

DESCRIPTION

TITLE: METHOD FOR MANUFACTURING A STRUCTURE COMPRISING A PLURALITY OF BURIED CAVITIES

FIELD OF THE INVENTION

The present invention relates to the field of microelectronics and electromechanical microsystems. In particular, the present invention relates to a method for the collective manufacture of a plurality of cavities that are buried within a structure comprising a support substrate and a thin layer, the cavities being confined between the support substrate and the thin layer.

TECHNOLOGICAL BACKGROUND OF THE INVENTION

MEMS devices (MEMS being the acronym of microelectromechanical systems) are widely used to fabricate various sensors, for a multitude of applications: mention may for example be made of pressure sensors, microphones, radio-frequency switches, electro-acoustic and ultrasonic transducers (piezoelectric micromachined ultrasonic transducers (pMUT) for example), etc. Many of these MEMS devices are based on a flexible membrane overhanging a cavity. In operation, the deflection of the membrane, which is related to a physical parameter (for example the propagation of an acoustic wave in the case of a pMUT), is converted into an electrical signal (or vice versa depending on whether the device is in receiver or emitter mode).

There are numerous layer-transfer methods for obtaining a structure comprising a thin layer (which will form the above-mentioned membrane) overhanging a plurality of cavities. These are advantageously based on assembly by direct bonding (which is to say without the addition of adhesive substance) of a donor substrate and of a support substrate, along the respective front faces thereof. One or the other of the substrates, conventionally the support substrate, comprises cavities opening onto its front face. These cavities are sealed during the assembly step as a result of molecular adhesion of the two substrates. A step of thinning the donor substrate causes a thin layer to be transferred onto the support substrate. This thinning step may notably be based on the Smart Cut™ technique which employs a buried weakened plane formed by implanting light species into the donor substrate which, with a front face of the donor substrate, delimits the thin layer (typically having a thickness less than 2 μm) that is to

be transferred. As is well known per se, the growth of micro-fissures in the buried weakened plane, through thermal and/or mechanical activation, leads to separation along said plane which gives rise to the transfer of the thin layer onto the support substrate. The rest of the donor substrate may be reused for a subsequent layer transfer.

Obtaining high-quality thin-layer transfer is nevertheless a complex matter, because of the presence of the cavities, plumb with which there is no stiffening effect. The stiffening effect is attributed here to the presence of the front face of the support substrate in contact with the thin layer.

Thus, the growth of the micro-fissures in the buried weakened plane may generate, plumb with the cavities, blisters or even local exfoliations that irreversibly damage the thin layer and correspond to transfer defects.

The greater the size of the cavities, the more difficult it is to ensure quality transfer. The target dimensions for the lateral dimensions of the cavities are typically of the order of a few microns to a few tens of microns, this being for a thin-layer thickness that remains below 2 μm .

SUBJECT OF THE INVENTION

The present invention proposes a method for the collective manufacture of a structure comprising a plurality of buried cavities, overhung by a high-quality thin layer, which is to say one exhibiting very few transfer defects. It is based on the formation of a buried weakened plane referred to as functional, the characteristics and properties of which differ between first zones and second zones, which either do or do not enjoy a stiffening effect: the objective being to decorrelate the maturation of the micro-fissures in these two zones in order to promote quality transfer of the layer.

BRIEF DESCRIPTION OF THE INVENTION

The present invention relates to a method for the manufacture of a structure comprising a plurality of cavities confined between a thin layer and a support substrate, the manufacturing method comprising the following steps:

- a) provision of a donor substrate and of a support substrate, each of the substrates having a front face and a rear face;
- b) implantation of first light species into the donor substrate in order to form a uniform buried weakened plane delineating, with the front face of the donor substrate, the thin layer that is to be transferred;

c) localized implantation of second species into the donor substrate so as to introduce said second species into the uniform buried weakened plane only in second zones, so as to form a functional buried weakened plane exhibiting:

- first zones containing the first light species and not the second species, and
- second zones containing the first light species and the second species;

d) formation of a plurality of cavities opening onto a front face of the donor substrate or of the support substrate;

e) assembly, by direct bonding, of the donor substrate onto the support substrate along their respective front faces so as to form a bonded structure in which the cavities are plumb with either the first zones or the second zones of the functional buried weakened plane;

f) application of a heat treatment to the bonded structure so as to bring about spontaneous separation along the functional buried weakened plane and form, on the one hand, the structure and, on the other hand, the rest of the donor substrate.

