CLAIMS

1. A semiconductor device comprising:

a first gate electrode layer over an insulating surface;

a first insulating layer over the first gate electrode layer;

oxide semiconductor stacked layers comprising a first oxide semiconductor layer and a second oxide semiconductor layer and overlapping with the first gate electrode layer with the first insulating layer interposed between the first gate electrode layer and the oxide semiconductor stacked layers;

a source electrode layer and a drain electrode layer over and in contact with the second oxide semiconductor layer;

a second insulating layer over and in contact with the source electrode layer, the drain electrode layer, and part of the oxide semiconductor stacked layers; and

a second gate electrode layer overlapping with the oxide semiconductor stacked layers with the second insulating layer interposed between the second gate electrode layer and the oxide semiconductor stacked layers,

wherein a region in contact with the second insulating layer in the oxide semiconductor stacked layers has a smaller thickness than a region in contact with the source electrode layer and a region in contact with the drain electrode layer in the oxide semiconductor stacked layers.

2. The semiconductor device according to claim 1,

wherein the first oxide semiconductor layer comprises indium and gallium, and

wherein an indium content is higher than a gallium content in the first oxide semiconductor layer.

3. The semiconductor device according to claim 1,

wherein the second oxide semiconductor layer comprises indium and gallium, and

wherein an indium content is lower than or equal to a gallium content in the second oxide semiconductor layer.

4. The semiconductor device according to claim 1, wherein at least one of the

first gate electrode layer and the second gate electrode layer is a conductive layer having a work function of 5 eV or more.

5. The semiconductor device according to claim 1, wherein at least one of the first gate electrode layer and the second gate electrode layer is an In-Ga-Zn-O film comprising nitrogen.

6. A semiconductor device comprising:

a first gate electrode layer over an insulating surface;

a first insulating layer over the first gate electrode layer;

oxide semiconductor stacked layers comprising a first oxide semiconductor layer and a second oxide semiconductor layer and overlapping with the first gate electrode layer with the first insulating layer interposed between the first gate electrode layer and the oxide semiconductor stacked layers;

a source electrode layer and a drain electrode layer over and in contact with the second oxide semiconductor layer;

a second insulating layer over and in contact with the source electrode layer, the drain electrode layer, and part of the oxide semiconductor stacked layers; and

a second gate electrode layer overlapping with the oxide semiconductor stacked layers with the second insulating layer interposed between the second gate electrode layer and the oxide semiconductor stacked layers,

wherein the first oxide semiconductor layer and the second oxide semiconductor layer have same constituent elements and different compositions of the constituent elements, and

wherein a region in contact with the second insulating layer in the oxide semiconductor stacked layers has a smaller thickness than a region in contact with the source electrode layer and a region in contact with the drain electrode layer in the oxide semiconductor stacked layers.

7. The semiconductor device according to claim 6,

wherein the first oxide semiconductor layer comprises indium and gallium, and

wherein an indium content is higher than a gallium content in the first oxide

semiconductor layer.

8. The semiconductor device according to claim 6,

wherein the second oxide semiconductor layer comprises indium and gallium, and

wherein an indium content is lower than or equal to a gallium content in the second oxide semiconductor layer.

9. The semiconductor device according to claim 6, wherein at least one of the first gate electrode layer and the second gate electrode layer is a conductive layer having a work function of 5 eV or more.

10. The semiconductor device according to claim 6, wherein at least one of the first gate electrode layer and the second gate electrode layer is an In-Ga-Zn-O film comprising nitrogen.

CLAIMS

1. A semiconductor device comprising:

a first gate electrode layer over an insulating surface;

a first insulating layer over the first gate electrode layer, the first insulating layer comprising silicon and oxygen;

oxide semiconductor stacked layers comprising a first oxide semiconductor layer and a second oxide semiconductor layer and overlapping with the first gate electrode layer with the first insulating layer interposed between the first gate electrode layer and the oxide semiconductor stacked layers, wherein a bottom surface of the first oxide semiconductor layer is in direct contact with the first insulating layer;

a source electrode layer and a drain electrode layer over and in direct contact with the second oxide semiconductor layer;

a second insulating layer over and in direct contact with the source electrode layer, the drain electrode layer, and an upper surface of the second oxide semiconductor layer between the source electrode layer and the drain electrode layer, the second insulating layer comprising silicon and oxygen; and

wherein the first oxide semiconductor layer and the second oxide semiconductor layer contain same constituent elements and have different compositions of the constituent elements,

wherein the second oxide semiconductor layer includes:

a first region in direct contact with the second insulating layer; and

a second region in direct contact with the source electrode layer, and

wherein a thickness of the first region is smaller than a thickness of the second region,

wherein the first oxide semiconductor layer comprises indium and gallium,

wherein the second oxide semiconductor layer comprises indium and gallium, and

wherein an indium content is lower than or equal to a gallium content in the second oxide semiconductor layer.

