CLAIMS

1. A method for bonding of a first contact surface (3) of a first substrate (1) to a second contact surface (4) of a second substrate (2) ~~with~~ comprising the following steps~~, especially the following sequence~~:

~~———~~forming a first reservoir (5) in a surface layer (6) on the first contact surface (3) ~~and a second reservoir (5') in a surface layer (6') on the second contact surface (4)~~, the surface layers (6~~, 6'~~) consisting at least largely of a native oxide material,

~~———at least~~ partially or completely filling ~~of~~ the first ~~and the second~~ reservoirs (5~~, 5'~~) with ~~a~~ one or more first educts ~~or a first group of educts~~,

~~———~~providing a second educt in a reaction layer (7) of the second substrate (2), said first educt being filled in the first reservoir (5) of the first substrate (1) and said second educt being contained in the reaction layer (7) of the second substrate (2); and

~~providing a growth layer (8) at the second contact surface (4) of the second substrate (2),~~

~~bringing the first contact surface (3) in contact with the second contact surface (4) for formation of a prebond connection,~~

~~———~~forming a permanent bond between the first and second contact surfaces (3, 4), said permanent bond being at least partially strengthened by ~~the~~ a first reaction of the first educts filled in the first reservoir (5) with the second educts contained in a reaction layer (7) of the second substrate (2)~~, wherein the first educt and the second educt are capable to form and/or strengthen the permanent bond, and~~

~~———inhibiting growth of the growth layer (8) before the contact surfaces (3, 4) make contact~~.

~~2. The method as claimed in Claim 1, wherein the educts are taken from the group consisting of O_x^+, O_2, O_3, N_2, NH_3, H_2O, H_2O_2, and NH_4OH.~~

~~3. The method as claimed in Claim 1, wherein the substrates (1,2) are comprised of a material capable of reacting as an educt with one of the first educt and the second educt to form a growth layer (8) on the substrates (1, 2) to result in a product with a higher molar volume.~~

42. The method as claimed in Claim 1, wherein formation and/or strengthening of the permanent bond takes place by diffusion of the first educts of the first reservoir (5) into the reaction layer (7) of the second substrate (2).

~~5~~3. The method as claimed in one of the preceding claims, wherein the formation of the permanent bond takes place at a temperature between room temperature and 200°C, ~~especially~~ during a maximum 12 days period~~, preferably a maximum 1 day, even more preferably a maximum 1 hour, best a maximum 15 minutes~~.

~~6~~4. The method as claimed in one of the preceding claims, wherein the irreversible bond has a bond strength of greater than 1.5 J/m^2~~, especially greater than 2 J/m^2, preferably greater than 2.5 J/m^2~~.

~~7~~5. The method as claimed in one of the preceding claims, wherein ~~during the reaction~~ a reaction product (10) is formed in the reaction layer (7) of the second substrate (2) during the forming of the permanent bond, said reaction product (10) having ~~with~~ a greater molar volume than ~~the~~ a molar volume of the second educts ~~is formed in the reaction layer (7)~~.

~~8~~6. The method as claimed in one of the preceding claims, wherein the reservoirs (5, 5') ~~is~~ are formed by plasma activation.

~~9~~7. The method as claimed in one of the preceding claims, wherein the surface layer (6) ~~consists essentially completely~~ of the first contact surface (6) is comprised of an

amorphous material~~, especially silicon oxide~~ produced by thermal oxidation, and the reaction layer (7) of the second substrate (2) ~~consists~~ is comprised of an oxidizable material~~, especially predominantly, preferably essentially completely,~~ selected from the group consisting of Si, Ge, InP, GaP ~~or~~ and GaN.

~~10~~8. The method as claimed in one of the preceding claims, wherein a growth layer (8) is between the second contact surface (4) and the reaction layer (7) ~~there is a growth layer (8)~~ of the second substrate (2), ~~consisting especially at least largely~~ said growth layer (8) being comprised of a native oxide material~~, preferably predominantly of native silicon dioxide~~ of the second educts contained in the second substrate (2).

~~11~~9. The method as claimed in Claim 10, wherein before the formation of a permanent bond the growth layer (8) and/or the surface layer (6) has an average thickness A between 1 angstrom and 10 nm.

~~12~~10. The method as claimed in one of the preceding claims, wherein ~~a~~ one of said first reservoir (5) and second reservoir (5') is formed in a vacuum.

