

Description

Title of the Invention:

5 ULTRAVIOLET-CURABLE RESIN COMPOSITION FOR OPTICAL DISK,
CURED PRODUCT, AND ARTICLE

Technical Field

[0001]

10 The present invention relates to an ultraviolet-curable resin composition useful
for an optical disk having an organic dye recording layer.

Background Art

[0002]

15 At present, as optical disk recording media in practical use, there exist CD-R
and CD-RW where a recording layer, a reflective layer and a protective layer composed of
an ultraviolet-curable resin are laminated on a polycarbonate substrate having a thickness
of 1.2 mm and DVD-R, DVD+R, DVD-RW, DVD+RW, and DVD-RAM which are
constituted by attaching with an ultraviolet-curable resin a polycarbonate substrate having
a thickness of 0.6 mm and a polycarbonate substrate having a thickness of 0.6 mm which
20 has a recording layer and a reflective layer.

[0003]

25 In addition, recently, Blu-ray Disc (BD-R) of a single layer type having a
recording capacity about 5 times that of DVD is on the market. Blu-ray Disc is a disk
having a structure where a reflective layer, a recording layer and an interfacial layer are
formed on a transparent or opaque plastic substrate having a thickness of 1.1 mm and then
an about 0.1 mm light-transmitting layer is laminated on the interfacial layer, and where
recording/reproducing is carried out via the light-transmitting layer. An organic dye or an
inorganic compound is used in the recording layer, a light-transmitting inorganic substance
is used in the interfacial layer, and a cured product layer of an ultraviolet-curable resin is
30 used as the light-transmitting layer.

[0004]

 In Blu-ray Disc having a recording layer comprising an organic dye, the
recording layer is irradiated with a laser beam and recording is achieved utilizing
deformation by volume change of the organic dye. For the purpose of aiding the volume

change of the dye to obtain an excellent recording signal characteristic (e.g., jitter performance), there have been proposed a technology of forming a curable resin having an elastic modulus at 25°C of 40 MPa or less on the interfacial layer (Patent Document 1) and a technology of forming a curable resin having an elastic modulus at 25°C of 34 to 96 MPa or less (Patent Document 2).

[0005]

Moreover, as an evaluation index of reliability of the aforementioned optical disk recording media, there has been conducted an environmental test in which a sample is left under an environment of a temperature of 80°C/a relative humidity of 80% RH for 100 hours. In order to control a degree of deterioration of the recording signal before and after the environmental test, there has been proposed a technology of forming on the interfacial layer a curable resin having an elastic modulus of 100 MPa both at 5°C and 55°C and having a ratio of the elastic modulus at 5°C to the elastic modulus at 55°C of 10 or less (Patent Document 3).

[0006]

However, in Patent Documents 1 to 3, specific examples of the curable resins to be formed on the interface are not shown.

Background Art Documents

Patent Documents

[0007]

Patent Document 1: JP-A-2008-123631

Patent Document 2: JP-A-2008-269703

Patent Document 3: JP-A-2009-026379

Summary of the Invention

Problems that the Invention is to Solve

[0008]

An object of the present invention is to provide an ultraviolet-curable resin composition capable of imparting excellent recoding signal characteristic and durability in an optical disk having an organic dye recording layer.

Means for Solving the Problems

[0009]

As a result of the extensive studies for solving the above problems, the present inventors have found that a ultraviolet-curable resin composition containing a (meth)acrylate having a specific structure can impart excellent recoding signal characteristic and durability to an optical disk having an organic dye recording layer and thus they have accomplished the present invention.

[0010]

Namely, the present invention relates to the following (1) to (7).

(1) An ultraviolet-curable resin composition for an optical disk having an organic dye recording layer, the composition comprising (A) a (meth)acrylate having an alkylene group having 7 to 18 carbon atoms and (B) a photopolymerization initiator.

(2) The ultraviolet-curable resin composition for an optical disk according to the above (1), wherein the (meth)acrylate (A) having an alkylene group having 7 to 18 carbon atoms is at least one compound selected from the group consisting of isooctyl (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.

(3) The ultraviolet-curable resin composition for an optical disk according to the above (1) or the above (2), which contains (C) a (meth)acrylate other than (A).

