

CLAIMS

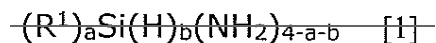
1. ——— A water repellent protective film forming liquid chemical, comprising the following components:

(I) an aminosilane compound of the following general formula [1];

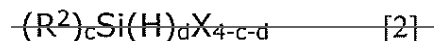
(II) a silicon compound of the following general formula [2]; and

(III) an aprotic solvent,

wherein the amount of the component (I) contained in the liquid chemical is 0.02 to 0.5 mass% based on the total amount of the components (I) to (III),

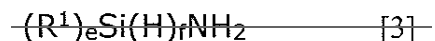


where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; a is an integer of 1 to 3; b is an integer of 0 to 2; and the sum of a and b is 1 to 3,



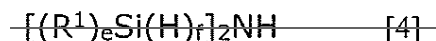
where R^2 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; X is at least one group selected from the group consisting of a halogen atom, a ---OC(=O)R^3 group, a $\text{---OS(=O)}_2\text{R}^3$ group, a $\text{---N(S(=O)}_2\text{R}^3)_2$ group and a $\text{---C(S(=O)}_2\text{R}^3)_3$ group; R^3 is a monovalent perfluoroalkyl group of 1 to 6 carbon atoms; c is an integer of 1 to 3; d is an integer of 0 to 2; and the sum of c and d is 1 to 3.

2. ——— The water repellent protective film forming liquid chemical according to claim 1, wherein the component (I) is a compound of the following general formula [3]



where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3.

3. — The water repellent protective film forming liquid chemical according to claim 1 or 2, further comprising: the following component: (IV) a silazane compound of the following general formula [4]



where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3.

4. — The water repellent protective film forming liquid chemical according to any one of claims 1 to 3, wherein the amount of the component (II) contained in the liquid chemical is 0.05 to 20 mass% based on the total amount of the components (I) to (III).

5. — The water repellent protective film forming liquid chemical according to any one of claims 1 to 4, wherein the component (II) is at least one kind of compound selected from the group consisting of those of the following general formula [5]



where R^2 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; R^3 is a monovalent perfluoroalkyl group of 1 to 6 carbon atoms; and g is an integer of 1 to 3.

6. — A surface treatment method for a wafer, comprising: a water repellent protective film forming step of, in a state that at least one kind of liquid selected from the group consisting of a cleaning liquid and a rinse liquid is retained on a surface of the wafer, replacing the liquid with a water repellent protective film forming liquid chemical and retaining the water repellent protective film forming liquid chemical on the surface of the wafer; and a drying step;

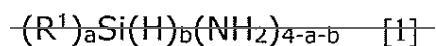
wherein the water repellent protective film forming liquid chemical comprises the following components:

(I) an aminosilane compound of the following general formula [1];

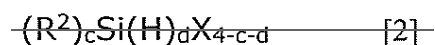
(II) a silicon compound of the following general formula [2]; and

(III) an aprotic solvent, and

wherein the amount of the component (I) contained in the liquid chemical is 0.02 to 0.5 mass% based on the total amount of the components (I) to (III),

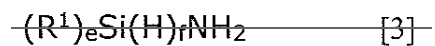


where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; a is an integer of 1 to 3; b is an integer of 0 to 2; and the sum of a and b is 1 to 3,



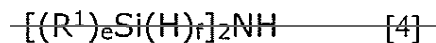
where R^2 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; X is at least one group selected from the group consisting of a halogen atom, a $-OC(=O)R^3$ group, a $-OS(=O)_2R^3$ group, a $-N(S(=O)_2R^3)_2$ group and a $-C(S(=O)_2R^3)_3$ group; R^3 is a monovalent perfluoroalkyl group of 1 to 6 carbon atoms; c is an integer of 1 to 3; d is an integer of 0 to 2; and the sum of c and d is 1 to 3.

7. The surface treatment method for the wafer according to claim 6, wherein the component (I) is a compound of the following general formula [3]



where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3.

8. The surface treatment method for the wafer according to claim 6 or 7, wherein the water repellent protective film forming liquid chemical further comprises the following component: (IV) a silazane compound of the following general formula [4]



where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3.

