CLAIMS

What is claimed is:

1. An acoustic wave device comprising:

a substrate;

a lower electrode formed on the substrate;

at least two piezoelectric films formed on the lower electrode;

an insulating film located between the at least two piezoelectric films; and

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

wherein outer peripheries of upper and lower surfaces of an uppermost piezoelectric film out of the at least two piezoelectric films in a region in which the lower electrode and the upper electrode face each other are positioned further in than an outer periphery of the upper electrode,

wherein in a region in which the outer peripheries of the upper and lower surfaces of the uppermost piezoelectric film are positioned further in than the outer periphery of the upper electrode, outer peripheries of upper and lower surfaces of a lowermost piezoelectric film out of the at least two piezoelectric films are positioned further out than the outer periphery of the upper electrode; and

wherein no electrode is formed between the lower electrode and the upper electrode.

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

a space or an acoustic reflection film are provided below the lower electrode, and

in the region in which the outer peripheries of the upper and lower surfaces of the uppermost piezoelectric film are positioned further in than the outer periphery of the upper electrode, an outer periphery of the space or an outer periphery of the acoustic reflection film is positioned further out than the outer periphery of the upper electrode.

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

a space is provided below the lower electrode, and

in the region in which the outer peripheries of the upper and lower surfaces of the uppermost piezoelectric film are positioned further in than the outer periphery of the upper electrode, an outer periphery of the space is positioned further out than the outer periphery of the upper electrode, and is positioned further in than the outer peripheries of the upper and lower surfaces of the lowermost piezoelectric film.

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

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

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

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

6. 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.

7. The acoustic wave device according to claim 1, further comprising:

acoustic wave resonators including the acoustic wave device according to claim 1, wherein

the lower electrodes of the acoustic wave resonators are connected to each other, and the lowermost piezoelectric films of the acoustic wave resonators are connected each other and/or the insulating films of the acoustic wave resonators are connected to each other.

8. An acoustic wave device comprising:

a reception filter which outputs a balanced output by a longitudinally coupled double-mode surface acoustic wave filter; and

a transmission filter in which acoustic wave resonators including at least one acoustic wave device according to claim 1 are connected in a ladder shape.

9. An acoustic wave device comprising:

a substrate;

a lower electrode formed on the substrate;

at least two piezoelectric films formed on the lower electrode;

an insulating film located between the at least two piezoelectric films; and

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

wherein an outer periphery of an uppermost piezoelectric film out of the at least two piezoelectric films in a region in which the lower electrode and the upper electrode face each other is positioned further in than an outer periphery of the upper electrode, and

wherein the insulating film is not formed between the upper electrode and the substrate which are located in at least a part of a region in which the upper electrode is formed and the lower electrode is not formed.

CLAIMS

What is claimed is:

1. An acoustic wave device comprising:

a substrate;

a lower electrode formed on the substrate;

at least two piezoelectric films formed on the lower electrode;

an insulating film located between the at least two piezoelectric films; and

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

an outer periphery of an uppermost piezoelectric film out of the at least two piezoelectric films in a region in which the lower electrode and the upper electrode face each other is positioned further in than an outer periphery of the upper electrode.

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

in the region in which the outer periphery of the uppermost piezoelectric film is positioned further in than the outer periphery of the upper electrode, an outer periphery of a lowermost piezoelectric film out of the at least two piezoelectric films is positioned further out than the outer periphery of the upper electrode.

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

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

in the region in which the outer periphery of the uppermost piezoelectric film is positioned further in than the outer periphery of the upper electrode, an outer periphery of the

space or an outer periphery of the acoustic reflection film is positioned further out than the outer periphery of the upper electrode.

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

a space is provided below the lower electrode, and

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

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

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

6. The acoustic wave device according to any one of claims 1 through 5, wherein

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

7. The acoustic wave device according to any one of claims 1 through 6, wherein

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

8. The acoustic wave device according to any one of claims 1 through 7, wherein

the insulating film is not formed between the upper electrode and the substrate which are located in at least a part of a region in which the upper electrode is formed and the lower electrode is not formed.

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

acoustic wave resonators including the acoustic wave device according to any one of claims 1 through 8, wherein

the lower electrodes of the acoustic wave resonators are connected each other, and the lowermost piezoelectric films and/or the insulating films on the lowermost piezoelectric films of the acoustic wave resonators are formed on the lower electrodes connected each other so that they are connected each other.

10. An acoustic wave device comprising:

a reception filter which outputs a balanced output by a longitudinally coupled double-mode surface acoustic wave filter; and

a transmission filter in which acoustic wave resonators including at least one acoustic wave device according to any one of claims 1 through 9 are connected in a ladder shape.