CLAIMS

1. A semiconductor device comprising:

a first transistor;

a barrier film over the first transistor; and

a second transistor comprising:

a first electrode in contact with the barrier film;

an oxide semiconductor layer over the first electrode;

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

a second electrode over the first electrode,

wherein the source electrode or the drain electrode is electrically connected to a gate electrode of the first transistor,

wherein the source electrode or the drain electrode is in an opening which penetrates the oxide semiconductor layer, and

wherein the first electrode is surrounded by the barrier film.

2. The semiconductor device according to claim 1, wherein the opening penetrates the barrier film.

3. The semiconductor device according to claim 1, wherein the barrier film comprises a first film in contact with side surfaces and a bottom surface of the first electrode and a second film in contact with a top surface of the first electrode.

4. The semiconductor device according to claim 1, wherein the barrier film comprises aluminum oxide.

5. The semiconductor device according to claim 1, further comprising an insulating layer containing excess oxygen between the barrier film and the oxide semiconductor layer.

6. The semiconductor device according to claim 1, wherein the first transistor comprises a silicon semiconductor.

7. A semiconductor device comprising:

a first transistor;

a first barrier film over the first transistor;

a second transistor comprising:

a first electrode in contact with the first barrier film;

an oxide semiconductor layer over the first electrode;

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

a second electrode over the first electrode; and

a second barrier film over and in contact with the second electrode and the oxide semiconductor layer,

wherein the source electrode or the drain electrode is electrically connected to a gate electrode of the first transistor,

wherein the source electrode or the drain electrode is in an opening which penetrates the oxide semiconductor layer, and

wherein the first electrode is surrounded by the first barrier film.

8. The semiconductor device according to claim 7, wherein the opening penetrates the first barrier film.

9. The semiconductor device according to claim 7, wherein the first barrier film comprises a first film in contact with side surfaces and a bottom surface of the first electrode and a second film in contact with a top surface of the first electrode.

10. The semiconductor device according to claim 7, wherein the first barrier film and the second barrier film comprise aluminum oxide.

11. The semiconductor device according to claim 7, further comprising an insulating layer containing excess oxygen between the first barrier film and the oxide semiconductor layer.

12. The semiconductor device according to claim 7, wherein the first transistor comprises a silicon semiconductor.

13. A semiconductor device comprising:

a first transistor;

a first barrier film over the first transistor;

a second transistor comprising:

a first electrode in contact with the first barrier film;

an oxide semiconductor layer over the first electrode;

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

a second electrode over the first electrode;

a second barrier film over and in contact with the second electrode and the oxide semiconductor layer; and

a capacitor over the second barrier film,

wherein the source electrode or the drain electrode is electrically connected to a gate electrode of the first transistor,

wherein the source electrode or the drain electrode is in an opening which penetrates the oxide semiconductor layer, and

wherein the first electrode is surrounded by the first barrier film.

14. The semiconductor device according to claim 13, wherein the opening penetrates the first barrier film.

15. The semiconductor device according to claim 13, wherein the first barrier film comprises a first film in contact with side surfaces and a bottom surface of the first electrode and a second film in contact with a top surface of the first electrode.

16. The semiconductor device according to claim 13, wherein the first barrier film and the second barrier film comprise aluminum oxide.

17. The semiconductor device according to claim 13, further comprising an insulating layer containing excess oxygen between the first barrier film and the oxide semiconductor layer.

18. The semiconductor device according to claim 13, wherein the first transistor comprises a silicon semiconductor.