

DESCRIPTION

BLU-RAY DISC, ULTRAVIOLET-CURABLE RESIN COMPOSITION FOR THE SAME, AND CURED PRODUCT

Technical Field

[0001]

The present invention relates to an ultraviolet-curable resin composition useful for an optical disc, particularly Blu-ray Disc, having an organic coloring matter recording layer.

Background Art

[0002]

At present, as a practical optical disc recording medium, there are a CD-R and a CD-RW where a recording layer, a reflecting layer and a protective layer comprising an ultraviolet-curable resin are laminated on a 1.2 mm polycarbonate substrate; and a DVD-R, a DVD+R, a DVD-RW, a DVD+RW and a DVD-RAM where a 0.6 mm polycarbonate substrate and a 0.6 mm polycarbonate substrate equipped with a recording layer and a reflecting layer are bonded with an ultraviolet-curable resin.

[0003]

In addition, recently, a Blu-ray Disc (BD-R) having a recording capacity about five-times that of a single layer-type DVD has come to market. The Blu-ray Disc is usually a disc having a structure in which a reflecting layer, a recording layer and an interface layer (also referred to as dielectric layer) are formed on a 1.1 mm transparent or opaque plastic substrate and then an about 0.1 mm light transmitting layer (cover layer) is laminated on the interface layer, where recording/reproducing are performed through the light transmitting layer. An organic coloring matter or an inorganic compound is used for the recording layer, and a light transmissive inorganic compound is used for the interface layer. Further, as the light transmitting layer, a

cured product layer of an ultraviolet-curable resin is used.

[0004]

In a Blu-ray Disc having a recording layer comprising an organic coloring matter, recording layer is irradiated with a laserbeam and deformation by volume change of an organic coloring matter is used to perform recording. A light information recording medium characterized in that a light transmissive cover layer is formed from a curing resin and the elastic modulus in the interface region facing the recording layer is 40 MPa or less at 25°C for the purpose of supporting volume change of the coloring matter and of obtaining excellent recording signal characteristics (for example, jitter characteristics) (Patent Literature 1), and a light information recording medium having a resin cured product layer with an elastic modulus of 34 to 96 MPa at 25°C on the recording layer of an organic coloring matter (Patent Literature 2) are proposed. However, in these literatures, there is no disclosure about the composition of the resin composition for the cured product layer to achieve such an elastic modulus.

[0005]

In addition, as an evaluation index of reliability of the above-mentioned optical disc recording medium, an environmental test of leaving under the circumstances of temperature: 80°C/relative humidity: 80% RH for 100 hours is conducted. In order that the deterioration rate of the recording signal before and after this environmental test is within a predetermined range, a technique for forming, on a recording layer, a cured product layer of a curing resin containing flexible urethane acrylate as a main component and monofunctional acrylate as a diluent or a curing resin containing urethane acrylate as a main component and monofunctional acrylate and polyfunctional acrylate as a diluent, where the storage elastic modulus is 100 MPa or less at both 5°C and 55°C and the ratio of the storage elastic modulus at 5°C and the storage elastic modulus at 55°C is 10 or less, is proposed (Patent Literature 3). However, this literature only discloses, as described above, that the main component is urethane acrylate and that monofunctional acrylate alone is used or monofunctional

acrylate and polyfunctional acrylate are used in combination as a diluent, but does not disclose the specific component composition.

Further, Patent Literature 4 discloses a light curing resin composition containing ethylene oxide 2 mol-modified phenol acrylate together with a thiophenol compound as an adhesive for a bonded optical disc (Example B5).

Related Technical Literature

[Patent Literature]

[0006]

[Patent Literature 1] Japanese Patent Laid-Open No. 2008-123631 A

[Patent Literature 2] Japanese Patent Laid-Open No. 2008-269703 A

[Patent Literature 3] Japanese Patent Laid-Open No. 2009-026379 A

[Patent Literature 4] WO 2009/144926 A1

Summary of the Invention

Problems to Be Solved by the Invention

[0007]

It is an object of the present invention to provide an optical disc, particularly Blu-ray Disc, having an organic coloring matter recording layer being excellent in recording signal characteristics and durability, and an ultraviolet-curable resin composition therefor.

Means of Solving the Problems

[0008]

The present inventors have intensively studied to solve the above problems and found that for an optical disc, particularly Blu-ray Disc, having an organic coloring matter recording layer, a Blu-ray Disc having a cured product layer of an ultraviolet-curable resin composition containing an ethylene oxide 2 to 10 mol-modified phenol (meth)acrylate of the later-described formula (1) surprisingly

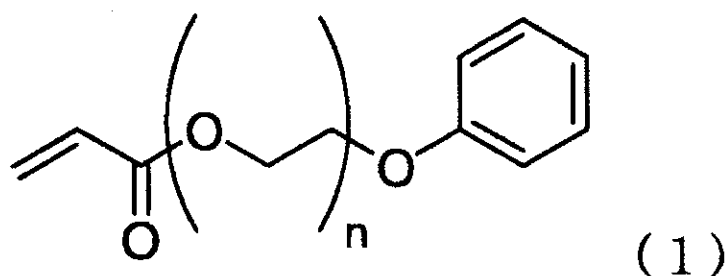
shows excellent recording signal characteristics and durability even though a Blu-ray Disc having a resin cured product layer containing phenoxyethyl (meth)acrylate or ethylene oxide 1 mol-modified phenol (meth)acrylate does not obtain good results, and the present invention has been completed.

[0009]

That is, the present invention relates to the following (1) to (18).

1. A Blu-ray Disc where a cured product layer of an ultraviolet-curable resin composition containing

(A) a (meth)acrylate having a structure shown by the below-described general formula (1):



(wherein, n denotes an integer number of 2 to 10)

and

(B) a photopolymerization initiator

is laminated on an interface layer on an organic coloring matter recording layer.

2. The Blu-ray Disc according to the above-described 1, which is characterized by further containing a (meth)acrylate (C) other than the above (meth)acrylate (A).

3. The Blu-ray Disc according to the above-described 1 or 2, wherein the content of the above (meth)acrylate (A) is 10 to 95% by weight based on the whole composition.

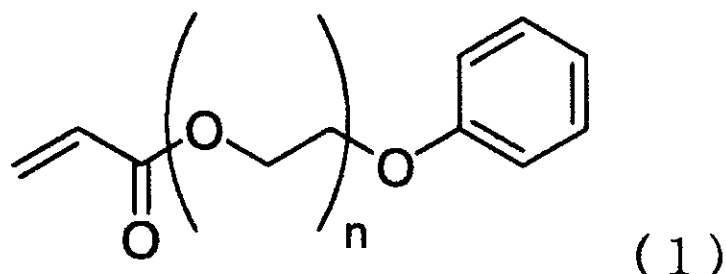
4. The Blu-ray Disc according to the above-described 2 or 3, wherein the above (meth)acrylate (C) is either one or both of (i) a reaction product (c-2a) of polyester polyol or polyether polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a).

[0010]

5. A method for manufacturing an optical disc, which comprises a process of coating

an ultraviolet-curable resin composition containing

(A) a (meth)acrylate represented by the below-described general formula (1):



(wherein, n denotes an integer number of 2 to 10)

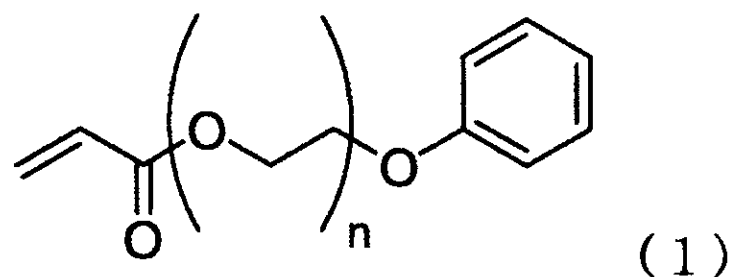
and

(B) a photopolymerization initiator

on an interface layer laminated on an organic coloring matter recording layer of an optical disc substrate to form a coating layer, which is then irradiated with an active energy ray to cure.

6. An ultraviolet-curable resin composition for a Blu-ray Disc having an organic coloring matter recording layer, which is characterized by containing

(A) a (meth)acrylate represented by the below-described general formula (1):



(wherein, n denotes an integer number of 2 to 10)

and

(B) a photopolymerization initiator.

7. The ultraviolet-curable resin composition according to the above-described 6, which is characterized by further containing a (meth)acrylate (C) other than the above (meth)acrylate (A).

8. The ultraviolet-curable resin composition according to the above-described 6 or 7, wherein the content of the above (meth)acrylate (A) is 10 to 95% by weight based on

the whole composition.

9. The ultraviolet-curable resin composition according to the above-described 7 or 8, wherein the above (meth)acrylate (C) is either one or both of (i) a reaction product (c-2a) of polyester polyol or polyether polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a).

[0011]

10. The ultraviolet-curable resin composition according to any one of the above-described 7 to 9, wherein as the (meth)acrylate (C) other than the above (meth)acrylate (A), urethane (meth)acrylate is not contained or is contained where its content is less than 30% by weight based on the total amount of said (A) component and said (C) component.

11. The ultraviolet-curable resin composition according to the above-described 9 or 10, wherein the (c-3a) component is polyethylene oxide-modified bisphenol A-type diacrylate having a polyethylene oxide repeating unit of 5 to 15.

