CURABLE COMPOSITION, CURED FILM, NEAR INFRARED CUT FILTER, CAMERA MODULE AND METHOD FOR MANUFACTURING CAMERA MODULE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a curable composition, a cured film, a near infrared cut filter, a camera module, and a method for manufacturing a camera module.

2. Description of the Related Art

[0002] For use of a near infrared cut filter for a solid-state imaging element such as a plasma display panel (PDP) or CCD, a near infrared-absorbing pigment is used.

As a composition for forming the near infrared cut filter, for example, a curable composition including a near infrared-absorbing pigment is used in JP2011-68731A. In addition, JP2007-246696A describes a curable composition for coating.

SUMMARY

[0004] As a result of studies by the present inventors, it was found that, when a cured film is produced using a certain curable composition of the related art including a near infrared-absorbing pigment and is immersed in a solvent, there are cases in which the near infrared-absorbing pigment is eluted.

An object of the present disclosure is to provide a curable composition which can be used to produce a cured film that does not easily allow a near infrared-absorbing pigment to be eluted even when the cured film is immersed in a solvent.

[0004a] In one aspect of the present disclosure, there is provided a curable composition comprising:

a near infrared-absorbing pigment (A) having a hydrophobic group; and

a curable compound (B) having a fluorine atom,

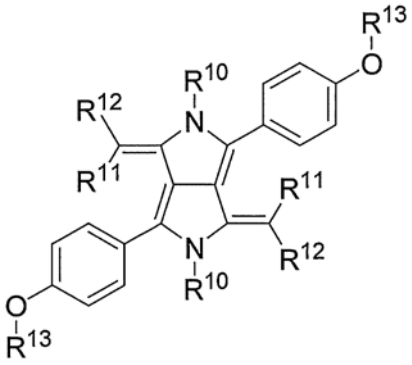
wherein the hydrophobic group is a branched alkyl group having 3 to 30 carbon atoms and having a CLogP value of 5.3 to 20,

wherein the near infrared-absorbing pigment (A) is a compound represented by the following formula(A2), and

wherein the curable compound (B) is a polymer having at least a repeating unit represented by Formula (B1) below.

Formula (A2)

[Chem 1]

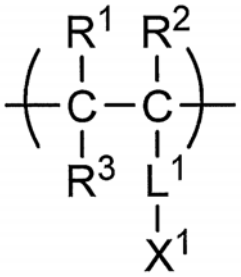


(In Formula (A2), each of R^{10}'s independently represents a hydrogen atom, an alkyl group, an aryl group, a heteroaryl group, diphenylboron, dibutylboron, dinaphthylboron, catechol boron or a metal atom and R^{10} may form a covalent bond or a coordination bond with R^{12}.

R^{11} represents a cyano group and R^{12} represents a heterocyclic group. Each of R^{13}'s independently represents a branched alkyl group having 3 to 30 carbon atoms and having a CLogP value of 5.3 to 20.)

Formula (B1)

[Chem 2]



(in Formula (B1), each of R^1 to R^3 independently represents a hydrogen atom, an alkyl group, or a halogen atom, L^1 represents a single bond or a divalent linking group, X^1 represents a (meth)acryloyloxy group.)

[0004b] In another aspect of the present disclosure, there is provided A cured film formed using the curable composition according to any one of Claims 1 to 8.

[0004c] In a further aspect of the present disclosure, there is provided a cured film comprising:

a near infrared-absorbing pigment (A) having a hydrophobic group and a cured product of a curable compound (B) having a fluorine atom,

wherein the hydrophobic group is a branched alkyl group having 3 to 30 carbon atoms and having a CLogP value of 5.3 to 20,

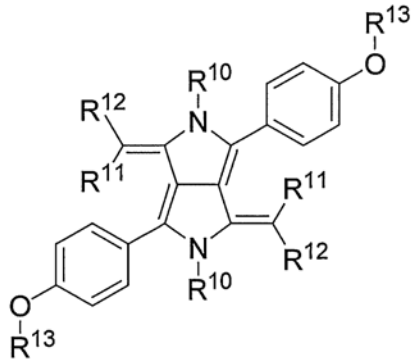
wherein the near infrared-absorbing pigment (A) is a compound represented by the following formula(A2),

wherein the curable compound (B) is a polymer having at least a repeating unit represented by Formula (B1) below, and

wherein a concentration of a fluorine atoms on one film surface of the cured film is higher than a concentration of a fluorine atoms in the entire film.

Formula (A2)

[Chem 5]

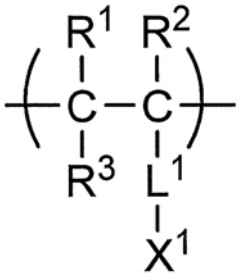


(In Formula (A2), each of R^{10}'s independently represents a hydrogen atom, an alkyl group, an aryl group, a heteroaryl group, diphenylboron, dibutylboron, dinaphthylboron, catechol boron or a metal atom and R^{10} may form a covalent bond or a coordination bond with R^{12}.