~~13~~11. The method as claimed in one of the preceding claims, wherein the reservoirs (5, 5') ~~is~~ are filled by one or more of the following steps ~~cited below~~:

~~———~~exposing the first contact surface (3) to ~~the~~ an atmosphere~~, especially with a high oxygen and/or water content~~,

~~———~~exposing the first contact surface (3) to ~~a~~ at least one fluid ~~consisting especially predominantly, preferably almost completely, of especially~~selected from the group consisting of deionized H_2O and~~/or~~ H_2O_2, and

~~———~~exposing the first contact surface (3) to at least one gas selected from the group consisting of N_2, ~~gas and/or~~ O_2, ~~gas~~ and~~/or~~ Ar ~~gas and/or forming gas, especially consisting of 95% Ar and 5% H_2, especially~~ with an ion energy in the range from 0 to 2000 eV.

~~14~~12. The method as claimed in one of the preceding claims, wherein the ~~formation and the filling of a reservoir take place additionally on the second contact surface (4), especially in the growth layer (8), and the formation of the~~ permanent bond is additionally strengthened by a second reaction of the first educts filled in the second reservoir (5') with ~~a~~ the second educts contained in a reaction layer (7') of the first substrate (1).

~~15~~13. The method as claimed in one of the preceding claims, wherein ~~the~~ an average distance (B) between the first reservoir (5) and the reaction layer (7) of the second substrate (2) immediately before the formation of the permanent bond is between 0.1 nm and 15 nm~~, especially between 0.5 nm and 5 nm, preferably between 0.5 nm and 3 nm~~.

~~16~~14. The method as claimed in one of the preceding claims, further comprising:

forming a prebond connection between the first and second contact surfaces (3, 4) by positioning the first contact surface (3) and the second contact surface (4) such that a group of the first educts positioned between the contact surfaces (3, 4) reacts with the first and second contact surfaces (3, 4) to bring the first contact surface (3) into direct contact with the second contact surface (4),

wherein the ~~irreversible~~ permanent bond has a bond strength which ~~comprises~~ is at least twice~~, preferably 4 times, more preferably 10 times, most preferably 25 times the prebond~~ a strength of the prebond connection.

~~17~~15. The method as claimed in one of the preceding claims, wherein ~~the size of~~ the first reservoir (5) and the second reservoir (5') ~~is configured~~ are dimensioned to hold the first educts ~~and to accomodate excess first educt remaining from the reaction of the first educt with the second educt~~,

wherein portions of the first educts held by the first and second reservoirs (5, 5') respectively react with the reaction layers (7, 7') of the second and first substrates (2, 1), and

wherein remaining portions of the first educts held by the first and second

reservoirs (5, 5') do not respectively react with the reaction layers (7, 7') of the second and first substrates (2, 1) and remain within the first reservoir (5) and second reservoir (5') to hinder a formation of bubbles therein.

~~18~~16. The method as claimed in one of the preceding claims, wherein the first reservoir (5) and/or the second reservoir (5') are produced by plasma discharge using O_2-gas ~~is used for plasma discharge~~.

17. The method as claimed in one of the preceding claims, wherein the native oxide material is silicon dioxide.

18. A method of bonding a first contact surface (3) of a first substrate (1) to a second contact surface (4) of a second substrate (2) comprising the following steps:

forming a first reservoir (5) in a surface layer (6) on the first contact surface (3) and a second reservoir (5') in a surface layer (6') on the second contact surface (4);

partially filling the first and second reservoirs (5, 5') with one or more first educts;

providing a second educt in a reaction layer (7) of the second substrate (2), said first educt being filled in the first reservoir (5) of the first substrate (1) and said second educt being contained in the reaction layer (7) of the second substrate (2);

forming a prebond connection between the first and second contact surfaces (3, 4) by bringing one or more portions of the first contact surface (3) into contact with one or more portions of the second contact surface (4) such that gaps are formed between the first and second contact surfaces (3, 4) at areas located between the respective contacted portions of the first and second contact surfaces (3, 4); and

forming a permanent bond between the first and second contact surfaces (3, 4) by forming a reaction product through a first reaction of the first educts filled in the first reservoir (5) with the second educts contained in a reaction layer (7) of the second substrate (2), the reaction product being formed between the reaction layer (7) of the second substrate (2) and the surface layer (6') of the second substrate (2), the first reaction

serving to bulge the surface layer of the second substrate (2) toward the first contact surface (3) to close the gaps and at least partially strengthen the permanent bond, the first reaction serving to deform a portion of the reaction layer (7) of the second substrate (2) into the reaction product (10).

20. The method as claimed in claim 19, wherein the areas in which the gaps are formed are filled with the bulged surface layer.

21. The method as claimed in claim 19, wherein the permanent bond is additionally strengthened by a second reaction of the first educts filled in the second reservoir (5') with the second educts contained in a reaction layer (7') of the first substrate (1).