(4) The ultraviolet-curable resin composition for an optical disk according to any one of the above (1) to (3), wherein the (meth)acrylate (A) having an alkylene group having 7 to 18 carbon atoms is included in an amount of 10 to 95% by weight based on the whole composition.

(5) The ultraviolet-curable resin composition for an optical disk according to any one of the above (1) to (4), wherein the (meth)acrylate (C) other than (A) is a reaction product of a polyester polyol or a polyether polyol, a polyisocyanate, and a hydroxy (meth)acrylate, and/or an ethylene oxide-modified bisphenol A-type diacrylate.

(6) A cured product obtained by irradiating the ultraviolet-curable resin composition for an optical disk according to any one of the above (1) to (5) with an active energy ray.

(7) An optical disk obtained by applying the ultraviolet-curable resin composition for an optical disk according to any one of the above (1) to (5) to an optical disk substrate and by irradiating the composition with an active energy ray.

5 Effect of the Invention

[0011]

In the case where the ultraviolet-curable resin composition containing a (meth)acrylate having an alkylene group having 7 to 18 carbon atoms of the present invention is used as a light-transmitting layer of an optical disk having an organic dye
10 recording layer, there can be provided an optical disk which is highly reliable at recording and in long-term use under high temperature and high humidity.

Embodiment for Carrying Out the Invention

[0012]

15 The ultraviolet-curable resin composition for an optical disk having an organic dye recording layer (hereinafter simply referred to as "ultraviolet-curable resin composition") of the present invention contains a (meth)acrylate having an alkylene group having 7 to 18 carbon atoms and a photopolymerization initiator. In the present invention, a (meth)acrylate means a methacrylate or an acrylate and the kind is not particularly
20 limited.

[0013]

As the (meth)acrylate (A) having an alkylene group having 7 to 18 carbon atoms contained in the ultraviolet-curable resin composition of the present invention, those having 7 to 18 carbon atoms can be used without limiting to a linear or branched structure.
25 However, when the number of the carbon atoms is less than 7, the recording signal characteristic and durability are not excellent and, on the other hand, when the number of the carbon atoms exceeds 18, liquid separates and thus is difficult to apply uniformly, so that the cases are not desirable in view of production. As the (meth)acrylate (A) having an alkylene group having 7 to 18 carbon atoms, lauryl (meth)acrylate (for example,
30 BLEMME LA manufactured by NOF Corporation), isooctyl (meth)acrylate (for example, Light Acrylate IO-A manufactured by Kyoeisha Chemical Co., Ltd.), isodecyl (meth)acrylate (for example, SR-395 manufactured by Sartomer Company Inc.), stearyl (meth)acrylate (for example, Light Acrylate IS-A manufactured by Kyoeisha Chemical Co., Ltd.), cetyl (meth)acrylate (for example, BLEMME CA manufactured by NOF

Corporation), isomyristyl (meth)acrylate (for example, Light Acrylate IM-A manufactured by Kyoeisha Chemical Co., Ltd.), tridecyl (meth)acrylate (for example, SR-489 manufactured by Sartomer Company Inc.), 2-ethyl-2-butyl-propanediol di(meth)acrylate (for example, NEW FRONTIER C9A manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.),
5 1,9-nonanediol di(meth)acrylate (for example, FANCRYL FA-129AS manufactured by Hitachi Chemical Co., Ltd.), and 1,10-decanediol di(meth)acrylate (for example, NK Ester A-DOD-N manufactured by Shin-Nakamura Chemical Co., Ltd.) are preferred. Of these, preferably, (meth)acrylates having an alkylene group having 7 to 14 carbon atoms are preferred.

10 [0014]

The content of the (A) component in the ultraviolet-curable resin composition is usually 10 to 95% by weight, preferably 20 to 80% by weight. When the content is less than 10% by weight, the volume change of dye cannot be aided and thus a jitter value (%) that is an index of the recording signal characteristic becomes worse.

