PURPOSE OF THE INVENTION

Embodiments of the invention seek to provide a substrate suitable for radiofrequency applications, remedying all or part of the disadvantages of the prior art.

BRIEF DESCRIPTION OF THE INVENTION

An aspect of the disclosure provides a substrate for microelectronic radiofrequency devices comprising:

a support substrate comprising a first semiconductor material having a resistivity greater than 500 ohms.cm;

a plurality of trenches in the support substrate partially filled with a second material and partially filled with a third material, the third material having a composition different than the second material., the plurality of trenches defining a plurality of first zones on a first side of the first semiconductor material and at least one second zone of a second material, the second material having a resistivity greater than 10 kohms.cm, the plurality of first zones having a maximum lateral dimension of less than 10 microns, the plurality of first zones being isolated from one another by the at least one second zone.

Another aspect of the disclosure provides a method for manufacturing a substrate for microelectronic radiofrequency devices, comprising:

providing a support substrate comprising a first semiconductor material having a resistivity greater than 500 ohms.cm, the support substrate having a first side;

etching, according to a mask, a plurality of trenches extending from the first side of the support substrate to a determined depth within the support substrate;

partially filling the plurality of trenches with a third material; and

filling remainders of the plurality of trenches with a second material to form first zones of a first material and at least one second zone on the first side of the second material, the first zones having a maximum lateral dimension of 10 microns or less, the first zones being insulated from one another by the second zone, the second material having a resistivity greater than 10 kohms.cm, the second material having a composition different than the third material.

Another aspect of the disclosure provides a method for manufacturing a substrate for microelectronic radiofrequency devices, comprising:

providing a support substrate comprising a first semiconductor material having a resistivity greater than 500 ohms.cm;

depositing, according to a mask, a plurality of pillars made from the first material and of a determined height, on the support substrate, an upper surface of the pillars defining a first side of the substrate, the pillars being insulated from each other by a plurality of trenches extending from the first side of the support substrate to a depth within the support substrate defined by the determined height of the pillars;

partially filling the plurality of trenches with a third material; and

filling remainders of the plurality of trenches with a second material to form first zones of the first material and at least one second zone on the first side of the second material, the first zones having a maximum lateral

dimension of 10 microns or less, the first zones being insulated from one another by the at least one second zone, the second material having a resistivity greater than 10 kohms.cm, the second material having a composition different than the third material.

An embodiment of the invention relates to a substrate for radiofrequency microelectronic devices comprising:

- A support substrate made of a first semiconductor material with a resistivity greater than 500 ohm.cm,
- A plurality of trenches in the support substrate, filled with a second material, and defining on a first side of the support substrate, a plurality of first zones of the first material and at least one second zone of the second material.

The substrate is remarkable in that:

- The second material has a resistivity greater than 10 kohms.cm;
- The first zones have a maximum dimension of less than 10 microns and are isolated from one another by the second zone.

The role of the upper part of the substrate according to the invention comprising the trenches filled with the second material is to block the movement of the movable charges which can be generated in the vicinity of the first side of the support substrate so that the latter maintains a high and stable resistivity level.

The restriction on the maximum dimension of the first zones and the insulation of these first zones from one another by at least one second zone made of a highly resistive

material, make it possible to block the movement of potential moving charges in the first zone semiconductor material constituting the support substrate, in the upper part. In this upper part, the charges have to travel a greater distance to pass from one first zone to another first neighbouring zone by bypassing the trenches filled with the second material. The effective resistivity of the substrate is thus increased.

This makes it possible to specifically eliminate the harmful effects of a parasitic conduction in a substrate on which RF devices are made.

According to advantageous features of embodiments of the invention, taken alone or in combination:

- The surface density of the first zones and of the second zone confers on an upper part of the substrate extending from the first side of the support substrate to a depth of the trenches an average thermal conductivity greater than 20 W/m.K, an average dielectric permittivity less than the permittivity of the first material and a resistivity higher than the resistivity of the first material;
- The second zone forms a mesh on the first side of the support substrate;
- The trench depth is between 1 micron and 100 microns;
- The first material constituting the support substrate is silicon;
- The second material filling the trenches is chosen from among a silicon oxide, a silicon nitride, a silicon oxynitride, an aluminium nitride, an amorphous or polycrystalline silicon, a carbon-rich silicon, a polymer or even a gas;

- The plurality of trenches is partially filled with the second material and partially with a third material of nature or composition different from the second material;
- The third material is chosen from among a silicon oxide, a silicon nitride, a silicon oxynitride, an aluminum nitride, an amorphous or polycrystalline silicon, a carbon-rich silicon, a polymer or even a gas;
- The second or the third material has the properties of trapping movable electrical charges that can be generated in the first material;
- The substrate comprises a dielectric layer laid out on the first side of the support substrate;
- The substrate comprises an additional layer between the dielectric layer and the first side of the support substrate, composed of the third material;
- The dielectric layer is made up of a material chosen from a silicon oxide, a silicon nitride, a silicon oxynitride, an aluminum nitride;
- The dielectric layer is composed of the second material;
- The substrate comprises a useful layer laid out on the first side of the support substrate;
- The dielectric layer is sandwiched between the useful layer and the first side of the support substrate;
- The useful layer is composed of a material chosen from semiconducting, insulating or conductive materials or piezoelectric materials.

Another embodiment of the invention relates to a structure of radiofrequency microelectronic devices comprising:

- A substrate such as above;
- A layer of microelectronic devices laid out on the substrate.

According to beneficial features of embodiments of the invention, taken alone or in combination, the microelectronic device is an antenna switch or adaptor or a power amplifier or a low noise amplifier or a passive component or a radiofrequency MEMS component or a radiofrequency filter or another circuit operating at high frequencies.

