

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. Furthermore, the present invention relates to a plate.

For a number of years, substrates have been connected to one another in the semiconductor industry by means of what are known as bonding processes. Prior to the connection, these substrates must be aligned with respect to one another as precisely as possible, wherein meanwhile, deviations in the nanometre range play a role. In this case, the alignment of the substrates takes place for the most part by means of alignment marks. In addition to alignment marks, other, particularly functional elements, also termed structures below, are also located on the substrates, which likewise have to be aligned with respect to one another during the bonding process. This alignment precision between the individual functional elements is requested for the entire substrate surface. It is therefore not sufficient for example if the alignment precision is very good at the centre of the substrates, but decreases towards the edge.

Chucks exist in different designs. A planar mounting surface or holding surface for holding/fixing the substrates is decisive for the chuck in particular, so that the structures can be correctly aligned and contacted on the substrates over the entire substrate surface.

In the prior art, a system already exists, with the aid of which one can reduce local distortions at least to some extent. This is a local distortion correction by means of the use of active control elements according to WO2012/083978A1.

Furthermore, first solution approaches for correcting “run-out” errors exist in the prior art. US20120077329A1 describes a method to obtain a desired alignment precision between the functional units of two substrates during and after the bonding, in that the lower substrate is not fixed. As a result, the lower substrate is not subjected to any boundary conditions and can freely bond freely to the upper substrate during the bonding process.

The alignment process plays a key role during the bonding of substrates. One of the greatest technical problems when connecting two substrates is the

alignment precision of the functional units between the individual substrates. Although the substrates can be aligned to one another very precisely by means of alignment systems, distortions of the substrates may also occur during the bonding process. Due to the distortions arising during the bonding process, the functional units are not necessarily aligned correctly with respect to one another at all positions. The alignment precision at a certain point on the substrate may be a result of a distortion, a scaling error, a lens fault (magnification or minimization fault), etc. In the semiconductor industry, all topics concerned with problems of this type are subsumed under the term "overlay". Overlay describes the overlay precision of structures from different manufacturing steps.

Overlay errors which primarily arise due to a distortion of at least one substrate during a bonding process are termed "run-out" errors. Due to the distortion of at least one substrate, the functional units of the first substrate are also distorted with respect to the functional units of the second substrate. These distortions constitute a problem not only during the bonding of two structured substrates, but rather can also lead to considerable problems even when bonding a structured substrate to a substantially unstructured substrate. This is the case in particular if, following the bonding, further process steps, which require a very precise alignment with respect to the structured substrate, should be carried out.

The resultant "run-out" errors for the most part become stronger radially-symmetrically around the contact point, that is to say increase from the contact point to the circumference. In most cases, this is a linearly increasing enhancement of the "run-out" errors. However, under specific conditions, the "run-out" errors may also increase non-linearly.

Embodiments of the present invention provide a device and a method for bonding two substrates, using which the bonding precision 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 mutually facing contact surfaces of the substrates, the first substrate being mounted on a first chuck and the second substrate being mounted on a second chuck, and wherein the second chuck comprises a plate and the plate being arranged between the second substrate and a surface of the second chuck, wherein the second substrate with the plate is deformed with respect to the second chuck before the bonding, or during the bonding, or before and during the bonding,

wherein the second substrate is deformed by deformation of the plate, wherein the thickness of the deformable plate is between 0.1 and 10 mm.

According to a second aspect of the present invention, there is provided a device for bonding a first substrate to a second substrate at mutually facing contact surfaces of the substrates, having: a first chuck for mounting the first substrate and a second chuck for mounting the second substrate, wherein the second chuck comprises a plate, the plate is arranged between the second substrate and a surface of the second chuck, wherein bend-changing means for deforming the plate with the second substrate with respect to the second chuck can be controlled during the bonding, wherein the second substrate is deformed by deformation of the plate, wherein the thickness of the deformable plate is between 0.1 and 10 mm.

According to a third aspect of the present invention, there is provided a plate for fixing a first plate side on a chuck of a device using a first fixing means and for fixing a first or second substrate on a second plate side arranged opposite the first plate side using a second fixing means, the plate having at least one fixing-element connection for the, fluid-technical, connection of the second fixing means to the chuck, wherein a deformation of the plate is adjustable, wherein the thickness of the deformable plate is between 0.1 and 10 mm.

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.

Embodiments of the invention are based on the idea that a plate is arranged between at least one of the substrates and the corresponding chuck, wherein the substrate with the plate is bent with respect to the chuck before and/or during the bonding. A, preferably planar, mounting surface of the chuck for mounting the plate and the substrate is consequently not deformed in particular. The chuck is used in particular for deforming/bending the