

**Method for the manufacture of substrates, in particular for
the optical, electronic or optoelectronic areas, and the
substrate obtained in accordance with the said method**

5 This present invention concerns the area of methods for
the manufacture of substrates, in particular for the optical,
electronic or optoelectronic areas, as well as that of the
substrates obtained by such methods. The invention more
particularly concerns substrates that can be used for the
10 manufacture of solar cells, electroluminescent diodes and
lasers.

 In the area of substrates for the optical, electronic
optoelectronic areas, one is very familiar with two main types
of method for creating a thin layer on a support substrate.

15 According to a first type of method, a thin layer is
taken from a donor substrate, in order to transfer it onto a
receiving support substrate with a view to obtaining
substrates that have a thin usable layer. By "thin layer" is
meant the layer of the substrate on which electronic
20 components such as electroluminescent diodes or others can be
manufactured.

 According to a second type of method, the thin layer is
deposited onto a receiving support substrate by a deposition
technique. This deposition technique can in particular consist
25 of epitaxy or chemical deposition in the vapour phase.

 Whatever the type of method used to create a usable layer
on a receiving support substrate, it is sometimes necessary to
eliminate at least one part of the receiving support in order
to obtain a final substrate that includes at least the usable
30 layer.

 Such elimination of the receiving support results in
losses of materials that increase the production costs of such
substrates.

 In order to overcome this drawback, a method has already
35 been proposed for the manufacture of substrates that include a
thin usable layer, in which the receiving support substrate is
removed to be recycled.

Such a method is described in an execution variant of American patent US 6 794 276 submitted by the applicant, which described a method for the manufacture of substrates.

This method includes a stage for the transfer of a seed
5 layer onto a receiving support by molecular adhesion at the level of an attachment interface, a stage of epitaxy of a usable layer onto the seed layer, and a stage for the application of stresses that lead to the detachment of the assembly composed of the seed layer and the usable layer in
10 relation to the receiving support at the level of the attachment interface.

By seed layer is meant the layer of material which allows the development of the usable epitaxy layer.

In this document, certain specifications are necessary in
15 order to allow the seed layer to be adapted to the thermal expansion of the receiving support and of the usable layer during the thermal treatments to which the substrate is subjected.

In this regard, this document recommends that the seed
20 layer should have a sufficiently small thickness, of the order of 0.5 microns, and preferably less than 1000 Å.

This document also mentions the fact that the receiving support is composed of a material whose thermal coefficient of expansion (TCE) is 0.7 to 3 times greater than that of the
25 usable layer.

It is specified that "thermal coefficient of expansion" refers to the coefficient of proportionality of the variation in the length of a solid as a function of the initial length of the solid and of its change of temperature according to the
30 following formula:

$$\Delta L = \alpha L_0 \Delta T, \text{ where } \alpha = \text{thermal coefficient of expansion}$$

In an execution variant, the method described by this document allows the receiving support substrate to be reused after its detachment.

35 The aim of the invention is to further perfect the method described by this document.

Indeed, this type of method has several drawbacks.

Although the thermal treatment preceding and leading to the detachment of the assembly composed of the seed layer and the usable layer in relation to the receiving support is useful in order to reinforce the attachment energy between the seed layer and the support, there is a risk of breaking the substrate in the case where the TCE difference between the materials of the seed layer and of the support is too great.

Furthermore, creasing, dislocations or similar phenomena that damage the seed layer can appear under the cumulative effect of the stress during the post-detachment stabilisation annealing which is normally useful firstly to correct certain defects in the said seed layer and secondly to reinforce the attachment of the seed layer onto the support.

Cracks can also appear in the seed layer if the TCE of the receiving support is greater than that of the seed layer, which then finds itself in tension during the thermal treatment.

Finally, during the detachment of the assembly composed of the seed layer and the usable layer, the rise in temperature causes an irreversible plastic deformation of certain materials. The stresses resulting from this plastic deformation generates a warp in the structure composed of the seed layer and the support, which then prevents the epitaxy or the attachment of the epitaxied structure onto the final support for the definitive transfer.

