

DESCRIPTION

COATING MATERIAL COMPOSITION AND HYDROPHILIC MEMBER

5 TECHNICAL FIELD

[0001]

The present invention relates to coating material compositions and hydrophilic members. More particularly, the present invention relates to a coating material composition and a hydrophilic member for forming a coating film having antifogging
10 properties.

BACKGROUND ART

[0002]

A mirror installed in a bathroom sink, for example, may fog up with moisture in
15 the air to cause water condensation on the surface of the mirror when the surface temperature of the mirror drops in winter. Various methods have been developed to deal with such a fogging-up problem.

[0003]

For example, Patent Literature 1 discloses a hard coat or a cured coating film
20 having high electrostatic properties and antifogging properties obtained such that a surface of a synthetic resin molded product is coated with a composition and then cured.

[0004]

The composition disclosed in Patent Literature 1 contains a polyfunctional monomer (A) having three or more of (meth)acryloyl groups, and a monofunctional or
25 bifunctional monomer (B). Examples of monomers (B) disclosed include polyethylene glycol mono(meth)acrylate, polyoxyethylene glycol mono(meth)acrylate, polyethylene glycol (meth)acrylate, and polypropylene glycol di(meth)acrylate.

[0005]

Patent Literature 1 also discloses in one example that the composition contains
30 25 parts by mass of PE-4A and 30 parts by mass of PE-3A as the monomer (A), and

contains 15 parts by mass of predetermined polyethylene glycol diacrylate as the monomer (B). The compound PE-4A refers to pentaerythritoltetraacrylate, and the compound PE-3A refers to pentaerythritoltriacylate.

5 CITATION LIST

PATENT LITERATURE

[0006]

Patent Literature 1: Japanese Unexamined Patent Application Publication No. H05-214044

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SUMMARY OF INVENTION

[0007]

Patent Literature 1 teaches that the cured coating film obtained from the above composition exerts high performance in all of scratch resistance, abrasion resistance, electrostatic properties, and antifogging properties. The composition described above, however, still does not have satisfactory antifogging properties sufficient to meet the recent demand for much higher antifogging properties in the market. A coating material composition capable of providing a coating film having greater antifogging properties thus further needs to be developed.

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[0008]

The present invention has been made to solve the conventional technical problem. An object of the present invention is to provide a coating material composition and a hydrophilic member capable of forming a coating film having high antifogging properties.

25

[0009]

To solve the above conventional technical problem, a coating material composition according to a first aspect of the present invention includes a first monomer including repeat units of an ethylene oxide group and a bifunctional (meth)acryloyl group per molecule, and a second monomer including a tri- or greater functional (meth)acryloyl group and a mono- or greater functional hydroxyl group per molecule. The first

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monomer has the number of the repeat units of the ethylene oxide group in a range of 18 to 40. The first monomer has a content in a range of 40% to 95% by mass and the second monomer has a content in a range of 5% to 60% by mass, with respect to 100% by mass of a total content of the first monomer and the second monomer. The content of the first monomer is in a range of 40% to 85% by mass with respect to a total solids content, and the content of the second monomer is in a range of 10% to 55% by mass with respect to the total solids content.

[0010]

A hydrophilic member according to a second aspect of the present invention includes a substrate, and a hydrophilic film provided on the substrate and formed from the coating material composition.

DESCRIPTION OF EMBODIMENTS

[0011]

[Coating material composition]

Patent Literature 1 discloses in Example 3 the composition described above including 25 parts by weight of PE-4A, 30 parts by weight of PE-3A, 25 parts by weight of NVP, 15 parts by weight of 45EO-DA, 20 parts by weight of EC, and 5 parts by weight of HCHPK. The compound PE-4A refers to pentaerythritoltetraacrylate, the compound PE-3A refers to pentaerythritoltriacylate, and the compound NVP refers to N-vinyl-2-pyrrolidone. The compound 45EO-DA used is polyethylene glycol diacrylate in which the number of repeat units of the ethylene oxide group is 45. The compound EC is ethyl cellosolve used as an unpolymerized solvent, and the component HCHPK is 1-hydroxycyclohexyl phenyl ketone used as a polymerization initiator.

[0012]

Patent Literature 1 teaches that the cured coating film obtained from the above composition exerts high performance in all of the scratch resistance, the abrasion resistance, the electrostatic properties, and the antifogging properties.

[0013]

The composition described above, however, still does not have satisfactory

antifogging properties sufficient to meet the recent demand for much higher antifogging properties in the market. A coating material composition capable of providing a coating film having greater antifogging properties thus further needs to be developed.

[0014]

5 Increasing the number of the repeat units in the ethylene oxide group which is a hydrophilic group can be a way for improving the antifogging properties in a coating film. As disclosed in Patent Literature 1, however, an excessive increase in the number of the repeat units in the ethylene oxide group may adversely lead to not only a reduction in the antifogging properties of the coating film but also a reduction in the electrostatic
10 properties, the scratch resistance, and the abrasion resistance.

[0015]

Increasing the content of polyethylene glycol diacrylate such as 45EO-DA can be another way for improving the antifogging properties in the coating film. Patent Literature 1 discloses that the content of the monomer (B) in the composition is preferably
15 set in the range of 5 to 30 parts by weight with respect to 100 parts by weight of the composition so as to ensure high antifogging properties in the cured coating film.

[0016]

However, the increase of the content of polyethylene glycol diacrylate such as 45EO-DA up to about 30 parts by mass would not necessarily ensure satisfactory fogging
20 properties. In addition, an excessive increase of the content of polyethylene glycol diacrylate such as 45EO-DA to more than 30 parts by mass could lead to a reduction in hardness and water resistance of the coating film. The compounds PE-4A and PE-3A in Example 3 disclosed in Patent Literature 1 are each presumed to correspond to the monomer (A). The compound 45EO-DA in Example 3 disclosed in Patent Literature 1
25 is presumed to correspond to the monomer (B). The content of the monomer (B) in Example 3 is presumed to be about 21% by mass with respect to 100% by mass which is the total content of the monomer (A) and the monomer (B). When the content of the monomer (B) in Example 3 is simply set to 30 parts by mass, the content of the monomer (B) in Example 3 is presumed to be about 35% by mass with respect to 100% by mass of
30 the total content of the monomer (A) and the monomer (B).

[0017]

A coating material composition according to the present embodiment includes a first monomer including repeat units of an ethylene oxide group and a bi- or greater functional (meth)acryloyl group per molecule. The coating material composition according to the present embodiment also includes a second monomer including a tri- or greater functional (meth)acryloyl group and a mono- or greater functional hydroxyl group per molecule. The number of the repeat units of the ethylene oxide group in the first monomer is in a range of 18 to 40. The content of the first monomer is in a range of 40% to 95% by mass, and the content of the second monomer is in a range of 5% to 60% by mass, with respect to 100% by mass of the total content of the first monomer and the second monomer.

[0018]

The coating material composition as described above includes the first monomer mainly exerting the antifogging properties on a coating film, and the second monomer mainly exerting the hardness and the water resistance on the coating film. The number of the repeat units of the ethylene oxide group in the first monomer is set in the predetermined range, and the content of each of the first monomer and the second monomer is set in the predetermined range. The coating material composition according to the present embodiment, when applied to a substrate and then cured, can form the coating film having the high antifogging properties, hardness, and water resistance. The respective constituents are described in detail below.