According to advantageous characteristics of the invention, taken alone or according to any achievable combination:

- the implantation of step c) is performed in the presence of a mask placed on the front face of the donor substrate plumb with the first zones of the functional buried weakened plane;
- the formation of the cavities in step d) is performed by local etching of the front face of the support substrate, for example by means of a mask placed on said front face;
- after step c), step d) of forming the cavities involves etching the front face of the donor substrate, plumb with the second zones, the first zones being protected from etching by the mask.
- The method comprises, after step d), and after removing the mask, a step c') of localized implantation of third species on the front face of the donor substrate, the third species thus being implanted in the first zones of the functional buried weakened plane and in another buried plane situated some distance from and below the second zones of the functional buried weakened plane;
- step d) of forming the cavities is performed before step c), and comprises:
 - the application of a mask placed on the front face of the donor substrate plumb with the second zones of the functional buried weakened plane which is intended to be formed in the later step c), and

- the etching of the front face of the donor substrate plumb with the first zones, the second zones being protected from etching by the mask;
- after step d), and after removing the mask from the front face of the donor substrate, implantation step c) is performed, the second species thus being implanted in the second zones of the functional buried weakened plane and in another buried plane situated some distance from and below the first zones of the functional buried weakened plane;
- the second zones of the functional buried weakened plane are plumb with the cavities, in the bonded structure, and the first light species are hydrogen atoms or ions and the second species are helium atoms or ions;
- the first zones of the functional buried weakened plane are plumb with the cavities, in the bonded structure, the first light species are hydrogen atoms or ions or helium atoms or ions or else hydrogen and helium atoms or ions, and the second species are silicon atoms or ions capable of slowing the rate of growth of micro-fissures in the second zones of the functional buried weakened plane compared with the rate of growth of the micro-fissures in the first zones;
- assembly step e) involves at least one intermediate layer placed on the donor substrate and/or on the support substrate, said intermediate layer having been deposited after one of steps a) to d).

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will emerge from the detailed description which will follow, with reference to the appended figures, in which:

[Fig. 1] Figure 1 depicts two structures produced using the manufacturing method according to the present invention;

[Fig. 2a]

[Fig. 2b]

[Fig. 2c]

[Fig. 2d]

[Fig. 2e]

[Fig. 2f]

Figures 2a to 2f depict steps of the manufacturing method according to a first embodiment of the present invention;

[Fig. 3a]

[Fig. 3b]

[Fig. 3c]

[Fig. 3d]

[Fig. 3e]

[Fig. 3f]

Figures 3a to 3f depict steps of the manufacturing method according to a second embodiment of the present invention;

[Fig. 4a]

[Fig. 4b]

[Fig. 4d]

[Fig. 4c]

[Fig. 4e]

[Fig. 4f]

Figures 4a to 4f depict steps of the manufacturing method according to a third embodiment of the present invention; note that step d) (Figure 4d) occurs before step c) (Figure 4c) in this third embodiment;

[Fig. 5] Figure 5 shows images, viewed from above, of SOI structures with cavities not in accordance with the invention, these having been obtained after isothermal annealing at different temperatures;

[Fig. 6a]

[Fig. 6b]

[Fig. 6c]

[Fig. 6d]

[Fig. 6c']

[Fig. 6e]

[Fig. 6f]

Figures 6a to 6f depict steps of the manufacturing method according to a variant of the first embodiment of the present invention; note that an additional step c') is added after step d) in this variant, compared with the first embodiment illustrated in Figures 2a to 2f.

Certain figures are schematic representations which, for the purpose of legibility, are not to scale. In particular, the thicknesses of the layers along the axis z are not to scale in relation to the lateral dimensions along the axes x and y. In the figures, the same references may have been used for elements of the same nature.

DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method for the manufacture of a structure 100 comprising a plurality of cavities 30 confined between a thin layer 10 and a support substrate 20, as illustrated in Figure 1. The structure 100 may potentially comprise at least one intermediate layer 50 between the thin layer 10 and the support substrate 20.

A first step a) of the manufacturing method consists in providing a donor substrate 11, from which the thin layer 10 will be transferred, and a support substrate 20 (Figure 2a, Figure 3a, Figure 4a, Figure 6a).

The donor substrate 11 and the support substrate 20 advantageously have the form of a wafer, of a diameter typically greater than 100 mm, for example 150 mm, 200 mm or 300 mm, and each have a front face 11a, 20a and a rear face 11b, 20b. Their thickness is typically between 200 and 900 microns. The donor substrate 11 may be formed of at least one material selected from silicon, germanium, group III-V semiconductor compounds, silicon carbide, lithium tantalate, lithium niobate, or some other material of interest for the target application. The support substrate 20 may be formed of at least one material selected from silicon, germanium, group III-V semiconductor compounds, silicon carbide, lithium tantalate, lithium niobate, a glass, a ceramic, or some other material of interest for the target application.

The next step b) of the method corresponds to implanting first light species in the donor substrate 11, through the entirety of the front face 11a thereof (or in other words, full-surface or “full wafer” implantation), so as to form a uniform buried weakened plane 12' which, with said front face 11a, delimits the thin layer 10 that is to be transferred (Figure 2b, Figure 3b, Figure 4b, Figure 6b). The term uniform here means that the implantation characteristics are the same across the entire extent of the buried weakened plane 12'.

These light species may notably be selected from hydrogen and/or helium atoms or ions. As is well known with reference to the Smart Cut™ process, these first species, once implanted in the donor substrate 11, are able to form lenticular defects in the uniform buried weakened plane 12'; these defects are liable to spread in the form of micro-fissures, activated by heat, through the diffusion of the light species and the coalescence of the lenticular defects. Remember that the lenticular defects are distributed in a thin layer which is buried within the donor substrate 11 and determined by the

implantation Gaussian profile; for the sake of simplicity, this layer is referred to as a buried weakened plane.

The implantation energy defines the depth at which the uniform buried weakened plane 12' will be generated in the donor substrate 11. For a given implantation energy and a given material of the donor substrate 11, the implanted dose of light species is the essential parameter that defines the rate of spread of the micro-fissures, namely the rate of blistering (without stiffener) and of fracturing (where a stiffener is used).

The applicant has identified that, in order to obtain a high-quality transfer of the thin layer 10, in a structure 100 with cavities, the required characteristics and properties of the buried weakened plane differ according to whether said plane lies plumb with a region benefiting from a stiffening effect or plumb with a cavity (which therefore has no stiffening effect). In regions that benefit from a stiffening effect, it seems advantageous for the rate of fracturing to be "slowed" so as to allow the use of relatively high temperatures in the heat treatment which is intended to bring about spontaneous separation in the buried weakened plane, while at the same time keeping controllable treatment times; a higher temperature also allows the micro-fissures to be placed under greater pressure, and promotes the continuity of the fracture wave. In regions that do not benefit from a stiffening effect (plumb with cavities), it is advantageous for the spread of the micro-fissures, during the above-mentioned heat treatment, to give rise to large-sized blisters, without premature local exfoliation.

Progress towards this objective is achieved by implementing the manufacturing method according to the invention which envisions the creation of a functional buried weakened plane 12 comprising first zones Z1 which differ from second zones Z2 in terms of the doses and/or nature of the implanted species.

Step c) of the method corresponds to localized implantation of second species into the donor substrate 11 so as to introduce said second species into the uniform buried weakened plane 12' only in second zones Z2. That makes it possible to form the functional buried weakened plane 12 (Figure 2c, Figure 3c, Figure 4c, Figure 6c). The latter plane then exhibits, in the plane (x,y) of the front face 11a:

- first zones Z1 containing the first light species and not the second species, and
- second zones Z2 containing the first light species and the second species.