12. The ultraviolet-curable resin composition according to any one of the above-described 7 to 11, wherein the (A) component content is more than 25% by weight and 90% by weight or less based on the total amount of the (A) component and the (C) component.

13. The ultraviolet-curable resin composition according to any one of the above-described 7 to 12, wherein:

the (A) component content is 10 to 95%, the (B) component content is 1 to 10%, the content of another additive (the later-described additive) other than the (A) to (C) components is 0 to 15%, based on the total amount of ultraviolet-curable resin composition, and the rest is a (C) component; and

(i) the (A) component content is more than 25% and 90% or less or (ii) the content of urethane (meth)acrylate (C-2) in the (C) component is zero or less than 30%, based on the total amount of the (A) component and the (C) component, and an organic or inorganic filler is not contained.

[0012]

14. The ultraviolet-curable resin composition according to any one of the above-described 7 to 13, wherein as the (meth)acrylate (C) other than the (A) component, either one or both of (i) a reaction product (c-2a) of polyester polyol or polyether polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a) is contained; the repeating number of ethylene oxide in the (c-3a) component is 5 to 15; the content of the (c-2a) component is less than 30% by weight, the total content of the (c-2a) component and the (c-3a) component is 10 to 85% by weight and the (A) component content is 15% by weight or more and 90% by weight or less, based on the total amount of the (A) component and the (C) component; the total amount of the (A) component, the (c-2a) component and the (c-3a) component is 70 to 99% by weight, the content of the (C) component other than the above-described (c-2a) and (c-3a) components is 0 to 29% by weight and the content of the (B) photopolymerization initiator is 1 to 10% by weight, based on the total amount of the ultraviolet-curable resin composition; and an organic or inorganic filler is not contained.

15. The ultraviolet-curable resin composition according to the above-described 7, wherein:

at least one kind selected from the group consisting of urethane acrylate (C-2), 5 to 15 mol polyethylene oxide-modified bisphenol A-type diacrylate (5 to 15 mol-modified c-3a), a (meth)acrylate monomer (c-3b) from the below-described Group (I) and a (meth)acrylate monomer (c-3c) from the below-described Group (II) is contained as the above (meth)acrylate (C); and

the total content of the content of the at least one kind selected from the above-described group and the (A) component content is 70 to 99% by weight, the (B) component is 1 to 10% by weight and the (meth)acrylate (C) other than the above-described one is 0 to 10% by weight, based on the total amount of the ultraviolet-curable resin composition:

Group (I):

(i) C5 to C18 alkyl (meth)acrylate or C7 to C18 alkylene glycol di(meth)acrylate, (ii)

(meth)acrylate or propylene oxide-modified (meth)acrylate having a polytetramethylene glycol structure and (iii) caprolactone-modified (meth)acrylate; and

Group (II):

dicyclopentenylloxyethyl (meth)acrylate, 1,6-hexanediol di(meth)acrylate, dipropylene glycol di(meth)acrylate or tripropylene glycol di(meth)acrylate.

[0013]

16. The ultraviolet-curable resin composition according to the above-described 15, wherein the (meth)acrylate monomer (c-3b) from the above Group (I) is at least one kind selected from the group consisting of the below-described (meth)acrylates:

(i) isooctyl (meth)acrylate, isoamyl (meth)acrylate, lauryl (meth)acrylate, isodecyl (meth)acrylate, stearyl (meth)acrylate, cetyl (meth)acrylate, isomyristyl (meth)acrylate, tridecyl (meth)acrylate, 2-ethyl-2-butyl-propanediol di(meth)acrylate, 1,9-nonanediol di(meth)acrylate and 1,10-decanediol di(meth)acrylate;

(ii) poly(ethylene glycol-tetramethylene glycol)diacrylate, poly(propylene glycol-tetramethylene glycol)diacrylate, polytetramethylene glycol diacrylate, poly(ethylene glycol-tetramethylene glycol)dimethacrylate, poly(propylene glycol-tetramethylene glycol)dimethacrylate, polytetramethylene glycol dimethacrylate, polypropylene glycol (meth)acrylate, polypropylene glycol di(meth)acrylate, polypropylene oxide-modified nonylphenyl (meth)acrylate, polypropylene oxide-modified neopentyl glycol di(meth)acrylate, polypropylene oxide-modified 1,6-hexanediol di(meth)acrylate, polypropylene oxide-modified bisphenol A-type di(meth)acrylate and methoxytripropylene glycol (meth)acrylate; and

(iii) caprolactone-modified hydroxyethyl (meth)acrylate, caprolactone-modified hydroxybutyl (meth)acrylate, caprolactone-modified hydroxypivalic acid neopentyl glycol di(meth)acrylate, caprolactone-modified tris(acryloxyethyl)isocyanurate and caprolactone-modified dipentaerythritol hexa(meth)acrylate.

17. The ultraviolet-curable resin composition according to any one of the

above-described 6 to 16, wherein the molecular weight of the polyester polyol or the polyether polyol is in the range of 200 to 3000.

18. The ultraviolet-curable resin composition according to any one of the above-described 6 to 17, wherein the elastic modulus of a cured product is 0.1 to 100 MPa at 25°C upon curing the ultraviolet-curable resin composition.

19. A cured product of the ultraviolet-curable resin composition according to any one of the above-described 10 to 18.

20. Use of the ultraviolet-curable resin composition according to any one of the above-described 10 to 18 for forming a resin cured product layer laminated on an interface layer of an organic coloring matter recording layer in a Blu-ray Disc.

21. A Blu-ray Disc where a cured product layer of the ultraviolet-curable resin composition according to any one of the above-described 10 to 18 is laminated on an interface layer on an organic coloring matter recording layer.

Effect of the Invention

[0014]

The Blu-ray Disc of the present invention having a cured product layer of the ultraviolet-curable resin composition of the present invention on an interface layer (also referred to as dielectric layer) directly laminated on an organic coloring matter recording layer has a low jitter value before and after durability test and high reliability in recording and reproducing even in use for long hours under high temperature and high humidity and is easy to manufacture. In addition, the cured product of the ultraviolet-curable resin composition of the present invention has a high light transmission around 400 nm for Blu-ray and a suitable elastic modulus, so it can be also used as a light transmitting layer (cover layer) directly laminated on an interface layer laminated to said recording layer or as a resin cured product layer laminated between an interface layer and a light transmitting layer, in a Blu-ray Disc having an organic coloring matter recording layer.

Mode for Carrying Out the Invention

[0015]

The ultraviolet-curable resin composition of the present invention (hereinafter, also referred to as resin composition of the present invention) contains a (meth)acrylate (A) represented by the formula (1) and a photopolymerization initiator (B).

[0016]

As the (meth)acrylate (A) (hereinafter, also referred to simply as (A) component) represented by the general formula (1) contained in the composition of the present invention, any can be used as long as n is in the range of 2 to 10. Specifically, it can include ethylene oxide 2 to 10 mol-modified phenol (meth)acrylates.

These can be used as a commercial product. For example, they can be commercially available as New Frontier^{RTM} PHE-2: wherein $n = 2$, (manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.) and New Frontier^{RTM} PHE-6: wherein $n = 6$, (manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.).

In this regard, in the present description, the superscript RTM stands for registered trademark.

[0017]

The content of the (A) component in the ultraviolet-curable resin composition is usually 10 to 95% by weight, preferably 15 to 90% by weight and more preferably 20 to 80% by weight based on the total amount of said composition (hereinafter, "%" is "% by weight" unless otherwise specifically noted).

For example, when a cured product layer of the resin composition of the present invention is provided on an interface layer of a Blu-ray Disc having an organic coloring matter recording layer, the content of said (A) component may be in the above-described range while an embodiment in which it is relatively high, for example, an embodiment in which it is more than 25% by weight and 90% or less based on the total amount of said composition is one of the preferable embodiments.

In addition, any of an embodiment in which the content of said (A) component is approximately 15 to 80%, an embodiment in which it is preferably approximately 20 to 80%, an embodiment in which it is more than 25% and 80% or less in some cases, and the like based on the total amount of said composition is one of the preferable embodiments.

A too low content thereof cannot help volume change of the coloring matter and leads to a bad jitter value (%) as an index of recording signal characteristics.

[0018]

The photopolymerization initiator (B) contained in the composition of the present invention is not particularly limited but can include, for example, 1-hydroxycyclohexylphenyl ketone (IRGACURETM 184; manufactured by CIBA Speciality Chemicals), 2-hydroxy-2-methyl-[4-(1-methylvinyl)phenyl]propanol oligomer (ONE-Rifined), 1-[4-(2-hydroxyethoxy)-phenyl]-2-hydroxy-2-methyl-1-propan-1-one (IRGACURETM 2959; manufactured by CIBA Speciality Chemicals), 2-hydroxy-1-[4-[4-(2-hydroxy-2-methyl-propionyl)-benzyl]-phenyl]-2-methyl-propan-1-one (IRGACURETM 127; manufactured by CIBA Speciality Chemicals), 2,2-dimethoxy-2-phenylacetophenone (IRGACURETM 651; manufactured by CIBA Speciality Chemicals), 2-hydroxy-2-methyl-1-phenyl-propan-1-one (DAROCURTM 1173; manufactured by CIBA Speciality Chemicals), 2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropan-1-one (IRGACURETM 907; manufactured by Ciba Specialty Chemicals), 2-benzyl-2-dimethylamino-1-(4-morpholinophenyl)-butan-1-one, 2-chlorothioxanthone, 2,4-dimethylthioxanthone, 2,4-diisopropylthioxanthone, isopropylthioxanthone, 2,4,6-trimethylbenzoyldiphenylphosphineoxide, bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide, bis(2,6-dimethoxy benzoyl)-2,4,4-trimethylpentylphosphineoxide and the like.