2. The semiconductor device according to claim 1,

wherein an indium content is higher than a gallium content in the first oxide semiconductor layer.

3. A semiconductor device comprising:

a first gate electrode layer over an insulating surface, the first gate electrode layer comprises tungsten;

a first insulating layer over the first gate electrode layer, the first insulating layer comprising silicon and oxygen;

oxide semiconductor stacked layers comprising a first oxide semiconductor layer and a second oxide semiconductor layer and overlapping with the first gate electrode layer with the first insulating layer interposed between the first gate electrode layer and the oxide semiconductor stacked layers, wherein a bottom surface of the first oxide semiconductor layer is in direct contact with the first insulating layer;

a source electrode layer and a drain electrode layer over and in direct contact with the second oxide semiconductor layer;

a second insulating layer over and in direct contact with the source electrode layer, the drain electrode layer, and an upper surface of the second oxide semiconductor layer between the source electrode layer and the drain electrode layer, the second insulating layer comprising silicon and oxygen; and

wherein the first oxide semiconductor layer and the second oxide semiconductor layer contain same constituent elements and have different compositions of the constituent elements,

wherein the second oxide semiconductor layer includes:

a first region in direct contact with the second insulating layer; and

a second region in direct contact with the source electrode layer, and

wherein a thickness of the first region is smaller than a thickness of the second region,

wherein the first oxide semiconductor layer comprises indium and gallium,

wherein the second oxide semiconductor layer comprises indium and gallium, and

wherein an indium content is lower than or equal to a gallium content in the second oxide semiconductor layer.

4. The semiconductor device according to claim 3,

wherein an indium content is higher than a gallium content in the first oxide semiconductor layer.

5. The semiconductor device according to claim 1,

wherein the first oxide semiconductor layer includes a third region and a pair of fourth regions,

wherein the third region overlaps with the first region of the second oxide semiconductor layer,

wherein the pair of fourth regions overlaps with the source electrode layer and the drain electrode layer, and

wherein a thickness of the third region is substantially the same as thicknesses of the pair of fourth regions.

6. The semiconductor device according to claim 3,

wherein the first oxide semiconductor layer includes a third region and a pair of fourth regions,

wherein the third region overlaps with the first region of the second oxide semiconductor layer,

wherein the pair of fourth regions overlaps with the source electrode layer and the drain electrode layer, and

wherein a thickness of the third region is substantially the same as thicknesses of the pair of fourth regions.

7. The semiconductor device according to claim 1,

wherein, in the first oxide semiconductor layer, a concentration of indium is higher than a concentration of gallium, and

wherein, in the second oxide semiconductor layer, a concentration of gallium is higher than a concentration of indium.

8. The semiconductor device according to claim 3,

wherein, in the first oxide semiconductor layer, a concentration of indium is higher than a concentration of gallium, and

wherein, in the second oxide semiconductor layer, a concentration of gallium is higher than a concentration of indium.

9. The semiconductor device according to claim 1, wherein a thickness of a portion of the oxide semiconductor stacked layers has a thickness of more than or equal to 3 nm and less than 20 nm, the portion being between the source electrode layer and the drain electrode layer.

10. The semiconductor device according to claim 3, wherein a thickness of a portion of the oxide semiconductor stacked layers has a thickness of more than or equal to 3 nm and less than 20 nm, the portion being between the source electrode layer and the drain electrode layer.

11. The semiconductor device according to claim 1, further comprising a second gate electrode layer overlapping with the oxide semiconductor stacked layers with the second insulating layer interposed between the second gate electrode layer and the oxide semiconductor stacked layers,

wherein the second gate electrode layer extends beyond edges of the oxide semiconductor stacked layers.

12. The semiconductor device according to claim 3, further comprising a second gate electrode layer overlapping with the oxide semiconductor stacked layers with the second insulating layer interposed between the second gate electrode layer and the oxide semiconductor stacked layers,

wherein the second gate electrode layer extends beyond edges of the oxide semiconductor stacked layers.

13. The semiconductor device according to claim 11, wherein at least one of the first gate electrode layer and the second gate electrode layer is a conductive layer having a work function of 5 eV or more.

14. The semiconductor device according to claim 11, wherein at least one of the first gate electrode layer and the second gate electrode layer is an In-Ga-Zn-O film comprising nitrogen.

15. The semiconductor device according to claim 12, wherein at least one of the first gate electrode layer and the second gate electrode layer is a conductive layer having a work function of 5 eV or more.

16. The semiconductor device according to claim 12, wherein at least one of the first gate electrode layer and the second gate electrode layer is an In-Ga-Zn-O film comprising nitrogen.