

DESCRIPTION

TRIPHENYLBORON COMPOUND-CONTAINING

ANTIFOULING COATING MATERIAL COMPOSITION

5 IMPROVED IN STABILITY, ANTIFOULING AGENT SET USED
FOR THE SAME AND METHOD FOR INHIBITING AND
CONTROLLING DECOMPOSITION OF TRIPHENYLBORON COMPOUND

TECHNICAL FIELD

10 [0001]

The present invention relates to a triphenylboron compound-containing antifouling coating material composition improved in stability, an antifouling agent set used for the same and a method for inhibiting and controlling
15 decomposition of a triphenylboron compound.

BACKGROUND ART

[0002]

At present, boron compounds such as pyridine-
20 triphenylboron and the like are widely used as antifouling agents for ship bottom coating materials and antifoulants for fishing nets. However, decomposition of a boron compound is expedited by a resin and other raw materials which are used in combination with the boron compound in preparing an

antifouling coating material and by a rise in the temperature and mixing of moisture in production and storage, and a content of a triphenylboron compound is reduced in a certain case during storage of the antifouling coating material.

5 Such antifouling coating material is reduced in an antifouling activity due to decomposition of the triphenylboron compound, and therefore it does not sufficiently display an intrinsic antifouling performance in a certain case when forming a coating film.

10 [0003]

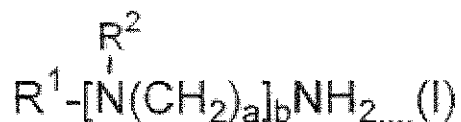
The following materials have so far been known as compositions (antifouling coating materials and the like) containing triphenylboron-amine complexes (pyridine-triphenylboron and the like) and other amine compounds.

15 [0004]

JP A 1998(H10)-77202 (patent document 1) discloses an antifouling composition for attached marine organisms prepared by dissolving an antifouling ingredient component comprising pyridine-triphenylborane and higher aliphatic
20 mono- or polyamine having an amino group in an organic solvent as an invention having an object of obtaining an antifouling composition which elevates a solubility of pyridine-triphenylboron and which does not cause precipitation. It is described therein that the above

antifouling composition has a good stability and does not form deposits (precipitates of triphenylboron) (evaluation in the examples: ○) and that since a solubility of pyridine-triphenylborane in an organic solvent is enhanced, it can
 5 evenly be coated on a net fabric in a coating bath when used as an antifoulant for fishing nets. The higher aliphatic mono- or polyamine having an amino group described above includes a compound represented by the following formula, and to be specific, diamine, triamine and the like are shown as
 10 the examples thereof.

[0005]



[0006]

(In Formula (1), R¹ is a saturated or unsaturated hydrocarbon
 15 group having 8 to 28 carbon atoms which may be substituted with a β-hydroxy group or a saturated or unsaturated alkoxy lower alkyl group having 8 to 28 carbon atoms; R² is a hydrogen atom or a group represented by -(CH₂)_{a=1-6}NH₂; a is an integer of 1 to 6; and b is an integer of 0 to 4.)

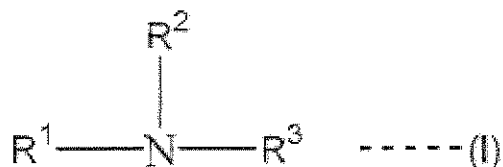
20 JP A 1998(H10)-167914 (patent document 2) discloses an antifouling composition for attached marine organisms comprising, as antifouling active ingredients, pyridine-triphenylborane and higher aliphatic secondary or tertiary

amine or a salt thereof as an invention having an object of enhancing an antifouling property. It is described therein that when the above antifouling composition (for example, a composition prepared by blending 15 parts of an acryl resin, 5 10 parts of pyridine-triphenylborane, 5 parts of di-n-coconut alkylamine and other components (total 100 parts) in Example 1) is used for fishing nets, ship bottoms and the like by coating it thereon, a so-called synergistic effect is displayed and that an antifouling effect thereof can be 10 continued.

[0007]

The higher aliphatic secondary or tertiary amine (I) described above includes a compound represented by the following formula, and to be specific, di-n-coconut 15 alkylamine, dimethyl beef tallow alkylamine, di-n-octylamine, dimethylhexadecylamine and the like are used.

[0008]



[0009]

20 (In Formula (1), R^1 , R^2 and R^3 may be the same as or different from each other and represent a saturated or unsaturated aliphatic hydrocarbon group having 1 to 28 carbon atoms which

may be substituted with one hydroxyl group or alkoxy group
(provided that one of R^1 , R^2 and R^3 may be a hydrogen atom).)

JP A 1998(H10)-182322 (patent document 3) discloses an
antifouling composition for attached marine organisms

5 comprising, as an antifouling active ingredient, a reaction
product obtained by reacting in advance triphenylborane or an
alkali metal hydroxide adduct thereof with specific higher
aliphatic polyamine or a salt thereof as an invention having
an object of enhancing an antifouling property. It is
10 described therein that the above antifoulant displays a so-
called synergistic effect and that an antifouling effect
thereof has continuity.

[0010]

JP A 1998(H10)-182323 (patent document 4) discloses an
15 antifouling composition for attached marine organisms
comprising, as an antifouling active ingredient, a reaction
product obtained by reacting in advance triphenylborane or an
alkali metal hydroxide adduct thereof with specific higher
aliphatic secondary or tertiary amine or a salt thereof as an
20 invention having an object of enhancing an antifouling
property. It is described therein that the above antifoulant
displays a so-called synergistic effect and that an
antifouling effect thereof has continuity.

[0011]

JP A 2004-244395 (patent document 5) discloses a composition comprising (4-isopropylpyridinyl)methyldiphenylboron (IPMB) and primary alkylamine having 8 to 18 carbon atoms as an invention having an object of obtaining an antifouling composition in which precipitates are not produced over a long period of time and in which stirring is not required before net coating work, considering particularly application thereof as an antifoulant for fishing nets. It is described therein that IPMB contained in the above composition is excellent in stability and does not lose an effect thereof even after stored over a long period of time, and that use of the above antifouling composition makes it possible to prevent organisms from being adhered over a long period of time.

[0012]

Further, n-octylamine, 2-ethylhexylamine, n-dodecylamine, n-octadecylamine and the like are shown as the examples of the primary alkylamine described above (paragraph [0019] of Patent document 5), and it is described therein that these amines are added usually in an amount of 0.5 to 2 moles based on 1 mole of IPMB, that if the above amine amount is less than 0.5 mole, the antifouling effect after stored over a long period of time is reduced and that if it exceeds 2 moles, the stability and the antifouling property are not

expected to be improved further more (paragraph [0009] of Patent document 5).

[0013]

However, the finding and technical idea that boron compounds contained in antifouling coating material compositions and the like are inhibited from being decomposed (improved in stability) by adding other amine compounds to triphenylboron-amine complexes such as pyridine-triphenylboron are not disclosed in any of the patent documents 1 to 5 described above. That is, it is neither described nor indicated therein that since in antifouling coating material compositions produced by using the above specific two components in combination, decomposition of the boron compounds caused by effects of combination thereof with other components such as a resin and the like, a rise in the temperature during production and storage and mixing of moisture is inhibited, the antifouling coating material compositions are excellent in a stability of an antifouling activity in storing for a long period and a long term antifouling property of an antifouling coating film obtained therefrom.

[0014]

JP A 2000-143417 (patent document 6) discloses underwater antifouling coating materials prepared by blending

underwater antifouling coating materials (antifoulants for fishing nets, antifouling coating materials for ship bottom and the like) comprising a compound as an active ingredient having a triphenylboron skeleton with at least one compound
5 selected from compounds having a -CONH- structure in a molecule and compounds having a heterocycle having 3 or more nitrogen atoms in a molecule (for example, tolyltriazole, 3-(N-salicyloyl)amino-1,2,4-triazole and 1,2,3-benzotriazole). It is described therein that even if the above underwater
10 antifouling coating material is further blended with cuprous oxide or copper rhodanate and the triphenylboron compound is brought into contact with them, the triphenylboron skeleton is scarcely decomposed and the underwater antifouling coating material can exhibit an excellent antifouling effect even
15 after stored over a long period of time.

[0015]

However, in the invention described above in which the compounds having a -CONH- structure in a molecule and the compounds of a triazole base are used, room for improvement
20 is left in terms of an effect to inhibit decomposition of a triphenylboron-amine complex.

[0016]

On the other hand, a method in which pyridine is added in quantitatively determining pyridine-triphenylboron (PIPB)

contained in artificial seawater with HPLC is described in
"Determination of Release Rate of Pyridine-triphenylborane
(PTPB) from Copper-free Antifouling Paints" (J. Jpn. Soc.
Colour Master, 78 [2], p. 50 to 57 (2005) by Kazunobu

5 Takahashi et al.: non-patent document 1).

[0017]

However, it is neither specifically described nor
indicated in the non-patent document 1 described above to
what extent the decomposition of PTPB is inhibited and
10 benzene is inhibited from being produced according to an
addition amount and the kind thereof when pyridine is
actually added to an antifouling coating material comprising
PTPB and, if necessary, a coating film-forming resin, and
whether or not a continuous and high antifouling performance
15 is displayed when an antifouling coating film is formed from
the above antifouling coating material. In addition thereto,
it is not even indicated in the above non-patent document 1
whether or not the same effect as that of pyridine is
obtained when amine compounds other than pyridine are added
20 and how the effects thereof are changed according to an
addition amount and the kind thereof.

Patent document 1: JP A 1998(H10)-77202

Patent document 2: JP A 1998(H10)-167914

Patent document 3: JP A 1998(H10)-182322

Patent document 4: JP A 1998(H10)-182323

5 Patent document 5: JP A 2004-244395

Patent document 6: JP A 2000-143417

Non-patent document 1: Kazunobu Takahashi et al.

"Determination of Release Rate of Pyridine-triphenylborane
(PTPB) from Copper-free Antifouling Paints" (J. Jpn. Soc.

10 Colour Master ,78 [2], p. 50 to 57 (2005)

DISCLOSURE OF THE INVENTION

Problem to be solved by the invention

[0018]

15 The present invention intends to solve the foregoing
problems involved in the conventional techniques, and an
object of the present invention is to provide an antifouling
coating material composition in which decomposition of a
triphenylboron compound contained therein is inhibited and
20 which is excellent in a stability of an antifouling activity
thereof in storing over a long period of time and forms an
antifouling coating film having an excellent long term
antifouling property. Further, an object thereof as another
aspect of the present invention is to provide an antifouling

agent set which can be used for producing an antifouling coating material composition having the excellent performances described above and a method for inhibiting and controlling decomposition of a triphenylboron-amine complex.

5

Means to solve the problem

[0019]

[1] The antifouling coating material composition according to the present invention is an antifouling coating material composition comprising a coating film-forming resin (A) and a triphenylboron-amine complex (b1) as an antifouling agent (B), wherein it further comprises an amine compound (C) (excluding the triphenylboron-amine complex (b1)) as a decomposition inhibitor for the triphenylboron-amine complex (b1).

[0020]

[2] The antifouling coating material composition according to the present invention further comprises preferably, in addition to the components (A), (B) and (C) described above, at least one component selected from the group consisting of an organic antifouling agent (b2) other than the triphenylboron-amine complex (b1), a color pigment (D), an extender pigment (E), an inorganic dehydrating agent

(F), a plasticizer (G), an anti-sagging/anti-settling agent (thixotropic agent) (H), an oxyalkylene group-containing linear organopolysiloxane (I) and at least one plastic resin selected from polybutenes, paraffins, vaselines and dialkyl sulfide compounds (J).

[0021]

[3] The amine compound (C) in the antifouling coating material composition described above is contained preferably in an amount of 1 to 210 parts by weight per 100 parts by weight of the triphenylboron-amine complex (b1).

[0022]

[4] The triphenylboron-amine complex (b1) in the antifouling coating material composition described above is contained preferably in an amount of 5 to 150 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

[0023]

[5] The amine compound (C) described above is preferably at least one selected from the group consisting of ammonia, heterocyclic amines, bridged cyclic amines, aliphatic amines which may contain an alkoxy group, alicyclic amines, aromatic amines and amino alcohols.

[0024]

[6] The amine compound (C) is preferably at least one

selected from the group consisting of primary amines, secondary amines and tertiary amines.

[0025]

[7] When the heterocyclic amine given in [5] is used as the amine compound (C), the heterocyclic amine is preferably a six-membered heterocyclic compound having 1 to 3 nitrogen atoms.

[0026]

[8] The six-membered heterocyclic compound described in [7] is preferably at least one selected from the group consisting of pyridines represented by pyridine (the pyridines may be incorporated into a polymer), pyridazines, pyrimidines, pyrazines, piperidines, piperazines, morpholines, picolines, quinolines represented by quinoline and isoquinoline, and quinaldines. The above six-membered heterocyclic compounds may be substituted with halogen, a lower alkyl group (1 to 3 carbon atoms), a phenyl group, an acetyl group, an amino group, a carboxyl group, a hydroxyl group or an alcohol group or may not be substituted (non-substituted).

[0027]

[9] When the heterocyclic amine given in [5] described above is used as the amine compound (C), the heterocyclic amine is preferably as well a five-membered heterocyclic

compound having 1 to 3 nitrogen atoms.

[0028]

[10] The five-membered heterocyclic compound given in [9] is preferably at least one selected from the group consisting of pyrroles, pyrrolines, indoles, isoindoles, imidazoles represented by imidazole, benzimidazoles, thiazoles and isothiazoles. The above five-membered heterocyclic compounds may be substituted with halogen, a lower alkyl group (1 to 3 carbon atoms), a phenyl group, an acetyl group, an amino group, a carboxyl group, a hydroxyl group or an alcohol group or may not be substituted (non-substituted).

[0029]

[11] When the bridged cyclic amine given in [5] described above is used as the amine compound (C), the bridged cyclic amine is preferably at least one of quinuclidines and triethylenediamines.

[0030]

[12] When at least one amine compound selected from the group consisting of primary amines, secondary amines and tertiary amines given in [6] described above is used as the amine compound (C), it is preferably at least one selected from:

at least one primary amine selected from n-propylamine,

n-butylamine, n-hexylamine, n-octylamine, n-decylamine, n-dodecylamine, n-tridecylamine, n-tetradecylamine, n-hexadecylamine, n-octadecylamine, aniline and toluidine;

at least one secondary amine selected from di-n-

5 butylamine, di-n-hexylamine, di-n-octylamine, di-n-decylamine, di-n-dodecylamine, di-n-tridecylamine, di-n-tetradecylamine, di-n-hexadecylamine, di-n-octadecylamine and diphenylamine; and

at least one tertiary amine selected from tri-n-

10 propylamine, tri-n-hexylamine, tri-n-octylamine, tri-n-decylamine, tri-n-dodecylamine, tri-n-tridecylamine, tri-n-tetradecylamine, tri-n-hexadecylamine, tri-n-octadecylamine and triphenylamine. Among them, the primary amines are preferred, and n-octadecylamine is particularly preferred.

15 [0031]

[13] The amine compound (C) given in [5] described above is preferably as well an alkoxy group-containing amine represented by the following Formula (I):

[0032]

20
$$\text{H}_2\text{N}-\text{R}^1-\text{O}-\text{R}^2 \quad (\text{I})$$

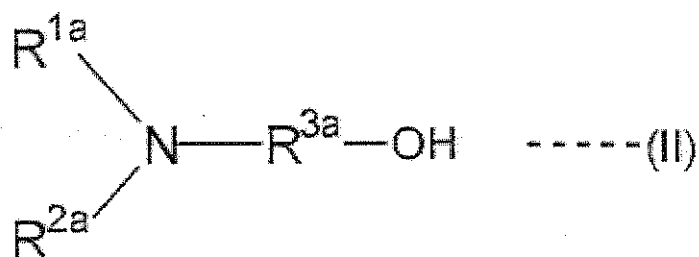
(in Formula (I), R^1 represents a linear or branched alkylene group having 1 to 8 carbon atoms or a phenylene group, and R^2 represents a linear or branched alkyl group having 1 to 18 carbon atoms).

