

DESCRIPTION

ULTRAVIOLET-CURABLE RESIN COMPOSITION FOR OPTICAL DISK AND
CURED PRODUCT THEREOF

Technical Field

[0001]

The present invention relates to an ultraviolet-curable resin composition, use of said composition for multilayer optical disks (particularly, use for intermediate resin layers), an optical disk having a cured layer of said resin composition, particularly to a resin composition for efficiently producing next-generation high-density multilayer optical disks having a high detachability from a polycarbonate stamper (a mold for optical disks) and less change in warping when curing and under high temperature and high humidity.

Background Art

[0002]

Recently, the capacity of an optical disk has been significantly increased and the multilayer-type optical disk has been rapidly spread in order to increase the memory capacity. The technique for increasing the recording capacity of the optical disk includes wavelength shortening of recording/reproducing beams, increasing NA (numerical aperture) of objective lens in recording/reproducing beam irradiation optical system, multi-layering of the recording layer, and the like. Among them, increasing the capacity by multi-layering of the recording layer can be a low cost compared with wavelength shortening and increasing NA.

For example, the DVD disk having two recording layers has a structure where two recording layers are laminated via a transparent resin intermediate layer (hereinafter, also referred to as an intermediate resin layer). Specifically, it is a structure where a 0.6 mm first transparent resin substrate, a first recording layer, a first translucent reflection film layer, an adhesive layer, a transparent resin

intermediate layer, a second recording layer, a second reflective film layer, an adhesive layer and a 0.6 mm second transparent resin substrate are laminated in sequence. The method for forming the transparent resin intermediate layer in this case includes, for example, a method where an ultraviolet-curable resin composition to be formed into a transparent resin intermediate layer is placed on an adhesive layer formed on a first translucent reflection film layer, a transparent resin stamper with a bump pattern such as a guide groove for guiding the recording/reproducing beams is mounted thereon and spin coated, the formed ultraviolet-curable resin composition layer is cured before detachment of the stamper, and the bumps are transferred on the surface of the ultraviolet-curable resin composition to form a transparent resin intermediate layer; or a method where after a cured product layer of the above resin composition is formed on a stamper, the stamper with said cured product layer is mounted on a resin for forming an adhesive layer placed on a first translucent reflection film layer, the adhesive layer is formed by spin coating before said adhesive layer is cured, and then the stamper is detached from the cured product layer of the above resin composition to form a transparent resin intermediate layer (transfer method).

[0003]

As for Blu-ray disc, in a disk exclusive for reading, recorded pit pattern is transferred on a single side of a substrate, for example, a polycarbonate substrate having a diameter of 120 mm and a thickness of 1.1 mm, and then on the surface of this substrate, a first reflective film layer to become a first recording layer, for example, a silver alloy reflective film layer is deposited. In addition, a transparent resin intermediate layer with the recorded pit pattern transferred is formed on the first reflective film layer via an adhesive layer, and then on this transparent resin intermediate layer (intermediate film), a second reflective film layer to become a second recording layer, for example, a silver alloy reflective film layer is deposited. And then, a transparent resin layer is laminated on said reflective film layer according to the configuration. In this regard, a means where a silver alloy reflective film layer

is deposited, for example, in vacuo by the sputtering method is proposed.

The recording-type disk has a structure where a first reflective film layer, a first dielectric layer, a first recording layer and a second dielectric layer are laminated on the substrate surface with recorded pit pattern transferred on a single side of, for example, a polycarbonate substrate having a diameter of 120 mm and a thickness of 1.1 mm, and further on the second dielectric layer, a transparent resin intermediate layer, a second reflective film layer, a third dielectric layer, a second recording layer, a fourth dielectric layer and a transparent resin layer are laminated in sequence via an adhesive layer.

In these cases, an ultraviolet-curable resin composition to be formed into a transparent resin intermediate layer is coated on a reflective film layer or a dielectric layer via an adhesive layer and pressed onto a transparent resin stamper with a bump pattern such as a guide groove for guiding the recording/reproducing beams, the ultraviolet-curable resin composition is cured before detachment from the stamper, and the bumps are transferred on the surface of the ultraviolet-curable resin composition for forming (transfer method).