[0019]

In the ultraviolet-curable resin composition of the present invention, these as

the (B) component can be used as a mixture of one or more kinds thereof at any ratio. The content of the (B) component in the ultraviolet-curable resin composition is usually 0.5 to 20% by weight and preferably 1 to 10% by weight based on the total amount of said resin composition.

[0020]

In addition, an amine and the like which can be a photopolymerization initiating auxiliary agent can be also used in combination with the above-described photopolymerization initiator, according to necessity. Amines and the like which can be used include benzoic acid 2-dimethylaminoethyl ester, dimethylaminoacetophenone, p-dimethylaminobenzoic acid ethylester, p-dimethylaminobenzoic acid isoamylester or the like. The photopolymerization initiating auxiliary agent such as said amines and the like may be absent, but when it is used according to necessity, the content in the resin composition of the present invention is usually 0.005 to 5% by weight and preferably 0.01 to 3% by weight based on the total amount of said resin composition.

[0021]

The (meth)acrylate (C) (hereinafter, also referred to simply as (C) component) other than (A) contained in the composition of the present invention can include (meth)acrylates having one or more and usually 1 to 6 (meth)acryloyl groups. In this regard, the (meth)acrylate in the present invention means methacrylate or acrylate. Its kind is not particularly limited. For example, (C-1) epoxy (meth)acrylate (hereinafter, also referred to as (C-1) component) and/or (C-2) urethane (meth)acrylate (hereinafter, also referred to as (C-2) component), and in addition, a (meth)acrylate compound (hereinafter, referred to as (meth)acrylate monomer (C-3)) and the like other than the (A) component, the (C-1) component and the (C-2) component described above can be used.

[0022]

The above-described epoxy (meth)acrylate (C-1) has a function of improving curing properties, and the degree of hardness and the curing rate of the cured

product. Said epoxy (meth)acrylate (C-1) can be obtained by reaction of a glycidyl ether-type epoxy compound with (meth)acrylic acid.

A preferable glycidyl ether-type epoxy compound to obtain the epoxy (meth)acrylate (C-1) includes diglycidyl ether of glycol described below.

The glycol for the above-described diglycidyl ether can include bisphenol A or alkylene oxide adducts thereof, bisphenol F or alkylene oxide adducts thereof, hydrogen added bisphenol A or alkylene oxide adducts thereof, hydrogen added bisphenol F or alkylene oxide adducts thereof, ethylene glycol, propylene glycol, neopentyl glycol, butanediol, hexanediol, cyclohexane dimethanol, polypropylene glycol and the like.

[0023]

The epoxy (meth)acrylate can be obtained by reaction of a glycidyl ether-type epoxy compound from them with (meth)acrylic acid and by ring-opening addition of the carboxy group of the (meth)acrylic acid to the epoxy group of the epoxy compound.

[0024]

The (meth)acrylic acid is reacted at a ratio of 0.9 to 1.5 mol and more preferably 0.95 to 1.1 mol based on 1 equivalent of the epoxy group of the glycidyl ether-type epoxy compound. The reaction temperature is preferably 80 to 120°C and the reaction time is approximately 10 to 35 hours. In order to facilitate the reaction, it is preferred to use a catalyst, for example, such as triphenylphosphine, 2,4,6-tris(dimethyl aminomethyl)phenol (TAP), triethanolamine, tetraethyl ammonium chloride and the like. In addition, as a polymerization inhibitor to prevent polymerization in the reaction, para methoxyphenol, methylhydroquinone and the like can be also used for example.

[0025]

In the present invention, the epoxy (meth)acrylate is more preferably bisphenol A-type epoxy (meth)acrylate obtained from a bisphenol A-type epoxy compound. In the present invention, the molecular weight of the epoxy (meth)acrylate (C-1) is

preferably 500 to 10000.

[0026]

The above urethane (meth)acrylate (C-2) is obtained by reaction of polyhydric alcohol, polyisocyanate and a hydroxy (meth)acrylate compound. More specifically, it can be obtained by reaction of polyhydric alcohol with polyisocyanate and by reaction of the obtained urethane oligomer with a hydroxy (meth)acrylate compound.

Said urethane (meth)acrylate (C-2) has functions of adjusting the viscosity of the resin composition of the present invention and the elastic modulus in the cured product, and of improving mechanical properties (reducing warp, distortion and the like) when the cured layer of said resin composition is used as a light transmitting layer.

[0027]

The polyhydric alcohol used in synthesis of the urethane (meth)acrylate (C-2) can include, for example, the below-described polyhydric alcohols.

(i) Aliphatic polyhydric alcohols such as neopentyl glycol, 3-methyl-1,5-pentanediol, ethylene glycol, propylene glycol, 1,4-butanediol, 1,6-hexanediol, trimethylolpropane, pentaerythritol, tricyclodecanedimethylol and bis-(hydroxymethyl)-cyclohexane and preferably an aliphatic polyhydric alcohol having 2 to 10 carbon atoms.

(ii) Polyester polyol obtained by reaction of one kind of aliphatic polyhydric alcohol described in the above-described (i) with a polybasic acid.

In this regard, the above-described polybasic acid can include, for example, succinic acid, phthalic acid, hexahydrophthalic anhydride, terephthalic acid, adipic acid, azelaic acid, tetrahydrophthalic anhydride and the like.

(iii) Caprolactone alcohol obtained by reaction of polyhydric alcohol and epsilon-caprolactone.

(iv) Polycarbonate polyols. For example, polycarbonate diol obtained by reaction of 1,6-hexanediol with diphenyl carbonate, and the like.

(v) Polyether polyols. For example, poly C2-C4 alkylene glycols such as

polyethylene glycol, polypropylene glycol or polytetramethylene glycol, ethylene oxide-modified bisphenol A, and the like.

Among the above, the polyhydric alcohol is preferably polyether polyol or polyester polyol. The average molecular weight of these is preferably approximately 200 to 8000, more preferably approximately 200 to 3000 and further preferably approximately 300 to 1800.

The organic polyisocyanate used in synthesis of the urethane (meth)acrylate (C-2) includes, for example, isophorone diisocyanate, hexamethylene diisocyanate, tolylene diisocyanate, xylene diisocyanate, diphenylmethane-4,4'-diisocyanate, dicyclopentanyl diisocyanate or the like. Among them, isophorone diisocyanate is preferable.

[0028]

The hydroxy (meth)acrylate compound used in synthesis of the urethane (meth)acrylate (C-2) includes, for example, hydroxy C2 to C8 aliphatic hydrocarbon (meth)acrylates such as hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate, hydroxybutyl (meth)acrylate, dimethylolcyclohexyl mono (meth)acrylate and hydroxycaprolactone (meth)acrylate.

[0029]

The synthesis reaction of the above urethane (meth)acrylate (C-2) can be carried out as follows for example.

That is, the organic polyisocyanate is mixed with the polyhydric alcohol so that the isocyanate group is preferably 1.1 to 2.0 equivalents per equivalent of the hydroxy group, and the mixture is reacted at a reaction temperature of preferably 70 to 90°C to synthesize a urethane oligomer. Subsequently, the hydroxy (meth)acrylate compound is mixed with the urethane oligomer so that the hydroxy group is preferably 1 to 1.5 equivalents per equivalent of the isocyanate group, and the mixture is reacted at 70 to 90°C to obtain the intended urethane (meth)acrylate.

The preferable urethane (meth)acrylate (C-2) can include urethane (meth)acrylate obtained using polyester polyol or polyether polyol as the polyhydric

alcohol and using 2-hydroxyethyl (meth)acrylate as the hydroxy (meth)acrylate, for example, urethane acrylate (c-2a) obtained from the three of polyester polyol or polyether polyol, polyisocyanate and 2-hydroxyethyl acrylate.

In addition, urethane (meth)acrylate obtained using polyester polyol or polyether polyol having a molecular weight of approximately 200 to 3000 (preferably a molecular weight of 300 to 1800) is one of preferable urethane (meth)acrylates.

Further, in some cases, urethane (meth)acrylate obtained by reaction of a poly C2 to C6 alkylene glycol having a molecular weight of approximately 300 to 1800 and more preferably having a molecular weight of approximately 300 to 1800, a C3 to C5 alkylene glycol, isophorone diisocyanate and a hydroxy C2 to C4 (meth)acrylate is one of the preferable urethane (meth)acrylates.

Furthermore, it can be commercially available as UX-0937: polyether-based urethane acrylate (manufactured by Nippon Kayaku Co., Ltd.) and the like.

The molecular weight of the urethane (meth)acrylate (C-2) is preferably approximately 400 to 10000.

[0030]

The (meth)acrylate monomer (C-3) used as the (meth)acrylate (C) other than (A) component, (C-1) component and (C-2) component is not particularly limited and can include the below-described monofunctional or polyfunctional (preferably 2 to 6 functional) (meth)acrylates.

