CLAIMS

1. A surface treatment agent for surface treatment of a workpiece, comprising the following components:

(I) at least one kind selected from the group consisting of silicon compounds represented by the following general formulas [1] and [2];

(II) at least one kind selected from the group consisting of a nitrogen-containing heterocyclic compound represented by the following general formula [3], a nitrogen-containing heterocyclic compound represented by the following general formula [4] and imidazole;

(III) an organic solvent; and

(IV) at least one kind selected from the group consisting of silicon compound represented by the following general formulas [5] and [6],

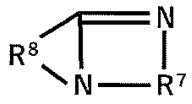
wherein the amount of the component (IV) contained relative to the amount of the component (I) is more than or equal to 0.001 and less than 1 in terms of molar ratio,

$$(R^1)_a(H)_bSi[N(R^2)C(=O)R^3]_{4-a-b} \quad [1]$$

where R^1 is each independently a C_1-C_{18} monovalent hydrocarbon group in which a part or all of hydrogen atoms may be substituted by a fluorine atom; R^2 is each independently a group selected from the group consisting of a C_1-C_6 alkyl group in which a part or all of hydrogen atoms may be substituted by a fluorine atom, and a hydrogen atom; R^3 is each independently a C_1-C_6 alkyl group in which a part or all of hydrogen atoms may be substituted by 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,

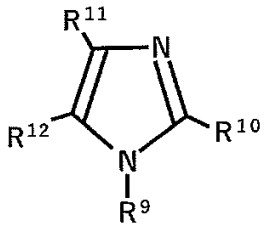
$$(R^4)_c(H)_dSi[OC(R^5)=NSi(R^6)_e(H)_{3-e}]_{4-c-d} \quad [2]$$

where R^4 and R^6 are each independently a C_1-C_{18} monovalent hydrocarbon group in which a part or all of hydrogen atoms may be substituted by a fluorine atom; R^5 is each independently a group selected from the group consisting of a C_1-C_6 alkyl group in which a part or all of hydrogen atoms may be substituted by a fluorine atom, and a hydrogen atom; c is an integer of 1 to 3; d is an integer of 0 to 2; e is an integer of 1 to 3; and the sum of c and d is 1 to 3,



[3]

where R^7 and R^8 are each independently a divalent organic group consisting of carbon and/or nitrogen and hydrogen, in which the total number of carbon and nitrogen atoms is 1 to 9; and, in the case where the total number of carbon and nitrogen atoms is 2 or greater, there may exit a carbon atom that does not form a ring,



[4]

where R^9 is a C_1-C_6 alkyl group in which a part of all of hydrogen atoms may be substituted by a fluorine atom, a trialkylsilyl group having a C_1-C_8 alkyl group in which a part of all of hydrogen atoms may be substituted by a fluorine atom, a C_2-C_6 alkenyl group in which a part of all of hydrogen atoms may be substituted by a fluorine atom, a C_1-C_6 alkoxy group in which a part of all of hydrogen atoms may be substituted by a fluorine atom, an amino group, an alkylamino group having a C_1-C_6 alkyl group in which a part of all of hydrogen atoms may be substituted by a fluorine atom, a dialkylamino group having a C_1-C_6 alkyl group in which a part of all of hydrogen atoms may be substituted by a fluorine atom, a C_1-C_6 aminoalkyl group in which a part of all of hydrogen atoms may be substituted by a fluorine atom, a nitro group, a cyano group, a phenyl group, a benzyl group, or a halogen atom; and R^{10}, R^{11} and R^{12} are each independently a C_1-C_6 alkyl group in which a part or all of hydrogen atoms may be substituted by a fluorine atom, or a hydrogen atom,

$$(R^{13})_f(H)_gSi[OC(=O)R^{14}]_{4-f-g} \quad [5]$$

where R^{13} is each independently a C_1-C_{18} monovalent hydrocarbon group in which a part or all of hydrogen atoms may be substituted by a fluorine atom; R^{14} is each independently a C_1-C_6 alkyl group in which a part or all of hydrogen atoms may be substituted by a fluorine atom; f is an integer of 1 to 3; g is an integer of 0 to 2; and the sum of f and g is 1 to 3,

$$(R^{15})_h(H)_iSiX_{4-h-i} \quad [6]$$

where R^{15} is each independently a C_1-C_{18} monovalent hydrocarbon group in which a part or all of hydrogen atoms may be substituted by a fluorine atom; X is each independently a halogen atom, an alkylsulfonate group, or a perfluoroalkylsulfonate group; h is an integer of 1 to 3; i is an integer of 0 to 2; and the sum of h and i is 1 to 3.

2. The surface treatment agent according to claim 1, wherein the component (IV) comprises at least one kind of silicon compound represented by the general formula [5] in which f is 3; and R^{14} is a C_1-C_6 fluorine-containing alkyl group.

3. The surface treatment agent according to claim 1 or 2, wherein the component (IV) comprises $(CH_3)_3SiOC(=O)CF_3$.

4. The surface treatment agent according to any one of claims 1 to 3, wherein the component (IV) comprises a silicon compound represented by the general formula [6] in which h is 3; i is 0; and R15 is a C_1-C_6 alkyl group or a C_1-C_6 fluorine-containing alkyl group.

5. The surface treatment agent according to any one of claims 1 to 4, wherein the component (IV) comprises a silicon compound represented by the general formula [6] in which X is a chlorine atom.

6. The surface treatment agent according to any one of claims 1 to 5, wherein the component (IV) comprises $(CH_3)_3SiCl$.

7. The surface treatment agent according to any one of claims 1 to 6, wherein the concentration of the component (II) is 0.05 to 10 mass% with respect to the total amount of the components (I) to (IV).

8. The surface treatment agent according to any one of claims 1 to 7, wherein the component (II) is liquid at 25°C and 1.0 atmospheric pressure.

9. The surface treatment agent according to any one of claims 1 to 8, wherein, in the general formula [4], R^9 is a C_1-C_4 alkyl group or a trimethylsilyl group, and R^{10}, R^{11} and R^{12} are hydrogen atoms, respectively.

10. The surface treatment agent according to any one of claims 1 to 9, wherein the component (II) is at least one selected from the group consisting of N-methylimidazole, N-ethylimidazole, N-propylimidazole, N-butylimidazole and trimethylsilylimidazole.

11. The surface treatment agent according to any one of claims 1 to 10, wherein the concentration of the component (I) is 0.1 to 35 mass% with respect to the total amount of the components (I) to (IV).

12. The surface treatment agent according to any one of claims 1 to 11, wherein the component (I) comprises at least one kind of silicon compound represented by the general formula [1] in which a is 3; R^2 is a methyl group; and R^3 is a C_1-C_6 fluorine-containing alkyl group.

13. The surface treatment agent according to any one of claims 1 to 12, wherein the component (I) comprises $(CH_3)_3SiN(CH_3)C(=O)CF_3$.

14. The surface treatment agent according to any one of claims 1 to 13, wherein the component (I) comprises at least one kind of silicon compound represented by the general formula [2] in which c and e are each 3; and R^5 is a methyl group or a trifluoromethyl group.

15. The surface treatment agent according to any one of claims 1 to 14, wherein the component (I) comprises $(CH_3)_3SiOC(CF_3)=NSi(CH_3)_3$.

16. The surface treatment agent according to any one of claims 1 to 15, wherein the organic solvent is an aprotic solvent.

17. A method for manufacturing a surface treated body, comprising bringing the surface treatment agent according to any one of claims 1 to 16 into contact with a surface of a workpiece and thereby surface treating the workpiece.