Here, usually, as for the disk exclusive for reading, the second reflective film layer is formed on the bump side of the transparent resin intermediate layer, and the other side is adhered to the first reflective film layer via the adhesive layer. On the other hand, as for the recording-type disk, the second reflective film layer is formed on the bump side of said transparent resin intermediate layer, and the other side is adhered to the second dielectric layer via the adhesive layer.

[0004]

In generally, said transfer method is called 2P (Photo Polymerization) method, and an ultraviolet-curable resin composition to be used is called 2P agent.

The transparent resin for transparent resin stampers includes acrylic-based resin, methacryl-based resin, polycarbonate resin, polyolefin-based resin (particularly, amorphous polyolefin), polyester-based resin, polystyrene resin, epoxy resin and the like. Among them, amorphous polyolefin is preferable in terms of detachability after

curing the 2P agent, low moisture absorbency, shape stability and the like, and polycarbonate resin is preferable in terms of material cost. So for the purpose of reducing the cost, a method for manufacturing a light recording medium (multilayer light recording medium) having a plurality of recording layers has been proposed which allows detachability even from an inexpensive polycarbonate stamper and improves yield, and also a resin suitable for said manufacturing method has been developed (Patent Literature 1).

[0005]

At present, the mainstream of the ultraviolet-curable resin composition in using the 2P method includes, for example, (a) a composition containing a prepolymer capable of photo radical polymerization, a monomer and a photopolymerization initiator, (b) a composition containing a prepolymer capable of photo cation polymerization, a monomer and a photopolymerization initiator, (c) a composition where photo radical polymerizable and cation polymerizable compositions are mixed, and the like.

[0006]

The prepolymer includes various epoxy (meth)acrylates (where a (meth)acryloyl group is added to the epoxy skeleton), urethane (meth)acrylates (where a (meth)acryloyl group is added to the urethane skeleton), or/and the like. These components respectively have a significant influence on moldability like detachability from a stamper and on required properties for optical disks like adhesiveness to a reflective film layer or a dielectric layer, moisture fastness and flexibility.

[0007]

As the monomer, a monomer having a (meth)acryloyl group as a functional group is generally used. In addition, a monomer having a vinyl group is also used. Prepolymers generally have a high viscosity and are difficult to use alone as a 2P agent, so a monomer is used as a reactive diluent. By using a trifunctional or more functional monomer for example, crosslink density of a cured product is increased, and hardness, Young's modulus and resistance to moist heat are improved.

[0008]

In making a multilayer optical disk, if detachability from a transparent resin stamper is low, a part of a transparent resin intermediate layer is detached together with a transparent resin stamper, causing a defect. Low transcribability causes an error when recording/reproducing. If the warp is large after ultraviolet curing, a recording layer or a reflective film layer cannot be uniformly formed on a formed bump pattern, a second substrate cannot be laminated in the case of DVD, or a 0.1 mm light transmitting layer cannot be uniformly formed in the case of Blu-ray disc. In addition, if a bump pattern is deformed under high temperature and high humidity, the recording properties (for example, jitter properties) of the first and second recording layers will not be equivalent.

With a 2P agent described in Patent Literatures 2 to 5, a bump pattern is formed on a layer formed on a glass substrate, using a metal stamper. In addition, Patent Literatures 6 to 10 describe various 2P agents.

Related technical Literature

Patent Literature

[0009]

Patent Literature 1: Japanese Patent Laid-Open No. 2007-224057 A

Patent Literature 2: Japanese Patent Laid-Open No. H5-59139 A

Patent Literature 3: Japanese Patent Laid-Open No. H5-132534 A

Patent Literature 4: Japanese Patent Laid-Open No. H5-140254 A

Patent Literature 5: Japanese Patent Laid-Open No. H5-132506 A

Patent Literature 6: Japanese Patent Laid-Open No. 2003-331463 A

Patent Literature 7: Japanese Patent Laid-Open No. 2004-288242 A

Patent Literature 8: Japanese Patent Laid-Open No. 2004-288264 A

Patent Literature 9: Japanese Patent Laid-Open No. 2005-332564 A

Patent Literature 10: Patent No. 4193916 B

Summary of the Invention

Problems to Be Solved by the Invention

[0010]

