A METHOD OF TREATING A WAFER SURFACE

The present invention relates to bonding two wafers comprising semiconductor materials to produce structures for use in the fields of microelectronics, optics, or optoelectronics.

More precisely, the invention relates to activating the bonding surface of at least one of the two wafers to be bonded even though it may have been oxidized and/or it may have undergone atomic species implantation.

Said atomic species implantation can form a zone of weakness within a wafer, termed the "donor" wafer, at a predetermined depth.

That method, known as "Smart-Cut™" (registered trade mark), is known to the skilled person. Reference could be made, for example, to the work "Silicon-on-Insulator Technology, Materials to VLSI, 2nd Edition, by Jean-Pierre Colinge, published by Kluwer Academic Publishers, pages 50 and 51).

A structure known by the acronym SOI (silicon-on-insulator) can then be produced by implantation through the oxidized surface of a silicon donor wafer and by transferring, by bonding onto a silicon wafer termed the "receiver" wafer, a thin film including the superficial oxide layer and the upper thin layer of silicon derived from said donor wafer.

The intensifying miniaturization of electronic components formed on such transferred thin films forces substrate fabricators to produce SOI type substrates with ever thinner upper layers of silicon, while retaining excellent quality.

As a result, improving the quality of transferred layers and thus improving techniques for taking off and transferring such layers is vital.

Bonding quality is essential to good layer transfer, where the quality of that bonding is principally measured by the bonding energy binding the two wafers.

As is explained below, it has now been established that the existence of certain contaminants on the wafer surfaces has the effect of reducing the bonding energy.

The implantation step generally brings hydrocarbon type contaminants to the wafer surface. In the presence of isolated particles or localized surface defects, that contamination can result in the formation of superficial blisters following detachment of the thin film and its transfer onto the receiver wafer, or even to the formation of non-transferred zones.

Withdrawing such contaminants is thus vital in order to guarantee good quality and bonding contact.

In addition, the article by Aditya Agarwal, T.E. Haynes, V.C. Venezia, O.W. Holland and D.J. Eaglesham entitled "Efficient production of silicon-on-insulator films by co-implantation of He^+ with H^+", Applied Physics Letters, vol 72 (1998), pp 1086-1088 shows that while methods employing co-implantation of hydrogen and helium allows a much lower total implantation dose than that for simple implantation to be used, blister type defects are more numerous at the bonding interface.

Further, it has been shown that SOI type substrates with a buried oxide layer that is very thin, i.e. less than 50 nm (50 nanometers) thick, are more difficult to produce, since they are much more sensitive to the appearance of blister type defects.

Thus, it is also important to reinforce the bonding energy in order to broaden the working conditions and the application possibilities of said "Smart-Cut™" method.

Finally, the bonding energy must also be reinforced to encourage proper detachment and layer transfer.

In fact, the existence of contaminants at the bonding interface can result in detachment of the layer at that interface rather than at the zone of weakness, thereby creating defects (non-transferred zones) on the

receiver wafer, which correspond to residues on the donor wafer.

The lower the bonding energy, the greater the quantity of non-transferred zones.

Further, when the bonding energy is low, it is more difficult for the bonding wave to reach the edge of the wafer diametrically opposite to that from which bonding has been initiated, and a larger number of defects is observed in that region.

The prior art already discloses several methods of treating the surface prior to bonding, to improve bonding and to eliminate all particles present on the surface of the wafers to be bonded.

Such treatments generally comprise two successive steps, namely:

a) a first step of cleaning and chemical activation; and

b) a second step of cleaning, which second step is carried out immediately prior to bonding and is termed "clean-before-bond" below.

The purpose of cleaning the surfaces to be bonded in step a) is to:

- render said surfaces hydrophilic;
- withdraw contaminants, in particular of the hydrocarbon type, that have appeared on the surfaces of the wafers following implantation;
- remove isolated particles;
- limit the roughness (on an atomic scale) to ensure that wafers are brought into intimate contact.

The hydrophilic nature of the surface encourages bonding and can increase the bonding energy, limiting the appearance of defects at the wafer edge.

The prior art contains such a cleaning and activation method, termed "RCA", which consists in treating the surfaces to be bonded in succession with:

- a first solution known as "SC1" (standard clean 1) which comprises a mixture of ammonium hydroxide (NH_4OH), hydrogen peroxide (H_2O_2), and deionized water;
- a second solution known as "SC2" (standard clean 2), which comprises a mixture of hydrochloric acid (HCl), hydrogen peroxide (H_2O_2), and deionized water.