15 [0015]

The photopolymerization initiator (B) contained in the ultraviolet-curable resin composition of the present invention is not particularly limited. Examples thereof include 1-hydroxycyclohexyl phenyl ketone (Irgacure 184; manufactured by Ciba Specialty Chemicals), 2-hydroxy-2-methyl-[4-(1-methylvinyl)phenyl]propanol oligomer (ONE-
20 Refined), 1-[4-(2-hydroxyethoxy)-phenyl]-2-hydroxy-2-methyl-1-propan-1-one (Irgacure-2959; manufactured by Ciba Specialty Chemicals), 2-hydroxy-1-{-[4-(2-hydroxy-2-methyl-propionyl)-benzyl]-phenyl}-2-methyl-propan-1-one (Irgacure-127; manufactured by Ciba Specialty Chemicals), 2,2-dimethoxy-2-phenylacetophenone (Irgacure-651; manufactured by Ciba Specialty Chemicals), 2-hydroxy-2-methyl-1-phenyl-propan-1-one
25 (Darocur 1173; manufactured by Ciba Specialty Chemicals), 2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropan-1-one (Irgacure-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-trimethylbenzoyldiphenylphosphine oxide, bis(2,4,6-
30 trimethylbenzoyl)-phenylphosphine oxide, bis(2,6-dimethoxybenzoyl)-2,4,4-trimethylpentylphosphine oxide, and the like.

[0016]

In the ultraviolet-curable resin composition of the present invention, one kind or two or more kinds of these (B) components can be used as a mixture at an optional ratio.

The content of the component (B) in the resin composition is usually 0.5 to 20% by weight and preferably 1 to 10% by weight.

[0017]

Furthermore, it is possible to use an amine, which can be a photopolymerization initiator auxiliary agent, in combination with the above photopolymerization initiator. Amines which can be used include benzoic acid 2-dimethylaminoethyl ester, dimethylaminoacetophenone, p-dimethylaminobenzoic acid ethyl ester, p-dimethylaminobenzoic acid isoamyl ester, and the like. When a photopolymerization initiator auxiliary agent such as the amine is used, its content in the ultraviolet-curable resin composition of the present invention is usually 0.005 to 5% by weight and preferably 0.01 to 3% by weight.

[0018]

The ultraviolet-curable resin composition of the present invention may further contain a (meth)acrylate (C) other than (A) besides the above components.

As the (meth)acrylate (C) other than (A) contained in the ultraviolet-curable resin composition of the present invention, for example, there may be mentioned (meth)acrylates having at least one (meth)acryloyl group. In the present invention, a (meth)acrylate means a methacrylate or an acrylate and the kind is not particularly limited. As the (meth)acrylate (C) other than (A), (C-1) epoxy (meth)acrylate, (C-2) urethane (meth)acrylate, (C-3) (meth)acrylate monomer(s), and the like can be used. Particularly, in the present invention, it is preferred to use (C-1) epoxy (meth)acrylate and/or (C-2) urethane (meth)acrylate and (C-3) (meth)acrylate monomer(s) singly or in combination, and it is more preferred to use (C-2) urethane (meth)acrylate and (C-3) (meth)acrylate monomers in combination.

[0019]

The epoxy (meth)acrylate (C-1) usable in the present invention has a function of improving curability and enhancing hardness of a cured product and a curing rate. Moreover, in the present invention, as the epoxy (meth)acrylate, any of those obtained by reacting glycidyl ether-type epoxy compounds with (meth)acrylic acid can be used. The glycidyl ether-type epoxy compounds for obtaining epoxy (meth)acrylates preferably used in the present invention include diglycidyl ether of bisphenol A or alkylene oxide adducts thereof, diglycidyl ether of bisphenol F or alkylene oxide adducts thereof, diglycidyl ether of hydrogenated bisphenol A or alkylene oxide adducts thereof, diglycidyl ether of hydrogenated bisphenol F or alkylene oxide adducts thereof, ethylene glycol diglycidyl

ether, propylene glycol diglycidyl ether, neopentyl glycol diglycidyl ether, butanediol diglycidyl ether, hexanediol diglycidyl ether, cyclohexanedimethanol diglycidyl ether, polypropylene glycol diglycidyl ether, and the like.

[0020]

5 The epoxy (meth)acrylate can be obtained by reacting the glycidyl ether compound with (meth)acrylic acid under the conditions as described below.

[0021]

(Meth)acrylic acid is reacted in an ratio of 0.9 to 1.5 mol, more preferably 0.95 to 1.1 mol relative to 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 accelerate the reaction, it is preferred to use a catalyst such as, for example, triphenylphosphine, 2,4,6-tris(dimethylaminomethyl)phenol (TAP), triethanolamine, or tetraethylammonium chloride. In addition, it is also possible to use, for example, paramethoxyphenol, methylhydroquinone, or the like as a polymerization inhibitor, in order to prevent polymerization during the reaction.