Thus, the invention aims to reduce the risks, during the different thermal treatments applied to the substrate, of substrate breakage, of damage, of cracking of the seed layer or the appearance of a residual warping of the final substrate, rendering it unusable.

In this regard, a method is proposed for the manufacture of substrates, in particular for the optical, electronic or optoelectronic industries, that includes at least the following stages for the transfer of a seed layer onto a receiving support, and then epitaxy of a usable layer onto the seed layer, which is notable in that the thermal coefficient of expansion of the receiving support is identical to or

slightly greater than the thermal coefficient of expansion of the usable layer, and the thermal coefficient of expansion of the seed layer is appreciably equal to the thermal coefficient of expansion of the receiving support.

5 Thus, during the later thermal treatments to which the structure is subjected, the seed layer and the receiving support will expand in appreciably the same manner.

Preferably, the seed layer is composed of a material whose thermal coefficient of expansion is equal to $(1 \pm \epsilon)$ times
10 that of the receiving support, where ϵ is the order of 0.2, and preferably ϵ is equal to 0.1.

In addition, the receiving support is composed of a material whose thermal coefficient of expansion is 1 to $1 + \epsilon'$ times that of the usable layer, with a typical value of 0.2
15 for ϵ' .

The seed layer and/or the receiving support includes a material that is on the list that includes silicon, germanium, silicon carbide, GaN and sapphire.

In addition, the chemical composition of the seed layer
20 is advantageously identical to that of the receiving support.

Another objective of the invention concerns a composite substrate, in particular for the optical, electronic or optoelectronic areas, that includes at least one seed layer on a receiving support, and a usable epitaxy layer on the seed
25 layer, this being notable in that the thermal coefficient of expansion of the receiving support is identical or slightly greater than the thermal coefficient of expansion of the usable layer, and the thermal coefficient of expansion of the seed layer is appreciably equal to the thermal coefficient of
30 expansion of the receiving support.

Other advantages and characteristics will emerge more clearly from the description that follows of several variants of execution, which are provided by way of non-limiting examples of a method for the manufacture of substrates
35 according to the invention, and of the substrate obtained by the said method, with reference to the appended drawings, in which:

- figure 1 schematically represents stages of one example of implementation of the method according to the invention,

5 - figure 2 schematically represents stages of another example of implementation of the method according to the invention,

With reference to figure 1, the method according to the invention includes a stage for the implantation of atomic species to a specified depth in a donor substrate 1 in order
10 to form a brittle zone 2.

In another stage 100, the donor substrate 1 is attached onto a receiving substrate 3 by any appropriate means.

In the remainder of the document, "attachment" refers to the bringing into intimate contact of the donor substrate 1
15 with the receiving substrate 3 in order to assemble them by molecular adhesion. This attachment can be achieved by different methods:

- bringing into direct contact of a surface of the donor substrate 1 with a surface of the receiving substrate 3,
- 20 - formation of an attachment layer in order to create a junction layer on the surface of the donor substrate 1, formation of an attachment layer in order to create a second junction layer on the surface of the receiving support substrate 3 and bringing into contact the surfaces of the
25 respective junction layers of the donor substrate 1 and the donor substrate 3,
- formation of an attachment layer on only one of the two substrates.

It will be noted that the attachment layer can consist,
30 for example, of an insulating layer or a dielectric layer.

In this particular implementation example of the method according to the invention, the donor substrate 1 is attached to the receiving substrate 3 by means of an attachment layer 4 deposited onto the surface of the donor substrate 1 and/or the
35 receiving substrate 3.

Apart from this, an annealing stage can be included at this stage in order to reinforce the attachment interface

between the attachment layer 4 and the surface of the donor substrate 1 and/or the receiving substrate 3.

However, attachment can also be achieved using any of the methods known to the professional engineer.