[0019]

(First Monomer)

The coating material composition according to the present embodiment includes the first monomer including the repeat units of the ethylene oxide group and the bi- or greater functional (meth)acryloyl group per molecule. In particular, the first monomer includes the repeat units of the ethylene oxide group contributing to the antifogging properties, and the bi- or greater functional (meth)acryloyl group contributing to the hardness and the water resistance of the coating film due to a polymerization reaction.

[0020]

The first monomer having the repeat units of the ethylene oxide group having hydrophilic properties can exert the antifogging properties on the coating film. The first monomer according to the present embodiment, which has the repeat units of the ethylene oxide group per molecule, thus can minimize an influence of a reduction in performance caused by bleed out or the passage of time, as compared with a case of a film to which an additive such as an antistatic agent so as to exert antifogging properties.

[0021]

The ethylene oxide group is represented by the constitutional unit of $-(CH_2CH_2O)-$. The first monomer includes the repeat units of the ethylene oxide group (CH_2CH_2O) per molecule. In particular, the number of the repeat units of the ethylene oxide group in the first monomer is in the range of 18 to 40. Setting the number of the repeat units to 18 or greater leads to an increase in the number of chemical structures having hydrophilic properties in the coating film, so as to absorb moisture which may cause water condensation. The first monomer can avoid defuse reflection caused by the water condensation, so as to improve the antifogging properties of the coating film. Setting the number of the repeat units to 40 or less can improve the hardness and the water resistance of the coating film. The number of the repeat units of the ethylene oxide group is preferably set to 20 or greater, more preferably set to 22 or greater, and still more preferably set to 23 or greater in view of the antifogging properties. The number of the repeat units of the ethylene oxide group is also preferably set to 38 or smaller, more preferably set to 36 or smaller, and further preferably set to 35 or smaller in view of the hardness and the water resistance. The repeat units of the ethylene oxide group may be continuously repeated within a single molecule, or may be intermittently repeated. The first monomer may also be used singly, or several types may be combined together. As used herein, the number of the repeat units of the ethylene oxide group is an integer obtained by subtracting a molecular amount with a chemical structure other than the ethylene oxide group from a number average molecular weight M_n of the first monomer, and dividing the value by the molecular amount of the ethylene oxide group and rounding off the obtained value.

[0022]

A weight average molecular weight M_w of the first monomer tends to be greater than the number average molecular weight M_n , and a ratio of the weight average molecular weight M_w to the number average molecular weight M_n (M_w/M_n) is typically one or greater. A value of the ratio M_w/M_n in the first monomer is preferably 1.4 or smaller, and more preferably 1.1 or smaller. As used herein, the weight average molecular weight M_w and the number average molecular weight M_n can be measured by gel permeation chromatography (GPC) so as calculate polyethylene glycol as a standard sample. When a molecular weight distribution of the first monomer has a plurality of peaks, the weight average molecular weight M_w and the number average molecular weight M_n can be calculated for the respective peaks.

[0023]

The first monomer has the bi- or greater functional (meth)acryloyl group per molecule. The (meth)acryloyl group is represented by $-\text{OCOCH}=\text{CH}_2$ or $-\text{OCOC}(\text{CH}_3)=\text{CH}_2$, and can form a polymer by the polymerization reaction. The first monomer having the bi- or greater functional (meth)acryloyl group per molecule can improve a cross-linked density of the polymer forming the coating film, as compared with a case of using a monofunctional group. The first monomer described above thus can improve the water resistance of the coating film.

[0024]

The (meth)acryloyl group included in the first monomer encompasses a case of a polyfunctional group such as a bi-, tri-, or tetra- or greater functional group. In view of the antifogging properties, the (meth)acryloyl group included in the first monomer is preferably either the bifunctional group or the trifunctional group, and more preferably the bifunctional group. Namely, the first monomer is preferably di(meth)acrylate. The (meth)acryloyl group of the first monomer, which encompasses a methacryloyl group and an acryloyl group, is preferably an acryloyl group in view of a curing speed.

[0025]

The first monomer is preferably a monomer having (meth)acryloyl groups at both ends in the main chain including the repeat units of the ethylene oxide group. The ethylene oxide group in which the number of the repeat units is in the range of 18 to 40

is preferably included in the main chain of the first monomer. The use of the first monomer of this type in the coating material composition can provide a coating film having high water resistance. The first monomer used may be at least one monomer selected from the group consisting of polyethylene glycol di(meth)acrylate represented by the following chemical formula (1), ethylene oxide modified bisphenol A di(meth)acrylate represented by the following chemical formula (2), ethylene oxide modified bisphenol F di(meth)acrylate represented by the following chemical formula (3), ethylene oxide modified hexanediol di(meth)acrylate represented by the following chemical formula (4), and ethylene oxide modified neopentyl glycol di(meth)acrylate represented by the following chemical formula (5):

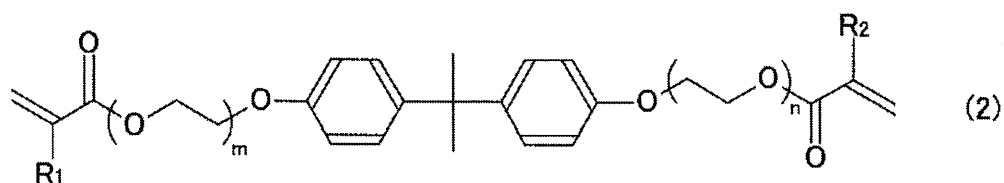
[0026]

[Chem. 1]



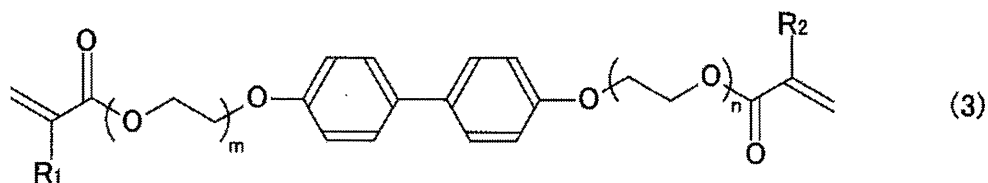
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[Chem. 2]



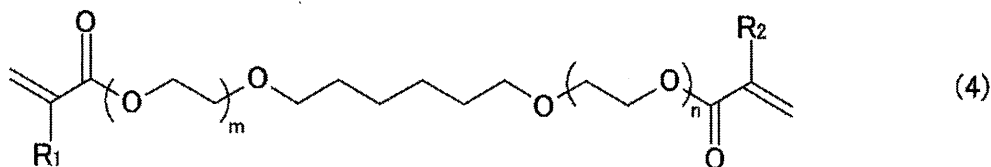
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[Chem. 3]



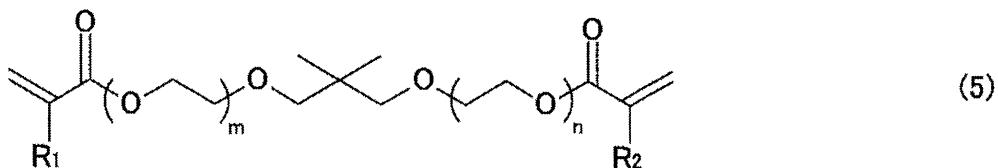
[0029]

[Chem. 4]



5 [0030]

[Chem. 5]



[0031]

In the chemical formulas (1) to (5), R_1 and R_2 are each either H or CH_3 , l is an integer in the range of 18 to 40, and $m + n$ is the integer in the range of 18 to 40.