For example, the monofunctional (meth)acrylate ((meth)acrylate having one (meth)acryloyl group) as the (C-3) component can be specifically exemplified by the below-described compounds. It can include:

- (i) C5 to C18 (preferably C7 to C18) alkyl (meth)acrylates such as isooctyl (meth)acrylate, isoamyl (meth)acrylate, lauryl (meth)acrylate, isodecyl (meth)acrylate, stearyl (meth)acrylate, cetyl (meth)acrylate, isomyristyl (meth)acrylate and tridecyl (meth)acrylate;
- (ii) acrylate compounds having a C7 to C10 aliphatic ring such as tricyclodecane (meth)acrylate, isobornyl (meth)acrylate, dicyclopentenyl acrylate (for example,

FANCRYL^{RTM} FA-511A, manufactured by Hitachi Chemical Co., Ltd.), dicyclopentenyl oxyethyl acrylate (for example, FANCRYL FA-512A, manufactured by Hitachi Chemical Co., Ltd.), dicyclopentadiene oxyethyl (meth)acrylate (for example, dicyclopentenyl oxyethyl methacrylate, FANCRYL^{RTM} FA-512M, manufactured by Hitachi Chemical Co., Ltd.), dicyclopentanyl acrylate (for example, FANCRYL^{RTM} FA-513A, manufactured by Hitachi Chemical Co., Ltd.), dicyclopentanyl methacrylate (for example, FANCRYL^{RTM} FA-513M, manufactured by Hitachi Chemical Co., Ltd.), 1-adamantyl acrylate (for example, Adamantate AA manufactured by Idemitsu Kosan Co., Ltd.), 2-methyl-2-adamantyl acrylate (for example, Adamantate MA manufactured by Idemitsu Kosan Co., Ltd.), 2-ethyl-2-adamantyl acrylate (for example, Adamantate EA manufactured by Idemitsu Kosan Co., Ltd.) and 1-adamantyl methacrylate (for example, Adamantate AM manufactured by Idemitsu Kosan Co., Ltd.);

[0031]

(iii) polypropylene oxide-modified (meth)acrylates such as polypropylene glycol (meth)acrylate, polypropylene oxide-modified nonylphenyl (meth)acrylate and methoxytripropylene glycol (meth)acrylate, or ethylene oxide-modified (meth)acrylates such as ethoxy diethylene glycol (meth)acrylate, ethylene oxide-modified phenoxyated phosphoric acid (meth)acrylate, ethylene oxide-modified butoxyated phosphoric acid (meth)acrylate and ethylene oxide-modified octyloxyated phosphoric acid (meth)acrylate,

specifically, a C2 or C3 alkylene oxide-modified (meth)acrylate compound;

(iv) caprolactone-modified hydroxy C1 to C5 alkyl (meth)acrylates such as caprolactone-modified hydroxyethyl (meth)acrylate and caprolactone-modified hydroxybutyl (meth)acrylate;

[0032]

(v) further, as a monofunctional acrylate other than the above-described ones, for example, benzyl (meth)acrylate, tetrahydrofurfuryl (meth)acrylate, morpholine (meth)acrylate, phenyl glycidyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate and

the like.

The (meth)acrylate monomer having one (meth)acryloyl group has a function of improving mechanical properties (suppressing warp, distortion and the like) of an optical disc (Blu-ray Disc) where the ultraviolet-curable resin composition of the present invention is formed as a light transmitting layer.

For example, for a Blu-ray Disc having an organic coloring matter recording layer, the above-described function is performed in a Blu-ray Disc where a cured product layer of the ultraviolet-curable resin composition of the present invention is laminated on an interface layer formed on said organic coloring matter recording layer so that it is directly contacted with said interface layer.

Among the above, a C5 to C18 (preferably C7 to C18) alkyl (meth)acrylate can be used in order to adjust the elastic modulus of a cured product of the resin composition of the present invention in a preferable range. By containing this component, a jitter value can be lower. Most preferable among the C5 to C18 (preferably C7 to C18) alkyl (meth)acrylates is lauryl acrylate.

[0033]

The polyfunctional (meth)acrylate monomer in the above-described (meth)acrylate monomer (C-3) can include (meth)acrylate monomers having 2 to 6 (meth)acryloyl groups described below.

(i) The (meth)acrylate monomer having 2 (meth)acryloyl groups as the (C-3) component;

It can include cyclohexane-1,4-dimethanol di(meth)acrylate, cyclohexane-1,3-dimethanol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate (for example, KAYARAD R-684 manufactured by Nippon Kayaku Co., Ltd., tricyclodecanedimethylol diacrylate and the like), dioxane glycol di(meth)acrylate (for example, KAYARAD R-604 manufactured by Nippon Kayaku Co., Ltd., dioxane glycol diacrylate and the like), neopentyl glycol di(meth)acrylate, dicyclopentanyl di(meth)acrylate, 1,6-hexanediol di(meth)acrylate, ethylene oxide-modified 1,6-hexanediol di(meth)acrylate, neopentyl glycol di(meth)acrylate,

(poly)ethylene oxide-modified neopentyl glycol di(meth)acrylate, hydroxypivalic acid neopentyl glycol di(meth)acrylate, polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, ethylene oxide-modified bisphenol A-type di(meth)acrylate (preferably polyethylene oxide-modified bisphenol A-type di(meth)acrylate and more preferably ethylene oxide 5 to 15 mol-modified bisphenol A-type di(meth)acrylates), (poly)ethylene oxide-modified phosphoric acid di(meth)acrylate and the like.

Among the above-described ones, polyethylene oxide-modified bisphenol A-type di(meth)acrylate (c-3a) is preferable, and in some cases, ethylene oxide 5 to 15 mol-modified bisphenol A-type di(meth)acrylates are more preferably.

In addition, di(meth)acrylates of a glycol having an alkylene group having 7 to 18 carbon atoms such as 2-ethyl-2-butyl-propanediol di(meth)acrylate, 1,9-nonanediol di(meth)acrylate and 1,10-decanediol di(meth)acrylate are also preferable. These can be used to adjust the elastic modulus of a cured product of the resin composition in a preferable range.

[0034]

(ii) The (meth)acrylate monomer having 3 (meth)acryloyl groups as the (C-3) component;

it can include trimethylolpropane tri(meth)acrylate, trimethylolpropane tri(meth)acrylate, trimethylolpropane polyethoxy tri(meth)acrylate, trimethylolpropane polypropoxy tri(meth)acrylate, trimethylolpropane polyethoxy polypropoxy tri(meth)acrylate, tris[(meth)acryloyloxyethyl]isocyanurate, caprolactone-modified tris[(meth)acryloyloxyethyl]isocyanurate, pentaerythritol tri(meth)acrylate, ethylene oxide-modified trimethylolpropane tri(meth)acrylate, propylene oxide-modified trimethylolpropane tri(meth)acrylate and the like.

[0035]

(iii) The (meth)acrylate monomer having 4 (meth)acryloyl groups as the (C-3) component;

It can include B pentaerythritol polyethoxy tetra(meth)acrylate, pentaerythritol

polypropoxy tetra(meth)acrylate, pentaerythritol tetra(meth)acrylate, ditrimethylolpropane tetra(meth)acrylate, dipentaerythritol tetra(meth)acrylate and the like.

[0036]

(iv) The (meth)acrylate monomer having 5 (meth)acryloyl groups as the (C-3) component;

It can include dipentaerythritol penta(meth)acrylate, caprolactone-modified dipentaerythritol penta(meth)acrylate and the like.

[0037]

(v) The (meth)acrylate monomer having 6 (meth)acryloyl groups as the (C-3) component;

It can include dipentaerythritol hexa(meth)acrylate acrylate, caprolactone-modified dipentaerythritol hexa(meth)acrylate and the like.

In this regard, the (meth)acrylate monomer which can be used in the present invention may be also a polyfunctional one having 7 or more (meth)acryloyl groups.

[0038]

Among the (C-3) components ((meth)acrylate monomers) listed above, the (meth)acrylate monomer (c-3b) described in Group (I) described below may improve reliability of recording and reproducing of an obtained Blu-ray Disc when used together with the above (A) component, so it is one of the preferable (meth)acrylate monomers.

Group (I):

(i) C5 to C18 alkyl (meth)acrylates such as isooctyl (meth)acrylate, isoamyl (meth)acrylate, lauryl (meth)acrylate, isodecyl (meth)acrylate, stearyl (meth)acrylate, cetyl (meth)acrylate, isomyristyl (meth)acrylate or tridecyl (meth)acrylate; or C7 to C18 alkylene glycol di(meth)acrylates such as 2-ethyl-2-butyl-propanediol di(meth)acrylate, 1,9-nonanediol di(meth)acrylate and 1,10-decanediol di(meth)acrylate;

(ii) (meth)acrylates having a polytetramethylene glycol structure such as

poly(ethylene glycol-tetramethylene glycol)diacrylate, poly(propylene glycol-tetramethylene glycol)diacrylate, polytetramethylene glycol diacrylate, poly(ethylene glycol-tetramethylene glycol)dimethacrylate, poly(propylene glycol-tetramethylene glycol)dimethacrylate and polytetramethylene glycol dimethacrylate; and propylene oxide-modified (meth)acrylates such as polypropylene glycol (meth)acrylate, polypropylene glycol di(meth)acrylate, polypropylene oxide-modified nonylphenyl (meth)acrylate, polypropylene oxide-modified neopentyl glycol di(meth)acrylate, polypropylene oxide-modified 1,6-hexanediol di(meth)acrylate, polypropylene oxide-modified bisphenol A-type di(meth)acrylate and methoxytripropylene glycol (meth)acrylate;

(iii) caprolactone-modified (meth)acrylates such as caprolactone-modified hydroxyethyl (meth)acrylate, caprolactone-modified hydroxybutyl (meth)acrylate, caprolactone-modified hydroxypivalic acid neopentyl glycol di(meth)acrylate, caprolactone-modified tris(acryloxyethyl)isocyanurate and caprolactone-modified dipentaerythritol hexa(meth)acrylate.

