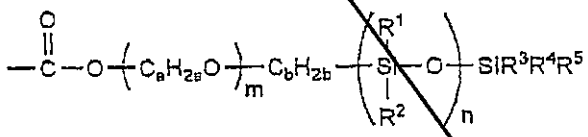
CLAIMS

1. An antifouling coating composition comprising:

a hydrolyzable resin having at least one kind of silicon-containing group selected from the group consisting of the groups represented by the following general formulas (I), (II), (III) and (IV) and a metal-atom-containing group containing a divalent metal atom M; and

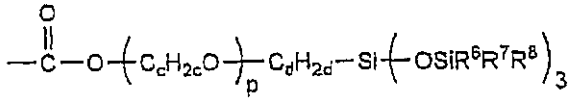
a thermoplastic resin and/or a plasticizer, wherein

the total content of said thermoplastic resin and/or plasticizer is 3 to 100 parts by mass per 100 parts by mass of said hydrolyzable resin:



(I)

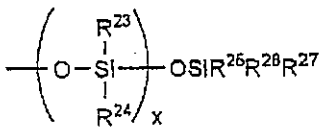
[wherein a and b each independently represent an integer of 2 to 5, m represents an integer of 0 to 50, and n represents an integer of 3 to 80; and R^1 to R^5 each independently represent an alkyl group, an alkoxy group, a phenyl group, a substituted phenyl group, a phenoxy group or a substituted phenoxy group];



(II)

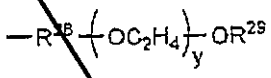
[wherein c and d each independently represent an integer of 2 to 5, and p represents an integer of 0 to 50; R^6, R^7 and R^8 each independently represent an alkyl group, R^a or R^b;

wherein R^a represents

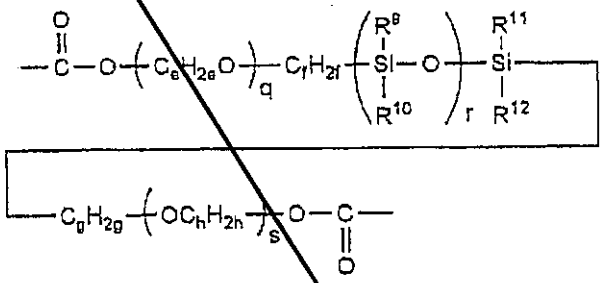


(wherein x represents an integer of 0 to 20; and R^{23} to R^{27} are the same or different and each represent an alkyl group), and

R^b represents

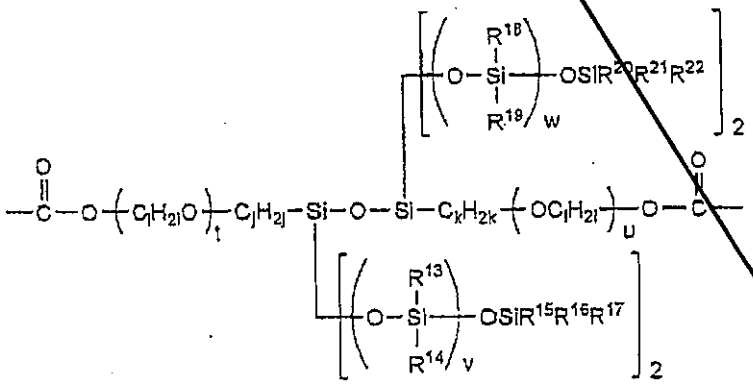


(wherein y represents an integer of 1 to 20; and R^{28} and R^{29} are the same or different and each represent an alkyl group)];



(III)

[wherein e, f, g and h each independently represent an integer of 2 to 5, q and s each independently represent an integer of 0 to 50, and r represents an integer of 3 to 80; and R^9 to R^{12} each independently represent an alkyl group, an alkoxy group, a phenyl group, a substituted phenyl group, a phenoxy group or a substituted phenoxy group]; and

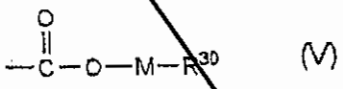


(IV)

[wherein i, j, k and l each independently represent an integer of 2 to 5, t and u each independently represent an integer of 0 to 50, and v and w each independently

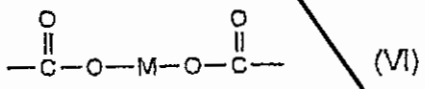
represent an integer of 0 to 20; and R^{13} to R^{22} are the same or different and each represent an alkyl group].