[0022]

In the present invention, the epoxy (meth)acrylate (C-1) is more preferably a 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.

[0023]

The urethane (meth)acrylate (C-2) usable in the present invention has a function of improving the mechanical properties (warping, distortion, etc.) of an optical disk laminated using the ultraviolet-curable resin composition of the present invention.

25 The urethane (meth)acrylate is obtained by reacting a polyhydric alcohol, a polyisocyanate, and a hydroxy (meth)acrylate compound.

[0024]

Examples of the polyhydric alcohol include neopentyl glycol, 3-methyl-1,5-pentanediol, (poly)ethylene glycol, (poly)propylene glycol, 1,4-butanediol, 1,6-hexanediol, trimethylolpropane, pentaerythritol, tricyclodecanedimethylol, bis-(hydroxymethyl)-cyclohexane and the like, polyester polyols obtained by reacting a polyhydric alcohol with a polybasic acid (for example, succinic acid, phthalic acid, hexahydrophthalic anhydride, terephthalic acid, adipic acid, azelaic acid, tetrahydrophthalic anhydride, or the like), caprolactone alcohols obtained by reacting a polyhydric alcohol with ϵ -caprolactone,

polycarbonate polyols (for example, a polycarbonate diol obtained by reacting 1,6-hexanediol with diphenyl carbonate, and the like), or polyether polyols (for example, polyethylene glycol, polypropylene glycol, polytetramethylene glycol, ethylene oxide-modified bisphenol A, and the like), and the like. Of these, a polyester polyol or a polyether polyol is preferred.

[0025]

Examples of the polyisocyanate include isophorone diisocyanate, hexamethylene diisocyanate, tolylene diisocyanate, xylene diisocyanate, diphenylmethane-4,4'-diisocyanate, dicyclopentanyl isocyanate, and the like.

[0026]

Examples of the hydroxy (meth)acrylate compound include hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate, hydroxybutyl (meth)acrylate, dimethylol cyclohexyl mono(meth)acrylate, hydroxycaprolactone (meth)acrylate, and the like. Of these, hydroxyethyl (meth)acrylate is preferred and 2-hydroxyethyl (meth)acrylate is particularly preferred.

[0027]

The above reaction may be carried, for example, as follows. That is, an organic polyisocyanate is mixed with a polyhydric alcohol so that the isocyanate group is preferably 1.1 to 2.0 equivalents relative to 1 equivalent of the hydroxyl group, and they are reacted at a reaction temperature of preferably 70 to 90°C to synthesize an urethane oligomer. Then a hydroxy (meth)acrylate compound is mixed therewith so that the hydroxyl group is preferably 1 to 1.5 equivalents relative to 1 equivalent of the isocyanate group of the urethane oligomer, and the intended urethane (meth)acrylate can be obtained by reacting them at 70 to 90°C. In addition, a product is commercially available as, for example, UX-0937: a 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.

[0028]

The (meth)acrylate monomer (C-3) usable as the (meth)acrylate (C) other than (A) is not particularly limited. Examples of the (meth)acrylate monomer having one (meth)acryloyl group include phenoxyethyl (meth)acrylate, phenoxypolyethylene glycol (meth)acrylate, benzyl (meth)acrylate, tetrahydrofurfuryl (meth)acrylate, morpholine (meth)acrylate, phenylglycidyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, ethoxydiethylene glycol (meth)acrylate, methoxyditripropylene glycol (meth)acrylate,