[14] The alkoxy group-containing amine represented by Formula (I) in [13] described above is preferably at least one selected from the group consisting of 3-ethoxypropylamine, 3-butoxypropylamine, 3-(2-ethylhexyloxy)propylamine, 3-lauryloxypropylamine, 3-stearyloxypropylamine, 4-(2-ethylhexyloxy)butylamine, 4-lauryloxybutylamine, 8-ethoxyoctylamine, 8-(2-ethylhexyloxy)octylamine, 2-ethylhexyloxyphenylamine and lauryloxyphenylamine, and 3-(2-ethylhexyloxy)propylamine is particularly preferred.

10 [0033]

[15] The amine compound (C) given in [5] described above is preferably as well amino alcohol represented by any of the following Formulas (II), (III) and (IV):

[0034]



15

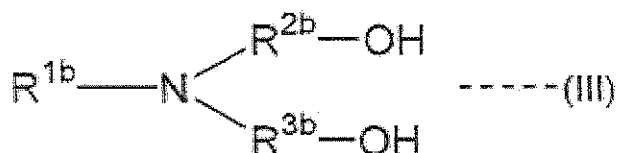
[0035]

(in Formula (II), R^{1a} and R^{2a} may be the same as or different from each other and are a hydrogen atom, an alkyl group or alkenyl group having 1 to 24 carbon atoms, a cycloalkyl group having 3 to 12 carbon atoms, an alkylallyl group (an alkyl group part has 1 to 24 carbon atoms), an aralkyl group (an

20

alkylene group part has 1 to 24 carbon atoms) or an allyl group, and R^{3a} is an alkylene group having 2 to 6 carbon atoms).

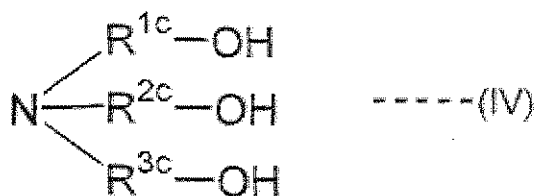
[0036]



[0037]

(in Formula (III), R^{1b} is a hydrogen atom, an alkyl group or alkenyl group having 1 to 24 carbon atoms, a cycloalkyl group having 3 to 12 carbon atoms, an alkylallyl group (an alkyl group part has 1 to 24 carbon atoms), an aralkyl group (an alkylene group part has 1 to 24 carbon atoms) or an allyl group, and R^{2b} and R^{3b} may be the same as or different from each other and are an alkylene group having 2 to 6 carbon atoms).

[0038]



[0039]

(in Formula (IV), R^{1c} , R^{2c} and R^{3c} may be the same as or different from each other and are an alkylene group having 2 to 6 carbon atoms).

[16] In the present invention, when the amine compound (C) described above is amino alcohol, this amino alcohol is preferably at least one selected from monoethanolamine, diethanolamine, triethanolamine, n-propyl alcohol amine, di-
5 n-propyl alcohol amine, tri-propyl alcohol amine, i-propyl alcohol amine, di-i-propyl alcohol amine and tri-i-propyl alcohol amine, and monoethanolamine included in Formula (II) is particularly preferred.

[0040]

10 [17] On the other hand, the triphenylboron-amine complex (b1) contained in the antifouling coating material composition according to the present invention is preferably a complex of triphenylboron with pyridine (pyridine-triphenylboron).

15 [0041]

[18] The triphenylboron-amine complex (b1) contained in the antifouling coating material composition according to the present invention is preferably as well a complex of triphenylboron with alkylamine.

20 [0042]

[19] The alkylamine forming the complex with triphenylboron in [18] described above is preferably at least one selected from the group consisting of n-propylamine, n-butylamine, n-hexylamine, n-octylamine, n-decylamine, n-

dodecylamine, n-tridecylamine, n-tetradecylamine, n-hexadecylamine, n-octadecylamine, aniline and toluidine, and n-octadecylamine is particularly preferred.

[0043]

5 [20] The triphenylboron-amine complex (b1) contained in the antifouling coating material composition according to the present invention is preferably as well a complex of triphenylboron with alkoxy group-containing amine.

[0044]

10 [21] The alkoxy group-containing amine forming the complex with triphenylboron in [20] described above is preferably a compound represented by the following Formula (I):

[0045]

15
$$\text{H}_2\text{N}-\text{R}^1-\text{O}-\text{R}^2 \quad (\text{I})$$

(in Formula (I), R^1 represents a linear or branched alkylene group having 1 to 8 carbon atoms or a phenylene group, and R^2 represents a linear or branched alkyl group having 1 to 8 carbon atoms).

20 [22] The alkoxy group-containing amine forming the complex with triphenylboron in [20] to [21] described above is preferably at least one selected from the group consisting of 3-ethoxypropylamine, 3-butoxypropylamine, 3-(2-ethylhexyloxy)propylamine, 3-lauryloxypropylamine, 3-

stearyloxypropylamine, 4-(2-ethylhexyloxy)butylamine, 4-lauryloxybutylamine, 8-ethoxyoctylamine, 8-(2-ethylhexyloxy)octylamine, 2-ethylhexyloxyphenylamine and lauryloxyphenylamine, and 3-(2-ethylhexyloxy)propylamine is particularly preferred.

[0046]

[23] The amine compound (C) is contained preferably in an amount of 0.1 to 3 moles per mole of the triphenylboron-amine complex (b1) in the antifouling coating material composition according to the present invention.

[0047]

[24] The coating film-forming resin (A) contained in the antifouling coating material composition as described in any of [1] to [23] described above is preferably at least one selected from the group consisting of (meth)acrylic acid metal salt copolymers, trialkylsilyl acrylate (co)polymers, vinyl chloride base resins, vinyl chloride-vinyl acetate copolymers, vinyl chloride-vinyl isobutyl ether copolymers, chlorinated rubber base resins, chlorinated polyethylene resins, chlorinated polypropylene resins, acryl resins, styrene-butadiene base resins, polyester base resins, epoxy base resins, phenol base resins, synthetic rubbers, silicone rubbers, silicone base resins, petroleum base resins, rosin ester base resins, rosin base soaps and rosin.

[0048]

[25] The antifouling coating material composition as described in [1] to [24] further comprises preferably, in addition to the triphenylboron•amine complex (b1), a
5 different organic antifouling agent (b2) as the antifouling agent (B).

[0049]

[26] The different organic antifouling agent (b2) in [25] described above is preferably at least one selected from
10 the group consisting of 2-pyridinethiol-1-oxide copper salt (copper pyrithione), 2-pyridinethiol-1-oxide zinc salt (zinc pyrithione), 4,5-dichloro-2-n-octyl-4-isothiazoline-3-one, N,N-dimethyldichlorophenylurea, 2,4,6-trichlorophenylmaleimide, 2-methylthio-4-tert-butylamino-6-
15 cyclopropyl-S-triazine, 2,4,5,6-tetrachloroisophthalonitrile, bisdimethyldithiocarbamoylzinc ethylenebisdithiocarbamate, chloromethyl-n-octyl disulfide, N,N'-dimethyl-N'-phenyl-(N-fluorodichloromethylthio)sulfamide, N,N'-dimethyl-N'-tolyl-(N-fluorodichloromethylthio)sulfamide, tetraalkylthiuram
20 disulfide (the alkyl group has 1 to 5 carbon atoms), zinc dimethyldithiocarbamate, zinc ethylenebisdithiocarbamate, 2,3-dichloro-N-(2',6'-diethylphenyl)maleimide, 2,3-dichloro-N-(2'-ethyl-6'-methylphenyl)maleimide and zinc sulfide.

[0050]

[27] The antifouling coating material composition as described in [1] to [26] further comprises preferably, in addition to the components described above, at least one color pigment selected from the group consisting of red iron oxide, titan white, yellow iron oxide and organic pigments as the color pigment (D) in an amount of 0.05 to 125 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

[0051]

[28] The antifouling coating material composition as described in [1] to [27] further comprises preferably, in addition to the components described above, at least one extender pigment selected from the group consisting of talc, silica, mica, clay, zinc oxide, calcium carbonate, kaolin, alumina white, white carbon, aluminum hydroxide, magnesium carbonate, barium carbonate, barium sulfate and zinc sulfide as the extender pigment (E) in an amount of 2.5 to 250 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

[0052]

[29] The antifouling coating material composition as described in [1] to [28] further comprises preferably, in addition to the components described above, at least one inorganic dehydrating agent selected from the group

consisting of anhydrite and gypsum hemihydrate (casting plaster) as the inorganic dehydrating agent (F) in an amount of 1.0 to 25 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

5 [0053]

[30] The antifouling coating material composition as described in [1] to [29] further comprises preferably, in addition to the components described above, at least one plasticizer selected from the group consisting of chlorinated paraffin and terphenol as the plasticizer (G) in an amount of 0.5 to 50 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

[0054]

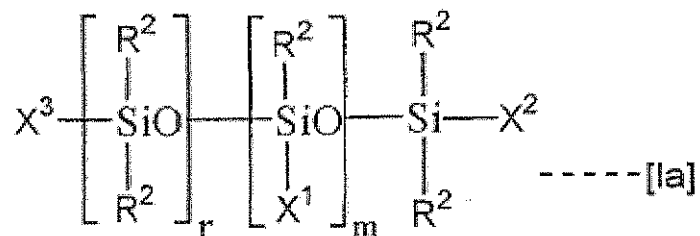
[31] The antifouling coating material composition as described in [1] to [30] further comprises preferably, in addition to the components described above, at least one anti-sagging/anti-settling agent selected from the group consisting of respective amine salts, stearate salts, lecithin salts and alkylsulfonic acid salts of Al, Ca and Zn (organic clay base wax); polyethylene wax, amide wax, hydrogenated castor oil wax and polyamide wax (organic wax); mixtures of the organic clay base wax and the organic wax described above; and synthetic fine powder silica; polyethylene oxide base wax; and fatty acid amide wax as the

anti-sagging/anti-settling agent (thixotropic agent) (H) in an amount of 0.25 to 50 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

[0055]

5 [32] The antifouling coating material composition as described in [1] to [31] further comprises preferably, in addition to the components described above, a compound represented by the following Formula [1a] in which a hydrophile-lipophile balance (HLB) is 2 to 12 as the
10 oxyalkylene group-containing linear organopolysiloxane (I) in an amount of 0.5 to 200 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content):

[0056]



15 [0057]

(in Formula [1a], X^1 , X^2 and X^3 each represent independently a polyether group: $-R-A-(R^3O)_n-R^4$ (R represents an alkylene group having 1 to 5 carbon atoms; A represents a single bond or an oxygen atom; R^3 represents an alkylene group having 1
20 to 5 carbon atoms; R^4 represents an alkyl group having 1 to 5 carbon atoms or hydrogen; and n represents a repeating unit

number) or an alkyl group having 1 to 5 carbon atoms; at least one of X^1 , X^2 and X^3 is the polyether group described above: $-R-A-(R^3O)_n-R^4$; R^2 represents an alkyl group having 1 to 3 carbon atoms; r and m each represent a repeating unit total number, and a bonding order of the repeating units $[-Si(R^2)_2O-]$ and $[-Si(R^2)(X^1)O-]$ may be optional).

[0058]

[33] The antifouling coating material composition as described in [1] to [32] further comprises preferably, if necessary, at least one of polybutenes, paraffins, vaselines and a dialkyl sulfide compound represented by the following Formula (VI) as the plastic resin (J) in addition to the components described above in an amount of 5 to 100 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content):

[0059]



(in Formula (VI), plural R^{3d} and R^{3e} may be the same as or different from each other and each represent a linear or branched alkyl group having 1 to 20 carbon atoms, and n represents an integer of 1 to 20).

[34] The antifouling agent set according to the present invention is characterized by comprising a triphenylboron-amine complex (b1) as an antifouling agent (B) and an amine

compound (C) (excluding the triphenylboron-amine complex (b1); hereinafter the same shall apply) as a decomposition inhibitor for the triphenylboron-amine complex (b1), and it further comprises, if necessary, a solvent (M) which can
5 dissolve the above components (b1) and (C); and the amine compound (C) is contained in an amount of 1 to 210 parts by weight per 100 parts by weight of the triphenylboron-amine complex (b1).

[0060]

10 [35] The triphenylboron-amine complex (b1) contained in the antifouling agent set described in [34] is preferably the same as the triphenylboron-amine complex used for the antifouling coating material composition as described in any of [17] to [22].

15 [0061]

[36] The amine compound (C) contained in the antifouling agent set described in [34] to [35] is preferably the same as the amine compound used for the antifouling coating material composition as described in any of [5] to
20 [16].

[0062]

[37] The antifouling coating film according to the present invention is characterized by comprising the antifouling coating material composition as described in any

of [1] to [33].

[0063]

[38] The substrate provided with a coating film according to the present invention is characterized by that a surface of the substrate is coated with a coating film obtained by curing the antifouling coating material composition as described in any of [1] to [33].

[0064]

[39] The antifouling substrate according to the present invention is characterized by that a surface of the substrate brought into contact with seawater or refined water is coated with a coating film obtained by curing the antifouling coating material composition as described in any of [1] to [33].

[0065]

[40] The antifouling substrate according to the present invention is preferably any of an underwater structure, a ship outside plate, a fishing net and a fishing equipment.

[0066]

[41] The method for forming a coating film on a surface of a substrate according to the present invention is characterized by coating or impregnating a surface of a substrate with the antifouling coating material composition as described any of [1] to [33] and then curing it to form a

coating film.

[0067]

[42] The antifouling method for a substrate according to the present invention is characterized by coating or
5 impregnating a surface of a substrate with the antifouling coating material composition as described in any of [1] to [33] and then curing the above antifouling coating material to form an antifouling coating film.

[0068]

10 [43] In the antifouling method for a substrate according to the present invention, the substrate described above is preferably any of an underwater structure, a ship outside plate, a fishing net and a fishing equipment.

[0069]

15 [44] The inhibiting and controlling method for decomposition of a triphenylboron-amine complex according to the present invention is characterized by adding the amine compound (C) (excluding the triphenylboron-amine complex (b1)) to the triphenylboron-amine complex (b1) or a material
20 containing the triphenylboron-amine complex (b1).

[0070]

[45] In the inhibiting and controlling method for decomposition of a triphenylboron-amine complex as described in [44], the triphenylboron-amine complex (b1) described

above is preferably the triphenylboron-amine complex as described in any of [17] to [22].

[0071]

[46] The amine compound (C) used in the inhibiting and
5 controlling method for decomposition of a triphenylboron-
amine complex as described in [44] to [45] is preferably the
same as the amine compound used for the antifouling coating
material composition as described in any of [5] to [16].

[0072]

10 An addition amount of the amine compound (C) is
preferably the amount as described in [3] in terms of a
weight ratio (that is, an amount of 1 to 210 parts by weight
per 100 parts by weight of the triphenylboron-amine complex
(b1)) and the amount as described in [23] in terms of a mole
15 ratio (that is, an amount of 0.1 to 3 moles per mole by
weight of the triphenylboron-amine complex (b1)).

Effect of the invention

[0073]

20 The antifouling coating material composition according
to the present invention is inhibited, though containing the
triphenylboron compound (triphenylboron-amine complex) as the
antifouling agent, in decomposition of the triphenylboron
compound in storing, and it is referred to as an antifouling

coating material having an excellent storage stability. The above antifouling coating material is applied onto parts of ships, fishing nets, other fishing materials and the like which are brought into contact with seawater, whereby an
5 antifouling coating film having an excellent static antifouling property is obtained.

[0074]

If the antifouling agent set according to the present invention is blended as an antifouling agent with an
10 antifouling coating material, decomposition of the triphenylboron compound in storing is inhibited, and an antifouling coating material which can form an antifouling coating film having an excellent static antifouling property is obtained.

15 [0075]

According to the inhibiting and controlling method for decomposition of a triphenylboron-amine complex related to the present invention, decomposition of the triphenylboron-amine complex (b1) can readily and efficiently be inhibited,
20 and as a result thereof, production of benzene and generation of benzene odor which are brought about by decomposition of the triphenylboron-amine complex (b1) can notably be inhibited and reduced. In particular, the effects of the triphenylboron-amine complex (b1) as an antifouling agent are

continued favorably as well during storage and preservation of the antifouling coating material composition by adding the amine compound (C) to the triphenylboron-amine complex (b1) contained in the antifouling coating material composition.

