[CLAIMS]

[Claim 1]

A resistance change memory device comprising:

a first electrode containing a first element;

a resistance change layer provided on the first electrode and containing an oxide of the first element;

an oxygen conductive layer provided on the resistance change layer, containing a second element and oxygen, having oxygen ion conductivity, and having a relative permittivity higher than a relative permittivity of the resistance change layer; ~~and~~

a second electrode provided on the oxygen conductive layer, the second electrode being formed of a material that does not react with the oxygen conductive layer; and

a power supply circuit configured to apply a voltage between the first electrode and the second electrode,

satisfying the following mathematical formula,

$$V_{app} \geq E_{VR}^{BD}\left(t_{VR} + \frac{k_{VR}}{k_{OC}} \times t_{OC}\right)$$

where V_{app} is a voltage that the power supply circuit is capable of outputting, E_{VR}^{BD} is an electric field strength necessary for dielectric breakdown of the resistance change layer, t_{VR} is a thickness of the resistance change layer, k_{VR} is a relative permittivity of the resistance change layer, t_{OC} is a thickness of the oxygen conductive layer, and k_{OC} is a relative permittivity of the oxygen conductive layer, and

configured such that the resistance change layer undergoes dielectric breakdown earlier than the oxygen conductive layer when a voltage between the first electrode and the second electrode is continuously increased from zero.

~~[Claim 2]~~

~~The resistance change memory device according to claim 1, further comprising a power supply circuit configured to apply a voltage between the first electrode and the second electrode,~~

~~satisfying the following mathematical formula,~~

~~$$V_{app} \geq E_{VR}^{BD}\left(t_{VR} + \frac{k_{VR}}{k_{OC}} \times t_{OC}\right)$$~~

~~where V_{app} is a voltage that the power supply circuit is capable of outputting, E_{VR}^{BD} is an electric field strength necessary for dielectric breakdown of the resistance change layer, t_{VR} is a thickness of the resistance change layer, k_{VR} is a relative permittivity of the resistance change layer, t_{OC} is a thickness of the oxygen conductive layer, and k_{OC} is a relative permittivity of the oxygen conductive layer.~~

[Claim 2~~3~~]

The resistance change memory device according to claim 1, wherein an absolute value of a difference between an electronegativity of the first element and an electronegativity of oxygen is smaller than an absolute value of a difference between an electronegativity of the second element and an electronegativity of oxygen.

[Claim 3~~4~~]

The resistance change memory device according to claim 1, wherein the resistance change layer is made of a covalently bonded oxide.

[Claim 4~~5~~]

The resistance change memory device according to claim 1, wherein the first element is silicon.

[Claim 5~~6~~]

The resistance change memory device according to claim 4~~5~~, wherein the first electrode is formed of silicon containing an impurity or a metal silicide.

[Claim 6~~7~~]

The resistance change memory device according to claim 1, wherein the first electrode is formed of a material by which the same kind of material as a material of the resistance change layer is formed by local anodic oxidation.

[Claim 7~~8~~]

The resistance change memory device according to claim 1, wherein the oxygen conductive layer is made of an ionically bonded oxide.

[Claim 8~~9~~]

The resistance change memory device according to claim 1, wherein a crystal structure of the oxygen conductive layer is of a fluorite type.

[Claim 9~~10~~]

The resistance change memory device according to claim 1, wherein the oxygen conductive layer contains one or more oxides selected from the group consisting of a cerium oxide, a hafnium oxide, a zirconium oxide, a titanium oxide, strontium titanate, and yttria stabilized zirconia.

[Claim 10~~11~~]

The resistance change memory device according to claim 9~~10~~, wherein the oxygen conductive layer is made of a cerium oxide.

[Claim 11~~12~~]

The resistance change memory device according to claim 1, wherein the second electrode is formed of a material that does not react with the second element.