

WHAT IS CLAIMED IS:

1. A composition for silicon-nitride-film etching comprising:

- 5 phosphoric acid as a first inorganic acid;
a first additive, being any one selected from the group consisting of phosphorous acid, an organic phosphite, a hypophosphite, and mixtures thereof;
a second additive, being any one selected from silane inorganic acid salt, alkoxysilane compound, siloxane compound, oxime compound, oxime silane compound, and mixtures thereof; and
10 a solvent;
wherein the phosphoric acid is at a proportion of 70% to 99% by weight with respect to the total amount of the composition;
wherein the first additive is at a proportion of 0.01% to 15% by weight with respect to the total amount of the composition; and
15 wherein the second additive is at a proportion of 0.01% to 20% by weight with respect to the total amount of the composition.

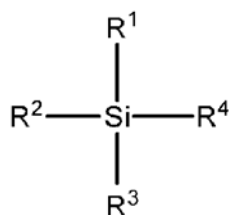
2. The composition for silicon-nitride-film etching according to claim 1, wherein the organic phosphite is an alkyl phosphite, being any one selected from the group consisting of dimethyl
20 phosphite, diethyl phosphite, dipropyl phosphite, diisopropyl phosphite, dibutyl phosphite, trimethyl phosphite, triethyl phosphite, tripropyl phosphite, triisopropyl phosphite, tributyl phosphite, diphenyl phosphite, dibenzyl phosphite, and mixtures thereof.

3. The composition for silicon-nitride-film etching according to claim 1, wherein the hypophosphite
25 is any one selected from the group consisting of ammonium hypophosphite, sodium hypophosphite, potassium hypophosphite, and mixtures thereof.

4. The composition for silicon-nitride-film etching according to claim 1, wherein the silane inorganic acid salt is a silane inorganic acid salt produced by reacting any one second inorganic acid, which is selected from the group consisting of sulfuric acid, fuming sulfuric acid, nitric acid, phosphoric acid, anhydrous phosphoric acid, pyrophosphoric acid, polyphosphoric acid and mixtures thereof, with a silane compound represented by following Chemical Formula 10:

<Chemical Formula 10>

[Chemical Formula 1]



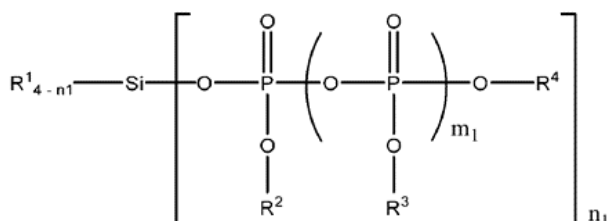
wherein, in Chemical Formula 10,

R1 to R4 each independently represent any one selected from the group consisting of a hydrogen atom, a halogen atom, an alkyl group having 1 to 10 carbon atoms, an alkoxy group having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms; and at least any one of R1 to R4 represents a halogen atom or an alkoxy group having 1 to 10 carbon atoms.

5. The composition for silicon-nitride-film etching according to claim 4, wherein the silane inorganic acid salt comprises a compound represented by following Chemical Formula 100:

<Chemical Formula 100>

[Chemical Formula 2]



wherein, in Chemical Formula 100,

R1 represents any one selected from the group consisting of a hydrogen atom, a halogen atom, an

alkyl group having 1 to 10 carbon atoms, an alkoxy group having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms;

n1 represents an integer from 1 to 4; m1 represents an integer from 1 to 10; and

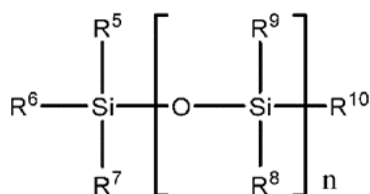
R2 to R4 each independently represent a hydrogen atom.