The first solution is principally intended to withdraw isolated particles present on the wafer surface and to render the surfaces hydrophilic, while the second solution is intended to remove metallic contamination.

However, it has been shown that after carrying out such a treatment, the roughness of the wafer surfaces can sometimes be greater than that before the treatment, which considerably alters their bonding energy.

Further, the patent application WO-2005/096369 discloses a method of cleaning the oxidized surface of a wafer for bonding it to another wafer. Said method employs a mixture of ammonia solution (NH_4OH) and hydrogen peroxide (H_2O_2) and can remove isolated particles while avoiding creating surface roughness.

Furthermore, it should be noted that while the above-mentioned Smart-Cut™ method comprises multiple cleaning steps, the clean-before-bond step b) is highly specific as it predetermines the quality of the substrates obtained after the step for transferring the layer(s).

That step is aimed at withdrawing particles that have been deposited during the interval between the cleaning step a) and bonding. It is also aimed at reinforcing the hydrophilic nature of the wafers, as that tends to be reduced substantially as the time interval between the cleaning step a) and bonding is increased.

The cleaning step b) is generally carried out by brushing the surfaces to be bonded with a solution of

deionized water; see, for example, French patent application FR-A-2 854 493.

With the above-mentioned two-step method, it unfortunately appears that the more the surface to be bonded is rendered hydrophilic in order to limit the number of transfer defects, the more the roughness of the surface increases, thus increasing the probability of the appearance of blister type defects.

In the above-mentioned RCA type treatment, a greater hydrophilic nature is obtained by using the SC1 solution at a high temperature (>70°C). However, in contrast, the treated surface will be etched, which will increase its roughness, and that increase in surface roughness increases with increasing temperature of the SC1 bath.

Finally, an additional constraint also appears when using the above-mentioned method, as the time interval between the two steps a) and b) must be minimized in order to preserve the hydrophilic nature of the treated wafers and to maximize the bonding energy. When carrying out the fabrication method on an industrial scale, that results in additional constraints when managing batches of wafers to be treated.

As a result, embodiments of the present invention aim to overcome the above-mentioned disadvantages and to introduce chemical activation of the surfaces during the clean-before-bond step, preferably carried out at ambient temperature, to simplify the prior cleaning step a) or even to dispense with it.

If the prior cleaning step a) is retained, embodiments of the invention also aim to allow the storage time for wafers between that cleaning step a) and the clean-and-activate-before-bond step of the invention to be increased, while keeping the bonding energy high following bonding of the two wafers.

Finally, the activation step according to embodiments of the invention preferably must also be smoothly integrated into the existing industrial method of fabricating SOI substrates.

To this end, embodiments of the invention relate to a method of treating one or the other or both surfaces, termed "bonding" surfaces of a first wafer termed the "donor" wafer and a second wafer termed the "receiver" wafer intended to be bonded one against the other with the aim of fabricating a structure used in the optics, electronics, or opto-electronics fields.

In accordance with a first aspect of the present invention, there is provided a method of cleaning and activating one or the other or both surfaces termed "bonding" surfaces of a first wafer termed the "donor" wafer and a second wafer termed the "receiver" wafer intended to be bonded one against the other with the aim of fabricating a structure used in the optics, electronics, or opto-electronics fields, the method being characterized in that it comprises a cleaning and activation step carried out immediately prior to bonding said donor and receiver wafers, by applying to said bonding surface or surfaces a solution termed the "surface treatment" comprising at least about 97% of a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%.

Other advantageous, non-limiting embodiments of the invention, taken alone or in combination, are as follows:

- the treatment solution may be constituted by a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%;
- the treatment solution may be constituted by about 97% of a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%, and about 3% of chelating agents and/or surfactants;
- the solution of ammonia (NH_4OH) may have a concentration by weight in water in the range

from about 0.5% to 1.6%, preferably still close to 0.8%;

- the cleaning and activation step may be carried out by applying said surface treatment solution at a temperature of 70°C or less;

- the surface treatment solution may be applied when the donor and receiver wafers are on the bonding machine;
- the surface treatment solution may be applied directly on the bonding machine, preferably for a period in the range 10 seconds to 2 minutes;
- said cleaning and activation step may be carried out by simultaneously applying said surface treatment solution and brushing the bonding surface to be treated;
- at least one of the two bonding surfaces may be covered with a layer of oxide;
- the donor wafer may have undergone atomic species implantation prior to bonding to form a zone of weakness defining a thin layer to be transferred.

