CLAIMS

1. A semiconductor device comprising:

a first gate electrode extending in a first direction;

a first gate insulating film covering a top surface and side surfaces of the first gate electrode;

an oxide semiconductor film covering the first gate electrode with the first gate insulating film interposed between the top surface of the first gate electrode and the oxide semiconductor film and between the side surfaces of the first gate electrode and the oxide semiconductor film;

a second gate insulating film covering the oxide semiconductor film; and

a second gate electrode over the second gate insulating film, the second gate electrode extending in a second direction perpendicular to the first direction.

2. The semiconductor device according to claim 1, further comprising a source electrode and a drain electrode electrically connected to the oxide semiconductor film through an opening in the second gate insulating film.

3. The semiconductor device according to claim 1,

wherein the oxide semiconductor film comprises a channel formation region and a pair of low-resistance regions, and

wherein the second gate electrode overlaps with the channel formation region.

4. The semiconductor device according to claim 1, further comprising an insulating film over the second gate insulating film and the second gate electrode.

5. The semiconductor device according to claim 1, further comprising a capacitor, the capacitor comprising:

a lower electrode film comprising the same material as the first gate electrode; and

an upper electrode film comprising the same material as the second gate electrode.

6. The semiconductor device according to claim 5,

wherein the capacitor comprises an insulating film between the lower electrode film and the upper electrode film, and

wherein the insulating film comprises the same material as the first gate insulating film or the second gate insulating film.

7. The semiconductor device according to claim 5, wherein a height of the lower electrode film is larger than a width of the lower electrode film.

8. A semiconductor device comprising:

a first gate electrode extending in a first direction;

a first gate insulating film covering a top surface and side surfaces of the first gate electrode;

an oxide semiconductor film covering the first gate electrode with the first gate insulating film interposed between the top surface of the first gate electrode and the oxide semiconductor film and between the side surfaces of the first gate electrode and the oxide semiconductor film;

a source electrode and a drain electrode covering part of the oxide semiconductor film;

a second gate insulating film covering part of the oxide semiconductor film, the source electrode, and the drain electrode; and

a second gate electrode over the second gate insulating film, the second gate electrode extending in a second direction perpendicular to the first direction.

9. The semiconductor device according to claim 8, wherein the second gate electrode is provided between the source electrode and the drain electrode.

10. The semiconductor device according to claim 8, further comprising an insulating film over the second gate insulating film and the second gate electrode.

11. The semiconductor device according to claim 8, further comprising a capacitor, the capacitor comprising:

a lower electrode film comprising the same material as the first gate electrode; and

an upper electrode film comprising the same material as the second gate electrode.

12. The semiconductor device according to claim 11,

wherein the capacitor comprises an insulating film between the lower electrode film and the upper electrode film, and

wherein the insulating film comprises the same material as the first gate insulating film or the second gate insulating film.

13. The semiconductor device according to claim 11, wherein a height of the lower electrode film is larger than a width of the lower electrode film.

14. A method for manufacturing a semiconductor device, comprising the steps of:

forming a first gate electrode in a first direction;

forming a first gate insulating film covering a top surface and side surfaces of the first gate electrode;

forming an oxide semiconductor film covering the first gate electrode with the first gate insulating film interposed between the top surface of the first gate electrode and the oxide semiconductor film and between the side surfaces of the first gate electrode and the oxide semiconductor film;

forming a second gate insulating film covering the oxide semiconductor film; and

forming a second gate electrode over the second gate insulating film, the second gate electrode extending in a second direction perpendicular to the first direction.

15. The method for manufacturing a semiconductor device according to claim 14, further comprising the step of forming a source electrode and a drain electrode electrically connected to the oxide semiconductor film through an opening in the second

gate insulating film.

16. The method for manufacturing a semiconductor device according to claim 14, further comprising the step of forming a source electrode and a drain electrode, wherein the second gate electrode is provided between the source electrode and the drain electrode.

17. The method for manufacturing a semiconductor device according to claim 14,

wherein the semiconductor device comprises a capacitor comprising a lower electrode film and an upper electrode film,

wherein the lower electrode film is formed in the same step as forming the first gate electrode, and

wherein the upper electrode film is formed in the same step as forming the second gate electrode.

