

envisionable; nevertheless, the cost of these specific materials combined with that of circuit-transfer technologies is still too high for mass adoption of these solutions.

OBJECT OF THE INVENTION

Embodiments of the invention seek to provide a substrate suitable for radiofrequency applications, which may remedy all or some of the drawbacks of the prior art.

BRIEF DESCRIPTION OF THE INVENTION

An aspect of the invention provides a substrate for radiofrequency microelectronic devices comprising a carrier substrate made of a semiconductor, and a sintered composite layer placed on the carrier substrate and formed from powders of at least a first dielectric and a second dielectric different from the first; said sintered composite layer has a thickness larger than 5 microns and a thermal expansion coefficient that is matched with that of the carrier substrate, to plus or minus 30%.

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

- the sintered composite layer has a thickness comprised between 10 microns and 100 microns;
- the thermal expansion coefficient of the sintered composite layer is matched with that of the carrier substrate, to plus or minus 10%, or even to plus or minus 5%;
- the carrier substrate has a resistivity higher than 500 ohm.cm;
- the carrier substrate is made of silicon;

- the first and second dielectrics are chosen from silicon oxide, silicon nitride, aluminium nitride, alumina, and mullite;
- the substrate comprises a protective layer placed between the carrier substrate and the sintered composite layer;
- the substrate comprises an intermediate layer placed on the sintered composite layer;
- the intermediate layer is a dielectric layer formed from a material chosen from a silicon oxide, a silicon nitride, a silicon oxynitride, and an aluminium nitride;
- the substrate comprises a useful layer placed on the intermediate layer;
- the useful layer is composed of a material chosen from the semiconductors, insulators or conductors, or even the piezoelectrics.

Another aspect of the invention provides a radiofrequency-microelectronic-device structure comprising:

- a substrate such as above;
- a layer of microelectronic devices, which layer is placed on said substrate.

According to advantageous embodiments, the microelectronic device is an antenna adapter or switch or a power amplifier or a low-noise amplifier or a passive component or other circuit operating at high frequency or a radiofrequency MEMS component or even a radiofrequency filter.

Another aspect of the invention provides a process for fabricating a substrate for radiofrequency microelectronic devices, comprising the following steps:

CLAIMS

1. Substrate for radiofrequency microelectronic devices comprising a carrier substrate made of a semiconductor,
5 characterized in that it comprises a sintered composite layer placed on the carrier substrate and formed from powders of at least a first dielectric and a second dielectric different from the first, said sintered composite layer having a thickness larger than 5 microns and a thermal expansion
10 coefficient that is matched with that of the carrier substrate, to plus or minus 30%.
2. Substrate for radiofrequency microelectronic devices according to the preceding claim, wherein the sintered
15 composite layer has a thickness comprised between 10 microns and 100 microns.
3. Substrate for radiofrequency microelectronic devices according to one of the preceding claims, wherein the carrier
20 substrate has a resistivity higher than 500 ohm.cm.
4. Substrate for radiofrequency microelectronic devices according to one of the preceding claims, wherein the carrier
25 substrate is made of silicon.
5. Substrate for radiofrequency microelectronic devices according to one of the preceding claims, wherein the first
and second dielectrics are chosen from silicon oxide, silicon nitride, aluminium nitride, alumina, and mullite.
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6. Substrate for radiofrequency microelectronic devices according to one of the preceding claims, comprising a protective layer placed between the carrier substrate and the sintered composite layer.

7. Substrate for radiofrequency microelectronic devices according to one of the preceding claims, comprising an intermediate layer placed on the sintered composite layer.

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8. Substrate for radiofrequency microelectronic devices according to the preceding claim, wherein the intermediate layer is a dielectric layer formed from a material chosen from a silicon oxide, a silicon nitride, a silicon oxynitride, and an aluminium nitride.

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9. Substrate for radiofrequency microelectronic devices according to one of the two preceding claims, comprising a useful layer placed on the intermediate layer.

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10. Substrate for radiofrequency microelectronic devices according to the preceding claim, wherein the useful layer is composed of a material chosen from the semiconductors, insulators or conductors, or even the piezoelectrics.

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11. Radiofrequency-microelectronic-device structure comprising:

- a substrate according to the preceding claim;
- a layer of microelectronic devices, which layer is placed on said substrate.

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12. Radiofrequency-microelectronic-device structure according to the preceding claim, wherein the microelectronic device is an antenna adapter or switch or a power amplifier or a low-noise amplifier or a passive component or other circuit operating at high frequency or a radiofrequency MEMS component or a radiofrequency filter.

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13. Process for fabricating a substrate for radiofrequency microelectronic devices, characterized in that it comprises the following steps:

a) Providing a carrier substrate made of a semiconductor,
5 having a first side;

b) Depositing a layer formed from a mixture of powders of at least a first dielectric and a second dielectric different from the first, on the first side of the carrier substrate;

10 c) Sintering the layer formed from the mixture of powders in order to obtain a sintered composite layer that is firmly attached to the first side of the carrier substrate and that has a thickness larger than 5 microns; the first dielectric, the second dielectric and the
15 proportion of said dielectrics in the mixture of powders being chosen to give the sintered composite layer a thermal expansion coefficient that is matched with that of the carrier substrate, to plus or minus 30%.

20 14. Process for fabricating a substrate for radiofrequency microelectronic devices according to the preceding claim, wherein the first side of the carrier substrate comprises a protective layer, prior to the deposition of the layer formed from the mixture of powders in step b).

25 15. Process for fabricating a substrate for radiofrequency microelectronic devices according to the preceding claim, wherein the protective layer is formed by at least one material chosen from silicon nitride, silicon oxynitride,
30 and silicon oxide.

16. Process for fabricating a substrate for radiofrequency microelectronic devices according to one of the three preceding claims, wherein the mixture of powders takes the

form of a viscous paste, and the layer formed by said mixture is deposited, in step b), by spin coating.

17. Process for fabricating a substrate for radiofrequency microelectronic devices according to the preceding claim, wherein the deposition of the layer formed by the mixture of powders is followed by a low-temperature heat treatment in order to remove at least one liquid component from the viscous paste.

18. Process for fabricating a substrate for radiofrequency microelectronic devices according to one of the five preceding claims, comprising, after step c), a step d) of bonding a useful layer and the carrier substrate so as to place the sintered composite layer between the useful layer and the carrier substrate.

19. Process for fabricating a substrate for radiofrequency microelectronic devices according to the preceding claim, wherein an intermediate layer is placed between the useful layer and the sintered composite layer.

20. Process for fabricating a substrate for radiofrequency microelectronic devices according to one of the two preceding claims, wherein the useful layer provided for bonding step d) is a donor substrate composed of a material chosen from the semiconductors, insulators or conductors, or even the piezoelectrics.

21. Process for fabricating a substrate for radiofrequency microelectronic devices according to the preceding claim, comprising a step e) of thinning the donor substrate to the thickness desired for the useful layer for the fabrication of the radiofrequency microelectronic devices.