The second species may be of the same nature as the first species or of a different nature. The implantation energy used to introduce the second species is adjusted so that their implantation profile is

substantially superposed with the implantation profile of the first light species. Advantageously, the maxima of the implantation profiles of the first and second species are located at depths that are equal to within $\pm 20\%$, or more advantageously still, to within $\pm 10\%$.

Localized implantation may be obtained in different ways. A first option, implemented in a first and a second embodiment of the invention (Figure 2c, Figure 3c) consists in using a mask (M), applied to the front face 11a of the donor substrate 11, so as to protect the first zones Z1 from implantation. Such a mask is conventionally formed using deposition, lithography and etching techniques. Another option, illustrated in Figure 4c, with reference to a third embodiment of the invention, is to make use of a difference in relief, on the front face 11a, between the regions plumb with the first zones Z1 and those plumb with the second zones Z2, so as to locate the second species in the second zones Z2 of the functional buried weakened plane 12 and introduce them at some distance beneath the first zones of said plane 12, in another, but discontinuous, buried plane 12". The second species may then contribute to the characteristics and properties of the second zones Z2, but not (or to only a very limited extent) to those of the first zones Z1.

During a step d) of the method, a plurality of cavities 30 is formed at the front face 11a of the donor substrate 11 (1st and 3rd embodiments, Figure 2d, Figure 6d and Figure 4d) or that 20a of the support substrate 20 (2nd embodiment, Figure 3d).

It is important to note that step d) may be performed after step c) (1st embodiment, Figure 2d, Figure 6d) or before step c) (3rd embodiment, Figure 4d), or even in parallel with step c) (2nd embodiment, Figure 3d).

The formation of the cavities in one of the substrates is performed conventionally by local etching of the front face 11a, 20a, for example by means of a mask (M, M') placed on said front face 11a, 20a.

The depth of the cavities 30 may typically vary between 100 nm and 100 μm . Their shape, in the plane (x,y) of the front face 11a, 20a of the relevant substrate 11, 20, may be circular, square, rectangular or polygonal. The characteristic dimension(s) (or lateral dimension(s)) of a cavity 30 in the plane (x,y), namely its diameter (in the case of a circular shape) or its side length (in the case of a square shape) or else its width and its length (in the case of a rectangular shape) is(are) typically comprised between 1 μm and 500 μm . The spacing between the cavities 30 may be comprised between 1 μm and several hundred μm .

The 1st and 3rd embodiments, which envision the formation of the cavities 30 in the donor substrate 11 (Figure 2d, Figure 4d), offer the advantage of requiring only one mask (M) for performing steps c) and d). Nevertheless, these embodiments limit the range of possible cavity depths because the depth needs to remain less than the difference between the depth of the functional buried weakened plane 12 and the target thickness of the thin layer 10 that is to be transferred.

The 2nd embodiment envisages forming cavities 30 in the support substrate 20 (Figure 3d). In this case, it is necessary for the mask M' used for defining the position of the cavities 30 in said substrate 20, and the mask M used for defining the position of the first and second zones Z1, Z2 to allow the cavities 30 and first or second zones Z1, Z2 to correspond with one another during the later assembly step.

The manufacturing method next comprises a step e) of assembly by direct bonding of the donor substrate 11 to the support substrate 20 at the respective front faces 11a, 20a thereof, so as to form a bonded structure 90 (Figure 2e, Figure 3e, Figure 4e, Figure 6e). A bonding interface 40, devoid of adhesive substance, is defined between the two assembled faces.

The cavities 30 live plumb either with the first zones Z1 or with the second zones Z2 of the functional buried weakened plane 12, depending on the implementation.

The principle of direct bonding, which is well known in the prior art, will not be described in detail here. Because it is based on molecular adhesion between assembled faces, a very good surface finish (cleanliness, low roughness, etc.) of the substrates 11, 20 is required, in order to obtain good quality assembly.