The above-described (meth)acrylate monomer (c-3b) is used, according to necessity, in the resin composition of the present invention to help improvement in reliability of a cured product layer of the resin composition of the present invention, and an obtained Blu-ray Disc therefrom is excellent in recording properties.

When the elastic modulus of a cured product layer of the resin composition of the present invention at 25°C is adjusted in the range of 0.1 to 100 MPa and preferably 0.1 to 50 MPa, a Blu-ray Disc having said cured product layer on an interface layer laminated to the organic coloring matter recording layer is excellent in recording properties.

[0039]

Among the above, propylene oxide-modified (meth)acrylate is one of the preferable ones as the (meth)acrylate monomer (c-3b), and in some cases, it can impart more excellent recording signal characteristics and durability to the Blu-ray Disc of the present invention.

The repeating number of the propylene oxide unit in said propylene oxide-modified (meth)acrylate (the number of the modified moles) is preferably approximately 2 to 15. When the number of (meth)acryloyl groups in the molecule is large, the number of the modified moles of the propylene oxide is preferably larger. For example, in the case of one (meth)acryloyl group in the molecule, the repeating number of the propylene oxide unit (the number of the modified moles) is preferably 2 or more, preferably approximately 2 to 20 and more preferably approximately 5 to 15. In the case of two (meth)acryloyl groups, the repeating number of the propylene oxide unit is preferably 7 or more, more preferably approximately 7 to 15 and further preferably approximately 10 to 15.

Preferable propylene oxide-modified (meth)acrylate can include, for example, polypropylene glycol (meth)acrylate, polypropylene oxide-modified nonylphenyl (meth)acrylate, methoxytripropylene glycol (meth)acrylate, polypropylene glycol di(meth)acrylate or the like.

The polypropylene glycol (meth)acrylate can include, for example, BLEMME^{RTM} AP-150 (the repeating number of the propylene oxide unit is 3), AP-400 (the repeating number of the propylene oxide unit is 6), AP-550 (the repeating number of the propylene oxide unit is 9) and the like manufactured by NOF corporation. In addition, the polypropylene glycol di(meth)acrylate includes, for example, FANCY^{RTM} FA-P240A (the repeating number of the propylene glycol unit is 7) and FA-P270A (the repeating number of the propylene glycol unit is 12) manufactured by Hitachi Chemical Co., Ltd.; the polypropylene oxide-modified nonylphenyl (meth)acrylate includes, for example, M-117 (the repeating number of the propylene glycol unit is 2.5) manufactured by Toagosei Co., Ltd. and New Frontier^{RTM} NP-5P (the repeating number of the propylene glycol unit is 5) manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.; and the methoxytripropylene glycol (meth)acrylate includes, for example, NK Ester AM-30PG (the repeating number of the propylene glycol unit is 3) and the like manufactured by Shin-Nakamura Chemical Co., Ltd. A larger number of the repeating number of the

propylene glycol unit (for example, the repeating number is 7 to 15, preferably 10 to 15 and most preferably 12) such as that of the above-described FA-P270A leads to excellent recording properties and is thus preferable.

[0040]

In addition, among the above (C-3) components ((meth)acrylate monomer), the (meth)acrylate monomer (c-3c) in the below-described Group (II) can increase the degree of hardness in a cured product when used together with the above (A) component, and it is thus preferable as the (meth)acrylate monomer (C-3) for such a purpose.

(Meth)acrylate monomer (c-3c) in Group (II):

dicyclopentenylxyethyl (meth)acrylate, 1,6-hexanediol di(meth)acrylate, dipropylene glycol di(meth)acrylate, tripropylene glycol di(meth)acrylate or the like.

The above-described (meth)acrylate monomer (c-3c) can be used according to necessity to obtain, in some cases, a cured product having less change in the elastic modulus of the cured product due to temperature change and a suitable degree of hardness.

[0041]

In the ultraviolet-curable resin composition of the present invention, these as the (C) component can be used as a mixture of one or more kinds thereof at any ratio.

In the present invention, a more preferable combination of these as the (C) component is at least one kind selected from the group consisting of urethane (meth)acrylate (C-2) (preferably polyether urethane (meth)acrylate), ethylene oxide 5 to 15 mol-modified bisphenol A, C5 to C18 alkyl (meth)acrylates and propylene glycol diacrylate, and a combination of at least two kinds thereof is more preferable.

Usually, the content of the (C) component in the ultraviolet-curable resin composition of the present invention is usually 4 to 89% by weight, preferably 9 to 84% and more preferably 19 to 79% by weight based on the total amount of said resin composition.

In addition, in some cases, the content of the (C) component may be also 30 to

80% by weight and preferably 40 to 70% by weight based on the total amount of said resin composition.

Further, when either one or both of the (C-1) component or the (C-2) component and the (C-3) component are used in combination as the (C) component, the content ratio of either one or both of the (C-1) or (C-2) components is usually 5 to 50 parts by weight and preferably approximately 10 to 30 parts by weight respectively when the total amount of the (C) component is 100 parts by weight, and the rest is the (C-3) component. The (C-3) component is used in a ratio of 20 to 80 parts by weight and preferably approximately 25 to 75 parts by weight when the total amount of the (C) component is 100 parts by weight.

In the present invention, an embodiment in which either one or both of the (C-2) component (urethane (meth)acrylate) or the (C-3) component ((meth)acrylate monomer) are used as the (C) component in combination with the (A) component is one of the preferable embodiments.

Furthermore, in the above-described preferable embodiment, an embodiment in which the (c-2a) component listed as the above preferable urethane (meth)acrylate is used as the urethane (meth)acrylate (C-2) and a preferable ethylene oxide-modified bisphenol A-type di(meth)acrylate (c-3a) is used as the (C-3) component is one of the more preferable embodiments.

[0042]

In the present invention, in order to obtain a cured product layer having excellent recording properties and a sufficient degree of hardness, an embodiment in which usually the (C) component is further contained together with the (A) component and the (B) component is preferable.

In the above, the ratio of the total of the (A) component and the (C) component based on the total amount of the resin composition is usually 70% by weight or more and preferably 80% by weight or more, and 90% by weight or more is preferable.

In the above, further, a more preferable embodiment can include an embodiment in which the total of the (A) component, the (C-2) component, the (c-3a)

component, the (c-3b) component and the (c-3c) component is usually 70% by weight or more and preferably 80% by weight or more based on the total amount of the resin composition. In this case, the ethylene oxide-modified bisphenol A-type di(meth)acrylate of the (c-3a) component is preferably one where the ethylene oxide repeating unit number is 5 to 15 and particularly preferably 10.

In addition, in the above, a more preferable embodiment can include an embodiment in which the (A) component content is more than 25% by weight and 90% by weight or less based on the total amount of the (A) component and the (C) component.

Further, one of the other more preferable embodiments can be an embodiment in which the (C-2) (urethane acrylate) component content is 0 or less than 30% by weight based on the total amount of the (A) component and the (C) component (embodiment in which it is contained in an amount of further preferably 0 or 28% by weight or less).

[0043]

In addition, some of the preferable embodiments (resin compositions) of the resin composition of present invention containing the (A) component, the (B) component and the (C) component described above will be described below. “%” represents “% by weight” unless otherwise specifically noted.

1. An embodiment in which the (A) component content is 10 to 95%, the (B) component content is 1 to 10% and the content of another additive other than the (A) to (C) components (additive described later) is 0 to 15%, based on the total amount of the resin composition of the present invention, and the rest is the (C) component; and (i) the (A) component content is more than 25% and 90% or less or (ii) the content of the urethane acrylate (C-2) in the (C) component is zero or less than 30%, based on the total amount of the (A) component and the (C) component, and no inorganic or organic filler is contained.

2. The embodiment according to the above-described 1, wherein either one or both of (i) urethane (meth)acrylate (c-2a) obtained by reaction of polyester polyol or polyether

polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a) are contained as the (meth)acrylate (C).

3. The embodiment according to the above-described 2, wherein the repeating number of the ethylene oxide in the (c-3a) component is 5 to 15.

4. The embodiment according to the above-described 2 or 3, wherein the content of the (c-2a) component is zero or less than 30% by weight and the total content of the (c-2a) component and the (c-3a) component is 10 to 85% by weight based on the total amount of the (A) component and the (C) component.

5. The embodiment according to any one of the above-described 2 to 4, wherein the (A) component content is 15% by weight or more and 90% by weight or less, and based on the total amount of ultraviolet-curable resin composition, the total amount of the (A) component, the (c-2a) component and the (c-3a) component is 70 to 99% by weight and the content of the (C) component other than the above-described (c-2a) and (c-3a) components is 0 to 29% by weight.

6. The embodiment according to any one of the above-described 2 to 5, wherein a hindered amine compound is contained as an additive other than the (A) to (C) components.

7. An embodiment in which the elastic modulus at 25°C of a cured product layer of the ultraviolet-curable resin composition of the embodiment according to any one of the above-described 2 to 5 is 0.1 to 100 MPa.

