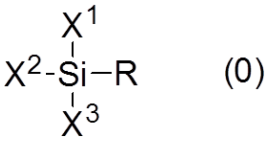
CLAIMS

1. A treatment composition comprising a silane-and-phosphorus-containing compound formed by reacting a mixture comprising one or more silane-containing components and one or more phosphorus-containing components wherein at least one of the silane-containing components has the following structure:

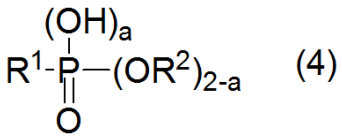


(0)

where R is selected from hydrogen, unsubstituted straight, cyclic and branched alkyl groups, unsubstituted aryl groups, unsubstituted heteroaryl groups, substituted straight, cyclic and branched alkyl groups, substituted aryl groups or substituted heteroaryl groups, wherein said substituted alkyl, aryl and heteroaryl groups are selected from halogen-substituted straight, cyclic and branched alkyl, halogen-substituted aryl groups or halogen-substituted heteroaryl groups, ether, amine, ester, amide, and alkoxy groups, with the proviso that there is no hydrogen bonded to a nitrogen or an oxygen in said silane-containing component of structure (0);

X^1, X^2 and X^3 are independently selected from the group consisting of halogens, alkoxy groups, organic acid groups, unsubstituted straight, cyclic and branched alkyl groups, unsubstituted aryl groups, unsubstituted heteroaryl groups, substituted straight, cyclic and branched alkyl groups, substituted aryl groups or substituted heteroaryl groups, wherein said substituted alkyl, aryl and heteroaryl groups are selected from halogen-substituted straight, cyclic and branched alkyl, halogen-substituted aryl groups, halogen-substituted heteroaryl groups, ether, amine, ester and amide groups, with the proviso that at least one of X^1, X^2 and X^3 is selected from the group consisting of a halogen, an alkoxy group or an organic acid group;

and at least one of said one or more phosphorus-containing components has the following structure:



(4)

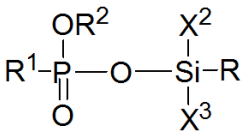
where, a is 1 or 2, and R^1 and R^2 are independently selected from hydrogen, unsubstituted straight, cyclic and branched alkyl groups, unsubstituted aryl groups,

unsubstituted heteroaryl groups, substituted straight, cyclic and branched alkyl groups, substituted aryl groups or substituted heteroaryl groups, wherein said substituted alkyl, aryl and heteroaryl groups are selected from halogen-substituted straight, cyclic and branched alkyl, halogen-substituted aryl groups, halogen-substituted heteroaryl groups, ether, amine, ester, amide, and alkoxy groups;

and optionally further comprising one or more non-aqueous solvents,

wherein the treatment composition comprises 0.001 to 10 wt % of the one or more phosphorus-containing components of structure (4).

2. The treatment composition of claim 1 said silane-and-phosphorus-containing compound comprises the following structure:



where R is selected from hydrogen, unsubstituted straight, cyclic and branched alkyl groups, unsubstituted aryl groups, unsubstituted heteroaryl groups, substituted straight, cyclic and branched alkyl groups, substituted aryl groups or substituted heteroaryl groups, wherein said substituted alkyl, aryl and heteroaryl groups are selected from halogen-substituted straight, cyclic and branched alkyl, halogen-substituted aryl groups, halogen-substituted heteroaryl groups, ether, amine, ester, amide, and alkoxy groups; X^2 and X^3 are independently selected from the group consisting of halogen, alkoxy groups, organic acid groups, hydrogens, or unsubstituted straight, cyclic and branched alkyl groups, unsubstituted aryl groups, unsubstituted heteroaryl groups, substituted straight, cyclic and branched alkyl groups, substituted aryl groups or substituted heteroaryl groups, wherein said substituted alkyl, aryl and heteroaryl groups are selected from halogen-substituted straight, cyclic and branched alkyl, halogen-substituted aryl groups, halogen-substituted heteroaryl groups, ether, amine, ester and amide groups, with the proviso that there is no hydrogen bonded to a nitrogen or an oxygen in said X^2, X^3 and R; and R^1 and R^2 are independently selected from hydrogen, unsubstituted straight, cyclic and branched alkyl groups, unsubstituted aryl groups, unsubstituted heteroaryl groups, substituted straight, cyclic and branched alkyl groups, substituted aryl groups or substituted heteroaryl groups, wherein said substituted alkyl, aryl and heteroaryl groups are selected from halogen-substituted straight, cyclic and branched

alkyl, halogen-substituted aryl groups or halogen-substituted heteroaryl groups, ether, amine, ester, amide, and alkoxy groups.