2. The antifouling coating composition according to claim 1, wherein said metal-atom-containing group is at least one kind of group selected from the group consisting of the groups represented by the following general formulas (V) and (VI):



(V)

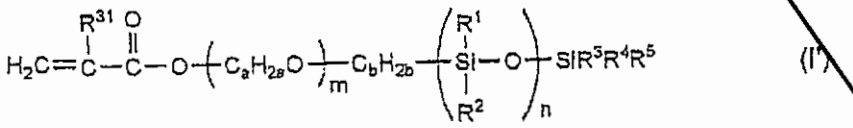
[wherein M represents a divalent metal atom, and R^{30} represents an organic acid residue or an alcohol residue]; and



(VI)

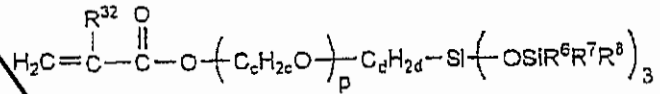
[wherein M represents a divalent metal atom].

3. The antifouling coating composition according to claim 1, wherein said hydrolyzable resin comprises a constituent unit derived from at least one kind of silicon-containing polymerizable monomer (a) selected from the group consisting of a monomer (a1) represented by the following general formula (I'), a monomer (a2) represented by the following general formula (II'), a monomer (a3) represented by the following general formula (III') and a monomer (a4) represented by the following general formula (IV'), and a constituent unit derived from a metal-atom-containing polymerizable monomer (b) containing a divalent metal atom M:



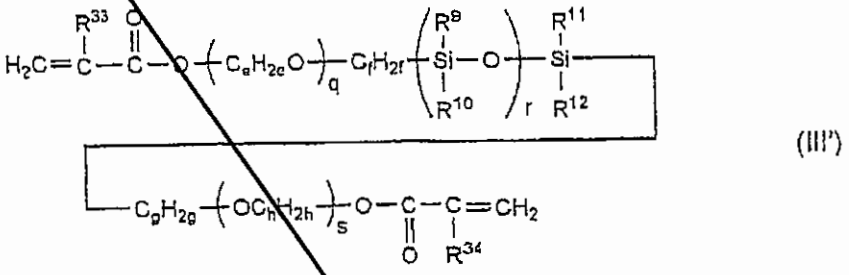
(I')

[wherein R^{31} represents a hydrogen atom or a methyl group, and a, b, m, n and R^1 to R^5 represent the same meaning as previously mentioned]:



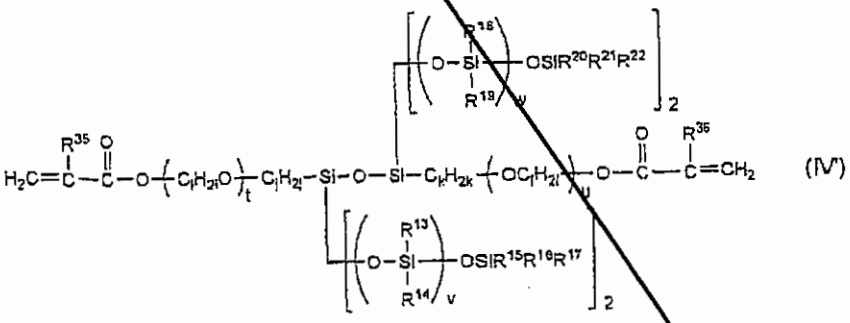
(II')

[wherein R^{32} represents a hydrogen atom or a methyl group, and c, d, p and R^6 to R^8 represent the same meaning as previously mentioned];



(III')

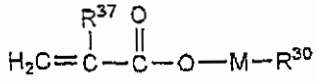
[wherein R^{33} and R^{34} represent a hydrogen atom or a methyl group, and e, f, g, h, q, r, s and R^9 to R^{12} represent the same meaning as previously mentioned]; and



(IV')

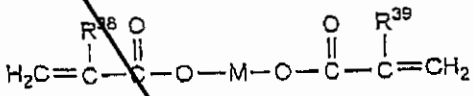
[wherein R^{35} and R^{36} represent a hydrogen atom or a methyl group, and i, j, k, l, t, u, v, w and R^{13} to R^{22} represent the same meaning as previously mentioned].