Usually, the ultraviolet-curable resin to be used as a 2P agent is required to be easily peeled off from a stamper (highly detachable from a stamper) after forming a bump pattern by a stamper, while maintaining said pattern. In doing so, if it is difficult to detach from the stamper, the resin adheres to the stamper, which causes deficiency of the resin layer, the bump pattern or the like and causes problems in forming a reflective film or a dielectric layer, resulting in lowered production efficiency. Even with a resin having a high detachability from a stamper, when ultraviolet curing or in the case where the multilayer disk is placed under high temperature and high humidity, large warp variation will cause problems such as reading error.

[0011]

Therefore, with these facts considered, an object of the present invention is to offer a resin composition which is excellent in detachment from a stamper, particularly in detachment from a polycarbonate stamper and has less warp variation even when curing a formed resin layer or after the multilayer disk having said cured product layer is placed under high temperature and high humidity, by using a (meth)acrylate having an aliphatic chain, particularly a (meth)acrylate having a certain aliphatic chain.

[0012]

In addition, the resin composition of the present invention is adhered directly to any of a reflective film or a dielectric layer by curing, whereby it is not necessary in detachment of the stamper to put an adhesive layer to adhere an curing resin layer to a reflective film or a dielectric layer and then detach a stamper. That is, a resin layer is directly formed on either a reflective film or a dielectric layer, and by forming bumps and/or curing on a stamper, the stamper can be easily detached as it is. Therefore, it allows to omit an adhesive layer for adhering a cured product layer of an ultraviolet-curable resin composition to be used as a 2P agent to the surface of a reflective film and a dielectric layer.

Means of Solving the Problems

[0013]

The present inventors have found a resin composition which has a higher detachability from a stamper, particularly a polycarbonate stamper and less warp variation when curing or after the multilayer disk is placed under high temperature and high humidity, by using a (meth)acrylate having an aliphatic chain, particularly a (meth)acrylate having a certain aliphatic chain. Thus, they have developed an ultraviolet-curable resin composition which is excellent in detachability from a polycarbonate stamper and has less warp variation when curing and even after the multilayer disk is placed under high temperature and high humidity.

[0014]

The present invention relates to the below-described (1) to (12).

(1) An ultraviolet-curable resin composition for a multilayer optical disk, characterized by containing (A) a (meth)acrylate having an aliphatic chain, (B) a (meth)acrylate monomer and/or (C) a urethane (meth)acrylate, and (D) a photopolymerization initiator.

(2) The ultraviolet-curable resin composition for a multilayer optical disk according to (1), wherein the (A) (meth)acrylate having an aliphatic chain is one kind or two kinds or more selected from the group consisting of lauryl (meth)acrylate, stearyl (meth)acrylate, cetyl (meth)acrylate, behenyl (meth)acrylate, isolauryl (meth)acrylate, isostearyl (meth)acrylate, isocetyl (meth)acrylate and isobehenyl (meth)acrylate.

(3) The ultraviolet-curable resin composition for a multilayer optical disk according to (1) or (2), wherein the (B) (meth)acrylate monomer is one kind or two kinds or more selected from the group consisting of isobornyl (meth)acrylate, propylene oxide-modified neopentyl glycol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate and hydroxypivalaldehyde-modified trimethylolpropane di(meth)acrylate.

(4) The ultraviolet-curable resin composition for a multilayer optical disk according to

any one of (1) to (3), wherein (A) component is 5 to 90% by weight, (B) component and/or (C) component is 5 to 90% by weight and (D) component is 1 to 15% by weight, relative to the whole resin composition.

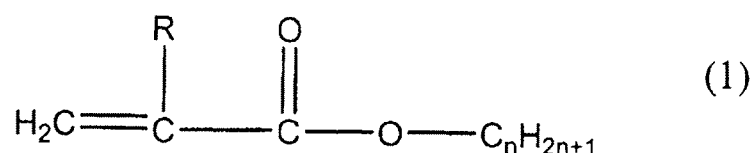
(5) An optical disk having a cured product obtained by irradiating the resin composition according to any one of the above (1) to (4) with ultraviolet rays.