In accordance with a second aspect of the present invention, there is provided a method of fabricating a structure intended to be used in the optics, electronics, or opto-electronics field, characterised in that it comprises the following steps:

- implanting atomic species into a wafer termed the "donor" wafer having an oxide layer on its surface, to form therein a zone of weakness defining a thin layer;
- cleaning and activating the oxidized surface of said donor wafer immediately prior to bonding, in accordance with the method of the first aspect;
- bonding said activated surface of the donor wafer onto the surface of another wafer termed the "receiver" wafer, optionally oxidized, said surface optionally having been cleaned and activated in accordance with the method of the first aspect; and
- detaching said thin layer and said oxide layer at said zone of weakness in order to take them off and transfer them onto said receiver wafer.

Other embodiments of the invention, taken alone or in combination, are as follows:

- said method may comprise a consolidating anneal step between the bonding step and the detachment step; and
- the donor wafer may be produced from a semiconductor material, from silicon or from stressed silicon.

In particular, this method may allow a semiconductor-on-insulator type structure or a silicon-on-insulator (SOI) type structure to be fabricated.

Other characteristics and advantages of the invention will become apparent from the following description made with reference to the accompanying drawings which show a possible, non-limiting implementation by way of indication.

In the drawings:

- Figures 1a to 1d show the principal steps in a method of taking off and transferring layers applied to the production of a SOI type substrate;
- Figure 2 is a diagram showing a technique for measuring the bonding energy between two wafers;
- Figure 3 is a graph showing the bonding energy τ between two wafers as a function of the temperature of the anneal treatment, for series of wafers that have respectively undergone either a "control" cleaning and activation method or the clean-and-activate-before-bond method of the invention;
- Figure 4 is a graph showing the results of measuring the number of transfer defects in a transferred layer, from series of wafers that have respectively undergone either a "control" cleaning and activation method or the clean-

and-activate-before-bond method of the invention; and

- Figure 5 shows the change in the bonding energy τ between two wafers for batches of wafers that have undergone a first cleaning treatment, then a second cleaning and activation treatment immediately prior to bonding, but not at the same time as the first clean, said second treatment being either a "control" clean or a treatment in accordance with the invention.

A principal aim of the present invention is to reduce the number of defects and the surface roughness of at least one of the two wafers intended to be bonded one to the other, to increase the bonding energy between the wafers.

More particularly, the invention is applicable to wafers coated with a layer of oxide, said oxide being either "native", i.e. resulting from oxidation of the wafer in the open air, or additional and resulting from heat treating said wafer or from deposition of a layer of oxide, for example.

The invention is of particular application when fabricating an SOI type substrate.

The various steps in this fabrication method are recalled below.

With reference to Figure 1a, a first step consists in oxidizing a wafer formed from semiconductor material 13 to form a donor wafer 10 with a layer of oxide 11 on the surface.

In general, said oxidation results from heat treatment or deposition of a layer of oxide, for example a layer of SiO_2 when the wafer 13 is formed from silicon.

Referring now to Figure 1b, the donor wafer 10 undergoes, through one of its oxidized surfaces, implantation of atomic species such as hydrogen and/or helium, for example.

The energy and doses for said implantation are selected so as to form a zone of weakness 15 at a predetermined depth beneath the surface of the donor wafer 10, more precisely inside the wafer 13. A thin layer 16 is thus formed, defined on one side by the zone of weakness 15 and on the other side by the layer of oxide 11.

The oxidized surface of the donor wafer 10 which has undergone implantation carries reference numeral 12. This surface 12 and/or the surface 22 of a wafer 20, the "receiver", then undergo a clean-before-bond treatment which is discussed in detail below.

Referring now to Figure 1c, the surfaces 12 and 22 are then brought into contact and bonded by molecular bonding.

At this stage, an annealing step is optionally carried out to reinforce the bonding interface 17 between the donor wafer 10 and the receiver wafer 20.

Finally, referring now to Figure 1d, energy of thermal, mechanical, and/or chemical origin is supplied, which energy is sufficient for detachment along the zone of weakness 15 to detach the thin layer 16 from the remainder 18 of the donor wafer.

The semiconductor-on-insulator structure shown in Figure 1d is thus obtained; the thin layer 16 taken off the donor wafer 10 forms the semiconductor portion and the subjacent oxide layer 11 forms the electrically insulating portion. This structure has reference numeral 30.

A finishing step using chemical-mechanical polishing, for example, is then optionally carried out to eliminate any defects or roughness appearing during detachment of the thin layer 16.