[0044]

To the ultraviolet-curable resin composition for an optical disc of the present invention, additives such as a rust preventive agent, an antioxidant, an organic solvent, a silane coupling agent, a polymerization inhibitor, a leveling agent, an antistatic agent, a surface lubricant, a fluorescent brightening agent, a light stabilizer (for example, a hindered amine compound and the like), a filler, an additive for improving durability (for example, a thiophenol compound), and the like may be added according to necessity.

Any hindered amine compound can be used without any particular limitation as long as it is known, and specific examples thereof include, for example, 1,2,2,6,6-pentamethyl-4-piperidyl alcohol, 2,2,6,6-tetramethyl-4-piperidyl alcohol, 1,2,2,6,6-pentamethyl-4-piperidyl (meth)acrylate (LA-82 manufactured by ADEKA Corporation) and the like.

These additives are added in a total amount usually ranging from 0 to 15% based on the total amount of the resin composition of the present invention.

In the resin composition of the present invention, an embodiment in which a hindered amine compound is contained as a light stabilizer is one of the preferable embodiments. The content of the hindered amine compound in the resin composition of the present invention is approximately 0 to 5% and preferably approximately 0.05 to 2% based on the total amount of the resin composition.

The resin composition of the present invention does not usually contain an inorganic or organic filler which inhibits light transmission, because it is used as a light transmitting layer or the like for a Blu-ray Disc.

[0045]

The ultraviolet-curable resin composition for an optical disc of the present invention can be obtained by mixing and dissolving the above components at ordinary temperature to 80°C, and according to necessity, foreign substances may be removed out by an operation such as filtration. For the resin composition of the present invention, it is preferred to appropriately adjust the mixing ratio of the components so that the viscosity at 25°C is in the range of 30 to 2000 MPa·s from a viewpoint of coating properties.

[0046]

The ultraviolet-curable resin composition for an optical disc of the present invention can be suitably used as a coating agent for a light transmitting layer on the laser incidence side of a Blu-ray Disc or the like. That is, it can be suitably used as a resin composition which is coated on an interface layer (dielectric layer) formed on an organic coloring matter recording layer in a Blu-ray Disc having an organic coloring

matter recording layer to form a cured layer.

Specifically, the composition is coated on an optical disc substrate by an arbitrary method, for example, a spin coating method, a 2P method, a roll coating method, a screen printing method or the like so that the film thickness of the coated resin after curing is 1 to 100 μm . After coating, irradiation with an ultraviolet to near ultraviolet ray (wavelength around 200 to 400 nm) is carried out from one side or both sides for curing. The irradiation amount is preferably about 50 to 1500 mJ/cm^2 and particularly preferably, approximately 100 to 1000 mJ/cm^2 . The light source for irradiation with an ultraviolet to near ultraviolet ray can be any light source as long as it is a lamp irradiating with an ultraviolet to near ultraviolet ray. For example, it includes a low pressure, high pressure or ultrahigh pressure mercury lamp, a metal halide lamp, a (pulse) xenon lamp, an electrodeless lamp or the like.

[0047]

In addition, the ultraviolet-curable resin composition of the present invention is, in the case where a light transmitting layer (or protective layer) comprises a first resin layer formed on a recording layer or an interface layer and a second resin layer formed on the surface opposite from the recording layer or interface layer side in relation of the first resin layer, suitably used for the above first resin layer. Particularly, in a Blu-ray Disc having an organic coloring matter recording layer as a recording layer and having an interface layer thereon, it is suitable as a first resin cured layer formed on said interface layer.

In this case, the thickness of the above first resin layer is usually 1 μm to 50 μm , preferably 5 μm to 40 μm and more preferably 10 μm to 30 μm .

On the other hand, the thickness of the above second resin layer is usually 50 μm to 100 μm , preferably 60 μm to 95 μm and more preferably 70 μm to 90 μm .

[0048]

In the case where the protective layer is composed of two layers, the composition is coated on the optical disc substrate by an arbitrary method, specifically, for example, a spin coating method, a 2P method, a roll coating method,

a screen printing method or the like as the protective layer forming method so that the film thickness of the resin coated as a first resin layer is 1 to 30 μm . After coating, irradiation with an ultraviolet to near ultraviolet ray (wavelength around 200 to 400 nm) is carried out from one side or both sides for curing. The irradiation amount is preferably 50 to 1500 mJ/cm^2 and particularly preferably, approximately 100 to 1000 mJ/cm^2 . After curing, the composition is coated on the optical disc substrate by an arbitrary method, for example, a spin coating method, a 2P method, a roll coating method, a screen printing method or the like so that the film thickness of the second resin layer is 70 to 100 μm . After coating, irradiation with an ultraviolet to near ultraviolet ray (wavelength around 200 to 400 nm) is carried out from one side or both sides for curing. The irradiation amount is preferably about 50 to 1500 mJ/cm^2 and particularly preferably, approximately 100 to 1000 mJ/cm^2 . Further, for curing by irradiation with an ultraviolet to near ultraviolet ray, the light source can be any light source as long as it is a lamp irradiating with an ultraviolet to near ultraviolet ray. For example, it can include a low pressure, high pressure or ultrahigh pressure mercury lamp, a metal halide lamp, a (pulse) xenon lamp, an electrodeless lamp or the like.

[0049]

In the cured product of the resin composition of the present invention, the elastic modulus at 25°C is preferably 0.1 to 100 MPa and more preferably 0.1 to 50 MPa.

The optical disc having the organic coloring matter recording layer of the present invention obtained as described above is an optical disc having, at least, a plastic supporting substrate such as carbonate which has a guide groove, a reflecting layer formed on said guide groove, a recording layer containing an organic coloring matter (usually azo coloring matter or the like) which is formed on said reflecting layer, an interface layer (dielectric layer) formed on said recording layer, and a cured product layer (light transmitting layer) of the resin composition of the present invention which is formed on said interface layer.

The optical disc of the present invention may further have a cured product layer

of another resin composition on the cured product layer of the resin composition of the present invention. In this case, the light transmitting layer is formed of two layers of a cured product layer of the resin composition of the present invention and a cured product layer of another resin composition.

In the optical disc of the present invention, it is necessary that a cured product layer of the resin composition of the present invention is formed directly on an interface layer formed on a recording layer containing an organic coloring matter (usually azo coloring matter or the like), whereby the effects of the present invention are achieved.

The interface layer is, as well known to those skilled in the art, a layer formed of an inorganic substance such as a complex containing a metal atom such as Zn.

Examples

[0050]

Hereinafter, the present invention will be more specifically explained with reference to Examples, but the present invention is not limited by these Examples.

[0051]

Examples 1 to 4 and Comparative Example 1

By uniformly mixing the components shown in Table 1 at the ratio (part(s) by weight) shown in Table 1, ultraviolet-curable resin compositions of Examples 1 to 4 and Comparative Example 1 were prepared.

Using each obtained ultraviolet-curable resin composition of the present invention, a Blu-ray Disc having a coloring matter recording layer was manufactured by the below-described (i) (Examples 1 to 3) and (ii) (Example 4) methods.

In addition, property evaluation of each Blu-ray Disc was carried out by the method described later and the results are shown in Table 1.

[0052]

(i) Manufacture of a Blu-ray Disc having a coloring matter recording layer for Examples 1 to 3

1. On a polycarbonate substrate having a guide groove with a 0.32 μm track pitch, a diameter of 12 cm and a thickness of 1.1 mm, a silver alloy was sputtered so that the film thickness was 100 nm, and a reflecting layer was thus formed. After that, a coloring matter solution dissolving an azo coloring matter in a TFP (tetrafluoropropanol) solvent was coated by a spin coating method and dried at 80°C for 30 minutes to form a coloring matter recording layer. Further thereon, ZnS-SiO₂ (molar ratio of 80:20) was sputtered so that the thickness was about 15 nm and an interface layer was thus formed, and a Blu-ray Disc substrate was manufactured.
2. The Blu-ray Disc substrate was put on a spin table with the interface layer being upside, circular cap treatment was carried out to cover the internal diameter of 11.5 mm, and then 2.0 g of an ultraviolet-curable resin composition of the present invention were supplied on the cap in the central part.
3. According to the viscosity of the ultraviolet-curable resin composition of the present invention, spin coating was carried out in the speed range of 1000 rpm to 1500 rpm for 4 seconds to 7 seconds so that the thickness of the coated film after curing was 25 μm . Just before the end of spin coating, 2 shots of irradiation from a xenon flashlamp were carried out to cure to the extent of no flowability on the surface.
4. Using a high-pressure mercury lamp, irradiation was carried out from the upper side at 400 mJ/cm² for 3 seconds to completely cure the ultraviolet-curable resin composition of the present invention.
5. The substrate was put on a spin table with the cured ultraviolet-curable resin composition of the present invention being upside, circular cap treatment was carried out to cover the internal diameter of 11.5 mm, and then 3.0 g of BRD-864 (resin for a light transmitting layer for a Blu-ray Disc, manufactured by Nippon Kayaku Co., Ltd.) were supplied on the cap in the central part.
6. Spin coating was carried out in the speed range of 1500 rpm for 4 seconds to 7 seconds so that the thickness of the coated film after curing is 75 μm . Just before the end of spin coating, 2 shots of irradiation from a xenon flashlamp were carried out to cure to the extent of no flowability of the surface.

7. Using a high-pressure mercury lamp, irradiation was carried out from the upper side at 400 mJ/cm² for 3 seconds to completely cure the BRD-864, and a Blu-ray Disc of the present invention was thus manufactured.