[0032]

The respective monomers represented by the chemical formulas (1) to (5) may be used singly, or may be used in combination. The first monomer preferably includes polyethylene glycol di(meth)acrylate represented by the chemical formula (1) in view of the antifogging properties.

[0033]

The first monomer also preferably includes (meth)acrylate having a bisphenol skeleton as represented by the chemical formula (2) or (3) so as to improve the rigidity of the coating film. The first monomer preferably includes polyethylene glycol di(meth)acrylate represented by the chemical formula (1) and (meth)acrylate having a

bisphenol skeleton in view of the antifogging properties and the rigidity. In particular, the first monomer preferably includes polyethylene glycol di(meth)acrylate represented by the chemical formula (1), and at least one of ethylene oxide modified bisphenol A di(meth)acrylate represented by the chemical formula (2) or ethylene oxide modified bisphenol F di(meth)acrylate represented by the chemical formula (3). The first monomer also preferably includes polyethylene glycol di(meth)acrylate represented by the chemical formula (1) and ethylene oxide modified bisphenol A di(meth)acrylate represented by the chemical formula (2).

[0034]

Specific examples of monomers used as the first monomer include NK-Ester A-1000 (polyethylene glycol 1000 diacrylate: in the chemical formula (1), $R_1 = H$, $R_2 = H$, and $l = 23$) available from Shin-Nakamura Chemical Co., Ltd, and NK-Ester A-BPE-20 (ethylene oxide (EO) modified bisphenol A diacrylate: in the chemical formula (2), $R_1 = H$, $R_2 = H$, and $m + n = 20$) available from Shin-Nakamura Chemical Co., Ltd.

[0035]

The weight average molecular weight of the first monomer is preferably set in a range of 800 to 3,000 g/mol, and more preferably set in a range of 850 to 2,300 g/mol. The weight average molecular weight of the first monomer set in the above range can improve the coating characteristics of the coating material composition.

[0036]

The content of the first monomer with respect to the total solids content of the coating material composition is preferably set in a range of 35% to 95% by mass, and more preferably set in a range of 40% to 85% by mass. The content of the first monomer set in the above range can provide the coating material composition capable of improving the antifogging properties, the water resistance, and the hardness of the coating film.

[0037]

(Second Monomer)

The second monomer includes the tri- or greater functional (meth)acryloyl group and the mono- or greater functional hydroxyl group per molecule. In particular, the second monomer includes the tri- or greater functional (meth)acryloyl group contributing

to the hardness and the water resistance of the coating film due to the polymerization reaction. The second monomer also includes the mono- or greater functional hydroxyl group contributing to the improvement of the antifogging properties of the coating film and serving as a hydrogen donor capable of avoiding inhibition of the reaction to further contribute to the improvement of the hardness of the coating film.

[0038]

The second monomer includes the tri- or greater functional (meth)acryloyl group per molecule. A polymer formed by the polymerization reaction forms a three-dimensional mesh structure, so as to improve the hardness and the water resistance of the coating film, as compared with a case of including a bi- or less functional (meth)acryloyl group. The (meth)acryloyl group of the second monomer, which encompasses a methacryloyl group and an acryloyl group, is preferably an acryloyl group in view of the curing speed.

[0039]

The (meth)acryloyl group included in the second monomer may be the trifunctional group, or a tetra- or greater functional group. In view of prevention of curing contraction, the second monomer preferably includes the trifunctional (meth)acryloyl group per molecule.

[0040]

The second monomer may include any hydroxyl group that is a mono- or greater functional hydroxyl group, but preferably includes the monofunctional hydroxyl group.

[0041]

In particular, the second monomer preferably includes the trifunctional (meth)acryloyl group and the monofunctional hydroxyl group per molecule. The second monomer with these functional groups can provide the coating material composition capable of forming the coating film having the high antifogging properties, hardness, and water resistance.

[0042]

Examples of monomers used as the second monomer include pentaerythritol tri(meth)acrylate, dipentaerythritol tri(meth)acrylate, dipentaerythritol

tetra(meth)acrylate, dipentaerythritol penta(meth)acrylate, and ditrimethylolpropane tri(meth)acrylate. The respective monomers listed above may be used singly, or may be used in combination. Among these monomers, pentaerythritol tri(meth)acrylate is preferably used in view of the coating characteristics. The second monomer to be used
5 may be NEW FRONTIER (registered trademark) PET-3 (pentaerythritol triacrylate) available from Dai-ichi Kogyo Seiyaku Co., Ltd.

[0043]

A weight average molecular weight of the second monomer is preferably, but not necessarily, set in a range of 230 to 800 g/mol, more preferably set in a range of 260
10 to 600 g/mol, and still more preferably set in a range of 200 to 400 g/mol. The weight average molecular weight of the second monomer set in the above range can improve the coating characteristics of the coating material composition.

[0044]

The content of the second monomer with respect to the total solids content of
15 the coating material composition is preferably set in a range of 4% to 60% by mass, and more preferably set in a range of 10% to 55% by mass. The content of the second monomer set in the above range can provide the coating material composition capable of improving the antifogging properties, the water resistance, and the hardness of the coating film.

20 [0045]

The present embodiment sets the content of the first monomer in the range of 40% to 95% by mass, and sets the content of the second monomer in the range of 5% to 60% by mass, with respect to 100% by mass which is the total content of the first monomer and the second monomer. The respective contents of the first monomer and
25 the second monomer set in the above ranges can provide the coating material composition capable of improving the antifogging properties, the water resistance, and the hardness of the coating film. The content of the first monomer is more preferably set in a range of 45% to 85% by mass, and the content of the second monomer is more preferably set in a range of 15% to 55% by mass, with respect to 100% by mass which is the total content
30 of the first monomer and the second monomer. The content of the first monomer is still

more preferably set in a range of 50% to 80% by mass, and the content of the second monomer is still more preferably set in a range of 20% to 50% by mass, with respect to 100% by mass which is the total content of the first monomer and the second monomer. The total content of the first monomer and the second monomer with respect to the total solids content of the coating material composition is preferably 70% by mass or greater, more preferably 80% by mass or greater, still more preferably 90% by mass or greater, and particularly preferably 95% by mass or greater. The total content of the first monomer and the second monomer with respect to the total solids content of the coating material composition is preferably less than 100% by mass.

[0046]

The coating material composition according to the present embodiment may further include a third monomer, in addition to the first monomer and the second monomer, within a range not impeding the effects of the present embodiment. Examples of monomers used as the third monomer include a styrene monomer, an olefin monomer, a vinyl monomer, and an acryl monomer. An example of the styrene monomer is styrene. An example of the olefin monomer is ethylene or propylene. An example of the vinyl monomer is vinyl chloride or vinylidene chloride. An example of the acryl monomer is (meth)acrylate. The (meth)acrylate encompasses acrylate and methacrylate. These monomer components may be used singly, or may be used in combination. The content of the third monomer with respect to the total solids content of the coating material composition is preferably, but not necessarily, set in a range of 0.001% to 25% by mass, and more preferably set in a range of 0.005% to 15% by mass.

