## CLAIMS

1. A transducer, comprising:

a first electrode;

a second electrode disposed over the first electrode such that the first electrode and the second electrode form respective capacitive electrodes of a capacitor, the second electrode comprising a core portion and a peripheral portion;

a third electrode disposed relative to the second electrode such that the third electrode overlaps with the peripheral portion of the second electrode; and

a piezoelectric element disposed between the peripheral portion of the second electrode and the third electrode, so as to tune a tensional force provided by the piezoelectric element onto the second electrode by varying a piezoelectric voltage applied between the second electrode and the third electrode.

2. The transducer of claim 1, wherein the tensional force provided by the piezoelectric element onto the second electrode is in a direction substantially perpendicular to the direction of the piezoelectric voltage applied between the second electrode and the third electrode.

3. The transducer of claim 1 or 2, wherein the tensional force comprises a tensile strain.

4. The transducer of any one of claims 1 to 3, wherein the first electrode and the second electrode are configured to be substantially parallel to each other.

5. The transducer of any one of claims 1 to 4, wherein the second electrode is disposed over the first electrode such that at least a portion of the first electrode and at least a portion of the second electrode are separated by an air gap or vacuum.

6. The transducer of any one of claims 1 to 5, wherein the first electrode is positioned substantially along the same plane as the third electrode.

7. The transducer of claim 6, further comprising a first isolator disposed between the first electrode and the third electrode.

8. The transducer of any one of claims 1 to 7, wherein the first electrode comprises a cross-sectional dimension smaller than the second electrode.

9. The transducer of any one of claims 1 to 5, further comprising a second isolator disposed between the first electrode and the second electrode.

10. The transducer of claim 9, wherein the first electrode comprises a cross-sectional dimension substantially similar to the second electrode.

11. The transducer of claim 9 or 10, wherein each of the first electrode, the second electrode and the third electrode are positioned in substantially different planes.

12. The transducer of any one of claims 1 to 11, wherein the second electrode comprises a vibrating membrane.

13. The transducer of claim 12, wherein the piezoelectric element is disposed between the peripheral portion of the second electrode and the third electrode so as to minimize interference to movement of the second electrode.

14. The transducer of any one of claims 1 to 13, wherein the transducer is configured to perform a capacitive transduction when a capacitive voltage is applied between the first electrode and the second electrode.

15. The transducer of any one of claims 1 to 14, wherein the piezoelectric element comprises a material selected from a group consisting of Aluminum Nitride (AlN), Lead Zironate Titanate (PZT), Polyvinylidene Fluoride (PVDF), and Zinc Oxide (ZnO).

16. The transducer of any one of claims 1 to 15, wherein each of the first electrode, the second electrode and the third electrode comprises a metal selected from a group consisting of Aluminum (Al), Titanium (Ti), Chromium (Cr) and Molybdenum (Mo).

17. The transducer of any one of claims 1 to 16, wherein each of the first electrode, the second electrode and the third electrode comprises doped polycrystalline silicon or single crystalline silicon.

18. The transducer of any one of claims 1 to 17, wherein each of the first isolator and the second isolator comprises a material selected from a group consisting of silicon carbide (SiC) and silicon oxide ($SiO_2$).

19. A transducer, comprising:

a first electrode;

a second electrode disposed over the first electrode such that the first electrode and the second electrode form respective capacitive electrodes of a capacitor, the second electrode comprising a core portion and a peripheral portion; and

a piezoelectric element disposed between the peripheral portion of the second electrode and the first electrode, so as to tune a tensional force provided by the piezoelectric element onto the second electrode by varying a piezoelectric voltage applied between the first electrode and the second electrode.