[0053]

(ii) Blu-ray Disc of Example 4

Manufacture of a Blu-ray Disc having an organic coloring matter recording layer

1. On a polycarbonate substrate having a guide groove with a 0.32 μm track pitch, a diameter of 12 cm and a thickness of 1.1 mm, a silver alloy was sputtered so that the film thickness is 100 nm, and a reflecting layer was thus formed. After that, a coloring matter solution dissolving a TFP (tetrafluoropropanol) solvent in an azo coloring matter was coated by a spin coating method and dried at 80°C for 30 minutes to form an organic coloring matter recording layer. Further, ZnS-SiO₂ (molar ratio of 80:20) was sputtered so that the thickness was about 15 nm and an interface layer was thus formed, and a Blu-ray Disc substrate was manufactured.

2. The Blu-ray Disc substrate was put on a spin table with the interface layer being upside, circular cap treatment was carried out to cover the internal diameter of 11.5 mm, and then 2.0 g of the ultraviolet-curable resin composition of the present invention were applied on the cap in the central part.

3. According to the viscosity of the ultraviolet-curable resin composition of the present invention, spin coating was carried out in the speed range of 800 rpm to 1300 rpm for 4 seconds to 7 seconds so that the thickness of the coated film after curing was 100 μm . Just before the end of spin coating, 2 shots of irradiation from a xenon flashlamp were carried out to cure to the extent of no flowability of the surface.

4. Using a high-pressure mercury lamp, irradiation was carried out from the upper side at a light amount of 400 mJ/cm² for 3 seconds to completely cure the ultraviolet-curable resin composition of the present invention, and a Blu-ray Disc of the present invention was thus manufactured.

[0054]

(iii) Recording signal characteristics before and after durability test of Blu-ray Disc

The optical discs of the present invention and the optical disc of Comparative Example 1 obtained above were left under the circumstances of 80°C and 85% RH for 250 hours. Using a Blu-ray Disc data signal measuring device: ODU-1000 manufactured by Pulstec Industrial Co., Ltd., recording was carried out at a linear velocity of 4.92 m/s, a reproducing power of 0.30 mW, a recording power of 6.0 mW and T continuous recording (1 T length = 0.08 μ m), and using the same measuring device, recording signal characteristics (jitter value) of the Blu-ray Discs were measured before and after durability test and then evaluated in accordance with the below-described criteria. The evaluation results are shown together with the above-described composition in the below-described Table 1.

The jitter value is one of the electric signals of an optical disc, a higher numerical value means more deterioration of signal data in a Blu-ray Disc, and 10% or more leads to difficulty in reading and writing data.

Evaluation of jitter value

O···Jitter value is less than 10.0%.

X···Jitter value is 10.0% or more.

[0055]

[Table 1]

Table 1. Resin composition and evaluation result

	Example 1	Example 2	Example 3	Example 4	Comparative Example 1
Component (A)					
PHE-2	75		50	25	
PHE-6		75			
PHE					75
Component (B)					
IRGACURE 184	4	4	4	4	4
Component (C)					
UA-1	20	20		25	20
BPE-10			45	45	
Other component					
LA-82	0.5	0.5	0.5	0.5	0.5
PMP	0.5	0.5	0.5	0.5	0.5
Jitter value (%) before durability test	6.1	6.4	6.2	6.5	11.0
Judgment	O	O	O	O	×
Jitter value (%) after durability test	8.4	8.6	8.8	8.7	12.3
Judgment	O	O	O	O	×
Elastic modulus (MPa) 25°C/1 Hz	0.4	1.2	1.0	1.7	2.6

[0056]

In this regard, the components shown in abbreviation in Table 1 are as described below.

PHE-2: Ethylene oxide 2 mol-modified phenol acrylate, wherein $n = 2$, manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.

PHE-6: Ethylene oxide 6 mol-modified phenol acrylate, wherein $n = 6$, manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.

PHE: Phenoxyethyl acrylate, wherein $n = 1$, manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.

UA-1: Urethane acrylate obtained by reaction of three components of

polytetramethylene glycol (molecular weight of 850), isophorone diisocyanate and 2-hydroxyethyl acrylate at a molar ratio of 1:2:2.

BPE-10: Ethylene oxide 10 mol-modified bisphenol A-type diacrylate, manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.

IRGACURE^{RTM} 184: 1-Hydroxycyclohexylphenyl ketone, manufactured by Ciba Specialty Chemicals.

LA-82: Light stabilizer (hindered amine: 1,2,2,6,6-pentamethyl-4-piperidyl methacrylate, manufactured by ADEKA Corporation).

PMP: 4-Mercapto phenol.

[0057]

(iv) Measurement of elastic modulus of the resin cured product layers of the present invention

The elastic modulus was measured according to a dynamic viscoelasticity measuring method based on JIS K 7244-5. That is, a coating film was formed with each resin composition of the present invention so that the thickness after curing was 1 mm and cured using a Fusion lamp D bulb at an integrated light amount of 1 J/cm², and then a sample piece having a size of a length of 5 cm, a width of 1 cm and a thickness of 1 mm was made and measured by a viscoelasticity measuring device: DMS6100, manufactured by SII Nano Technology Inc. The measurement was carried out in bending mode under the conditions of an amplitude loading of 10 mN, a frequency of 1 Hz and a temperature rising rate of 2°C/minute in the range of -50°C to 200°C.

[0058]

Examples 5 to 7

By uniformly mixing the components in Table 2 at the ratio (part(s) by weight) shown in Table 2, ultraviolet-curable resin compositions of Examples 5 to 7 were prepared.

Using each obtained ultraviolet-curable resin composition of the present invention, in the same manner as in the above (i) (Examples 1 to 3), a Blu-ray Disc

having a coloring matter recording layer was manufactured.

In addition, property evaluation of each Blu-ray Disc was carried out in the same manner as the above, and the results are shown in Table 2.

[0059]

[Table 2]

Table 2. Resin composition and evaluation result

	Example 5	Example 6	Example 7
Component (A)			
PHE-2		40	25
PHE-6	55		
PHE			
Component (B)			
IRGACURE 184	4	4	4
Component (C)			
UX-0937	20		25
BPE-10		45	25
Lauryl acrylate		10	20
FA-P270A	20		
Viscosity			
Other component			
LA-82	0.5	0.5	0.5
PMP	0.5	0.5	0.5
Jitter value (%) before durability test	6.2	6.1	6.1
Judgment	O	O	O
Jitter value (%) after durability test	8.2	7.8	7.6
Judgment	O	O	O
Elastic modulus (MPa) 25°C/1Hz	6.7	9.5	4.9

[0060]

In this regard, the same abbreviations in Table 2 as the abbreviations in Table 1 are as described in Table 1 and the other components are as described below.

UX-0937: Polyether-based urethane acrylate (manufactured by Nippon Kayaku Co.,

Ltd.)

FA-P270A: Polypropylene glycol di(meth)acrylate (manufactured by Hitachi Chemical Co., Ltd.), trade name: FANCRYL^{RTM} FA-P270A (the repeating number of the propylene glycol unit is 12).

[0061]

Light transmittance of cured film at 405 nm:

A 100 μ m cured film was made with each resin composition obtained in the above-described Examples, and using a spectrophotometer (U-3310, manufactured by Hitachi High-Technologies Corporation), the absorbance of said film at 405 nm was measured to determine its light transmittance. As the result, any cured film obtained from the compositions of Examples 1 to 7 has a light transmittance of 85% or more.

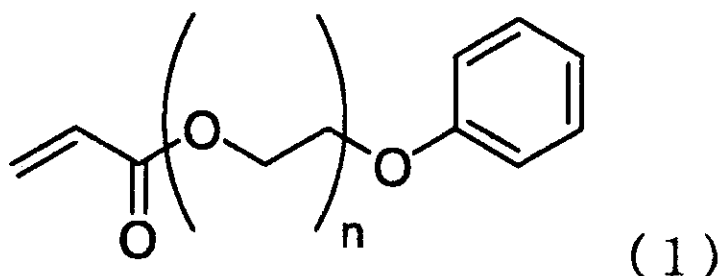
[0062]

As is clear from the results shown in Table 1 and Table 2, the resin compositions of the present invention of Examples 1 to 7 containing a (meth)acrylate having a structure shown by the general formula (1) obtained good recording signal characteristics before and after durability test. On the other hand, Comparative Example 1 containing no (meth)acrylate having a structure shown by the general formula (1) did not obtain good recording signal characteristics before and after durability test.

Claims

1. A Blu-ray disc where a cured product layer of an ultraviolet-curable resin composition containing:

(A) a (meth)acrylate having a structure shown by the below-described general formula (1):



(wherein, R represents a hydrogen atom or a methyl group, and n denotes an integer number of 2 to 10)

and

(B) a photopolymerization initiator

is directly laminated, as a cover layer, on an interface layer laminated on an organic coloring matter recording layer.

2. The Blu-ray disc according to Claim 1, which is characterized by further containing a (meth)acrylate (C) other than the above (meth)acrylate (A).

