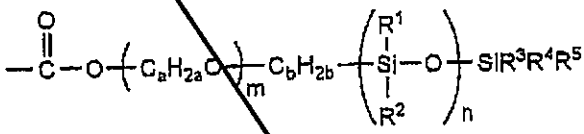
CLAIMS

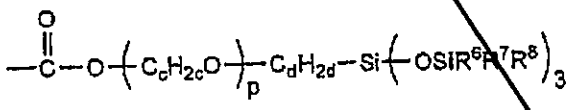
1. An antifouling coating composition comprising:

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 triorganosilyl oxycarbonyl group represented by the following general formula (V):



(I)

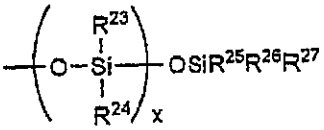
[wherein a and b each independently represent an integer of 2 to 5, m represents an integer of 0 to 50, and n represents an integer of 3 to 80; and R^1 to R^5 each independently represent an alkyl group, an alkoxy group, a phenyl group, a substituted phenyl group, a phenoxy group or a substituted phenoxy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



(II)

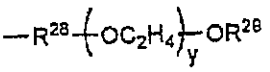
[wherein c and d each independently represent an integer of 2 to 5, and p represents an integer of 0 to 50; R^6, R^7 and R^8 each independently represent an alkyl group, R^a or R^b;

wherein R^a represents

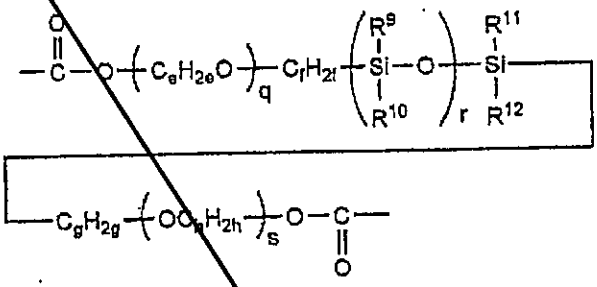


(wherein x represents an integer of 0 to 20; and R^{23} to R^{27} are the same or different and each represent an alkyl group), and

R^b represents

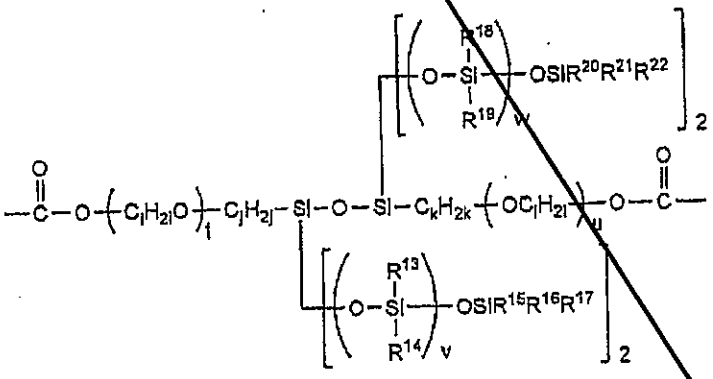


(wherein y represents an integer of 1 to 20; and R^{28} and R^{29} are the same or different and each represent an alkyl group)];



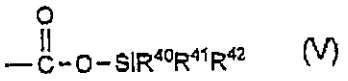
(III)

[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];



(IV)

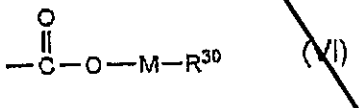
[wherein i, j, k and l each independently represent an integer of 2 to 5, t and u each independently represent an integer of 0 to 50, and v and w each independently represent an integer of 0 to 20; and R^{13} to R^{22} are the same or different and each represent an alkyl group]; and



(V)

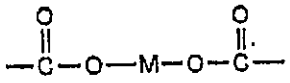
[wherein R^{40}, R^{41} and R^{42} are the same or different and represent a hydrocarbon residue having 1 to 20 carbon atoms].

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



(VI)

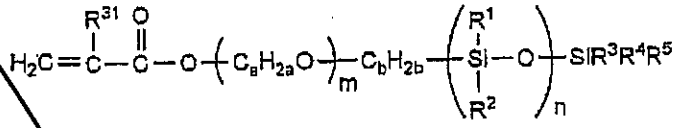
[wherein M represents a divalent metal atom, and R^{30} represents an organic acid residue or an alcohol residue]; and



(VII)

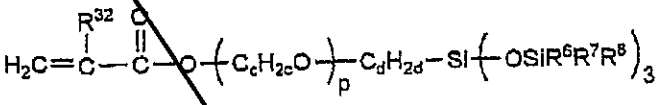
[wherein M represents a divalent metal atom].