5 At stage 200, a seed layer 5 is detached from the donor substrate 1 at the level of the brittle zone 2, and then, at stage 300, a usable layer 6 is deposited onto the surface of the seed layer 5.

10 The usable layer 6 is preferably obtained by epitaxy, which is well known to the professional engineer, at stage 300.

15 The stage for the implantation of atomic species and for detachment 200 of the seed layer 5 corresponds to a method of the Smart CutTM type, for which a general description can be found in the publication entitled "Silicon-On-Insulator Technology: VLSI materials, 2nd Edition" by Jean-Pierre Colinge at "Kluwer Academic Publishers", pp. 50 and 51.

20 The dissociation of the seed layer 5 and the donor substrate 1 is effected by an operation that exists in the list which includes a thermal treatment, application of mechanical stresses and a chemical attack, or a combination of at least two of these operations.

25 The seed layer 5 is composed of a material whose thermal coefficient of expansion is equal to $(1 \pm \epsilon)$ times that of the receiving support 3, where ϵ is of the order of 0.2, and preferably ϵ equals 0.1.

30 It will be seen however that the thermal coefficient of expansion varies not only as a function of the temperature and the defects present within the layers but also of the measurement techniques employed.

35 Thus, during the thermal treatments to which the structure is subjected, in particular during the detachment of the seed layer 5 and the usable layer 6 from the receiving substrate 3, which will be described later in greater detail, the seed layer 5 and the receiving support 3 will expand more-or-less in the same manner.

The receiving support 3, for its part, is composed of a material whose thermal coefficient of expansion is 1 to $1+\epsilon'$ times that of the usable layer 6, where the value of ϵ' is between 0 and 0.8, and preferably between 0.2 and 0.3. This proximity of the coefficients of thermal expansion of the usable layer 6, the seed layer 5 and the receiving support 3 allows one to obtain expansions of the same order of magnitude as the said different layers 5 and 6 and the receiving support 3 during the thermal treatments, thus eliminating any risk of damage to the substrate, or the appearance of a residual warp in the final substrate.

The seed layer 5 and/or the receiving support 3 includes a material that is on the list that includes silicon, such as silicon {111}, germanium, polycrystalline or monocrystalline silicon carbide, GaN, polycrystalline or monocrystalline AlN and sapphire.

In addition, the chemical composition of the seed layer 5 can be identical to that of the receiving support 3.

Apart from this, between the stages for detachment 200 and deposition 300 of the usable layer, the method according to the invention includes stages for preparation of the surface of the seed layer 5. These preparation stages include operations such as polishing, annealing, smoothing annealing, with hydrogen for example, annealing intended to strengthen the attachment interface, sacrificial oxidation (oxidation and then elimination of the oxide material), etching, etc.

Stage 400, leads to the detachment of the assembly composed of the seed layer 5 and the usable layer 6 in relation to the receiving support 3 at the level of the attachment layer 4.

It will be seen that the assembly formed by the seed layer 5 and the usable layer 6 can be detached from the receiving support 3 only if its thickness is equal to or greater than 50 μm , in the case where it is desired to obtain a self-supporting substrate.

In order to perform the detachment, different techniques are available, and in particular the application of

mechanical, thermal, electrostatic stresses, and/or the application of any type of etching (wet, dry, or gaseous chemical etching, etching by plasma, and so on) and/or the application of any type of attack by irradiation; like the
5 laser, for example, or by chemical attack at the level of the attachment layer 4, or similar.

One then obtains firstly the receiving substrate 3, which can be either destroyed or recycled to be reused during the manufacture of a new substrate according to the invention, and
10 secondly a structure composed of the seed layer 5 and the usable layer 6.

It will be noted that in order to perform the detachment of the assembly composed of the seed layer 5 and the usable layer 6 in relation to the receiving support 3 at the level of
15 the attachment layer 4, chemical etching can be used to advantage if the said receiving substrate 3 is to be destroyed. On the other hand, if the receiving substrate 3 is to be recycled for reuse, then it is preferable to use mechanical stress or chemical attack on the attachment layer
20 4, which results in complete detachment.

