

**METHOD FOR HEALING DEFECTS IN A LAYER OBTAINED BY
IMPLANTATION THEN DETACHMENT FROM A SUBSTRATE**

FIELD OF THE INVENTION

5 The present invention relates to a method for healing defects in a layer of composition ABO_3 , where A consists of at least one element selected from: Li, Na, K, H, Ca, Mg, Ba, Sr, Pb, La, Bi, Y, Dy, Gd, Tb, Ce, Pr, Nd, Sm, Eu, Ho, Zr, Sc, Ag, Tl and B consists of at
10 least one element selected from: Nb, Ta, Sb, Ti, Zr, Sn, Ru, Fe, V, Sc, C, Ga, Al, Si, Mn, Zr, Tl, obtained by a method involving an implantation followed by a detachment from a substrate, and a method for producing such a layer, notably for an application to a
15 microelectronic, photonic or optic device. The invention also relates to methods for producing a bulk acoustic wave device and a surface acoustic wave device comprising such a layer.

20 **BACKGROUND OF THE INVENTION**

Among acoustic components used for filtering in the radiofrequency domain, two main categories of filters may be distinguished:

- 25 - on the one hand, surface acoustic wave (SAW) filters;
- on the other hand, bulk acoustic wave (BAW) filters and resonators.

For a review of these technologies, reference may be made to the article of W. Steichen and S.
30 Ballandras, "*Composants acoustiques utilisés pour le filtrage - Revue des différentes technologies*", *Techniques de l'Ingénieur, E2000, 2008*.

Surface acoustic wave filters typically comprise a thick piezoelectric layer (that is to say of thickness
35 generally of several hundreds of μm) and two electrodes

in the form of two interdigitated metal combs deposited on the surface of said piezoelectric layer. An electrical signal, typically a variation in electrical voltage, applied to an electrode is converted into an elastic wave which propagates on the surface of the piezoelectric layer. The propagation of this elastic wave is favoured if the frequency of the wave corresponds to the frequency range of the filter. This wave is again converted into an electrical signal on reaching the other electrode.

Bulk acoustic wave filters for their part typically comprise a thin piezoelectric layer (that is to say of thickness generally much less than 1 μm) and two electrodes arranged on each main face of said thin layer. An electrical signal, typically a variation in electrical voltage, applied to an electrode is converted into an elastic wave which propagates through the piezoelectric layer. The propagation of this elastic wave is favoured if the frequency of the wave corresponds to the frequency range of the filter. This wave is again converted into an electrical voltage on reaching the electrode situated on the opposite face.

In the case of surface acoustic wave filters, the piezoelectric layer has to have an excellent crystalline quality so as not to cause attenuation of the surface wave. It will thus be preferred to use a monocrystalline layer here. At the present time, suitable materials that can be used industrially are quartz, LiNbO_3 or LiTaO_3 . The piezoelectric layer is obtained by cutting from an ingot of one of said materials, the precision required for the thickness of said layer not being very important in so far as the waves have to propagate essentially on its surface.

In the case of bulk acoustic wave filters, the piezoelectric layer must have a determined thickness

that is uniform over the whole of the layer, and must be so in a precisely controlled manner. On the other hand, crystalline quality hence passing to the second order of parameters of importance for the performances of the filter, compromises are presently made with regard to the crystalline quality and a polycrystalline layer has for a long time been considered as acceptable. The piezoelectric layer is thus formed by deposition on a support substrate (for example a silicon substrate). At the present time, the materials employed industrially for such a deposition are AlN, ZnO and PZT.

The choices of materials are thus very limited in both technologies.

Yet, the choice of a material results from a compromise between different properties of the filter, as a function of the specifications of the manufacturer of the filter.

In order to offer more freedom in the dimensioning of bulk acoustic wave filters or surface acoustic wave filters, it would be desirable to be able to use more materials than the materials listed above. In particular, materials traditionally used for surface acoustic wave filters could represent interesting alternatives for bulk acoustic wave filters.

This imposes however being able to obtain thin, uniform layers of good quality of these materials.

A first possibility would be to thin the thick layers cut from ingots, by polishing and/or etching techniques. However, these techniques lead to a considerable loss of material and do not make it possible to obtain a layer of several hundreds of nanometres thickness with the required uniformity.

