The present invention is obviating the above mentioned problems.

Summary

In one aspect, the present disclosure refers to a surface acoustic wave device, comprising, a support substrate comprising a functional layer having a thickness below 1 µm, wherein at least a portion of the functional layer has been modified to form a charge trapping layer, a piezoelectric material bonded over a top surface of the support substrate, and wherein the charge trapping layer electrically disconnects or decouples the piezoelectric material from the support substrate and prevents any electrical loss of signals within the functional layer of the support substrate during operation of the surface acoustic wave device.

In another aspect, the present disclosure refers to a method of manufacturing a surface acoustic wave device, comprising, providing a support substrate comprising a functional layer having a thickness below 1 µm, modifying at least a portion of the functional layer to form a charge trapping layer; and bonding a piezoelectric material over a top surface of the support substrate, wherein the charge trapping layer substantially disconnects or decouples the piezoelectric material from the support substrate and prevents any electrical loss of signals within the functional layer of the support substrate during operation of the surface acoustic wave device.

Description of the invention

In particular, the present invention relates to a heterostructure, in particular a piezoelectric structure, comprising a cover layer, in particular a layer of piezoelectric material, the cover layer having a first coefficient of thermal expansion, assembled to a support substrate, the support substrate having a second coefficient of thermal expansion substantially different from the first

coefficient of thermal expansion, at an interface wherein the cover layer comprises at least a recess extending from the interface into the cover layer.

Further advantageous embodiments relate to a heterostructure wherein the at least a recess forms a trench extending over the entire cover layer.

Further advantageous embodiments relate to a heterostructure wherein parts of the cover layer separated by the at least a recess have a lateral extension smaller than a predetermined critical length above which breakage due to a thermal treatment at a predefined temperature would occur.

Further advantageous embodiments relate to a heterostructure wherein the at least a recess extends to the surface of the cover layer opposed to the interface to the support substrate.

Further advantageous embodiments relate to a heterostructure wherein at least one of the coefficients of thermal expansion shows strong anisotropy.

Further advantageous embodiments relate to a heterostructure wherein the material of the cover layer is a piezoelectric material, in particular chosen among LTO, LNO, AlN, ZnO.

CLAIMS

1. A surface acoustic wave device, comprising:

a support substrate comprising a functional layer having a thickness below 1 μm, wherein at least a portion of the functional layer has been modified to form a charge trapping layer;

a piezoelectric material bonded over a top surface of the support substrate; and

wherein the charge trapping layer electrically disconnects or decouples the piezoelectric material from the support substrate and prevents any electrical loss of signals within the functional layer of the support substrate during operation of the surface acoustic wave device.

2. The surface acoustic wave device of claim 1, wherein the piezoelectric material comprises at least one recess extending from an interface between the support substrate and the piezoelectric material into the piezoelectric material.

3. The surface acoustic wave device of claim 2, wherein the at least one recess forms a trench extending over an entire width of a wafer.

4. The surface acoustic wave device of claim 3, wherein the at least one recess extends from the interface between the support substrate and the piezoelectric material entirely through the piezoelectric material to an opposing free surface of the piezoelectric material.

5. The surface acoustic wave device of claim 4, wherein a plurality of the at least one recesses, extending over the entire width of the wafer, separate the piezoelectric material into a plurality of singular piezoelectric islands.

6. The surface acoustic wave device of claim 2, wherein the at least one recess is 1 mm to 2 mm wide.

7. The surface acoustic wave device of claim 2, wherein the at least one recess extends into the piezoelectric material to a depth of between 100 nm to 20 μm.

8. The surface acoustic wave device of claim 1, wherein the piezoelectric material has a thickness below 10 μm.

9. The surface acoustic wave device of claim 8, wherein the piezoelectric material has a thickness below 1 μm.

10. The surface acoustic wave device of claim 9, wherein the piezoelectric material has a thickness below 100 nm.

11. The surface acoustic wave device of claim 1, wherein the piezoelectric material comprises a material selected from the group consisting of: Lithium

Tantalate (LTO), Lithium Niobate (LNO), Aluminum Nitride (AlN), and Zinc Oxide (ZnO).

12. The surface acoustic wave device of claim 11, the piezoelectric material is lithium tantalate.

13. The surface acoustic wave device of claim 1, further comprising a bonding layer between the piezoelectric material and the top surface of the support substrate.

14. The surface acoustic wave device of claim 13, wherein the bonding layer comprises silicon oxide.

15. The surface acoustic wave device of claim 13, wherein the bonding layer comprises two silicon oxide layers deposited on each of the piezoelectric material and the top surface of the support substrate.

16. The surface acoustic wave device of claim 1, wherein the support substrate comprises high-resistivity silicon.

17. The surface acoustic wave device of claim 1, wherein the functional layer has a thickness below 100 nm.

18. A method of manufacturing a surface acoustic wave device, comprising:

providing a support substrate comprising a functional layer having a thickness below 1 μm;

modifying at least a portion of the functional layer to form a charge trapping layer; and

bonding a piezoelectric material over a top surface of the support substrate;

wherein the charge trapping layer substantially disconnects or decouples the piezoelectric material from the support substrate and prevents any electrical loss of signals within the functional layer of the support substrate during operation of the surface acoustic wave device.

19. The method of claim 18, further comprising, forming at least one recess extending from an interface between the support substrate and the piezoelectric material into the piezoelectric material.

20. The method of claim 19, wherein the at least one recess forms a trench extending over an entire width of a wafer.

21. The method of claim 20, wherein the at least one recess extends from the interface between the support substrate and the piezoelectric material entirely through the piezoelectric material to an opposing free surface of the piezoelectric material.

22. The method of claim 21, wherein a plurality of the at least one recesses separate the piezoelectric material into singular piezoelectric islands.

23. The method of claim 18, further comprising forming a bonding layer between the piezoelectric material and the top surface of the support substrate.

24. The method of claim 23, wherein the bonding layer comprises silicon oxide.

25. The method of claim 23, wherein forming the bonding layer comprises depositing a layer of silicon oxide onto each of the piezoelectric material and the top surface of the support substrate, and then bonding each layer of silicon oxide together.

26. The method of claim 18, further comprising, forming the charge trapping layer by introducing a predetermined level of porosity.

27. The method of claim 18, wherein, wherein the charge trapping layer comprises poly-crystalline silicon.