R^{11} represents a cyano group and R^{12} represents a heterocyclic group. Each of R^{13}'s independently represents a branched alkyl group having 3 to 30 carbon atoms and having a CLogP value of 5.3 to 20.)

Formula (B1)

[Chem 6]



(in Formula (B1), each of R^1 to R^3 independently represents a hydrogen atom, an alkyl group, or a halogen atom, L^1 represents a single bond or a divalent linking group, X^1 represents a (meth)acryloyloxy group.)

[0004d] In another aspect of the present disclosure, there is provided a method for manufacturing a cured film comprising:

applying the curable composition disclosed herein in a lamellar shape;

irradiating the curable composition with active radioactive rays; and/or

heating the curable composition.

[0004e] In a further aspect of the present disclosure, there is provided a near infrared cut filter formed using the curable composition disclosed herein.

[0004f] In another aspect of the present disclosure, there is provided a method for manufacturing a near infrared cut filter, comprising:

applying the curable composition disclosed herein a substrate in a lamellar shape; and

forming a pattern image by exposing the lamellar curable composition through a mask and then developing the curable composition.

[0004g] In a further aspect of the present disclosure, there is provided a camera module comprising:

a solid-state imaging element and the near infrared cut filter disclosed herein.

[0004h] In another aspect of the present disclosure, there is provided a method for manufacturing a camera module including a solid-state imaging element and a near infrared cut filter, comprising:

forming the near infrared cut filter by applying the curable composition disclosed herein on a light-receiving side of the solid-state imaging element.

[0005] As a result of intensive studies on the basis of the above-described circumferences, the present inventors found that, when a curable compound having one or more atoms or groups selected from a fluorine atom, a silicon atom, a linear alkyl group having 8 or more carbon atoms, and a branched alkyl group having 3 or more carbon atoms is formulated into a curable composition, the above-described problem can be solved.

Specifically, the above-described problem can be solved using the following means <1> and preferably <2> to <27>.

<1> A curable composition including: a near infrared-absorbing pigment (A) and a curable compound (B) having one or more atoms or groups selected from a fluorine atom, a silicon atom, a linear alkyl group having 8 or more carbon atoms, and a branched alkyl group

WHAT IS CLAIMED IS:

1. A curable composition comprising:

a near infrared-absorbing pigment (A) having a hydrophobic group; and

a curable compound (B) having a fluorine atom,

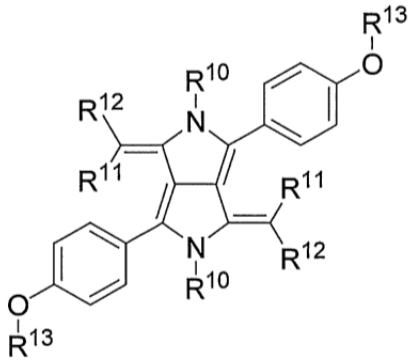
wherein the hydrophobic group is a branched alkyl group having 3 to 30 carbon atoms and having a CLogP value of 5.3 to 20,

wherein the near infrared-absorbing pigment (A) is a compound represented by the following formula(A2), and

wherein the curable compound (B) is a polymer having at least a repeating unit represented by Formula (B1) below.

Formula (A2)

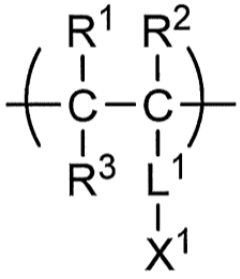
[Chem 1]



(In Formula (A2), each of R^{10}'s independently represents a hydrogen atom, an alkyl group, an aryl group, a heteroaryl group, diphenylboron, dibutylboron, dinaphthylboron, catechol boron or a metal atom and R^{10} may form a covalent bond or a coordination bond with R^{12}. R^{11} represents a cyano group and R^{12} represents a heterocyclic group. Each of R^{13}'s independently represents a branched alkyl group having 3 to 30 carbon atoms and having a CLogP value of 5.3 to 20.)

Formula (B1)

[Chem 2]



(in Formula (B1), each of R^1 to R^3 independently represents a hydrogen atom, an alkyl group, or a halogen atom, L^1 represents a single bond or a divalent linking group, X^1

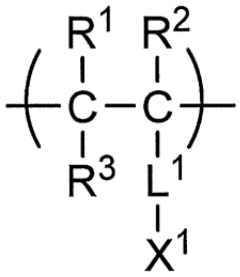
represents a (meth)acryloyloxy group.)