3. The antifouling coating composition according to claim 1, wherein said hydrolyzable resin contains 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 triorganosilyl (meth)acrylate (b) represented by the following general formula (V'):



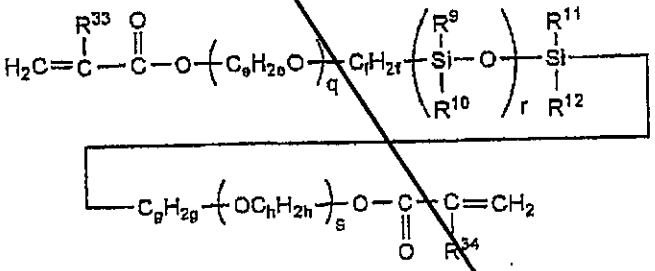
(I')

[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];



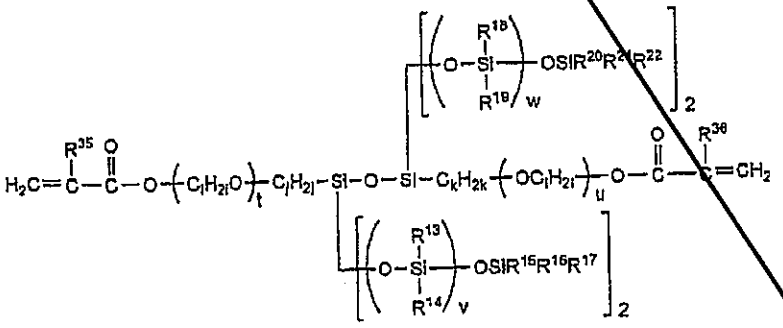
(II')

[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];



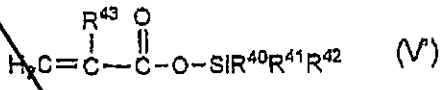
(III')

[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];



(IV')

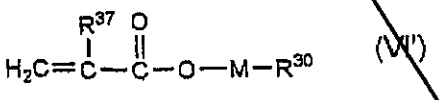
[wherein R^{35} and R^{36} represent a hydrogen atom or a methyl group, and i, j, k, l, t, u, v, w and R^{13} to R^{22} represent the same meaning as previously mentioned]; and



(V')

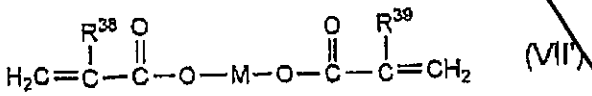
[wherein R^{43} represents a hydrogen atom or a methyl group, and R^{40} to R^{42} represent the same meaning as previously mentioned].

4. The antifouling coating composition according to claim 3, wherein said hydrolyzable resin further contains a constituent unit derived from at least one kind of metal-atom-containing polymerizable monomer (c) selected from the group consisting of a monomer (c1) represented by the following general formula (VI') and a monomer (c2) represented by (VII'):



(VI')

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



(VII')

[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 total content percentage of constituent units derived from said silicon-containing polymerizable monomer (a) and said triorganosilyl (meth)acrylate (b) in the entire constituent units of said hydrolyzable resin is within the range of 5 to 90% by mass.

6. The antifouling coating composition according to claim 3, wherein the ratio between the content of the constituent unit derived from said silicon-containing polymerizable monomer (a) and the content of the constituent unit derived from said triorganosilyl (meth)acrylate (b) is within the range of 20/80 to 80/20 by mass ratio.

7. The antifouling coating composition according to claim 4, wherein the ratio between the total content of the constituent units derived from said silicon-containing polymerizable monomer (a) and said triorganosilyl (meth)acrylate (b), and the content of the constituent unit derived from said metal-atom-containing polymerizable monomer (c) is within the range of 10/90 to 90/10 by mass ratio.

8. The antifouling coating composition according to claim 1, further comprising a thermoplastic resin and/or a plasticizer.

9. The antifouling coating composition according to claim 8, wherein the total content of said thermoplastic resin and/or plasticizer per 100 parts by mass of said hydrolyzable resin is 3 to 100 parts by mass.

10. The antifouling coating composition according to claim 8, wherein said thermoplastic resin is at least one kind selected from the group consisting of chlorinated paraffin, polyvinyl ether, rosin and a vinyl chloride-isobutyl vinyl ether copolymer.

11. The antifouling coating composition according to claim 8, wherein said plasticizer is at least one kind selected from the group consisting of a phthalate ester plasticizer and a phosphate ester plasticizer.

12. 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.

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

14. 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.