[0015]

(6) An ultraviolet-curable resin composition containing:

(A) a (meth)acrylate having an aliphatic chain represented by the following formula

(1):



wherein, R represents H or CH₃ and n represents an integer number of 10 to 25,

and

(B) at least one kind of (meth)acrylate monomer selected from the group consisting of isobornyl (meth)acrylate, propylene oxide-modified neopentyl glycol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate and hydroxypivalaldehyde-modified trimethylolpropane di(meth)acrylate, or

(C) a urethane (meth)acrylate obtained by reaction of organic polyisocyanate with a hydroxy (meth)acrylate compound,

and

(D) a photopolymerization initiator,

wherein

(i) (A) component is 5 to 90% by weight,

(ii) (B) component or (C) component or the total of both (B) and (C) is 5 to 90% by weight, and the total amount of (A) to (C) components is 85 to 99% by weight, and

(iii) (D) component is 1 to 15% by weight

relative to the total amount of the resin composition.

[0016]

(7) The ultraviolet-curable resin composition according to (6), wherein the aliphatic chain of the (meth)acrylate having an aliphatic chain is an aliphatic chain having a branched chain.

(8) The ultraviolet-curable resin composition according to (7), wherein the (meth)acrylate having an aliphatic chain is at least one kind selected from the group consisting of isodecyl acrylate, isolauryl (meth)acrylate, isostearyl (meth)acrylate, isocetyl (meth)acrylate and isobehenyl (meth)acrylate.

(9) The ultraviolet-curable resin composition according to any one of the above-described (6) to (8), the organic polyisocyanate is at least one kind of diisocyanate selected from the group consisting of isophorone diisocyanate, hexamethylene diisocyanate, tolylene diisocyanate, xylene diisocyanate and diphenylmethane-4,4'-diisocyanate, or dicyclopentanyl isocyanate.

(10) The ultraviolet-curable resin composition according to any one of the above-described (6) to (9), wherein the hydroxy (meth)acrylate compound is a hydroxy-substituted C2 to C10 aliphatic (meth)acrylate.

(11) Use of the ultraviolet-curable resin composition according to any one of the above-described (6) to (10) for an intermediate resin layer of a multilayer disk.

(12) A multilayer disk having a cured product layer of the ultraviolet-curable resin composition according to any one of the above-described (6) to (10).

Effect of the Invention

[0017]

The ultraviolet-curable resin composition of the present invention and a cured product thereof are excellent in detachability from a stamper, particularly in detachment from a polycarbonate stamper (low peeling strength from a stamper) and useful as a 2P agent which is less both in warp variation before and after curing and in warp variation before and after the multilayer disk having said cured product layer is placed under high temperature and high humidity. In addition, with regard to the

ultraviolet-curable resin composition of the present invention, it is possible to form an intermediate resin layer with one liquid without an adhesive layer. Further, by the combination of (A) component and (B) component or/and (C) component, it is possible to properly adjust the viscosity and it is possible to efficiently form an intermediate resin layer for a multilayer disk.

Mode for Carrying Out the Invention

[0018]

The present invention relates to an ultraviolet-curable resin composition for multilayer optical disks which is characterized by containing (i) (A) a (meth)acrylate having an aliphatic chain, (ii) (B) a (meth)acrylate monomer and/or (C) a urethane (meth)acrylate, and (iii) (D) a photopolymerization initiator.

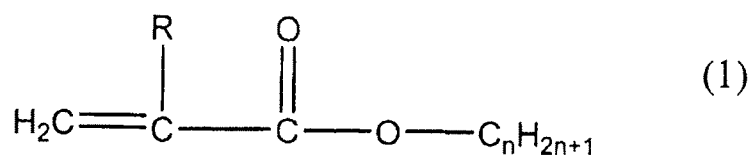
In this regard, in the present invention, the term “(meth)acrylate” is used as meaning either acrylate or methacrylate or meaning the both, in the same manner as usual.