The seed layer 5 is then eliminated by any appropriate means.

In an execution variant of the method according to the invention, the usable layer 6 is transferred onto a final
25 support substrate 7. This final support 7 includes a material that is on the list that includes the semiconductor materials, such as silicon, germanium, etc., metals such as copper for example, plastic materials and glass.

It will be noted that the structure thus obtained is not
30 subjected to thermal treatment, and the final support substrate 7 can be created from any material that has a thermal coefficient of expansion and/or a lattice parameter different from those of the usable layer 6.

Preferably, the usable layer 6 is transferred onto the
35 final support substrate 7 by attachment, with the attachment being obtained by the application of an attachment layer 8

onto one of the surfaces of the usable layer 6 and/or of the final support substrate 7.

In the same manner as for the choice of the final substrate 7, the attachment techniques employed to this stage
5 are not more limited by the behaviour with temperature or by contamination than by the thermal coefficient of expansion and/or the lattice parameter of the usable layer 6.

The layer 8 used is on the list which includes insulating layers of the SiO_2 , Si_3N_4 type, the organic layers like the
10 polyimides, the conducting metal interfaces and the sealing materials such as palladium silicide Pd_2Si and tungsten silicide WSi_2 , SiAu , PdIn , etc. The conducting interfaces then ensure an effective contact on the rear face of the layer.

Apart from this, structures can be buried in this
15 attachment layer 8 thus enabling creation of the rear junction of a triple junction for the production of solar cells.

This buried structure can, for example, consist of a triple junction based on amorphous silicon of the n-i-p type. This buried structure then includes a lower layer called the
20 rear contact layer composed of a metallisation, such as silver (Ag) or aluminium (Al), on which a transparent conducting oxide has been deposited. This rear contact layer firstly creates an electrical contact which is used to connect the triple-junction solar cell, and secondly a rear mirror which
25 is used to reflect any light that has not been absorbed by the solar cell. The latter is composed of three layers of amorphous silicon, of type n, i and p respectively, deposited successively onto the rear contact layer.

It will be seen that for the manufacture of LEDs, mirrors
30 can also be buried in the attachment layer 8.

According to an execution variant of the method according to the invention, not shown in figure 1, the usable layer 6 and the seed layer 5 are transferred onto the final support substrate 7 prior to elimination of the seed layer 5.

35 According to another preferred variant of execution of the method according to the invention, represented in figure 2, atomic species are implanted, in the same manner as

previously, to a specified depth in a donor substrate 1, in order to form a brittle zone 2, and then in another stage 100, the donor substrate 1 is attached onto a receiving substrate 3 by any appropriate means.

5 At stage 200, a seed layer 5 is detached from the donor substrate 1 at the level of the brittle zone 2, and then at stage 300, a usable layer 6 is deposited onto the surface of the seed layer 5.

10 The dissociation of the seed layer 5 and the donor substrate 1 is effected by an operation that exists in the list which includes thermal treatment, the application of mechanical stresses and chemical attack, or a combination of at least two of these operations.

15 According to a final execution variant, the seed layer 5 is a result of the thinning of the donor substrate using a method of the BESOI type for example before the deposition of the usable layer 6.

 The final support substrate 7 is then transferred onto the usable layer 6 by means of an attachment layer 8.

20 One then applies the stresses that lead to detachment of the structure composed of the seed layer 5, the usable layer 6 the attachment layer 8 and the final support substrate 7 in relation to the receiving support 3 at the level of the attachment layer 4.

25 The result is firstly a receiving substrate 3 ready to be recycled, and secondly a structure composed of the seed layer 5, the usable layer 6, the attachment layer 8 and the final support substrate 7.

30 The seed layer 5 is then eliminated by any appropriate means in order to obtain the final substrate.

 The following is a description of two particular but not limiting examples of the creation of a substrate, obtained according to the invention, with reference to figure 2, intended for the manufacture of solar cells and of
35 electroluminescent diodes respectively.

