insensitive to later heat treatments. Said particles may consist of oxygen and/or other materials, excluding metals and semiconductors. These precipitates then form impurity trapping sites.

Document WO 2010/002515 discloses an alternative to the use of an HR silicon-based substrate in the HR-SOI substrates mentioned above, by replacing this bulk base substrate by a structure comprising a thick semiconducting layer with high resistivity on a support with standard resistivity.

To prevent the risk of doping agents or contaminants present in the support diffusing into this highly resistive semiconducting layer and thus reducing its resistivity, it is recommended that a diffusion barrier should be placed between the support and said semiconducting layer. Such a diffusion barrier may consist of one or several layers of silicon oxide and/or silicon nitride and has a thickness of at least 20 nm.

Moreover, this resistive layer can be considered like a substrate due to its high thickness (of the order of 50 to 100 µm).

Substrates for radiofrequency devices are affected by the electric field that, due to the high frequency, penetrates into the substrate and affects any charge carriers that it meets with the consequences firstly of useless energy consumption (called « transmission loss », and secondly it can influence other devices whose behaviour will be modified through the substrate (called the « crosstalk » phenomenon).

Moreover, increasing and decreasing the signal induces a variation in the capacitance of the substrate that causes the generation of waves at harmonic frequencies of the main frequency. These harmonic waves and combinations of them can form parasite signals particularly damaging for radiofrequency applications. The use of a polycrystalline silicon layer blocks the potential under the BOX, thus limiting capacitance variations and therefore reducing the power of the generated harmonic waves.

Finally, the presence of any charges in the BOX and the use of DC voltages by some devices can lead to the creation of an accumulation or inversion layer (therefore highly conducting) under the BOX. The polycrystalline silicon layer eliminates this negative effect by blocking the potential under the BOX.

Embodiments~~Therefore, a first purpose~~ of the invention seek~~is~~ to define a method for manufacturing an HR-SOI type substrate with improved properties for radiofrequency applications.

Embodiments~~Another purpose~~ of the invention also seek~~is~~ to procure an HR-SOI type substrate in or on which components for radiofrequency devices with improved operating characteristics can~~will~~ be manufactured.

BRIEF DESCRIPTION OF THE INVENTION

A first aspect of tThe invention providesdiscloses a method for manufacturing a semiconductor on insulator type substrate for radiofrequency applications, comprising the following steps in sequence:

(a) provision of a silicon substrate with an electrical resistivity of more than 500 Ohm.cm,

(b) formation of a polycrystalline silicon layer on said substrate,

said method being characterised in that it comprisesing a step between steps a) and b) to form a dielectric material layer, different from a native oxide layer, on the substrate, said dielectric material layer being between 0.5 and 10 nm thick,

(c) subjecting the silicon substrate, the dielectric material layer and the polycrystalline silicon layer to a thermal treatment, wherein the dielectric material layer is at least partially dissolved during said thermal treatment.

Advantageously, the method comprises the following steps in sequence after step (b):

(b1e) formation of a dielectric material layer on said polycrystalline silicon layer and/or on a semiconducting material layer of a donor substrate;

(b2d) bonding of the substrate obtained in step (c) on the donor substrate, the dielectric layer(s) formed in step (c) being at the interface;

(b3e) separation of said semiconducting materialthin layer from the donor substrate.

The concentration of doping agents in the polycrystalline silicon layer may beis less than or equal to 10^{16} cm^{-3}, and preferably less than or equal to 10^{14} cm^{-3}.

Furthermore, the polycrystalline silicon layer may beis between 100 and 10000 nm thick, and preferably between 300 and 3000 nm.

According to one preferred embodiment of the invention, the dielectric material formed under the polycrystalline silicon layer is silicon oxide.

A second aspect of tThe invention providesalso relates to a base substrate for the formation of a semiconductor on insulator type substrate comprising a silicon substrate with an electrical resistivity of more than 500 Ohm.cm and a polycrystalline silicon layer, characterised in that it comprises a dielectric material layer, different from a native oxide layer, between the substrate and the polycrystalline silicon layer, between 0.5 and 10 nm thick.

A third aspectAnother purpose of the invention providesis a semiconductor on insulator type substrate for radiofrequency applications, comprising a silicon substrate with an electrical resistivity of more than 500 Ohm.cm, followed successively by a polycrystalline silicon layer, a dielectric material layer, and a monocrystalline semiconducting material layer, characterised in that it comprises a dielectric material layer, different from a native oxide layer, between the substrate and the polycrystalline silicon layer, with a thickness less than or equal to 2 nm, and in that the electrical resistivity of the polycrystalline silicon layer is equal to at least that of the substrate.

The concentration of doping agents in the polycrystalline silicon layer may be~~is~~ less than or equal to 10^{16} cm^{-3}, and is preferably less than or equal to 10^{14} cm^{-3}.