In addition, in the present invention, “%”, “part(s)” or the like means “% by weight” or “part(s) by weight” unless otherwise described. Further, the ultraviolet-curable resin composition of the present invention is also referred as “the resin composition of the present invention” for simplicity.

[0019]

In the resin composition of the present invention, (A) a (meth)acrylate having an aliphatic chain is used as an essential component. The aliphatic chain of the (meth)acrylate having an aliphatic chain is preferably a C10 to C25 aliphatic chain, and more preferably a C10 to C25 alkyl group represented by $-C_nH_{2n+1}$ (n is an integer number of 10 to 25) described in the following formula (1). Therefore, the (meth)acrylate having an aliphatic chain is preferably a (meth)acrylate represented by the following formula (1).

The formula (1)



(Wherein, R is H or CH₃, and n represents an integer number of 10 to 25.)

[0020]

Specific examples thereof include, for example, lauryl (meth)acrylate, stearyl (meth)acrylate, cetyl (meth)acrylate, behenyl (meth)acrylate, isolauryl (meth)acrylate, isostearyl (meth)acrylate, isocetyl (meth)acrylate, isobehenyl (meth)acrylate and the like.

As the aliphatic chain of the (meth)acrylate having an aliphatic chain, a branched chain is more preferable than a straight chain in terms of easy detachment from a stamper, so a (meth)acrylate having a branched aliphatic chain is preferable. More preferably is a (meth)acrylate having a C10 to C25 branched chain. Therefore, among the above-described specific examples, isolauryl (meth)acrylate, isostearyl (meth)acrylate, isocetyl (meth)acrylate or isobehenyl (meth)acrylate is more preferably.

The content of (A) acrylate having an aliphatic chain in the composition is 5 to 90% by weight and preferably about 10 to 80% by weight relative to the total amount (whole) of the resin composition. This content varies depending on (B) or (C) component to be used in combination and cannot be generally suggested, but it is, in some cases, preferably about 5 to 50% by weight, more preferably about 5 to 40% by weight, further preferably about 10 to 40% by weight and most preferably about 10 to 30% by weight.

Commercial products of the (A) (meth)acrylate having an aliphatic chain include for example, BLEMMER SA, BLEMMER CA and BLEMMER VA manufactured by NOF corporation; Isostearyl Acrylate manufactured by Shin-Nakamura Chemical Co., Ltd.; Light Acrylate IS-A, Light Acrylate IM-A and the like manufactured by Kyoeisha Chemical Co., Ltd.

[0021]

In the resin composition of the present invention, (B) a (meth)acrylate monomer is used. As a (meth)acrylate monomer to be used, any can be used without any particular limitation as long as it is a known (meth)acrylate monomer other than (A) component and (C) component. Examples thereof include tricyclodecane (meth)acrylate, benzyl (meth)acrylate, dicyclopentanyl (meth)acrylate, isobornyl (meth)acrylate, adamantyl (meth)acrylate, benzyl (meth)acrylate, tetrahydrofurfuryl (meth)acrylate, morpholine (meth)acrylate, propylene oxide-modified neopentyl glycol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate, hydroxypivalaldehyde-modified trimethylolpropane di(meth)acrylate, hydroxypivalic acid neopentyl glycol di(meth)acrylate and the like.

[0022]

In the combination use with the above (A) component, it is preferred to use at least one kind selected from the group consisting of isobornyl acrylate, propylene oxide-modified neopentyl glycol diacrylate, tricyclodecanedimethylol diacrylate and hydroxypivalaldehyde-modified trimethylolpropane diacrylate as a (meth)acrylate monomer for improvement of detachability and the like.

These allow the resin composition of the present invention to have the low peeling strength and also less warp variation by using in combination with a (meth)acrylate having a branched aliphatic chain as the above (A) component. Among them, isobornyl (meth)acrylate or/and hydroxypivalaldehyde-modified trimethylolpropane diacrylate are more preferably, and further preferable is a combination use of the both.

