CLAIMS

What is claimed is:

1. An acoustic wave device comprising:

a piezoelectric thin film resonator including:

a substrate;

a lower electrode formed on the substrate;

at least two piezoelectric films formed on the lower electrode;

an insulating film sandwiched by the at least two piezoelectric films; and

an upper electrode formed on the at least two piezoelectric films, wherein

an area of the insulating film within a resonance region, in which the lower electrode and the upper electrode face each other across the at least two piezoelectric films, is different from an area of the resonance region.

2. An acoustic wave device comprising:

a piezoelectric thin film resonator including:

a substrate;

a lower electrode formed on the substrate;

at least two piezoelectric films formed on the lower electrode;

an insulating film sandwiched by the at least two piezoelectric films; and

an upper electrode formed on the at least two piezoelectric films, wherein

the insulating film within a resonance region, in which the lower electrode and the upper electrode face each other across the at least two piezoelectric films, has a concave

portion and a convex portion.

3. The acoustic wave device according to claim 1, wherein

the insulating film has a temperature coefficient of elastic constant opposite in sign to a temperature coefficient of elastic constant of the at least two piezoelectric films.

4. The acoustic wave device according to claim 1, wherein

the acoustic wave device includes a plurality of the piezoelectric thin film resonators having area ratios different from each other, the area ratio being a ratio of the area of the insulating film within the resonance region to the area of the resonance region.

5. The acoustic wave device according to claim 4, wherein

the plurality of the piezoelectric thin film resonators include series resonators and parallel resonators of a filter, and

at least one of the series resonators has the area ratio different from the area ratio of at least one of the parallel resonators.

6. The acoustic wave device according to claim 4, wherein

the plurality of the piezoelectric thin film resonators include series resonators and parallel resonators of a filter, and

at least one of the series resonators has the area ratio different from the area ratio of another of the series resonators and/or at least one of the parallel resonators has the area ratio different from the area ratio of another of the parallel resonators.

7. The acoustic wave device according to claim 1, wherein

at least a part of an outer periphery of an uppermost piezoelectric film out of the at least two piezoelectric films in the resonance region is located further in than an outer periphery of the upper electrode.

8. The acoustic wave device according to claim 7, wherein

a space or an acoustic reflection film is located below the lower electrode, and

an outer periphery of the space or an outer periphery of the acoustic reflection film is located further out than the outer periphery of the upper electrode in a region in which the outer periphery of the uppermost piezoelectric film is formed further in than the outer periphery of the upper electrode.

9. The acoustic wave device according to claim 7, wherein

a space is located below the lower electrode, and

an outer periphery of the space is located further out than the outer periphery of the upper electrode, and further in than an outer periphery of a lowermost piezoelectric film in a region in which the outer periphery of the uppermost piezoelectric film is formed further in than the outer periphery of the upper electrode.

10. The acoustic wave device according to claim 1, wherein

the at least two piezoelectric films mainly include aluminum nitride, and the insulating film mainly includes silicon oxide.

11. An acoustic wave device comprising:

a piezoelectric thin film resonator including:

a substrate;

a piezoelectric film located on the substrate;

a lower electrode and an upper electrode that face each other across the piezoelectric film;

a temperature compensation film having a temperature coefficient of elastic constant opposite in sign to a temperature coefficient of elastic constant of the piezoelectric film; and

conductive films formed on an upper surface and a lower surface of the temperature compensation film, and mutually electrically short-circuited, wherein

an area of the temperature compensation film within a resonance region, in which the lower electrode and the upper electrode facing each other across the piezoelectric film, is different from an area of the resonance region.

12. The acoustic wave device according to claim 11, wherein

at least one of the lower electrode and the upper electrode includes at least one of the conductive films.

13. The acoustic wave device according to claim 11, wherein

the temperature compensation film mainly includes silicon oxide or silicon nitride.

14. The acoustic wave device according to claim 11, wherein

the temperature compensation film mainly includes silicon oxide, and additionally includes at least one of F, H, CH_3, CH_2, Cl, C, N, P, and S.

15. The acoustic wave device according to claim 11, wherein

a space is formed between the substrate and the lower electrode in the resonance region.

16. The acoustic wave device according to claim 11, further comprising:

an acoustic reflection film, which reflects an acoustic wave propagated through the piezoelectric film, below the lower electrode in the resonance region.

17. The acoustic wave device according to claim 11, wherein

the temperature compensation film has a tapered side surface so as to have an upper surface with a width smaller than that of a lower surface.

18. The acoustic wave device according to claim 11, wherein

the acoustic wave device includes a plurality of the piezoelectric thin film resonators having area ratios different from each other, where the area ratio is a ratio of the area of the temperature compensation film within the resonance region to the area of the resonance region.

19. The acoustic wave device according to claim 18, further comprising:

a filter including a plurality of the piezoelectric thin film resonators.

20. The acoustic wave device according to claim 19, further comprising:

a duplexer including the filter.

CLAIMS

What is claimed is:

1. An acoustic wave device comprising:

a piezoelectric thin film resonator including:

a substrate;

a lower electrode formed on the substrate;

at least two piezoelectric films formed on the lower electrode;

an insulating film sandwiched by the at least two piezoelectric films; and

an upper electrode formed on the at least two piezoelectric films, wherein

an area of the insulating film within a resonance region, in which the lower electrode and the upper electrode face each other across the at least two piezoelectric films, is different from an area of the resonance region.