3. The treatment composition of claim 1 further wherein at least one of said X^1, X^2, or X^3 is a halogen.

4. The treatment composition of claim 1 further wherein one, and only one, of said X^1, X^2, or X^3 is a halogen.

5. The treatment composition of claim 1, 2 or 4 further and X^2, X^3, and R are independently selected from unsubstituted alkyl, aryl, and heteroaryl groups or fluorine-substituted alkyl, aryl, and heteroaryl groups.

6. The treatment composition of claim 1 wherein said silane-containing component of structure (0) is selected from the group consisting of alkoxydimethylalkylsilane, dialkoxymethylalkylsilane, trialkoxyalkylsilane, chlorodimethylalkylsilane, dichloromethylalkylsilane, trichloroalkylsilane, alkoxydiethylalkylsilane, dialkoxyethylalkylsilane, trialkoxyalkylsilane, chlorodiethylalkylsilane, dichloroethylalkylsilane, in which the alkyl groups independently comprise 1 to 30 carbons, and wherein said carbons may have halogens substituted for some or all hydrogens attached to said carbons, and the alkoxy groups may be any C_1-C_8 alkoxy group, and may comprise halogens substituted for some or all hydrogens in the alkoxy groups.

7. The treatment composition of claim 1, 2, 4 or 5 wherein said R comprises 7 to 30 carbons.

8. The treatment composition of claim 1, 2, 4, 5 or 7 wherein said R^1 comprises 4 to 30 carbon atoms in any of the substituted and unsubstituted alkyl, aryl and heteroaryl groups.

9. The treatment composition of claim 1, 3, 4 or 6 wherein said phosphorus-containing component of structure (4) is selected from the group consisting of octadecylphosphonic acid, octylphosphonic acid, decylphosphonic acid, dodecylphosphonic acid, tetradecylphosphonic acid, hexadecylphosphonic acid, eicosylphosphonic acid, docosylphosphonic acid and tetracosylphosphonic acid.

10. The treatment composition of claim 1, 3, 4, 6 or 9 comprising said one or more silane-containing components of structure (0) in excess of an amount that will react with said one or more phosphorus-containing component of structure (4).

11. The treatment composition of any of the preceding claims, further comprising said one or more non-aqueous solvents selected from the group consisting of: silicone oil, 3,3′,4,4′-oxydiphthalic dianhydride, benzyl alcohol, 1-octanol, NMP, glycol ether, C_{1-40} aliphatic hydrocarbons; C_{1-40} aromatic hydrocarbons, substituted naphthalenes, d-limonene, l-limonene, dl-limonene, orange peel oil, dipentene, halogenated hydrocarbons, fluorinated hydrocarbons, silane-containing components of structure (0), and mixtures thereof.

12. The treatment composition of any of the preceding claims further comprising one or more non-aqueous solvents selected from the group consisting of: silane-containing components of structure (0), silicone oil, hexane, octane, decane, dodecane, tetradecane, hexadecane, octadecane, icosane, benzene, toluene, xylene, mesitylene, naphthalene, methylnaphthalene, dimethylnapthalene, trimethylnapthalene, tetramethylnapthalene, tetrahydronaphthalene, d-limonene, l-limonene, dl-limonene, orange peel oil, dipentene, methylene chloride, chloroform, 1,1,1-trichloroethane, trichloroethylene; fluorochlorohydrocarbons, fluorochlorocarbons, chlorohydrocarbons, fluorohydrocarbons, fluorocarbons, chlorocarbons, ethers of fluorochlorohydrocarbon with hydrocarbon, fluorochlorohydrocarbons, fluorochlorocarbons, chlorohydrocarbons, fluorohydrocarbons, fluorocarbons or chlorocarbons; ethers of fluorochlorocarbon with hydrocarbon, fluorochlorohydrocarbons, fluorochlorocarbons, chlorohydrocarbons, fluorohydrocarbons, fluorocarbons or chlorocarbons; ethers of chlorohydrocarbon with hydrocarbon, fluorochlorohydrocarbon, fluorochlorocarbon, chlorohydrocarbon, fluorohydrocarbon, fluorocarbon or chlorocarbons; ethers of fluorohydrocarbon with hydrocarbon, fluorochlorohydrocarbons, fluorochlorocarbons, chlorohydrocarbons, fluorohydrocarbons, fluorocarbons or chlorocarbons; ethers of fluorocarbon with hydrocarbon, fluorochlorohydrocarbon, fluorochlorocarbon, chlorohydrocarbon, fluorohydrocarbon, fluorocarbon or chlorocarbon; ethers of chlorocarbon with hydrocarbon, fluorochlorohydrocarbon, fluorochlorocarbon, chlorohydrocarbon, fluorohydrocarbon, fluorocarbon or chlorocarbon; and mixtures thereof.