tricyclodecane (meth)acrylate, isobornyl (meth)acrylate, dicyclopentadieneoxyethyl
 (meth)acrylate, dicyclopentenyl acrylate (for example, FANCRYL FA-511A manufactured
 by Hitachi Chemical Co., Ltd.), dicyclopentenylloxyethyl acrylate (for example,
 FANCRYL FA-512A manufactured by Hitachi Chemical Co., Ltd.), dicyclopentenylloxy
 5 methacrylate (for example, FANCRYL FA-512M manufactured by Hitachi Chemical Co.,
 Ltd.), dicyclopentanyl acrylate (for example, FANCRYL FA-513A manufactured by
 Hitachi Chemical Co., Ltd.), dicyclopentanyl methacrylate (for example, FANCRYL 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
 10 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.), 1-adamantyl methacrylate (for example, Adamantate AM manufactured by
 Idemitsu Kosan Co., Ltd.), ethylene oxide-modified phenoxylated phosphate
 (meth)acrylate, ethylene oxide-modified butoxylated phosphate (meth)acrylate, ethylene
 15 oxide-modified octyloxylated phosphate (meth)acrylate, and the like. The (meth)acrylate
 monomer having one (meth)acryloyl group has a function of improving the mechanical
 properties (suppression of warping, distortion and the like) of an optical disk where the
 ultraviolet-curable resin composition of the present invention is formed as the light-
 transmitting layer.

[0029]

With regard to the (meth)acrylate monomer (C-3) which can be used as the
 (meth)acrylate (C) other than (A), the (meth)acrylate monomer having two (meth)acryloyl
 groups includes cyclohexane-1,4-dimethanol di(meth)acrylate, cyclohexane-1,3-
 dimethanol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate (for example,
 25 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, alkylene oxide-modified 1,6-hexanediol di(meth)acrylate, neopentyl
 30 glycol di(meth)diacrylate, alkylene 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, ethylene oxide-modified phosphate di(meth)acrylate,

and the like. In the present invention, particularly, it is preferred to use ethylene oxide-modified bisphenol A-type di(meth)acrylate.

[0030]

5 With regard to the (meth)acrylate monomer (C-3) which can be used as the (meth)acrylate (C) other than (A), the (meth)acrylate monomer having three (meth)acryloyl groups includes 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
10 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.

[0031]

15 With regard to the (meth)acrylate monomer (C-3) which can be used as the (meth)acrylate (C) other than (A), the (meth)acrylate monomer having four (meth)acryloyl groups includes 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.

[0032]

20 With regard to the (meth)acrylate monomer (C-3) which can be used as the (meth)acrylate (C) other than (A), the (meth)acrylate monomer having five (meth)acryloyl groups includes dipentaerythritol penta(meth)acrylate, caprolactone-modified dipentaerythritol penta(meth)acrylate, and the like.

[0033]

25 With regard to the (meth)acrylate monomer (C-3) which can be used as the (meth)acrylate (C) other than (A), the (meth)acrylate monomer having six (meth)acryloyl groups includes dipentaerythritol hexa(meth)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
30 having seven or more (meth)acryloyl groups.

[0034]

In the ultraviolet-curable resin composition of the present invention, one kind or two or more kinds of these (C) components can be used as a mixture at an optional ratio. The content of the component (C) in the ultraviolet-curable resin composition is usually 30

to 80% by weight and preferably 40 to 70% by weight. Moreover, in the case where (C-1) and/or (C-2) and (C-3) are used in combination as the (C) component, (C-1) and/or (C-2) are each usually used in an amount of 5 to 70 parts by weight and preferably about 10 to 60 parts by weight relative to 100 parts by weight of the ultraviolet-curable resin composition and the (C-3) component is used so that the total amount of the (C-3) component and the (A) component satisfies the range of 20 to 80 parts by weight and preferably 25 to 75 parts by weight relative to 100 parts by weight of the ultraviolet-curable resin composition.

[0035]

To the ultraviolet-curable resin composition of the present invention, an additive such as an antirust, 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) and a filler may be added according to necessity. As the hindered amine compound, known ones can be used without particular limitation. 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.

[0036]

The ultraviolet-curable resin composition of the present invention can be obtained by mixing and dissolving the above described components at an ordinary temperature to 80°C. In addition, according to necessity, foreign substances may be removed by an operation such as filtration. As for the ultraviolet-curable resin composition of the present invention, it is preferred to appropriately control the mixing ratio of the components so that the viscosity at 25°C is in the range of 30 to 2000 mPa.s, in view of coating properties.

