METHOD FOR PRODUCING THIN LAYERS OF SEMICONDUCTOR MATERIAL FROM A DOUBLE-SIDED DONOR WAFER

The present invention relates to a method for producing thin layers of semiconductor material from a so-called donor wafer.

Known methods, in particular of the Smart-cut® type (as described especially in Document FR 2 681 472) or the like, make it possible to take a semiconductor thin layer from a donor wafer.

These methods are principally based on the use of two steps:

1) formation of a weakened region below one face of the wafer, at a depth corresponding substantially to an intended thin-layer thickness,

2) detachment of a thin layer from the wafer at the level of the weakened region, the thin layer being the part of the wafer lying on the side of the weakened region next to the face on the detachment side.

This two-step method is generally preceded by a step of preparing or recycling the wafer, which is intended to achieve surface roughness correction in order to improve the planarity of at least the face of the wafer on the detachment side.

However, this recycling operation does not generally correct the roughness sufficiently to achieve the thin-layer manufacturer's specifications, given that these prerequisite roughness specifications are established with a view to ensuring good subsequent bonding of the detached thin layer onto a support or another layer, and/or in order to finally obtain a layer with a thickness uniform enough to provide a high-quality structure, especially in the case of very thin layers such as in conventional SOI structures (standing for "Silicon On Insulator").

A finishing step for roughness correction is therefore normally carried out on the face of the donor wafer on the detachment side, in order to correct the

excessive residual roughness after the recycling step so as to comply with the said specifications.

The two-step detachment method is then carried out at the face whose roughness was corrected during the finishing step, in order to provide on the one hand a thin layer, optionally bonded onto a support, and on the other hand the donor wafer reduced by the thickness of the thin layer.

This donor wafer can then be reused for the fabrication of a second thin layer after subjecting it to another step of recycling and surface correction.

Although this type of method has provided genuine progress in the fabrication of thin layers, and especially in the fabrication of SOI structures, it is still desirable to improve it, especially in terms of efficiency, speed and fabrication cost, and in particular to reduce the number of fabrication steps.

It would thus be useful to substantially reduce the number of recycling steps required.

For example, it would be conceivable to form a weakened region on each of the faces of the donor wafer, then to detach two thin layers simultaneously, as proposed for example in Documents EP 0,961,312 and US 5,856,229, thus avoiding intermediate recycling between two detachments.

Such double implantation followed by such double detachment, however, involves extra technical working difficulties such as the need to turn the donor wafer over in order to form the second weakened region, thus increasing the risk of contamination and electrical and mechanical damage, the need for large and expensive equipment to bond two receptor wafers simultaneously onto the two faces of the donor wafer, and more difficult coordination of the various working steps since both the handling and processing tasks are increased at the same time.

For these reasons, these latter methods do not constitute technical progress in relation to the former

ones, but instead lead to undesirable extra technical difficulties.

Example embodiments of the present invention seek to improve the situation. In accordance with a first aspect of the present invention, there is provided a method for producing thin layers of a material selected among semiconductor materials from a donor wafer having two main faces, characterized in that it comprises the following successive steps, which are sequenced without an intermediate recycling step;

(a) formation of a first weakened region in the wafer below a first of its main faces and at a depth corresponding substantially to a thin-layer thickness,

(b) detachment of a first thin layer from the wafer at the level of the first weakened region, the first thin layer being the part of the wafer lying on the side of the first weakened region next to the first face,

(c) formation of a second weakened region in the wafer below a second of its main faces and at a depth corresponding substantially to a thin-layer thickness,

(d) detachment of a second thin layer from the wafer at the level of the second weakened region, the second thin layer being the part of the wafer lying on the side of the second weakened region next to the second face.

