Method and device for aligning substrates

Description

The invention relates to a method for aligning and contacting a first substrate with a second substrate and a corresponding device.

In the semiconductor industry, alignment equipment (engl.: aligners) is used to align substrates, in particular wafers, with one another, in order to join them together in a further process step. The joining process is called bonding.

Alignment processes in which alignment markings are present on the substrate surfaces to be bonded are referred to as face-to-face alignments.

Inasmuch as the substrates are not transparent for the electromagnetic radiation that is used to measure the substrates in order to enable a detection and/or determination of the position and orientation of the alignment markings from the external substrates surfaces facing away from the substrates surfaces to be bonded, alignment markings are detected with image detection means between the substrates before the substrates are brought towards one another.

This had various drawbacks, in particular particle contamination by the camera and a large distance between the substrates to allow the positioning of the camera between two substrates for the detection. Alignment errors during the mutual approach arise from this.

An improvement of the face-to-face alignment is represented by the alignment equipment of publication US6214692B1, which can be regarded as the closest prior art. In the case of the latter, two groups of lenses are used with in each case two lenses lying opposite each other, in order to create a system with two reference points in relation to which the substrates are mutually positioned. The reference points are points of intersection of the optical axes of two lenses lying opposite one another.

The problem with the prior art consists in the fact that the increasing demands made on alignment accuracy can no longer be met by the disclosed open, controlled methods.

Publication US6214692B1 is based on the comparison and the position correction of two images of alignment markings. The position of alignment markings on the two substrates arranged face-to-face is detected individually by means of a camera system. A positioning table (substrate holder and stage) is actuated from a calculated relative orientation and relative position of the alignment markings in such a way that the incorrect position is corrected. The positioning table comprises guide transducers and incremental path transducers positioned close to the drive.

Embodiments of the present invention provide a device and a method for the alignment and contacting of substrates, with which a more precise and more efficient alignment and contacting of the substrates is enabled.

According to a first aspect of the present invention, there is provided a method for aligning and contacting a first contact face of a first substrate with a second contact face of a second substrate with the following steps, in particular the following sequence: fixing of a first support face of the first substrate on a first substrate holder and a second support face of the second substrate on a second substrate holder, which can be arranged opposite the first substrate holder, detection of a first X-Y position, in particular related to a focal plane of a first detection unit, and/or first alignment orientation of a first alignment marking arranged in particular in a peripheral region of the first substrate, detection of a second X-Y position, in particular related to a focal plane of a second detection unit, and/or second alignment orientation of a second alignment marking arranged in particular in a peripheral region of the second substrate, alignment of the first substrate with respect to the second substrate, and contacting of the first substrate with the second substrate, said first substrate being aligned with respect to the second substrate, characterised in that, before the alignment, additionally a detection of a third X-Y position and/or third alignment orientation of the first substrate holder and/or the first substrate takes place by a third detection unit, by means of which the alignment is controlled,

wherein the first alignment marking and the third alignment marking are arranged on different sides of the first substrate or of the first substrate holder, said sides in particular lying mutually opposite in a Z-direction.

According to a second aspect of the present invention, there is provided a device for aligning and contacting a first contact face of a first substrate with a second contact face of a second substrate with: a first substrate holder for fixing a first support face of the first substrate, a second substrate holder for fixing a second support face of the second substrate, said second substrate holder being able to be arranged lying opposite the first substrate holder, a first detection unit for detecting a first X-Y position and/or first alignment orientation of a first alignment marking, a second detection unit for detecting a second X-Y position and/or second alignment orientation of a second alignment marking, alignment means for aligning the first substrate with respect to the second substrate, and contacting means for contacting the first substrate with the second substrate, said first substrate being aligned with respect to the second substrate, characterised in that the device comprises a third detection unit for detecting a third X-Y position and/or third alignment orientation of the first substrate holder and/or the first substrate, by means of which the alignment can be controlled, wherein the first alignment marking and the third alignment marking are arranged on different sides of the first substrate or of the first substrate holder, said sides in particular lying mutually opposite in a Z-direction.

All combinations of at least two features given in the description, the claims and/or the figures also fall within the scope of the invention. In stated value ranges, values lying inside the stated limits are also deemed to be disclosed as limiting values and can be claimed in any combination.