A second possibility would be to implement a Smart Cut™ type layer transfer by creating a weakened zone in

a donor substrate of LiNbO_3 or LiTaO_3 so as to delineate the thin layer to transfer, by bonding said layer to transfer on a support substrate and by detaching the donor substrate along the weakened zone so as to transfer the thin layer onto the support substrate. However, the creation of the weakened zone by ion implantation in the donor substrate damages the transferred layer and deteriorates its piezoelectric properties. Healing methods (notably annealings) known for the transfer of silicon layers do not always make it possible to repair completely the piezoelectric layer, on account of the complex crystalline structure of said layer and damage mechanisms that seem different to those that intervene in silicon.

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BRIEF DESCRIPTION OF THE INVENTION

Embodiments of the invention seek to conceive a method making it possible to heal more efficiently defects linked to the implementation of the Smart Cut™ method in an ABO_3 type substrate.

An aspect of the invention provides a method for healing defects in a layer of composition ABO_3 where A consists of at least one element selected from: Li, Na, K, H, Ca, Mg, Ba, Sr, Pb, La, Bi, Y, Dy, Gd, Tb, Ce, Pr, Nd, Sm, Eu, Ho, Zr, Sc, Ag, Tl and B consists of at least one element selected from: Nb, Ta, Sb, Ti, Zr, Sn, Ru, Fe, V, Sc, C, Ga, Al, Si, Mn, Zr, Tl, said layer being obtained by a layer transfer method in which ionic species are implanted into a substrate of composition ABO_3 so as to form a weakened zone delineating said layer, then said substrate is detached along the weakened zone to obtain a layer that is detached from the rest of the donor substrate, said method being characterised in that it comprises exposing said layer to a medium containing ions of

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the constituent element A so as to make said ions penetrate into said transferred layer.

"Substrate of composition ABO_3 " is taken to mean a substrate entirely consisting of ABO_3 or comprising at least one layer of this material and in which may be formed, by implantation then detachment, the layer of composition ABO_3 subject to said method for healing defects.

In the case where A consists of two or more elements, "constituent element A" designates one of these elements. By extension and for the sake of concision, the element that the healing method makes it possible to penetrate into the layer to heal is designated by "element A" in the remainder of the text.

In a particularly advantageous manner, the ions of the element A penetrate into the layer by an ion exchange mechanism.

According to one embodiment, the medium containing the ions of the element A is a liquid and the layer is immersed in a bath of said liquid.

For example, the layer of composition ABO_3 may be immersed in a bath comprising an acid solution of a salt comprising the element A.

According to another embodiment, the medium containing the ions of the element A is in gaseous phase and the layer of composition ABO_3 is exposed to said gas.

According to another embodiment, the medium containing the ions of the element A is in solid phase, a layer of said medium being deposited on the layer of composition ABO_3 .

Advantageously, the method comprises at least one annealing step to favour the diffusion of the element A from the medium to the layer of composition ABO_3 .

According to a particular embodiment, the element A is lithium.

The layer may be immersed in a bath comprising an acid solution of a lithium salt.

5 Lithium ions advantageously penetrate into the layer by a reverse proton exchange mechanism.

According to one embodiment of the invention, the layer of composition ABO_3 is monocrystalline.

Another aspect of the invention provides a method
10 for producing a layer of composition ABO_3 where A consists of at least one element selected from: Li, Na, K, H, Ca, Mg, Ba, Sr, Pb, La, Bi, Y, Dy, Gd, Tb, Ce, Pr, Nd, Sm, Eu, Ho, Zr, Sc, Ag, Tl and B consists of at least one element selected from: Nb, Ta, Sb, Ti, Zr,
15 Sn, Ru, Fe, V, Sc, C, Ga, Al, Si, Mn, Zr, Tl, characterised in that it comprises:

- providing a donor substrate of composition ABO_3 ,
- the formation of a weakened zone by implantation of ionic species in the donor substrate so as to
20 delineate the layer,
- the detachment from the donor substrate along the weakened zone so as to obtain the layer detached from the rest of the donor substrate, said layer comprising defects,
- 25 - implementing the method for healing defects of the layer as described above.

Preferably, the implanted species comprises hydrogen and/or helium.

According to one embodiment, before the healing
30 step, a part of the thickness of the layer of composition ABO_3 is removed.

According to one embodiment, the thickness of the layer is greater than 2 μm , preferably greater than 20 μm , said layer being self-supporting at the end of the
35 detachment from the donor substrate.

According to another embodiment, the method comprises, between the step of formation of the weakened zone and the step of detachment from the donor substrate along said weakened zone, the application of
5 a receiver substrate on the donor substrate, the layer of composition ABO_3 being at the interface between said substrates, said layer (10) being transferred onto the receiver substrate at the end of the detachment from the donor substrate.

