

Method for the alignment of substrates before bonding

Description

The present invention relates to a method for the alignment of a first substrate comprising at least two first alignment marks with a second substrate comprising at least two second alignment marks as well as a corresponding device.

There are a number of methods for aligning and bonding two, in particular structured, substrates with one another. In the majority of all the methods, the aligner and the bonder are separate modules/chambers. The aligner orientates two substrates with one another with the aid of alignment marks. Fixing, in particular by clamping, takes place after the alignment. For this purpose, the two substrates are fixed against one another and against a sample holder. The fixing of the substrates to one another without the use of a sample holder is also conceivable. Such fixing without a sample holder is disclosed in publication WO2014154272A1, in which it is shown how a direct fixing of two substrates can take place by means of magnetic bodies.

The substrates fixed to one another then pass by means of a transport system into a bonding system, in which bonding of the two substrates takes place.

A fusion bonder represents a special case of such a bonding system. A fusion bonder is understood to mean a device which produces the bonding of two substrates by an, in particular, concentric contacting with the aid of a pin. As a result of the extremely clean surfaces of the substrates, self-fixing occurs due to the adhesive forces between the substrate surfaces. The adhesive forces are primarily van-der-Waals forces. A bond thus produced is referred to as a prebond, since it does not yet have the full strength that is theoretically to be obtained, which is produced in a further process step by a heat treatment and the accompanying generation of covalent bonds.

There are essentially two major problems with carrying out a fusion bond.

The first problem consists in obtaining alignment accuracy over long distances. Modern aligners are already capable of achieving alignment accuracies of less than 200 nm. This means that two substrates with corresponding alignment marks can be aligned and fixed in relation to one another with greater precision than 100-200 nm. However, this alignment accuracy has to be maintained over times as long as possible and/or over distances as long as possible. Furthermore, the fixing of the two substrates to

one another must take place so securely that the achieved alignment accuracy is not lost by a displacement of the substrates in relation to one another, in particular during a handling process, for example by a robot.

The second problem is that the throughput with the alignment and therefore with the production of a bond is usually low with the previously known methods.

In very many cases, a complex and therefore costly aligner is used, which is able to implement different alignment methods, in particular face-to-face, back-to-face or back-to-back alignments.

Thermocompression bonders are a type of bonder preferably used according to the invention. High pressures and high temperatures can be produced with the aid of a thermocompression bonder. It is used preferably for metal diffusion bonding and/or for eutectic bonding. Since the metal surfaces should preferably be completely free from oxides, it is of fundamental importance that the atmosphere in such bonder chambers can be adjusted and monitored in a targeted manner. Embodiments of the present invention not only comprise a simple method of increasing the bonding throughput, but also describe in an advantageous way a method with which a controlled atmosphere can be generated and continuously maintained in a bonding chamber. Such atmospheres are particularly advantageous for the production of pure metal-metal bonds.

Embodiments of the invention provide a method and a system, with the aid of which an improved and in particular quicker alignment of two substrates in relation to one another can be carried out.

According to a first aspect of the present invention, there is provided a method for the alignment of a first substrate comprising at least two first alignment marks with a second substrate comprising at least two second alignment marks, wherein by means of a first assignment, the first alignment marks are assigned to at least two first characteristic alignment features of the first substrate in an X-direction and in a Y-direction, by means of a second assignment, the second alignment marks are assigned to at least two second characteristic alignment features of the second substrate in an X-direction and in a Y-direction and by means an alignment, the first and second alignment marks are aligned in relation to one another in an X- and Y-direction by means of the first and second characteristic alignment features.

According to a second aspect of the present invention, there is provided a device for the alignment of a first substrate comprising at least two first

alignment marks with a second substrate comprising at least two second alignment marks, with a first assignment module for the assignment of the first assignment marks to at least two first characteristic assignment features of the first substrate in an X-direction and in a Y-direction, a second assignment module for the assignment of the second assignment marks to at least two second characteristic assignment features of the second substrate in an X-direction and in a Y-direction and an alignment module, constituted in particular as a bonding module, for the alignment of the first and second alignment marks in relation to one another in the X- and Y-direction by means of the first and second characteristic alignment features.

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

Embodiments of the invention provide a method for the alignment of a first substrate comprising at least two first alignment marks with a second substrate comprising at least two second alignment marks, wherein

- by means of a first assignment, the first alignment marks are assigned to at least two first characteristic alignment features of the first substrate in an X-direction and in a Y-direction,
- by means of a second assignment, the second alignment marks are assigned to at least two second characteristic alignment features of the second substrate in an X-direction and in a Y-direction and
- by means an alignment, the first and second alignment marks are aligned in relation to one another in an X- and Y-direction by means of the first and second characteristic alignment features.

According to the device, embodiments of the invention can be implemented in particular by the following features:

- a first assignment module for the assignment of the first assignment marks to at least two first characteristic assignment features of the first substrate in an X-direction and in a Y-direction,