Some preferred but nonlimiting embodiments of the method are as follows:

- the donor wafer before step (a) may be a wafer recycled after having been used during previous thin-layer production, and the method may furthermore comprise at least one step of finishing the surface condition of this recycled donor wafer before step (a),
- the method may furthermore comprise a step of recycling the donor wafer after step (d), followed by a step of finishing the surface condition of the donor wafer recycled in this way, in order to be reused during subsequent production of thin layers,

- the recycling step may comprise the use of double-sided polishing,

- the finishing step may comprise the use of at least one technique selected among mechanical polishing, chemical-mechanical polishing, sacrificial oxidation, chemical etching, plasma-assisted chemical etching and annealing in an inert atmosphere,

- the method may furthermore comprise two respective steps of bonding the donor wafer between steps (a) and (b) and between steps (c) and (d), respectively at its first and second faces, onto two respective target substrates.

- the method may furthermore comprise a step of forming an insulating layer on the wafer before step(b),

- the insulating layer may be a layer of SiO_2 formed by thermal oxidation of a silicon surface or by deposition of SiO_2,

- the formation of at least one weakened region may be carried out by implantation of atomic species through a respective face of the wafer at the depth of the weakened region,

- the formation of at least one weakened region may be carried out by porosification of a surface layer of the material of the donor wafer, and the associated thin layer is formed by semiconductor material deposition on the porosified layer,

- at least one of the thin-layer detachment steps may be carried out by input of energy,

- the method may furthermore comprise the following steps, before step (d):

- inspecting the quality of the second face of the wafer, and

- if the inspected quality of the second face of the wafer is less than a minimum acceptable quality value, carrying out a step of correcting the quality of the said second face.

- the bonding interface layer may an insulating layer, and the finishing step may be selected from simple removal of the insulating layer and removal of the oxidized layer followed by thickness correction of the second face,

- the finishing step may be followed by a step of re-forming the insulating layer on the wafer,

- the re-formed insulating layer may be a layer of SiO_2 formed by thermal oxidation of a silicon surface or by deposition of SiO_2,

- the finishing step may comprise the use of a technique selected from the group which comprises mechanical polishing, chemical-mechanical polishing, sacrificial oxidation, chemical etching, plasma-assisted chemical etching and annealing in an inert atmosphere,

- the method may furthermore comprise a step of recycling the wafer, carried out after step (d) .

Embodiments of the present invention also relate to the application of the method as defined above to the production of semiconductor-on-insulator structures

Other aspects, objects and advantages of the present invention will become more readily apparent on reading the following detailed description of a preferred embodiment of it, which is given by way of a nonlimiting example and with reference to the appended drawings, in which:

Figures 1a to 1h describe step-by-step a method for producing two thin layers according to the invention.

Figure 2 represents a perspective view of the polishing or CMP device used in a method according to the invention.

Figure 3 represents a view from above of a polishing or CMP device used in a method according to the invention.

Figure 4 represents a view from above of a CMP device used in a method according to the invention.

It will be noted here that the drawings represented by Figures 1a to 1i are schematic and do not reflect the true situation in terms of spatial scales, as they have been produced with the sole aim of optimally explaining the principle of a method according to the invention.

Referring to Figure 1a, a donor wafer 10 of semiconductor material such as monocrystalline silicon has faces 11 and 12 from which thin layers are to be taken alternately, as will be described below.

The wafer 10 has a typical thickness of between a few tens of microns and a few millimetres.

The faces 11 and 12 of the wafer 10 have the typical characteristics of a wafer which is "fresh" or in the raw state, that is to say a wafer which has not been used since its fabrication.

Figure 1a represents a wafer 10 in the raw state, which has characteristics customarily encountered after fabrication, namely a low average roughness on its front face (face 11 in Figure 1a) and a large average roughness on its rear face (face 12 in Figure 1a).

It should be pointed out here that the average rear-face roughness is moreover often greater in the case of medium-size wafers (having for example a diameter of 200 mm) than in the case of larger-sized wafers (having for example a diameter of 300 mm).