91. ~~The surface treatment method for the wafer according to any one of claims 6 to 8, further comprising, A surface treatment method for a wafer, comprising: a water-repellent protective film-forming step of, in a state that at least one kind of liquid selected from the group consisting of a cleaning liquid and a rinse liquid is retained on a surface of the wafer, replacing the liquid with a water-repellent protective film-forming liquid chemical and retaining the water-repellent protective film-forming liquid chemical on the surface of the wafer; and a drying step,~~

wherein the water-repellent protective film-forming liquid chemical comprises the following components:

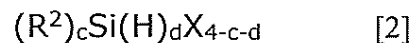
(I) an aminosilane compound of the following general formula [1];

(II) a silicon compound of the following general formula [2]; and

(III) an aprotic solvent,



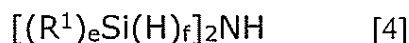
where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; a is an integer of 1 to 3; b is an integer of 0 to 2; and the sum of a and b is 1 to 3,



where R^2 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; X is at least one group selected from the group consisting of a halogen atom, a $-\text{OC}(=\text{O})\text{R}^3$ group, a $-\text{OS}(=\text{O})_2-\text{R}^3$ group, a $-\text{N}(\text{S}(=\text{O})_2-\text{R}^3)_2$ group and a $-\text{C}(\text{S}(=\text{O})_2-\text{R}^3)_3$ group; R^3 is a monovalent perfluoroalkyl group of 1 to 6 carbon atoms; c is an integer of 1 to 3; d is an integer of 0 to 2; and the sum

of c and d is 1 to 3,

wherein the surface treatment method further comprises, before the water-repellent protective film-forming step, a liquid chemical preparation step of bringing, into contact with a raw chemical containing the following components: (II) the silicon compound of the general formula [2]; (IV) a silazane compound of the following general formula [4]; and (III) the aprotic solvent, a protic compound in an amount of 0.001 to 0.3 mol relative to 1 kg of the total amount of the components (II), (III) and (IV), thereby preparing the water-repellent protective film-forming liquid chemical containing the components (I) to (III) wherein the amount of the component (I) contained in the liquid chemical is 0.02 to 0.5 mass% based on the total amount of the components (I) to (III),



where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3.

~~102. The surface treatment method for the wafer according to claim 8, further comprising,~~ A surface treatment method for a wafer, comprising: a water-repellent protective film-forming step of, in a state that at least one kind of liquid selected from the group consisting of a cleaning liquid and a rinse liquid is retained on a surface of the wafer, replacing the liquid with a water-repellent protective film-forming liquid chemical and retaining the water-repellent protective film-forming liquid chemical on the surface of the wafer; and a drying step,

wherein the water-repellent protective film-forming liquid chemical comprises the following components:

(I) an aminosilane compound of the following general formula [1];

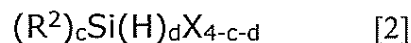
(II) a silicon compound of the following general formula [2];

(III) an aprotic solvent; and

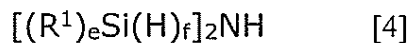
(IV) a silazane compound of the following general formula [4],



where R¹ is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; a is an integer of 1 to 3; b is an integer of 0 to 2; and the sum of a and b is 1 to 3,

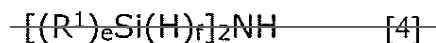


where R² is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; X is at least one group selected from the group consisting of a halogen atom, a -OC(=O)R^3 group, a $\text{-OS(=O)}_2\text{-R}^3$ group, a $\text{-N(S(=O)}_2\text{-R}^3\text{)}_2$ group and a $\text{-C(S(=O)}_2\text{-R}^3\text{)}_3$ group; R³ is a monovalent perfluoroalkyl group of 1 to 6 carbon atoms; c is an integer of 1 to 3; d is an integer of 0 to 2; and the sum of c and d is 1 to 3,



where R¹ is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3,

wherein the surface treatment method further comprises, before the water-repellent protective film-forming step, a liquid chemical preparation step of bringing, into contact with a raw chemical containing the following components: (II) the silicon compound of the general formula [2]; (IV) ~~a~~the silazane compound of the ~~following~~ general formula [4]; and (III) the aprotic solvent, a protic compound in an amount of 0.001 to 0.3 mol relative to 1 kg of the total amount of the components (II), (III) and (IV), thereby preparing the water-repellent protective film-forming liquid chemical containing the components (I) to (IV) wherein the amount of the component (I) contained in the liquid chemical is 0.02 to 0.5 mass% based on the total amount of the components (I) to (III);



~~where R¹ is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the~~

sum of e and f is 3.

