CLAIMS

1. A semiconductor device comprising:

an insulating film;

an oxide semiconductor film provided to be 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,

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

wherein at least the first region includes a crystal portion.

2. The semiconductor device according to claim 1,

wherein the first region has a thickness less than or equal to 5 nm, and

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

3. The semiconductor device according to claim 1, wherein a crystal portion is included in a region in the oxide semiconductor film other than the first region.

4. The semiconductor device according to claim 1, wherein a c-axis in the crystal portion is aligned in a direction perpendicular to an interface between the oxide semiconductor film and the insulating film.

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 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.

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

8. A semiconductor device comprising:

a gate electrode;

a gate insulating film covering the gate electrode;

an oxide semiconductor film provided to be in contact with the gate insulating film and overlap with at least the gate electrode;

a channel protective film provided to be in contact with the oxide semiconductor film; and

a source electrode and a drain electrode which are provided over the channel protective film and electrically connected to the oxide semiconductor film,

wherein the gate insulating film includes silicon and oxygen,

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

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

wherein at least the first region includes a crystal portion.

9. The semiconductor device according to claim 8,

wherein the first region has a thickness less than or equal to 5 nm, and

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

10. The semiconductor device according to claim 8, wherein a crystal portion is included in a region in the oxide semiconductor film other than the first region.

11. The semiconductor device according to claim 8, wherein a c-axis in the crystal portion is aligned in a direction perpendicular to an interface between the oxide semiconductor film and the gate insulating film.

12. The semiconductor device according to claim 8, wherein the concentration of silicon included in the first region is lower than or equal to 0.1 at.%.

13. The semiconductor device according to claim 8,

wherein the gate 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.

14. A semiconductor device comprising:

a gate electrode;

a gate insulating film covering the gate electrode;

an oxide semiconductor film provided to be in contact with the gate insulating film and overlap with at least the gate electrode;

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

a protective insulating film covering the oxide semiconductor film, the source electrode and the drain electrode,

wherein each of the gate insulating film and the protective insulating film includes silicon and oxygen,

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

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

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

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

wherein at least the first region and the second region include a crystal portion.

15. The semiconductor device according to claim 14,
wherein the first region has a thickness less than or equal to 5 nm,
wherein the second region has a thickness less than or equal to 5 nm, and
wherein a concentration of silicon included in a region other than the first region and the second region is lower than the concentrations of silicon included in the first region and the second region.

16. The semiconductor device according to claim 14, wherein a region in the oxide semiconductor film other than the first region and the second region includes a crystal portion.

17. The semiconductor device according to claim 14, wherein a c-axis in the crystal portion is aligned in a direction perpendicular to an interface between the oxide semiconductor film and the gate insulating film.

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

19. The semiconductor device according to claim 14,
wherein the gate 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.

CLAIMS

1. An oxide semiconductor film in contact with an insulating film including silicon,

wherein the oxide semiconductor film includes indium and zinc, and

wherein the oxide semiconductor film includes a first region in which a concentration of silicon distributed from an interface on the insulating film side toward an inside of the oxide semiconductor film is lower than or equal to 1.0 at.%.

2. An oxide semiconductor film in contact with an insulating film including silicon,

wherein the oxide semiconductor film includes indium and zinc,

wherein the oxide semiconductor film includes a first region in which a concentration of silicon distributed from an interface on the insulating film side toward an inside of the oxide semiconductor film is lower than or equal to 1.0 at.%,

wherein the oxide semiconductor film includes a second region different from the first region, and

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

3. An oxide semiconductor film in contact with an insulating film including silicon,

wherein the oxide semiconductor film includes indium and zinc,

wherein the oxide semiconductor film includes a first region and a second region,

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

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