The thermal conductivity of such SOI substrates, since the oxide thickness exceeds about 50 nm, may then be limited by the conductivity of this silicon oxide, of the order of 1 to 2 W/m K, which is insufficient for the intended applications.

According to a second known solution, the components may be produced on a first substrate, for example a silicon substrate, and after the production thereof said components may be transferred onto a final support substrate made of sapphire which is a material having an electrical resistivity of the order of 10^{14}Ohm.cm.

Such an approach is presented for example in document US 6,944,375.

However, sapphire has a thermal conductivity of 30 to 40 W/m K, which is considered to have scope for improvement for the intended applications.

An oxide layer is inserted between the layer supporting the components and the sapphire substrate, to facilitate bonding.

However, as explained above, this oxide layer may form a thermal barrier preventing heat dissipation within the sapphire substrate.

Moreover, sapphire substrates are relatively costly, particularly for diameters larger than 150 mm.

One aim of the present invention is thus of providing a support substrate for a device for radiofrequency or power applications.

More specifically, this support substrate may have both a high electrical resistivity, i.e. greater than 3000 Ohm.cm, and a thermal conductivity at least equally as good as that of silicon (preferably greater than 30 W/m K), while being less costly than sapphire.

This substrate should be suitable for being manufactured to form large wafers, i.e. typically having a diameter greater than 150 mm.

This support substrate should also be suitable for the manufacturing process of the device, and particularly have the required thermal properties (in particularly, in terms of thermal expansion coefficient and temperature resistance) according to the process defined.

BRIEF DESCRIPTION OF THE INVENTION

A first aspect of tThe invention providesrelates to an electronic device for radiofrequency or power applications, comprising a semiconductor layer supporting electronic components

on a support substrate, characterised in that it comprises a bonding layer between the support substrate and the layer supporting the components, said bonding layer consisting of a silicon oxide layer having a thickness of less than 50 nm, a layer of AlN, of alumina or of high-resistivity polycrystalline silicon, and in that the support substrate comprises a base layer having a thermal conductivity of at least 30 W/m K and a superficial layer having a thickness of at least 5 µm, said superficial layer having an electrical resistivity of at least 3000 Ohm.cm and a thermal conductivity of at least 30 W/m K.

Said superficial layer is between the base layer and the semiconductor layer.

According to an embodiment of the invention, the support substrate is a bilayer substrate comprising a superficial layer of AlN, alumina or amorphous diamond-like carbon having a thickness greater than 5 µm on a silicon base substrate.

According to an embodiment of the invention, the support substrate is a silicon substrate comprising a porous surface region having a thickness greater than 5 µm.

According to an embodiment of the invention, the support substrate is an aluminium substrate encased with an AlN or alumina coating having a thickness greater than 5 µm.

According to an embodiment of the invention, the support substrate is a silicon substrate comprising a surface region doped with gold, with a concentration greater than 10^{15} at/cm^3 and having a thickness greater than 5 µm.

The layer supporting the components is preferably made of silicon, germanium or a group III-V alloy.

~~Optionally, a silicon oxide layer having a thickness of less than 50 nm is inserted between the support substrate and the layer supporting the components.~~

Alternatively, a layer of AlN, alumina, amorphous diamond-like carbon or high-resistivity polycrystalline silicon may be inserted between the support substrate and the layer supporting the components.

The device may be a wafer having a diameter greater than or equal to 150 mm.

Alternatively, the device may be a chip.

Another aspect of the invention provides~~Another object of the invention is~~ a process for manufacturing a device for radiofrequency or power applications, comprising a layer supporting electronic components on a support substrate, said process comprising the following successive steps:

a) formation of a structure comprising a semiconductor layer on the support substrate via a bonding layer formed on the semiconductor layer, said bonding layer consisting of a silicon oxide layer having a thickness of less than 50 nm, a layer of AlN, of alumina or of high-resistivity polycrystalline silicon,

(b) manufacture of the components in the semiconductor layer,

characterised in that in step (a), a support substrate comprising a base layer having a thermal conductivity of at least 30 W/m K and a superficial layer having a thickness of at least 5 µm, said superficial layer having an electrical resistivity of at least 3000 Ohm.cm and a thermal conductivity of at least 30 W/m K, is used.

According to an embodiment, the support substrate is a bilayer substrate comprising a layer of AlN, alumina or amorphous diamond-like carbon having a thickness greater than 5 µm on a silicon base substrate.

According to another embodiment, the support substrate is a silicon substrate comprising a porous surface region having a thickness greater than 5 µm.