In one particular configuration of the wafer 10 (not shown), it may nevertheless have other characteristics such as two faces 11 and 12 each having a large average roughness (for example after having undergone grinding and lapping operations). The two faces 11 and 12 may in this case be rectified during a recycling step, for example by carrying out double-sided polishing at the same time.

In another particular configuration of the wafer 10 (not shown), it has two faces 11 and 12 with a

low average roughness (that is to say close to the specifications necessary for good bonding).

The face 11 of the donor wafer 10 may then be flat enough to comply with the customary specifications, in terms of surface condition, so that a thin layer taken from the wafer can then be bonded properly onto a support or the like and/or in order to finally have a thin layer which has a sufficiently uniform thickness. These specifications relate inter alia to the surface roughness, and they usually depend on the thickness of the thin layers to be produced.

For instance, these specifications generally stipulate a maximum acceptable value of surface roughness, below which the surface condition of these faces 11 and 12 must lie in order to be able to start the process of forming thin layers as described below.

The maximum surface roughness value is usually defined by a roughness standard deviation value or "RMS" value (standing for "Root Mean Square") determined on the basis of roughness measurements taken using an atomic force or AFM microscope (standing for "Atomic Force Microscopy").

The maximum acceptable value of the roughness is typically an RMS roughness of about 5 angstroms, measured in a region measuring 1 micron by 1 micron on the surface of the layer.

In the majority of cases, and especially when a particularly thin layer is to be formed subsequently from the wafer 10, the surface roughness of the wafer 10 is still too great compared with this acceptable value, and it is therefore expedient to carry out a step of finishing the surface condition of the face 11 of the wafer 10.

This finishing step is carried out by using a fine roughness correction so as to finally comply with the specifications stipulated by the manufacturer.

Several techniques which may be used for this finishing step will be described below.

The wafer 10 after the finishing step is illustrated in Figure 1b.

Referring to Figure 1c, the roughness of the first face 11 now being acceptable for the formation of thin layers, a step of forming an insulating layer 13 on the donor wafer 10 is advantageously carried out.

For example, an insulating layer 13 of SiO_2 may be formed by conventional techniques, such as thermal oxidation of a silicon surface or deposition of SiO_2.

A donor wafer 10 covered with an insulating layer 13 of SiO_2 is then obtained.

This insulating layer 13 may consist of materials other than SiO_2, for example Si_3N_4 (the insulating layer 13 then being formed, for example, by nitriding a silicon surface of the donor wafer 10) or SiO_xN_y.

It should be noted that the formation of the insulating layer 13 at the level of the second face 12 of the donor wafer 10 is generally accompanied by attenuation of the average roughness under the insulating layer 13, at the level of the interface 18 with the underlying semiconductor material. This is because the formation of the insulating layer 13 generally has a property of smoothing the average surface roughness.

For example, oxidation of the second face 12 attenuates its roughness commensurately more when the thickness of the insulating oxide layer 13 being formed is large; this property is moreover used in some applications solely as a smoothing technique, referred to as the technique of "sacrificial oxidation".

Referring to Figure 1d, a first weakened region 14 of the wafer 10 is then formed below the first face 11 and at a depth corresponding substantially to the thickness of the thin layer which is intended to be obtained.

A thin-layer thickness produced using the present method according to the invention typically

lies between a few hundreds of nanometres and a few micrometres.

A weakened region is defined as having weaker and/or fewer inter-atomic bonds than those found in the rest of the wafer 10. It is therefore a region which tends to fracture before the rest of the wafer 10 when external energy is applied.

The weakened region 14 is advantageously substantially flat and parallel to the plane defined by the face 11.

Two preferred ways of producing the weakened region 14 will be described below.

Referring now to Figure 1e, a first thin layer 21 is detached from the wafer 10 at the level of the weakened region 14, the thin layer 21 being the part of the wafer lying between the face 11 and the weakened region 14.

The detachment of the thin layer 21 is performed after having previously carried out bonding between the face 11 optionally provided with the insulating layer 13 (which forms a bonding interface) and a target substrate 24.