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6. The composition for silicon-nitride-film etching according to claim 1, wherein the silane inorganic acid salt is a siloxane inorganic acid salt produced by reacting a second inorganic, which is selected from the group consisting of sulfuric acid, fuming sulfuric acid, nitric acid, phosphoric acid, anhydrous phosphoric acid, pyrophosphoric acid, polyphosphoric acid and mixtures thereof, with a siloxane compound represented by following Chemical Formula 20:

<Chemical Formula 20>

[Chemical Formula 3]



wherein, in Chemical Formula 20,

R5 to R10 each independently represent any one selected from the group consisting of a hydrogen atom, a halogen atom, an alkyl group having 1 to 10 carbon atoms, an alkoxy group having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms;

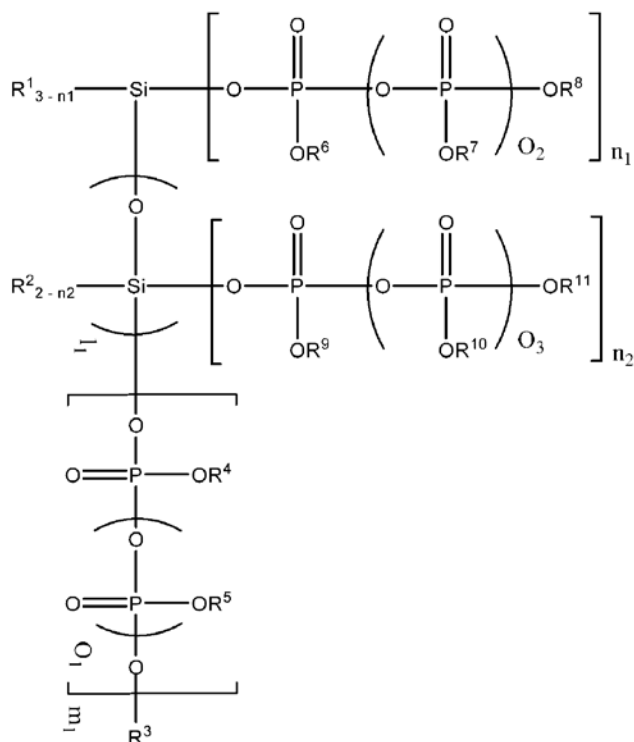
at least any one of R5 to R10 represents a halogen atom or an alkoxy group having 1 to 10 carbon atoms; and

n represents an integer from 1 to 10.

7. The composition for silicon-nitride-film etching according to claim 6, wherein the silane inorganic acid salt includes a compound represented by the following Chemical Formula 200:

<Chemical Formula 200>

[Chemical Formula 4]



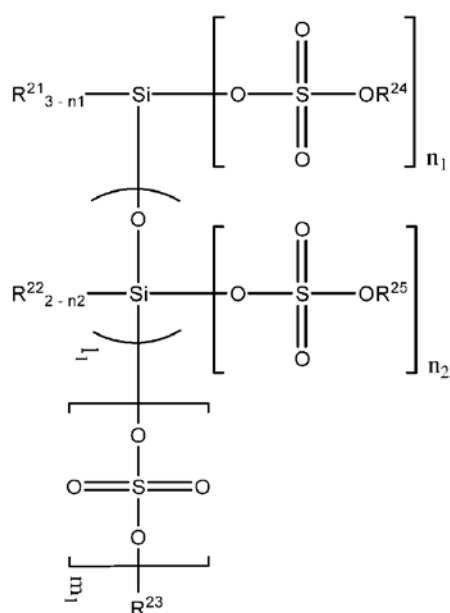
wherein, in Chemical Formula 200,

- 5 R1 and R2 each independently represents any one selected from the group consisting of a hydrogen atom, a halogen atom, an alkyl group having 1 to 10 carbon atoms, an alkoxy group having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms;
- n1 represents an integer from 0 to 3; n2 represents an integer from 0 to 2; m1 represents an integer of 0 or 1; the relation: $n_1+n_2+m_1 \geq 1$ is satisfied, l1 represents an integer from 1 to 10;
- 10 o1 to o3 each independently represent an integer from 0 to 10; and
- R3 to R11 each independently represent a hydrogen atom.