10 The application of the receiver substrate may comprise the deposition of said substrate on the donor substrate.

Alternatively, the application of the receiver substrate comprises the bonding of said substrate on
15 the donor substrate.

Advantageously, the thickness of the layer of composition ABO_3 is less than 20 μm .

Optionally, at least one electrically insulating layer and/or at least one electrically conducting layer
20 is formed at the interface between the receiver substrate and the layer to transfer.

The invention also relates to a method for producing a bulk acoustic wave device, comprising forming electrodes on two opposite main faces of a
25 piezoelectric layer, characterised in that it comprises the production of said piezoelectric layer by a method as described above.

The invention also relates to a method for producing a surface acoustic wave device, comprising
30 the formation of two interdigitated electrodes on the surface of a piezoelectric layer, characterised in that it comprises the production of said piezoelectric layer by a method as described above.

BRIEF DESCRIPTION OF THE DRAWINGS

Other characteristics and advantages of the invention will become clear from the detailed description that follows, with reference to the
5 appended drawings, in which:

- figures 1A to 1E schematically illustrate the steps of the method for producing a monocrystalline layer of composition ABO_3 according to one embodiment of the invention,
- 10 - figure 2 is a sectional principle view of a surface acoustic wave filter,
- figure 3 is a sectional principle view of a bulk acoustic wave filter.

For reasons of legibility of the figures, the
15 elements illustrated are not necessarily represented to scale. Furthermore, elements designated by the same reference signs in different figures are identical.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE 20 INVENTION

With reference to figures 1A to 1D, a method is considered for producing a layer of composition ABO_3 implementing the Smart Cut™ method, comprising the following steps:

- 25 - providing a donor substrate of composition ABO_3 ,
- forming a weakened zone 101 by implantation of ionic species (for example hydrogen and/or helium) into the donor substrate 100 so as to delineate the layer 10 to transfer (cf. figure 1A),
- 30 - applying a receiver substrate 110 on the donor substrate 100, the layer 10 to transfer being at the interface (cf. figure 1B),
- detaching the donor substrate 100 along the weakened zone 101 so as to transfer the layer 10 onto
35 the receiver substrate 110 (cf. figure 1C).

The donor substrate may be a bulk substrate of the considered material. Alternatively, the donor substrate may be a composite substrate, that is to say formed of a stack of at least two layers of different materials,
 5 of which a superficial layer consists of the considered monocrystalline material.

Among piezoelectric materials of particular interest are perovskites and comparable materials, of ABO_3 structure. However, the interest that can be
 10 placed in these materials is not limited to their piezoelectric character. Notably for other applications, for example linked to integrated optics, interest could also be taken in them if need be for their dielectric permittivity, for their refractive
 15 indices, or instead for their pyroelectric, ferroelectric or instead ferromagnetic properties for example and depending on the case.

Several large families stand out. One of them derives notably from binary materials such as $LiNbO_3$,
 20 $LiTaO_3$, $KNbO_3$, $KTaO_3$ to end up with a generic formula of ABO_3 type where A consists of one or more of the following elements: Li, Na, K, H and where B consists of one or more of the following elements: Nb, Ta, Sb, V. Another large family derives from $SrTiO_3$, $CaTiO_3$,
 25 $SrTiO_3$, $PbTiO_3$, $PbZrO_3$ materials notably to end up with a generic formula of ABO_3 type where A consists of one or more of the following elements: Ba, Ca, Sr, Mg, Pb, La, Y and where B consists of one or more of the following elements: Ti, Zr, Sn. Other less widespread
 30 families may also be derived from $BiFeO_3$, or instead $LaMnO_3$, $BaMnO_3$, $SrMnO_3$, or instead $LaAlO_3$, or instead, $LiAlO_3$, $LiGaO_3$, or instead $CaSiO_3$, $FeSiO_3$, $MgSiO_3$, or instead $DyScO_3$, $GdScO_3$ and $TbScO_3$.

In the end, it could be summarised by considering
 35 that A consists of one or more of the following

elements selected from: Li, Na, K, H, Ca, Mg, Ba, Sr, Pb, La, Bi, Y, Dy, Gd, Tb, Ce, Pr, Nd, Sm, Eu, Ho, Zr, Sc, Ag, Tl and B consists of one or more of the following elements selected from: Nb, Ta, Sb, Ti, Zr, Sn, Ru, Fe, V, Sc, C, Ga, Al, Si, Mn, Zr, Tl.

