for increasing the bond precision on the edge of the substrates.

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

contact-making of the contact surfaces (3k, 8k) at a bond initiation site (20),

bonding the first substrate (3) to the second substrate (8) along a bonding wave which is travelling from the bond initiation site (20) to the side edges (3s, 8s) of the substrates (3, 8), wherein the first substrate (3) and/or the second substrate (8) is/are deformed for alignment of the contact surfaces (3k, 8k) outside the bond initiation site (20) before and/or during the bonding, wherein detachment of the second substrate (8) from the second mounting apparatus (4) is controlled for increasing the bond precision on the edge of the substrates (3, 8).

2. A method for bonding of a first substrate (3) to a second substrate (8) on 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) and accommodating the second substrate (8) on a second mounting surface (2o') of a second mounting apparatus (4),

contact-making of the contact surfaces (3k, 8k) at a bond initiation site (20),

bonding the first substrate (3) to the second substrate (8) along a bonding wave which is travelling from the bond initiation site (20) to the side edges (3s, 8s) of the substrates (3, 8), wherein the first substrate (3) and/or the second substrate (8) is/are deformed for alignment of the contact surfaces (3k, 8k) outside the bond initiation site (20) before and/or during the bonding, wherein the substrates (3, 8) are fixed before a heating and/or cooling step for increasing the bond precision on the edge of the substrates (3, 8).

3. The method as claimed in claim 1 or 2, 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.

4. 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).

5. 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.

6. 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).

7. 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.

8. 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).

9. The method as claimed in one of the preceding claims, wherein the first substrate (3) and/or the second substrate (8) are fixed solely in the region of the side edges (3s, 8s) on the first and/or second mounting surfaces (2o, 2o').

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

a first mounting apparatus (1) for accommodating the first substrate (3) on a first mounting surface (2o) and a second mounting apparatus (4) for accommodating the second substrate (8) on a second mounting surface (2o'),

contact means for making contact of the contact surfaces (3k, 8k) at a bond initiation site (20),

bonding means for bonding the first substrate (3) to the second substrate (8) along a bonding wave which is travelling from the bond initiation site (20) to the side edges (3s, 8s) of the substrates (3, 8), wherein the first substrate (3) and/or the second substrate (8) is/are deformed by deformation means for deformation of the first substrate (3) and/or of the second substrate (8) for alignment of the contact surfaces (3k, 8k) outside the bond initiation site (20) before and/or during the bonding, and

control means for controlling detachment of the second substrate (8) from the second mounting apparatus (4) for increasing the bond precision on the edge of the substrates (3, 8).

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

a first mounting apparatus (1) for accommodating the first substrate (3) on a first mounting surface (2o) and a second mounting apparatus (4) for accommodating the second substrate (8) on a second mounting surface (2o'),

contact means for making contact of the contact surfaces (3k, 8k) at a bond initiation site (20),

bonding means for bonding the first substrate (3) to the second substrate (8) along a bonding wave which is travelling from the bond initiation site (20) to the side edges (3s, 8s) of the substrates (3, 8), wherein the first substrate (3) and/or the second substrate (8) is/are deformed by deformation means for deformation of the first substrate (3) and/or of the second substrate (8) for alignment of the contact surfaces (3k, 8k) outside the bond initiation site (20) before and/or during the bonding, and

fixing means for fixing the substrates before a heating and/or cooling step for increasing the bond precision on the edge of the substrates.

12. The device as claimed in claim 10 or 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.

13. The device as claimed in claim 10 or 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.

14. The device as claimed in at least one of Claims 10 to 13, 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).

15. The device as claimed in at least one of Claims 10 to 14, wherein fixing means for fixing of the first substrate (3) and/or of the second substrate (8) are located solely in the region of the side edges (3s, 8s) on the first and/or second mounting surfaces (2o, 2o').