2. The curable composition according to Claim 1,

wherein the curable compound (B) is a polymer having at least a repeating unit represented by Formula (B1) below and Formula (B2) below;

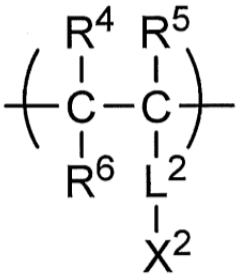
Formula (B1)

[Chem 3]



Formula (B2)

[Chem 4]



in Formula (B1) and (B2), each of R^1 to R^6 independently represents a hydrogen atom, an alkyl group, or a halogen atom, each of L^1 and L^2 independently represents a single bond or a divalent linking group, X^1 represents a (meth)acryloyloxy group and X^2 represents an alkyl group substituted with a fluorine atom, an aryl group substituted with a fluorine atom.

3. The curable composition according to Claim 1 or 2,

wherein a content of the curable compound (B) is in a range of 1% by mass to 50% by mass of all solid contents of the curable composition.

4. The curable composition according to any one of Claims 1 to 3,

wherein a weight-average molecular weight of the curable compound (B) is in a range of 5000 to 50000.

5. The curable composition according to any one of Claims 1 to 4, further comprising:

a curable compound (C) which is different from the curable compound (B),

wherein the curable compound (C) has one or more curable functional groups but does not have one or more atoms or groups selected from a fluorine atom, a silicon atom, a linear alkyl group having 8 or more carbon atoms, and a branched alkyl group having 3 or more carbon atoms.

6. The curable composition according to any one of Claims 1 to 5,

wherein a maximum absorption wavelength of the near infrared-absorbing pigment (A) is in a range of 700 nm to 1000 nm.

7. The curable composition according to any one of Claims 1 to 6, further comprising:

at least one component selected from a polymerization initiator (D), a curing agent (E), and a solvent (F).

8. The curable composition according to any one of Claims 1 to 7,

wherein the total amount of the solid contents in the curable composition is in a range of 5% by mass to 50% by mass.

9. A cured film formed using the curable composition according to any one of Claims 1 to 8.

10. A cured film comprising:

a near infrared-absorbing pigment (A) having a hydrophobic group and a cured product of a curable compound (B) having a fluorine atom,

wherein the hydrophobic group is a branched alkyl group having 3 to 30 carbon atoms and having a CLogP value of 5.3 to 20,

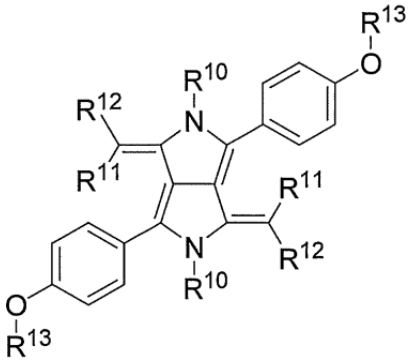
wherein the near infrared-absorbing pigment (A) is a compound represented by the following formula(A2),

wherein the curable compound (B) is a polymer having at least a repeating unit represented by Formula (B1) below, and

wherein a concentration of a fluorine atoms on one film surface of the cured film is higher than a concentration of a fluorine atoms in the entire film.

Formula (A2)

[Chem 5]



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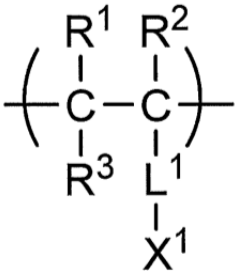
Formula (B1)

[Chem 6]



(in Formula (B1), each of R^1 to R^3 independently represents a hydrogen atom, an alkyl group, or a halogen atom, L^1 represents a single bond or a divalent linking group, X^1 represents a (meth)acryloyloxy group.)

11. The cured film according to Claim 10,

wherein an average concentration of the near infrared-absorbing pigment (A) in the entire film is higher than a concentration of the near infrared-absorbing pigment (A) on the one film surface.

12. The cured film according to Claim 10 or 11,

wherein, when the cured film is immersed in a solvent for five minutes, a retention percentage of an absorbance at a maximum absorption wavelength of the near infrared-absorbing pigment (A) before and after immersion, which is represented by the following expression, is 95% or higher;

expression: (the absorbance at the maximum absorption wavelength of the near

infrared-absorbing pigment (A) after immersion/the absorbance at the maximum absorption wavelength of the near infrared-absorbing pigment (A) before immersion)×100.

13. A method for manufacturing a cured film comprising:

applying the curable composition according to any one of Claims 1 to 8 in a lamellar shape;

irradiating the curable composition with active radioactive rays; and/or

heating the curable composition.

14. A near infrared cut filter formed using the curable composition according to any one of Claims 1 to 8.

15. A method for manufacturing a near infrared cut filter, comprising:

applying the curable composition according to any one of Claims 1 to 8 a substrate in a lamellar shape; and

forming a pattern image by exposing the lamellar curable composition through a mask and then developing the curable composition.

16. A camera module comprising:

a solid-state imaging element and the near infrared cut filter according to Claim 14.

17. A method for manufacturing a camera module including a solid-state imaging element and a near infrared cut filter, comprising:

forming the near infrared cut filter by applying the curable composition according to any one of Claims 1 to 8 on a light-receiving side of the solid-state imaging element.