Prior to assembly, the donor substrate 11 and support substrate 20 usually undergo preparation. By way of example, a conventional sequence used in microelectronics, especially for silicon-based substrates, comprises an ozone clean, an SC1 clean (SC1 being the acronym of Standard Clean 1) and an SC2 clean (SC2 being the acronym of Standard Clean 2) with intermediate rinses. The surfaces that are to be assembled may also possibly be activated, for example using a plasma, before being brought into contact, in order to promote a high bonding energy between said surfaces.

Optionally, the donor substrate 11 and/or the support substrate 20 may comprise an intermediate layer 50, at least on their respective front faces 11a, 20a, to promote quality bonding and bonding energy at their interface, or to suit the purposes of the application (Figure 2e, Figure 3e, Figure 4e, Figure 6e). This intermediate layer may notably be formed from an insulating material, such as silicon oxide, silicon nitride, etc. In the specific instance in which the donor substrate 11 and the support substrate 20 are

made of silicon, the structure 100 obtained at the outcome of the method is then an SOI (silicon on insulator) structure with buried cavities 30.

The intermediate layer 50 lying on the donor substrate 11 and/or on the support substrate 20 may be formed by growth or deposition after one of steps a) to d) of the method.

The direct bonding of step e) may be performed in an ambient atmosphere or in a controlled atmosphere (for example in a low-pressure chamber).

The next step f) of the manufacturing method corresponds to the application of a heat treatment to the bonded structure 90 so as to bring about spontaneous separation along the functional buried weakened plane 12 and form, on the one hand, the structure 100 and, on the other hand, the rest of the donor substrate 11' (Figure 2f, Figure 3f, Figure 4f, Figure 6f). The structure 100 comprises the thin layer 10, assembled with the support substrate 20 either directly or via an intermediate layer 50 along a bonding interface 40, and buried cavities 30.

As mentioned previously, the applicant has identified that the quality of the transfer of the thin layer 10 of the donor substrate 11 to the support substrate 20 is improved by the application of higher separation temperatures. Figure 5 shows images of a portion of the surface of a number of SOI structures with cavities (not in accordance with the invention), after transfer, for various heat treatment temperatures between 350°C and 450°C (isothermal annealing). It is clearly evident that the density of transfer defects (which appear in black in the images) decreases with the increase in heat treatment temperature at step f).

In the manufacturing method according to the invention, the functional buried weakened plane 12 is made up of two zones Z1, Z2 having distinct implantation characteristics, making it possible to promote, on the one hand, a transfer rate that is compatible with "high" temperatures (in the regions that benefit from the stiffening effect) and, on the other hand, the formation of large-sized blisters at these temperatures with, possibly, the minimum of local exfoliation (in the regions plumb with the cavities 30 which do not benefit from the stiffening effect).

According to one embodiment, it is the second zones Z2 of the functional buried weakened plane 12 that lie plumb with the cavities 30 in the bonded structure 90.

In the particular case of a target structure 100 of the SOI type with cavities, the first light species may be hydrogen atoms or ions, and the second species helium atoms or ions. In practice, the donor substrate 11 is therefore made of monocrystalline silicon, the support substrate 20 is made of silicon, and an intermediate layer 50 of silicon oxide (for example of a thickness of 200 nm) lies over all or part of one and/or the other of the front faces 11a, 20a, prior to assembly. By way of example, the cavities 30 are made in the donor substrate 11, and have a depth of 100 nm, lateral dimensions of 40 μm and a spacing of 7 μm . The implantation energy for the first light species (hydrogen) is 140 keV, at a dose of $6 \times 10^{16} / \text{cm}^2$; the implantation energy for the second species (helium) is 220 keV, at a dose of $2 \times 10^{16} / \text{cm}^2$. The first zones Z1 of the functional buried weakened plane 12, which contain only the hydrogen species, are plumb with regions benefiting from a stiffening effect; the implantation characteristics in the first zones Z1 here are favourable to transfer in the higher temperature ranges (typically equal to 450°C or higher).

The second zones Z2 of the functional buried weakened plane 12, which contain the first species (hydrogen) and the second species (helium), are plumb with regions that do not benefit from the stiffening effect (cavities 30); the implantation characteristics in the second zones Z2 here are favourable to the formation of large-sized blisters, in the aforementioned “high” temperature ranges.