5 As a result thereof, an antifouling effect of the coating film formed from the antifouling coating material can be continued over a long period of time.

BEST MODE FOR CARRYING OUT THE INVENTION

10 [0076]

The triphenylboron compound-containing antifouling coating material composition (hereinafter referred to as the antifouling coating material) according to the present invention which is improved in stability and the antifouling agent set which can be used for producing the same shall
15 specifically be explained below.

[0077]

Antifouling coating material composition and
20 antifouling agent set used for preparing the same

The antifouling coating material composition according to the present invention comprises the coating film-forming resin (A), the specific triphenylboron-amine complex (b1) as the antifouling agent (B) and the amine compound (C)

(excluding the triphenylboron-amine complex (b1); hereinafter the same shall apply) as the decomposition inhibitor for the triphenylboron-amine complex (b1) described above.

[0078]

5 The antifouling agent set according to the present invention comprises the specific triphenylboron-amine complex (b1) as the antifouling agent (B) and the amine compound (C) as the decomposition inhibitor for the triphenylboron-amine complex (b1) described above.

10 [0079]

 The solvent (M) which can dissolve the triphenylboron-amine complex (b1) and/or the amine compound (C), preferably both of the above components (b1) and (C), may further be contained, if necessary, in the above antifouling coating
15 material composition and antifouling agent set.

[0080]

 Further, at least one component of the other organic antifouling agent (b2), the color pigment (D), the extender pigment (E), the inorganic dehydrating agent (F), the
20 plasticizer (G), the anti-sagging/anti-settling agent (thixotropic agent) (H), the oxyalkylene group-containing linear organopolysiloxane (I) and the plastic resin (J) which are described later may further be contained, if necessary, in the above antifouling coating material composition.

[0081]

The respective components shall be explained below in order.

[0082]

5 - Coating film-forming resin (A):

The coating film-forming resin (A) contained in the antifouling coating material composition according to the present invention shall not specifically be restricted as long as it is a resin blended with conventional ship bottom
10 coating materials, antifoulants for fishing nets and the like. Resins which are hydrolyzed in seawater (e.g., a case of (meth)acrylic acid metal salt base copolymers) or dissolved therein (e.g., a case of rosin) to thereby allow a fresh
15 coating film surface to appear (self renewability of coating film) and which can release an antifouling agent contained in the coating film to exhibit an antifouling effect can be used, and in addition thereto, non-water soluble and non-hydrolyzable resins (e.g., vinyl chloride base resins) can be used as well.

20 [0083]

The coating film-forming resin (A) includes, for example, (meth)acrylic acid metal salt copolymers, trialkylsilyl acrylate (co)polymers, vinyl chloride base resins, vinyl chloride-vinyl acetate copolymers, vinyl

chloride-vinyl isobutyl ether copolymers, chlorinated rubber base resins, chlorinated polyethylene resins, chlorinated polypropylene resins, acryl resins, styrene-butadiene base resins, polyester base resins, epoxy base resins, phenol base resins, synthetic rubbers, silicone rubbers, silicone base resins, petroleum base resins, rosin ester base resins, rosin base soaps, rosin and the like. They may be used alone or in combination of two or more kinds thereof.

[0084]

10 Further, in the antifouling coating material composition according to the present invention, the resins described above can be used in combination with a monobasic acid. The monobasic acid includes, for example, rosin, versatic acid, naphthenic acid,

15 triphenylisobutenylcyclohexanecarboxylic acid (e.g., trade name: A-3000, manufactured by Yasuhara Chemical Co., Ltd.) and the like.

[0085]

An amount of the coating film-forming resin (A) (solid content) contained in the antifouling coating material composition according to the present invention is usually 5 to 35 % by weight, preferably 15 to 25 % by weight considering the coating property and a surface flatness of the coating film. The monobasic acid can be blended, if

necessary, with the coating material in an amount of 0.1 to 20 % by weight, preferably 0.5 to 15 % by weight considering the physical properties of the coating film. A blend ratio of the resin to the monobasic acid shall not specifically be restricted, and the monobasic acid can be blended in an amount of usually 0.1 to 250 parts by weight, preferably 0.5 to 200 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

10 [0086]

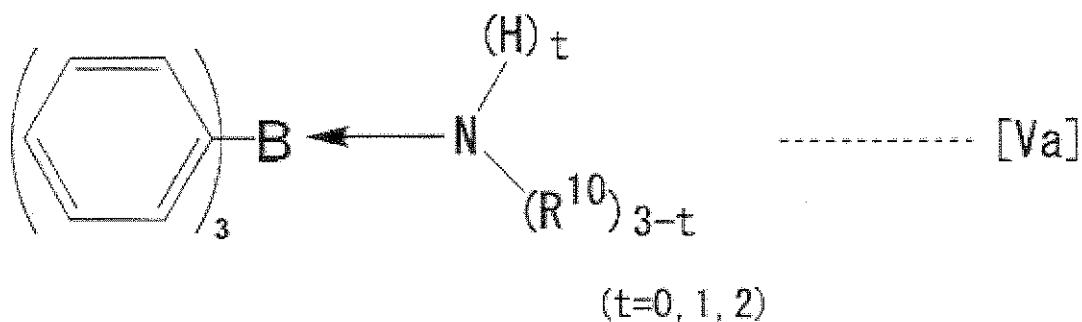
- Triphenylboron-amine complex (b1):

The antifouling coating material composition according to the present invention is blended with at least the triphenylboron-amine complex (b1) (particularly preferably pyridine-triphenylboron) as the antifouling agent (B).

[0087]

Capable of being used as the triphenylboron-amine complex (b1) are triphenylboron-amine complexes (b1) represented by the following Formula [Va] described in paragraph [0041] of JP A 2006-188453 and paragraphs [0049] to [0053] of JP A 2006-176785 which are disclosed by the present applicants:

[0088]



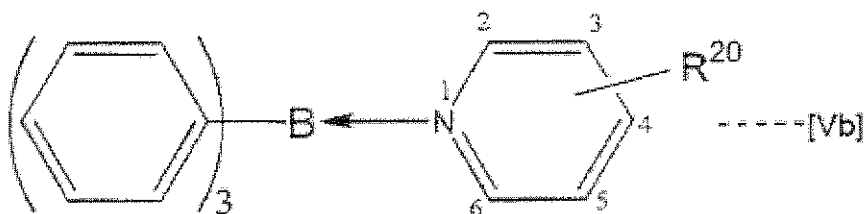
[0089]

In Formula [Va], R^{10} represents an alkyl group having 3 to 30 carbon atoms which may be linear or branched or an alkoxy group represented by $-R^1-O-R^2$ (R^1 represents a linear or branched alkylene group having 1 to 8 carbon atoms or a phenylene group, and R^2 represents a linear or branched alkyl group having 1 to 18 carbon atoms); and t is 0, 1 or 2.

[0090]

Further, a triphenylboron-pyridine (pyridine-triphenylborane) base compound represented by the following Formula [Vb] can be used as well for the triphenylboron-amine complex (b1):

[0091]



[0092]

In Formula [Vb], R^{20} represents H, a halogen atom (F,

Cl, Br or I) or an alkyl group having 1 to 5 carbon atoms which may be linear or branched).

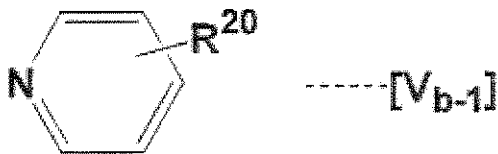
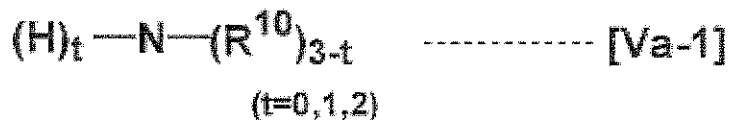
[0093]

That is, the triphenylboron-amine complex (b1) represented by Formula [Va] or [Vb] is a complex formed between triphenylboron and amines.

[0094]

The amines used in forming the triphenylboron-amine complex (b1) represented by Formula [Va] or [Vb] are compounds represented by the following Formula [Va-1] or [Vb-1] (R^{10} and R^{20} are defined in the same manner as in Formulas [Va] and [Vb]). They may be any of aliphatic amines, alicyclic amines, aromatic amines, heterocyclic amines, and these amines may be any of primary amines, secondary amines and tertiary amines and are preferably the primary amine in terms of a stability of the triphenylboron-amine complex (b1).

[0095]



[0096]

The amines [Va-1] or [Vb-1] used in forming the

triphenylboron-amine complex (b1) represented by Formula [Va] or [Vb] include, to be specific,

primary amines such as propylamine, butylamine, hexylamine, octylamine, decylamine, dodecylamine, 5 tridecylamine, tetradecylamine, hexadecylamine, octadecylamine, 3-(2-ethylhexyl)propylamine, 3-(2-ethylhexyloxy)propylamine, aniline, toluidine and the like;

secondary amines such as dibutylamine, dihexylamine, dioctylamine, didecylamine, didodecylamine, ditridecylamine, 10 ditetradecylamine, dihexadecylamine, dioctadecylamine, diphenylamine and the like; and

tertiary amines such as tripropylamine, trihexylamine, trioctylamine, tridecylamine, tridodecylamine, tritridecylamine, tritetradecylamine, trihexadecylamine, 15 trioctadecylamine, triphenylamine and the like.

[0097]

Among them, the primary amines are preferred, and octadecylamine is particularly preferred.

[0098]

20 In particular, when R^{10} of the amines [Va-1] used in forming the triphenylboron-amine complex represented by Formula [Va] is an alkoxy group represented by $-R^1-O-R^2$ (R^1 and R^2 are defined in the same manner as described above), the above amines are called alkoxy-containing amines, and

among them, alkoxy-containing amine represented by the following Formula (I) is preferred:

[0099]



5 In Formula (I), R^1 and R^2 are defined in the same manner as described above. That is, R^1 represents a linear or branched alkylene group having 1 to 8 carbon atoms or a phenylene group, and R^2 represents a linear or branched alkyl group having 1 to 18 carbon atoms.

10 [0100]

To be specific, the alkoxy-containing amine (I) includes, for example, 3-ethoxypropylamine, 3-butoxypropylamine, 3-(2-ethylhexyloxy)propylamine, 3-lauryloxypropylamine, 3-stearyloxypropylamine, 4-(2-ethylhexyloxy)butylamine, 4-lauryloxybutylamine, 8-ethoxyoctylamine, 8-(2-ethylhexyloxy)octylamine, 2-ethylhexyloxyphenylamine, lauryloxyphenylamine and the like.

[0101]

Among the above alkoxy-containing amines (I), 3-(2-ethylhexyloxy)propylamine is preferred.

[0102]

The amines represented by Formula [Vb-1] described above which are used in forming the triphenylboron-amine complex (b1) represented by Formula [Vb] can be shown by

examples such as pyridines, in addition to pyridine, including nuclear substituents of pyridine such as:

2-picoline, 3-picoline and 4-picoline which are obtained by substituting one H ($= R^{20}$) of pyridine with methyl; and

2-chloropicoline, 3-chloropicoline and 4-chloropicoline which are obtained by substituting one H ($= R^{20}$) of pyridine with Cl. Pyridine is particularly preferred in terms of a stability of the triphenylboron-amine complex (b1).

10 [0103]

Among the triphenylboron-amine complexes (b1) represented by Formula [Va] or [Vb], preferably used are triphenyl(octadecylamine)boron (that is, in Formula [Va], t is 2, and R^{10} is octadecyl group);

15 complexes of triphenylboron with alkoxy-containing amine, particularly triphenyl[3-(2-ethylhexyloxy)propylamine]boron (in Formula [Va], t is 2, and R^{10} is 3-(2-ethylhexyloxy)propyl group); and

triphenylboron-pyridine (pyridine-triphenylborane, 20 abbreviated as PTPB, that is, in Formula [Vb], R^{20} is H).

[0104]

- Amine compound (C):

The amine compound (C) in the present invention has a

function as a decomposition inhibitor for the triphenylboron-amine complex (b1).

[0105]

It is estimated that the amine compound (C) can inhibit
5 decomposition of the triphenylboron-amine complex (b1) in the antifouling coating material composition because of the following reason and reaction mechanism.

[0106]

The triphenylboron-amine complex (b1) in the coating
10 material stays in an equilibrium state with triphenylboron and the amine compound which stay in the state that the above complex (b1) is disengaged (dissociated), and it is considered that a bond of triphenylboron with the amine compound is formed by further adding the amine compound (C)
15 and that the equilibrium is deviated to a direction in which the complex (b1) is formed.

[0107]

If an acid component is added to the coating material blended with the above triphenylboron-amine complex (b1), the
20 decomposition reaction of the triphenylboron-amine complex (b1) tends to be accelerated, and if the temperature is elevated in producing or storing the coating material blended with the above triphenylboron-amine complex (b1) or moisture and foreign matters such as metals and the like are mixed

therein, the decomposition reaction of the triphenylboron-amine complex (b1) tends to be accelerated as well.

[0108]

The above decomposition reaction is considered to
5 proceed because of the reasons that a bond between
triphenylboron and the amine compound is broken to bare a
vacant orbital of a boron atom in the triphenylboron-amine
complex (b1) to thereby enhance the chemical reactivity and
that the structure of triphenylboron becomes instable, so
10 that a phenyl group is released.

[0109]

In contrast with this, it can be estimated that in the
present invention, if a bond between triphenylboron and the
amine compound (coordinately bonded with this triphenylboron)
15 is broken, the amine compound (C) which is added and
supplemented prevents the skeleton of the triphenylboron-
amine complex (b1) from becoming instable to contribute to
inhibition of the decomposition of the triphenylboron-amine
complex (b1).

20 [0110]

The above amine compound (C) may be any of ammonia,
heterocyclic amines, bridged cyclic amines, aliphatic amines,
alicyclic amines, aromatic amines and amino alcohols. An
alkoxy group-containing amine compound is included as well

in the aliphatic amines described above.

[0111]

The amine compound (C) may be any of primary amines, secondary amines and tertiary amines, and among them, the
5 primary amines are preferred in terms of a decomposition inhibiting effect of the triphenylboron-amine complex (b1).

[0112]

The heterocyclic amines described above include a six-membered heterocyclic compound having 1 to 3 nitrogen atoms,
10 a five-membered heterocyclic compound having 1 to 3 nitrogen atoms and the like.

[0113]

Among them, the six-membered heterocyclic compound having 1 to 3 nitrogen atoms is preferably pyridines,
15 pyridazines, pyrimidines, pyrazines, piperidines, piperazines, morpholines, picolines, quinolines and quinaldines, and the above six-membered heterocyclic compounds may be substituted with halogen, a lower alkyl group (1 to 3 carbon atoms), a phenyl group, an acetyl group, an amino group, a carboxyl
20 group, a hydroxyl group and an alcohol group or may not be substituted (non-substituted). Further, in the case of pyridine, it may be incorporated into a polymer as is the case with 4-vinylpyridine.

[0114]

When the amine compound (C) is selected from the six-membered heterocyclic compounds described above, preferred are pyridines represented by 4-hydroxypyridine and 4-acetylpypidine and quinolines represented by quinoline and isoquinoline.

[0115]

On the other hand, the five-membered heterocyclic compound having 1 to 3 nitrogen atoms is preferably pyrroles, pyrrolines, indoles, isoindoles, imidazoles, benzimidazoles, thiazoles and isothiazoles, and the above five-membered heterocyclic compounds may be substituted with halogen, a lower alkyl group (1 to 3 carbon atoms), a phenyl group, an acetyl group, an amino group, a carboxyl group, a hydroxyl group and an alcohol group or may not be substituted (non-substituted).

[0116]

When the amine compound (C) is selected from the five-membered heterocyclic compounds described above, imidazoles represented by imidazole are preferred.

[0117]

The bridged cyclic amines are preferably quinuclidines and triethylenediamines.

[0118]

When the amine compound (C) is selected from the

bridged cyclic amines described above, triethylenediamines represented by triethylenediamine are preferred.

[0119]

In addition thereto, the aliphatic amines, the
5 alicyclic amines and the aromatic amines include the same compounds as the amines described above for forming the triphenylboron-amine complex (b1).