~~11~~3. The surface treatment method for the wafer according to claim ~~9 or 10~~1 or 2, wherein the liquid chemical preparation step is performed by introducing the raw chemical into a space containing the protic compound and thereby bringing the protic compound into contact with the raw chemical.

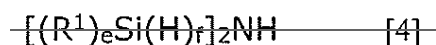
~~12~~4. The surface treatment method for the wafer according to any one of claims ~~9 to 11~~1 to 3, wherein the protic compound is in gaseous form.

~~13~~5. The surface treatment method for the wafer according to any one of claims ~~9 to 11~~1 to 3, wherein the protic compound is in liquid form.

~~14~~6. The surface treatment method for the wafer according to any one of claims ~~9 to 13~~1 to 5, wherein the protic compound is a compound having a -OH group and/or a -NH₂ group.

~~15~~7. The surface treatment method for the wafer according to any one of claims ~~9 to 14~~1 to 6, wherein the protic compound is water and/or 2-propanol.

~~16. — The surface treatment method for the wafer according to any one of claims 6 to 8, further comprising, before the water repellent protective film forming step, a liquid chemical preparation step of bringing, into contact with a raw chemical containing the following components: (IV) a silazane compound of the following general formula [4]; and (III) the aprotic solvent, an acidic compound of the following general formula [6] in an amount of 0.001 to 0.3 mole relative to 1 kg of the total amount of the components (III) and (IV), thereby preparing the water repellent protective film forming liquid chemical containing the components (I) to (III) wherein the amount of the component (I) contained in the liquid chemical is 0.02 to 0.5 mass% based on the total amount of the components (I) to (III);~~

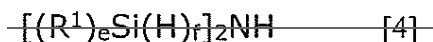


where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3,



where X is a halogen atom, a $-\text{OC}(=\text{O})\text{R}^3$ group, a $-\text{OS}(=\text{O})_2\text{R}^3$ group, a $-\text{N}(\text{S}(=\text{O})_2\text{R}^3)_2$ group or a $-\text{C}(\text{S}(=\text{O})_2\text{R}^3)_3$ group where R^3 is a monovalent perfluoroalkyl group of 1 to 6 carbon atoms.

17. The surface treatment method for the wafer according to claim 8, further comprising, before the water repellent protective film forming step, a liquid chemical preparation step of bringing, into contact with a raw chemical containing the following components: (IV) a silazane compound of the following general formula [4]; and (III) the aprotic solvent, an acidic compound of the following general formula [6] in an amount of 0.001 to 0.3 mole relative to 1 kg of the total amount of the components (III) and (IV), thereby preparing the water repellent protective film forming liquid chemical containing the components (I) to (IV) wherein the amount of the component (I) contained in the liquid chemical is 0.02 to 0.5 mass% based on the total amount of the components (I) to (III),



where R^1 is each independently a monovalent organic group having a monovalent hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the sum of e and f is 3,

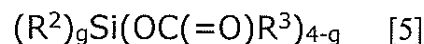


where X is a halogen atom, a $-\text{OC}(=\text{O})\text{R}^3$ group, a $-\text{OS}(=\text{O})_2\text{R}^3$ group, a $-\text{N}(\text{S}(=\text{O})_2\text{R}^3)_2$ group or a $-\text{C}(\text{S}(=\text{O})_2\text{R}^3)_3$ group; and R^3 is a monovalent perfluoroalkyl group of 1 to 6 carbon atoms.

18. The surface treatment method for the wafer according to any one of claims 6 to 17, wherein the amount of the component (II) contained in the liquid chemical is 0.05 to 20

mass% based on the total amount of the components (I) to (III).

199. The surface treatment method for the wafer according to any one of claims ~~6 to 181~~
to 8, wherein the component (II) is at least one kind of compound selected from those of the
following general formula [5]



where R^2 is each independently a monovalent organic group having a monovalent
hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may
be substituted with a fluorine atom; R^3 is a monovalent perfluoroalkyl group of 1 to 6
carbon atoms; and g is an integer of 1 to 3.

10. The surface treatment method for the wafer according to any one of claims 1 to 9,
wherein the component (I) is a compound of the following general formula [3]



where R^1 is each independently a monovalent organic group having a monovalent
hydrocarbon structure of 1 to 18 carbon atoms in which a part or all of hydrogen atoms may
be substituted with a fluorine atom; e is an integer of 1 to 3; f is an integer of 0 to 2; and the
sum of e and f is 3.