

In most cases, the arising "run-out" errors become more intensified radially symmetrical around the contact point, from which reason they increase from the contact point to the periphery. In most cases, it involves a linearly increasing intensification of the "run-out" errors. Under special conditions, the "run-out" errors can also increase non-linearly.

Under particularly optimum conditions, the "run-out" errors can be ascertained not only by suitable measuring devices (EP2463892), but can also be described by mathematical functions. Since the "run-out" errors represent translations and/or rotations and/or scaling between well-defined points, they are preferably described by vector functions. Generally, this vector function is a function $f:R^2 \rightarrow R^2$, i.e. a mapping rule, which maps the two-dimensional definition range of the position coordinates onto the two-dimensional value range of "run-out" vectors. Although an exact mathematical analysis of the corresponding vector fields has not yet been able to be carried out, assumptions are made concerning the function properties. The vector functions are, with a high degree of probability, at least C^n $n \geq 1$ functions, i.e. at least continuously differentiable. Since the "run-out" errors increase from the contact point to the edge, the divergence of the vector function will probably be different from zero. With a high degree of probability, therefore, the vector field is a source field.

Embodiments of the present invention provide a device and a method for bonding two substrates, with which the bonding quality, in particular the bonding accuracy, especially at 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 with a second substrate inside a sealed bonding chamber, said method including: a) fixing of the first and second substrates to respective first and second holding devices; b) arranging of the first and second substrates relative to each other; c) mutual approaching of the first and second substrates toward each other; d) contacting the first substrate with the second substrate at a bond initiation point; e) generating a bonding wave advancing from the bond initiation point to side edges of the first and second substrates; and f) influencing the bonding wave during advancing of the bonding wave by deforming an holding surface of the first holding device by use of mechanical actuators, and thereby deforming the first substrate fixed on the first holding surface,

wherein the influencing of the bonding wave includes a change of a temperature of atmosphere inside the bonding chamber and/or a change of a medium of the atmosphere in which the bonding wave runs, wherein the atmosphere is generated in a defined sealed spatial section in the bonding chamber, and the medium of the atmosphere includes a composition of gases or gas mixtures, wherein the composition of gases or gas mixtures includes inert gases and/or weakly reacting gases.

According to a second aspect of the present invention, there is provided a device for the bonding of a first substrate with a second substrate, said device including: a sealed bonding chamber; first and second holding devices for respectively holding and fixing the first and second substrates, wherein the first and second holding devices are configured for mutual approaching of the first and second substrates toward each other, for contacting of the first and second substrates and for generating a bonding wave; and influencing means for influencing the bonding wave during advancing of the bonding wave by deforming an holding surface of the first holding device by use of mechanical actuators, and thereby deforming the first substrate fixed on the first holding surface, wherein the influencing of the bonding wave comprises a change of a temperature of atmosphere inside the bonding chamber and/or a change of a medium of the atmosphere in which the bonding wave runs, wherein the atmosphere is generated in a defined sealed spatial section in the bonding chamber, and the medium of the atmosphere includes a composition of gases or gas mixtures, wherein the composition of gases or gas mixtures includes inert gases and/or weakly reacting gases.

All combinations of at least two features given in the description, in the

Claims

1. A method for bonding a first substrate with a second substrate inside a sealed bonding chamber, said method comprising:

- a) fixing of the first and second substrates to respective first and second holding devices;
- b) arranging of the first and second substrates relative to each other;
- c) mutual approaching of the first and second substrates toward each other;
- d) contacting the first substrate with the second substrate at a bond initiation point;
- e) generating a bonding wave advancing from the bond initiation point to side edges of the first and second substrates; and
- f) influencing the bonding wave during advancing of the bonding wave by deforming an holding surface of the first holding device by use of mechanical actuators, and thereby deforming the first substrate fixed on the first holding surface, wherein the influencing of the bonding wave comprises a change of a temperature of atmosphere inside the bonding chamber and/or a change of a medium of the atmosphere in which the bonding wave runs,

wherein the atmosphere is generated in a defined sealed spatial section in the bonding chamber, and the medium of the atmosphere comprises a composition of gases or gas mixtures,

wherein the composition of gases or gas mixtures comprises inert gases and/or weakly reacting gases.

2. The method according to claim 1, wherein the inert gases and/or weakly reacting gases comprise one of nitrogen, argon, helium and carbon dioxide

3. The method according to claim 1, wherein in step f) the influencing of the bonding wave comprises a regulated and/or a controlled change of a pressure inside the bonding chamber.
4. The method according to claim 1, wherein in step e) the fixing of at least one of the first and second substrates to the respective first and second holding devices is maintained and the first and second substrates approach each other in a regulated manner and thereby generate the bonding wave, and in step f) the influencing of the bonding wave comprises a regulated and/or controlled change in spacing between the first and second substrates.
5. The method according to claim 3, wherein the controlled change of the pressure inside the bonding chamber is more than 1 mbar/s.
6. The method according to claim 1, wherein the bonding wave is influenced such that speed of the advancing bonding wave is retarded by more than 0.1 cm/s.
7. The method according to claim 3, wherein the method comprises measuring the pressure with sensors located inside the bonding chamber and the change in the pressure is controlled and/or regulated depending on measured values from the sensors.
8. The method according to claim 3, wherein the change in the pressure takes place by means of a mobile piston that reduces the volume of the bonding chamber.
9. The method according to claim 3, wherein the change in the pressure takes place by means of a heating and/or cooling device that changes the temperature inside the bonding chamber.

10. The method according to claim 3, wherein the change in pressure takes place by means of a pump that pumps the gas and/or the gas mixture into the bonding chamber and/or sucks the gas and/or the gas mixture out of the bonding chamber.

11. The method according to claim 3, wherein, the change in the pressure takes place by conveying the gas and/or the gas mixture from a pressure vessel via a valve into the bonding chamber and/or allowing the gas and/or the gas mixture to escape from the bonding chamber.

12. The method according to claim 3, wherein the change in the pressure takes place by passing the gas and/or the gas mixture via at least two nozzles.

13. A device for bonding a first substrate with a second substrate, said device comprising:

- a sealed bonding chamber;

- first and second holding devices for respectively holding and fixing the first and second substrates, wherein the first and second holding devices are configured for mutual approaching of the first and second substrates toward each other, for contacting of the first and second substrates and for generating a bonding wave; and

- influencing means for influencing the bonding wave during advancing of the bonding wave by deforming an holding surface of the first holding device by use of mechanical actuators, and thereby deforming the first substrate fixed on the first holding surface, wherein the influencing of the bonding wave comprises a change of a temperature of atmosphere inside the bonding chamber and/or a change of a medium of the atmosphere in which the bonding wave runs,

- wherein the atmosphere is generated in a defined sealed spatial section in the bonding chamber, and the medium of the atmosphere comprises a composition of gases or gas mixtures,

wherein the composition of gases or gas mixtures comprises inert gases and/or weakly reacting gases.

14. The method according to claim 13, wherein the inert gases and/or weakly reacting gases comprise one of nitrogen, argon, helium and carbon dioxide.

15. The device according to claim 13, wherein the influencing means comprises pressure-changing means for changing pressure inside the bonding chamber.

16. The device according to claim 13, wherein the influencing means comprises spacing-changing means for changing the spacing between the first and second substrates.