[0047]

The third monomer preferably includes (meth)acrylate including at least one of fluorine or polysiloxane per molecule. The (meth)acrylate of this type tends to be localized on the surface after the application of the coating material composition. The (meth)acrylate of this type can reduce surface tension of the coating film itself and thus allow the surface of the coating film to have water repellency and oil repellency. The coating material composition according to the present embodiment including the first monomer having the hydrophilic properties as described above has water absorbency.

The coating material composition, when including (meth)acrylate including at least one of fluorine or polysiloxane per molecule, leads the surface of the coating film to have water repellency and oil repellency after being cured. The coating material composition thus can repel waterdrops on the surface of the coating film due to the water repellent effect of the third monomer, regardless of the presence of moisture exceeding the water-absorption capacity of the first monomer, so as to improve the antifogging properties of the coating film. In addition, the coating film provided with the cured coating material composition including (meth)acrylate including at least one of fluorine or polysiloxane also has oil repellency. The addition of (meth)acrylate including at least one of fluorine or polysiloxane to the coating material composition thus can provide the coating film exerting not only the antifogging properties but also antisoiling properties.

[0048]

The added amount of (meth)acrylate including at least one of fluorine or polysiloxane per molecule may be determined as appropriate without impeding the effects of the present embodiment. The small amount of (meth)acrylate including at least one of fluorine or polysiloxane per molecule is sufficient to exert the water repellency and the oil repellency described above. The content of (meth)acrylate including at least one of fluorine or polysiloxane per molecule with respect to the total solids content of the coating material composition is preferably set in a range of 0.001% to 5% by mass, and more preferably set in a range of 0.005% to 1% by mass.

[0049]

Examples of (meth)acrylate including fluorine per molecule include trifluoromethyl (meth)acrylate, trifluoroethyl (meth)acrylate, perfluorodecyl ethyl (meth)acrylate, perfluorooctyl ethyl (meth)acrylate, perfluorohexyl ethyl (meth)acrylate, perfluorobutyl ethyl (meth)acrylate, and perfluoropolyether (meth)acrylate.

[0050]

The third monomer, when including (meth)acrylate including polysiloxane, can reform the surface characteristics of the coating film so as to provide slip characteristics or a smooth texture on the surface of the coating film. The coating material composition according to the present embodiment thus preferably further includes (meth)acrylate

including polysiloxane. The coating film exerting the slip characteristics can improve sliding performance on its surface, so as to increase a degree of a pencil hardness, for example. In addition, the coating film ensuring the smooth texture can improve a feeling of texture on its surface.

5 [0051]

An example of (meth)acrylate including polysiloxane per molecule is (meth)acrylate obtained such that a structure having polysiloxane as a main skeleton, such as polydimethyl siloxane, polydiethyl siloxane, polydiphenyl siloxane, or polymethylphenyl siloxane, is modified by (meth)acrylate. A specific example of
10 (meth)acrylate including polysiloxane per molecule is Shin-Etsu Silicone (registered trademark) X-22-174ASX (methacrylate including polydimethyl siloxane (methacryl modified silicone oil)) available from Shin-Etsu Chemical Co., Ltd.

[0052]

The coating material composition according to the present embodiment
15 preferably includes a polymerization initiator for promoting the polymerization reaction of the first monomer and the second monomer having a carbon-carbon unsaturated bond. The content of the polymerization initiator is preferably, but not necessarily, set in a range of 1% to 10% by mass with respect to the total solids content of the coating material composition. The polymerization initiator to be used may be at least one of a
20 photopolymerization initiator and a thermal polymerization initiator, and is preferably a photopolymerization initiator. The use of the photopolymerization initiator allows the first monomer and the second monomer to be instantaneously cured by irradiation with an active energy ray, so as to decrease the manufacturing steps.

[0053]

25 The photopolymerization initiator is a compound having a function of starting the polymerization reaction of the first monomer and the second monomer, and is a substance led to an excited state when absorbing light having a specific wavelength from the active energy ray so as to generate radicals or ions. An example of the photopolymerization initiator may be at least one compound selected from the group
30 consisting of benzoin ether, ketal, acetophenone, benzophenone, and thioxanthone. A

specific example of the photopolymerization initiator may be Irgacure (registered trademark) 184 (1-hydroxycyclohexyl phenyl ketone (acetophenone)) available from BASF.

[0054]

5 The thermal polymerization initiator is a compound having a function of starting the polymerization reaction of the first monomer and the second monomer, and is a substance that generates active species such as radicals or ions by heating. An example of the thermal polymerization initiator may be at least one compound selected from the group consisting of an azo compound such as 2,2'-azobis(isobutyronitrile), a peroxide
10 such as benzoyl peroxide, a benzenesulfonic acid ester, and an alkylsulfonium salt.

[0055]

 The coating material composition according to the present embodiment may include additives having various kinds of functions within a range not impeding the effects of the present embodiment. Examples of additives include a surfactant, a
15 surface-characteristic modifier, a durability improver, a colorant, an ultraviolet absorber, and a light stabilizer. The respective additives may be used singly, or may be used in combination.

[0056]

 The surfactant can be added in order to improve leveling performance and
20 defoaming performance, and hydrophilize the surface of the coating film. The surfactant may be any surfactant such as nonionic surfactant, a cationic surfactant, and an anionic surfactant, and may be determined as appropriate depending on the purpose. The surfactant may be chemically bonded to the first monomer or the second monomer to exert the effects described above, or may intervene in the first monomer or the second
25 monomer without chemical bonding with these monomers so as to exert the effects described above.

[0057]

 The surface-characteristic modifier can be added to the coating material composition in order to improve the surface characteristics such as a feeling of texture.

30 Examples of surface-characteristic modifiers to be added include a silicon monomer and

a fluorine monomer. The surface-characteristic modifier chemically bonding to the first monomer or the second monomer can exert the effects on the coating film as described above.

[0058]

5 The durability improver can be added to the coating material composition in order to improve the durability to chemicals, heat, and sliding movements. Examples of durability improvements include a material having a stiff chemical structure such as a benzene ring or a bisphenol structure, and a material having a soft chemical structure such as alkane.

10 [0059]

 A method of manufacturing the coating material composition according to the present embodiment is described below. The coating material composition can be prepared such that the first monomer and the second monomer are mixed together with the additives to be added as necessary. The mixing conditions can be determined as
15 appropriate, and the mixture may be prepared at a room temperature in the ambient air. The mixing order of the first monomer, the second monomer, and the additives is also determined as appropriate.

[0060]

 A dispersion solvent is preferably added to the coating material composition
20 when the first monomer and the second monomer are mixed to adjust the viscosity so as to facilitate the application of the coating material composition. The dispersion solvent for the viscosity adjustment may be at least one of water or an organic solvent. The organic solvent is determined as appropriate so as to easily volatilize during the preparation of the coating film but not to impede the curing process when forming the
25 coating film. Examples of organic solvents include aromatic hydrocarbons (such as toluene and xylene), alcohols (such as methanol, ethanol, and isopropyl alcohol), and ketones (such as acetone, methyl ethyl ketone, methyl isobutyl ketone, and cyclohexanone). Still other examples include aliphatic hydrocarbons (such as hexane and heptane), ethers (such as tetrahydrofuran), amide solvents (such as N,N-
30 dimethylformamide (DMF) and dimethylacetamide (DMAc)), methyl acetate, and butyl

acetate. These organic solvents may be used singly, or may be used in combination. The amount of the dispersion solvent to be added can be determined as appropriate, and may be set in a range of 0.1 to 500 parts by mass with respect to 100 parts by mass of the coating material composition.

