

consist of multiple, particularly symmetrically distributed heating elements, particularly such that can be actuated individually are also conceivable. One document that describes such an apparatus is WO2012083978A. The disadvantage in this case is that actuation of this nature also entails a correspondingly complicated control system.

Embodiments of the present invention provide an apparatus and a method which at least partially, and in particular completely eliminate the described drawbacks of the related art. In particular, Embodiments of the present invention provide an apparatus and a method with which it is possible to produce a desired temperature distribution on a surface, in particular a substrate surface.

The temperature distribution is preferably homogeneous, but in principle may be modulated in any way necessary. Additionally, an apparatus and method as per embodiments of the present invention are to be described with the aid of which it is possible to compensate for and/or offset an undesirable deformation of the heater.

According to a first aspect of the present invention, there is provided an apparatus for heating a substrate, comprising: a heater, a substrate holder with a substrate holder surface, wherein the substrate to be heated can be placed on the substrate holder surface, wherein the apparatus further comprises: means for exerting forces on the heater, a control unit for controlling the means, wherein the heater can be deformed by the means, wherein the apparatus includes a stage, wherein the heater is arranged inside the stage with an open space provided between an interior surface of the stage and an heater surface of the heater, whereby the heater is deformable independently of the substrate holder surface.

According to a second aspect of the present invention, there is provided a method for heating a substrate, in particular for creating a predetermined target temperature distribution in a substrate and/or to offset a deformation of the heater caused by external forces, preferably with the above apparatus, wherein a heater heats the substrate and a substrate holder holds the substrate in place on a substrate holder surface, wherein means exert forces on the heater, and wherein the means are controlled by a control unit, and wherein the heater is deformed by the means, wherein the apparatus includes a stage, wherein the heater is arranged inside the stage with an open space provided between an interior surface of the stage and an heater surface of the heater, whereby the heater is deformable independently of the substrate holder surface.

According to a third aspect of the present invention, there is provided an apparatus for processing and/or bonding a substrate, comprising the above apparatus.

According to a fourth aspect of the present invention, there is provided a method for processing and/or bonding a substrate, in particular with the above apparatus, wherein the substrate is heated with the above method.

The scope of the invention also encompasses all combinations of at least two of the features presented in the description, the claims and/or the drawings. Where value ranges are specified, values within the stated limits are also to be considered disclosed as limit values and claimable in any combination.

In the following text, the terms substrate and substrate stack are used synonymously. In particular, a substrate may also consist of a plurality of substrates that are also arranged preferably side by side on a substrate holder for processing.

CLAIMS

1. An apparatus (1, 1', 1'', 1''') for heating a substrate (6), having:
 - i) a heater (3),
 - ii) a substrate holder (5) with a substrate holder surface (5o), wherein the substrate (6) to be heated can be placed on the substrate holder surface (5o),
characterized in that the apparatus (1, 1', 1'', 1''') further has:
 - iii) means (7, 8, 9, 11) for exerting forces on the heater (3),
 - iv) a control unit for controlling the means (7, 8, 9, 11),wherein the heater (3) can be deformed by the means (7, 8, 9),
wherein the apparatus (1, 1', 1'', 1''') includes a stage (2), wherein the heater (3) is arranged inside the stage (2) with an open space (12) provided between an interior surface (2i) of the stage (2) and an heater surface (3o) of the heater (3), whereby the heater (3) is deformable independently of the substrate holder surface (5o).
2. The apparatus (1, 1', 1'', 1''') according to Claim 1, wherein due to the deformation of the heater (3) effected by the means (7, 8, 9, 11) an actual temperature distribution in the substrate (6) is adaptable to a target temperature distribution.
3. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein due to the deformation of the heater (3) effected by the means (7, 8, 9, 11) a deformation of the heater (3) caused by external forces can be offset.
4. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein the apparatus (1, 1', 1'', 1''') includes at least one deformation element (8) connected to the heater (3), wherein the at least one deformation element (8) is connected to at least one actuator, so that the heater (3) is deformable in targeted manner.

5. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein the heater (3) is arranged on a side of the substrate holder surface (5o) opposite the substrat (6).
6. The apparatus (1, 1', 1'', 1''') according claim 1, wherein the substrate holder (5) is arranged on a stage surface (2o) of the stage (2).
7. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein the heater (3) has a heating element (4) of flat constrution or a plurality of heating elements (4) in a flat arrangement.
8. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein the apparatus (1, 1', 1'', 1''') has at least one fixing element (7), wherein the at least one fixing element (7) is connected to the heater (3) and fixes at least one point of the heater (3).
11. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein the apparatus (1, 1', 1'', 1''') has at least one support element (9) which is not connected to the heater (3), wherein the at least one support element (9) can only apply pressure to the heater (3) and/or can only limit the deformation of the heater (3).
10. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein the apparatus (1, 1', 1'', 1''') has at least one limiting element (11) which is not connected to the heater (3), wherein the at least one limiting element (11) can limit the deformation of the heater (3) and/or can predefine the deformation through the shape of the limiting element (11).
11. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein a fluid stream (10) can be flushed between the heater (3) and other components, between the heater (3) and the stage (2) and/or between the heater (3) and the substrate holder (5), in order to optimise the transfer of heat between the heater (3) and the other components.

12. The apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein the apparatus (1, 1', 1'', 1''') further includes:

a plate,

wherein the plate is arranged between the heater (3) and the substrate holder (5).

13. A method for heating a substrate (6), for creating a predetermined target temperature distribution in a substrate (6) and/or to offset a deformation of the heater (3) caused by external forces, with an apparatus (1, 1', 1'', 1''') according to at least one of the preceding claims, wherein a heater (3) heats the substrate (6) and a substrate holder (5) holds the substrate (6) in place on a substrate holder surface (5o),

characterized in that means (7, 8, 9, 11) exert forces on the heater (3), and wherein the means (7, 8, 9, 11) are controlled by a control unit, and wherein the heater (3) is deformed by the means (7, 8, 9, 11),

wherein the apparatus (1, 1', 1'', 1''') includes a stage (2), wherein the heater (3) is arranged inside the stage (2) with an open space (12) provided between an interior surface (2i) of the stage (2) and an heater surface (3o) of the heater (3), whereby the heater (3) is deformable independently of the substrate holder surface (5o).

14. The method according to Claim 13 having the following steps, with the following sequence:

- i) Positioning and/or fixing the substrate (6) on a substrate holder surface (5o) of a substrate holder (5),
- ii) Determining an actual temperature distribution in the substrate, on the substrate surface (6o),
- iii) On the basis of an analysis of the actual temperature distribution compared with a target temperature distribution, deforming the heater (3) with the means (7, 8, 9, 11), wherein the means (7, 8, 9, 11) are controlled by the control unit so that the deformation of the heater (3) has the effect of

adjusting the actual temperature distribution of the substrate (6) in targeted manner to the predefined target temperature distribution.

15. The method according to at least one of Claims 13 or 14 having the following steps, with the following sequence:
 - i) Positioning and/or fixing the substrate (6) on a substrate holder surface (5o) of a substrate holder (5),
 - ii) Determining a deformation of the heater (3) of the heater surface (3o), caused by external forces,
 - iii) On the basis of an analysis of the deformation of the heater (3) caused by the external forces, deforming the heater (3) with the means (7, 8, 9, 11), wherein the means (7, 8, 9, 11) are controlled by the control unit so that the deformation of the heater (3) has the effect of offsetting the deformation of the heater (3) caused by the external forces.
16. An apparatus for processing and/or bonding a substrate (6), comprising the apparatus (1, 1', 1'', 1''') according to any one claims 1 to 12.
17. A method for processing and/or bonding a substrate (6), with the apparatus (1, 1', 1'', 1''') according to any one of claims 1 to 12, wherein the substrate is heated with the method according to any one of Claims 13, 14 or 15.