high pressure drop at the outlet of the substrate wiping space. Due to the fact that the process takes place within a fraction of a second, the energy cannot be dissipated quickly enough and the process can be regarded as isenthalpic. Consequently, the JTC of the gas or gas mixture decides whether cooling or heating of the gas or gas mixture takes place during the isenthalpic expansion. The cooling of the gas or gas mixture can be so strong that the dew point of the gas or gas mixture is undershot and the gas or gas mixture or individual components of the gas mixture condense. The substrate surface serves as a crystallization nucleus. It is therefore a heterogeneous nucleation which has an even lower nucleation energy than a homogeneous nucleation in the gas phase. This physical process of condensation must be avoided.

Embodiments of the present invention overcome the disadvantages of the prior art and in particular to achieve an improved bond result.

All combinations of at least two features specified in the description, the claims and/or the drawings also fall within the scope of the invention. In the case of value ranges, values lying within the limits mentioned should also be disclosed as limit values and be claimable in any desired combination.

The core idea as per embodiments of the invention is that the substrate surface or the substrate surfaces are widened in such a manner that the gas which is displaced from the centre outwards during the bonding process does not already expand at the edge between the substrates but rather the expansion of the gas only takes place outside of the two substrates. In other words: the gas is still forced out of the intermediate space between the substrates with increased pressure, and the pressure drop or expansion only takes place when the surrounding elevation or the expansion surface has been reached or the gas has run beyond or been pushed beyond the elevation or the expansion surface.

The substrates may have any desired shape, but are preferably circular. The diameter of the substrates is in particular industrially standardized. For wafers, the industry-standard diameters are 1 inch, 2 inches, 3 inches, 4 inches, 5 inches, 6 inches, 8 inches, 12 inches and 18 inches. Embodiments of the invention may however fundamentally handle any substrate, independently of the diameter thereof.

According to a first aspect of the present invention, there is provided a device for bonding a first substrate surface of a first substrate to a second substrate surface of a second substrate, including: a first substrate holder for accommodating the first substrate, a second substrate holder for accommodating the second substrate, characterized in that at least the first substrate holder has a first recess with a fixing device for fixing the first substrate in the first recess, as well as an elevation at least partly surrounding the recess, wherein the recess and/or the elevation is/are adapted to the first substrate, in particular to the shape of the first substrate, in such a manner that the substrate surface with the expansion surface forms a substantially continuous surface and/or merges into the elevation, wherein a first distance between a substrate periphery of the first substrates and an interior wall of the elevation is smaller than 1 mm, wherein a second distance between the first substrate surface and the extension surface (8os) is smaller than 1mm.

According to embodiments of the invention, a system is furthermore provided, which is made up of a device according to embodiments of the invention and the first substrate, wherein the first substrate surface merges into the elevation.

According to a second aspect of the present invention, there is provided a method for bonding a first substrate surface of a first substrate to a second substrate surface of a second substrate by means of a device according to the invention, wherein a gas arranged between the substrate surfaces during the bonding process is displaced from a centre to the edge of the substrates, wherein the first substrate surface merges into the elevation in such a manner that an expansion of the gas only takes place outside the substrates and/or the difference $p-p_0$ of a pressure p at the substrate edge at the end of the bonding process and an ambient pressure p_0 is greater than zero.

Advantageously, the condensation of a gas or gas mixture driven forth between the substrates and upstream of the bond wave can be prevented so that it does not lead to the formation of a condensed phase and thus edge voids are not formed. The substrate surfaces of the substrates are widened in such a way so that the physical effects responsible for the creation of the edge voids advantageously take place outside the substrate surfaces.

Claims

1. A device (10, 10') for bonding a first substrate surface (2os) of a first substrate (2o) to a second substrate surface (2us) of a second substrate (2u), having:
   - a first substrate holder (6o, 6o') for accommodating the first substrate (2o),
   - a second substrate holder (6u, 6u ') for accommodating the second substrate (2u),

   characterized in that

   at least the first substrate holder (6o, 6o') has a first recess (7o) with a fixing device (3) for fixing the first substrate (2o) in the first recess, as (7o) well as an elevation (8o) at least partly surrounding the recess, wherein the recess (7o) and/or the elevation (8o) is/are adapted to the first substrate (2o), in particular to the shape of the first substrate (2o), in such a manner that the substrate surface (2os) with the expansion surface (8os) forms a substantially continuous surface and/or merges into the elevation (8o), wherein a first distance (ho) between a substrate periphery (9o) of the first substrates (2o) and an interior wall (8oi) of the elevation (8o) is smaller than 1 mm, wherein a second distance (vo) between the first substrate surface (2os) and the extension surface (8os) is smaller than 1mm.

2. The device (10, 10') according to Claim 1, wherein the elevation (8o) has an expansion surface (8os) for, in particular seamless, expansion of the first substrate surface (2os).

3. The device (10, 10') according to one of the preceding claims, wherein the recess (7o) and/or the elevation (8o) can be adapted manually and/or semi-automatically and/or automatically such that the substrate surface (2os) forms a substantially continuous surface with the expansion surface (8os) and/or merges into the elevation (8o).

4. The device (10, 10') according to one of the preceding claims, wherein the first substrate holder (6o, 6o') has an outer component (1o') and an inner component (5o) movable in the outer component (1o'), wherein the outer and/or inner

component (5o) is translationally and/or rotatably movable, wherein the components (1o', 5o) can be fixed to one another.

5. The device (10, 10') according to one of the preceding claims, wherein the vertical distance (vo, vu) between the first substrate surface (2os) and the expansion surface (8os) is adjustable.

6. The device (10, 10') according to one of the preceding claims, having at least one hole (11) for evacuating and/or rinsing the recess (7o), wherein several holes (11) are preferably arranged in a symmetrically distributed manner, in particular in the inner component (5o').

7. The device (10, 10') according to one of the preceding claims, wherein the elevation (8o, 8', 8") has an inwardly and/or outwardly curved expansion surface (8o, 8s', 8s'').

8. The device (10, 10') according to one of the preceding claims, wherein the elevation (8o, 8"', 8IV) has an inwardly and/or outwardly bevelled extension surface (8o, 8s"', 8sIV) at an angle (a).

9. A system made up of a device (10, 10') according to one of the preceding claims and the first substrate (2o), characterized in that the first substrate surface (2os) merges into the elevation (8o).

10. A method for bonding a first substrate surface (2os) of a first substrate (2o) to a second substrate surface (2us) of a second substrate (2u) by means of a device (10, 10') according to one of the preceding claims, wherein a gas arranged between the substrate surfaces (2os, 2us) during the bonding process is displaced from a centre to the edge (9, 9o, 9u) of the substrates (2o, 2u),
characterized in that
at least the first substrate surface (2os) merges into the elevation (8o) in such a way that expansion of the gas only takes place outside the substrates (2o, 2u).