Claims:

1. Method for producing a direct bond between a bonding side of a first substrate (1) and a bonding side of a second substrate (14) in a workspace (22), in which

   a) at least one of the bonding sides is modified in a plasma chamber (4) and is subsequently bonded with the bonding side of the second substrate (14) in a bonding chamber (5), and/or

   b) at least one of the bonding sides is modified in a bonding/plasma chamber (20) and subsequently bonded with the bonding side of the second substrate (14) in the bonding/plasma chamber (20),

   wherein modification of at least one of the bonding sides takes place through a change in the stoichiometry of an oxide layer (2) on at least one of the bonding sides,

   and wherein one or more or the following specified reducing gases is introduced into the plasma chamber (4) for modification:

   Hydrogen, Nitrogen oxides, Carbon monoxide, Methane,

   and wherein the reducing gas is mixed with one or more of the following inert gases:

   - Xenon, Argon, Helium, Nitrogen, Carbon dioxide.

2. Method according to Claim 1, in which the modification takes place by:

   a) altering an oxide layer (2) on at least one of the bonding sides, and/or

   b) at least partial, and particularly complete, removal of part of an oxide layer (2) from at least one of the bonding sides.

3. Method according to one of the Claims 1 or 2, in which the bonding layer is exposed to an ion energy of less than 1000eV, especially less than 500eV, preferably less than 250eV, that is applied between an upper electrode (10) and a lower electrode (9) of the plasma chamber (4) and/or the bonding/plasma chamber (20).

4. Method according to Claim 3, in which an AC voltage with a frequency greater than the frequency of the AC voltage applied to the lower electrode is supplied to the upper electrode (10).

Device and Method for Bonding Substrates

Patent Claims

1. Device for producing an electrically conductive direct bond between a bonding side of a first substrate (1) and a bonding side of a second substrate (14) with the following features:
   - a workspace (22) that can be closed, gas-tight, against the environment and can be supplied with a vacuum,
   - the workspace (22) comprises:
     a) at least one plasma chamber (4) for modifying at least one of the bonding sides and at least one bonding chamber (5) for bonding the bonding sides and/or
     b) at least one combined bonding/plasma chamber (20) for modifying at least one of the bonding sides and for bonding the bonding sides.
2. Device according to Claim 1 with a movement mechanism (6) for moving the first and second substrates in the workspace (22), especially from a storage container (8) for substrates, particularly sealingly attached to the workspace (22), to the modules of the module group (3).
3. Device according to Claim 1 or 2, whereby the plasma chamber (4) or the bonding/plasma chamber (20) can be supplied with a reducing gas for modifying an oxide layer (2) provided on at least one of the bonding sides.
4. Device according to one of the previous claims, whereby the plasma chamber (4) or the bonding/plasma chamber (20) has an upper electrode (10) that can be supplied with AC voltage and a lower electrode (9) that can be supplied with AC voltage, between which an ion energy of the ions striking the substrate surface of less than 1000eV, especially less than 500eV, preferably less than 250eV can be applied.

5. Device according to Claim 4, whereby an AC voltage with a frequency greater than the frequency of the AC voltage applied to the lower electrode (9) can be supplied to the upper electrode (10).
6. Device according to one of the previous claims that has a source-detector system, especially docked on the workspace (22) or arranged in the workspace (22), for detecting the condition or the change in the condition of the bonding layer during modification.
7. Method for producing an electrically conductive direct bond between a bonding side of a first substrate (1) and a bonding side of a second substrate (14) in a workspace (22) that can be closed, gas-tight, against the environment and can be supplied with a vacuum, in which
   a) at least one of the bonding sides is modified in a plasma chamber (4) and is subsequently bonded with the bonding side of the second substrate (14) in a bonding chamber (5), and/or
   b) at least one of the bonding sides is modified in a bonding/plasma chamber (20) and subsequently bonded with the bonding side of the second substrate (14) in the bonding/plasma chamber (20).

   wherein modification of at least one of the bonding sides takes place through a change in the stoichiometry of an oxide layer (2) on at least one of the bonding sides
8. Method according to Claim 7, in which the modification takes place by:
   a) altering an oxide layer (2) on at least one of the bonding sides, and/or
   b) at least partial, and particularly complete, removal of part of an oxide layer (2) from at least one of the bonding sides.
9. Method according to one of the Claims 7 or 8, in which one or more or the following specified reducing gases is introduced into the plasma chamber (4) for modification:

- Hydrogen,
- Nitrogen oxides,
- Carbon monoxide,
- Methane.

10. Method according to Claim 9, in which the reducing gas is mixed with one or more of the following inert gases:
    - Xenon,
    - Argon,
    - Helium,
    - Nitrogen,
    - Carbon dioxide.
11. Method according to one of the Claims 7 through 10, in which the bonding layer is exposed to an ion energy of less than 1000eV, especially less than 500eV, preferably less than 250eV, that is applied between an upper electrode (10) and a lower electrode (9) of the plasma chamber (4) and/or the bonding/plasma chamber (20).
12. Method according to Claim 11, in which an AC voltage with a frequency greater than the frequency of the AC voltage applied to the lower electrode is supplied to the upper electrode (10).