

CLAIMS

1. A semiconductor device comprising:
 - a first layer over a substrate;
 - a second layer over the first layer;
 - a third layer in contact with a top surface and a side surface of the second layer and with a side surface of the first layer;
 - a gate electrode layer over the third layer with a gate insulating layer interposed therebetween; and
 - an aluminum oxide film over the gate electrode layer,wherein each of the first layer, the second layer and the third layer contains indium, gallium and zinc.
2. The semiconductor device according to claim 1, wherein each of the first layer and the third layer has a higher proportion of gallium in atomic ratio than the second layer.
3. The semiconductor device according to claim 1, wherein the second layer is thicker than the first layer and the third layer.
4. The semiconductor device according to claim 1, further comprising another gate electrode layer below the first layer.
5. The semiconductor device according to claim 1, further comprising a source electrode layer and a drain electrode layer in contact with another side surface of the second layer.
6. The semiconductor device according to claim 1, wherein the semiconductor device is incorporated in one selected from the group consisting of a television set, an alarm device, an air conditioner, a refrigerator, and an electric vehicle.
7. A semiconductor device comprising:
 - a first layer over a substrate;
 - a second layer over the first layer;
 - a third layer in contact with a top surface and a side surface of the second layer

and with a side surface of the first layer;

a gate electrode layer over the third layer with a gate insulating layer interposed therebetween; and

an aluminum oxide film over the gate electrode layer,

wherein each of the first layer, the second layer and the third layer contains indium, gallium and zinc, and

wherein the gate electrode layer covers the top surface and the side surface of the second layer.

8. The semiconductor device according to claim 7, wherein each of the first layer and the third layer has a higher proportion of gallium in atomic ratio than the second layer.

9. The semiconductor device according to claim 7, wherein the second layer is thicker than the first layer and the third layer.

10. The semiconductor device according to claim 7, further comprising another gate electrode layer below the first layer.

11. The semiconductor device according to claim 7, further comprising a source electrode layer and a drain electrode layer in contact with another side surface of the second layer.

12. The semiconductor device according to claim 7, wherein the semiconductor device is incorporated in one selected from the group consisting of a television set, an alarm device, an air conditioner, a refrigerator, and an electric vehicle.

13. The semiconductor device according to claim 1, wherein the aluminum oxide film contains excess oxygen.

14. The semiconductor device according to claim 7, wherein the aluminum oxide film contains excess oxygen.

15. A semiconductor device comprising:
a first layer over a substrate;

a second layer over the first layer;
a third layer over the second layer;
a gate electrode layer over the third layer with a gate insulating layer interposed therebetween;
an aluminum oxide film over the gate electrode layer; and
a source electrode layer and a drain electrode layer partly interposed between the second layer and the third layer,
wherein each of the first layer, the second layer and the third layer contains indium, gallium and zinc.

16. The semiconductor device according to claim 15, wherein each of the first layer and the third layer has a higher proportion of gallium in atomic ratio than the second layer.

17. The semiconductor device according to claim 15, wherein the second layer is thicker than the first layer and the third layer.

18. The semiconductor device according to claim 15, further comprising another gate electrode layer below the first layer.

19. The semiconductor device according to claim 15, wherein the semiconductor device is incorporated in one selected from the group consisting of a television set, an alarm device, an air conditioner, a refrigerator, and an electric vehicle.

20. The semiconductor device according to claim 15, wherein the aluminum oxide film contains excess oxygen.

21. A semiconductor device comprising:
a first layer over a substrate;
a second layer over the first layer;
a third layer over the second layer;
a gate electrode layer over the third layer with a gate insulating layer interposed therebetween;
an aluminum oxide film over the gate electrode layer; and
a source electrode layer and a drain electrode layer partly interposed between

the second layer and the third layer,

wherein each of the first layer, the second layer and the third layer contains indium, gallium and zinc, and

wherein the gate electrode layer covers the top surface and the side surface of the second layer.

22. The semiconductor device according to claim 21, wherein each of the first layer and the third layer has a higher proportion of gallium in atomic ratio than the second layer.

23. The semiconductor device according to claim 21, wherein the second layer is thicker than the first layer and the third layer.

24. The semiconductor device according to claim 21, further comprising another gate electrode layer below the first layer.

25. The semiconductor device according to claim 21, wherein the semiconductor device is incorporated in one selected from the group consisting of a television set, an alarm device, an air conditioner, a refrigerator, and an electric vehicle.

26. The semiconductor device according to claim 21, wherein the aluminum oxide film contains excess oxygen.