8. The composition for silicon-nitride-film etching according to claim 6, wherein the siloxane inorganic acid salt includes a compound represented by the following Chemical Formula 230:

<Chemical Formula 230>

[Chemical Formula 5]



wherein, in Chemical Formula 230,

R²¹ and R²² each independently represent any one selected from the group consisting of a hydrogen atom, a halogen atom, an alkyl group having 1 to 10 carbon atoms, an alkoxy group

having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms;

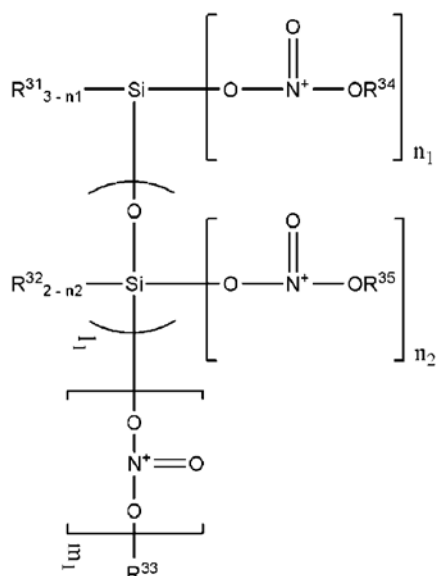
n₁ represents an integer from 0 to 3; n₂ represents an integer from 0 to 2; m₁ represents an integer of 0 or 1; the relation: n₁+n₂+m₁≥1 is satisfied; l₁ represents an integer from 1 to 10; and

R²³ to R²⁵ each independently represent a hydrogen atom.

9. The composition for silicon-nitride-film etching according to claim 6, wherein the siloxane inorganic acid salt includes a compound represented by the following Chemical Formula 260:

<Chemical Formula 260>

[Chemical Formula 6]



wherein in Chemical Formula 260,

R31 and R32 each independently represent any one selected from the group consisting of a hydrogen atom, a halogen atom, an alkyl group having 1 to 10 carbon atoms, an alkoxy group having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms;

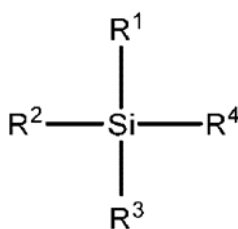
n1 represents an integer from 0 to 3; n2 represents an integer from 0 to 2; m1 represents an integer of 0 or 1; the relation: $n_1+n_2+m_1 \geq 1$ is satisfied, l₁ represents an integer from 1 to 10; and

R33 to R35 each independently represent a hydrogen atom.

10. The composition for silicon-nitride-film etching according to claim 6, wherein the alkoxy silane compound includes a compound represented by the following Chemical Formula 300:

<Chemical Formula 300>

[Chemical Formula 7]



wherein in Chemical Formula 300,

R1 to R4 each independently represent any one selected from the group consisting of a hydrogen

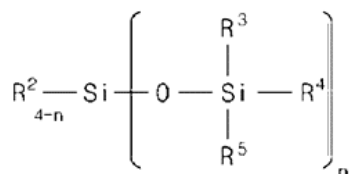
atom, a halogen atom, a hydroxyl group, an alkyl group having 1 to 10 carbon atoms, an alkoxy group having 1 to 10 carbon atoms, an aminoalkyl group having 1 to 10 carbon atoms, an aminoalkoxy group having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms; and

5 at least any one of R1 to R4 represents an alkoxy group having 1 to 10 carbon atoms, an aminoalkyl group having 1 to 10 carbon atoms, or an aminoalkoxy group having 1 to 10 carbon atoms.