2. An acoustic wave device comprising:

a piezoelectric thin film resonator including:

a substrate;

a lower electrode formed on the substrate;

at least two piezoelectric films formed on the lower electrode;

an insulating film sandwiched by the at least two piezoelectric films; and

an upper electrode formed on the at least two piezoelectric films, wherein

the insulating film within a resonance region, in which the lower electrode and

the upper electrode face each other across the at least two piezoelectric films, has a concave portion and a convex portion.

3. The acoustic wave device according to claim 1 or 2, wherein

the insulating film has a temperature coefficient of elastic constant opposite in sign to a temperature coefficient of elastic constant of the at least two piezoelectric films.

4. The acoustic wave device according to any one of claims 1 through 3, wherein

the at least two piezoelectric films are two piezoelectric films, and the insulating film is a single insulating film.

5. The acoustic wave device according to claim 1, wherein

the acoustic wave device includes a plurality of the piezoelectric thin film resonators having area ratios different from each other, the area ratio being a ratio of the area of the insulating film within the resonance region to the area of the resonance region.

6. The acoustic wave device according to claim 2, wherein

the acoustic wave device includes a plurality of the piezoelectric thin film resonators having area ratios different from each other, the area ratio being a ratio of an area of the concave portion within the resonance region to an area of the resonance region.

7. The acoustic wave device according to claim 5 or 6, wherein

the plurality of the piezoelectric thin film resonators include series resonators and

parallel resonators of a filter, and

at least one of the series resonators has the area ratio different from the area ratio of at least one of the parallel resonators.

8. The acoustic wave device according to claim 5 or 6, wherein

the plurality of the piezoelectric thin film resonators include series resonators and parallel resonators of a filter, and

at least one of the series resonators has the area ratio different from the area ratio of another of the series resonators and/or at least one of the parallel resonators has the area ratio different from the area ratio of another of the parallel resonators.

9. The acoustic wave device according to any one of claims 1 through 8, wherein

at least a part of an outer periphery of an uppermost piezoelectric film out of the at least two piezoelectric films in the resonance region is located further in than an outer periphery of the upper electrode.

10. The acoustic wave device according to claim 9, wherein

a space or an acoustic reflection film is located below the lower electrode, and

an outer periphery of the space or an outer periphery of the acoustic reflection film is located further out than the outer periphery of the upper electrode in a region in which the outer periphery of the uppermost piezoelectric film is formed further in than the outer periphery of the upper electrode.

11. The acoustic wave device according to claim 9, wherein

a space is located below the lower electrode, and

an outer periphery of the space is located further out than the outer periphery of the upper electrode, and further in than an outer periphery of a lowermost piezoelectric film in a region in which the outer periphery of the uppermost piezoelectric film is formed further in than the outer periphery of the upper electrode.

12. The acoustic wave device according to any one of claims 1 through 9, wherein

the at least two piezoelectric films mainly include aluminum nitride, and the insulating film mainly includes silicon oxide.

13. An acoustic wave device comprising:

a piezoelectric thin film resonator including:

a substrate;

a piezoelectric film located on the substrate;

a lower electrode and an upper electrode that face each other across the piezoelectric film;

a temperature compensation film having a temperature coefficient of elastic constant opposite in sign to a temperature coefficient of elastic constant of the piezoelectric film; and

conductive films formed on an upper surface and a lower surface of the temperature compensation film, and mutually electrically short-circuited, wherein

an area of the temperature compensation film within a resonance region, in

which the lower electrode and the upper electrode facing each other across the piezoelectric film, is different from an area of the resonance region.

14. The acoustic wave device according to claim 13, wherein

at least one of the lower electrode and the upper electrode includes at least one of the conductive films.

15. The acoustic wave device according to claim 13 or 14, wherein

the temperature compensation film mainly includes silicon oxide or silicon nitride.

16. The acoustic wave device according to claim 13 or 14, wherein

the temperature compensation film mainly includes silicon oxide, and additionally includes at least one of F, H, CH_3, CH_2, Cl, C, N, P, and S.

17. The acoustic wave device according to any one of claims 13 through 16, wherein

the piezoelectric film mainly includes aluminum nitride.

18. The acoustic wave device according to any one of claims 13 through 17, wherein

a space is formed between the substrate and the lower electrode in the resonance region.

19. The acoustic wave device according to any one of claims 13 through 17,

further comprising:

an acoustic reflection film, which reflects an acoustic wave propagated through the piezoelectric film, below the lower electrode in the resonance region.

20. The acoustic wave device according to any one of claims 13 through 19, wherein

the temperature compensation film has a tapered side surface so as to have an upper surface with a width smaller than that of a lower surface.

21. The acoustic wave device according to any one of claims 13 through 20, wherein

the acoustic wave device includes a plurality of the piezoelectric thin film resonators having area ratios different from each other, where the area ratio is a ratio of the area of the temperature compensation film within the resonance region to the area of the resonance region.

22. The acoustic wave device according to claim 21, further comprising:

a filter including a plurality of the piezoelectric thin film resonators.

23. The acoustic wave device according to claim 22, wherein

the filter is a ladder-type filter, and

the plurality of the piezoelectric thin film resonators include a series resonator and a parallel resonator.

24. The acoustic wave device according to claim 23, wherein

a difference in resonance frequency between the series resonator and the parallel resonator is formed with a difference in the area ratio between the series resonator and the parallel resonator.

25. The acoustic wave device according to any one of claims 22 through 24, further comprising:

a duplexer including the filter.