Example 1

In this example, a brittle zone 2 is created by the implantation of atomic species to a specified depth in the donor substrate 1, created in germanium (Ge), and then the receiving substrate 3, also created in Ge, is attached by means of an attachment layer 4.

This attachment layer 4, preferably created in a nitride or an oxide, is formed on the face of at least one of the donor 1 or receiving 3 substrates.

At stage 200, a seed layer 5 of Ge is detached, whose coefficient of thermal expansion (also expressed as CTE) varies from 4.66 to 6.67 e-6 for temperatures ranging from 25°C to 600°C, from the donor substrate 1 at the level of the brittle zone 2, using the SmartCutTM method as described in the publication entitled "Silicon-On-Insulator Technology: VLSI Materials, 2nd Edition" by Jean-Pierre Colinge at "Kluwer Academic Publishers", pp.50 and 51.

The dissociation of the seed layer 5 and the donor substrate 1 is effected by an operation that exists in the list which includes thermal treatment, application of mechanical stresses and chemical attack, or a combination of at least two of these operations.

In stage 300, one then deposits a usable layer 6 of gallium arsenide onto the surface of the seed layer 5, where the TCE of the AsGa is 5.00 to 7.40 e-6 for temperatures ranging from 25°C to 600°C.

Different layers can be deposited by epitaxy after deposition of the AsGa layer, such as epitaxy layers of InP, AsGa, GaInP, InGaAs, InGaAlP, or InGaAsN for example, in order to form an epitaxial stack with a view to the creation of junctions (triples junctions, quadruple junctions, etc.).

It will be seen that the usable layer 6 has a crystalline quality at least equal to the crystalline quality that can be obtained by epitaxy on a solid substrate of Ge.

The usable layer 6 and the seed layer 5 are then transferred onto a final support substrate 7.

It will be noted that the final support 7 can also be brought into contact with the epitaxial stack if the latter has been created beforehand.

This final support 7 includes a material that is on the list that includes semiconductors (silicon or germanium), plastic materials and glass.

This transfer of the usable layer 6 and the seed layer 5 onto the final support substrate 7 is effected by attachment, with this attachment being obtained by the use of an attachment layer 8 that exists in the list which includes the insulating layers (SiO_2 , Si_3N_4 , etc.), the organic layers (polyimides), the metal layers such as the palladium silicide Pd_2Si and tungsten silicide WSi_2 , and the sealing materials (SiAu , PdIn , etc.)

The final support substrate 7, the seed layer 5 and the usable layer 6 are then detached by any appropriate means, for example at the level of the attachment layer 4, from the receiving support 3 which can thus be advantageously recycled. This detachment can be achieved by the application of stresses at the level of the attachment interface, such as mechanical stresses, thermal stresses, electrostatic stresses and stresses by laser irradiation for example.

Finally, the seed layer is eliminated in order to obtain the final substrate composed of the final support substrate 7, the attachment layer 8 and the usable layer 6 or the epitaxial stack.

Example 2

In this example, a brittle zone 2 is created by the implantation of atomic species to a specified depth in the donor substrate 1 created in solid sapphire whose TCE varies from 4.30 to 9.03 e-6 for temperatures ranging from 25°C to 1000°C.

Implantation consists of the implantation of hydrogen at a rate of between 0.5×10^{17} and 3×10^{17} at/cm², and preferably between 1 and 2×10^{17} at/cm², and at an energy of the order of 20 to 210 keV, and preferably 100 keV.

The receiving substrate 3, also in solid sapphire, is attached by means of an attachment layer 4, where the said attachment layer 4 can reach up to one micron in thickness, thus facilitating later detachment of the receiving support substrate 3 by a lateral chemical attack on this attachment layer 4.