11. The composition for silicon-nitride-film etching according to claim 1, wherein the siloxane compound includes a compound represented by the following Chemical Formula 350:

10 <Chemical Formula 350>

[Chemical Formula 8]



wherein in Chemical Formula 350,

15 R2 to R5 each independently represent any one selected from the group consisting of a hydrogen atom, a halogen atom, a hydroxyl group, an alkyl group having 1 to 10 carbon atoms, an alkoxy group having 1 to 10 carbon atoms, an aminoalkyl group having 1 to 10 carbon atoms, an aminoalkoxy group having 1 to 10 carbon atoms, and an aryl group having 6 to 30 carbon atoms; at least any one of R<2 >to R<5 >represents an alkoxy group having 1 to 10 carbon atoms, an aminoalkyl group having 1 to 10 carbon atoms, or an aminoalkoxy group having 1 to 10 carbon atoms; and

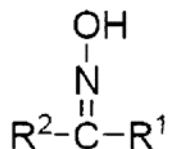
20 n represents an integer from 1 to 4.

12. The composition for silicon-nitride-film etching according to claim 1, wherein the oxime

compound includes a compound represented by the following Chemical Formula 400:

<Chemical Formula 400>

[Chemical Formula 9]

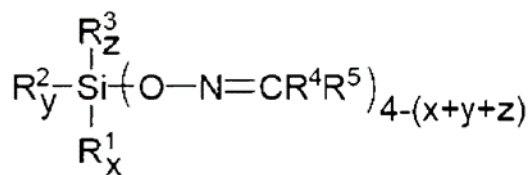


- 5 wherein, in Chemical Formula 400,
- R1 and R2 each independently represent any one selected from the group consisting of a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkoxy group having 1 to 20 carbon atoms, an alkenyl group having 2 to 20 carbon atoms, a cycloalkyl group having 3 to 20 carbon atoms, an aminoalkyl group having 1 to 20 carbon atoms, an aryl group having 6 to 20 carbon atoms, an alkylcarbonyl group having 1 to 20 carbon atoms, an alkylcarbonyloxy group having 1 to 20 carbon atoms, and a cyanoalkyl group having 1 to 10 carbon atoms.
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13. The composition for silicon-nitride-film etching according to claim 1, wherein the oxime silane compound includes a compound represented by the following Chemical Formula 500:

15 <Chemical Formula 500>

[Chemical Formula 10]



wherein, in Chemical Formula 500,

- R1 to R3 each independently represents any one selected from the group consisting of a hydrogen atom, a halogen atom, an alkyl group having 1 to 20 carbon atoms, an alkenyl group having 2 to 20 carbon atoms, a cycloalkyl group having 3 to 20 carbon atoms, an aryl group having 6 to 20 carbon atoms, an arylalkyl group having 7 to 20 carbon atoms, and an alkylcarbonyl group having
- 20

1 to 20 carbon atoms;

R4 and R5 each independently represents any one selected from the group consisting of an alkyl group having 1 to 20 carbon atoms, a cycloalkyl group having 3 to 20 carbon atoms, an aryl group having 6 to 20 carbon atoms, an arylalkyl group having 7 to 20 carbon atoms, and an alkylcarbonyl group having 1 to 20 carbon atoms, or R4 and R5 are bonded to each other, as the alkylene groups having 3 to 12 carbon atoms, to form an alicyclic ring;

x, y, and z each independently represents an integer from 0 to 3, and $x+y+z$ represents an integer from 0 to 3.

10 14. The composition for silicon-nitride-film etching according to claim 1, comprising an ammonium-based compound at a proportion of 0.01% to 20% by weight and/or a fluorine-based compound at a proportion of 0.01% to 1% by weight, with respect to the total amount of the composition.

15 15. A method of manufacturing a semiconductor device, the method comprising a silicon-nitride-film etching process carried out by using the composition for silicon-nitride-film etching according to claim 1.

16. The method according to claim 15, wherein the silicon-nitride-film etching process involves selective etching of a nitride film relative to an oxide film, and
20 the silicon-nitride-film etching process is carried out at a temperature of from 50°C to 300°C.