Some of these materials are monocrystalline; others are not monocrystalline.

The crystalline nature and the composition of the donor substrate are selected by those skilled in the art depending on the use planned for the layer to transfer.

The receiver substrate has a function of mechanical support of the transferred layer. It may be of any nature and, advantageously but not imperatively, adapted to the targeted application, the transferred layer optionally being able to be transferred later onto another substrate. The receiver substrate may be bulk or composite.

According to one embodiment, the application of the receiver substrate on the donor substrate is carried out by bonding.

Alternatively, the application of the receiver substrate on the donor substrate is carried out by a deposition of the receiver substrate on the donor substrate. Any suitable deposition technique, such as, for example but in a non-limiting manner, an evaporation, a cathodic sputtering, an aerosol sputtering, a chemical phase deposition, an electrodeposition, a spread coating, a spin coating, a varnishing, a screen printing, an immersion, may be used. Such a solution is particularly advantageous to compensate for poor adhesion of the donor substrate vis-à-vis the receiver substrate.

Optionally, the method comprises forming at least one electrically insulating layer and/or at least one

electrically conducting layer (not represented) at the interface between the receiver substrate 110 and the layer 10 to transfer.

In the case where the layer 10 is sufficiently
5 thick to confer thereon a certain mechanical strength, notably during the operation of detachment along the weakened zone, the step of application of the receiver substrate may be omitted. The layer 10 is then called self-supporting after its detachment from the rest of
10 the donor substrate. In this case, the thickness of the layer 10 is typically greater than 2 μm , preferably greater than 20 μm , and the implantation energy of the ionic species is greater than 1 MeV.

A transferred layer of composition LiXO_3 is taken
15 as example in the remainder of the text, where X is niobium and/or tantalum. In other words, in this non-limiting example, the element A is lithium and the element B is niobium and/or tantalum, it being understood that those skilled in the art are able to
20 define suitable conditions for the other materials cited above. Notably, the healing of the layer 10 involves an ion exchange mechanism that is used in the glass field. For example, it is known to replace a part of the Na^+ ions present in certain glasses by Ag^+ or K^+
25 ions, by implementing a treatment consisting in immersing the glass in a bath of molten salts for example AgNO_3 or KNO_3 , respectively. Similarly, the invention may be implemented by exposing the layer to heal to a medium containing ions of the element A with
30 which it is wished to enrich said layer, said medium being able to be liquid (for example a bath of an acid solution of a salt comprising the element A), gaseous or solid.

During the method for transferring the layer 10
35 from the donor substrate to the receiver substrate,

notably during the implantation of the ionic species and/or thermal treatments of reinforcement of the bonding or detachment, lithium may be made to migrate outside of said layer 10.

5 This migration of lithium may optionally be accompanied by a replacement of the atoms concerned by hydrogen atoms implanted to form the weakened zone.

The transferred layer 10 is thus defective on account of this lithium deficiency.

10 To remedy this, the invention proposes a method for healing defects of the transferred layer, in which the transferred layer (and optionally the whole of the receiver substrate that supports it) is exposed to a medium M containing lithium ions (cf. figure 1D).

15 This exposure has the effect of making lithium ions migrate from the medium M to the transferred layer 10, thereby enriching the transferred layer with lithium and restoring the structure of said layer prior to the implantation and to the transfer.

20 Optionally, hydrogen atoms situated at the location of lithium atoms can migrate to the medium M.

A reverse proton exchange type mechanism is brought into play in this migration.

25 Reverse proton exchange is described, in relation with a completely other application than that addressed by the present invention, in the article of Yu. N. Korkishko *et al.* entitled "Reverse proton exchange for buried waveguides in LiNbO_3 ", J. Opt. Soc. Am. A, Vol. 15, No. 7, July 1998.

30 The medium M may be a liquid, in which case the transferred layer is immersed in a bath of said liquid. For example, in the present example, the medium M is an acid solution of a lithium salt. Those skilled in the art also know how to use mixtures of solutions of

LiNO_3 , KNO_3 and NaNO_3 to better control the efficiency of this operation.

Alternatively, the medium M may be gaseous, in which case the transferred layer is placed in an enclosure containing said gas.

Those skilled in the art are able to define the operating conditions of this exposure, notably the composition of the medium, the duration and the temperature of exposure, as a function of the composition of the transferred layer to heal.

Advantageously, the thickness of the transferred layer is less than 20 μm , preferably less than 2 μm .