15. The composite film according to claim 14, 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.

16. The composite film according to claim 15, wherein said intermediate film is a coating film formed from an antifouling coating composition containing an antifouling agent.

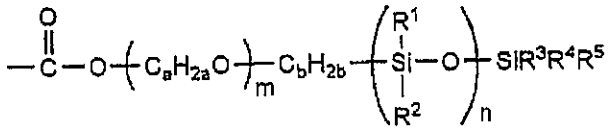
17. An in-water structure having the antifouling film according to claim 13 or the composite film according to any one of claims 14 to 16.

18. A ship having the antifouling film according to claim 13 or the composite film according to any one of claims 14 to 16.

CLAIMS

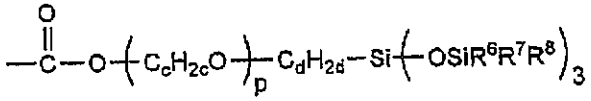
1. An antifouling coating composition comprising:

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 triorganosilyl oxycarbonyl group represented by the following general formula (V):



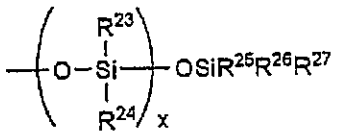
(I)

[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];



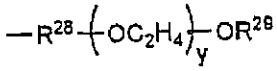
(II)

[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

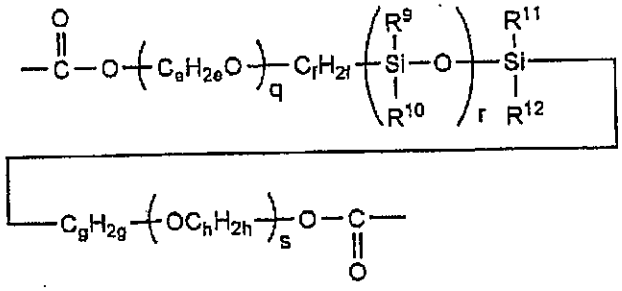


(wherein x represents an integer of 0 to 20; and R^{23} to R^{27} are the same or different and each represent an alkyl group), and

R^b represents

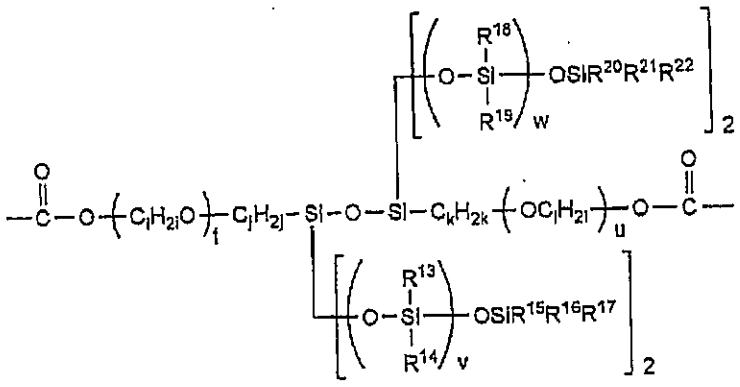


(wherein y represents an integer of 1 to 20; and R^{28} and R^{29} are the same or different and each represent an alkyl group)];



(III)

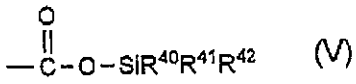
[wherein e, f, g and h each independently represent an integer of 2 to 5, q and s each independently represent an integer of 0 to 50, and r represents an integer of 3 to 80; and R^9 to R^{12} each independently represent an alkyl group, an alkoxy group, a phenyl group, a substituted phenyl group, a phenoxy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



(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

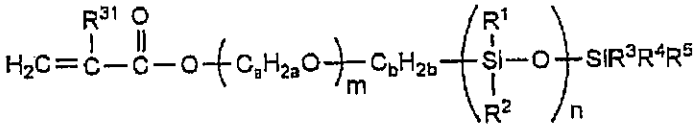
group]; and



(V)

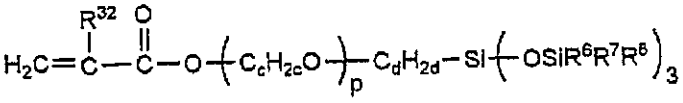
[wherein R^{40}, R^{41} and R^{42} are the same or different and represent a hydrocarbon residue having 1 to 20 carbon atoms],

wherein said hydrolyzable resin contains 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 triorganosilyl(meth)acrylate (b) represented by the following general formula (V'):