[0037]

The ultraviolet-curable resin composition of the present invention can be used as a coating agent for light transmitting layers on the laser incident side of Blu-ray Disc and the like. Specifically, the composition is coated on an optical disk substrate by an arbitrary method, for example, a spin coating method, a photo polymerization method, a roll coating method, a screen printing method, and the like so that the film thickness of the applied resin is 1 to 100 μm . After coating, by irradiation with an ultraviolet to near ultraviolet ray (wavelength: around 200 to 400 nm) from one side or both sides, the composition is cured. The irradiation amount is preferably about 50 to 1500 mJ/cm^2 and

particularly preferably, approximately 100 to 1000 mJ/cm². For curing by irradiation with the ultraviolet to near ultraviolet ray, any lamp can be used as long as it allows irradiation of the ultraviolet to near ultraviolet ray. For example, it includes a low, high or ultrahigh pressure mercury lamp, a metal halide lamp, a (pulse) xenon lamp, an electrodeless lamp, or the like.

[0038]

Moreover, the ultraviolet-curable resin composition of the present invention can be applied to the case where the light-transmitting layer is composed of a plurality of layers. For example, in the case where the light-transmitting layer is composed of a first resin layer formed on the recording layer or the interfacial layer and a second resin layer formed on a face opposite to the recording layer or the interfacial layer viewing from the first resin layer, the resin composition can be preferably used as the first resin layer.

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

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

[0039]

In the case where the light-transmitting layer is composed of two layers, as a forming method of the light-transmitting layer, specifically, the composition is coated on an optical disk substrate by an arbitrary method, for example, a spin coating method, a photo polymerization method, a roll coating method, a screen printing method, and the like so that the film thickness of the resin applied as the first resin layer is 1 μm to 50. After coating, by irradiation with an ultraviolet to near ultraviolet ray (wavelength: around 200 to 400 nm) from one side or both sides, the composition is cured. The irradiation amount is preferably about 50 to 1500 mJ/cm² and particularly preferably, approximately 100 to 1000 mJ/cm². After curing, the composition is coated on an optical disk substrate by an arbitrary method, for example, a spin coating method, a photo polymerization method, a roll coating method, a screen printing method, and the like so that the film thickness of the resin applied as the second resin layer is 50 μm to 100 μm. After coating, by irradiation with an ultraviolet to near ultraviolet ray (wavelength: around 200 to 400 nm) from one side or both sides, the composition is cured. The irradiation amount is preferably about 50 to 1500 mJ/cm² and particularly preferably, approximately 100 to 1000 mJ/cm². For curing by irradiation with the ultraviolet to near ultraviolet ray, any lamp can be used as long as it allows irradiation of the ultraviolet to near ultraviolet ray. For example, it

includes a low, high or ultrahigh pressure mercury lamp, a metal halide lamp, a (pulse) xenon lamp, an electrodeless lamp or the like.

Examples

5 [0040]

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

[0041]

10 Ultraviolet-curable resin compositions for Examples 1 to 4 and Comparative Examples 1 to 2 were prepared according to the composition shown in Table 1.

[0042]

[Table 1]

Table 1. Resin Composition and Evaluation Results

	Example 1	Example 2	Example 3	Example 4	Comparative Example 1	Comparative Example 2
Composition (A)						
LA	50					
ISA		50				
NDDA			30	25		
HDDA					30	
VA						50
Composition (B)						
Irgacure-184	4	4	4	4	4	4
Composition (C)						
UA-1	45	45	45	40	45	45
BPE-10				30		
FA-512A			20		20	
Other component						
LA-82	0.5	0.5	0.5	0.5	0.5	0.5
PMP	0.5	0.5	0.5	0.5	0.5	0.5
Appearance of liquid	O	O	O	O	O	X
Jitter value (%) before durability test	6.4	6.3	6.2	6.9	12.3	Not performed
Judgment	O	O	O	O	X	
Jitter value (%) after durability test	8.5	8.3	8.6	8.4	16.0	
Judgment	O	O	O	O	X	

[0043]

In this regard, the components abbreviated in Table 1 are as follows.