In the event that the bonding-interface insulating layer 13 is present on the first thin layer 21 and/or an insulating layer is present on the target substrate 24, heat treatment is advantageously carried out in order to reinforce the bonding.

A structure 20a comprising the target substrate 24, an insulating layer 13a and the detached first thin layer 21 is then obtained.

If the detached first thin layer 21 is made of silicon and if the insulating layer 13 is thick enough to provide sufficient electrical insulation, then a "silicon on insulator" (SOI) structure 20a is obtained.

In all cases, the detached first thin layer 21 may then be corrected for thickness and surface roughness, particularly by means of one or more treatments such as mechanical polishing, chemical-

mechanical planarization (CMP), sacrificial oxidation, chemical etching, plasma-assisted chemical etching, annealing in an inert atmosphere (particularly in hydrogen), in a manner which is known per se.

The donor wafer 10 remaining after the first detachment has, according to the conventional detachment techniques, a ring 19a on its first face 11 substantially constituting the negative counterpart of the detached first thin layer 21.

Before forming a second weakened region 17, as will be described with reference to Figure 1f, an operation of inspecting the surface condition of the face 12 is advantageously carried out, comprising a measurement or evaluation of the quality of the surface, particularly in order to ascertain the integrity of the surface.

For instance, it is possible to measure the roughness and detect the presence or absence of scratches, downgrading defects, contaminants or isolated particles.

In the event that this measurement gives a quality complying with the specifications and therefore making it possible to detach a second thin layer on the same side as this face 12, the formation of this second thin layer is then carried out as illustrated in Figure 1f.

Conversely, in the event that this measurement gives an insufficient quality in relation to the specifications, in particular because of defects (particulate contamination; minor scratches, etc.) which may have been created during the production of the first thin layer 21, or because of roughness initially present on the second face 12 (see Figure 1a), a second finishing step is then carried out in order to correct the surface condition of the face 12 and in particular to bring the roughness value to within the specifications.

This second finishing step is advantageously carried out by the same technique as the first finishing step.

Still in the scope of this second exemplary case, and in the particular case when an insulating layer 13 is present on the surface of the wafer 10, this roughness correction may comprise:

- removal of the insulating layer 13, or
- removal of the insulating layer 13 followed by thickness correction of the face 12 exposed in this way (which is in fact the interface 18 represented in Figure 1e).

The choice depends principally on the extent of the roughness defects or other defects on the face 12, as revealed by the aforementioned inspecting operation.

The removal of the insulating layer 13 is preferably carried out by chemical means, and in particular using corrosion by an agent such as hydrofluoric acid in the case of a thin layer 21 of silicon. A step of surface re-oxidizing the wafer 10 may then be carried out after the finishing step, if an insulating layer 13 is intended to be present in order to form a bonding interface.

A high-quality second face 12 is then obtained, in particular one having very little roughness, as illustrated in Figure 1f.

This step of finishing the second face 12, subsequently making it possible to carry out a second layer detachment (thin layer 22 with reference to Figure 1g) from the donor wafer 10, is simpler to carry out than a standard step of recycling the first face 11 after the said first detachment, which might be carried out in order to prepare it for a second layer detachment as is the case in the prior art.

Specifically, in contrast to recycling, the finishing step treats a surface 12 in which:

- the roughness is buried (i.e. interface 18);

- there are no discontinuities at the edge, such as those of the ring 19a on the face 11 after detachment;

- the planarity is most often better at the level of the insulating layer 13, after its removal, than in the case of the surface 15 after the first detachment, in particular because of the natural smoothing which is provided by the operation of forming the insulating layer 13 (as explained above).

However, in an extreme case in which the surface condition of the face 12 requires an excessive amount of work, or excessively time-consuming work, in order to be compensated for by a finishing step, the wafer 10 is then sent for recycling. Yet if all the handling precautions have been taken, such an extreme case will occur very infrequently.

