

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 can not 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.

According to 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, having a first substrate holder for accommodating the first substrate, a second substrate holder for accommodating the second substrate, wherein 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 first recess; and wherein at least one of the first substrate holder and the second substrate holder has at least one hole for evacuating and/or rinsing the first recess, the first recess is rinsed with a gas and/or a gas mixture with a negative Joule-Thompson coefficient (JTC) before and/or during and/or after the bonding of the first substrate and the second substrate.

According to second aspect of the present invention, there is provided a system made up of the above device and the first substrate, wherein the first substrate surface merges into the elevation.

According to third 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 the above device, wherein a gas arranged between the substrate surfaces during the bonding process is displaced from a centre to the edge of the substrates, wherein at least the first substrate surface merges into the elevation in such a way that expansion of the gas only takes place outside the substrates; and wherein the first recess is rinsed with a gas and/or a gas mixture with a negative JTC before and/or during and/or after the bonding of the first substrate and the second substrate.

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