13. The treatment composition of claim 1, 3, 4, 6, 9, 10, 11 or 12 wherein said one or more silane-containing components of structure (0) is selected from the group consisting of chlorotrimethylsilane, chlorodimethyloctylsilane, trichlorooctylamine, bis(triethoxysilyl)ethane, and (tridecafluoro-1,1,2,2-tetrahydrooctyl)trichlorosilane.

14. The treatment composition of claim 1, 3, 4, 6, 9, 10, 11 or 12 wherein said treatment composition comprises: (i) 0.01 to 99.999 wt% of the one or more silane-containing components of structure (0); (ii) 0.001 to 10 wt % of the one or more phosphorus-containing components of structure (4); and (iii) 0 to 99.989 wt % non-aqueous solvent (excluding the silane-containing components of structure (0) which are included in (i)) based on the total weight of the composition.

15. The treatment composition of claim 1, 3, 4, 6, 9, 10, 11 or 12 wherein said treatment composition comprises: (i) 40 to 99.999 wt% of the one or more silane-containing components of structure (0); (ii) 0.001 to 10 wt % of the one or more phosphorus-containing components of structure (4); and (iii) 0 to 50 wt % non-aqueous solvent (excluding the silane-containing components of structure (0) which are included in (i)) based on the total weight of the composition.

16. The treatment composition of claim 1 wherein said treatment composition comprises: (i) 0.01 to 49.999 wt% of the one or more silane-containing components of structure (0); and (ii) 0.001 to 10 wt % of the one or more phosphorus-containing components of structure (4); and (iii) 50 to 99.989 wt % non-aqueous solvent (excluding the silane-containing components of structure (0) which are included in (i)) based on the total weight of the composition.

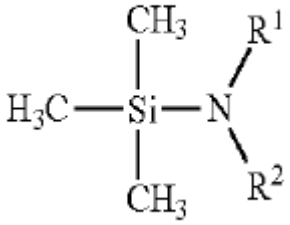
17. The treatment composition of any of the preceding claims wherein said silane-and-phosphorus-containing compound is selected from the group consisting of alkylsilyl alkylphosphonates, arylsilyl alkylphosphonates, alkylsilyl arylphosphonates, arylsilyl arylphosphonates, heteroarylsilyl alkylphosphonates, alkylsilyl heteroarylphosphonates, heteroarylsilyl heteroarylphosphonates, aryllsilyl heteroarylphosphonates and heteroarylsilyl arylphosphonates.

18. The treatment composition of any of the preceding claims wherein said silane-and-phosphorus-containing compound comprises dimethylsilyl octadecylphosphonate.

19. The treatment composition of any of the preceding claims, further comprising octanol and wherein said one or more phosphorus-containing components comprises octadecylphosphonic acid.

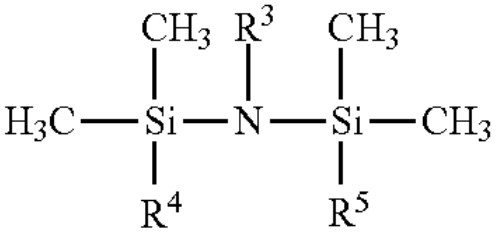
20. The treatment composition of any of the preceding claims, further comprising at least one silane-containing component selected from the following structure:

(1)



where R^1 represents a hydrogen atom, or a saturated or unsaturated alkyl group; R^2 represents a saturated or unsaturated alkyl group, a saturated or unsaturated cycloalkyl group, or a saturated or unsaturated heterocycloalkyl group; and R^1 and R^2 may link to each other to form a saturated or unsaturated heterocycloalkyl group having a nitrogen atom or the following structure

(2)



where R^3 represents a hydrogen atom, a methyl group, a trimethylsilyl group, or a dimethylsilyl group; and R^4 and R^5 each independently represent a hydrogen atom, a methyl group, an alkyl group, or a vinyl group.

21. A substrate comprising the treatment composition of any of the preceding claims.

22. A method of treating the surface of a substrate comprising the step of: contacting at least a portion of the surface of a substrate with a treatment composition of any of the preceding claims.

23. The method of claim 22 further comprising one or more optional additional steps selected from the steps of: cleaning said substrate; pre-rinsing said substrate in said one or more pre-rinsing steps with one or more optional pre-rinsing compositions prior to said contacting step; post-rinsing said substrate in one or more optional post-rinsing steps with one or more optional post-rinsing compositions; and drying said substrate.