Referring to Figure 1f, a second weakened region 17 is then formed in the wafer 10, below the second of its faces 12 and at a depth corresponding substantially to an intended thickness of the thin layer to be detached.

The way in which this second weakened region 17 is formed may be the same as that used to form the first weakened region 14.

Referring to Figure 1g, a second thin layer 22 is detached from the wafer 10 at the level of the second weakened region 17, the second thin layer 22 which is detached being the part of the wafer 10 lying substantially between the second face 12 and the second weakened region 17.

The technique or techniques employed in order to detach this second thin layer 22 may be identical to that or those used to detach the first thin layer 21, with attachment to a second target substrate 26.

A second structure 20b comprising the second target substrate 26, an insulating layer 13b and the detached second thin layer 22 is then obtained.

The way in which the surface condition of the second thin layer 22 is treated may be the same as the way in which the surface of the first thin layer 21 is treated.

The donor wafer 10 remaining after the first detachment has, according to the conventional detachment techniques, a ring 196a on its second face 12 substantially constituting the negative counterpart of the detached second thin layer 22.

The method according to the invention therefore makes it possible to produce two thin layers 21 and 22 from the same donor wafer 10, without the latter needing to be subjected to an intermediate recycling step, given that such recycling always slows the rates of fabrication, in particular when the wafer needs to be transported to a recycling site which may be geographically separate from the site where the thin layers are detached. Merely a simple finishing step is optionally carried out, involving a minor roughness correction.

Referring to Figure 1h, the wafer 10 reduced by the thicknesses of the thin layers 21 and 22 may be subjected to a recycling step during which the roughnesses of its new faces 15 and 16 are corrected, so that the method can be repeated and two new thin layers can be produced before the next recycling.

In particular, double polishing may then be carried out (that is to say polishing which affects both the faces 15 and 16 of the donor wafer 10 simultaneously) in order to carry out rapid recycling of the donor wafer 10.

Preferred techniques for technical implementation of the method according to the invention will now be described.

A first preferred way of producing the weakened regions 14 and 17 involves a method of the Smart-cut® type, that is to say species are implanted through the face 11 or the face 12 of the wafer 10, respectively,

the depth of the weakened region 14 or 17 corresponding substantially to the penetration depth of the species in the wafer 10.

The species in question are preferably ions, in particular hydrogen ions, which are implanted by an ion bombardment machine or by a plasma machine.

In a preferred embodiment, and as described above, the insulating layer 13 is formed at the surface of the wafer 10 before implantation.

According to a variant, another implantation of atomic species precedes the implantation that forms the weakened region 14 or 17. The main aim of this other implantation, preferably ion implantation, for example of hydrogen species or hydrogen and boron species, is to create defects at the level of the future weakened region in order to trap the species which are implanted subsequently.

In another preferred embodiment, heat treatment is carried out during and/or after the implantation of the species, in order to accentuate the weakening of the donor wafer 10 at the level of its weakened region 14 or 17.

The detachment of the thin layer 21 or 22 is then carried out by input of energy produced thermally, preferably by means of heat treatment in a temperature range typically lying between 300°C and 500°C in the case of a thin layer 21 or 22 of silicon, and/or produced mechanically, preferably by means of mechanical forces exerted on the wafer 10.

A second way of producing the weakened region 14 or 17 comprises the formation of a porous semiconductor layer on each surface of an initial wafer of crystalline material, for example by anodization.

A layer of semiconductor material forming the thin layer 21 and 22 to be detached may then be produced by epitaxy on the porous layer, preferably by a "CVD" technique (standing for "Chemical Vapour Deposition").

The wafer 10 provided with the porous layer and the deposited layer 21 or 22 is then preferably oxidized at the surface in order to form the insulating layer 13, which will form a bonding interface layer during attachment to the target substrate.

