CLAIMS

Claim 1. A wet etching solution for selectively removing a second metal layer made of at least one of a cobalt-based material or a copper-based material from a semiconductor substrate while suppressing etching of a first metal layer made of a tungsten-based material,

the first metal layer and the second metal layer being co-present on the semiconductor substrate,

an oxide layer being formed on a surface layer of at least the at least one of a cobalt-based material or a copper-based material,

the etching solution comprising a solution in which a β-diketone containing a trifluoromethyl group and a carbonyl group bonded together is dissolved in an organic solvent.

Claim 2. The wet etching solution according to claim 1,

wherein a material of the semiconductor substrate is a silicon-based material or a silicate glass material.

Claim 3. The wet etching solution according to claim 1 or 2,

wherein the β-diketone is present at a concentration of 1 to 80 mass%.

Claim 4. The wet etching solution according to any one of claims 1 to 3,

wherein the etching solution has a moisture content of 1 mass% or less.

Claim 5. The wet etching solution according to any one of claims 1 to 4,

wherein at least one gas selected from oxygen, air,

and ozone as an oxidant is dissolved in the etching solution.

Claim 6. The wet etching solution according to any one of claims 1 to 5,

wherein the etching solution further comprises an acid.

Claim 7. The wet etching solution according to claim 6,

wherein the acid is at least one selected from the group consisting of citric acid, formic acid, acetic acid, and trifluoroacetic acid.

Claim 8. A wet etching method of selectively removing a second metal layer made of at least one of a cobalt-based material or a copper-based material with respect to a first metal layer made of a tungsten-based material, the method comprising:

a third step of bringing an oxidant into contact with a semiconductor substrate on which the first metal layer and the second metal layer are co-present, to form a second metal oxide layer on a surface layer of at least the second metal layer; and

a fourth step of bringing the second metal oxide layer into contact with an etching solution which comprises a solution in which a β-diketone containing a trifluoromethyl group and a carbonyl group bonded together is dissolved in an organic solvent.

Claim 9. The wet etching method according to claim 8,

wherein in the third step, the oxidant is oxygen, air, ozone, or a peroxide.

Claim 10. The wet etching method according to claim 8

or 9,

wherein the fourth step comprises bringing the etching solution into contact with the second metal oxide layer after degassing the etching solution.

Claim 11. The wet etching method according to claim 8,

wherein the third step and the fourth step are simultaneously performed using a solution in which at least one gas selected from oxygen, air, and ozone as the oxidant is dissolved in the etching solution.

Claim 12. The wet etching method according to any one of claims 8 to 11,

wherein a material of the semiconductor substrate is a silicon-based material or a silicate glass material.

Claim 13. The wet etching method according to any one of claims 8 to 12,

wherein the β-diketone is present in the etching solution at a concentration of 1 to 80 mass%.

Claim 14. The wet etching method according to any one of claims 8 to 13,

wherein the etching solution has a moisture content of 1 mass% or less.

Claim 15. The wet etching method according to any one of claims 8 to 14,

wherein the etching solution further comprises an acid.

Claim 16. The wet etching method according to claim 15,

wherein the acid is at least one selected from the group consisting of citric acid, formic acid, acetic acid, and trifluoroacetic acid.

Claim 17. The wet etching method according to any one of claims 8 to 16,

wherein, in the third step, the oxidant used is at least one gas selected from the group consisting of oxygen, air, and ozone, and the semiconductor substrate is oxidized by exposing the semiconductor substrate to the gas while rotating it horizontally.

Claim 18. The wet etching method according to claim 17,

wherein the semiconductor substrate is rotated at 1000 rpm or more.

Claim 19. The wet etching method according to any one of claims 8 to 18,

wherein, in the fourth step, the second metal oxide layer is brought into contact with the etching solution while rotating the semiconductor substrate.

Claim 20. The wet etching method according to claim 19,

wherein the semiconductor substrate is rotated at 1000 rpm or more.