20. The transducer of claim 19, wherein the second electrode comprises a vibrating membrane.

## CLAIMS

1. A transducer, comprising:

a first electrode;

a second electrode disposed over the first electrode such that the first electrode and the second electrode form respective capacitive electrodes of a capacitor, the second electrode comprising a core portion and a peripheral portion;

a third electrode disposed relative to the second electrode such that the third electrode overlaps with the peripheral portion of the second electrode; and

a piezoelectric element disposed between the peripheral portion of the second electrode and the third electrode, so as to tune a tensional force provided by the piezoelectric element onto the second electrode by varying a piezoelectric voltage applied between the second electrode and the third electrode,

wherein the first electrode is positioned substantially along the same plane as the third electrode.

2. The transducer of claim 1, wherein the tensional force provided by the piezoelectric element onto the second electrode is in a direction substantially perpendicular to the direction of the piezoelectric voltage applied between the second electrode and the third electrode.

3. The transducer of claim 1, wherein the tensional force comprises a tensile strain.

4. The transducer of claim 1, wherein the first electrode and the second electrode are configured to be substantially parallel to each other.

5. The transducer of claim 1, wherein the second electrode is disposed over the first electrode such that at least a portion of the first electrode and at least a portion of the second electrode are separated by an air gap or vacuum.

6. The transducer of claim 1, further comprising an isolator disposed between the first electrode and the third electrode.

7. The transducer of claim 1, wherein the second electrode comprises a vibrating membrane.

8. The transducer of claim 7, wherein the piezoelectric element is disposed between the peripheral portion of the second electrode and the third electrode so as to minimize interference to movement of the second electrode.

9. The transducer of claim 1, wherein the transducer is configured to perform a capacitive transduction when a capacitive voltage is applied between the first electrode and the second electrode.

10. The transducer of claim 1, wherein the piezoelectric element comprises a material selected from a group consisting of Aluminum Nitride (AlN), Lead Zironate Titanate (PZT), Polyvinylidene Fluoride (PVDF), and Zinc Oxide (ZnO).

11. The transducer of claim 1, wherein each of the first electrode, the second electrode and the third electrode comprises a metal selected from a group consisting of Aluminum (Al), Titanium (Ti), Chromium (Cr) and Molybdenum (Mo).

12. The transducer of claim 1, wherein each of the first electrode, the second electrode and the third electrode comprises doped polycrystalline silicon or single crystalline silicon.

13. The transducer of claim 6, wherein the isolator comprises a material selected from a group consisting of silicon carbide (SiC) and silicon oxide ($SiO_2$).

14. A transducer comprising:

a first electrode;

a second electrode disposed over the first electrode such that the first electrode and the second electrode form respective capacitive electrodes of a capacitor, the second electrode comprising a core portion and a peripheral portion;

a third electrode disposed relative to the second electrode such that the third electrode overlaps with the peripheral portion of the second electrode; and

a piezoelectric element disposed between the peripheral portion of the second electrode and the third electrode, so as to tune a tensional force provided by the piezoelectric element onto the second electrode by varying a piezoelectric voltage applied between the second electrode and the third electrode, and

wherein the core portion of the second electrode is free of any piezoelectric element.

15. A transducer, comprising:

a first electrode;

a second electrode disposed over the first electrode such that the first electrode and the second electrode form respective capacitive electrodes of a capacitor, the second electrode comprising a core portion and a peripheral portion; and

a piezoelectric element disposed between the peripheral portion of the second electrode and the first electrode, so as to tune a tensional force provided by the piezoelectric element onto the second electrode by varying a piezoelectric voltage applied between the first electrode and the second electrode.

16. The transducer of claim 14, wherein the first electrode comprises a cross-sectional dimension smaller than the second electrode.

17. The transducer of claim 14, further comprising an isolator disposed between the first electrode and the second electrode.

18. The transducer of claim 17, wherein the first electrode comprises a cross-sectional dimension substantially similar to the second electrode.

19. The transducer of claim 17, wherein each of the first electrode, the second electrode and the third electrode are positioned in substantially different planes.

20. The transducer of claim 15, wherein the second electrode comprises a vibrating membrane.