The detachment of the thin layer 21 or 22 is preferably carried out by input of energy, preferably mechanical energy by means of a jet of fluid applied at the level of the weakened region 14 or 17, respectively, and in particular by means of a jet of liquid such as water.

Referring to Figure 2, a device for carrying out a finishing or recycling step intended to correct the roughness of the faces 11 and 12 of the wafer 10 is represented. A polishing head 200 mounted on a rotary drive shaft 600 has a cavity capable of holding the wafer 10. A polishing plate 100, which can also be rotated, closes the cavity of the polishing head 200 by being pressed against it, so as to enclose the wafer 10 between the plate and the head.

The polishing head 200 is advantageously covered with a fabric.

A force 1 applied to the polishing head along the shaft 600 brings the wafer 10 in contact with the internal face of the cavity of the head 200 and with the upper face of the plate 100.

The respective rotational movements 2 and 4 of the head 200 and of the plate 100 with respect to the wafer 10 cause friction on its faces 11 and 12, and therefore polish these faces simultaneously.

In a preferred embodiment, the polishing head 200 accompanied by the wafer 10 is moved over the upper surface of the polishing plate 100 along a specific path in order to optimally homogenize the polishing of the faces 11 and 12. This movement may, for example, be a movement in translation to-and-fro along a specific axis, or a combined movement in rotation and in translation (spiral movement).

In another preferred version, it is possible to combine mechanical polishing, abrasion by injected abrasive particles (such as silica particles) and chemical etching, according to a so-called CMP method (standing for "Chemical-Mechanical Planarization").

In yet another embodiment, the polishing device comprises a polishing head 200 which holds a plurality of wafers.

A particular embodiment of this device is represented with reference to Figure 3. This device is similar to the one in Figure 2, with a polishing head 200 which this time holds three wafers 10a, 10b and 10c.

In a preferred version, this polishing head 200 is moved with respect to the polishing plate 100 along a diametral axis 6 in a to-and-fro translational movement 3 which, in combination with the rotational movement of the polishing head 200, imparts respective spiral movements to the wafers 10a, 10b and 10c with respect to the polishing plate 100, thus polishing the faces 11 and 12 of each wafer homogeneously at the surface.

With reference to Figure 4, another chemical-mechanical planarization device for carrying out the finishing step is represented. This device has three polishing plates 100a, 100b and 100c and three fluid injectors 300a, 300b and 300c. Three polishing heads 200a, 200b, 200c, which are connected together, are separated by an equal distance from a rotary shaft 700 and can move with respect to it.

The polishing plates 100a, 100b and 100c are preferably and respectively in contact with three brushing devices 400a, 400b, 400c so that surface residues can be removed regularly from the plates.

In one working version of this device, the plate 100a and the head 200a take care of polishing the faces 11 and 12 of a wafer 10 in the same way as that explained in Figure 2. In addition to this mechanical

polishing, the injector 100a may deliver a corrosive agent making it possible to carry out chemical etching, or alternatively an abrasive agent making it possible to carry out mechanical etching.

The polishing head 100a then brings the wafer 10 level with the second polishing plate 100b, and finally level with the third polishing plate 100c, by virtue of a rotational movement of the head 100a around the shaft 700, in order to carry out respective processes of cleaning the surface of the wafer 10 with the aid of cleaning fluids injected through the injectors 300b and 300c.

Other mechanical or chemical-mechanical polishing methods may of course be used in order to carry out the roughness correction of the faces 11 and 12 of the wafer 10. In particular, mention may be made of sacrificial oxidation, chemical etching, plasma-assisted chemical etching and annealing in an inert atmosphere.

The various methods described and mentioned above may in particular be used in a more elaborate way so as to carry out selective roughness correction, that is to say a different roughness correction on the faces 11 and 12 of the wafer 10, for example as a function of roughness measurements which have been carried out on these faces beforehand and which have detected some regions that are rougher than others, which may therefore be subjected to different and appropriate roughness corrections.