18. The method for manufacturing a semiconductor device according to claim 17,

wherein the capacitor comprises an insulating film between the lower electrode film and the upper electrode film, and

wherein the insulating film comprises the same material as the first gate insulating film or the second gate insulating film.

19. The method for manufacturing a semiconductor device according to claim 17, wherein a height of the lower electrode film is larger than a width of the lower electrode film.

CLAIMS

1. A semiconductor device comprising:

a first gate electrode over a surface of a substrate, the first gate electrode extending in a first direction parallel to the surface of the substrate;

a first gate insulating film covering a top surface and side surfaces of the first gate electrode;

an oxide semiconductor film covering the first gate electrode with the first gate insulating film interposed between the top surface of the first gate electrode and the oxide semiconductor film and between the side surfaces of the first gate electrode and the oxide semiconductor film;

a second gate insulating film covering the oxide semiconductor film; and

a second gate electrode over the second gate insulating film, the second gate electrode extending in a second direction parallel to the surface of the substrate,

wherein the second direction is substantially perpendicular to the first direction.

2. The semiconductor device according to claim 1, further comprising an insulating film over the second gate insulating film and the second gate electrode.

3. The semiconductor device according to claim 1, further comprising a capacitor, the capacitor comprising:

a lower electrode film comprising the same material as the first gate

electrode; and

an upper electrode film comprising the same material as the second gate electrode.

4. The semiconductor device according to claim 3,

wherein the capacitor comprises an insulating film between the lower electrode film and the upper electrode film, and

wherein the insulating film comprises the same material as the first gate insulating film or the second gate insulating film.

5. The semiconductor device according to claim 3, wherein a height of the lower electrode film is larger than a width of the lower electrode film.

6. A semiconductor device comprising:

a first gate electrode over a surface of a substrate, the first gate electrode extending in a first direction parallel to the surface of the substrate;

a first gate insulating film covering a top surface and side surfaces of the first gate electrode;

an oxide semiconductor film covering the first gate electrode with the first gate insulating film interposed between the top surface of the first gate electrode and the oxide semiconductor film and between the side surfaces of the first gate electrode and the oxide semiconductor film;

a source electrode and a drain electrode electrically connected to the oxide semiconductor film;

a second gate insulating film covering the oxide semiconductor film, the source electrode, and the drain electrode; and

a second gate electrode over the second gate insulating film, the second gate electrode extending in a second direction parallel to the surface of the substrate,

wherein the second direction is substantially perpendicular to the first direction.

7. The semiconductor device according to claim 6, wherein the second gate electrode is provided between the source electrode and the drain electrode.

8. The semiconductor device according to claim 6, further comprising an insulating film over the second gate insulating film and the second gate electrode.

9. The semiconductor device according to claim 6, further comprising a capacitor, the capacitor comprising:

a lower electrode film comprising the same material as the first gate electrode; and

an upper electrode film comprising the same material as the second gate electrode.

10. The semiconductor device according to claim 9,

wherein the capacitor comprises an insulating film between the lower

electrode film and the upper electrode film, and

wherein the insulating film comprises the same material as the first gate insulating film or the second gate insulating film.

11. The semiconductor device according to claim 9, wherein a height of the lower electrode film is larger than a width of the lower electrode film.

12. A semiconductor device comprising:

a first gate electrode over a surface of a substrate, the first gate electrode extending in a first direction parallel to the surface of the substrate;

an oxide semiconductor film covering a top surface and side surfaces of the first gate electrode, the oxide semiconductor film extending in the first direction as a channel length direction;

a source electrode and a drain electrode electrically connected to the oxide semiconductor film; and

a second gate electrode over the oxide semiconductor film, the second gate electrode extending in a second direction parallel to the surface of the substrate,

wherein the second direction is substantially perpendicular to the first direction.

13. The semiconductor device according to claim 12, further comprising an insulating film over the second gate electrode.

14. The semiconductor device according to claim 12, further comprising a capacitor, the capacitor comprising:

a lower electrode film comprising the same material as the first gate electrode; and

an upper electrode film comprising the same material as the second gate electrode.

15. The semiconductor device according to claim 14,

wherein the capacitor comprises an insulating film between the lower electrode film and the upper electrode film.

16. The semiconductor device according to claim 14, wherein a height of the lower electrode film is larger than a width of the lower electrode film.

17. The semiconductor device according to claim 12, wherein the second direction is a channel width direction.