According to another embodiment, it is the first zones Z1 of the functional buried weakened plane 12 that lie plumb with the cavities 30 in the bonded structure 90.

In the particular case of a target structure 100 of the SOI type with cavities, the first light species may be hydrogen atoms or ions, or helium atoms or ions, or else hydrogen and helium atoms or ions (and step c) would then involve co-implantation, namely two successive implantations of these two light species). The second species implanted locally are atoms or ions capable of slowing the rate of growth of micro-fissures in the second zones Z2 of the functional buried weakened plane 12 compared with the rate of growth of the micro-fissures in the first zones Z1. These second species may for example be silicon atoms or ions which will damage the material of the donor structure 11 to the point of achieving a greater or lesser extent of amorphization, thus modifying the rate of growth of the micro-fissures. Second species of a different nature could of course be implanted in order to achieve this same objective.

In practice, the donor substrate 11 is made of monocrystalline silicon, the support substrate 20 is made of silicon, and an intermediate layer 50 of silicon oxide (for example of a thickness of 200 nm) lies over the front face 20a, prior to assembly. By way of example, the cavities 30 are made in the donor substrate 11, and have a depth of 100 nm, lateral dimensions of 40 μm and a spacing of 7 μm . The

implantation energy for the first light species (co-implanted hydrogen and helium) is 32 keV (H) and 52 keV (He), at a dose of $1\text{E}16/\text{cm}^2$ and $1.5\text{E}16/\text{cm}^2$, respectively; the implantation energy for the second species (Si) is 360 keV, at a dose of $10\text{E}14/\text{cm}^2$.

The first zones Z1 of the functional buried weakened plane 12, which contain only the first species (hydrogen and helium), are plumb with regions that do not benefit from a stiffening effect (cavities 30); the implantation characteristics in the first zones Z1 here are favourable to the formation of large-sized blisters, possibly with limited local exfoliation, in the ranges of “high” temperatures desired for the separation heat treatment step f).

The second zones Z2 of the functional buried weakened plane 12, which contain first species (hydrogen and helium) and second species (Si), are plumb with regions benefiting from the stiffening effect; the implantation characteristics in the second zones Z2 here are favourable to transfer in the “high” temperature ranges (typically equal to 450°C or higher).

Note that the manufacturing method may comprise, after step f), conventional steps (be they mechanical, chemical-mechanical, chemical or thermal) of finishing and/or polishing the free surface 10a of the thin layer 10 with a view to achieving the crystalline quality and surface finish required of said thin layer 10 in the finished structure 100.

According to a variant of the first embodiment of the invention, which is illustrated in Figures 6a to 6f, a step c') of localized implantation of third species in the front face 11a of the donor substrate 11 may be performed. This step c') may in particular occur after step d) of forming the cavities 30 in the donor substrate 11 and after the removal of the mask M (Figure 6c'). The third species are thus implanted in the first zones Z1 of the functional buried weakened plane 12 and in another, but discontinuous, buried plane 12" situated some distance beneath the second zones Z2 of the functional buried weakened plane 12. These third species contribute to modifying the characteristics and properties of the first zones Z1 of the functional buried weakened plane 12 but have little or no effect on those of the second zones Z2.

At the end of the transfer of the thin layer 10, the discontinuous buried plane 12" lies in the rest of the donor substrate 11' (Figure 6f).

The present invention may be used for a wide range of MEMS or NEMS (Nano Electromechanical Systems) devices or for any other application that benefits from a thin layer 10 placed locally over a

cavity 30 within a structure 100. As already mentioned in this description, an SOI (silicon on insulator) substrate with buried cavities is a known example of such a structure 100.

The invention is not limited to the embodiments described and variant embodiments may be employed without departing from the scope of the invention such as defined by the claims.