[0120]

To be specific, preferred are, for example, primary
10 amines such as n-propylamine, n-butylamine, n-hexylamine, n-octylamine, n-decylamine, n-dodecylamine, n-tridecylamine, n-tetradecylamine, n-hexadecylamine, n-octadecylamine, aniline, toluidine and the like;

secondary amines such as di-n-butylamine, di-n-
15 hexylamine, di-n-octylamine, di-n-decylamine, di-n-dodecylamine, di-n-tridecylamine, di-n-tetradecylamine, di-n-hexadecylamine, di-n-octadecylamine, diphenylamine and the like; and

tertiary amines such as tri-n-butylamine, tri-n-
20 hexylamine, tri-n-octylamine, tri-n-decylamine, tri-n-dodecylamine, tri-n-tridecylamine, tri-n-tetradecylamine, tri-n-hexadecylamine, tri-n-octadecylamine, triphenylamine and the like.

[0121]

When the amine compound (C) is selected from the alkoxy group-containing amines described above, the alkoxy group-containing amine is preferably a compound represented by the following Formula (I):

5 [0122]



in Formula (I), R^1 represents a linear or branched alkylene group having 1 to 8 carbon atoms or a phenylene group, and R^2 represents a linear or branched alkyl group having 1 to 8
10 carbon atoms.

[0123]

To be specific, the above alkoxy group-containing amine is preferably, for example, 3-ethoxypropylamine, 3-butoxypropylamine, 3-(2-ethylhexyloxy)propylamine, 3-
15 lauryloxypropylamine, 3-stearyloxypropylamine, 4-(2-ethylhexyloxy)butylamine, 4-lauryloxybutylamine, 8-ethoxyoctylamine, 8-(2-ethylhexyloxy)octylamine, 2-ethylhexyloxyphenylamine, lauryloxyphenylamine and the like.

[0124]

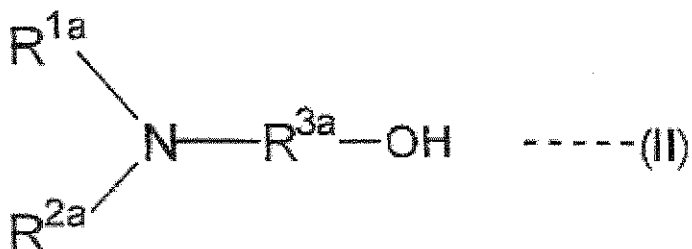
20 When the amine compound (C) is the alkoxy group-containing amine (I) described above, 3-(2-ethylhexyloxy)propylamine is preferred.

[0125]

The amino alcohol is preferably a compound represented

by any of the following Formulas (II), (III) and (IV).

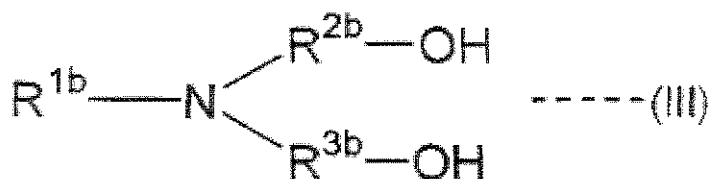
[0126]



[0127]

5 In Formula (II), R^{1a} and R^{2a} may be the same as or different from each other and are a hydrogen atom, an alkyl group having 1 to 24 carbon atoms, an alkenyl group having 1 to 24 carbon atoms, a cycloalkyl group having 3 to 12 carbon atoms, an alkylallyl group (an alkyl group part has 1 to 24 carbon atoms), an aralkyl group (an alkylene group part has 1 to 24 carbon atoms) or an allyl group, and R^{3a} is an alkyl group having 2 to 6 carbon atoms.

[0128]

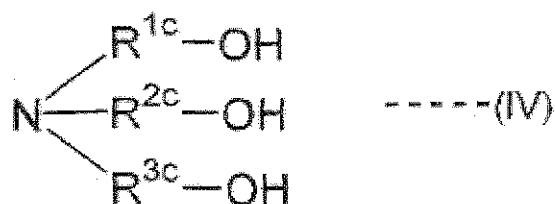


15 [0129]

In Formula (III), R^{1b} is a hydrogen atom, an alkyl group having 1 to 24 carbon atoms, an alkenyl group having 1 to 24 carbon atoms, a cycloalkyl group having 3 to 12 carbon atoms, an alkylallyl group (an alkyl group part has 1 to 24

carbon atoms), an aralkyl group (an alkylene group part has 1 to 24 carbon atoms) or an allyl group, and R^{2b} and R^{3b} may be the same as or different from each other and are an alkylene group having 2 to 6 carbon atoms.

5 [0130]



[0131]

In Formula (IV), R^{1c} , R^{2c} and R^{3c} may be the same as or different from each other and are an alkylene group having 2 to 6 carbon atoms.

[0132]

To be specific, the above amino alcohol is preferably, for example, monoethanolamine (β -aminoethanol, 2-aminoethanol and the like), diethanolamine, triethanolamine, n-propyl alcohol amine, di-n-propyl alcohol amine, tri-propyl alcohol amine, i-propyl alcohol amine, di-i-propyl alcohol amine, tri-i-propyl alcohol amine and the like. The above amino alcohols are used alone or in combination of two or more kinds thereof.

20 [0133]

When the amine compound (C) is the amino alcohol represented by any of Formulas (II), (III) and (IV) described

above, amino alcohol (II), particularly monoethanolamine is preferred.

[0134]

In the present invention, various kinds of the amine
5 compounds (C) described above may be used alone or in
combination of two or more kinds thereof, for example,
combination of (i) octadecylamine which is a kind of
aliphatic primary amines and (ii) 4-hydroxypyridine, 4-
acetylpypidine and the like which are a kind of the six-
10 membered heterocyclic compound having 1 to 3 nitrogen atoms
(may have the substituents described above).

[0135]

An addition amount of the above amine compounds (C) is
preferably a proportion of 0.1 to 3 mole per mole of the
15 triphenylboron-amine complex (b1), and it is more preferably
a proportion of 0.2 to 2 mole considering decomposition
inhibition and a long term storage stability of the
triphenylboron-amine complex (b1) and a long term antifouling
property of the antifouling coating film obtained.

20 [0136]

If an addition amount of the amine compound (C) is less
than 0.2 mole per mole of the triphenylboron-amine complex
(b1), the decomposition inhibition effect thereof tends to be
unsatisfactory. On the other hand, if an addition amount of

the amine compound (C) is more than 2 mole, a decomposition inhibition effect of the triphenylboron-amine complex (b1) is satisfactory, but a durability of the coating film when immersed in water over a long period of time is reduced, and as a result thereof, the long term antifouling property tends to be reduced as well.

[0137]

The amine compound (C) used in an amount of 1.0 to 210 parts by weight, preferably 2.0 to 150 parts by weight per 100 parts by weight of the triphenylboron-amine complex (b1) described above is preferred in terms of the effects described above.

[0138]

The triphenylboron-amine complex (b1) which is used in an amount of 5 to 150 parts by weight, preferably 7 to 100 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content) described above is preferred in terms of a coating workability of the antifouling coating material composition and a flatness of the antifouling coating film obtained.

[0139]

- Other antifouling agent (b2):

The antifouling coating material composition of the

present invention contains the triphenylboron-amine complex (b1) as an antifouling agent, and it may further contain, if necessary, the other antifouling agent (b2).

[0140]

5 The antifouling agent other than the triphenylboron-amine complex (b1) includes, for example, copper pyrithione, zinc pyrithione, 4,5-dichloro-2-n-octyl-4-isothiazoline-3-one, N,N-dimethyldichlorophenylurea, 2,4,6-trichlorophenylmaleimide, 2-methylthio-4-tert-butylamino-6-cyclopropyl-S-triazine, 2,4,5,6-tetrachloroisophthalonitrile, bisdimethyldithiocarbamoylzinc ethylenebisdithiocarbamate, chloromethyl-n-octyl disulfide, N,N'-dimethyl-N'-phenyl-(N-fluorodichloromethylthio)sulfamide, N,N'-dimethyl-N'-tolyl-(N-fluorodichloromethylthio)sulfamide, tetraalkylthiuram
10 disulfide, zinc dimethyldithiocarbamate, zinc ethylenebisdithiocarbamate, 2,3-dichloro-N-(2',6'-diethylphenyl)maleimide, 2,3-dichloro-N-(2'-ethyl-6'-methylphenyl)maleimide, zinc sulfide and the like. The above antifouling agents may be used alone or in combination of two
15 or more kinds thereof.

[0141]

The above antifouling agents (b2) are preferred since they exert less effects on the physical properties of the coating film.

[0142]

- Color pigment (D):

The antifouling coating material composition of the present invention may be blended with various kinds of conventionally known organic and inorganic pigments as the color pigment (D).

[0143]

The organic pigments include carbon black, naphthol red, phthalocyanine blue and the like. The inorganic pigments include, for example, red iron oxide, baryte powder, zinc oxide (ZnO), titan white, yellow iron oxide and the like. Various colorants such as dyes and the like may be included in the above pigments. The color pigment (D) of the present invention is particularly preferably red iron oxide, titan white and yellow iron oxide among the inorganic pigments in terms of a tinting power in terms of coloring properties, and the organic pigments described above are preferred as well since they can provide particularly a coating film having a brilliant color and cause less discoloration.

[0144]

When blending the color pigment (D), it is used preferably in an amount of 0.05 to 125 parts by weight per 100 parts by weight of the coating film-forming resin (A)

(solid content).

[0145]

- Extender pigment (E):

5 The antifouling coating material composition of the present invention may be blended with various kinds of conventionally known pigments as the extender pigment (E).

[0146]

10 The extender pigment is such a pigment that has a small refractive index and that is transparent when mixed with oil and varnish and does not mask a coated surface, and such extender pigment includes, for example, talc, silica, mica, clay, zinc oxide, calcium carbonate which is also used as an anti-settling agent, kaolin, alumina white, white carbon
15 which is also used as a delustering agent, aluminum hydroxide, magnesium carbonate, barium carbonate, barium sulfate and the like, and among them, zinc oxide, talc, silica, mica, clay, calcium carbonate, kaolin and barium sulfate are preferred. The above extender pigments can be used alone or in
20 combination of two or more kinds thereof. When blending the extender pigment (E), it is used preferably in an amount of 2.5 to 250 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

[0147]

- Inorganic dehydrating agent (F):

The antifouling coating material composition of the present invention may be further blended with anhydrite and gypsum hemihydrate (casting plaster) as the inorganic dehydrating agent (F). When blending the inorganic dehydrating agent (F), it is used preferably in an amount of 1.0 to 25 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

10

[0148]

- Plasticizer (G):

The antifouling coating material composition of the present invention may be further blended with chlorinated paraffin and terphenol as the plasticizer (G). When blending the plasticizer (G), it is used preferably in an amount of 0.5 to 50 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

20

[0149]

- Anti-sagging/anti-settling agent (thixotropic agent) (H):

The antifouling coating material composition of the present invention may be blended with organic clay base wax,

organic wax and the like as the anti-sagging/anti-settling agent (thixotropic agent) (H).

[0150]

The anti-sagging/anti-settling agent includes organic clay base waxes such as respective amine salts, stearate salts, lecithin salts and alkylsulfonic acid salts of Al, Ca and Zn; organic waxes such as polyethylene wax, amide wax, hydrogenated castor oil wax and polyamide wax; mixtures of the organic clay base waxes and the organic waxes; synthetic fine powder silica; polyethylene oxide base waxes, fatty acid amide waxes and the like, and among them, preferred are polyamide wax, synthetic fine powder silica, polyethylene oxide base waxes, fatty acid amide waxes and organic clay base waxes.

15 [0151]

When blending the anti-sagging/anti-settling agent (thixotropic agent) (H), it is used preferably in an amount of 0.25 to 50 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

20

[0152]

- Oxyalkylene group-containing linear organopolysiloxane (I):

The antifouling coating material composition of the

present invention, particularly the antifouling coating material composition for fishing nets may be blended, if necessary, with oxyalkylene group-containing linear organopolysiloxane (also referred to as polyether silicone).

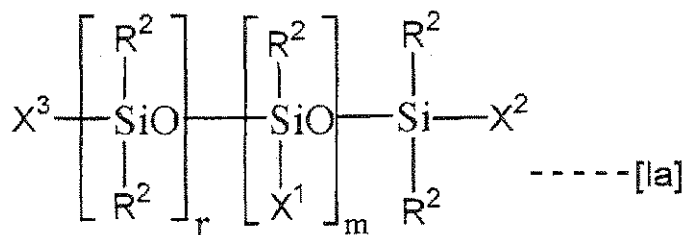
5 [0153]

The oxyalkylene group-containing linear organopolysiloxane includes, for example, polyether-modified polydimethylsiloxane, polyether-modified polyalkyl(methyl)siloxane and the like. Among the above
 10 oxyalkylene group-containing linear organopolysiloxanes, the particularly preferred compound includes polyether-modified polydimethylsiloxane represented by the following Formula [1a] which was described as a component (b) in paragraphs [0038] to [0045] of JP A 1999-199414 filed by the present
 15 applicants.

[0154]

The above polyether-modified polydimethylsiloxane has usually a hydrophile-lipophile balance (HLB) of 2 to 12, and it falls more preferably in a range of 2 to 7.

20 [0155]



[0156]

In Formula [1a], X^1 , X^2 and X^3 each represent independently a polyether group: $-R-A-(R^3O)_n-R^4$ (R represents an alkylene group having 1 to 5 carbon atoms; A represents a single bond or an oxygen atom; R^3 represents an alkylene group having 1 to 5 carbon atoms; R^4 represents an alkyl group having 1 to 5 carbon atoms or hydrogen; and n represents a repeating unit number) or an alkyl group having 1 to 5 carbon atoms; at least one of X^1 , X^2 and X^3 is the polyether group described above: $-R-A-(R^3O)_n-R^4$; R^2 represents an alkyl group having 1 to 3 carbon atoms; r and m each represent a repeating unit total number, and a bonding order of the repeating units $[-Si(R^2)_2O-]$ and $[-Si(R^2)(X^1)O-]$ is optional.

15 [0157]

The polyether silicone represented by Formula [1a] described above is also referred to as polyether-modified silicone, and it can be classified into:

(i) side chain type polyether silicone, wherein X^1 out of X^1 , X^2 and X^3 is a polyether group such as $-R-A-(C_2H_4O)_n-CH_3$ (R, A and n are the same as described above) and the like, and X^2 and X^3 are an alkyl group such as methyl and the like,

(ii) both end type polyether silicone, wherein X^1 out of X^1 , X^2 and X^3 is an alkyl group such as methyl and the like,

and X^2 and X^3 are a polyether group such as $-R-A-(C_2H_4O)_n-CH_3$ (R, A and n are the same as described above) and the like, and

composite type polyether silicone in which the polyether group described above is bonded to (iii): a side chain and one end, (iv): a side chain and both ends or (v) only one end. Among them, the side chain type polyether silicone (i) or the both end type polyether silicone (ii) is preferred in terms of the antifouling property and the like.

10 [0158]

In the polyether group described above: $-R-A-(R^3O)_n-R^4$, R represents an alkylene group having 1 to 5, preferably 2 to 5 carbon atoms, and this alkylene group may be either linear or branched. To be specific, the alkylene group includes methylene, ethylene, n-propylene, i-propylene, n-butylene and the like, and among them, the linear groups are preferred. Ethylene and n-propylene are more preferred, and ethylene is particularly preferred.

[0159]

20 R^3 represents an alkylene group having 1 to 5 carbon atoms which is the same as described above, and it includes preferably ethylene. The repeating unit number n is a number of 1 to 30. R^4 represents an alkyl group having 1 to 5 carbon atoms or hydrogen, and it is preferably an alkyl group.

The groups described above can be shown as the examples of the above alkyl group, and methyl is particularly preferred considering the antifouling property and a compatibility of polyether silicone with the resin.