The final structure 30 obtained is intended for applications in the fields of microelectronics, optics or optoelectronics.

Although not shown in the figures, the receiver wafer 20 could optionally be covered with a layer of oxide, in particular native oxide.

The aim of the invention is to provide a method of cleaning and activating the surfaces to be bonded prior to bonding, i.e. in the above-mentioned example, the surfaces 12 and/or 22. This method not only eliminates contaminants or isolated particles, but also activates the surfaces to be bonded.

When the two wafers are then brought into contact, their adhesion is reinforced when the respective bonding surfaces (or at least one of them) have been activated. Said adhesion is facilitated by the hydrophilic nature of the surfaces to be bonded and corresponds most of the time to a molecular interaction between the hydrogen atoms present on the surface of the wafers to be bonded.

Reference can be made, for example, to the article by R. Stengl et al, "A model for the silicon wafer bonding method", Japanese Journal of Applied Physics, vol 28, n° 10, October 1989, pp 1735-1741 for the description of surface activation phenomena and hydrophilic bonding.

In accordance with the invention, the Applicant has observed that the treatment of the bonding surfaces of the two wafers to be bonded, or of at least one of said surfaces using a specific solution, can increase the bonding energy between said two wafers. Below and in the claims, this solution is known as a "surface treatment" solution.

Said surface treatment solution comprises at least about 97% of a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%.

In accordance with a first implementation of the invention, the surface treatment is constituted by a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%.

Said solution of ammonia is a pure solution, i.e. a solution wherein the concentration of metallic contaminant type pollutants (copper, iron, chromium, titanium, nickel, aluminum) and/or alkaline contaminants (lithium, sodium, calcium, potassium, etc) does not exceed a concentration of 10 ppt (parts per trillion) for each element.

In accordance with a second implementation of the invention, a surface treatment solution is used constituted by about 97% of the above-mentioned solution of ammonia and by about 3% of chelating agents and/or surfactants.

Said chelating agents act to bind contaminants such as metals or ions in solution, which contaminants are often present in industrial ammonia and which would risk remaining trapped on the bonding interface, thereby modifying the electrical characteristics of the final substrate obtained. The surfactant can increase the efficiency of removal of particles which are likely to lead to the formation of superficial blisters.

Preferably, the concentration by weight of the ammonia solution is in the range 0.5% to 1.6%, more preferably close to 0.8%.

Advantageously, because it is simpler to carry out industrially, the above-mentioned solution of ammonia is used at ambient temperature.

However, it may be applied at higher temperatures, preferably not exceeding 70°C. At higher temperatures, surface roughness increases substantially, leading to an increase in the number of blister type defects.

The above-mentioned cleaning and activation treatment is carried out immediately prior to bonding, preferably directly on the bonding machine, to reactivate the hydrophilic nature of the wafers in contact even if there has been a time interval of several hours following the cleaning step, as will be detailed below.

The activation solution can be distributed either directly onto the wafers to be treated without brushing, or directly onto the brushes used for activation, or onto the wafers, before subsequent brushing.

This brushing technique has been described, for example, in above-mentioned FR-A-2 854 493.

The solution of ammonia is preferably delivered for a period of 10 seconds to 2 minutes, more preferably 30 seconds to 1 minute, at a rate of the order of 1.5 l/min (liters/minute), directly into the bonding equipment, for example using a distributor arm.

In a variation, the solution of ammonia can be distributed from specific cleaning equipment, for example by spraying ("single wafer" type equipment) or using a bath ("wet bench" type equipment).

The Applicant has carried out a comparative study of the bonding energy at the interface between two wafers, using series of wafers which have respectively undergone either a "control" cleaning and activation method or the method of the invention.

The Applicant used an accurate technique for measuring the bonding energy proposed by Maszara in the document entitled "Silicon on insulator by wafer bonding" (J Electrochem Soc, volume 138, page 341 (1991)).

In accordance with that technique, shown schematically in Figure 2, the Applicant inserted a blade 40 into one or more edges of the assembly of wafers 10 and 20 in contact with each other, at the bonding interface 17.

Application of a mechanical force via the blade 40 in a direction parallel to the plate of the interface 17 caused local unbonding of the two wafers 10 and 20 and propagation of the unbonded zone over a certain distance.

The length **L** between the outer edge of the wafers 10, 20 and the point at which unbonding stops, which corresponds to the sum of the length of the zone locally unbonded by the blade 40 and the length of the

propagation of the unbonded zone, gives an indication of the bonding energy existing between the two wafers 10 and 20.

