CLAIMS

What is claimed is:

1. A filter comprising:

a plurality of piezoelectric thin film resonators, each having a multilayered film including a lower electrode located on a substrate, a piezoelectric film located on the lower electrode, and an upper electrode located on the piezoelectric film so as to face the lower electrode, wherein

at least two piezoelectric thin film resonators each have a thick film portion in at least a part of an outer peripheral portion of a resonance region, the thick film portion being absent in an inner area of the resonance region that is surrounded by said outer peripheral portion, and the multilayered film in the thick film portion is thicker than the multilayered film in any other areas in the resonance region, the resonance region being defined as a region where the lower electrode and the upper electrode face each other across the piezoelectric film for each of said at least two piezoelectric thin film resonators, and

respective lengths of the thick film portions from edges of the resonance regions are different from each other in the at least two piezoelectric thin film resonators.

2. The filter according to claim 1, wherein

the plurality of piezoelectric thin film resonators include a series resonator that is connected in series between terminals and a parallel resonator that is connected in parallel between the terminals, the series resonator and the parallel resonator forming a ladder-type filter.

3. The filter according to claim 2, wherein

the length of the thick film portion from the edge of the resonance region of the series resonator is different from that of the parallel resonator.

4. The filter according to claim 3, wherein

the filter includes a plurality of the series resonators and/or a plurality of the parallel resonators, and

the lengths of the thick film portions from the edges of the resonance regions are different from each other in the plurality of the series resonators and/or the lengths of the thick film portions from the edges of the resonance regions are different from each other in the plurality of the parallel resonators.

5. The filter according to claim 1, wherein

the piezoelectric film is mainly made of aluminum nitride.

6. The filter according to claim 1, wherein

the piezoelectric film includes an element that increases a piezoelectric constant.

7. The filter according to claim 1, wherein

a space is located below the lower electrode.

8. The filter according to claim 1, wherein

an acoustic reflection film is located below the lower electrode.

9. A duplexer comprising;

the filter according to claim 1 as at least one of a transmission filter and a reception filter.

10. A duplexer comprising:

the filter according to claim 1 as at least one of a transmission filter and a reception filter, wherein

at least one of the transmission filter and the reception filter is a ladder-type filter in which a series resonator and a parallel resonator included in the piezoelectric thin film resonators are connected in a ladder shape,

the length of the thick film portion from the edge of the resonance region of one resonator, which is the series resonator or the parallel resonator so as to contribute to a skirt characteristic at a side of a guard band between a transmission band and a reception band, is longer than that of the other resonator.

11. The duplexer according to claim 10, wherein

the duplexer includes a plurality of the series resonators and/or a plurality of the parallel resonators, and

the lengths of the thick film portions from the edges of the resonance regions are different from each other in resonators that are the plurality of the series resonators or the plurality of the parallel resonators so as to contribute to the skirt characteristic at the side of the guard band.

12. The filter according to claim 1, wherein

a space is located below the lower electrode in the resonance region,

the thick film portion is located over the space.

13. The filter according to claim 1, wherein

an acoustic reflection film is located below the lower electrode in the resonance region,

the thick film portion is located over the acoustic reflection film.

14. The filter according to claim 1, further comprising an additional film that forms the thick film portion, wherein

the upper electrode has an incline portion that is located above an edge of the lower electrode, and

at least a portion of the additional film is located in the incline portion of the upper electrode.

15. The filter according to claim 1, further comprising an additional film that forms the thick film portion, wherein

the additional film is provided continuously from an inside to an outside of the resonance region.

CLAIMS

What is claimed is:

1. A filter comprising:

a plurality of piezoelectric thin film resonators, each having a multilayered film including a lower electrode located on a substrate, a piezoelectric film located on the lower electrode, and an upper electrode located on the piezoelectric film so as to face the lower electrode, wherein

at least two piezoelectric thin film resonators have thick film portions, in each of which the multilayered film is thicker in at least a part of an outer peripheral portion than in an inner portion of a resonance region in which the lower electrode and the upper electrode face each other across the piezoelectric film, and

lengths of the thick film portions from edges of the resonance regions are different from each other in the at least two piezoelectric thin film resonators.

2. The filter according to claim 1, wherein

the plurality of piezoelectric thin film resonators include a series resonator and a parallel resonator, and the series resonator and the parallel resonator are connected in a ladder shape.

3. The filter according to claim 2, wherein

the length of the thick film portion from the edge of the resonance region of the series resonator is different from that of the parallel resonator.

4. The filter according to claim 3, wherein

the filter includes a plurality of the series resonators and/or a plurality of the parallel resonators, and

the lengths of the thick film portions from the edges of the resonance regions are different from each other in the plurality of the series resonators and/or the lengths of the thick film portions from the edges of the resonance regions are different from each other in the plurality of the parallel resonators.

5. The filter according to any one of claims 1 through 4, wherein the piezoelectric film is mainly made of aluminum nitride.

6. The filter according to any one of claims 1 through 5, wherein the piezoelectric film includes an element that increases a piezoelectric constant.

7. The filter according to any one of claims 1 through 6, wherein a space is located below the lower electrode.

8. The filter according to any one of claims 1 through 6, wherein an acoustic reflection film is located below the lower electrode.

9. A duplexer comprising;

the filter according to any one of claims 1 through 8 as at least one of a transmission filter and a reception filter.

10. A duplexer comprising:

the filter according to claim 1 as at least one of a transmission filter and a reception filter, wherein

at least one of the transmission filter and the reception filter is a ladder-type filter in which a series resonator and a parallel resonator included in the piezoelectric thin film resonators are connected in a ladder shape,

the length of the thick film portion from the edge of the resonance region of one resonator, which is the series resonator or the parallel resonator so as to contribute to a skirt characteristic at a side of a guard band between a transmission band and a reception band, is longer than that of the other resonator.

11. The duplexer according to claim 10, wherein

the duplexer includes a plurality of the series resonators and/or a plurality of the parallel resonators, and

the lengths of the thick film portions from the edges of the resonance regions are different from each other in resonators that are the plurality of the series resonators or the plurality of the parallel resonators so as to contribute to the skirt characteristic at the side of the guard band.