5 [0160]

The above polyether group includes, for example, $-C_3H_6-O-(C_2H_4O)_n-C_2H_5$, $-C_2H_4-O-(C_3H_6O)_n-CH_3$, $-C_3H_6-O-(C_2H_4O)_n-CH_3$, $-C_2H_4-O-(C_3H_6O)_n-CH_3$, $-C_3H_6-(C_2H_4O)_n-CH_3$, $-C_2H_4-(C_3H_6O)_n-CH_3$, $-C_3H_6-(C_2H_4O)_n-H$, $-C_2H_4-(C_3H_6O)_n-H$, $-(C_3H_6O)_n-CH_3$, $-CH_2-O-(C_2H_4O)_n-CH_3$,
 10 $-CH_2-O-(C_2H_4O)_n-H$, $-(C_2H_4O)_n-CH_3$, $-(C_2H_4O)_n-H$, $-CH_2-O-(C_4H_6O)_n-CH_3$, $-CH_2-O-(C_4H_6O)_n-H$, $-(C_4H_6O)_n-H$ and the like. Among the above polyether groups, the groups having a methoxy group at an end are preferred considering the antifouling property and a compatibility of polyether silicone with the resin, and -
 15 $C_3H_6-O-(C_2H_4O)_n-CH_3$ and $-C_2H_4-O-(C_3H_6O)_n-CH_3$ are particularly preferred.

[0161]

R^2 in Formula [1a] represents an alkyl group having 1 to 3 carbon atoms (methyl, ethyl, n-propyl, i-propyl and the
 20 like). Plural R^2 may be the same as or different from each other, and all of them are preferably methyl.

[0162]

A bonding order of the repeating units $[-Si(R^2)_2O-]$ and $[-Si(R^2)(X^1)O-]$ is optional. That is, when X^1 on a side chain

is the polyether group described above: $-R-A-(R^3O)_n-R^4$, this X^1 may be present in any positions of the side chain group in a polyether silicone molecule.

[0163]

5 The repeating unit number r is a number of 1 to 7000, and m is a number of 1 to 50. The above polyether silicone has a molecular weight of usually 1,000 to 50,000, preferably 3,000 to 10,000.

[0164]

10 The above oxyalkylene group-containing linear organopolysiloxane (I) can be used in an amount of, for example, 0.5 to 200 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

15 [0165]

- Plastic resin (J):

The antifouling coating material composition of the present invention may be further blended, if necessary, with the plastic resin (J) such as polybutenes, paraffins,
20 vaselines, dialkyl sulfide compounds and the like. When blending the plastic resin (J), it is used preferably in an amount of 0.5 to 50 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

[0166]

The polybutenes described above include, for example, "Polybutene LV-7", "Polybutene LV-10", "Polybutene LV-50" and "Polybutene LV-100" each manufactured by Nippon Petrochemicals Co., Ltd.

5 [0167]

The paraffins described above include, for example, n-paraffin (manufactured by Nippon Petrochemicals Co., Ltd.), chlorinated paraffin (e.g., A-40, A-50, A-70, A-145 and A-150 manufactured by Tosoh Corp.) and the like.

10 [0168]

The vaselines include, for example, white vaseline and yellow vaseline (manufactured by Andoh Parachemie Co., Ltd. and the like). The dialkyl sulfide compound described above includes a compound represented by the following Formula (VI).

15 [0169]



In Formula (VI), plural R^{3d} and R^{3e} may be the same as or different from each other and each represent a linear or branched alkyl group having 1 to 20 carbon atoms, and n represents an integer of 1 to 20.

[0170]

The linear or branched alkyl group having 1 to 20 carbon atoms represented by R^{3d} or R^{3e} includes methyl, ethyl, propyl, hexyl, octyl, nonyl, decyl, dodecyl, octadecyl and

the like, and among them, an alkyl group having 4 to 19 carbon atoms is particularly preferred.

[0171]

The term n in Formula (VI) is an integer of 1 to 20,
5 and n is preferably 1 to 10, more preferably 4 to 10 in terms of maintaining the antifouling property.

[0172]

The dialkyl sulfide compound (VI) includes, for example,
di-tert-butyl decasulfide, dipentyl tetrasulfide, dipentyl
10 pentasulfide, dipentyl decasulfide, dioctyl disulfide,
dioctyl tetrasulfide, dioctyl pentasulfide, dinonyl
tetrasulfide, dinonyl pentasulfide, di-tert-nonyl
tetrasulfide, di-tert-nonyl pentasulfide, didecyl
tetrasulfide, didodecyl tetrasulfide, dioctadecyl
15 tetrasulfide, dinonadecyl tetrasulfide and the like. It shall
not be restricted to the above compounds.

[0173]

- Solvent (M):

20 Various components described above are dissolved or dispersed in a solvent in the antifouling coating material composition (antifouling coating material) of the present invention.

[0174]

The solvent used in the above case includes, for example, various solvents blended usually into antifouling coating materials, such as aliphatic solvents, aromatic solvents, ketone base solvents, ester base solvents, ether base solvents and the like. The aromatic solvents described above include, for example, xylene, toluene and the like. The ketone base solvents include, for example, MIBK and the like. The ether base solvents include, for example, propylene glycol monomethyl ether, propylene glycol monomethyl ether acetate (PMAC) and the like.

[0175]

When the triphenylboron-amine complex (b1) or the amine compounds (C) which is solid at ambient temperature is used in the antifouling agent set of the present invention, the solvent (M) which can dissolve the above components (b1) and (C) may be blended if necessary, and the solvent (M) used in this case includes the same solvents as described above.

[0176]

20 Production of antifouling coating material composition and antifouling agent set

The antifouling coating material composition according to the present invention is obtained by adding the amine compound (C) to conventional ship bottom coating materials,

antifoulants for fishing nets, which contain components such as, for example, the coating film-forming resin (A) and the triphenylboron-amine complex (b1) but do not contain the amine compound (C), in an amount of 1 to 210 parts by weight, preferably 2 to 150 parts by weight per 100 parts by weight of the triphenylboron-amine complex (b1), in other words, in an amount of 0.1 to 3 mole, preferably 0.2 to 2.0 mole per mole of the triphenylboron-amine complex (b1).

[0177]

10 The amine compound (C) is contained in the antifouling coating material composition according to the present invention thus obtained, and therefore the triphenylboron-amine complex (b1) can be inhibited from being decomposed. In addition thereto, an antifouling coating film having an
15 excellent static antifouling property is obtained by coating the antifouling coating material of the present invention containing the above triphenylboron-amine complex (b1) onto parts of ships, fishing nets, other fishing materials and the like which are brought into contact with seawater.

20 [0178]

 It is a matter of course that when conventional ship bottom coating materials, antifoulants for fishing nets and the like contain neither the triphenylboron-amine complex (b1) nor the amine compound (C), the components (b1) and (C)

which are the essential components of the antifouling agent set according to the present invention may be added and mixed with the above ship bottom coating materials and the like and that the solvent (M) may be added and mixed as well if

5 necessary.

[0179]

The antifouling agent set of the present invention is obtained by blending the triphenylboron-amine complex (b1) and the amine compound (C) and further blending (mixing), if
10 necessary, the solvent (M) which can dissolve them.

[0180]

In preparing any of the antifouling coating material composition and the antifouling agent set according to the present invention, an order of adding the above components
15 (b1) and (C) shall not specifically be restricted.

[0181]

In preparing the antifouling coating material composition of the present invention, the components (b1), (C) and (M) which constitute the antifouling agent set may be
20 blended (added) in the amounts described above.

[0182]

Antifouling coating film, substrate provided with
coating film, antifouling substrate and antifouling method

for substrate

The antifouling coating film according to the present invention is characterized by comprising any of the antifouling coating material compositions described above.

5 [0183]

The substrate provided with a coating film according to the present invention is characterized by that the surface of the substrate is coated with a coating film obtained by curing any of the antifouling coating material compositions
10 described above.

[0184]

The antifouling substrate according to the present invention is characterized by that the surface of the substrate brought into contact with seawater or freshwater is
15 coated with a coating film obtained by curing any of the antifouling coating material compositions described above.

[0185]

The antifouling substrate or the substrate described above which is a coated matter having an antifouling coating
20 film formed thereon includes underwater structures, ship outside plates, fishing net, fishing equipments and the like.

[0186]

The method for forming a coating film on the surface of a substrate according to the present invention is

characterized by coating or impregnating the surface of the substrate with any of the antifouling coating material compositions described above and then curing the antifouling coating material to form a coating film.

5 [0187]

The antifouling method for a substrate according to the present invention is characterized by coating or impregnating the surface of the substrate with any of the antifouling coating material compositions described above and then curing
10 the above antifouling coating material to form an antifouling coating film.

[0188]

Method for inhibiting and controlling decomposition of
15 triphenylboron-amine complex

The method for inhibiting and controlling decomposition of a triphenylboron-amine complex according to the present invention is characterized by adding the amine compound (C) to the triphenylboron-amine complex (b1).

20 [0189]

The suited examples of the triphenylboron-amine complex (b1) in the above inhibiting and controlling method are the same as in the cases of the antifouling coating material composition and the antifouling agent set each described

above, and the suited examples given therefor are preferably used.

[0190]

The suited examples of the amine compound (C) in the
5 above decomposition inhibiting and controlling method are
also the same as in the cases of the antifouling coating
material composition and the antifouling agent set each
described above, and the suited examples given therefor are
preferably used.

10 [0191]

An addition amount of the amine compound (C) in this
case is the same as an addition amount thereof in the
antifouling coating material composition described above.

That is, the amine compound (C) is added in an amount of

15 usually 1 to 210 parts by weight, preferably 2.0 to 150 parts
by weight per 100 parts by weight of the triphenylboron-amine
complex (b1) in terms of a weight ratio, and the amine
compound (C) is added in an amount of usually 0.1 to 3 mole,
preferably 0.2 to 2 mole per mole of the triphenylboron-amine
20 complex (b1) in terms of a mole ratio. An effect which is
well balanced between decomposition inhibition of the
triphenylboron-amine complex (b1) at ambient temperature
(e.g., 15 to 25°C) to high temperature (e.g., vicinity of
50°C), a long term storage stability of the antifouling

coating material composition and a long term antifouling property and a durability of the coating film obtained therefrom is obtained by controlling an addition amount of the amine compound (C) in the above ranges.

5 [0192]

The inhibiting and controlling method for decomposition of the triphenylboron-amine complex according to the present invention makes it possible to inhibit readily and efficiently the decomposition of the triphenylboron-amine
10 complex (b1), and as a result thereof, production of benzene and generation of benzene odor which are brought about by decomposition of the triphenylboron-amine complex (b1) can notably be inhibited and reduced.

[0193]

15 The triphenylboron-amine complex (b1) which is a target in the decomposition inhibiting and controlling method according to the present invention may be any of (i) the triphenylborone-amine complex (b1) contained in an antifouling coating material obtained by removing only the
20 amine compound (C) from the antifouling coating material composition of the present invention, (ii) the triphenylborone-amine complex (b1) contained in a conventionally known antifouling coating material (contains the component (b1) but does not contain the amine compound

(C)), (iii) the triphenylboron-amine complex (b1) itself which does not contain the other components and (iv) the triphenylborone-amine complex (b1) contained in a solution or a dispersion of the above complex containing the
5 triphenylboron-amine complex (b1) and a solvent, a dispersion medium and the like, and it shall not specifically be restricted.

[0194]

The antifouling coating material composition of the
10 present invention is prepared by adding the amine compound (C) to the antifouling coating material (i) or (ii) described above, and the antifouling agent set of the present invention is prepared by adding the amine compound (C) to the antifouling coating material (iii) or (iv) described above.

15 [0195]

The embodiment of the method for inhibiting and controlling the decomposition of the triphenylboron-amine complex shall not be restricted to an embodiment in which the amine compound (C) is added to the triphenylboron-amine
20 complex (b1) and the blended matter thereof as described above. The decomposition of the triphenylboron-amine complex can be inhibited as well by adding the triphenylboron-amine complex (b1) to the amine compound (C) and blending and mixing the amine compound (C) and the triphenylboron-amine

complex (b1) at the same time.

EXAMPLES

[0196]

5 The suited embodiments of the antifouling coating material composition according to the present invention, the antifouling agent set and the method for inhibiting and controlling the decomposition of the triphenylboron-amine complex shall more specifically be explained below with
10 reference to examples, but the present invention shall by no means be restricted by the examples shown below.

[0197]

 In examples and production examples shown below, "parts" shows parts by weight.

15

[0198]

Preparation of compositions in Examples A group to D group and Comparative Examples 1 to 13

 Prepared by conventional methods were antifouling
20 coating material compositions of Example A group (Examples A1 to A17: Table 1), Example B group (Examples B1 to B17: Table 2) and Example C group (Examples C1 to C15: Table 3) in which different kinds of the copolymers (A) and other components in addition to the triphenylboron-amine complex (b1) and the

amine compound (C) are contained, and antifouling agent sets of Example D group (Examples D1 to D14: Table 4) comprising the triphenylboron-amine complex (b1), the amine compound (C) and the solvent.

5 [0199]

Further, prepared as well by conventional methods were antifouling coating material compositions of Comparative Examples 1 to 12 (Table 5) which contain the triphenylboron-amine complex (b1) but do not contain the amine compound (C),
10 and an antifouling agent set prepared in Comparative Example 13 (Table 6) comprising only the triphenylboron-amine complex (b1) and the solvent.

[0200]

- Method for preparing the antifouling coating material
15 compositions:

The antifouling coating material composition of Example A1 was prepared by charging a vessel with a copolymer (A) which is the coating film-forming resin (A), pyridinetriphenylboron which is the antifoulant component
20 (b1), pyridine which is the amine compound (C), chlorinated paraffin, zinc oxide, casting plaster, titan white, phthalocyanine blue, polyethylene oxide wax, a thixotropic agent (fatty acid amide wax, polyethylene oxide wax) and various solvents (xylene, propylene glycol monomethyl ether)

in a lump in blend amount ratios shown in Table 1 and then mixing and dispersing the above components by means of a paint shaker.

[0201]

5 Timing of adding the amine compound (C) in a step of producing the coating materials may be any timing including an embodiment in which it is added after producing a coating material containing no amine compound (C)An effect of inhibiting the decomposition of the antifoulant component
10 (b1) did not change in what step the amine compound (C) was added.

[0202]

 Further, the antifouling coating material compositions of the other examples (Examples A group to D group) were
15 prepared as well in the same manner as in the method of Example A1 described above, and in respect to timing of adding the amine compound (C), the same results as in the case of Example A1 described above were obtained.

20 [0203]

Performance evaluations of the respective compositions

 The respective antifouling coating material compositions prepared in the manners described above were subjected to performance evaluations of three items according

to test methods shown below.

[0204]

[1] Residual rate of the triphenylboron-amine complex

5 (b1) in the coating materials:

The respective antifouling coating material compositions were stored under the condition of 50°C for one month, and then a residual amount of the antifoulant component (b1) was quantitatively analyzed by high
10 performance liquid chromatograph (HPLC) to determine the residual rate.

[0205]

The measuring conditions of HPLC described above are shown below.

15 [0206]

Apparatus: high performance liquid chromatograph "Alliance 2695" and a UV detector "2487" (all manufactured by Waters Corporation)

Column: "Inertsil ODS-3" (manufactured by GL Sciences
20 Inc.)

Eluate: acetonitrile (a) + water (b) + 0.5 mol/L of tetrabutylammonium phosphate (c) = (a) 65 + (b) 34 + (c) 1
(unit: volume ratio)

Flow rate: 1 mL/minute

Column temperature: 40°C

Measuring wavelength: 220 nm

[2] Production amount of benzene:

5 The respective antifouling coating material compositions were stored at 23°C for six months and then diluted with a solvent dimethylsulfoxide and the like. The solution obtained was sampled and put in a 40 ml vial bottle (airtight vessel) so that an amount did not exceed 0.0150 g
10 and tightly sealed, and a concentration of benzene in the respective antifouling coating material compositions was measured by head space GC/MS to calculate a production amount of benzene during storage period.

[0207]

15 The details of analytical conditions in head space GC/MS are shown below.

[0208]

- Head space (HT3, manufactured by Teledyne-Tekmar):

Valve oven temperature: 160°C

20 Transfer line temperature: 160°C

Sample oven temperature: 50°C

Pressure applied to sample: 9 PSIG

Time for pressurizing sample: 2 minutes

Pressure equilibrating time: 0.2 minute

Loop filling pressure: 5 PSIG

Loop filling time: 2 minutes

Time: 1 minute

- GC (GC 6890N, manufactured by Agilent):

5 Column: DB-5MS (length: 30 m, inner diameter: 0.25 mm,
film thickness: 0.25 μ m, manufactured by J & W Scientific Co.,
Ltd.)