5 [0061]

As described above, the coating material composition according to the present embodiment includes the first monomer including the repeat units of the ethylene oxide group and the bi- or greater functional (meth)acryloyl group per molecule. The coating material composition according to the present embodiment also includes the second
10 monomer including the tri- or greater functional (meth)acryloyl group and the mono- or greater functional hydroxyl group per molecule. The number of the repeat units of the ethylene oxide group in the first monomer is in the range of 18 to 40. The content of the first monomer is in the range of 40% to 95% by mass, and the content of the second monomer is in the range of 5% to 60% by mass, with respect to 100% by mass of the total
15 content of the first monomer and the second monomer.

[0062]

As described above, the coating material composition according to the present embodiment includes the first monomer mainly exerting the antifogging properties on the coating film, and the second monomer mainly exerting the hardness and the water
20 resistance on the coating film. The number of the repeat units of the ethylene oxide group in the first monomer is set to the predetermined range, and the content of each of the first monomer and the second monomer is set to the predetermined range. The coating material composition according to the present embodiment thus enables the coating film to have high antifogging properties, and further enables the coating film to
25 have high hardness and water resistance. The coating material composition according to the present embodiment thus can provide the coating film exerting the high antifogging properties, hardness, and water resistance.

[0063]

The coating film obtained from the coating material composition described
30 above with high hydrophilic properties can also wash out oil stains with the use of a large

amount of water so as to easily remove the oil stains. The coating material composition according to the present embodiment thus can enhance the antisoiling properties for oil.

[0064]

The coating material composition according to the present embodiment having the antifogging properties can be used for various kinds of equipment such as housing members, vehicle members, and security members. Examples of members include a mirror, window glass, a lens, and a display. The coating film obtained from the coating material composition according to the present embodiment has the hydrophilic properties and also has the antisoiling properties for oil. The coating film thus can be used for the housing members including kitchen components. In particular, the coating film can be used for a sirocco fan or a propeller fan installed in a rangehood in a kitchen.

[0065]

[Hydrophilic member]

A hydrophilic member according to the present embodiment is described below.

The hydrophilic member according to the present embodiment includes a substrate and a hydrophilic film formed from the coating material composition described above and provided on the substrate. In particular, the hydrophilic member according to the present embodiment is obtained such that the above coating material composition is applied to the substrate and then cured so as to form the hydrophilic film (the coating film) having hydrophilic properties.

[0066]

The substrate may be, but not limited to, either an inorganic substance substrate including an inorganic material or an organic substance substrate including an organic material. An example of the inorganic substance substrate may be ceramic such as aluminum, iron, stainless steel, a zinc-plated steel plate, glass, enamel, ceramics, slate, and alumina. An example of the organic substance substrate may be a plastic material or sheet such as polycarbonate, acrylic resin, acrylonitrile butadiene styrene (ABS) resin, vinyl chloride resin, epoxy resin, polyester resin, and fiber-reinforced plastic. Examples of fiber-reinforced plastic include carbon fiber reinforced plastic, glass fiber reinforced plastic, and sheet molding compound (SMC).

[0067]

Alternatively, the substrate may be obtained such that the inorganic substance substrate or the organic substance substrate is coated with an organic film. Examples of organic films include an acrylic film, a polyester film, a urethane film, an epoxy film, a
5 melamine film, a silicone film, a fluorine film. To improve the adhesion between the above coating film and the substrate, the substrate may be subjected to surface treatment such as solvent degreasing, alkaline degreasing, or grinding, or may be coated with an acrylic, epoxy, or silicone primer as a base layer.

[0068]

10 The hydrophilic film is obtained such that the coating material composition is cured. The hydrophilic film is obtained from a polymer of the first monomer and the second monomer.

[0069]

A thickness of the hydrophilic film in the hydrophilic member is preferably, but
15 not necessarily, set in a range of 1 μm to 100 μm , and more preferably set in a range of 10 μm to 80 μm . The hydrophilic film having the thickness within the above range can enhance the hardness and the water resistance. The hydrophilic film having the thickness set to 100 μm or less can be firmly bonded to the substrate so as to prevent separation.

20 [0070]

A contact angle of water to the surface of the hydrophilic film in the hydrophilic member is preferably 20 degrees or smaller, and more preferably 10 degrees or smaller. The contact angle of water to the surface of the hydrophilic film set to 20 degrees or smaller leads the hydrophilic film to have high hydrophilic properties, so as to improve
25 the antifogging properties and easily remove oil adhering to the surface of the hydrophilic film. The contact angle of water can be measured by a static sessile drop method.

[0071]

A method of manufacturing the hydrophilic member according to the present embodiment is described below. First, the surface of the substrate is washed to remove
30 stains on the surface. The washing method used may be any conventional method.

[0072]

Next, the above coating material composition is applied to the surface of the washed substrate. The method of applying the coating material composition may be determined as appropriate. The coating material composition can be applied to the main surface of the substrate by a painting method or a printing method. The painting method when applying the coating material composition may use an air spray, a brush, a bar coater, a Meyer bar, or an air knife. A spin coat method may also be used to apply the coating material composition. The printing method may use gravure printing, reverse gravure printing, offset printing, flexographic printing, or screen printing.

[0073]

The surface of the substrate to which the coating material composition is applied may be subjected to drying treatment as necessary so as to remove the dispersion solvent in the coating material composition. The surface of the substrate may be dried under any drying conditions that can remove the dispersion solvent, and may be subjected to heating treatment as necessary.

[0074]

The surface of the substrate with the coating material composition applied is irradiated with the active energy ray so as to cure the coating material composition when the photopolymerization initiator is used as the polymerization initiator. The active energy ray irradiated for curing the coating material composition may be at least one of an ultraviolet ray, an electron beam, an X ray, an infrared ray, or a visible ray. The active energy ray is preferably an ultraviolet ray or an electron beam in view of curing performance and prevention of degradation of the resin.

[0075]

Various kinds of ultraviolet irradiation devices can be used when the coating material composition is cured by the ultraviolet irradiation. Examples of ultraviolet devices include a xenon lamp, a high-pressure mercury lamp, and a metal halide lamp. The irradiation amount of the ultraviolet ray is typically in a range of 10 to 10,000 mJ/cm². To enhance the hardness of the composition, the irradiation amount of the ultraviolet ray is preferably 100 mJ/cm² or greater. The ultraviolet ray is preferably irradiated under

the nitrogen atmosphere so as not to impede the curing process due to the oxygen in the air.

[0076]

The surface of the substrate with the coating material composition applied is heated so as to cure the coating material composition when the thermal polymerization initiator is used as the polymerization initiator. The surface of the substrate may be heated under any heating conditions such as heat temperature that can decompose the thermal polymerization initiator used so as to generate active species.

[0077]

As described above, the hydrophilic member according to the present embodiment can be prepared by applying the coating material composition to the substrate, followed by curing. The hydrophilic member having high hydrophilic properties thus can be obtained by a simple method.