According to another alternative, the medium M may be in solid phase, and the transferred layer 10 is exposed to said medium by deposition of a layer of said medium on the layer 10 (cf. figure 1E). "On" is here taken to mean either directly in contact with said layer 10, or through one or more layers formed of different materials, in so far as said intermediate layers do not block the migration of the element A from the layer constituting the medium M to the layer 10.

A better penetration of the ions of the element A into the layer 10 is made possible by one or more annealing steps. The deposited layer containing the element A may be removed at the end of the operation, optionally between two successive annealing steps.

Optionally, before the healing step, a part of the thickness of the layer transferred onto the receiver substrate is removed. This removal may be carried out by chemical mechanical polishing, by etching or by any other appropriate technique.

Two non-limiting applications of the layer 10 transferred and healed according to the invention are described hereafter.

Figure 2 is a principle view of a surface acoustic wave filter.

Said filter comprises a piezoelectric layer 10 and two electrodes 12, 13 in the form of two interdigitated metal combs deposited on the surface of said piezoelectric layer. On the side opposite to the electrodes 12, 13, the piezoelectric layer rests on a support substrate 11. The piezoelectric layer 10 is monocrystalline, an excellent crystalline quality indeed being necessary so as not to cause attenuation of the surface wave.

Figure 3 is a principle view of a bulk acoustic wave resonator.

The resonator comprises a thin piezoelectric layer (that is to say of thickness generally less than 1 μm , preferably less than 0.2 μm) and two electrodes 12, 13 arranged on either side of said piezoelectric layer 10. The piezoelectric layer 10 rests on a support substrate 11. To insulate the resonator from the substrate and thereby avoid the propagation of waves in the substrate, a Bragg mirror 14 is interposed between the electrode 13 and the substrate 11. Alternatively (not illustrated), this insulation could be achieved by arranging a cavity between the substrate and the piezoelectric layer. These different arrangements are known to those skilled in the art and thus will not be described in detail in the present text.

In certain cases, the receiver substrate may not be optimal for the final application. It may then be advantageous to transfer the layer 10 onto a final substrate (not represented) of which the properties are selected as a function of the targeted application, by bonding it on said final substrate and by removing the receiver substrate by any suitable technique.

In the case where it is wished to produce a surface acoustic wave device, metal electrodes 12, 13 in the form of two interdigitated combs are deposited on the surface of the layer 10 opposite to the receiver substrate 110 or, if need be, opposite to the final substrate (whether it is the receiver substrate 110 or the final substrate 111, said substrate forms the support substrate noted 11 in figure 2).

In the case where it is wished to produce a bulk acoustic wave device, an adaptation of the method described above has to be made. On the one hand, before the step of bonding illustrated in figure 1B, a first electrode is deposited on the free surface of the layer 10 to transfer of the donor substrate, this first electrode (referenced 13 in figure 3) being buried in the final stack. After the transfer step illustrated in figure 1C, a second electrode (referenced 12 in figure 3) is deposited on the free surface of the layer 10, opposite to the first electrode. Another option is to transfer the layer 10 onto a final substrate as mentioned above and to form the electrodes before and after said transfer. On the other hand, to avoid the propagation of acoustic waves in the receiver substrate 110, it is possible to integrate therein an insulation means, for example, a Bragg mirror (as illustrated in figure 3) or a cavity etched beforehand in the receiver substrate or in the final substrate if need be.

Finally, it goes without saying that the examples that have been given are only particular illustrations that are in no way limiting with regard to the application fields of the invention.

REFERENCES

W. Steichen and S. Ballandras, *Composants acoustiques utilisés pour le filtrage - Revue des différentes technologies, Techniques de l'Ingénieur*,
5 E2000, 2008

Yu. N. Korkishko et al., Reverse proton exchange for buried waveguides in LiNbO₃, J. Opt. Soc. Am. A, Vol. 15, No. 7, July 1998

CLAIMS

1. Method for healing defects in a layer (10) of composition ABO_3 where A consists of at least one
5 element selected from: Li, Na, K, H, Ca, Mg, Ba, Sr, Pb, La, Bi, Y, Dy, Gd, Tb, Ce, Pr, Nd, Sm, Eu, Ho, Zr, Sc, Ag, Tl and B consists of at least one element selected from: Nb, Ta, Sb, Ti, Zr, Sn, Ru, Fe, V, Sc, C, Ga, Al, Si, Mn, Zr, Tl, said layer (10) being
10 obtained by a layer transfer method in which ionic species are implanted into a substrate (100) of composition ABO_3 so as to form a weakened zone delineating said layer, said substrate then being detached along the weakened zone in order to obtain a
15 layer (10) detached from the rest of the donor substrate, characterised in that it comprises exposing said layer (10) to a medium (M) containing ions of a constituent element A so as to make said ions penetrate into said transferred layer.

