

METHOD FOR PRODUCING A LAYER

FIELD OF THE INVENTION

The present invention relates to a method for
5 producing a layer of composition $AA'BO_3$ where A and A'
consist of at least one element selected from: Li, Na,
K, 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,
10 Sn, Ru, Fe, V, Sc, C, Ga, Al, Si, Mn, Zr, Tl, notably
piezoelectric, in particular for an application to a
microelectronic, photonic or optic device. In
particular but in a non-limiting manner, said device
may be a surface acoustic wave device or a bulk
15 acoustic wave device for radiofrequency applications.

BACKGROUND OF THE INVENTION

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

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

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

30 Surface acoustic wave filters typically comprise a
thick piezoelectric layer (that is to say of thickness
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
35 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. Thus a monocrystalline layer will be preferred in this case. 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 on the crystalline quality of said layer 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 $\text{Pb}(\text{Zr}_x, \text{Ti}_{1-x})\text{O}_3$ (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 particular, the electromechanical coupling coefficient of the piezoelectric materials are criteria of choice of the material to use for a given application and a given component architecture.

For example, LiNbO_3 and LiTaO_3 are highly anisotropic materials. The coupling coefficient depending on the crystalline orientation, the choice of a particular orientation of the material offers a first degree of freedom in the choice of the material. This is the reason why substrates can be found according to a multiplicity of crystalline orientations, for example: X-cut, Y-cut, Z-cut, YZ-cut, 36° rotated Y axis, 42° rotated Y axis, etc.

However, apart from the possibility of selecting a particular crystalline orientation, those skilled in the art only have at their disposal quartz, LiNbO_3 and LiTaO_3 for designing a surface acoustic wave filter, which only offers a limited range of parameters for optimising the characteristics of the filter, even if several other materials could complete this list in the future such as langasite $\text{La}_3\text{Ga}_5\text{SiO}_{14}$ for example.

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, without
 5 moreover adversely affecting the quality of the materials.

BRIEF DESCRIPTION OF THE INVENTION

One aim of the invention is to overcome the
 10 aforesaid drawbacks and notably to conceive a method for producing a monocrystalline layer, notably piezoelectric, in particular for a surface acoustic wave device, made of other materials than the materials used for this application, in particular by making it
 15 possible to obtain layers that are thin (that is to say of thickness less than 20 μm , or even less than 1 μm) and uniform of the materials used for surface acoustic wave devices. Moreover, this method must also make it possible to use a greater variety of support substrates
 20 than in existing bulk acoustic wave devices.

In accordance with the invention, a method is proposed for producing a layer of composition $\text{AA}'\text{BO}_3$ where A consists of at least one element selected from: Li, Na, K, Ca, Mg, Ba, Sr, Pb, La, Bi, Y, Dy, Gd, Tb,
 25 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 of composition ABO_3 ,
- 30 - forming a layer of composition ABO_3 by thinning said donor substrate,
- before and/or after the thinning step, exposing said layer of composition ABO_3 to a medium containing ions of an element A' belonging to the same list of
 35 elements as A, A' being different from A, such that

said ions penetrate into said layer to form a layer of composition $AA'BO_3$.

"Donor substrate of composition ABO_3 " is taken to mean a substrate entirely consisting of ABO_3 or
5 comprising at least one layer of this material and in which may be formed, by thinning of said substrate, a layer of composition ABO_3 intended to be converted into the layer of composition $AA'BO_3$.

In the case where A consists of two or more
10 elements, by extension "element A" designates all of the elements constituting A. In this case, the expression "A' is different from A" signifies that the element A' is different from each of the elements constituting A.

15 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
20 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
25 containing the ions of the element A' is in gaseous phase and the layer is exposed to said gas.

According to one embodiment, the ions of the element A' penetrate into the layer by implantation and a heat treatment may be implemented to make said ions
30 diffuse into said layer.