At stage 200, a seed layer 5 of sapphire is detached from the donor substrate 1 at the level of the brittle zone 2 using the Smart CutTM method, and then at stage 300, useful layers 6 are deposited onto the surface of the seed layer 5. These useful layers 6 are deposited by epitaxy, based on GaN, AlN, InGaN, or InN, and their ternary compounds (AlGaN, InGaN, etc.) for example.

The dissociation of the seed layer 5 and the donor substrate 1 is effected by an operation that exists in the list which includes thermal treatment, the application of mechanical stresses, and chemical attack, or a combination of at least two of these operations.

In the same manner as in the previous example, the usable layer 6 and the seed layer 5 are then transferred onto a final support substrate 7 in sapphire or including a material that is on the list that includes silicon, copper, plastic materials and glass.

This transfer of the usable layer 6 and the seed layer 5 onto the final support substrate 7 is effected by attachment, with this attachment being achieved by the use of an attachment layer that exists in the list which includes the insulating layers (SiO_2 , Si_3N_4 , etc.), the organic layers (the polyimides, etc.), the metal layers such as the palladium silicide Pd_2Si and tungsten silicide WSi_2 , and the sealing materials (SiAu , PdIn , etc.).

The final support substrate 7, the seed layer 5 and the usable layer 6 are then detached by any appropriate means, at the level of the attachment layer 4, from the receiving support 3, which can advantageously be recycled.

Finally, it is quite obvious that the examples which have just been described are not limiting in any way regarding the areas of application of the invention.

CLAIMS

1. A method for the manufacture of substrates, in particular for the optical, electronic or optoelectronic areas, that includes at least the following stages:

- transfer of a seed layer (5) onto a receiving support (3), and
- epitaxy of a usable layer (6) onto the seed layer (5),

characterised in that the thermal coefficient of expansion of the receiving support (3) is identical to or slightly greater than the thermal coefficient of expansion of the usable layer (6), and the thermal coefficient of expansion of the seed layer (5) is more-or-less equal to the thermal coefficient of expansion of the receiving support (3).

2. A method according to the preceding claim, characterised in that the seed layer (5) is composed of a material whose thermal coefficient of expansion is equal to $(1 \pm \epsilon)$ times that of the receiving support (3), where ϵ is of the order of 0.2, and preferably ϵ equals 0.1.

3. A method according to either of claims 1 or 2, characterised in that the receiving support (3) is composed of a material whose thermal coefficient of expansion is 1 to $1 + \epsilon'$ times that of the usable layer (6), with a typical value of 0.2 for ϵ' .

4. A method according to any of claims 1 to 3, characterised in that the seed layer (5) and/or the receiving support (3) includes a material that is on the list that includes silicon, germanium, silicon carbide, GaN and sapphire.

5. A method according to any of claims 1 to 4, characterised in that the chemical composition of the seed layer (5) is identical to that of the receiving support (3).

6. A method according to any of claims 1 to 5, characterised in that it includes a stage for the application of stresses and/or etching and/or irradiation that leads to

detachment of the assembly composed of the seed layer (5) and the usable layer (6) in relation to the receiving support (3).

7. A method according to claim 6, characterised in that the stresses applied in order to perform the detachment are
5 chosen from the group that includes the mechanical stresses, the thermal stresses, and the electrostatic stresses.

8. A method according to claim 6, characterised in that the etching applied in order to perform the detachment is
10 chosen from the group that includes dry, wet, and gaseous chemical etching and etching by plasma.

9. A method according to claim 6, characterised in that the irradiation applied in order to perform the detachment is chosen from the group that includes the use of a laser.

10. A method according to any of the preceding claims,
15 characterised in that the seed layer (5) is taken from a donor substrate (1) by thinning of the said substrate (1) after bringing into contact with the receiving support (3).

11. A method according to any of the preceding claims, characterised in that the seed layer (5) is taken from a donor
20 substrate (1), by dissociating the seed layer (5) from the said donor substrate (1) at the level of a previously brittled zone (2).