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2. Method according to claim 1, in which said ions penetrate into the layer (10) by an ion exchange mechanism.

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3. Method according to one of claims 1 or 2, in which the medium (M) containing the ions is a liquid and the layer (10) is immersed in a bath of said liquid.

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4. Method according to one of claims 1 to 3, in which the layer (10) of composition ABO_3 is immersed in a bath comprising an acid solution of a salt comprising said constituent element A.

5. Method according to one of claims 1 or 2, in which the medium (M) containing the ions is in gaseous phase and the layer (10) is exposed to said gas.

5 6. Method according to one of claims 1 or 2, in which the medium (M) containing the ions is in solid phase, a layer of said medium (M) being deposited on the layer (10).

10 7. Method according to claim 6, comprising at least one annealing step to favour the diffusion of the constituent element A from the medium (M) to the layer (10).

15 8. Method according to one of claims 1 to 7, in which A is lithium.

20 9. Method according to claim 8, in which the lithium ions penetrate into the layer (10) by a reverse proton exchange mechanism.

25 10. Method according to one of claims 8 or 9, in which the layer (10) is immersed in a bath comprising an acid solution of a lithium salt.

30 11. Method according to one of claims 1 to 10, in which the layer (10) is monocrystalline.

35 12. Method for producing a layer (10) of composition ABO_3 where A consists of at least one element selected from: Li, Na, K, H, Ca, Mg, Ba, Sr, Pb, La, Bi, Y, Dy, Gd, Tb, Ce, Pr, Nd, Sm, Eu, Ho, Zr, Sc, Ag, Tl and B consists of at least one element selected from: Nb, Ta, Sb, Ti, Zr, Sn, Ru, Fe, V, Sc, C, Ga, Al, Si, Mn, Zr, Tl, characterised in that it comprises:

- providing a donor substrate (100) of composition ABO_3 ,

- forming a weakened zone (101) by implantation of ionic species in the donor substrate (100) so as to
5 delineate the layer (10),

- detaching the donor substrate (100) along the weakened zone (101) so as to obtain the layer (10) detached from the rest of the donor substrate (100), said layer comprising defects,

10 - implementing the method for healings defects of the layer (10) according to one of claims 1 to 11.

13. Method according to claim 12, in which the implanted species comprises hydrogen and/or helium.

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14. Method according to one of claims 12 or 13, in which, before the healing step, a part of the thickness of the layer (10) is removed.

20 15. Method according to one of claims 12 to 14, in which the thickness of the layer (10) is greater than $2\text{ }\mu\text{m}$, preferably greater than $20\text{ }\mu\text{m}$, said layer being self-supporting at the end of the detachment from the donor substrate (100).

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16. Method according to one of claims 12 to 14, comprising, between the step of formation of the weakened zone and the step of detachment from the donor substrate along said weakened zone, the application of
30 a receiver substrate (110) on the donor substrate (100), the layer (10) being at the interface between said substrates (100, 110), said layer (10) being transferred onto the receiver substrate (110) at the end of the detachment from the donor substrate (100).

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17. Method according to claim 16, in which the application of the receiver substrate comprises the deposition of said substrate (110) on the donor substrate (100).

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18. Method according to claim 16, in which the application of the receiver substrate comprises the bonding of said substrate (110) on the donor substrate (100).

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19. Method according to one of claims 16 to 18, in which the thickness of the layer (10) is less than 20 μm .

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20. Method according to one of claims 16 to 19, in which at least one electrically insulating layer and/or at least one electrically conducting layer is formed at the interface between the receiver substrate (110) and the layer (10) to transfer.

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21. Method for producing a bulk acoustic wave device, comprising the formation of electrodes (12, 13) on two opposite main faces of a piezoelectric layer (10), characterised in that it comprises the production of said piezoelectric layer (10) by a method according to one of claims 12 to 20.

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22. Method for producing a surface acoustic wave device, comprising the formation of two interdigitated electrodes (12, 13) on the surface of a piezoelectric layer (10), characterised in that it comprises the production of said piezoelectric layer by a method according to one of claims 12 to 20.

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