CLAIMS

1. A semiconductor device comprising:

a first oxide semiconductor film; and

a second oxide semiconductor film over the first oxide semiconductor film,

wherein the first oxide semiconductor film and the second oxide semiconductor film each comprises indium, gallium, and zinc, and

wherein the first oxide semiconductor film has a lower content percentage of indium and a higher content percentage of gallium than the second oxide semiconductor film.

2. The semiconductor device according to claim 1, wherein the first oxide semiconductor film comprises a low-resistance region and a high-resistance region, the high-resistance region being located outside the second oxide semiconductor film.

3. The semiconductor device according to claim 1, wherein the second oxide semiconductor film comprises a channel region and a pair of low-resistance regions in contact with the channel region.

4. The semiconductor device according to claim 1, wherein either end of the second oxide semiconductor film in a channel width direction comprises a high-resistance region.

5. The semiconductor device according to claim 1, wherein a content percentage of gallium is higher than or equal to a content percentage of indium in the first oxide semiconductor film.

6. The semiconductor device according to claim 1, wherein a content percentage of indium is higher than a content percentage of gallium in the second oxide semiconductor film.

7. The semiconductor device according to claim 1, wherein the second oxide

semiconductor film comprises a crystal portion having a c-axis aligned in a direction parallel to a normal vector of a surface where the second oxide semiconductor film is formed.

8. A semiconductor device comprising:

a first oxide semiconductor film over an oxide film;

a second oxide semiconductor film over the first oxide semiconductor film;

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

a gate electrode over the second oxide semiconductor film with the gate insulating film interposed therebetween,

wherein the first oxide semiconductor film and the second oxide semiconductor film each comprises indium, gallium, and zinc, and

wherein the first oxide semiconductor film has a lower content percentage of indium and a higher content percentage of gallium than the second oxide semiconductor film.

9. The semiconductor device according to claim 8, further comprising:

a protective insulating film over the gate electrode;

an interlayer insulating film over the protective insulating film; and

a source electrode and a drain electrode which are over the interlayer insulating film and electrically connected to the second oxide semiconductor film.

10. The semiconductor device according to claim 8, further comprising:

a protective insulating film over the gate electrode;

an interlayer insulating film over the protective insulating film;

a first opening and a second opening which are provided in the gate insulating film, the protective insulating film, and the interlayer insulating film; and

a source electrode and a drain electrode which are embedded in the first opening and the second opening and electrically connected to the second oxide semiconductor film.

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

a protective insulating film and an interlayer insulating film which are over the gate electrode;

a first opening and a second opening which are formed in the gate insulating film, the protective insulating film, the interlayer insulating film, and the second oxide semiconductor film; and

a source electrode and a drain electrode which are embedded in the first opening and the second opening and electrically connected to the second oxide semiconductor film,

wherein the gate electrode covers a top surface and a side surface of the second oxide semiconductor film with the gate insulating film interposed therebetween.

12. The semiconductor device according to claim 9, wherein the source electrode and the drain electrode each have a surface which is planarized by chemical mechanical polishing treatment.

13. The semiconductor device according to claim 10, wherein the source electrode and the drain electrode each have a surface which is planarized by chemical mechanical polishing treatment.

14. The semiconductor device according to claim 11, wherein the source electrode and the drain electrode each have a surface which is planarized by chemical mechanical polishing treatment.

15. The semiconductor device according to claim 8, wherein the first oxide semiconductor film comprises a low-resistance region and a high-resistance region, the high-resistance region being located outside the second oxide semiconductor film.

16. The semiconductor device according to claim 8, wherein the second oxide semiconductor film comprises a channel region and a pair of low-resistance regions in contact with the channel region.

17. The semiconductor device according to claim 8, wherein either end of the

second oxide semiconductor film in a channel width direction comprises a high-resistance region.

18. The semiconductor device according to claim 8, wherein a content percentage of gallium is higher than or equal to a content percentage of indium in the first oxide semiconductor film.

19. The semiconductor device according to claim 8, wherein a content percentage of indium is higher than a content percentage of gallium in the second oxide semiconductor film.

20. The semiconductor device according to claim 8, wherein the second oxide semiconductor film comprises a crystal portion having a c-axis aligned in a direction parallel to a normal vector of a surface where the second oxide semiconductor film is formed.

21. The semiconductor device according to claim 9, wherein the protective insulating film is an aluminum oxide film having a film density of higher than or equal to 3.2 g/cm^3.

22. The semiconductor device according to claim 10, wherein the protective insulating film is an aluminum oxide film having a film density of higher than or equal to 3.2 g/cm^3.

23. The semiconductor device according to claim 11, wherein the protective insulating film is an aluminum oxide film having a film density of higher than or equal to 3.2 g/cm^3.

