Claims

1. A method for transferring a thin film (10) to a support substrate (2), comprising:

- providing a bonded assembly (100) that comprises a donor substrate (1) and the support substrate (2), assembled by direct bonding at their respective front faces (1a, 2a), following a bonding interface (3), the bonded assembly (100) having a local unbonded area (31) within this bonding interface (3), the donor substrate (1) further comprising a buried brittle plane (11),

- separating along the buried brittle plane (11), initiated at the local unbonded area (31) after microcrack growth in said plane (11) by thermal activation, the separation resulting in the transfer of a thin film (10) from the donor substrate (1) to the support substrate (2),

wherein the local unbonded area (31) is generated solely by a roughened area (31a), produced deliberately on at least one of the front faces (1a, 2a) of the donor (1) and support (2) substrates prior to assembly, said roughened area (31a) being free of topology and having a predetermined roughness with an amplitude of between 0.5 nm RMS and 60.0 nm RMS.

2. The transfer method according to the preceding claim, wherein the roughened area is produced by at least one laser shot generating only a surface fusion, within the first 1 to 30 nanometers, of a material making up the donor substrate (1) and/or the support substrate (2), on the side of their respective front faces (1a, 2a).

3. The transfer method according to claim 2, wherein the laser shot has a pulse duration of between 1 ns and 1000 ns, preferentially between 10 ns and 500 ns.

4. The transfer method according to claim 3, wherein the laser shot is performed with a laser of wavelength 308 nm, and with an energy density of between 1.8 J/cm2 and 2.5 J/cm2.

5. The transfer method according to one of claims 2 to 4, wherein a laser shot irradiates a circular surface with a diameter of less than 200 micrometers.

6. The transfer method according to claim 5, wherein the roughened area (31a) is produced by a plurality of laser shots, for example between two and fifteen laser shots, the adjacent circular surfaces irradiated by successive laser shots being tangential or having an overlap percentage of between 1% and 95%.

7. The transfer method according to one of the preceding claims, wherein:
- the front face (1a, 2a), whereupon the roughened area (31a) is formed, is made of monocrystalline silicon, and the predetermined roughness has an amplitude between 0.5 nm RMS and 4.0 nm RMS, preferentially between 1.0 nm RMS and 2.5 nm RMS, or
- the front face (1a, 2a), whereupon the roughened area (31a) is formed, is made of polycrystalline silicon, and the predetermined roughness has an amplitude between 0.5 nm RMS and 5.0 nm RMS, preferentially between 2.0 nm RMS and 5.0 nm RMS, or
- the front face (1a, 2a), whereupon the roughened area (31a) is formed, is made of silicon oxide, and the predetermined roughness has an amplitude of between 1.0 nm RMS and 60.0 nm RMS.

8. The transfer method according to one of the preceding claims, wherein the roughened area (31a) is produced on the front face (1a) of the donor substrate (1), prior to the formation of the buried brittle plane (11) in said donor substrate (1).

9. The transfer method according to claim 8, wherein:
- the donor substrate (1) is formed from a first material on its front face (1a), and a preliminary roughened area is formed on the surface of said material, and

- thermal oxidation of the first material of the donor substrate (1) is carried out after formation of the preliminary roughened area and before formation of the buried brittle plane (11), to form an insulating layer that will be assembled on the support substrate (2) in the bonded assembly (100), said insulating layer comprising, on its free face, the roughened area (31a) plumb with the preliminary roughened area.

10. The transfer method according to one of claims 1 to 7, wherein:

- the support substrate (2) is formed from a first material at its front face (2a), and a preliminary roughened area is formed on the surface of said material, and

- thermal oxidation of the first material of the support substrate (2) is carried out after formation of the preliminary roughened area, to form an insulating layer that will be assembled on the donor substrate (1) in the bonded assembly (100), said insulating layer comprising, on its free face, the roughened area (31a) plumb with the preliminary roughened area.

11. The transfer method according to one of the preceding claims, wherein the local unbonded area (31) has a shape, in the plane of the bonding interface (3), whereof at least a portion of the contour has a radius of curvature smaller than the radius of a circular bonding defect of the same area.

12. The transfer method according to one of the preceding claims, wherein the local unbonded area (31) has at least one lateral dimension, in the plane of the bonding interface (3), of less than 300 micrometers.

13. The transfer method according to one of the preceding claims, wherein the local unbonded area (31) is located in a central region of the bonded assembly (100), in the plane of the bonding interface (3).

14. The transfer method according to one of the preceding claims, wherein the thin film (10) from the donor substrate (1) is monocrystalline silicon and the

support substrate (2) comprises monocrystalline silicon, to form a stacked SOI structure (110).