Termination of unbonding corresponds to equilibrium between the bonding energy and the elastic deformation characterizing unbonding.

A mean bonding energy τ can then be calculated from a relationship between the length of the unbonded zone **L** and the surface energy.

Reference can be made, for example, to the following formula taken from Maszara's document:

$$\tau = \frac{3.E.t^3.y^2}{32.L^4}$$

in which

E is the Young's modulus of the material present at the interface between the two wafers 10 and 20;

y is the half-thickness of the blade;

t is the thickness of each wafer.

Said comparative study was carried out using several batches of structures comprising two wafers of eight inch (200 mm) silicon one of which had been oxidized and had undergone a hydrogen ion implantation step, said two wafers being assembled by molecular bonding.

The results obtained are shown in the graph in Figure 3.

The bonding energy τ between the two wafers was measured using the method described above.

Figure 3 shows the bonding energy τ as a function of the temperature and of optional anneal treatment (termed "consolidation treatment"), carried out for 2 hours.

Some of the structures did not undergo a subsequent consolidation treatment (results obtained when the temperature was close to 20°C), and others underwent said treatment for 2 hours, at various temperatures.

The curve drawn as a dotted line shows the results obtained with batches in which the bonding surfaces of the wafers had undergone a treatment of rinsing in water and of simultaneous activation by brushing, the treatment being carried out immediately prior to bonding. That treatment is termed a "control" treatment below.

The curve drawn as a solid line shows the results obtained with batches in which the bonding surfaces of the wafers had undergone a cleaning and activation treatment in accordance with the invention.

That treatment, carried out immediately prior to bonding, consisted of applying a solution of ammonia (NH_4OH) in deionized water in a concentration by weight of 0.5%, at ambient temperature, said solution being distributed onto brushes when brushing the wafers.

These results show that independently of the temperature at which the subsequent consolidation treatment is carried out, the bonding energy τ value obtained is higher with the activation method of the invention. Said increase is greater when the consolidation treatment is over 300°C.

A second comparative study was carried out to measure the number of transfer defects appearing in the thin film 16 and the oxide layer 11, after detachment along the zone of weakness 15.

Batches of wafers similar to those described for the above test were used.

Figure 4 shows the results of this study.

The ordinate axis shows the number of transfer defects **N** measured per wafer.

The abscissa shows the results obtained, firstly with the control batches **Te** in which the surface treatment step was carried out using the above-mentioned "control" method, and secondly with batches **I**, in which the cleaning and activation step was carried out in accordance with the invention, as described in association with Figure 3.

The mean number of transfer defects **N** in the first case was 4.09, while it was close to 0.83 in the second case.

A thin layer transferred onto a receiver wafer, after the bonding surfaces of the donor and receiver wafers have undergone the activation treatment of the invention, thus has on average nearly five times fewer transfer defects than a thin layer obtained after "control" treatment.

Finally, a third series of comparative tests was carried out to measure the value of the bonding energy τ between a donor wafer, oxidized and implanted, and a receiver wafer, as a function of the time interval between a first conventional cleaning step for the surfaces to be bonded and bonding proper, said wafers also having undergone a surface treatment and activation step immediately prior to bonding.

The two wafers were formed from silicon and measured eight inches in diameter (200 mm).

The first cleaning treatment was of the above-mentioned RCA type.

The cleaning and activation treatment of the invention was carried out by brushing, in a dilute ammonia solution, at a concentration by weight of below 0.5% in deionized water.

In Figure 5, the curve drawn as a solid line shows the results obtained with wafers which had undergone the "control" surface treatment described in respect of Figures 3 and 4.

The curve shown as a dotted line shows the results obtained with wafers which have undergone a cleaning and activation treatment in accordance with the invention.

These results show that not only the bonding energy τ is increased when using the treatment of the invention, but also that the bonding energy is reduced only very slightly from a time interval of 0 to 14 hours 30 of

interval between the first clean and final bonding, and that it then stabilizes with time.

In general, the Applicant has demonstrated the importance of implementing the cleaning and activation method of the invention in a method of taking off and transferring a layer, and more precisely in fabricating an SOI type substrate.

The method of the invention can increase the bonding energy, which means that the criteria for carrying out a first clean carried out a certain period before bonding can be less stringent, or it may even be completely dispensed with.

This can simplify and homogenize the surface preparation steps carried out in a production line prior to bonding proper.

