To ensure good adhesion between the thick piezoelectric substrate and the carrier substrate, in particular when the thick piezoelectric substrate has a high level of roughness, the current process requires a large number of steps such as the deposition of multiple oxide layers followed by chemical mechanical polishing (CMP) of said oxide layers, said oxide layers deposited alternately on both faces of the thick piezoelectric substrate in order to avoid substantial bowing that makes bonding impossible.

DISCLOSURE OF THE INVENTION

Embodiments of ~~T~~the present invention aim~~s~~ to overcome these limitations of the prior art by proposing a process for manufacturing a piezoelectric structure for a radiofrequency device, which can also be used to transfer a piezoelectric layer, and a process for transferring such a piezoelectric layer.

An aspect of ~~T~~the invention ~~relates to~~provides a process for manufacturing a piezoelectric structure for a radiofrequency device, said process being characterized in that it comprises providing a substrate of piezoelectric material, providing a carrier substrate, depositing a dielectric bonding layer at a temperature less than or equal to 300°C on a single face of the substrate of piezoelectric material, a step of joining the substrate of piezoelectric material to the carrier substrate by way of the dielectric bonding layer, a thinning step to form the piezoelectric structure comprising a layer of piezoelectric material joined to a carrier substrate.

Thus, the low stress caused by depositing a dielectric bonding layer at low temperature as mentioned above, less than or equal to 300°C, makes it possible to ensure sufficient mechanical stability allowing thinning steps as described in the rest of the description and during the packaging steps used subsequently during the manufacture of components.

In some embodiments, the dielectric bonding layer comprises a layer of silicon oxide deposited on the substrate of piezoelectric material by plasma-assisted chemical vapor deposition.

In advantageous embodiments, the joining step comprises a molecular bonding between the dielectric bonding layer and the carrier substrate or between the dielectric bonding layer and a dielectric bonding layer formed on the carrier substrate.

In advantageous embodiments, there is a bonding interface consolidation anneal at a temperature below the deposition temperature of said dielectric bonding layer.

In advantageous embodiments, the thinning step is performed at a temperature below the deposition temperature of said dielectric bonding layer.

In advantageous embodiments, the substrate of piezoelectric material has a rough surface designed to reflect a radiofrequency wave.

In advantageous embodiments, the thickness of the dielectric bonding layer is between 200 nm and 500 nm.

In advantageous embodiments, a dielectric bonding layer is provided on the carrier substrate.

In advantageous embodiments, the thinning step comprises etching and/or chemical mechanical polishing.

Another aspect of ~~T~~the invention ~~also relates to~~provides a process for transferring a piezoelectric layer to a final substrate, comprising providing a piezoelectric structure obtained by implementing the manufacturing process as ~~claimed in any one of the preceding claims~~described, forming a weakened zone in the layer of piezoelectric

material so as to delimit the piezoelectric layer to be transferred, providing the final substrate, preferably forming dielectric bonding layers on a main face of the final substrate and/or the layer of piezoelectric material, a step of bonding together the layer of piezoelectric material ~~to~~ and the final substrate, a detachment step comprising breaking and separating the piezoelectric structure along the weakened zone, at a temperature less than or equal to the deposition temperature of the dielectric bonding layer.

In advantageous embodiments, the weakened zone is formed by implanting atomic species in the layer of piezoelectric material .

In advantageous embodiments, the final substrate and the carrier substrate have identical coefficients of expansion.

DESCRIPTION OF THE FIGURES

Other features and advantages of the invention will be better understood from reading the detailed description that follows, with reference to the appended drawings, in which:

figure 1 shows a manufacturing process according to one embodiment of the invention and a substrate according to this embodiment of the invention;

figure 2 shows a manufacturing process according to another embodiment of the invention and a substrate according to this other embodiment of the invention;

figure 3 shows a transfer process according to one embodiment of the invention;

figure 4 shows a transfer process according to another embodiment of the invention.

CLAIMS

1. A process for manufacturing a piezoelectric structure ~~(10, 10')~~ for a radiofrequency device, said process being characterized in that it comprises providing a substrate of piezoelectric material ~~(20)~~, providing a carrier substrate ~~(100)~~, depositing a dielectric bonding layer ~~(1001)~~ at a temperature less than or equal to 300°C on a single face of the substrate of piezoelectric material ~~(20)~~, a step of joining ~~(1')~~ the substrate of piezoelectric material ~~(20)~~ to the carrier substrate ~~(100)~~ by way of the dielectric bonding layer ~~(1001)~~, a thinning step ~~(2')~~ to form the piezoelectric structure ~~(10, 10')~~ comprising a layer of piezoelectric material ~~(200)~~ joined to a carrier substrate ~~(100)~~.

2. The process as claimed in the preceding claim, wherein the dielectric bonding layer ~~(1001)~~ comprises a layer of silicon oxide deposited on the substrate of piezoelectric material ~~(20)~~ by plasma-assisted chemical vapor deposition.

3. The process as claimed in either one of the preceding claims, wherein the joining step ~~(1')~~ comprises a molecular bonding between the dielectric bonding layer ~~(1001)~~ and the carrier substrate ~~(100)~~ or between the dielectric bonding layer ~~(1001)~~ and a dielectric bonding layer ~~(1002)~~ formed on the carrier substrate ~~(100)~~.

4. The process as claimed in any one of the preceding claims, further comprising a bonding interface consolidation anneal at a temperature below the deposition temperature of said dielectric bonding layer ~~(1001)~~.

5. The process as claimed in any one of the preceding claims, for which the thinning step ~~(2')~~ is performed at a temperature below the deposition temperature of said dielectric bonding layer ~~(1001)~~.

6. The process as claimed in any one of the preceding claims, wherein the substrate of piezoelectric material ~~(20)~~ has a rough surface designed to reflect a radiofrequency wave.

7. The process as claimed in any one of the preceding claims, wherein the thickness of the dielectric bonding layer ~~(1001)~~ is between 200 nm and 500 nm.

8. The process as claimed in any one of the preceding claims, further comprising providing a dielectric bonding layer ~~(1002)~~ on the carrier substrate ~~(100)~~.

9. The process as claimed in any one of the preceding claims, wherein the thinning step ~~(2')~~ comprises etching and/or chemical mechanical polishing.

10. A process for transferring a piezoelectric layer ~~(200')~~ to a final substrate ~~(300')~~, comprising providing a piezoelectric structure ~~(10, 10')~~ obtained by implementing the manufacturing process as claimed in any one of the preceding claims, forming a weakened zone ~~(0'')~~ in the layer of piezoelectric material ~~(200)~~ so as to delimit the piezoelectric layer ~~(200')~~ to be transferred, providing the final substrate ~~(300')~~, preferably forming dielectric bonding layers ~~(2001, 2002)~~ on a main face of the final substrate ~~(300')~~ and/or the layer of piezoelectric material ~~(200)~~, a step of bonding together ~~(1'')~~ the layer of piezoelectric material ~~(200)~~ and the final substrate ~~(300')~~, a detachment step ~~(2'')~~ comprising breaking and separating the piezoelectric structure ~~(10, 10')~~ along the weakened zone, at a temperature less than or equal to the deposition temperature of the dielectric bonding layer ~~(1001)~~.

11. The process as claimed in the preceding claim, wherein the weakened zone is formed by implanting atomic species in the layer of piezoelectric material ~~(200)~~.

12. The process as claimed in either of claims 10 and 11, wherein the final substrate ~~(300')~~ and the carrier substrate ~~(100)~~ have identical coefficients of expansion.