The present invention is of course in no way limited to the embodiments which have been described and represented, and the person skilled in the art will be able to make numerous variations and modifications to them.

CLAIMS

1. Method for producing thin layers of a material selected among semiconductor materials from a donor wafer having two main faces, characterized in that it comprises the following successive steps, which are sequenced without an intermediate recycling step:

(a) formation of a first weakened region in the wafer below a first of its main faces and at a depth corresponding substantially to a thin-layer thickness,

(b) detachment of a first thin layer from the wafer at the level of the first weakened region, the first thin layer being the part of the wafer lying on the side of the first weakened region next to the first face,

(c) formation of a second weakened region in the wafer below a second of its main faces and at a depth corresponding substantially to a thin-layer thickness, and

(d) detachment of a second thin layer from the wafer at the level of the second weakened region, the second thin layer being the part of the wafer lying on the side of the second weakened region next to the second face.

2. Method according to Claim 1, characterized in that the donor wafer before step (a) is a wafer recycled after having been used during previous thin-layer production, and in that the method furthermore comprises at least one step of finishing the surface condition of this recycled donor wafer before step (a).

3. Method according to Claim 1, characterized in that it further comprises a step of recycling the donor wafer after step (d), followed by a step of finishing the surface condition of this recycled donor wafer, in order to be reused during subsequent production of thin layers.

4. Method according to the preceding claim, characterized in that the recycling step comprises the use of double-sided polishing.

5. Method according to one of Claims 2 to 4, characterized in that the finishing step comprises the use of at least one technique selected among mechanical polishing, chemical-mechanical polishing, sacrificial oxidation, chemical etching, plasma-assisted chemical etching and annealing in an inert atmosphere.

6. Method according to Claim 1, characterized in that it further comprises two respective steps of bonding the donor wafer between steps (a) and (b) and between steps (c) and (d), respectively at its first and second faces, onto two respective target substrates.

7. Method according to one of the preceding claims, characterized in that it further comprises a step of forming an insulating layer on the wafer before step (b).

8. Method according to the preceding claim, characterized in that the insulating layer is a layer of SiO_2 formed by thermal oxidation of a silicon surface or by deposition of SiO_2.

9. Method according to Claim 1, characterized in that the formation of at least one weakened region is carried out by implantation of atomic species through a respective face of the wafer at the depth of the weakened region.

10. Method according to Claim 1, characterized in that the formation of at least one weakened region is carried out by porosification of a surface layer of the material of the donor wafer, and in that the associated thin layer is formed by semiconductor material deposition on the porosified layer.

11. Method according to Claim 1, characterized in that at least one of the thin-layer detachment steps is carried out by input of energy.

12. Method according to one of Claims 1 to 4, characterized in that it further comprises the following steps, before step (d):

- inspecting the quality of the second face of the wafer, and
- if the inspected quality of the second face of the wafer is less than a minimum acceptable quality value, carrying out a step of correcting the quality of the said second face.

13. Method according to Claims 7 and 12 taken in combination, characterized in that a finishing step is carried out and selected from simple removal of the insulating layer and removal of the insulating layer followed by thickness correction of the second face.

14. Method according to Claim 13, characterized in that the finishing step is followed by a step of re-forming the insulating layer on the wafer.

15. Method according to Claim 14, characterized in that the re-formed insulating layer is a layer of SiO_2 formed by thermal oxidation of a silicon surface or by deposition of SiO_2.

16. Method according to one of Claims 12 to 14, characterized in that the finishing step comprises the use of a technique selected from the group which comprises mechanical polishing, chemical-mechanical polishing, sacrificial oxidation, chemical etching, plasma-assisted chemical etching and annealing in an inert atmosphere.

17. Method according to one of the preceding claims, characterized in that it furthermore comprises a step of recycling the wafer, carried out after step (d).

18. Application of the method according to one of Claims 1 to 17 to the production of semiconductor-on-insulator structures.