Oven temperature: 40°C (1 minute)-10°C/minute-200°C

Carrier gas: helium

10 Injection method: splitter (GC 15010, manufactured by
GL Sciences Inc.) injection

Column flow rate: 1.5 mL/minute

Split ratio: 2 : 1

- MS (JMS-K9, manufactured by JEOL Ltd.):

15 Measuring mode: selective ion detection method

Monitor ion: 52/77/78/79

Ionizing current: 200 μ A

Ionization energy: 70 eV

Detector voltage: -1000 Volt

20 Ion source temperature: 200°C

Interface temperature: 200°C

[3] Static antifouling property of antifouling coating film:

- Preparation of test pieces: panel test:

Test pieces used in Examples A to C and Comparative Examples 1 to 12 were prepared by the following method.

[0209]

An epoxy base anticorrosive coating material (epoxy anticorrosive coating material, brand name: "Bannoh 500", manufactured by Chugoku Marine Paints Ltd.) was coated in advance on a sand blast-treated steel plate (height 300 mm x width 100 mm x thickness 3.2 mm) so that a dry film thickness thereof was 150 μ m, and then an epoxy base binder coating material (brand name: "Bannoh 500N", manufactured by Chugoku Marine Paints Ltd.) was coated thereon so that a dry film thickness thereof was 100 μ m.

[0210]

Next, the antifouling coating material compositions having blend compositions shown in Examples A group to C group (Table 1 to Table 3) and Comparative Examples 1 to 12 (Table 5) which were stored at 50°C for one month were coated once so that a dry film thickness thereof was 150 μ m and dried to prepare test plates provided with a coating film. A coating interval was set to 1 day/1 coat in any of the coating material (e.g., "Bannoh 500") and the coating

material (e.g., "Bannoh 500N") overcoated on the surface thereof.

[0211]

- Evaluation criteria of static antifouling property:

- 5 0 point: adhesion area of aquatic organisms is about 100 %
- 1 point: adhesion area of aquatic organisms is about 90 %
- 2 point: adhesion area of aquatic organisms is about 80 %
- 3 point: adhesion area of aquatic organisms is about 70 %
- 4 point: adhesion area of aquatic organisms is about 60 %
- 10 5 point: adhesion area of aquatic organisms is about 50 %
- 6 point: adhesion area of aquatic organisms is about 40 %
- 7 point: adhesion area of aquatic organisms is about 30 %
- 8 point: adhesion area of aquatic organisms is about 20 %
- 9 point: adhesion area of aquatic organisms is about 10 %
- 15 10 point: no adhesion of aquatic organisms

The results of the performance evaluations of the three items described above are shown all together in Table 1 to Table 3.

[0212]

- 20 The antifouling coating material compositions prepared in Comparative Examples 1 to 12 were used to measure a residual rate and a static antifouling property of the triphenylboron-amine complex (b1) in the same manners as in the examples described above, and the results thereof are

shown all together in Table 5.

[0213]

Review

5 As shown in the examples described above, the triphenylboron compound is stabilized in the antifouling coating material compositions of the present invention, and benzene hazardous to human bodies which was produced by the decomposition of the triphenylboron compound is inhibited as
10 well from being produced. The above antifouling coating material compositions are not reduced in an antifouling property even after stored for long time and therefore exhibit an excellent antifouling effect against a wide variety of aquatic organisms over a long period of time.

15

[0214]

Products and the like used in the examples

The details (product names, the physical properties thereof etc.) of the blend components shown in Table 1 to
20 Table 6 which were used for preparing the antifouling coating material composition and the antifouling agent sets in the examples described above are shown below.

[0215]

(1) Copolymer A: refer to a production method described later.

[0216]

(2) Copolymer B: refer to a production method described later.

[0217]

(3) Copolymer C: refer to a production method described later.

5 [0218]

(4) Chlorinated paraffin: trade name "Toyoparacs 150"

(average carbon atom number: 14.5, chlorine content (amount):

50 %, viscosity: 12 poise/25°C, specific gravity: 1.25/25°C,
manufactured by Tosoh Corporation).

10 [0219]

(5) Zinc oxide: trade name "Zinc Oxide No. 3" (manufactured
by Hakusui Tech Co., Ltd.).

[0220]

(6) Talc: trade name "TTK Talc" (manufactured by Takehara
15 Chemical Co., Ltd.).

[0221]

(7) Casting plaster: trade name "FT-2" (manufactured by
Noritake Gypsum Co., Ltd.).

[0222]

20 (8) Titanium white: trade name "Titanium Oxide R-5N"
(manufactured by Sakai Chemical Industry Co., Ltd.).

[0223]

(9) Phthalocyanine blue: trade name "Cyanine blue S-2010"
(manufactured by Dainichiseika Color & Chemicals Mfg.Co.,

Ltd.)

[0224]

(10) Pyridine-triphenylborane: trade name "PK Boron"

(manufactured by Hokko Chemical Ind. Co., Ltd.)

5 [0225]

(11) 4,5-Dichloro-2-n-octyl-4-isothiazoline-3-one: trade name

"SEA-NINE 211" (solid content: 30 % by weight, manufactured by Rohm & Haas Co., Ltd.).

[0226]

10 (12) 2-Pyridinethiol-1-oxide zinc salt: trade name "AF-Z"

(manufactured by Yoshitomi Fine Chemical Co., Ltd.).

[0227]

(13) N,N'-dimethyl-N'-tolyl-(N-fluorodichloromethylthio)-

sulfamide: trade name "Preventol A-5S" (manufactured by

15 Ranxess K.K.).

[0228]

(14) Pyridine (manufactured by Kanto Chemical Co., Inc.)

reagent, pure grade.

[0229]

20 (15) Isoquinoline (manufactured by Kanto Chemical Co., Inc.)

reagent, pure grade.

[0230]

(16) Imidazole (manufactured by Kanto Chemical Co., Inc.)

reagent, extra pure grade.

[0231]

(17) 4-Hydroxypyridine (manufactured by Kanto Chemical Co., Inc.) reagent, extra pure grade.

[0232]

5 (18) 4-Acetylpyridine (manufactured by Kanto Chemical Co., Inc.) reagent, extra pure grade.

[0233]

(19) Polyethylene oxide wax: trade name "DISPARLON 4200-20"

(20 % xylene paste, manufactured by Kusumoto Chemicals, Ltd.)

10 [0234]

(20) Fatty acid amide wax: trade name "DISPARLON A630-20X"

(20 % xylene paste, manufactured by Kusumoto Chemicals, Ltd.)

[0235]

(21) Solvent: propylene glycol monomethyl ether: trade name

15 "Kuraray PGM" (manufactured by Kuraray Co., Ltd.)

Table 1

Product name	Component name	Example (A group)								
		A1	A2	A3	A4	A5	A6	A7	A8	A9
Blend composition	Copolymer A (solid content 45 %)	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4
	Zn polymer diacryl type									
	Copolymer B (solid content 50 %)									
	Zn polymer versatic acid end type									
	Copolymer C (solid content 50 %)									
	silyl base polymer									
	Toyoparacs 150	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	zinc oxide	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
	FT-2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TiO2 R-5N	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Performance evaluation	Cyanine blue S-2010	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	PK Boron	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	SEA-NINE 211									
	Zinc Pyrithione									
	Preventol A-5S									
	2-pyridinethiol-1-oxide zinc salt									
	N,N'-dimethyl-N'-tolyl-(N-fluoro-dichloromethylthio)-sulfamide									
	pyridine	0.2	0.6	1.3	2.5	5.0	7.5	0.4	2.0	4.0
	isoquinoline									
	imidazole									
Performance evaluation	4-hydroxypyridine									
	4-acetylpyridine									
	Disparlon 4200-20	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Disparlon A630-20X	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	fatty acid amide wax	19.9	19.5	18.8	17.6	15.1	12.6	19.7	18.1	16.1
	xylene	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	propylene glycol monomethyl ether	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Total weight part	1/0.1	1/0.3	1/0.5	1/1	1/2	1/3	1/0.1	1/0.5	1/1
	Mole ratio (boron compound/amine compound)									
	Boron compound residual rate (%)	53	87	93	98	99	99	50	92	98
Performance evaluation	Benzene production amount (ppm) by decomposition of triphenylboron compound	250	187	143	95	not detected	not detected	278	161	99
	Static antifouling property (coating material stored at 50°C for 1 month)	6	8	8	10	10	10	5	7	9
		5	8	8	10	10	8	5	7	9
		5	7	8	10	10	7	5	7	9
		4	7	7	10	10	6	4	7	9

Table 1 (continued)

Product name	Component name	Example (A group)									
		A10	A11	A12	A13	A14	A15	A16	A17		
Copolymer A (solid content 45 %)											
Zn polymer diacryl type		44.4	44.4	44.4	44.4	44.4	44.4	44.4	44.4		
Copolymer B (solid content 50 %)											
Zn polymer versatic acid end type											
Copolymer C (solid content 50 %)											
silyl base polymer											
Tovoparacs 150	Chlorinated paraffin	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
ZnO No.3	zinc oxide	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
FT-2	casting plaster	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TiO2 R-5N	titanium white	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Cyanine blue S-2010	phthalocyanine blue	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
PK Boron	pyridine-triphenylborane	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
SEA-NINE 211	4,5-dichloro-2-n-octyl-4-isothiazoline-3-one (solid content 30 %)				10.0						
Zinc Pyrrithione	2-pyridinethiol-1-oxide zinc salt					3.0					
Preventol A-5S	N,N'-dimethyl-N'-tolyl-(N-fluorodichloromethylthio)-sulfamide						3.0				
	pyridine				2.5	2.5	2.5				
	isoquinoline	8.0	12.0								
	imidazole			2.1							
	4-hydroxypyridine							2.7			
	4-acetylpyridine										
Disparlon 4200-20	polyethylene oxide wax	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Disparlon A630-20X	fatty acid amide wax	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Xylene	xylene	12.1	8.1	18.0	7.6	14.6	14.6	17.4	16.7		
Kuraray PGM	propylene glycol monomethyl ether	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	Total weight part	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Mole ratio (boron compound/amine compound)	1/2	1/3	1/1	1/1	1/1	1/1	1/1	1/1	1/1	1/1
Boron compound residual rate (%)	Mole ratio (boron compound/amine compound) after stored at 50°C for 1 month	99	99	94	98	98	98	96	95		
Benzene production amount (ppm) by decomposition of triphenylboron compound	after stored at 23°C for 6 months	not detected	not detected	100	91	97	95	100	105		
Static antifouling property (coating material stored at 50°C for 1 month)	immersed in seawater for 1 month	9	9	9	10	10	10	10	10	10	10
	immersed in seawater for 2 months	9	7	9	10	10	10	10	10	10	10
	immersed in seawater for 3 months	9	6	8	10	10	10	9	9	9	9
	immersed in seawater for 4 months	9	6	8	10	10	10	9	9	9	9

Blend composition

Performance evaluation

Table 2

Product name		Component name	Example (B group)									
			B1	B2	B3	B4	B5	B6	B7	B8	B9	
Blend composition	Copolymer A (solid content 45 %)											
	Zn polymer diacryl type											
	Copolymer B (solid content 50 %)											
	Zn polymer versatic acid end type		40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	
	Copolymer C (solid content 50 %)											
	silyl base polymer											
	Toyoparacs 150		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
	ZnO No.3		8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	
	FT-2		1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
	TiO2 R-5N		2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
	Cyanine blue S-2010		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	
	PK Boron		10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
	SEA-NINE 211											
	Zinc Pyrithione											
	Preventol A-5S											
				0.2	0.6	1.3	2.5	5.0	7.5	0.4	2.0	4.0
			pyridine									
			isoquinoline									
			imidazole									
			4-hydroxypyridine									
			4-acetylpyridine									
	Disparlon 4200-20			2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Disparlon A630-20X			2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Xylene			24.3	23.9	23.2	22.0	19.5	17.0	24.1	22.5	20.5
	Kuraray PGM			5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
		propylene glycol monomethyl ether	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
		Total weight part	170.1	170.3	170.5	171	172	173	170.1	170.5	171	
		Mole ratio (boron compound/amine compound)										
Boron compound residual rate (%)		after stored at 50°C for 1 month	50	83	89	97	98	99	49	89	96	
Benzene production amount (ppm) by decomposition of triphenylboron compound		after stored at 23°C for 6 months	273	195	159	99	not detected	not detected	285	179	111	
		immersed in seawater for 1 month	5	8	8	10	10	10	5	7	9	
		immersed in seawater for 2 months	5	8	8	10	10	8	5	7	8	
		immersed in seawater for 3 months	4	8	8	10	10	6	4	7	8	
		immersed in seawater for 4 months	4	7	7	10	10	5	4	6	7	
Static antifouling property (coating material stored at 50°C for 1 month)												

Table 2 (continued)

Product name		Example (B group)									
		B10	B11	B12	B13	B14	B15	B16	B17		
Component name											
Blend composition	Copolymer A (solid content 45 %)										
	Zn polymer diacryl type										
	Copolymer B (solid content 50 %)										
	Zn polymer versatic acid end type	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Copolymer C (solid content 50 %)										
	silyl base polymer										
	Toyoparacs 150	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	ZnO No.3	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
	FT-2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TiO2 R-5N	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Cyanine blue S-2010	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	PK Boron	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	SEA-NINE 211				10.0						
	Zinc Pyrithione					3.0					
	Preventol A-5S						3.0				
						2.5	2.5	2.5			
			8.0	12.0	2.1						
									2.7		
										3.4	
	Disparlon 4200-20	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
	Disparlon A630-20X	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	
	Xylene	16.5	12.5	22.4	12.0	19.0	19.0	21.8	21.1	21.1	
	Kuraray PGM	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
	propylene glycol monomethyl ether	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
	Total weight part	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
	Mole ratio (boron compound/amine compound)	1/2	1/3	1/1	1/1	1/1	1/1	1/1	1/1	1/1	
	Boron compound residual rate (%)	99	99	93	96	98	97	95	94		
	Benzene production amount (ppm) by decomposition of triphenylboron compound	not detected	not detected	108	100	112	115	102	106		
	Static antifouling property (coating material stored at 50°C for 1 month)	9	9	9	10	10	10	10	10	10	
		9	7	9	10	10	10	10	10	10	
		8	6	9	10	10	10	9	9	9	
		8	5	8	10	10	10	9	9	9	

Blend composition

Performance evaluation

[0238]

Product name	Component name	Example (C group)								
		C1	C2	C3	C4	C5	C6	C7	C8	C9
Blend composition	Copolymer A (solid content 45 %)									
	Zn polymer diacryl type									
	Copolymer B (solid content 50 %)									
	Zn polymer versatic acid end type									
	Copolymer C (solid content 50 %)									
	silyl base polymer	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
	Toyoparacs 150									
	zinc oxide	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5	11.5
	Talc	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	FT-2	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TiO2 R-5N	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
Cyanine blue S-2010	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	
PK Boron	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	
SEA-NINE 211	4,5-dichloro-2-n-octyl-4-isothiazoline-3-one (solid content 30 %)									
Zinc Pyrrithione	2-pyridinethiol-1-oxide zinc salt									
Preventol A-5S	N,N'-dimethyl-N'-tolyl-(N-fluoro-dichloromethylthio)-sulfamide									
	pyridine	0.2	0.6	1.3	2.5	5.0	7.5			
	isoquinoline							0.4	2.0	4.0
	imidazole									
Disparlon 4200-20	polyethylene oxide wax	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Disparlon A630-20X	fatty acid amide wax	22.3	21.9	21.2	20.0	17.5	15.0	22.1	20.5	18.5
Xylene	xylene									
Kuraray PGM	propylene glycol monomethyl ether	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Total weight part	1/0.1	1/0.3	1/0.5	1/1	1/2	1/3	1/0.1	1/0.5	1/1
Boron compound residual rate (%)	Mole ratio (boron compound/amine compound) after stored at 50°C for 1 month	51	89	91	98	99	99	51	89	97
Benzene production amount (ppm) by decomposition of triphenylboron compound	after stored at 23°C for 6 months	265	181	165	96	not detected	not detected	277	171	98
Performance evaluation	immersed in seawater for 1 month	5	8	8	10	10	8	5	8	9
	immersed in seawater for 2 months	5	8	8	10	10	7	5	7	9
	immersed in seawater for 3 months	5	7	7	10	10	6	5	7	9
	immersed in seawater for 4 months	4	7	7	10	10	5	4	7	8