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

According to one embodiment, the thinning of the donor substrate comprises the application of a receiver substrate on the donor substrate, the layer of composition ABO_3 being at the interface, and the
10 transfer of said layer onto the receiver substrate.

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

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

The thickness of the layer transferred onto the receiver substrate is advantageously less than 20 μm .

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

According to one embodiment, the thickness of the layer of composition ABO_3 is greater than 2 μm ,
25 preferably greater than 20 μm , said layer being self-supporting at the end of the thinning of the donor substrate.

The thinning of the donor substrate may comprise the following steps:

30 - the formation of a weakened zone in the donor substrate so as to delineate the layer of composition ABO_3 ,

- the detachment from the donor substrate along the weakened zone.

Said weakened zone is advantageously formed by ion implantation in the donor substrate.

According to a particular embodiment, the element A is lithium and the element A' is sodium and/or potassium. The element B may then be advantageously niobium and/or tantalum.

The invention also relates to a method for producing a bulk acoustic wave device comprising forming electrodes on two opposite main faces of a 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 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 appended drawings, in which:

- figures 1A to 1F schematically illustrate the steps of the method for producing a monocrystalline layer of composition $AA'BO_3$ according to one embodiment of the invention,
- 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 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 5 INVENTION

Generally speaking, a layer of composition ABO_3 is formed by thinning a donor substrate of composition ABO_3 . Said thinning may be carried out by any appropriate technique, among which may be cited the
10 Smart Cut™ method thanks to which is formed, by implantation of ionic species in the donor substrate, a weakened zone delineating the layer of interest; any other technique of formation of the weakened zone being able to be employed; or instead the implementation of
15 one or more steps of etching the donor substrate so as to conserve only the layer of interest.

If the layer is sufficiently thick, it may be self-supporting, that is to say that it does not need to be applied on a stiffener substrate in order to have
20 sufficient mechanical strength.

Alternatively, notably if the layer is thin, the thinning of the donor substrate is preceded by a step of applying, on the donor substrate, a receiver substrate. The application of said receiver substrate
25 may be done notably by bonding or by deposition on the donor substrate.

From the layer of composition ABO_3 thereby obtained, a layer of more complex composition of $\text{AA}'\text{BO}_3$ type is obtained, in which A' belongs to the same list
30 of elements as A but is different from A . Obtaining such a layer assumes exposing the layer of composition ABO_3 to a medium comprising ions of the element A' , so as to make at least one part of said ions penetrate into the layer.

The conversion of the layer of initial composition ABO_3 into a layer of composition $AA'BO_3$ advantageously involves an ion exchange mechanism that is used in the glass field. For example, it is known to replace a part
5 of the Na^+ ions present in certain glasses by Ag^+ or K^+ 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
10 convert into a layer of more complex composition to a medium containing ions of the element A' with 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.

15 With reference to figures 1A to 1D, a method is considered for producing a layer of composition $AA'BO_3$ according to one embodiment implementing the Smart Cut™ method, comprising the following steps:

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

30 In an alternative (not illustrated) to the Smart Cut™ method, the transfer of the layer 10 onto the receiver substrate may be carried out by thinning the donor substrate 100 by its face opposite to the bonding interface, down to the layer 10 to transfer. This
35 thinning may involve at least one etching, chemical

mechanical polishing and/or another appropriate technique.

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

Among piezoelectric materials of particular
10 interest are perovskites and comparable materials, of ABO_3 structure. However, the interest that can be placed in these materials is not limited to their piezoelectric character. Notably for other applications, for example linked to integrated optics,
15 interest could also be taken in them if need be for their dielectric permittivity, for their refractive indices, or instead for their pyroelectric, ferroelectric or instead ferromagnetic properties for example and depending on the case. Several large
20 families stand out. One of them derives notably from binary materials such as $LiNbO_3$, $LiTaO_3$, $KNbO_3$, $KTaO_3$ 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 and where B consists of one or more of the
25 following elements: Nb, Ta, Sb, V. Another large family derives from $SrTiO_3$, $CaTiO_3$, $SrTiO_3$, $PbTiO_3$, $PbZrO_3$ 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
30 B consists of one or more of the following elements: Ti, Zr, Sn. Other less widespread 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 $DyScO_3$,
35 $GdScO_3$ and $TbScO_3$.