[0078]

The hydrophilic member according to the present embodiment includes the substrate, and the hydrophilic film formed from the coating material composition and provided on the substrate. The hydrophilic film has high antifogging properties, hardness, and water resistance. The hydrophilic film also having high hydrophilic properties can allow water to be brought into contact with the hydrophilic member to enter between the surface of the hydrophilic film and oil such as oil stains when adhering to the hydrophilic film. The entrance of the water can wash the oil out and easily remove the oil from the surface of the hydrophilic film.

[0079]

Examples of members used as the hydrophilic member include housing members, vehicle members, and security members. Specific examples include a mirror, window glass, a lens, and a display. The hydrophilic member according to the present embodiment can also be used for a hot house sheet or food wrapping which needs to have antifogging properties.

[0080]

The hydrophilic member according to the present embodiment can be used as

not only members needing to have the antifogging properties but also members needing to have the hydrophilic properties so as to remove oil, for example. Examples of kitchen equipment for which the hydrophilic member is appropriate to facilitate the removal of oil include a range hood, doors for a kitchen storage shelf, a kitchen counter, a sink, a space around a gas range, a kitchen board, a floor in a kitchen, and a refrigerator. Oil stains such as lipid peroxidation tend to adhere to the surface of these kinds of kitchen equipment. The use of the hydrophilic film according to the present embodiment can easily remove with water both oil in the initial state after adhesion and viscous oil. While the oil stains to be removed are typically derived from cooking oil used in a kitchen, the hydrophilic film can also facilitate the removal of oil and fat derived from dirt from hands, fingerprints, sebum, or sweat.

EXAMPLES

[0081]

The present embodiment is further described in detail below by reference to examples and comparative examples, but is not intended to be limited to these examples.

[0082]

The respective coating material compositions of Examples and Comparative Examples were prepared as described below. In particular, a monomer A, a monomer B, a monomer C, a photopolymerization initiator, and a dispersion solvent described below were mixed together in each example as shown in Table 1, Table 4, and Table 6. The mixture was prepared with a centrifugal mixer THINKY MIXER (registered trademark) available from THINKY CORPORATION such that the raw materials were sufficiently mixed together to obtain the coating material composition of each example. The content by percentage of the monomer A shown in Table 1, Table 4, and Table 6 refers to a mass ratio of the content of the monomer A to the total content of the monomer A and the monomer B.

[0083]

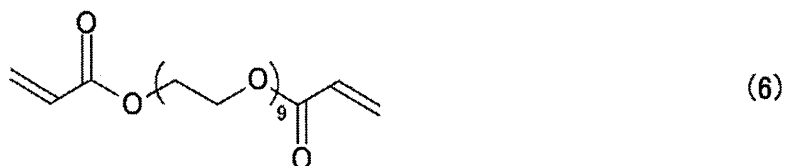
(Monomer A)

Monomer A1: polyethylene glycol diacrylate having the number of the repeat

units of the ethylene oxide group which is 9 (refer to the following chemical formula (6))

[0084]

[Chem. 6]

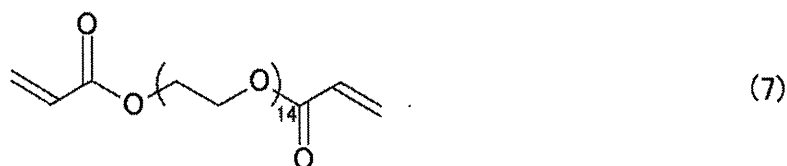


5 [0085]

Monomer A2: polyethylene glycol diacrylate having the number of the repeat units of the ethylene oxide group which is 14 (refer to the following chemical formula (7))

[0086]

10 [Chem. 7]



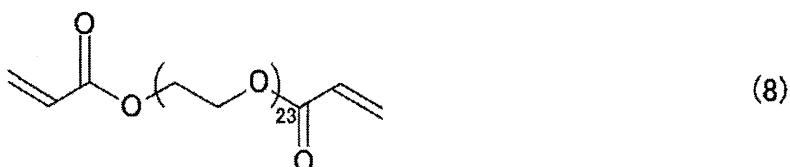
[0087]

Monomer A3: polyethylene glycol diacrylate having the number of the repeat units of the ethylene oxide group which is 23 (refer to the following chemical formula (8))

15 (8))

[0088]

[Chem. 8]



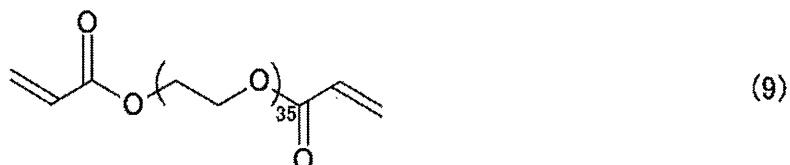
[0089]

20 Monomer A4: polyethylene glycol diacrylate having the number of the repeat units of the ethylene oxide group which is 35 (refer to the following chemical formula

(9))

[0090]

[Chem. 9]

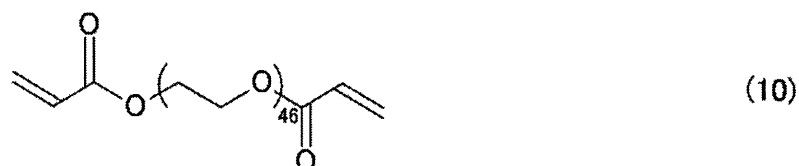


5 [0091]

Monomer A5: polyethylene glycol diacrylate having the number of the repeat units of the ethylene oxide group which is 46 (refer to the following chemical formula (10))

[0092]

10 [Chem. 10]

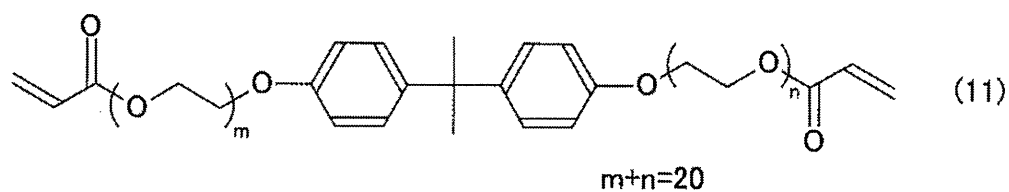


[0093]

Monomer A6: ethylene oxide (EO) modified bisphenol A diacrylate having the number of the repeat units of the ethylene oxide group which is 20 (refer to the following chemical formula (11))

[0094]

[Chem. 11]



[0095]

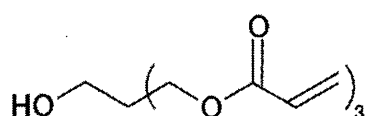
(Monomer B)

Monomer B: pentaerythritol triacrylate (refer to the following chemical formula

(12)

5 [0096]

[Chem. 12]



(12)

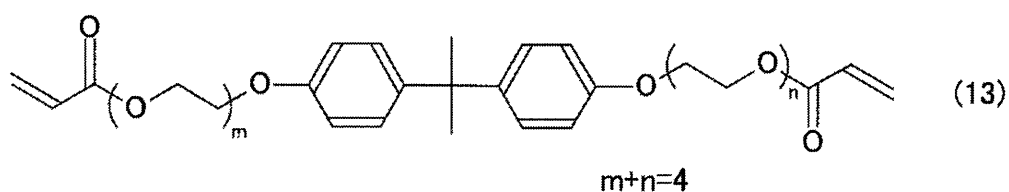
[0097]