Table 3 (continued)

Product name	Component name	Example (C group)				
		C10	C11	C12	C13	C14
Copolymer A (solid content 45 %)						
Zn polymer diacryl type						
Copolymer B (solid content 50 %)						
Zn polymer versatic acid end type						
Copolymer C (solid content 50 %)						
silyl base polymer		40.0	40.0	40.0	40.0	40.0
Toyoparacs 150	chlorinated paraffin					
ZnO No.3	zinc oxide	11.5	11.5	11.5	11.5	11.5
FT-2	casting plaster	10.0	10.0	10.0	10.0	10.0
Talc	talc	1.0	1.0	1.0	1.0	1.0
TiO2 R-5N	titanium white	1.0	1.0	1.0	1.0	1.0
Cyanine blue S-2010	phthalocyanine blue	2.0	2.0	2.0	2.0	2.0
PK Boron	pyridine-triphenylborane	10.0	10.0	10.0	10.0	10.0
SEA-NINE 211	4,5-dichloro-2-n-octyl-4-isothiazoline-3-one (solid content 30 %)			10.0		
Zinc Pyrithione	2-pyridinethiol-1-oxide zinc salt					3.0
Preventol A-5S	N,N'-dimethyl-N'-tolyl-(N-fluoro-dichloromethylthio)-sulfamide				2.5	2.5
	pyridine	8.0	12.0			
	isoquinoline			2.1		
	imidazole					
Disparlon 4200-20	polyethylene oxide wax	2.0	2.0	2.0	2.0	2.0
Disparlon A630-20X	fatty acid amide wax					
Xylene	xylene	14.5	10.5	20.4	10.0	17.0
Kuraray FGM	propylene glycol monomethyl ether					
	Total weight part	100.0	100.0	100.0	100.0	100.0
	Mole ratio (boron compound/amine compound)	1/2	1/3	1/1	1/1	1/1
Boron compound residual rate (%)	after stored at 50°C for 1 month	99	99	95	98	97
Benzene production amount (ppm) by decomposition of triphenylboron compound	after stored at 23°C for 6 months	not detected	not detected	111	101	109
Static antifouling property (coating material stored at 50°C for 1 month)	immersed in seawater for 1 month	9	7	9	10	10
	immersed in seawater for 2 months	9	6	8	10	10
	immersed in seawater for 3 months	8	5	8	10	10
	immersed in seawater for 4 months	8	5	8	10	10

Blend composition

Performance evaluation

[0239]

Table 4 Antifouling agent set

Product name	Component name	Example (D group)													
		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
PK Boron	pyridine-triphenylborane	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	pyridine	0.2	0.6	1.3	2.5	5.0	7.5	0.4	2.0	4.0	8.0	12.0			
	isoquinoline														
	imidazole												2.1		
	4-hydroxypyridine													2.7	
xylene	4-acetylpyridine	89.8	89.4	88.7	87.5	85.0	82.5	89.6	88.0	86.0	82.0	78.0	87.9	87.3	3.4
	xylene	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	86.6
	Total weight part	100.1	100.3	100.5	100.5	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Boron compound residual rate (%)	Mole ratio (boron compound/amine compound)	1/0.1	1/0.3	1/0.5	1/1	1/2	1/3	1/0.1	1/0.5	1/1	1/2	1/3	1/1	1/1	1/1
	after stored at 50°C for 1 month	60	90	93	99	99	99	58	95	99	99	99	96	97	97

[0240]

Blend composition	Product name	Component name	Comparative Example								
			1	2	3	4	5	6	7	8	
Performance evaluation	Copolymer A (solid content 45 %)	Zn polymer diacryl type	44.4	44.4	44.4	44.4					
	Copolymer B (solid content 50 %)	Zn polymer versatic acid end type					40.0	40.0	40.0	40.0	40.0
	Copolymer C (solid content 50 %)	silvyl base polymer									
	Toyoparacs 150	chlorinated paraffin	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	ZnO No.3	zinc oxide	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
	Talc	talc									
	FT-2	casting plaster	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	TiO2 R-5N	titanium white	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Cyanine blue S-2010	phthalocyanine blue	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
	PK Boron	pyridine-triphenylborane	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	SEA-NINE 211	4,5-dichloro-2-n-octyl-4-isothiazoline-3-one (solid content 30 %)		10.0					10.0		
	Zinc Pyrithione	2-pyridinethiol-1-oxide zinc salt			3.0					3.0	
	Preventol A-5S	N,N'-dimethyl-N'-tolyl-(N-fluoro-dichloromethylthio)-sulfamide				3.0					3.0
		pyridine									
		isoquinoline									
		imidazole									
	Disparlon 4200-20	polyethylene oxide wax	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
	Disparlon A630-20X	fatty acid amide wax	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Xylene	xylene	20.1	10.1	17.1	17.1	24.5	14.5	21.5	21.5	21.5
	Kuraray PGM	propylene glycol monomethyl ether	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
	Total weight part	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
	Mole ratio (boron compound/amine compound)	-	-	-	-	-	-	-	-	-	
	Boron compound residual rate (%)	37	35	38	38	39	38	35	35	35	
	Benzene production amount (ppm) by decomposition of triphenylboron compound	878	870	885	889	888	885	893	897	897	
	Static antifouling property (coating material stored at 50°C for 1 month)	2	2	2	2	2	2	2	2	2	
		2	2	2	2	2	2	2	2	2	
		2	2	2	2	2	2	2	2	2	
		1	2	2	2	1	2	2	2	2	

Table 5 (continued)

Product name		Component name	Comparative Example			
			9	10	11	12
Copolymer A (solid content 45 %)						
Zn polymer diacryl type						
Copolymer B (solid content 50 %)						
Zn polymer versatic acid end type						
Copolymer C (solid content 50 %)			40.0	40.0	40.0	40.0
silyl base polymer						
Toyoparacs 150		chlorinated paraffin				
ZnO No.3		zinc oxide	11.5	11.5	11.5	11.5
Talc		talc	10.0	10.0	10.0	10.0
FT-2		casting plaster	1.0	1.0	1.0	1.0
TiO2 R-5N		titanium white	1.0	1.0	1.0	1.0
Cyanine blue S-2010		phthalocyanine blue	2.0	2.0	2.0	2.0
PK Boron		pyridine-triphenylborane	10.0	10.0	10.0	10.0
SEA-NINE 211		4,5-dichloro-2-n-octyl-4-isothiazoline-3-one (solid content 30 %)		10.0		
Zinc Pyrithione		2-pyridinethiol-1-oxide zinc salt			3.0	
Preventol A-5S		N,N'-dimethyl-N'-tolyl-(N-fluoro-dichloromethylthio)-sulfamide				3.0
		pyridine				
		isoquinoline				
		imidazole				
Disparlon 4200-20		polyethylene oxide wax				
Disparlon A630-20X		fatty acid amide wax	2.0	2.0	2.0	2.0
Xylene		xylene	22.5	12.5	19.5	19.5
Kuraray PGM		propylene glycol monomethyl ether				
		Total weight part	100.0	100.0	100.0	100.0
		Mole ratio (boron compound/amine compound)	-	-	-	-
Boron compound residual rate (%)		after stored at 50 °C for 1 month	36	35	37	38
Benzene production amount (ppm) by decomposition of triphenylboron compound		after stored at 23 °C for 6 months	525	510	553	570
Static antifouling property (coating material stored at 50 °C for 1 month)		immersed in seawater for 1 month	2	2	2	2
		immersed in seawater for 2 months	2	2	2	2
		immersed in seawater for 3 months	2	2	2	2
		immersed in seawater for 4 months	1	2	2	2

Blend composition	Performance evaluation
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Blend composition

Performance evaluation

[0241]

Table 6 Antifouling agent set

Product name	Component name	Comparative Example 13
PK Boron	pyridine-triphenylborane	10.0
Xylene	Xylene	90.0
Total weight part		100.0
Mole ratio (boron compound/amine compound)		-
Boron compound residual rate (%)	After stored at 50°C for 1 month	31

[0242]

5 [A] Production method for copolymer A

- Production of metal-containing monomer a

A four neck flask equipped with a condenser, a thermometer, a dropping funnel and a stirrer was charged with 85.4 parts of propylene glycol methyl ether (PGM) and 40.7 parts of zinc oxide (ZnO), and the flask was heated to 75°C while stirring. Subsequently, raw materials shown in Table 7, that is, a mixture comprising 43.1 parts of methacrylic acid (MAA), 36.1 parts of acrylic acid (AA) and 5 parts of water was dropwise added at a constant speed in 3 hours.

15 [0243]

After finishing dropwise adding, the reaction solution changed from an opalescent state to a transparent state.

After further stirring for 2 hours, 6.7 parts of n-butyl alcohol (n-BuOH) and 29.2 parts of xylene were added thereto

to obtain a transparent mixture solution (a) containing a metal-containing monomer.

[0244]

A solid content (showing a metal-containing polymer obtained by subjecting a metal-containing monomer mixture a in the solution to polymerization reaction; hereinafter the same shall apply) contained in the mixture solution obtained above was 44.9 % by weight.

[0245]

10 The blend compositions and the like are shown all together in Table 7.

[0246]

Table 7 Production of metal-containing monomer mixture

	Charge amount (mole ratio)				Content (%) of volatile components in metal- containing monomer mixture				Solid content (weight %)
	MAA	AA	ZnO	Water	PGM	n-BuOH	Xylene	Water	
Metal-containing reaction mixture solution (a)	0.5	0.5	0.5	0.27	34.8	2.7	11.9	5.7	44.9

<Remark> MMA: methacrylic acid, AA: acrylic acid, N-BuOH: n-butyl alcohol, PGM: propylene glycol methyl ether

15 [0247]

-Production of copolymer A

A four neck flask equipped with a condenser, a thermometer, a dropping funnel and a stirrer was charged with 15 parts of propylene glycol methyl ether, 57 parts of xylene and 4 parts of ethyl acrylate, and the flask was heated to

20

100°C while stirring.

[0248]

Subsequently, raw materials shown in Table 8, that is, a transparent mixture comprising 13 parts of methyl methacrylate (MMA), 65 parts of ethyl methacrylate (EA), 37.8 parts of the mixture solution (a) obtained in the "Production of metal-containing monomer a" step described above, 10 parts of xylene, 1 part of a chain transfer agent ("Nofmer MSD", manufactured by NOF CORPORATION), 2.5 parts of AIBN (azobisisobutyronitrile, manufactured by Nippon Hydrazine Industry Co., Ltd.) and 7 parts of AMBN (azobismethylbutyronitrile, manufactured by Nippon Hydrazine Industry Co., Ltd.) was dropwise added from the dropping funnel at a constant speed in 6 hours.

15 [0249]

After finishing dropwise adding, 0.5 part of t-butylperoxy octoate (TBPO) and 7 parts of xylene were dropwise added in 30 minutes, and after further stirred for one and a half hour, 4.4 parts of xylene was added to obtain a resin composition, which had a heat residue (measuring condition: measured from the heat residue after heated for 3 hours at 105°C; hereinafter the same shall apply) of 46.2 % in the resin composition, a Gardner viscosity (measured at a resin concentration of 35 % by weight and 25°C) of "+Y", the

resin contained in which has a number average molecular weight Mn of 2200 and a weight average molecular weight Mw of 5600 each measured by DPC and which was free from insoluble matters in the composition and pale yellow transparent and

5 contained a copolymer A.

[0250]

The kinds and the blend amounts (parts by weight) of the copolymerization monomers, the initiators and the chain transfer agent used and the characteristic values of the
10 copolymer A obtained are shown all together in Table 8.

[0251]

Table 8 Production of copolymer A

Kind of polymer		Copolymer A
Metal-containing reaction mixture solution (a)		37.8
Copolymerization monomer	MMA	13
	EA	65
Initiator	AIBN	25
	AMBN	7
	TBPO	0.5
Chain transfer agent	Nofmer MSD	1
Characteristic value	Gardner viscosity	+Y
	solid content (%)	46.2
	molecular weight (Mn)	2200
	molecular weight (Mw)	5600

Remark: the blend amount shows "parts by weight"

[0252]

[B] Production method of copolymer B:

A four neck flask equipped with a condenser, a thermometer, a dropping funnel and a stirrer was charged with 30 parts by weight of PGM (propylene glycol monomethyl ether) and 40 parts by weight of xylene, and the flask was heated to 100°C while stirring.

[0253]

Subsequently, raw materials shown in Table 9, that is, a mixture comprising the respective monomers comprising 35 parts of zinc versatate methacrylate, 10 parts of 2-methoxyethyl acrylate, 30 parts of 3-methoxybutyl acrylate and 25 parts of ethyl acrylate and 6 parts of t-butylperoxy octoate as a polymerization initiator was dropwise added from the dropping funnel at a constant speed in 3 hours.

15 [0254]

After finishing dropwise adding, 1 part by weight of t-butylperoxy octoate as an additional catalyst and 10 parts by weight of xylene were dropwise added in 2 hours, and after further stirred for 2 hours, 20 parts by weight of xylene was added to obtain a copolymer B (side chain end metal salt bond-containing copolymer) having characteristic values shown in Table 9.

[0255]

Table 9 Production of copolymer B

Kind of polymer		Copolymer B
Metal-containing monomer	zinc versatate methacrylate	35
Polymerizable monomer	2-methoxyethyl acrylate	10
	3-methoxybutyl acrylate	30
Unsaturated monomer	ethyl acrylate	25
Polymerization initiator	t-butylperoxy octoate	6
Characteristic value	Gardner viscosity	+Z
	solid content (%)	50.5

Remark: the blend amount shows "parts by weight"

[0256]

5 [C] Production method of copolymer C

A reaction vessel equipped with a stirrer, a condenser, a thermometer, a dropping equipment and a heating and cooling jacket was charged with 100 parts of xylene, and the solution was heated and stirred on a temperature condition of 83°C under nitrogen flow.

[0257]

A mixture comprising 60 parts of triisopropylsilyl acrylate, 39.5 parts of methyl methacrylate, 0.5 part of ethyl acrylate and 1.0 part of 2,2'-azobisisobutyronitrile as a polymerization initiator was dropwise added from the dropping equipment in 4 hours while maintaining the above temperature.

[0258]

Then, the solution was continued to be stirred at the above temperature to obtain a transparent and colorless resin composition containing copolymer C. The resin composition
5 thus obtained was heated at 105°C for 3 hours, and then the heat residue thereof was measured to find that it was 49.7 % by weight.

[0259]

A glass transition temperature (Tg) of the copolymer C
10 (heat residue) in the resin composition was 45°C, and it had a number average molecular weight (Mn) of 6,800 and a weight average molecular weight (Mw) of 24,500 which were measured by GPC.

[0260]

15 The kinds and the blend amounts (parts by weight) of the copolymerization monomers used and the like and the characteristic values of the copolymer C obtained are shown all together in Table 10.