The thickness of the polycrystalline silicon layer may be~~is~~ between 100 and 10000 nm, and preferably between 300 and 3000 nm.

A fourth aspect of the invention provides~~Finally, the invention relates to~~ a radiofrequency device comprising components formed in or on the layer of semiconducting material in a semiconductor on insulator type substrate as defined in the third aspect~~like that described above~~.

BRIEF DESCRIPTION OF THE DRAWINGS

Other characteristics and advantages of the invention will become clear after reading the following description with reference to the appended drawings on which:

- Figure 1 is a diagram of a known HR-SOI type substrate;
- Figure 2 is a graph showing the variation in electrical resistivity as a function of the depth in the substrate, for a substrate according to prior art (a) and a substrate conforming with the invention (b);
- Figure 3 is a diagram of an HR-SOI substrate conforming with the invention;
- Figures 4A to D diagrammatically show steps in the method of manufacturing the HR-SOI substrate conforming with the invention;
- Figure 5 shows photographs of the polycrystalline silicon layer of an HR-SOI substrate according to prior art (a) and an HR-SOI substrate conforming with the invention (b), taken with a transmission electron microscope;
- Figure 6 is a graph showing the variation in electrical resistivity as a function of the depth in the substrate, for a substrate conforming with the invention in which the dielectric layer located under the polycrystalline silicon layer is a silicon oxide layer (b) and for a similar substrate but with a silicon nitride layer (c) instead of the oxide layer;
- Figure 7 is a photograph of the polycrystalline silicon layer of an HR-SOI substrate conforming with the invention in which the dielectric layer is a silicon nitride layer, taken with a transmission electron microscope.

DETAILED DESCRIPTION OF THE INVENTION

Figure 3 shows an example of a semiconductor on insulator HR-SOI type substrate conforming with the invention.

Note that the thicknesses of the various layers are not all shown to the same scale, to make the figures more easily understandable.

CLAIMS

1. Method for manufacturing a semiconductor on insulator type substrate for radiofrequency applications, comprising the following steps in sequence:

(a) provision of a silicon substrate with an electrical resistivity of more than 500 Ohm.cm,

(b) formation of a polycrystalline silicon layer on said substrate,

said method comprising a step between steps a) and b) to form a dielectric material layer, different from a native oxide layer, on the substrate, said dielectric material layer being between 0.5 and 10 nm thick,

(c) subjecting the silicon substrate, the dielectric material layer and the polycrystalline silicon layer to a thermal treatment, wherein the dielectric material layer is at least partially dissolved during said thermal treatment.

2. Method according to claim 1, wherein it comprises the following steps in sequence after step (b):

(b1) formation of a dielectric material layer on said polycrystalline silicon layer and/or on a semiconducting material layer of a donor substrate,

(b2) bonding of the substrate obtained in step (b1) on the donor substrate, the dielectric layer(s) formed in step (b1) being at the interface,

(b3) separation of said semiconducting material layer from the donor substrate.

3. Method according to either claim 1 or 2, wherein the concentration of doping agents in the polycrystalline silicon layer is less than or equal to 10^{16} cm^{-3}, and preferably less than or equal to 10^{14} cm^{-3}.

4. Method according to one of claims 1 to 3, wherein the polycrystalline silicon layer is between 100 and 10000 nm thick, and preferably between 300 and 3000 nm.

5. Method according to one of claims 1 to 4, wherein the dielectric material of layer formed between the substrate and the polycrystalline silicon layer is silicon oxide.

6. Base substrate for the formation of a semiconductor on insulator type substrate comprising a silicon substrate with an electrical resistivity of more than 500 Ohm.cm and a polycrystalline silicon layer, wherein it comprises a dielectric material layer,

different from a native oxide layer, between the substrate and the polycrystalline silicon layer, between 0.5 and 10 nm thick.

7. Semiconductor on insulator type substrate for radiofrequency applications, comprising a silicon substrate with an electrical resistivity of more than 500 Ohm.cm, followed successively by a polycrystalline silicon layer, a dielectric material layer and a monocrystalline semiconducting material layer, wherein it comprises a dielectric material layer, different from a native oxide layer, between the substrate and the polycrystalline silicon layer, with a thickness less than or equal to 2 nm, and in that the electrical resistivity of the polycrystalline silicon layer is equal to at least that of substrate.

8. Substrate according to claim 7, wherein the concentration of doping agents in the polycrystalline silicon layer is less than or equal to 10^{16} cm^{-3}, and is preferably less than or equal to 10^{14} cm^{-3}.

9. Substrate according to either claim 7 or 8, wherein the thickness of the polycrystalline silicon layer is between 100 and 10000 nm, and preferably between 300 and 3000 nm.

10. Radiofrequency device comprising components formed in or on the layer of semiconducting material in a semiconductor on insulator type substrate according to one of claims 7 to 9.