(Monomer C)

10 Monomer C1: ethylene oxide (EO) modified bisphenol A diacrylate having the number of the repeat units of the ethylene oxide group which is 4 (refer to the following chemical formula (13))

[0098]

[Chem. 13]



(13)

15

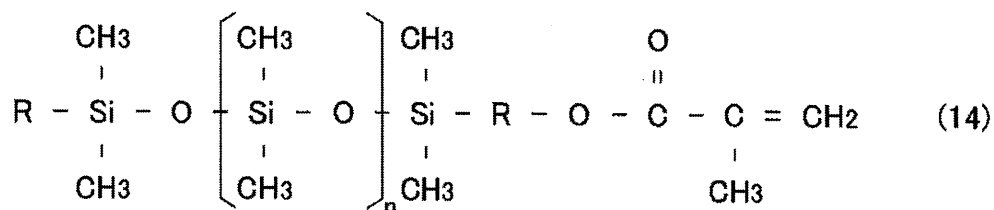
[0099]

Monomer C2: methacrylate including polydimethyl siloxane (methacryl modified silicone oil) (refer to the following chemical formula (14))

[0100]

20

[Chem. 14]



[0101]

(Photopolymerization Initiator)

1-hydroxycyclohexyl phenyl ketone

5 [0102]

(Dispersion Solvent)

2-butanone (methyl ethyl ketone (MEK))

[0103]

Next, a mirror with the outermost surface formed from acrylic resin having a size of 100 mm × 100 mm was prepared as the substrate, and the surface was then washed. The coating material composition was applied to the surface of the substrate of each example with a bar coater, and was dried at 80 degree Celsius for 5 minutes so as to remove the dispersion solvent. The applied coating material composition was irradiated with an ultraviolet ray of 600 mJ/m² under the nitrogen atmosphere so as to cure the coating material composition. A test sample of each example with the surface of the substrate provided with a coating (a hydrophilic film) was thus prepared. The ultraviolet ray was irradiated by use of a spot UV irradiation device SPOT-CURE (registered trademark) SP-9 available from Ushio Inc. The coating thickness of the sample of each example was about 50 μm.

20 [0104]

[Evaluation]

The respective test samples were evaluated with regard to the pencil hardness, the antifogging properties, and the water resistance as described below. The evaluation results of the respective test samples are indicated in Table 2, Table 5, and Table 7. Table 3 shows the relationships of the results shown in Table 2 in which “the content by

percentage of Monomer A” and “the number of the repeat units of the ethylene oxide group in the monomer A” are summarized. The item “the content by percentage of Monomer A” in the respective tables refers to the mass ratio of the content of Monomer A to the total content of Monomer A and Monomer B.

5 [0105]

(Pencil Hardness)

The pencil hardness was measured according to Japanese Industrial Standards JIS K5600-5-4: 1999 (ISO/DIS 15184: 1996) (Testing methods for paints—Part 5: Mechanical property of film—Section 4: Scratch hardness (Pencil method)). The
10 evaluation of the pencil hardness was based on the following ratings:

Excellent: Pencil hardness grade F or harder

Good: Pencil hardness grade HB and B

Failed: Pencil hardness grade 2B or softer

[0106]

15 (Antifogging Properties)

The antifogging properties were measured such that the time from which the temperature of each test sample was set to 10°C to which the substrate visually started fogging at 25°C under the atmosphere of 75% relative humidity (RH) was counted. The
evaluation of the antifogging properties was based on the following ratings:

20 Good: No fogging was visually observed on the test sample for 60 seconds or longer

Failed: Fogging was visually observed on the test sample for less than 60 seconds

[0107]

25 (Water Resistance)

The water resistance was measured such that each test sample immersed in deionized water at 25°C was taken out once a day, and the external appearance was then visually observed. The evaluation of the water resistance was based on the following ratings:

30 Good: No change after seven days

Failed: Separation of the coating film observed within six days

[0108]

[Table 1]

	Monomer A			Monomer B	Photopolymerization initiator (parts by mass)	Dispersion solvent (parts by mass)
	Content (parts by mass)	Content by percentage (% by mass)	Number of repeat units of ethylene oxide group	Content (parts by mass)		
Example 1	5.0	50	23	5.0	0.3	5
Example 2	5.0	50	35	5.0	0.3	5
Example 3	6.7	67	23	3.3	0.3	5
Example 4	6.7	67	35	3.3	0.3	5
Example 5	8.0	80	23	2.0	0.3	5
Example 6	8.0	80	35	2.0	0.3	5
Example 7	9.0	90	23	1.0	0.3	5
Example 8	9.0	90	35	1.0	0.3	5
Comparative Example 1	0.0	0	-	10.0	0.3	5
Comparative Example 2	2.0	20	23	8.0	0.3	5
Comparative Example 3	2.0	20	35	8.0	0.3	5
Comparative Example 4	2.0	20	46	8.0	0.3	5
Comparative Example 5	3.3	33	23	6.7	0.3	5
Comparative Example 6	3.3	33	35	6.7	0.3	5
Comparative Example 7	3.3	33	46	6.7	0.3	5
Comparative Example 8	5.0	50	46	5.0	0.3	5
Comparative Example 9	6.7	67	9	3.3	0.3	5
Comparative Example 10	6.7	67	14	3.3	0.3	5
Comparative Example 11	6.7	67	46	3.3	0.3	5
Comparative Example 12	8.0	80	9	2.0	0.3	5
Comparative Example 13	8.0	80	14	2.0	0.3	5
Comparative Example 14	8.0	80	46	2.0	0.3	5
Comparative Example 15	9.0	90	9	1.0	0.3	5
Comparative Example 16	9.0	90	14	1.0	0.3	5
Comparative Example 17	9.0	90	46	1.0	0.3	5

[0109]

[Table 2]

	Pencil hardness		Antifogging properties		Water resistance	
	Result	Evaluation	Result	Evaluation	Result	Evaluation
Example 1	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 2	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 3	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 4	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 5	H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 6	F	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 7	B	Good	60 seconds or longer	Good	7 days or longer	Good
Example 8	B	Good	60 seconds or longer	Good	7 days or longer	Good
Comparative Example 1	8H	Excellent	20 seconds	Failed	7 days or longer	Good
Comparative Example 2	6H	Excellent	25 seconds	Failed	7 days or longer	Good
Comparative Example 3	5H	Excellent	28 seconds	Failed	7 days or longer	Good
Comparative Example 4	3H	Excellent	34 seconds	Failed	7 days or longer	Good
Comparative Example 5	4H	Excellent	40 seconds	Failed	7 days or longer	Good
Comparative Example 6	3H	Excellent	38 seconds	Failed	7 days or longer	Good
Comparative Example 7	2H	Excellent	44 seconds	Failed	7 days or longer	Good
Comparative Example 8	H	Excellent	60 seconds or longer	Good	2 days	Failed
Comparative Example 9	3H	Excellent	30 seconds	Failed	7 days or longer	Good
Comparative Example 10	3H	Excellent	30 seconds	Failed	7 days or longer	Good
Comparative Example 11	H	Excellent	60 seconds or longer	Good	Several hours	Failed
Comparative Example 12	2H	Excellent	27 seconds	Failed	7 days or longer	Good
Comparative Example 13	H	Excellent	35 seconds	Failed	7 days or longer	Good
Comparative Example 14	HB	Good	60 seconds or longer	Good	Several hours	Failed
Comparative Example 15	H	Excellent	38 seconds	Failed	7 days or longer	Good
Comparative Example 16	B	Good	55 seconds	Failed	7 days or longer	Good
Comparative Example 17	2B	Failed	60 seconds or longer	Good	Several hours	Failed