LA: lauryl acrylate, manufactured by NOF Corporation, an acrylate having an alkylene group having 12 carbon atoms;

5 ISA: isostearyl acrylate, manufactured by Kyoeisha Chemical Co., Ltd., an acrylate having an alkylene group having 18 carbon atoms;

NDDA: 1,9-nonanediol diacrylate, manufactured by Hitachi Chemical Co., Ltd., a diacrylate having an alkylene group having 9 carbon atoms;

10 HDDA: 1,6-hexanediol diacrylate, manufactured by Nippon Kayaku Co., Ltd., a diacrylate having an alkylene group having 6 carbon atoms;

VA: behenyl acrylate, manufactured by NOF Corporation, an acrylate having an alkylene group having 22 carbon atoms;

15 UA-1: a urethane acrylate obtained by reacting three components: polytetramethylene glycol (molecular weight: 850), isophorone diisocyanate, and 2-hydroxyethyl acrylate, in 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.;

FA-512A: dicyclopentenloxyethyl acrylate, manufactured by Hitachi Chemical Co., Ltd.;

20 Irgacure-184: 1-hydroxycyclohexyl phenyl ketone, manufactured by Ciba Specialty Chemicals;

LA-82: 1,2,2,6,6-pentamethyl-4-piperidyl methacrylate, manufactured by ADEKA Corporation;

PMP: 4-mercaptophenol

25 [0044]

Using the obtained ultraviolet-curable resin compositions of the present invention, Blu-ray Disk having an organic dye recording layer was produced and evaluated for the properties.

[0045]

30 Production of Blu-ray Disc Having Organic Dye Recording Layer (Examples 1 to 3, Comparative Examples 1 to 2)

1. A silver alloy was sputtered on a polycarbonate substrate having a diameter of 12 cm and a thickness of 1.1 mm which had a guide groove having a track pitch of 0.32 μm so that the film thickness was 100 nm, thereby producing a reflective layer. Thereafter, a dye

solution containing an azo dye dissolved in TFP (tetrafluoropropanol) solvent was applied by a spin coating method and dried at 80°C for 30 minutes to form an organic die recording layer. Furthermore, ZnS-SiO₂ (molar ratio: 80:20) was sputtered so that the thickness was about 15 nm, thereby forming an interfacial layer to produce a Blu-ray Disc substrate.

2. The Blu-ray Disc substrate was put on a spin table so that the interfacial layer was upward and a cap treatment was carried in a circle pattern for covering it until an internal diameter of 11.5 mm, and then 2.0 g of an ultraviolet-curable resin composition of the present invention was provided on the cap of the center.

3. In accordance with the viscosity of the ultraviolet-curable resin composition of the present invention, spin coating was carried out at a rate range of 1000 rpm to 1500 rpm for 4 seconds to 7 seconds to perform coating so that each coated film thickness was 25 μm. Shortly before completion of the spin coating, irradiation of 2 shots was carried out with a xenon flash lamp to cure the composition to the degree that the surface flowability disappeared.

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

5. The resulting Blu-ray Disc substrate was put on a spin table so that the cured ultraviolet-curable resin composition of the present invention was upward and a cap treatment was carried in a circle pattern for covering it until an internal diameter of 11.5 mm, and then 3.0 g of BRD-864 (a resin for light-transmitting layer for Blu-ray Disc manufactured by Nippon Kayaku Co., Ltd.) was provided on the cap of the center.

6. Spin coating was carried out at a rate range of 1500 rpm for 4 seconds to 7 seconds to perform coating so that coated film thickness was 75 μm. Shortly before completion of the spin coating, irradiation of 2 shots was carried out with a xenon flash lamp to cure it to the degree that the surface flowability disappeared.

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

[0046]

Production of Blu-ray Disc Having Organic Dye Recording Layer (Example 4)

1. A silver alloy was sputtered on a polycarbonate substrate having a diameter of 12 cm and a thickness of 1.1 mm which had a guide groove having a track pitch of 0.32 μm so

that the film thickness was 100 nm, thereby producing a reflective layer. Thereafter, a dye solution containing an azo dye dissolved in TFP (tetrafluoropropanol) solvent was applied by a spin coating method and dried at 80°C for 30 minutes to form an organic die recording layer. Furthermore, ZnS-SiO₂ (molar ratio: 80:20) was sputtered so that the thickness was about 15 nm, thereby forming an interfacial layer to produce a Blu-ray Disc substrate.

2. The Blu-ray Disc substrate was put on a spin table so that the interfacial layer was upward and a cap treatment was carried in a circle pattern for covering it until an internal diameter of 11.5 mm, and then 2.0 g of an ultraviolet-curable resin composition of the present invention was provided on the cap of the center.

