CLAIMS

1. A semiconductor device comprising:

an insulating film;

an oxide semiconductor film over and in contact with the insulating film;

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

a gate electrode adjacent to the oxide semiconductor film,

wherein the insulating film includes silicon and oxygen,

wherein the oxide semiconductor film includes a first region in contact with the insulating film, and

wherein a concentration of silicon in the first region is lower than or equal to 1.0 at.%.

2. The semiconductor device according to claim 1, wherein the gate electrode is located below the oxide semiconductor film with the insulating film interposed therebetween.

3. The semiconductor device according to claim 2, further comprising a channel protective film over the gate electrode.

4. The semiconductor device according to claim 2, further comprising a protective insulating film which includes silicon and oxygen, wherein the protective insulating film covers the oxide semiconductor film, the source electrode and the drain electrode.

5. The semiconductor device according to claim 1,

wherein a thickness of the first region is 5 nm, and

wherein a concentration of silicon included in a region other than the first region of the oxide semiconductor film is lower than the concentration of silicon included in the first region.

6. The semiconductor device according to claim 1, wherein the concentration of silicon included in the first region is lower than or equal to 0.1 at.%.

7. The semiconductor device according to claim 1,

wherein the insulating film includes carbon, and

wherein a concentration of carbon in the first region is lower than or equal to 1.0×10^{20} atoms/cm^3.

8. The semiconductor device according to claim 1, wherein the oxide semiconductor film has crystallinity.

9. The semiconductor device according to claim 1, wherein the oxide semiconductor film has an amorphous structure.

10. The semiconductor device according to claim 9, wherein the oxide semiconductor film includes a crystal portion.

11. A semiconductor device comprising:

a first insulating film;

an oxide semiconductor film over and in contact with the first insulating film;

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

a gate electrode adjacent to the oxide semiconductor film; and

a second insulating film over and in contact with the oxide semiconductor film,

wherein the first insulating film includes silicon and oxygen,

wherein the oxide semiconductor film includes a first region in contact with the first insulating film,

wherein a thickness of the first region is 5 nm,

wherein a concentration of silicon in the first region is lower than or equal to 1.0 at.%,

wherein the second insulating film includes silicon and oxygen,

wherein the oxide semiconductor film includes a second region in contact with the second insulating film,

wherein a thickness of the second region is 5 nm,

wherein a concentration of silicon in the second region is higher than 1.0 at.%, and

wherein a concentration of silicon included in a region other than the first region and the second region of the oxide semiconductor film is lower than the concentration of silicon included in the first region.

12. The semiconductor device according to claim 11, wherein the gate electrode is located below the oxide semiconductor film with the first insulating film interposed therebetween.

13. The semiconductor device according to claim 12, wherein the second insulating film is a channel protective film.

14. The semiconductor device according to claim 12, wherein the second insulating film is a protective insulating film that covers the oxide semiconductor film, the source electrode and the drain electrode.

15. The semiconductor device according to claim 11, wherein the concentration of silicon included in the first region is lower than or equal to 0.1 at.%.

16. The semiconductor device according to claim 11,

wherein the first insulating film includes carbon, and

wherein a concentration of carbon in the first region is lower than or equal to 1.0×10^{20} atoms/cm^3.

17. The semiconductor device according to claim 11, wherein the oxide semiconductor film has crystallinity.

18. The semiconductor device according to claim 11, wherein the oxide semiconductor film has an amorphous structure.

19. The semiconductor device according to claim 18, wherein the oxide semiconductor film includes a crystal portion.

CLAIMS

1. A semiconductor device comprising:

a first insulating layer;

an oxide semiconductor layer over and in contact with the first insulating layer;

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

a gate electrode adjacent to the oxide semiconductor layer; and

a second insulating layer over and in contact with the oxide semiconductor layer,

wherein the first insulating layer includes silicon and oxygen,

wherein the oxide semiconductor layer includes a first region in contact with the first insulating layer,

wherein a thickness of the first region is 5 nm,

wherein a concentration of silicon in the first region is lower than or equal to 1.0 at. %,

wherein the second insulating layer includes silicon and oxygen,

wherein the oxide semiconductor layer includes a second region in contact with the second insulating layer,

wherein a thickness of the second region is 5 nm,

wherein a concentration of silicon in the second region is higher than 1.0 at. %,

wherein the oxide semiconductor layer includes a third region between the first region and the second region, and

wherein a concentration of silicon in the third region is lower than the concentration of silicon in the first region.

2. The semiconductor device according to claim 1, wherein the gate electrode is located below the oxide semiconductor layer with the first insulating layer interposed therebetween.

3. The semiconductor device according to claim 2, wherein the second insulating layer is a channel protective layer.

4. The semiconductor device according to claim 2, wherein the second insulating layer is a protective insulating layer that covers the oxide semiconductor layer, the source electrode and the drain electrode.

5. The semiconductor device according to claim 1, wherein the concentration of silicon included in the first region is lower than or equal to 0.1 at. %.

6. The semiconductor device according to claim 1,

wherein the first insulating layer includes carbon, and

wherein a concentration of carbon in the first region is lower than or equal to 1.0×10^{20} atoms/cm^3.

7. The semiconductor device according to claim 1, wherein the oxide semiconductor layer has crystallinity.

8. The semiconductor device according to claim 1, wherein the oxide semiconductor layer has an amorphous structure.

9. The semiconductor device according to claim 8, wherein the oxide semiconductor layer includes a crystal portion.

10. A semiconductor device comprising:

a first insulating layer;

an oxide semiconductor layer over and in contact with the first insulating layer;

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

a gate electrode adjacent to the oxide semiconductor layer; and

a second insulating layer over and in contact with the oxide semiconductor layer,

wherein the first insulating layer includes silicon,

wherein the oxide semiconductor layer includes a first region,

wherein a concentration of silicon in the first region is lower than or equal to 1.0 at. %,

wherein the second insulating layer includes silicon,

wherein the oxide semiconductor layer includes a second region,

wherein the concentration of silicon in the first region is lower than a concentration of silicon in the second region,

wherein the oxide semiconductor layer includes a third region between the first region and the second region, and

wherein a concentration of silicon in the third region is lower than the concentration of silicon in the first region.

11. The semiconductor device according to claim 10, wherein the gate electrode is located below the oxide semiconductor layer with the first insulating layer interposed therebetween.

12. The semiconductor device according to claim 11, wherein the second insulating layer is a channel protective layer.

13. The semiconductor device according to claim 11, wherein the second insulating layer is a protective insulating layer that covers the oxide semiconductor layer, the source electrode and the drain electrode.

14. The semiconductor device according to claim 10, wherein the concentration of silicon included in the first region is lower than or equal to 0.1 at. %.

15. The semiconductor device according to claim 10,

wherein the first insulating layer includes carbon, and

wherein a concentration of carbon in the first region is lower than or equal to 1.0×10^{20} atoms/cm^3.

16. The semiconductor device according to claim 10, wherein the oxide semiconductor layer has crystallinity.

17. The semiconductor device according to claim 10, wherein the oxide semiconductor layer has an amorphous structure.

18. The semiconductor device according to claim 17, wherein the oxide semiconductor layer includes a crystal portion.