[Table 3]

Sample	Number of repeat units of ethylene oxide group in monomer A				
	Pencil hardness	Antifogging properties	Water resistance		
Content by percentage of monomer A (% by mass)	0	Comparative Example 1 8H 20 seconds 7 days or longer	14	9	23
	20	-	-	-	-
	33	-	-	-	-
	50	-	-	-	-
Content by percentage of monomer A (% by mass)	67	Comparative Example 9 3H 30 seconds 7 days or longer	Comparative Example 10 3H 30 seconds 7 days or longer	Excellent Failed Good	Excellent Failed Good
	80	Comparative Example 12 2H 27 seconds 7 days or longer	Comparative Example 13 H 35 seconds 7 days or longer	Excellent Failed Good	Excellent Failed Good
	90	Comparative Example 15 H 38 seconds 7 days or longer	Comparative Example 16 B 55 seconds 7 days or longer	Good Failed Good	Good Failed Good

[0111]

[Table 4]

	Monomer A			Monomer B	Monomer C	Photopolymerization initiator (parts by mass)	Dispersion solvent (parts by mass)
	Monomer A3	Monomer A6	Content by percentage (% by mass)	Monomer B1	Monomer C1		
	Content (parts by mass)	Content (parts by mass)		Content (parts by mass)	Content (parts by mass)		
Example 3	6.7	-	67	3.3	-	0.3	5
Example 9	6.7	-	67	3.3	2.5	0.3	5
Example 10	5.3	2	73	2.7	-	0.3	5
Example 11	7.3	-	73	2.7	-	0.3	5

[0112]

5

[Table 5]

	Pencil hardness		Antifogging properties		Water resistance	
	Result	Evaluation	Result	Evaluation	Result	Evaluation
Example 3	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 9	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 10	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 11	H	Excellent	60 seconds or longer	Good	7 days or longer	Good

[0113]

[Table 6]

	Monomer A		Monomer B	Monomer C	Photopolyme rization initiator (parts by mass)	Dispersion solvent (parts by mass)
	Monomer A3		Monomer B1	Monomer C2		
	Content (parts by mass)	Content by percentage (% by mass)	Content (parts by mass)	Content (parts by mass)		
Example 5	8.0	80	2.0	-	0.3	5
Example 12	8.0	80	2.0	0.01	0.3	5

[0114]

[Table 7]

	Pencil hardness		Antifogging properties		Water resistance	
	Result	Evaluation	Result	Evaluation	Result	Evaluation
Example 5	H	Excellent	60 seconds or longer	Good	7 days or longer	Good
Example 12	2H	Excellent	60 seconds or longer	Good	7 days or longer	Good

[0115]

5 As shown in Table 1 to Table 3, the examples in which the number of the repeat units of the ethylene oxide group in the monomer A was 23 or 35, and the content by percentage of the monomer A was in the range of 50% to 90% by mass, had the excellent or good evaluation results with regard to all of the pencil hardness, the antifogging properties, and the water resistance. The examples with 80% by mass or smaller of the

10 content by percentage of the monomer A all had the excellent evaluation results with regard to the pencil hardness.

[0116]

The examples in which the number of the repeat units of the ethylene oxide group in the monomer A was 14 or smaller were all failed in the evaluation of the

15 antifogging properties. The examples in which the number of the repeat units of the ethylene oxide group in the monomer A was 23 or greater but the content by percentage of the monomer A was 33% by mass or smaller, were also failed in the evaluation of the antifogging properties.

[0117]

20 The examples in which the number of the repeat units of the ethylene oxide group in the monomer A was 46 were failed in the evaluation of the water resistance when the content by percentage of the monomer A was 50% by mass or greater. The examples in which the number of the repeat units of the ethylene oxide group in the monomer A was 46 had good evaluation results with regard to the pencil hardness when the content

by percentage of the monomer A was 80% by mass, but were failed in the evaluation of the pencil hardness when the content by percentage of the monomer A was 90% by mass. [0118]

The test results revealed that, as shown in Table 4 and Table 5, the coating film obtained from the coating material composition such as Example 9 and Example 10 also had good evaluation results with regard to all of the pencil hardness, the antifogging properties, and the water resistance. Namely, the coating material composition in which EO modified bisphenol A diacrylate was substituted for part of polyethylene glycol diacrylate can provide the coating film with the high antifogging properties, hardness, and water resistance under the predetermined conditions. It was revealed that the coating film with the high antifogging properties, hardness, and water resistance can be provided when the number of the repeat units of the ethylene oxide group in the monomer A and the content by percentage of the monomer A are both in the predetermined ranges. [0119]

The test results revealed that, as shown in Table 6 and Table 7, the coating film obtained from the coating material composition such as Example 12 had a better result with regard to the pencil hardness. Namely, the coating material composition further including methacryl modified silicone oil as the monomer C in addition to the monomer A and the monomer B can result in the higher pencil hardness.

[0120]

As described above, it was revealed that the coating material composition having the number of the repeat units of the ethylene oxide group in the monomer A in the predetermined range and having the content by percentage of each of the monomer A and the monomer B in the predetermined range, can provide the coating film having high antifogging properties, hardness, and water resistance.

[0121]

The entire content of Japanese Patent Application No. P2017-231598 (filed on December 1, 2017) is herein incorporated by reference.

[0122]

The present embodiment described above is not intended to be limited to the

above descriptions, and various modifications can be made within the scope of the present embodiment.

INDUSTRIAL APPLICABILITY

5 [0123]

The present invention can provide a coating material composition and a hydrophilic member capable of forming a coating film having high antifogging properties.

CLAIMS

1. A coating material composition comprising:

a first monomer including repeat units of an ethylene oxide group and a
5 bifunctional (meth)acryloyl group per molecule; and

a second monomer including a tri- or greater functional (meth)acryloyl group
and a mono- or greater functional hydroxyl group per molecule,

wherein the first monomer has a number of the repeat units of the ethylene oxide
group in a range of 18 to 40,

10 the first monomer has a content in a range of 40% to 95% by mass and the second
monomer has a content in a range of 5% to 60% by mass, with respect to 100% by mass
of a total content of the first monomer and the second monomer,

the content of the first monomer is in a range of 40% to 85% by mass with
respect to a total solids content, and

15 the content of the second monomer is in a range of 10% to 55% by mass with
respect to the total solids content.

2. The coating material composition according to claim 1, wherein the first
monomer is a di(meth)acrylate monomer having the (meth)acryloyl group at both ends in
20 a main chain including the repeat units of the ethylene oxide group.

3. The coating material composition according to claim 1 or 2, further comprising
(meth)acrylate including polysiloxane.

25 4. A hydrophilic member comprising:

a substrate; and

a hydrophilic film provided on the substrate and formed from the coating
material composition according to any one of claims 1 to 3.