4. The antifouling coating composition according to claim 3, wherein said metal-atom-containing polymerizable monomer (b) includes at least one kind selected from the group consisting of a monomer (b1) represented by the following general formula (V') and a monomer (b2) represented by (VI'):



(V')

[wherein R^{37} represents a hydrogen atom or a methyl group, and M and R^{30} represent the same meaning as previously mentioned]; and



(VI')

[wherein R^{38} and R^{39} represent a hydrogen atom or a methyl group, and M represents the same meaning as previously mentioned].

5. The antifouling coating composition according to claim 3, wherein the ratio between the content of said constituent unit derived from the silicon-containing polymerizable monomer (a) and the content of said constituent unit derived from the metal-atom-containing polymerizable monomer (b) containing a divalent metal atom M is in the range of 30/70 to 90/10 by mass ratio.

6. The antifouling coating composition according to claim 1, wherein said thermoplastic resin is at least one kind selected from the group consisting of chlorinated paraffin, polyvinyl ether, rosin and a vinyl chloride-isobutylvinyl ether copolymer.

7. The antifouling coating composition according to claim 1, wherein said plasticizer is at least one kind selected from the group consisting of a phthalate ester plasticizer and a phosphate ester plasticizer.

8. The antifouling coating composition according to claim 1, containing 0 to 20 parts by mass of an antifouling agent per 100 parts by mass of the total amount of said hydrolyzable resin, said thermoplastic resin and said plasticizer.

9. An antifouling film formed from the antifouling coating composition according to claim 1.

10. A composite film having a primer film formed from an antirust paint, and an antifouling film formed from the antifouling coating composition according to claim 1, overlaid on said primer film.

11. The composite film according to claim 10, further having an intermediate film formed on the entire or part of a surface of said primer film between said primer film and said antifouling film.

12. The composite film according to claim 11, wherein said intermediate film is a coating film formed from an antifouling coating composition containing an antifouling agent.

13. An in-water structure having the antifouling film according to claim 9 or the composite film according to any one of claims 10 to 12.

14. A ship having the antifouling film according to claim 9 or the composite film according to any one of claims 10 to 12.

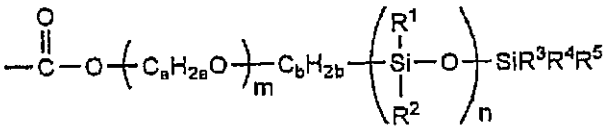
CLAIMS

1. An antifouling coating composition comprising:

a hydrolyzable resin having at least one kind of silicon-containing group selected from the group consisting of the groups represented by the following general formulas (I), (II), (III) and (IV) and a metal-atom-containing group containing a divalent metal atom M; and

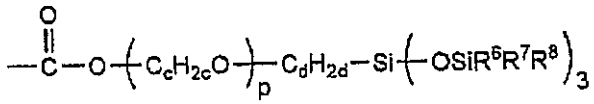
a thermoplastic resin and/or a plasticizer, wherein

the total content of said thermoplastic resin and/or plasticizer is 3 to 100 parts by mass per 100 parts by mass of said hydrolyzable resin:



(I)

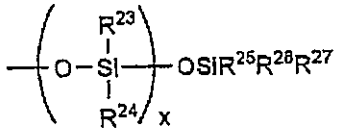
[wherein a and b each independently represent an integer of 2 to 5, m represents an integer of 0 to 50, and n represents an integer of 3 to 80; and R^1 to R^5 each independently represent an alkyl group, an alkoxy group, a phenyl group, a substituted phenyl group, a phenoxy group or a substituted phenoxy group];



(II)

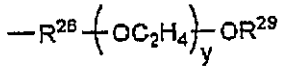
[wherein c and d each independently represent an integer of 2 to 5, and p represents an integer of 0 to 50; R^6, R^7 and R^8 each independently represent an alkyl group, R^a or R^b;

wherein R^a represents

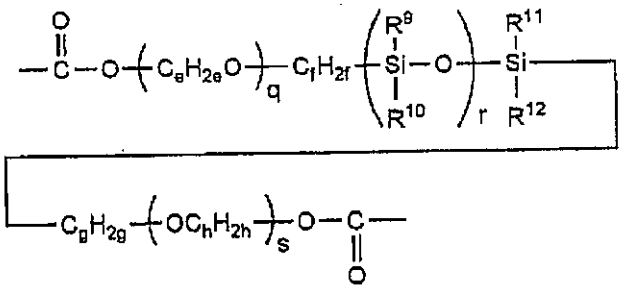


(wherein x represents an integer of 0 to 20; and R^{23} to R^{27} are the same or different and each represent an alkyl group), and