CLAIMS

1. Method for the manufacture of a structure (100) comprising a plurality of cavities (30) confined between a thin layer (10) and a support substrate (20), the manufacturing method comprising the following steps:
 - a) provision of a donor substrate (11) and of a support substrate (20), each of the substrates (11, 20) having a front face (11a, 20a) and a back face (11b, 20b);
 - b) implantation of first light species into the donor substrate (11) in order to form a uniform buried weakened plane (12') delineating, with the front face (11a) of the donor substrate (11), the thin layer (10) that is to be transferred;
 - c) localized implantation of second species into the donor substrate (11) so as to introduce said second species into the uniform buried weakened plane (12') only in second zones (Z2), so as to form a functional buried weakened plane (12) exhibiting:
 - first zones (Z1) containing the first light species and not the second species, and
 - second zones (Z2) containing the first light species and the second species;
 - d) formation of a plurality of cavities (30) opening onto a front face (11a, 20a) of the donor substrate (11) or of the support substrate (20);
 - e) assembly, by direct bonding, of the donor substrate (11) onto the support substrate (20) along their respective front faces (11a, 20a) so as to form a bonded structure (90) in which the cavities (30) are plumb with either the first zones (Z1) or the second zones (Z2) of the functional buried weakened plane (12);
 - f) application of a heat treatment to the bonded structure (90) so as to bring about spontaneous separation along the functional buried weakened plane (12) and form, on the one hand, the structure (100) and, on the other hand, the rest of the donor substrate (11').
2. Manufacturing method according to Claim 1, wherein the implantation of step c) is performed in the presence of a mask (M) placed on the front face (11a) of the donor substrate (11) plumb with the first zones (Z1) of the functional buried weakened plane (12).
3. Manufacturing method according to Claim 2, wherein the formation of the cavities (30) in step d) is performed by local etching of the front face (20a) of the support substrate (20) for example by means of a mask (M') placed on said front face (20a).

4. Manufacturing method according to Claim 2, wherein, after step c), step d) of forming the cavities (30) involves etching the front face (11a) of the donor substrate (11), plumb with the second zones (Z2), the first zones (Z1) being protected from etching by the mask (M).
5. Manufacturing method according to Claim 4, comprising, after step d), and after removing the mask (M), a step c') of localized implantation of third species on the front face (11a) of the donor substrate (11), the third species thus being implanted in the first zones (Z1) of the functional buried weakened plane (12) and in another buried plane (12'') situated some distance from and below the second zones (Z2) of the functional buried weakened plane (12).
6. Manufacturing method according to Claim 1, wherein step d) of forming the cavities (30) is performed before step c), and comprises:
 - the application of a mask (M) placed on the front face (11a) of the donor substrate (11) plumb with the second zones (Z2) of the functional buried weakened plane (12) which is intended to be formed in the later step c), and
 - the etching of the front face (11a) of the donor substrate (11) plumb with the first zones (Z1), the second zones (Z2) being protected from etching by the mask (M).
7. Manufacturing method according to Claim 6, wherein, after step d), and after removing the mask (M) from the front face (11a) of the donor substrate (11), implantation step c) is performed, the second species thus being implanted in the second zones of the functional buried weakened plane (12) and in another buried plane (12'') situated some distance from and below the first zones (Z1) of the functional buried weakened plane (12).
8. Manufacturing method according to one of Claims 1 to 5, wherein:
 - the second zones (Z2) of the functional buried weakened plane (12) are plumb with the cavities (30) in the bonded structure (90), and
 - the first light species are hydrogen atoms or ions, and the second species are helium atoms or ions.
9. Manufacturing method according to one of Claims 1, 2, 3, 6 and 7, wherein:
 - the first zones (Z1) of the functional buried weakened plane (12) are plumb with the cavities (30) in the bonded structure (90),

- the first light species are hydrogen atoms or ions, or helium atoms or ions or else hydrogen and helium atoms or ions, and
- the second species are silicon atoms or ions capable of slowing the rate of growth of micro-fissures in the second zones (Z2) of the functional buried weakened plane (12) compared with the rate of growth of the micro-fissures in the first zones (Z1).

10. Manufacturing method according to one of Claims 1 to 9, wherein assembly step e) involves at least one intermediate layer (50) placed on the donor substrate (11) and/or on the support substrate (20), said intermediate layer (50) having been deposited after one of steps a) to d).