WHAT IS CLAIMED IS:

1. A semiconductor device, comprising:

a substrate;

a bottom electrode on the substrate,

the bottom electrode including a first part including a plurality of protrusions that protrude outward from a sidewall of the first part, and

a top surface of the bottom electrode being flat;

a first support layer on the substrate next to a sidewall of the bottom electrode, the first part of the bottom electrode being on the first support layer;

a second support layer on the sidewall of the bottom electrode, the second support layer on the first support layer,

a dielectric layer covering the sidewall of the bottom electrode and a top surface of the bottom electrode; and

a top electrode on the dielectric layer,

wherein the sidewall of the first part extends to contact the second support layer.

2. The semiconductor device of claim 1, wherein

the first part includes a lower segment and an upper segment,

the lower segment is between the first support layer and the second support layer,

the upper segment is on the lower segment, and

the plurality of protrusions are along a sidewall of the lower segment.

3. The semiconductor device of claim 2, wherein a sidewall of the upper segment is flat.

4. The semiconductor device of any one of claims 1 to 3, wherein

the sidewall of the bottom electrode has a concave segment that is recessed from the top surface of the bottom electrode, and

the concave segment is at an upper corner of the bottom electrode.

5. The semiconductor device of any one of claims 1 to 4, wherein

the bottom electrode further includes a second part under the first part, and

a sidewall of the second part is flat.

6. The semiconductor device of any one of claims 1 to 4, wherein

the bottom electrode further includes a second part under the first support layer, and

a sidewall of the second part is perpendicular to a top surface of the substrate.

7. The semiconductor device of any one of claims 1 to 6, wherein the plurality of protrusions have convexly curved surfaces.

8. The semiconductor device of any one of claims 1 to 7, wherein a shape of the bottom electrode is one of cylindrical, pillar, or U shape.

9. The semiconductor device of claim 1, wherein

a top surface of the second support layer is located at a same level as a level of the top surface of the bottom electrode.

10. The semiconductor device of any one of claims 1 to 9, wherein the plurality of protrusions are spaced apart from the first support layer.

11. The semiconductor device of any one of claims 1 to 10, wherein the plurality of protrusions are spaced apart from each other in a direction perpendicular to a top surface of the substrate.

12. The semiconductor device of any one of claims 1 to 11, wherein the plurality of protrusions have different sizes from each other.

13. The semiconductor device of any one of claims 1 to 12, wherein a vertical thickness of each of the plurality of protrusions is 3 nm to 7 nm.

14. A semiconductor device, comprising:

a substrate;

a bottom electrode on the substrate,

the bottom electrode including a plurality of protrusions that protrude outward from a sidewall of the bottom electrode,

a top surface of the bottom electrode being flat, and

the plurality of protrusions having convexly curved surfaces;

a first support layer and a second support layer on the substrate next to the sidewall of the bottom electrode;

a dielectric layer covering a surface of the bottom electrode; and

a top electrode on the dielectric layer,

wherein the sidewall of the bottom electrode extends to contact the second support layer.

15. The semiconductor device of claim 14, wherein

the bottom electrode includes a plurality of vertical segments and a horizontal segment between the plurality of vertical segments,

the plurality of vertical segments extend in parallel along a vertical direction from a top surface of the substrate,

the plurality of protrusions are on outer sidewalls of the plurality of vertical segments, and

inner sidewalls of the plurality of vertical segments are flat.

16. The semiconductor device of claim 14, wherein

the plurality of protrusions are between the first support layer and the second support layer.

17. A semiconductor device, comprising:

a substrate;

a plurality of bottom electrodes on the substrate,

each of the plurality of bottom electrodes including a sidewall, a plurality of protrusions that protrude outward from the sidewall, and a plurality of first parts that are between the plurality of protrusions and vertically spaced apart from each other,

the plurality of bottom electrodes including a first bottom electrode and a second bottom electrode, and

distances between the plurality of first parts of the first bottom electrode and the plurality of first parts of the second bottom electrode being uniform;

a first support layer on the substrate next to sidewalls of the plurality of bottom electrodes;

a second support layer on the first support layer;

a dielectric layer covering surfaces of the first bottom electrode and the second bottom electrode; and

a top electrode on the dielectric layer,

wherein top surfaces of the plurality of bottom electrodes are flat, and

the sidewalls of the plurality of bottom electrodes extend to contact the second support layer.

18. The semiconductor device of claim 17, wherein the plurality of protrusions have convexly curved surfaces.

19. The semiconductor device of claim 17 or claim 18,

wherein the plurality of protrusions are between the first support layer and the second support layer.

20. The semiconductor device of any one of claims 17 to 19, wherein the top electrode conformally covers a surface of the dielectric layer.