Another embodiment of the invention further relates to a substrate for radiofrequency microelectronic devices comprising:

- Providing a support substrate made of a first semiconductor material with a resistivity greater than 500 ohm.cm,
- Etching, according to a mask, of a plurality of trenches extending from the first side of the support substrate to a determined depth;
- Filling the plurality of trenches with a second material to form, on the first side, first areas of first material and at least one second zone of the second material;

The method is remarkable in that the first zones, whose maximum dimension is less than 10 microns, are insulated from one another by the second zone whose second material has a resistivity greater than 10 kohms.cm.

Another embodiment of the invention relates to a substrate for radiofrequency microelectronic devices comprising:

- Providing a support substrate made of a first semiconductor material with a resistivity greater than 500 ohms.cm;
- The local coating, according to a mask, of a plurality of pillars formed from the first material and of a given height, on the support substrate; an upper surface of the pillars defining a first side of the substrate and the pillars being insulated from each other by a plurality of trenches extending from the first side of the substrate

CLAIMS

1. A substrate for microelectronic radiofrequency devices comprising:

a support substrate comprising a first semiconductor material having a resistivity greater than 500 ohms.cm;

a plurality of trenches in the support substrate partially filled with a second material and partially filled with a third material, the third material having a composition different than the second material., the plurality of trenches defining a plurality of first zones on a first side of the first semiconductor material and at least one second zone of a second material, the second material having a resistivity greater than 10 kohms.cm, the plurality of first zones having a maximum lateral dimension of less than 10 microns, the plurality of first zones being isolated from one another by the at least one second zone.

2. The substrate of claim 1, wherein a surface density of the plurality of first zones and the at least one second zone confers on an upper part of the substrate extending from the first side of the support substrate to a depth of the plurality of trenches, an average thermal conductivity greater than 20 W/m.K, an average dielectric permittivity lower than the permittivity of the first semiconductor material, and a resistivity higher than the resistivity of the first semiconductor material.

3. The substrate of claim 1, wherein the at least one second zone forms a mesh on the first side of the support substrate.

4. The substrate of claim 1, wherein the depth of the plurality of trenches is between 1 micron and 100 microns.

5. The substrate of claim 1, wherein the first semiconductor material comprises silicon.

6. The substrate of claim 1, wherein the second material partially filling the plurality of trenches is selected from the group consisting of silicon oxide, silicon nitride, silicon oxynitride, aluminum nitride, amorphous or polycrystalline silicon, carbon-rich silicon, a polymer, or a gas.

7. The substrate of claim 1, wherein the third material is located on internal walls defining the plurality of trenches and the second material is located on a side of the third material opposite the first semiconductor material of the support substrate.

8. The substrate of claim 1, wherein the third material is selected from the group consisting of silicon oxide, silicon nitride, silicon oxynitride, aluminum nitride, amorphous or polycrystalline silicon, carbon-rich silicon, a polymer, or a gas.

9. The substrate of claim 1, further comprising a dielectric layer on the first side of the support substrate.

10. The substrate of claim 9, further comprising an additional layer between the dielectric layer and the first

side of the support substrate comprised of a third material.

11. The substrate of claim 9, wherein the dielectric layer comprises a material selected from the group consisting of silicon oxide, silicon nitride, silicon oxynitride, or aluminum nitride.

12. The substrate of claim 9, wherein the dielectric layer is comprised of the second material.

13. The substrate of claim 1, further comprising a useful layer on the first side of the support substrate.

14. The substrate of claim 13, further comprising a dielectric layer on the first side of the support substrate, wherein the dielectric layer is sandwiched between the useful layer and the first side of the support substrate.

15. The substrate of claim 13, wherein the useful layer comprises a material selected from a group consisting of a semiconductor material, an insulating material, a conductive material, or a piezoelectric material.

16. A microelectronic device structure, comprising:
a substrate as recited in claim 1; and
a layer of microelectronic devices on the substrate.

17. The microelectronic device structure of claim 35, wherein at least one of the microelectronic devices comprises an antenna switch, an adaptor, a power amplifier, a low noise amplifier, a passive component, a high

frequency circuit, a radio frequency MEMS component, or a radiofrequency filter.

18. A method for manufacturing a substrate for microelectronic radiofrequency devices, comprising:

providing a support substrate comprising a first semiconductor material having a resistivity greater than 500 ohms.cm, the support substrate having a first side;

etching, according to a mask, a plurality of trenches extending from the first side of the support substrate to a determined depth within the support substrate;

partially filling the plurality of trenches with a third material; and

filling remainders of the plurality of trenches with a second material to form first zones of a first material and at least one second zone on the first side of the second material, the first zones having a maximum lateral dimension of 10 microns or less, the first zones being insulated from one another by the second zone, the second material having a resistivity greater than 10 kohms.cm, the second material having a composition different than the third material.

19. A method for manufacturing a substrate for microelectronic radiofrequency devices, comprising:

providing a support substrate comprising a first semiconductor material having a resistivity greater than 500 ohms.cm;

depositing, according to a mask, a plurality of pillars made from the first material and of a determined height, on the support substrate, an upper surface of the pillars defining a first side of the

substrate, the pillars being insulated from each other by a plurality of trenches extending from the first side of the support substrate to a depth within the support substrate defined by the determined height of the pillars;

partially filling the plurality of trenches with a third material; and

filling remainders of the plurality of trenches with a second material to form first zones of the first material and at least one second zone on the first side of the second material, the first zones having a maximum lateral dimension of 10 microns or less, the first zones being insulated from one another by the at least one second zone, the second material having a resistivity greater than 10 kohms.cm, the second material having a composition different than the third material.