Embodiments of this invention disclose a method for careful production of a permanent bond with a bond force which is as high as possible.

According to an aspect of the present invention, there is provided a method for bonding of a first contact surface of a first substrate to a second contact surface of a second substrate, the method including: forming a reservoir in a surface layer on the first contact surface by plasma activation of the first contact substrate using at least a forming gas comprising 95% Ar and 5% H_2, at least partially filling the reservoir with a first educt or a first group of educts, contacting the first contact surface with the second contact surface for formation of a prebond connection, and forming a permanent bond between the first and second contact surface, the permanent bond at least partially strengthened by the reaction of the first educt with a second educt contained in a reaction layer of the second substrate.

All combinations of at least two of the features given in the specification, the claims and/or the figures also fall within the framework of the invention. At the given value ranges, values within the indicated limits will also be disclosed as boundary values and will be claimed in any combination.

The basic idea of embodiments of this invention is to devise a reservoir for holding a first educt at least on one of the substrates, to react it after making contact or producing a temporary bond between the substrates with a second educt which is present in the other substrate, and thus to form an irreversible or permanent bond between the substrates. Before or after forming the reservoir in one surface layer on the first contact surface, generally cleaning of the substrate or substrates, especially by a flushing step, occurs. This cleaning should generally ensure that there are no particles on the surfaces which would result in unbonded sites. The reservoir and the educt contained in the reservoir form a technical possibility for inducing a reaction which strengthens the permanent bond and which increases the bond speed in a controlled manner directly on the contact surfaces after producing the temporary or reversible bond, especially by deforming at least one of the contact

Claims

1. A method for bonding of a first contact surface of a first substrate to a second contact surface of a second substrate, said method comprising:

forming a reservoir in a surface layer on the first contact surface by plasma activation of the first contact surface using at least a forming gas comprising 95% Ar and 5% H_2,

at least partially filling the reservoir with a first educt or a first group of educts,

contacting the first contact surface with the second contact surface for formation of a prebond connection, and

forming a permanent bond between the first and second contact surface, said permanent bond at least partially strengthened by the reaction of the first educt with a second educt contained in a reaction layer of the second substrate.

2. The method as claimed in claim 1, wherein formation and/or strengthening of the permanent bond takes place by diffusion of the first educt into the reaction layer.

3. The method as claimed in claim 1, wherein the formation of the permanent bond takes place at a temperature between room temperature and 200^o Celsius, especially during a maximum of 1 hour.

4. The method as claimed in claim 1, wherein the permanent bond has a bond strength of greater than 1.5 J/m^2.

5. The method as claimed in claim 1, wherein during the reaction a reaction product with a greater molar volume than the molar volume of the second educts is formed in the reaction layer.

6. The method as claimed in claim 1, wherein the reservoir is formed by plasma activation, wherein reduced species of the ions present in the plasma process are located in the reservoir.

7. The method as claimed in claim 6, wherein the reduced species are O_2-, N_2-, H_2-, Ar-ions.

8. The method as claimed in claim 1, wherein the surface layer is comprised of an amorphous material and the reaction layer is comprised of an oxidizable material.

9. The method as claimed in claim 1, wherein between the second contact surface and the reaction layer there is a growth layer comprised predominantly of native silicon dioxide.

10. The method as claimed in Claim 9, wherein before formation of a permanent bond the growth layer has an average thickness A between 1 angstrom and 10 nm.

11. The method as claimed in claim 1, wherein the reservoir is formed in a vacuum.

12. The method as claimed in claim 1, wherein the reservoir is formed in an average thickness (R) between 0.1 nm and 25 nm.

13. The method as claimed in claim 1, wherein the average distance (B) between the reservoir and the reaction layer immediately before formation of the permanent bond is between 0.1 nm and 15 nm.

14. The method as claimed in claim 1, wherein the permanent bond has a bond strength which comprises 2 times the prebond strength.