Another aspect~~object~~ of the invention provides~~is~~ a process for manufacturing a device for radiofrequency or power applications, comprising a layer supporting electronic components on a support substrate, comprising the following successive steps:

(a) manufacturing of the components in a semiconductor layer of a donor substrate,

(b) bonding of the semiconductor layer supporting the components on an intermediate substrate,

(c) removal of the remainder of the donor substrate to transfer the layer supporting the components onto the intermediate layer,

(d) bonding of the layer supporting the components on the support substrate,

(e) removal of the intermediate substrate,

characterised in that a bonding layer being at the interface between the support substrate and the layer supporting the components, said bonding layer consisting of a silicon oxide layer having a thickness of less than 50 nm, a layer of AlN, of alumina or of high-resistivity polycrystalline silicon, and in that, in step (d), a support substrate comprising a base layer having a thermal conductivity of at least 30 W/m K and a superficial layer having a thickness of at least 5 µm, said superficial layer having an electrical resistivity of at least 3000 Ohm.cm and a thermal conductivity of at least 30 W/m K, is used.

According to an embodiment, the support substrate is a bilayer substrate comprising a layer of AlN, alumina or amorphous diamond-like carbon having a thickness greater than 5 µm on a silicon base substrate.

CLAIMS

1. Electronic device for radiofrequency or power applications, comprising a semiconductor layer (2') supporting electronic components on a support substrate (1), characterized in that it comprises a bonding layer (3, 23) between the support substrate (1) and the layer (2') supporting the components, said bonding layer (3, 23) consisting of a silicon oxide layer having a thickness of less than 50 nm, a layer of AlN, of alumina or of high-resistivity polycrystalline silicon, and in that the support substrate (1) comprises a base layer (12) having a thermal conductivity of at least 30 W/m K and a superficial layer (13, 14) having a thickness of at least 5 µm, said superficial layer having an electrical resistivity of at least 3000 Ohm.cm and thermal conductivity of at least 30 W/m K.

2. Electronic device according to claim 1, wherein the support substrate (1) comprises a silicon base substrate (12).

3. Electronic device according to claim 1, wherein the support substrate (1) is an aluminum substrate encased with an AlN or alumina coating having a thickness greater than 5 µm.

4. Device according to claim 1, wherein the layer (2') supporting the components is made of silicon, germanium or a group III-V alloy.

5. Device according to claim 1, wherein it is a wafer having a diameter greater than or equal to 150 mm.

6. Device according to claim 1, wherein it is a chip.

7. Device according to claim 1, wherein the superficial layer is between the base layer and the semiconductor layer.

8. Process for manufacturing a device for radiofrequency or power applications, comprising a layer (2') supporting electronic components on a support substrate (1), comprising the following successive steps :
   a. formation of a structure comprising a semiconductor layer (2) bonded on the support substrate (1) via a bonding layer (3) formed on the semiconductor layer (2), said bonding layer (3) consisting of a silicon oxide layer having a thickness of less than 50 nm, a layer of AlN, of alumina or of high-resistivity polycrystalline silicon,
   b. manufacture of the components in the semiconductor layer (2),

   characterized in that in step (a), a support substrate (1) comprising a base layer (12) having a thermal conductivity of at least 30 W/m K and a

superficial layer (13, 14) having a thickness of at least 5 µm, said superficial layer having an electrical resistivity of at least 3000 Ohm.cm and thermal conductivity of at least 30 W/m K, is used.

9. Process according to claim 8, wherein the support substrate (1) comprises silicon base substrate (12).

10. Process for manufacturing a device for radiofrequency or power applications, comprising a layer (2') supporting electronic components on a support substrate (1), comprising the following successive steps :
    a. manufacture of the components in the semiconductor layer (2) of a donor substrate (20),
    b. bonding the semiconductor layer (2') supporting the components on an intermediate substrate (4),
    c. removal of the remainder (22) of the donor substrate (20) to transfer the layer (2') supporting the components onto the intermediate substrate (4),
    d. bonding of the layer (2') supporting the components on the support substrate (1),
    e. removal of the intermediate substrate (4),

    characterized in that a bonding layer (23) being at the interface between the support substrate (1) and the layer (2') supporting the components, said bonding layer (23) consisting of a silicon oxide layer having a thickness of less than 50 nm, a layer of AlN, of alumina or of high-resistivity polycrystalline silicon, and in that, in step (d), a support substrate (1) comprising a base layer (12) having a thermal conductivity of at least 30 W/m K and a superficial layer (13, 14) having a thickness of at least 5 µm, said superficial layer having an electrical resistivity of at least 3000 Ohm.cm and thermal conductivity of at least 30 W/m K, is used.

11. Process according to claim 10, wherein the support substrate comprises silicon base substrate (12).