Further, the activation method of the invention can reduce the number of transfer defects at the edge of the wafer to less than one per plate on average, which considerably enhances the quality of the thin layer in which future electronic components will be produced.

Finally, the present invention is not limited to an activation method of bonding two silicon wafers at least one of which is covered with a silicon oxide layer, but can be extended to any type of material such as stressed silicon or another semiconductor material which can be used with Smart-Cut™ technology.

CLAIMS

1. A method of cleaning and activating one or the other or both surfaces termed "bonding" surfaces of a first wafer termed the "donor" wafer and a second wafer termed the "receiver" wafer intended to be bonded one against the other with the aim of fabricating a structure used in the optics, electronics, or opto-electronics fields, the method being characterized in that it comprises a cleaning and activation step carried out immediately prior to bonding said donor and receiver wafers, by applying to said bonding surface or surfaces a solution termed the "surface treatment" comprising at least about 97% of a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%.

2. A method according to claim 1, characterized in that the treatment solution is constituted by a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%.

3. A method according to claim 1, characterized in that the treatment solution is constituted by about 97% of a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%, and by about 3% of chelating agents and/or surfactants.

4. A method according to any preceding claim, characterized in that the solution of ammonia (NH_4OH) has a concentration by weight in water in the range from about 0.5% to 1.6%.

5. A method according to claim 4, characterized in that the solution of ammonia (NH_4OH) has a concentration by weight in water that is close to 0.8%.

6. A method according to any of claims 1 to 3, characterized in that the cleaning and activation step is carried out by applying said surface treatment solution at a temperature of 70°C or less.

7. A method according to any of claims 1 to 3, characterized in that the surface treatment solution is applied when the donor wafer and the receiver wafer are on the bonding machine.

8. A method according to any of claims 1 to 3, characterized in that the surface treatment solution is applied for a period in the range 10 seconds to 2 minutes.

9. An method according to any of claims 1 to 3, characterized in that said cleaning and activation step is carried out by simultaneously applying said surface treatment solution and brushing the bonding surface to be treated.

10. A method according to any of claims 1 to 3, characterized in that at least one of the two bonding surfaces is covered with a layer of oxide.

11. A method according to any of claims 1 to 3, characterized in that the donor wafer has undergone atomic species implantation prior to bonding to form a zone of weakness defining a thin layer to be transferred.

12. A method of fabricating a structure intended for use in the optics, electronics, or optoelectronics field, characterized in that it comprises the following steps:

- implanting atomic species into a wafer termed the "donor" wafer having an oxide layer

on its surface, to form therein a zone of weakness defining a thin layer;
- cleaning and activating the oxidized surface of said donor wafer immediately prior to bonding, in accordance with a method according to any preceding claim;
- bonding said activated surface of the donor wafer onto the surface of another wafer termed the "receiver" wafer, optionally oxidized, said surface optionally having been cleaned and activated in accordance with a method according to any preceding claim; and
- detaching said thin layer and said oxide layer at said zone of weakness in order to take them off and transfer them onto said receiver wafer.

13. A method according to claim 12, characterized in that it comprises a consolidating anneal step between the bonding step and the detachment step.

14. A method of fabricating a semiconductor-on-insulator structure according to claim 12 or claim 13, characterized in that the donor wafer is produced from a semiconductor material.

15. A method according to claim 14, characterized in that the donor wafer is produced from stressed silicon.

16. A method of fabricating a silicon-on-insulator (**SOI**) type structure according to claim 14, characterized in that the donor wafer is produced from silicon.

A B S T R A C T

A METHOD OF TREATING A WAFER SURFACE

The invention concerns a method of treating one or the other or both surfaces (12, 22) termed the "bonding" surfaces of a first wafer (10) termed the "donor" wafer and a second wafer (20) termed the "receiver" wafer intended to be bonded one against the other. The method is remarkable in that it comprises a cleaning and activation step carried out immediately prior to bonding said donor (10) and receiver (20) wafers, by applying to said bonding surface or surfaces (12, 22) a solution termed the "surface treatment" comprising at least about 97% of a solution of ammonia (NH_4OH) in water, preferably deionized, in a concentration by weight in the range from about 0.05% to 2%. The invention is applicable to fabricating structures used in the optics, electronics, or optoelectronics fields.

Translation of the title and the abstract as they were when originally filed by the Applicant. No account has been taken of any changes that may have been made subsequently by the PCT Authorities acting ex officio, e.g. under PCT Rules 37.2, 38.2, and/or 48.3.