In the end, it could be summarised by considering that A consists of one or more of the following elements selected from: Li, Na, K, 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 destination of 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 thick to confer thereon a certain mechanical strength, notably during the operation of detachment along the weakened zone or during its later use, 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 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 energy of implantation of the ionic species is greater than 1 MeV.

Whether the layer 10 of initial composition ABO_3 is self-supporting or transferred onto the receiver substrate 110, it is next converted into a layer of composition $\text{AA}'\text{BO}_3$ where A' is an element belonging to the same list as A but which is different to the element A.

This modification of the composition of the transferred layer 10 is carried out by exposing said layer (and optionally the whole of the receiver substrate that supports it) to a medium M comprising ions of the element A' (cf. figure 1D).

This exposure has the effect of making ions of the element A' migrate from the medium M to the transferred layer 10, thereby enriching the transferred layer with element A' .

Optionally, atoms of the element A situated in the layer 10 can migrate to the medium M.

Similarly, if obtaining the layer 10 requires the implementation of an implantation of H^+ ions, of

hydrogen atoms present in the transferred layer at the location of atoms of the element A, said hydrogen atoms can migrate to the medium M. A reverse proton exchange type mechanism is brought into play in this migration.

5 Reverse proton exchange is described, in relation with an entirely 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. 10 15, No. 7, July 1998.

According to one embodiment, the layer 10 is exposed to the medium M before the step of thinning the donor substrate and thus has a composition $\text{AA}'\text{BO}_3$ before being transferred onto the receiver substrate or 15 be formed as a self-supporting layer, if need be.

Optionally, the exposure to the medium M may be implemented both before and after the thinning of the donor substrate.

Furthermore, different elements A' may be inserted 20 into the layer 10, by successively exposing said layer to different media each comprising ions of the element A'. It is thus possible to obtain a layer 10 having a complex composition with several elements of the list to which the element A belongs.

25 An ion exchange type mechanism is brought into play in the migration of ions of the element A' into the layer of initial composition ABO_3 .

The medium M may be a liquid, in which case the transferred layer is immersed in a bath of said liquid.

30 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 35 composition of the medium, the duration and the

temperature of exposure, as a function of the desired composition of the layer.

According to one particular embodiment, illustrated in figure 1E, the exposure to the medium may be carried
5 out by implantation of ions of the element A' into the transferred layer (this implantation is shown schematically by arrows). Since the implantation results in a peak of ions implanted at a determined depth of the layer, it must be followed by a heat
10 treatment intended to cause a diffusion of said ions into the whole of the thickness of the layer, in order to homogenise the composition thereof. Such an annealing also makes it possible to repair crystalline defects created by the implantation. This annealing is
15 generally carried out immediately after the implantation. In certain cases, it starts during the implantation step itself, notably when the substrate subjected to the implantation heats up under the exposure of the corresponding energy flux. But the
20 annealing can also take place later in the sequencing of steps of methods. It is thereby possible to intercalate other steps between the implantation step and the annealing step, such as for example, the lift-off of a superficial passivation layer, or instead a
25 polishing step, an etching step or instead a layer transfer operation. The annealing may moreover be carried out in several stages, which can be spread out over different steps of the overall method. The implantation may be of conventional type, that is to
30 say in which the ions are transported in the form of a beam of ions accelerated to a certain energy (typically several tens to several hundreds of keV). In an alternative, the implantation may be carried out by plasma immersion, which makes it possible to implant
35 rapidly a high dose of A' ions in the vicinity of the

surface of the transferred layer. These techniques are known to those skilled in the art.