3. In accordance with the viscosity of the ultraviolet-curable resin composition of the present invention, spin coating was carried out at a rate ranging from 800 rpm to 1300 rpm for 4 seconds to 7 seconds to perform coating so that coated film thickness was 100 µm. Shortly before completion of the spin coating, irradiation of 2 shots was carried out with a xenon flash lamp to cure it to the degree that the surface flowability disappeared.

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

[0047]

Evaluation of Change in Recording Signal Characteristic Before and After Durability Test of Blu-ray Disc

The Blu-ray Disc of the present invention and the Blu-ray Disc of Comparative Example 1 were left for 250 hours under the circumstances of 80°C and 85% RH. Using a Blu-ray Disc data signal measuring device, ODU-1000 manufactured by Pulstec Industrial Co., Ltd., the recording signal characteristic (jitter value) of the Blu-ray Disc before and after the durability test was measured and evaluated according to the following criteria. The jitter value is one of the electric signals from an optical disk, and a higher numerical value of the value means a more deteriorated data of Blu-ray Disc. When the value is 10% or more, it becomes difficult to read and write data.

Evaluation of Jitter Value

O . . . The jitter value is less than 10.0%

X . . . The jitter value is 10.0% or more.

[0048]

Evaluation of Appearance upon Storage of Ultraviolet-Curable Resin Composition

After the ultraviolet-curable resin compositions of the present invention and Comparative Examples were prepared, each of them was stored at room temperature (25°C, 45% RH) for 24 hours and appearance of the liquid was observed. When the liquid separates upon storage, it becomes difficult to apply and cure the ultraviolet-curable resin composition homogeneously, so that the case is not preferable.

Evaluation of Appearance of Liquid

O . . . The ultraviolet-curable resin composition does not separate;

10 X . . . The ultraviolet-curable resin composition separates.

[0049]

From the results of Table 1, the ultraviolet-curable resin compositions of the present invention in Examples 1 to 4 each containing a (meth)acrylate having an alkylene group having 7 to 18 carbon atoms have good coating properties and also provide a good recording signal characteristic before and after the durability test. On the other hand, a good recording signal characteristic was not obtained before and after the durability test in Comparative Example 1 in which the (meth)acrylate having an alkylene group having 7 to 18 carbon atoms is not contained. Similarly, in Comparative Example 2 in which the (meth)acrylate having an alkylene group having 7 to 18 carbon atoms is not contained, bad appearance owing to liquid separation took place upon storage at room temperature for 24 hours.

[0050]

While the invention has been described in detail and with reference to specific embodiments thereof, it will be apparent to one skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope thereof.

The present application is based on Japanese Patent Application No. 2010-017575 filed on January 29, 2010, and the contents are incorporated herein by reference. Also, all the references cited herein are incorporated as a whole.

Claims

1. An ultraviolet-curable resin composition for an optical disk having an organic dye recording layer, the composition comprising (A) a (meth)acrylate having an alkylene group having 7 to 18 carbon atoms and (B) a photopolymerization initiator.
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2. The ultraviolet-curable resin composition for an optical disk according to claim 1, wherein the (meth)acrylate (A) having an alkylene group having 7 to 18 carbon atoms is at least one compound selected from the group consisting of isooctyl
10 (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.
- 15 3. The ultraviolet-curable resin composition for an optical disk according to claim 1 or 2, which contains (C) a (meth)acrylate other than (A).
4. The ultraviolet-curable resin composition for an optical disk according to any one of claims 1 to 3, wherein the (meth)acrylate (A) having an alkylene group having
20 7 to 18 carbon atoms is included in an amount of 10 to 95% by weight based on the whole composition.
5. The ultraviolet-curable resin composition for an optical disk according to any one of claims 1 to 4, wherein the (meth)acrylate (C) other than (A) is a reaction
25 product of a polyester polyol or a polyether polyol, a polyisocyanate, and a hydroxy (meth)acrylate, and/or an ethylene oxide-modified bisphenol A-type diacrylate.
6. A cured product obtained by irradiating the ultraviolet-curable resin composition for an optical disk according to any one of claims 1 to 5 with an active energy
30 ray.
7. An optical disk obtained by applying the ultraviolet-curable resin composition for an optical disk according to any one of claims 1 to 5 to an optical disk substrate and by irradiating the composition with an active energy ray.