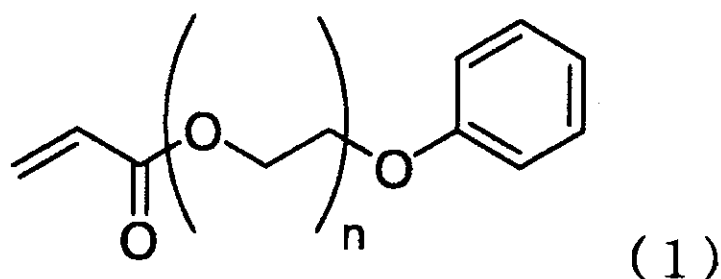
3. The Blu-ray disc according to Claim 1, wherein the content of the above (meth)acrylate (A) is 10 to 95% by weight based on the whole composition.

4. The Blu-ray disc according to Claim 1, wherein the above (meth)acrylate (C) is either one or both of (i) a reactant (c-2a) of polyester polyol or polyether polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a).

5. A method for manufacturing a Blu-ray disc, which comprises a process of directly

coating an ultraviolet-curable resin composition containing:

(A) a (meth)acrylate represented by the below-described general formula (1):



(wherein, R represents a hydrogen atom or a methyl group, and n denotes an integer number of 2 to 10)

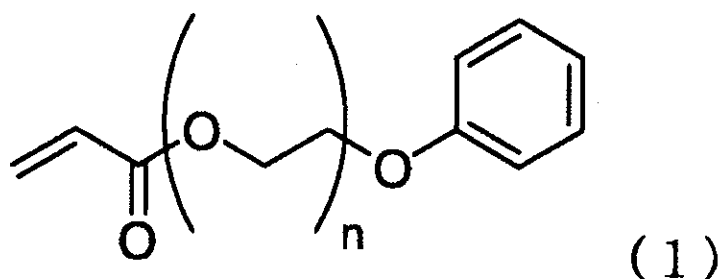
and

(B) a photopolymerization initiator

on an interface layer laminated on an organic coloring matter recording layer of a Blu-ray disc substrate to form a coating layer, which is then irradiated with an active energy ray to cure.

6. An ultraviolet-curable resin composition for a cover layer directly laminated on an interface layer of a Blu-ray disc having an organic coloring matter recording layer, which is an ultraviolet-curable resin composition containing:

(A) a (meth)acrylate represented by the below-described general formula (1):



(wherein, R represents a hydrogen atom or a methyl group, and n denotes an integer number of 2 to 10)

and

(B) a photopolymerization initiator,

and which is characterized in that said resin composition is used for a cover layer

directly laminated on an interface layer laminated on an organic coloring matter recording layer.

7. The ultraviolet-curable resin composition according to Claim 6, which is characterized by further containing a (meth)acrylate (C) other than the above (meth)acrylate (A).

8. The ultraviolet-curable resin composition according to Claim 6, wherein the content of the above (meth)acrylate (A) is 10 to 95% by weight based on the whole composition.

9. The ultraviolet-curable resin composition according to Claim 7, wherein the above (meth)acrylate (C) is either one or both of (i) a reactant (c-2a) of polyester polyol or polyether polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a).

10. The ultraviolet-curable resin composition according to Claim 7, wherein as the (meth)acrylate (C) other than the above (meth)acrylate (A), urethane (meth)acrylate is not contained or is contained where its content is less than 30% by weight based on the total amount of said (A) component and said (C) component.

11. The ultraviolet-curable resin composition according to Claim 9, wherein the (c-3a) component is polyethylene oxide-modified bisphenol A-type diacrylate having a polyethylene oxide repeating unit of 5 to 15.

12. The ultraviolet-curable resin composition according to Claim 7, wherein the (A) component content is more than 25% by weight and 90% by weight or less based on the total amount of the (A) component and the (C) component.

13. The ultraviolet-curable resin composition according to Claim 7, wherein:
the (A) component content is 10 to 95% by weight, the (B) component content is 1 to 10% by weight, the content of another additive other than the (A) to (C) components is 0 to 15% by weight, based on the total amount of ultraviolet-curable resin composition, and the rest is a (C) component; and
(i) the (A) component content is more than 25% by weight and 90% by weight or less or (ii) the content of urethane (meth)acrylate (C-2) in the (C) component is zero or less than 30% by weight, based on the total amount of the (A) component and the (C) component, and an organic or inorganic filler is not contained.

14. The ultraviolet-curable resin composition according to any one of Claims 7 to 13, wherein as a (meth)acrylate (C) other than (A) component, either one or both of (i) a reaction product (c-2a) of polyester polyol or polyether polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a) are contained; and based on the total amount of the ultraviolet-curable resin composition, the content of (A) component is 15% by weight or more and 90% by weight or less, and the total amount of (A) component, (c-2a) component and (c-3a) component is 70 to 99% by weight, and the content of (C) component other than (c-2a) component and (c-3a) component is 0 to 29% by weight.

15. The ultraviolet-curable resin composition according to any one of Claims 7 to 13, wherein as the (meth)acrylate (C) other than the (A) component, either one or both of (i) a reactant (c-2a) of polyester polyol or polyether polyol with polyisocyanate and 2-hydroxyethyl acrylate or (ii) polyethylene oxide-modified bisphenol A-type diacrylate (c-3a) is contained; the repeating number of ethylene oxide in the (c-3a) component is 5 to 15; based on the total amount of the (A) component and the (C) component, the content of the (c-2a) component is less than 30% by weight and the total content of the (c-2a) component and the (c-3a) component is 10 to 85% by weight; the content of (A) component based on the total amount of the ultraviolet-curable resin

composition is 15% by weight or more and 90% by weight or less; based on the total amount of the ultraviolet-curable resin composition, the total amount of the (A) component, the (c-2a) component and the (c-3a) component is 70 to 99% by weight, the content of the (C) component other than the above-described (c-2a) and (c-3a) components is 0 to 29% by weight and the content of the (B) photopolymerization initiator is 1 to 10% by weight; and an organic or inorganic filler is not contained.

16. The ultraviolet-curable resin composition according to Claim 7, wherein:
at least one kind selected from the group consisting of urethane (meth)acrylate (C-2), 5 to 15 mol polyethylene oxide-modified bisphenol A-type diacrylate (5 to 15 mol-modified c-3a), a (meth)acrylate monomer (c-3b) from the below-described Group (I) and a (meth)acrylate monomer (c-3c) from the below-described Group (II) is contained as the above (meth)acrylate (C); and
the total content of the content of the at least one kind selected from the above-described group and the (A) component content is 70 to 99% by weight, the (B) component is 1 to 10% by weight and the (meth)acrylate (C) other than the above-described one is 0 to 10% by weight, based on the total amount of the ultraviolet-curable resin composition:

Group (I):

(i) C5 to C18 alkyl (meth)acrylate or C7 to C18 alkylene glycol di(meth)acrylate, (ii) (meth)acrylate having a polytetramethylene glycol structure or propylene oxide-modified (meth)acrylate and (iii) caprolactone-modified (meth)acrylate; and

Group (II):

dicyclopentenylxyethyl (meth)acrylate, 1,6-hexanediol di(meth)acrylate, dipropylene glycol di(meth)acrylate or tripropylene glycol di(meth)acrylate.

17. The ultraviolet-curable resin composition according to Claim 16, wherein the (meth)acrylate monomer (c-3b) in the above-described (I) group is contained as the above (meth)acrylate (C).

18. The ultraviolet-curable resin composition according to Claim 16, wherein the (meth)acrylate monomer (c-3b) from the above Group (I) is at least one kind selected from the group consisting of the below-described (meth)acrylates:

- (i) isooctyl (meth)acrylate, isoamyl (meth)acrylate, lauryl (meth)acrylate, isodecyl (meth)acrylate, stearyl (meth)acrylate, cetyl (meth)acrylate, isomyristyl (meth)acrylate, tridecyl (meth)acrylate, 2-ethyl-2-butyl-propanediol di(meth)acrylate, 1,9-nonanediol di(meth)acrylate and 1,10-decanediol di(meth)acrylate;
- (ii) polypropylene glycol (meth)acrylate, polypropylene glycol di(meth)acrylate, polypropylene oxide-modified nonylphenyl (meth)acrylate, polypropylene oxide-modified neopentyl glycol di(meth)acrylate, polypropylene oxide-modified 1,6-hexanediol di(meth)acrylate, polypropylene oxide-modified bisphenol A-type di(meth)acrylate and methoxytripropylene glycol (meth)acrylate; and
- (iii) caprolactone-modified hydroxyethyl (meth)acrylate, caprolactone-modified hydroxybutyl (meth)acrylate, caprolactone-modified hydroxypivalic acid neopentyl glycol di(meth)acrylate, caprolactone-modified tris(acryloxyethyl)isocyanurate and caprolactone-modified dipentaerythritol hexa(meth)acrylate.

19. The ultraviolet-curable resin composition according to Claim 9, wherein the molecular weight of the polyester polyol or the polyether polyol is in the range of 200 to 3000.

20. The ultraviolet-curable resin composition according to Claim 6, wherein the elastic modulus of a cured product is 30 to 100 MPa at 25°C upon curing the ultraviolet-curable resin composition.

21. A cured product of the ultraviolet-curable resin composition according to any one of Claim 10 to 18.

22. Use of the ultraviolet-curable resin composition according to Claim 10 for forming a resin cured product layer directly laminated, as a cover layer, on an interface layer laminated on an organic coloring matter recording layer in a Blu-ray disc.

23. A Blu-ray disc where a cured product layer of the ultraviolet-curable resin composition according to Claim 10 is directly laminated, as a cover layer, on an interface layer laminated on an organic coloring matter recording layer.