R^b represents

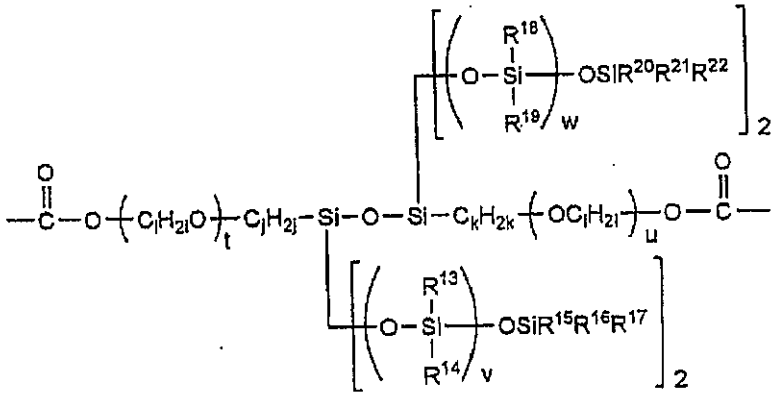


(wherein y represents an integer of 1 to 20; and R^{28} and R^{29} are the same or different and each represent an alkyl group)];



(III)

[wherein e, f, g and h each independently represent an integer of 2 to 5, q and s each independently represent an integer of 0 to 50, and r represents an integer of 3 to 80; and R^9 to R^{12} each independently represent an alkyl group, an alkoxy group, a phenyl group, a substituted phenyl group, a phenoxy group or a substituted phenoxy group]; and

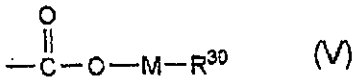


(IV)

[wherein i, j, k and l each independently represent an integer of 2 to 5, t and u each independently represent an integer of 0 to 50, and v and w each independently

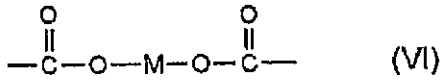
represent an integer of 0 to 20; and R^{13} to R^{22} are the same or different and each represent an alkyl group].

2. The antifouling coating composition according to claim 1, wherein said metal-atom-containing group is at least one kind of group selected from the group consisting of the groups represented by the following general formulas (V) and (VI):



(V)

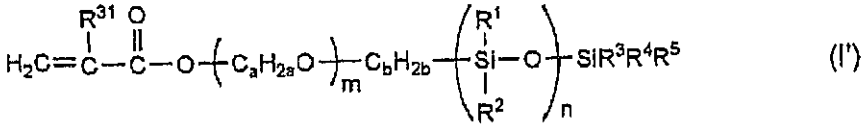
[wherein M represents a divalent metal atom, and R^{30} represents an organic acid residue or an alcohol residue]; and



(VI)

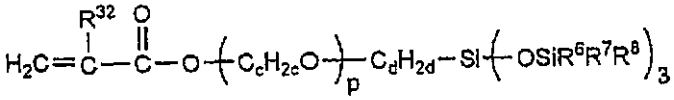
[wherein M represents a divalent metal atom].

3. The antifouling coating composition according to claim 1, wherein said hydrolyzable resin comprises a constituent unit derived from at least one kind of silicon-containing polymerizable monomer (a) selected from the group consisting of a monomer (a1) represented by the following general formula (I'), a monomer (a2) represented by the following general formula (II'), a monomer (a3) represented by the following general formula (III') and a monomer (a4) represented by the following general formula (IV'), and a constituent unit derived from a metal-atom-containing polymerizable monomer (b) containing a divalent metal atom M:



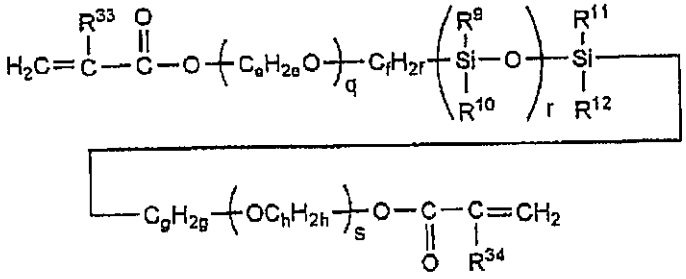
(I')