[0261]

Table 10 Production of copolymer C

Added components (unit: parts by weight)	triisopropylsilyl methacrylate		60
	methyl methacrylate		39.5
	ethyl acrylate		0.5
	2,2'-azobisisobutyronitrile		1
Polymerization temperature (°C)			83
Physical properties of the product	heat residue (% by weight)		49.7
	viscosity/25°C (CPS)		160
	GPC measurement value	Mn	6,800
		Mw	24,500
		Mw/Mn	3.6
Tg (°C)		45	

CLAIMS

1. An antifouling coating material composition comprising a coating film-forming resin (A) and a triphenylboron-amine complex (b1), wherein the antifouling coating composition further comprises (C) at least one amine compound (excluding the triphenylboron-amine complex (b1)) selected from the group consisting of:

ammonia;

heterocyclic amines consisting of

pyridines (the pyridine may be incorporated into a polymer), pyridazines, pyrimidines, pyrazines, piperidines, piperazines, morpholines, picolines, quinolines and quinaldines, pyrroles, pyrrolines, indoles, isoindoles, imidazoles, benzimidazoles, thiazoles and isothiazoles,

wherein among the above heterocyclic compounds, the pyridines (the pyridine may be incorporated into a polymer) may be substituted with a lower alkyl group (1 to 3 carbon atoms), a phenyl group, an acetyl group, an amino group, a carboxyl group, a hydroxyl group or an alcohol group or may not be substituted (non-substituted) and,

the other above heterocyclic compounds may be substituted with halogen, a lower alkyl group (1 to 3 carbon atoms), a phenyl group, an acetyl group, an amino group, a carboxyl group, a hydroxyl group or an alcohol group or may not be substituted (non-substituted);

bridged cyclic amines;

aliphatic amines which may contain an alkoxy group

consisting of

primary amines consisting of n-propylamine, n-butylamine, and n-hexylamine,

secondary amines consisting of di-n-butylamine, di-n-hexylamine, di-n-octylamine, di-n-decylamine, di-n-dodecylamine, di-n-tridecylamine, di-n-tetradecylamine, di-n-hexadecylamine, and di-n-octadecylamine,

tertiary amines consisting of tri-n-propylamine, tri-n-hexylamine, tri-n-octylamine, tri-n-decylamine, tri-n-dodecylamine, tri-n-tridecylamine, tri-n-tetradecylamine, tri-n-hexadecylamine, and tri-n-octadecylamine, and

alkoxy group-containing amines consisting of 3-ethoxypropylamine, 3-butoxypropylamine, 4-(2-ethylhexyloxy)butylamine, 4-lauryloxybutylamine, 8-ethoxyoctylamine, 8-(2-ethylhexyloxy)octylamine, 2-ethylhexyloxyphenylamine and lauryloxyphenylamine;

alicyclic amines;

aromatic amines consisting of aniline, toluidine, diphenylamine, and triphenylamine; and

amino alcohols.

2. The antifouling coating material composition as described in claim 1 comprising, in addition to the components (A), (b1) and (C) described above, at least one

component selected from the group consisting of an organic antifouling agent (b2) other than the triphenylboron-amine complex (b1) and zinc sulfide, a color pigment (D), an extender pigment (E), an inorganic dehydrating agent (F), a plasticizer (G), an anti-sagging/anti-settling agent (thixotropic agent) (H), an oxyalkylene group-containing linear organopolysiloxane (I) and a plastic resin (J).

3. The antifouling coating material composition as described in any of claims 1 to 2, wherein the amine compound

(C) is contained in an amount of 1.0 to 210 parts by weight per 100 parts by weight of the triphenylboron-amine complex

5 (b1).

4. The antifouling coating material composition as described in any of claims 1 to 3, wherein the triphenylboron-amine complex (b1) is contained in an amount
10 of 5 to 150 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

15

20

5. The antifouling coating material composition as described in claim 1, wherein the amine compound (C) comprises at least one bridged cyclic amine of quinuclidines and triethylenediamines .

5

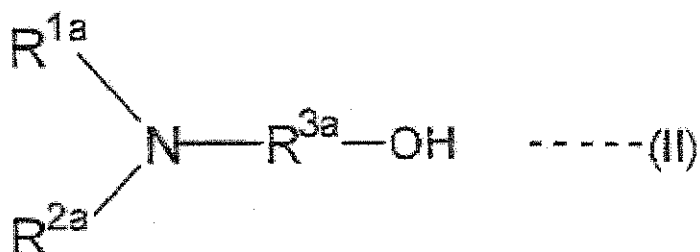
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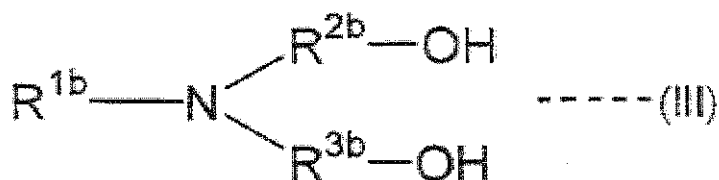
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6. The antifouling coating material composition as described in claim 1, wherein the amine compound (C) is amino alcohol represented by any of the following Formulas (II), (III) and (IV):

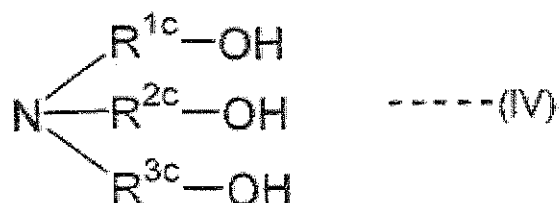


(in Formula (II), R^{1a} and R^{2a} may be the same as or different from each other and are a hydrogen atom, an alkyl group or alkenyl group having 1 to 24 carbon atoms, a cycloalkyl group having 3 to 12 carbon atoms, an alkylallyl group (an alkyl group part has 1 to 24 carbon atoms), an aralkyl group (an alkylene group part has 1 to 24 carbon atoms) or an allyl group, and R^{3a} is an alkylene group having 2 to 6 carbon atoms);



(in Formula (III), R^{1b} is a hydrogen atom, an alkyl group or alkenyl group having 1 to 24 carbon atoms, a cycloalkyl group

having 3 to 12 carbon atoms, an alkylallyl group (an alkyl group part has 1 to 24 carbon atoms), an aralkyl group (an alkylene group part has 1 to 24 carbon atoms) or an allyl group, and R^{2b} and R^{3b} may be the same as or different from each other and are an alkylene group having 2 to 6 carbon atoms); and



(in Formula (IV), R^{1c} , R^{2c} and R^{3c} may be the same as or different from each other and are an alkylene group having 2 to 6 carbon atoms).

7. The antifouling coating material composition as described in claim 6, wherein the amino alcohol is at least one selected from monoethanolamine, diethanolamine, triethanolamine, n-propyl alcohol amine, di-n-propyl alcohol amine, tri-propyl alcohol amine, i-propyl alcohol amine, di-i-propyl alcohol amine and tri-i-propyl alcohol amine.

8. The antifouling coating material composition as described in any of claims 1 to 4, wherein the triphenylboron-amine complex (b1) is a complex of triphenylboron with pyridine (pyridine-triphenylboron).

9. The antifouling coating material composition as described in any of claims 1 to 4, wherein the triphenylboron-amine complex (b1) is a complex of triphenylboron with alkylamine, aniline or toluidine.

5

10. The antifouling coating material composition as described in claim 9, wherein the alkylamine is at least one selected from the group consisting of n-propylamine, n-butylamine, n-hexylamine, n-octylamine, n-decylamine, n-dodecylamine, n-tridecylamine, n-tetradecylamine, n-hexadecylamine, and n-octadecylamine.

11. The antifouling coating material composition as described in any of claims 1 to 4, wherein the triphenylboron-amine complex (b1) is a complex of triphenylboron with alkoxy group-containing amine.

12. The antifouling coating material composition as described in claim 11, wherein the alkoxy group-containing amine is a compound represented by the following Formula (I):



(in Formula (I), R^1 represents a linear or branched alkylene group having 1 to 8 carbon atoms or a phenylene group, and R^2

represents a linear or branched alkyl group having 1 to 8 carbon atoms).

13. The antifouling coating material composition as
5 described in claim 12, wherein the alkoxy group-containing amine is at least one selected from the group consisting of 3-ethoxypropylamine, 3-butoxypropylamine, 3-(2-ethylhexyloxy)propylamine, 3-lauryloxypropylamine, 3-stearyloxypropylamine, 4-(2-ethylhexyloxy)butylamine, 4-
10 lauryloxybutylamine, 8-ethoxyoctylamine, 8-(2-ethylhexyloxy)octylamine, 2-ethylhexyloxyphenylamine and lauryloxyphenylamine.

14. The antifouling coating material composition as
15 described in any of claims 1 to 2, wherein the amine compound (C) is contained in an amount of 0.1 to 3 moles per mole of the triphenylboron-amine complex (b1).

15. The antifouling coating material composition as
20 described in any of claims 1 to 14, wherein the coating film-forming resin (A) is at least one selected from the group consisting of (meth)acrylic acid metal salt copolymers, trialkylsilyl acrylate (co)polymers, vinyl chloride base resins, vinyl chloride-vinyl acetate copolymers, vinyl

chloride-vinyl isobutyl ether copolymers, chlorinated rubber base resins, chlorinated polyethylene resins, chlorinated polypropylene resins, acryl resins, styrene-butadiene base resins, polyester base resins, epoxy base resins, phenol base resins, synthetic rubbers, silicone rubbers, silicone base resins, petroleum base resins, rosin ester base resins, rosin base soaps and rosin.

16. The antifouling coating material composition as described

in any one of claims 2 to 15, which comprises at least one organic antifouling agent (b2) other than the triphenylboron-amine complex (b1) selected from the group consisting of copper salt of 2-pyridinethiol-1-oxide (copper pyrithione), 2-pyridinethiol-1-oxide zinc salt (zinc pyrithione), 4,5-dichloro-2-n-octyl-4-isothiazoline-3-one, N,N-dimethyldichlorophenylurea, 2,4,6-trichlorophenylmaleimide, 2-methylthio-4-tert-butylamino-6-cyclopropyl-S-triazine, 2,4,5,6-tetrachloroisophthalonitrile, bisdimethyldithiocarbamoylzinc ethylenebisdithiocarbamate,

chloromethyl-n-octyl disulfide, N,N'-dimethyl-N'-phenyl-(N-fluorodichloromethylthio)sulfamide, N,N'-dimethyl-N'-tolyl-(N-fluorodichloromethylthio)sulfamide, tetraalkylthiuram disulfide (the alkyl group has 1 to 5 carbon atoms), zinc

5 dimethyldithiocarbamate, zinc ethylenebisdithiocarbamate, 2,3-dichloro-N-(2',6'-diethylphenyl)maleimide, and 2,3-dichloro-N-(2'-ethyl-6'-methylphenyl)maleimide.

17. The antifouling coating material composition as described in
10 any of claims 2 to 16, which comprises at least one color pigment (D) selected from the group consisting of red iron oxide, titan white, yellow iron oxide and organic pigments in an amount of 0.05 to 125 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

15

18. The antifouling coating material composition as described in any of claims 2 to 17, which comprises at least one extender pigment (E) selected from the group consisting of talc, silica, mica, clay, zinc oxide, calcium carbonate, kaolin, alumina white,
20 white carbon, aluminum hydroxide, magnesium carbonate, barium carbonate, barium sulfate and zinc sulfide in an amount of 2.5 to 250 parts by weight per 100 parts by weight of the coating

film-forming resin (A) (solid content).

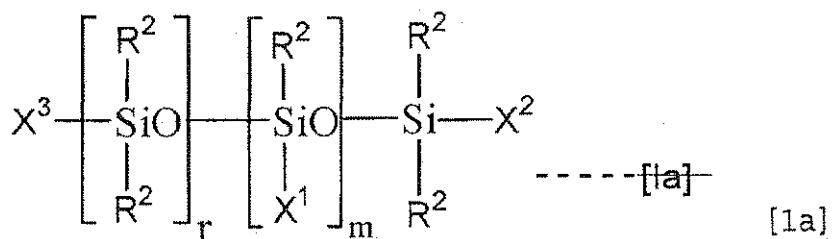
19. The antifouling coating material composition as described in any of claims 2 to 18, which comprises at least one inorganic dehydrating agent (F) selected from the group consisting of anhydrite and gypsum hemihydrate (casting plaster) in an amount of 1.0 to 25 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

20. The antifouling coating material composition as described in any of claims 2 to 19, which comprises at least one plasticizer (G) selected from the group consisting of chlorinated paraffin and terphenol in an amount of 0.5 to 50 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

21. The antifouling coating material composition as described in any of claims 2 to 20, which comprises at least one anti-sagging/anti-settling agent (H) selected from the group consisting of respective amine salts, stearate salts, lecithin salts and alkylsulfonic acid salts of Al, Ca and Zn (organic clay base wax); polyethylene wax, amide wax, hydrogenated castor oil wax and polyamide wax (organic wax);

mixtures of the organic clay base wax and the organic wax described above; and synthetic fine powder silica; polyethylene oxide base wax; and fatty acid amide wax in an amount of 0.25 to 50 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content).

22. The antifouling coating material composition as described in any of claims 2 to 21, which comprises an oxyalkylene group-containing linear organopolysiloxane (I) represented by the following Formula [1a] in which a hydrophile-lipophile balance (HLB) is 2 to 12 in an amount of 0.5 to 200 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content):



(in Formula [1a], X^1 , X^2 and X^3 each represent independently a polyether group: $-\text{R}-\text{A}-(\text{R}^3\text{O})_n-\text{R}^4$ (R represents an alkylene group having 1 to 5 carbon atoms; A represents a single bond or an oxygen atom; R^3 represents an alkylene group having 1 to 5 carbon atoms; R^4 represents an alkyl group having 1 to 5 carbon atoms or hydrogen; and n represents a repeating unit

number) or an alkyl group having 1 to 5 carbon atoms; at least one of X^1 , X^2 and X^3 is the polyether group described above: $-R-A-(R^3O)_n-R^4$; R^2 represents an alkyl group having 1 to 3 carbon atoms; r and m each represent a repeating unit total number, and a bonding order of the
 5 repeating units $[-Si(R^2)_2O-]$ and $[-Si(R^2)(X^1)O-]$ may be optional).

23. The antifouling coating material composition as described in any of claims 2 to 22, which comprises at least one plastic resin (J) selected from the group consisting of polybutenes, paraffins,
 10 vaselines and a dialkyl sulfide compound represented by the following Formula (VI) in an amount of 5 to 100 parts by weight per 100 parts by weight of the coating film-forming resin (A) (solid content):



(in Formula (VI), plural R^{3d} and R^{3e} may be the same as or different
 15 from each other and each represent a linear or branched alkyl group having 1 to 20 carbon atoms, and n represents an integer of 1 to 20).

24. A mixture comprising a triphenylboron-amine complex (b1) and the amine compound (C) (excluding the triphenylboron-amine complex (b1);
 20 hereinafter the same shall apply) defined in claim 1

, and it further comprises, if necessary, a solvent (M) which can dissolve the above components (b1) and (C), and which is selected from aliphatic solvents, aromatic solvents, ketone base solvents, ester base solvents, and ether base solvents; and the amine compound (C) is contained in an amount of 1 to 210 parts by weight per 100 parts by weight of the triphenylboron-amine complex (b1).

25. The mixture as described in claim 24, wherein the triphenylboron-amine complex (b1) is as described in any of claims 8 to 13.

26. The mixture as described in any of claims 24 to 25, wherein the amine compound (C) is as described any of claims 5 to 7.

27. An antifouling coating film obtainable by curing the antifouling coating material composition as described in any of claims 1 to 23.

28. A substrate provided with an antifouling coating film characterized by that a surface of the substrate is coated with the antifouling coating film

as described in claim 27.

29. An antifouling substrate having a surface coated with the antifouling coating film as described in claim 27, wherein
5 said coated surface of said antifouling substrate is to be brought into contact with seawater or refined water.

30. The antifouling substrate as described in claim 29, wherein the substrate is any of an underwater structure, a
10 ship outside plate, a fishing net and a fishing equipment.

31. A method for forming a coating film on a surface of a substrate characterized by coating or impregnating a surface of a substrate with the antifouling coating material
15 composition as described in any of claims 1 to 23 and then curing it to form a coating film.

32. An antifouling method for a substrate characterized by coating or impregnating a surface of a substrate with the
20 antifouling coating material composition as described in any of claims 1 to 23 and then curing the above antifouling coating material to form an antifouling coating film.

33. The antifouling method for a substrate as described in claim 32, wherein the substrate is any of an underwater structure, a ship outside plate, a fishing net and a fishing equipment.

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34. An inhibiting method for decomposition of a triphenylboron-amine complex characterized by adding the amine compound (C) (excluding the triphenylboron-amine complex (b1)) defined in claim 1 to the triphenylboron-amine complex (b1) or
10 a material containing the triphenylboron-amine complex (b1).

35. The inhibiting method for decomposition of a triphenylboron-amine complex as described in claim 34, wherein the triphenylboron-amine complex (b1) is as described in any
15 of claims 8 to 13.

36. The inhibiting method for decomposition of a triphenylboron-amine complex as described in claim 34, wherein the amine compound (C) is as described in any of claims 5 to 7.