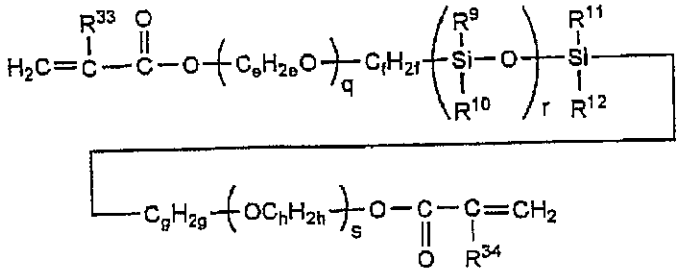
(I')

[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];



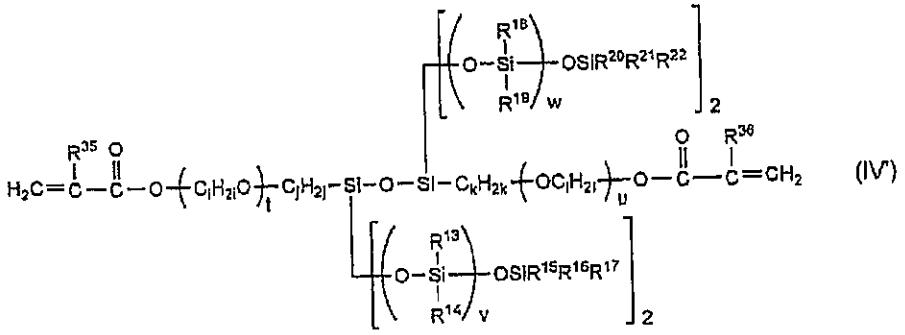
(II')

[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];



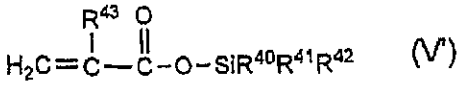
(III')

[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];



(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]; and

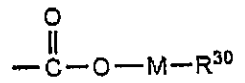


(V')

[wherein R^{43} represents a hydrogen atom or a methyl group, and R^{40} to R^{42} represent the same meaning as previously mentioned], wherein the ratio between the content of the constituent unit derived from said silicon-containing polymerizable monomer (a) and the content of the constituent unit derived from said triorganosilyl(meth)acrylate (b) is within the range of 20/80 to 80/20 by mass ratio.

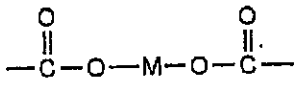
2. The antifouling coating composition according to claim 1, wherein said hydrolyzable resin further has at least one kind of metal-atom-containing group selected from the

group consisting of the groups represented by the following general formulas (VI) and (VII):



(VI)

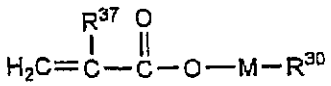
[wherein M represents a divalent metal atom, and R^{30} represents an organic acid residue or an alcohol residue]; and



(VII)

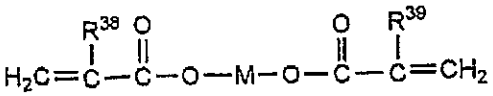
[wherein M represents a divalent metal atom].

3. The antifouling coating composition according to claim 1, wherein said hydrolyzable resin further contains a constituent unit derived from at least one kind of metal-atom-containing polymerizable monomer (c) selected from the group consisting of a monomer (c1) represented by the following general formula (VI') and a monomer (c2) represented by (VII'):



(VI')

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



(VII')

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

4. The antifouling coating composition according to claim 1, wherein the total content percentage of constituent units derived from said silicon-containing polymerizable monomer (a) and said triorganosilyl(meth)acrylate (b) in the entire constituent units of said hydrolyzable resin is within the range of 5 to 90% by mass.

5. The antifouling coating composition according to claim 3, wherein the ratio between the total content of the constituent units derived from said silicon-containing polymerizable monomer (a) and said triorganosilyl(meth)acrylate (b), and the content of the constituent unit derived from said metal-atom-containing polymerizable monomer (c) is within the range of 10/90 to 90/10 by mass ratio.

6. The antifouling coating composition according to claim 1, further comprising a thermoplastic resin and/or a plasticizer.

7. The antifouling coating composition according to claim 6, wherein the total content of said thermoplastic resin and/or plasticizer per 100 parts by mass of said hydrolyzable resin is 3 to 100 parts by mass.

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

9. The antifouling coating composition according to claim 6, wherein said plasticizer is at least one kind selected from the group consisting of a phthalate ester plasticizer and a phosphate ester plasticizer.

10. 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.

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

12. 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.

13. The composite film according to claim 12, 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.

14. The composite film according to claim 13, wherein said intermediate film is a coating film formed from an antifouling coating composition containing an antifouling agent.

15. An in-water structure having the antifouling film according to claim 11.

16. A ship having the antifouling film according to claim 11.