According to another alternative, the medium M may be in solid phase, and the transferred layer 10 is
5 exposed to said medium by deposition of a layer of said medium on the layer 10 (cf. figure 1F). "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
10 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
15 be removed at the end of the operation, optionally between two successive annealing steps.

In the remainder of the text a layer of initial composition LiXO_3 , where X is niobium and/or tantalum, is taken as example. In other words, in this non-
20 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 define suitable conditions for the other materials cited above.

25 To transform the layer of initial composition LiXO_3 into a layer of composition LiKXO_3 or LiNaXO_3 , said layer is exposed to an acid solution of a potassium or sodium salt.

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

Optionally, before the step of enrichment with
35 element A', 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.

5 Two applications of the layer 10 of composition modified according to the invention are described hereafter.

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

10 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
15 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
20 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.
25 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
30 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 bonding step 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.

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REFERENCES

W. Steichen and S. Ballandras, *Composants acoustiques utilisés pour le filtrage - Revue des différentes technologies, Techniques de l'Ingénieur*,
10 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 producing a layer of composition $AA'BO_3$ where A consists of at least one element
5 selected from: Li, Na, K, 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:
- 10 - providing a donor substrate (100) of composition ABO_3 ,
- forming a layer (10) of composition ABO_3 by thinning said donor substrate (100),
- before and/or after the thinning step, exposing
15 said layer (10) of composition ABO_3 to a medium (M) containing ions of an element A' belonging to the same list of elements as A, A' being different from A, such that said ions penetrate into said layer (10) to form a layer of composition $AA'BO_3$.
- 20
2. Method according to claim 1, in which the ions of the element A' penetrate into the layer (10) by an ion exchange mechanism.
- 25
3. Method according to one of claims 1 or 2, in which the medium (M) containing the ions of the element A' is a liquid and the layer (10) is immersed in a bath of said liquid.
- 30
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 the element A'.
- 35
5. Method according to one of claims 1 or 2, in which the medium (M) containing the ions of the element

A' is in gaseous phase and the layer (10) is exposed to said gas.

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

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

8. Method according to claim 1, in which the ions
15 of the element A' penetrate into the layer (10) by implantation.

9. Method according to claim 8, further comprising
at least one heat treatment step to make the implanted
ions diffuse into the layer (10).

20

10. Method according to one of claims 1 to 9, in
which the layer (10) is monocrystalline.

11. Method according to one of claims 1 to 10, in
25 which the thinning of the donor substrate (100) comprises the application of a receiver substrate (110) on the donor substrate (10), the layer (10) being at the interface, and the transfer of the layer (10) onto the receiver substrate (110).

30

12. Method according to claim 11, in which the
application of the receiver substrate comprises the
deposition of said substrate (110) on the donor
substrate (100).

35

13. Method according to claim 11, in which the application of the receiver substrate comprises the bonding of said substrate (110) on the donor substrate (100).

5

14. Method according to one of claims 11 to 13, in which the thickness of the layer (10) is less than 20 μm .

10

15. Method according to one of claims 11 to 14, 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).

15

16. Method according to one of claims 1 to 10, in which the thickness of the layer (10) is greater than 2 μm , preferably greater than 20 μm , said layer being self-supporting at the end of the thinning of the donor substrate (100).

20

17. Method according to claim 11, in which the thinning of the donor substrate (10) comprises the following steps:

25

- the formation of a weakened zone (101) in the donor substrate (100) so as to delineate the layer (10) of composition ABO_3 ,
- the detachment from the donor substrate (100) along the weakened zone (101).

30

18. Method according to claim 17, in which the weakened zone (101) is formed by ion implantation in the donor substrate (100).

19. Method according to one of claims 1 to 18, in which A is lithium and the element A' is sodium and/or potassium.

5 20. Method according to claim 19, in which the element B is niobium and/or tantalum.

21. Method for producing a bulk acoustic wave device, comprising forming electrodes (12, 13) on two
10 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 1 to 20.

15 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
20 according to one of claims 1 to 20.