12. A method according to claim 11, characterised in that the previously brittled zone (2) is created by implanting
25 atomic species into the donor substrate (1) to a depth corresponding to the thickness of the donor substrate (1).

13. A method according to either of claims 11 or 12, characterised in that the dissociation of the seed layer (5) and the donor substrate (1) is effected by an operation that
30 exists in the list which includes thermal treatment, the application of mechanical stresses, and chemical attack, or a combination of at least two of these operations.

14. A method according to any of the preceding claims, characterised in that the usable layer (6) and possibly the
35 seed layer (5) is transferred onto a final support substrate (7).

15. A method according to claim 14, characterised in that the final support (7) includes a material that is on the list that includes the semiconductor materials, the plastic materials, glass and metals.

5 16. A method according to claim 14, characterised in that the final support (7) includes a material that is on the list that includes silicon, germanium, SiC, copper and sapphire.

10 17. A method according to any of claims 14 to 16, characterised in that the usable layer (6) and possibly the seed layer (5) is transferred onto the final support substrate (7) by attachment.

15 18. A method according to claim 15, characterised in that the attachment is achieved by the use of an attachment layer (8) that exists in the list which includes:

- the insulating layers such as the SiO_2 , and Si_3N_4
- the organic layers, such as the polyimides,
- the metallic interfaces,
- the sealing layers such as Pd_2Si , WSi_2 , SiAu , PdIn .

20 19. A method according to any of claims 14 to 16, characterised in that structures are buried in the attachment layer (8).

20. A substrate in particular for the optical, electronic or optoelectronic areas, that includes at least:

- 25
- a seed layer (5) on a receiving support (3), and
 - a usable layer (6) epitaxied onto the seed layer (5),

30 characterised in that the thermal coefficient of expansion of the receiving support (3) is identical to or slightly greater than the thermal coefficient of expansion of the usable layer (6), and the thermal coefficient of expansion of the seed layer (5) is appreciably equal to the thermal coefficient of expansion of the receiving support (3).

35 21. A substrate according to claim 20, characterised in that the seed layer (5) is composed of a material whose thermal coefficient of expansion is equal to $(1 \pm \epsilon)$ times that

of the receiving support (3), where ϵ is of the order of 0.2, and preferably ϵ equals 0.1.

22. A substrate according to either of claims 20 or 21, characterised in that the receiving support (3) is composed of
5 a material whose thermal coefficient of expansion is 1 to $1+\epsilon'$ times that of the usable layer (6), with a typical value of 0.2 for ϵ' .

23. A substrate according to any of claims 20 to 22, characterised in that the seed layer (5) and/or the receiving
10 support (3) includes a material that is on the list that includes silicon, germanium, silicon carbide, GaN and sapphire.

24. A substrate according to any of claims 20 to 23, characterised in that the chemical composition of the seed
15 layer (5) is identical to that of the receiving support (3).

25. A substrate according to any of claims 20 to 24, characterised in that it includes a final support substrate (7) onto which the usable layer (6) and possibly the seed layer (5) is transferred.

20 26. A substrate according to claim 25, characterised in that the final support (7) includes a material that is on the list that includes the semiconductor materials, the plastic materials, glass and metals.

27. A substrate according to claim 25, characterised in
25 that the final support (7) includes a material that is on the list that includes silicon, germanium, SiC, copper and sapphire.

28. A substrate according to claims 23 and 27, characterised in that the receiving support (3) and the final
30 support (7) are created in sapphire.

29. A substrate according to any of claims 20 to 28, characterised in that it includes an attachment layer (8) to attach the usable layer (6) and possibly the seed layer (5) onto the final support substrate (7).

35 30. A substrate according to claim 29, characterised in that the attachment layer (8) exists in the list which includes:

- the insulating layers such as SiO_2 and Si_3N_4
 - the organic layers, such as the polyimides
 - the metallic interfaces
 - the sealing layers such as Pd_2Si , WSi_2 , SiAu , and
- 5 PdIn.