[wherein R^{31} represents a hydrogen atom or a methyl group, and a, b, m, n and R^1 to R^5 represent the same meaning as previously mentioned];



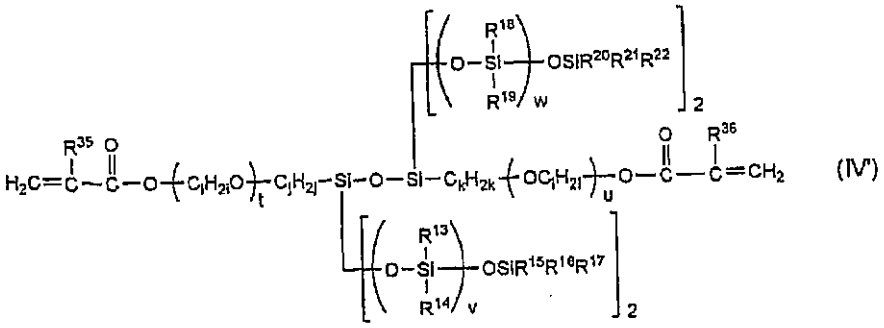
(II')

[wherein R^{32} represents a hydrogen atom or a methyl group, and c, d, p and R^6 to R^8 represent the same meaning as previously mentioned];



(III')

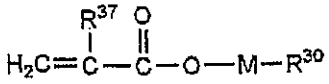
[wherein R^{33} and R^{34} represent a hydrogen atom or a methyl group, and e, f, g, h, q, r, s and R^9 to R^{12} represent the same meaning as previously mentioned]; and



(IV')

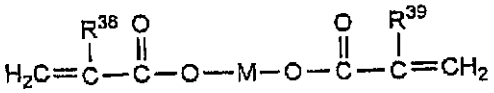
[wherein R^{35} and R^{36} represent a hydrogen atom or a methyl group, and i, j, k, l, t, u, v, w and R^{13} to R^{22} represent the same meaning as previously mentioned].

4. The antifouling coating composition according to claim 3, wherein said metal-atom-containing polymerizable monomer (b) includes at least one kind selected from the group consisting of a monomer (b1) represented by the following general formula (V') and a monomer (b2) represented by (VI'):



(V')

[wherein R^{37} represents a hydrogen atom or a methyl group, M represents a divalent metal atom, and R^{30} represents an organic acid residue or an alcohol residue]; and



(VI')

[wherein R^{38} and R^{39} represent a hydrogen atom or a methyl group, and M represents a divalent metal atom].

5. The antifouling coating composition according to claim 3, wherein the ratio between the content of said constituent unit derived from the silicon-containing polymerizable monomer (a) and the content of said constituent unit derived from the metal-atom-containing polymerizable monomer (b) containing a divalent metal atom M is in the range of 30/70 to 90/10 by mass ratio.

6. The antifouling coating composition according to claim 1, wherein said thermoplastic resin is at least one kind selected from the group consisting of chlorinated paraffin, polyvinyl ether, rosin and a vinyl chloride-isobutylvinyl ether copolymer.

7. The antifouling coating composition according to claim 1, wherein said plasticizer is at least one kind selected from the group consisting of a phthalate ester plasticizer and a phosphate ester plasticizer.

8. The antifouling coating composition according to claim 1, containing 0 to 20 parts by mass of an antifouling agent per 100 parts by mass of the total amount of said hydrolyzable resin, said thermoplastic resin and said plasticizer.

9. An antifouling film formed from the antifouling coating composition according to claim 1.

10. A composite film having a primer film formed from an antirust paint, and an antifouling film formed from the antifouling coating composition according to claim 1, overlaid on said primer film.

11. The composite film according to claim 10, further having an intermediate film formed on the entire or part of a surface of said primer film between said primer film and said antifouling film.

12. The composite film according to claim 11, wherein said intermediate film is a coating film formed from an antifouling coating composition containing an antifouling agent.

13. An in-water structure having the antifouling film according to claim 9 or the composite film according to any one of claims 10 to 12.

14. A ship having the antifouling film according to claim 9 or the composite film according to any one of claims 10 to 12.