

the monocrystalline silicon layer 13 is transferred to the receiving substrate 2 by detaching the donor substrate along the weakened zone (cf. Figure 1E);

- trenches T are formed around a portion of the stack consisting of the strained silicon-germanium layer 20, the buried oxide layer 11 and the transferred semiconductor layer 13, said trenches extending into the receiver substrate 2 beyond the strained silicon-germanium layer 20 (cf. Figure 1F). Said cutting operation results in the at least partial relaxation of the silicon-germanium and the transmission of at least part of said strain to the transferred silicon layer in said portion, thus allowing the strained semiconductor-on-insulator substrate, denoted by sSOI, to be formed.

For applications beyond the 22 nm technological node, the thickness of the buried dielectric layer should be less than or equal to 25 nm.

For such a low thickness of the dielectric layer, the final defectivity of the sSOI substrate heavily depends on the bonding conditions, and in particular on the materials present at the bonding interface.

However, although surface preparation treatments that are conventionally used in the field of semiconductors are applied to the silicon-germanium layer, a substantial degree of defectivity of the sSOI substrate is still observed.

BRIEF DESCRIPTION OF THE INVENTION

Embodiments of the invention seek to provide a method for fabricating a strained semiconductor-on-insulator substrate that makes it possible to decrease the defectivity of said substrate linked to the conditions of bonding the donor substrate to the receiving layer.

According to an aspect of the invention, a method for fabricating a strained semiconductor-on-insulator substrate comprises:

(a) the provision of a donor substrate comprising a monocrystalline semiconductor layer;

(b) the provision of a receiving substrate comprising a surface layer of a strained monocrystalline semiconductor material;

(c) the bonding of the donor substrate to the receiving substrate, a dielectric layer being at the interface between the monocrystalline semiconductor layer of the donor substrate and the surface layer of the receiving substrate;

(d) the transfer of the monocrystalline semiconductor layer from the donor substrate to the receiving substrate;

(e) the cutting of a portion from a stack formed from the transferred monocrystalline semiconductor layer, from the dielectric layer and from the strained semiconductor material layer, by forming trench isolations extending into said stack beyond the strained semiconductor material layer, said cutting operation resulting in the relaxation of the strain in the strained semiconductor material, and in the application of at least a part of said strain to the transferred monocrystalline semiconductor layer;

- the operation of cutting said portion of the stack is carried out by means of trench isolations extending into the receiving substrate beyond the strained semiconductor material layer.

Another aspect of the invention relates to a strained semiconductor-on-insulator substrate obtained by means of a method such as described above.

Said substrate comprises, in succession, a strained monocrystalline semiconductor layer, an electrically insulating layer, an at least partially relaxed layer of the same material as the strained semiconductor layer, a relaxed layer of a semiconductor material that differs from that of the strained semiconductor layer and a carrier substrate.

Advantageously, the thickness of the electrically insulating layer is less than or equal to 50 nm, preferably less than or equal to 25 nm, and the thickness of the at least partially relaxed layer of the same material as the strained semiconductor layer is between 1 and 20 nm.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will emerge from the detailed description which follows, with reference to the appended drawings in which:

- Figures 1A to 1F schematically illustrate steps of a method for fabricating a strained silicon-on-insulator substrate leading to overly high defectivity;
- Figures 2A to 2G schematically illustrate steps of a method for fabricating a strained semiconductor-on-insulator substrate according to a first embodiment of the invention;
- Figures 3A to 3G schematically illustrate steps of a method for fabricating a strained semiconductor-on-insulator substrate according to a second embodiment of the invention;
- Figures 4A to 4G schematically illustrate steps of a method for fabricating a strained semiconductor-on-insulator substrate according to a third embodiment of the invention;

In order to facilitate the readability of the figures, the various layers are not shown to scale.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

A donor substrate is provided that comprises at least one monocrystalline semiconductor layer. The substrate may be a bulk semiconductor substrate or else a composite substrate, i.e. which consists of at least two layers of different materials including the monocrystalline semiconductor layer which is arranged on the surface of said substrate.

CLAIMS

1. Method for fabricating a strained semiconductor-on-insulator substrate, comprising:

5 (a) the provision of a donor substrate (1) comprising a monocrystalline semiconductor layer (13);

(b) the provision of a receiving substrate (2) comprising a surface layer (20) of a strained monocrystalline semiconductor material;

10 (c) the bonding of the donor substrate (1) to the receiving substrate (2), a dielectric layer (11, 22) being at the interface between the monocrystalline semi-conductor layer (13) of the donor substrate and the surface layer (20) of the receiving substrate;

(d) the transfer of the monocrystalline semiconductor layer (13) from the donor substrate (1) to the receiving substrate (2);

15 (e) the cutting of a portion from a stack formed from the transferred monocrystalline semiconductor layer (13), from the dielectric layer (11, 22) and from the strained semiconductor material layer (20), by forming trench isolations (T) extending into said stack beyond the strained semiconductor material layer (20), said cutting operation resulting in the relaxation of the strain in the strained semiconductor material, and in the application of at least a part of said strain to the transferred monocrystalline
20 semiconductor layer;

said method being characterized in that step (b) additionally comprises the formation, on the strained semiconductor material layer (20) of the receiving substrate (2), of a dielectric bonding layer (22) or of a bonding layer consisting of the same relaxed, or at least partially relaxed, monocrystalline material (23) as the monocrystalline
25 semiconductor layer (13) of the donor substrate (1), and in that in step (c) said bonding layer (22, 23) is at the bonding interface between the donor substrate and the receiving substrate.

30 2. Method according to Claim 1, in which said bonding layer (22) is formed by deposition of a dielectric material on the strained semiconductor material layer (20) of the receiving substrate.

35 3. Method according to Claim 2, in which the donor substrate (1) comprises a first dielectric layer (11) on the monocrystalline semiconductor layer, the first dielectric layer (11) and the bonding layer (22) together forming a buried electrically insulating layer (30) of the strained semiconductor-on-insulator substrate.

4. Method according to either of Claims 2 and 3, in which the bonding layer (22) comprises an oxide or a nitride of a semiconductor material.

15. Method according to one of Claims 1 to 14, in which the operation of cutting said portion of the stack is carried out by means of trench isolations (T) extending into the receiving substrate (2) beyond the strained semiconductor material layer (20).

5 16. Strained semiconductor-on-insulator substrate, comprising successively: a strained monocrystalline semiconductor layer (13), an electrically insulating layer (11), an at least partially relaxed layer (23) of the same material as the strained semiconductor layer (13), a relaxed layer (20) of a semiconductor material that differs from that of the strained semiconductor layer (13) and a carrier substrate (21).

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17. Substrate according to Claim 16, in which the thickness of the electrically insulating layer (11) is less than or equal to 50 nm, preferably less than or equal to 25 nm, and the thickness of the at least partially relaxed layer (23) of the same material as the strained semiconductor layer is between 1 and 20 nm.

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