24. A semiconductor device comprising:

a first oxide semiconductor film over an oxide film;

a second oxide semiconductor film over the first oxide semiconductor film;

a gate insulating film over the second oxide semiconductor film;

a gate electrode over the second oxide semiconductor film with the gate insulating film interposed therebetween;

an insulating film over the gate electrode;

a sidewall insulating film along a side surface of the gate electrode and a side surface of the insulating film;

a source electrode and a drain electrode which are on the sidewall insulating film and electrically connected to the second oxide semiconductor film; and

a protective insulating film and an interlayer insulating film which are over the source electrode and the drain electrode,

wherein the first oxide semiconductor film and the second oxide semiconductor film each comprises indium, gallium, and zinc, and

wherein the first oxide semiconductor film has a lower content percentage of indium and a higher content percentage of gallium than the second oxide semiconductor film.

25. A semiconductor device comprising:

a first oxide semiconductor film over an oxide film;

a second oxide semiconductor film over the first oxide semiconductor film;

a source electrode and a drain electrode on a top surface of the first oxide semiconductor film;

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

a gate electrode over the second oxide semiconductor film with the gate insulating film interposed therebetween,

wherein the second oxide semiconductor film is between the source electrode and the drain electrode, and electrically connected to the source electrode and the drain electrode,

wherein the first oxide semiconductor film and the second oxide semiconductor film each comprises indium, gallium, and zinc, and

wherein the first oxide semiconductor film has a lower content percentage of indium and a higher content percentage of gallium than the second oxide semiconductor film.

26. The semiconductor device according to claim 25, wherein the second oxide semiconductor film is flush with the source electrode and the drain electrode.

27. The semiconductor device according to claim 25, further comprising:

a first conductive film along one side surface of the gate electrode;

a second conductive film along the other side surface of the gate electrode;

a sidewall insulating film on the first conductive film and the second conductive film; and

a protective insulating film and an interlayer insulating film which are over the gate electrode, the source electrode, and the drain electrode.

28. The semiconductor device according to claim 27,

wherein the first conductive film is over the source electrode with the gate insulating film interposed therebetween, and

wherein the second conductive film is over the drain electrode with the gate insulating film interposed therebetween.

CLAIMS

1. A semiconductor device comprising:

a first oxide semiconductor film; and

a second oxide semiconductor film over the first oxide semiconductor film,

wherein the first oxide semiconductor film and the second oxide semiconductor film each comprises indium, gallium, and zinc,

wherein the first oxide semiconductor film has a lower content percentage of indium and a higher content percentage of gallium than the second oxide semiconductor film, and

wherein the second oxide semiconductor film comprises a crystal portion having a c-axis aligned in a direction parallel to a normal vector of a surface where the second oxide semiconductor film is formed.

2. The semiconductor device according to claim 1, wherein the first oxide semiconductor film comprises a low-resistance region and a high-resistance region, the high-resistance region being located outside the second oxide semiconductor film.

3. The semiconductor device according to claim 1, wherein the second oxide semiconductor film comprises a channel region and a pair of low-resistance regions in contact with the channel region.

4. The semiconductor device according to claim 1, wherein either end of the second oxide semiconductor film in a channel width direction comprises a high-resistance region.

5. The semiconductor device according to claim 1, wherein a content percentage of gallium is higher than or equal to a content percentage of indium in the first oxide semiconductor film.

6. The semiconductor device according to claim 1, wherein a content percentage of indium is higher than a content percentage of gallium in the second oxide

semiconductor film.

7. A semiconductor device comprising:

a first oxide semiconductor film over an oxide film;

a second oxide semiconductor film over the first oxide semiconductor film;

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

a gate electrode over the second oxide semiconductor film with the gate insulating film interposed therebetween,

wherein the first oxide semiconductor film and the second oxide semiconductor film each comprises indium, gallium, and zinc,

wherein the first oxide semiconductor film has a lower content percentage of indium and a higher content percentage of gallium than the second oxide semiconductor film, and

wherein the second oxide semiconductor film comprises a crystal portion having a c-axis aligned in a direction parallel to a normal vector of a surface where the second oxide semiconductor film is formed.

8. The semiconductor device according to claim 7, wherein the first oxide semiconductor film comprises a low-resistance region and a high-resistance region, the high-resistance region being located outside the second oxide semiconductor film.

9. The semiconductor device according to claim 7, wherein the second oxide semiconductor film comprises a channel region and a pair of low-resistance regions in contact with the channel region.

10. The semiconductor device according to claim 7, wherein either end of the second oxide semiconductor film in a channel width direction comprises a high-resistance region.

11. The semiconductor device according to claim 7, wherein a content percentage of gallium is higher than or equal to a content percentage of indium in the first oxide semiconductor film.

12. The semiconductor device according to claim 7, wherein a content percentage of indium is higher than a content percentage of gallium in the second oxide semiconductor film.

13. The semiconductor device according to claim 7, further comprising:

a source electrode and a drain electrode over the gate insulating film,

wherein the gate insulating film has a first opening and a second opening,

wherein the source electrode and a drain electrode are electrically connected to the second oxide semiconductor film through the first opening and the second opening, respectively, and

wherein the distance between the gate electrode and the first opening and the distance between the gate electrode and the second opening are different.