

WHAT IS CLAIMED IS:

1. A surface acoustic wave device comprising:
a quartz substrate;
a piezoelectric film formed from LiTaO_3 or LiNbO_3 and disposed over the quartz substrate;
an interdigital transducer electrode formed over the piezoelectric film;
a bonding layer implemented over the piezoelectric film; and
a cap layer formed over the bonding layer to thereby substantially confine energy of a propagating wave below the cap layer.
2. The acoustic wave device of claim 1 wherein the bonding layer is formed from SiO_2 .
3. The acoustic wave device of claim 1 wherein the cap layer is formed from Si.
4. The acoustic wave device of claim 1 wherein the interdigital transducer electrode is formed directly on an upper surface of the piezoelectric film, and a lower surface of the cap layer is in direct contact with an upper surface of the bonding layer.
5. The acoustic wave device of claim 4 wherein the bonding layer encapsulates the interdigital transducer electrode.
6. The acoustic wave device of claim 4 wherein a volume above the interdigital transducer electrode includes a cavity defined by the upper surface of the piezoelectric film and the lower surface of the cap layer, such that the interdigital transducer electrode is exposed to the cavity.
7. The acoustic wave device of claim 6 wherein the cavity is further defined laterally by a side wall.
8. The acoustic wave device of claim 7 wherein the side wall is formed by a peripheral portion of the bonding layer.

9. The acoustic wave device of claim 7 wherein the side wall is formed by a wall structure at least partially embedded within the bonding layer.

10. The acoustic wave device of claim 9 wherein the wall structure includes one or more trenches filled with SiN, the one or more trenches partially or fully surrounding the cavity.

11. The acoustic wave device of claim 9 wherein the one or more trenches includes a single trench that substantially surrounds the cavity.

12. The acoustic wave device of claim 6 wherein the cap layer defines one or more openings resulting from formation of the cavity.

13. The acoustic wave device of claim 1 further comprising first and second contact pads formed over the piezoelectric film and electrically connected to the interdigital transducer electrode.

14. The acoustic wave device of claim 13 further comprising a conductive via that extends from each of the first and second contact pads to an upper surface of the cap layer.

15. The acoustic wave device of claim 1 further comprising first and second reflectors implemented on the piezoelectric film and positioned on first and second sides of the interdigital transducer electrode.

16. A method for fabricating an acoustic wave device, the method comprising:
forming or providing a piezoelectric layer formed from LiTaO₃ or LiNbO₃;
forming an interdigital transducer electrode over the piezoelectric layer;
implementing a bonding layer over the piezoelectric layer;
bonding a cap layer onto the bonding layer such that the bonding layer is between the cap layer and the piezoelectric layer, the cap layer configured to allow confinement of energy of a propagating wave to a volume below the cap layer; and
thinning the piezoelectric layer to provide a piezoelectric film.

17. The method of claim 16 further comprising attaching a quartz substrate onto the piezoelectric film.

18. The method of claim 17 wherein the piezoelectric layer has first and second surfaces, such that the interdigital transducer electrode is formed on the first surface of the piezoelectric layer, and the bonding layer is implemented on the first surface of the piezoelectric layer.

19. The method of claim 18 wherein the thinning of the piezoelectric layer is performed on the side of the second surface of the piezoelectric layer to result in a new second surface on the piezoelectric film.

20. The method of claim 19 wherein the attaching of the quartz substrate onto the piezoelectric film includes bonding of the quartz substrate onto the new second surface of the piezoelectric film.

21. The method of claim 18 wherein the implementing of the bonding layer results in the bonding layer encapsulating the interdigital transducer electrode.

22. The method of claim 18 wherein the implementing the bonding layer results in a cavity above the interdigital transducer electrode and defined by the first surface of the piezoelectric film and a lower surface of the cap layer, such that the interdigital transducer electrode is exposed to the cavity.

23. The method of claim 22 wherein the cavity is further defined laterally by a side wall.

24. The method of claim 23 wherein the implementing the bonding layer further results in the side wall being formed by a peripheral portion of the bonding layer.

25. The method of claim 23 further comprising embedding a wall structure at least partially within the bonding layer, such that the wall structure forms the side wall of the cavity.

26. The method of claim 18 further comprising forming first and second conductive vias through the cap layer and the bonding layer to provide an electrical connection for each of first and second contact pads associated with the interdigital transducer electrode to a location at or near an upper surface of the cap layer.

27. A radio-frequency filter comprising:
an input node for receiving a signal;
an output node for providing a filtered signal; and
an acoustic wave device implemented to be electrically between the input node and the output node to generate the filtered signal, the acoustic wave device including a quartz substrate, a piezoelectric film formed from LiTaO_3 or LiNbO_3 and disposed over the quartz substrate, and an interdigital transducer electrode formed over the piezoelectric film, the surface acoustic wave device further including a bonding layer implemented over the piezoelectric film, and a cap layer formed over the bonding layer to thereby substantially confine energy of a propagating wave below the cap layer.

28. A radio-frequency module comprising:
a packaging substrate configured to receive a plurality of components;
a radio-frequency circuit implemented on the packaging substrate and configured to support either or both of transmission and reception of signals; and
a radio-frequency filter configured to provide filtering for at least some of the signals, and including a surface acoustic wave device having a quartz substrate, a piezoelectric film formed from LiTaO_3 or LiNbO_3 and disposed over the quartz substrate, and an interdigital transducer electrode formed over the piezoelectric film, the surface acoustic wave device further including a bonding layer implemented over the piezoelectric film, and a cap layer formed over the bonding layer to thereby substantially confine energy of a propagating wave below the cap layer.

29. A wireless device comprising:

a transceiver;

an antenna; and

a wireless system implemented to be electrically between the transceiver and the antenna, the wireless system including a filter configured to provide filtering functionality for the wireless system, the filter including a surface acoustic wave device having a quartz substrate, a piezoelectric film formed from LiTaO_3 or LiNbO_3 and disposed over the quartz substrate, and an interdigital transducer electrode formed over the piezoelectric film, the surface acoustic wave device further including a bonding layer implemented over the piezoelectric film, and a cap layer formed over the bonding layer to thereby substantially confine energy of a propagating wave below the cap layer.