Method for bonding substrates

Description

The invention relates to a method for bonding a first substrate with a second substrate .

Substrates have been aligned with one another and joined with one another for many years in the semiconductor industry. The joining, the so-called bonding, serves to build up a multi-substrate stack. In such a multi-substrate stack, functional units, in particular memory chips, microprocessors, MEMS etc. are connected to one another and thus combined with one another. Diverse possible applications arise from these combination options.

The density of the functional units is increasing year by year. As a result of advancing technological development, the size of the functional units is becoming smaller and smaller. The increasing density is therefore accompanied by a greater number of functional units per substrate. This increasing number of units is primarily responsible for the reduction in parts costs.

The drawback with increasingly small functional units primarily consists in the increasing difficulty of producing an error-free, in particular also complete superposition

Temperature differences of a few Kelvin, sometimes even a tenth of a Kelvin, are already sufficient to generate such distortions.

Second partial component R2 describes the extrinsic part of the "run-out" error, i.e. the part that is not caused until the bonding process. It is not present before the bonding process. This includes primarily local and/or overall distortions of the first and/or second substrate due to forces acting between the substrates, which can lead to a deformation in the nanometre range.

Embodiments of the present invention provide a method for bonding two substrates, with which the bonding accuracy is increased as far as possible at every position of the substrates. Embodiments of the invention provide a method with which an error-free, in particular full-area congruence of the structures of two substrates can be produced.

According to an aspect of the present invention, there is provided a method for bonding a first substrate with a second substrate at contact faces of the substrates with the following steps, in particular the following sequence: holding of the first substrate to a first sample holder surface of a first sample holder with a holding force FH1 and holding of the second substrate to a second sample holder surface of a second sample holder with a holding force FH2, contacting of the contact faces at a bond initiation point and heating of at least the second sample holder surface to a heating temperature TH, bonding of the first substrate with the second substrate along a bonding wave running from the bond initiation point to the side edges of the substrates, characterised in that heating temperature TH is reduced at the second sample holder surface during the bonding.

. All combinations of at least two features given in the description, in the claims and/or the drawings also fall within the scope of the invention. In the 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. If an individual or a plurality of method steps can be performed on different devices or modules, the latter are in each case disclosed separately as an independent method.

The idea underlying embodiments of the invention is to reduce a heating temperature T_H already during the bonding and to switch off heating during the bonding. Heating temperature T_H serves in particular to produce a temperature sufficient for the bonding at a bonding face of the substrates. An embodiment of the invention consists in removing the fixing of a substrate, in particular during the bonding, in order

Claims

1. A method for bonding a first substrate (2) with a second substrate (2') at contact faces (2o, 2o') of the substrates (2, 2') with the following steps, in particular the following sequence:

   - holding of the first substrate (2) to a first sample holder surface (1o) of a first sample holder (1) with a holding force F_{H1} and holding of the second substrate (2') to a second sample holder surface (1o') of a second sample holder (1') with a holding force F_{H2},

   - contacting of the contact faces (2o, 2o') at a bond initiation point (20) and heating of at least the second sample holder surface (1o, 1o') to a heating temperature T_H,

   - bonding of the first substrate (2) with the second substrate (2') along a bonding wave running from the bond initiation point (20) to the side edges (2s, 2s') of the substrates (2, 2'),

   characterised in that

   heating temperature T_H is reduced at the second sample holder surface (1o') during the bonding.