[0023]

(C) urethane (meth)acrylate to be used in the present invention can be also used instead of the above (B) component to give a resin composition containing (A) component and (C) component as a resin component but not containing (B) component, but usually, said (C) component is used in combination with (B) component.

The urethane (meth)acrylate as (C) component is preferably a compound obtained by reaction of an organic polyisocyanate compound with a hydroxy (meth)acrylate compound.

The organic polyisocyanate includes, for example, diisocyanates such as isophorone diisocyanate, hexamethylene diisocyanate, tolylene diisocyanate, xylene diisocyanate and diphenylmethane-4,4'-diisocyanate, or isocyanates such as dicyclopentanyl isocyanate.

Among them, isophorone diisocyanate or tolylene diisocyanate is more preferable.

The hydroxy (meth)acrylate compound includes, for example, hydroxy-substituted C2 to C10 aliphatic (meth)acrylate, hydroxycaprolactone (meth)acrylate or the like. Preferable is the hydroxy-substituted C2 to C10 aliphatic (meth)acrylate, specifically includes hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate, hydroxybutyl (meth)acrylate, dimethylolcyclohexyl mono(meth)acrylate, pentaerythritol tri(meth)acrylate, dipentaerythritol penta(meth)acrylate and the like.

As a more preferable one among them, hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate, hydroxybutyl (meth)acrylate, pentaerythritol tri(meth)acrylate and the like are included.

Therefore, as a preferable urethane (meth)acrylates, a urethane (meth)acrylate obtained by reaction of the above-described organic polyisocyanate with the above-described hydroxy-substituted C2 to C10 aliphatic (meth)acrylate or hydroxycaprolactone (meth)acrylate can be included. In addition, as a more preferable urethane (meth)acrylate, a urethane (meth)acrylates obtained by reaction of isophorone diisocyanate or tolylene diisocyanate exemplified as the above-described preferable organic polyisocyanate with a compound exemplified as a preferable one of the above-described hydroxy (meth)acrylate can be included.

The reaction is carried out as follows. That is, the organic polyisocyanate is mixed with the hydroxy (meth)acrylate compound so that the hydroxy group is

preferably 1.0 to 2.1 equivalent per 1.0 of the isocyanate group, and the mixture is reacted at 70 to 90°C to obtain the intended urethane (meth)acrylate.

The above-described urethane (meth)acrylates can be used as a mixture of one kind or two kinds or more thereof at an arbitrary ratio.

[0024]

The content of the (B) (meth)acrylate monomer or at least one kind of (C) urethane (meth)acrylate in the resin composition of the present invention is about 5 to 90% and preferably about 10 to 80% as a ratio (by weight) to the total amount of said resin composition. In addition, the preferable range is, in some cases, 50 to 90% and more preferably 60 to 85%.

Further, the content ratio of the total amount of (A) to (C) components relative to the total amount of the resin composition of the present invention can be any as long as it is in the range where the effects of the present Invention are achieved. Usually, in view of viscosity of the resin composition, detachability from a stamper of a cured product layer and light permeability of a cured product layer, and warping and durability of an optical disk having said cured product layer, it is preferred that the total amount of (A) to (C) components to be contained is preferably at least 50% and more preferably at least 70% relative to the total amount of said resin composition. Further preferably, the total amount of (A) to (C) components is 85 to 99% and most preferably 90 to 99% relative to the total amount of said resin composition.

In the above-described cases, as for the ratio of (A) component to the other components ((B) and (C) components), the ratio of the other component (which is the total amount of (B) component or (C) component or the total amount of (B) and (C) in the case of containing the both) is usually about 1 to 20 parts, preferably about 2 to 10 parts and further preferably 3 to 7 parts relative to 1 part of (A) component.

There is usually no problem as long as at least either (B) component or (C) component is contained in said resin composition. Therefore, either one may be 100% and the other may be 0%, relative to the total amount of both the components. Usually, (B) component is 30 to 100%, more preferably 50 to 100% and further

preferably 70 to 100% and (C) component is preferably 0 to 70%, more preferably 0 to 50% and further preferably 0 to 30%, relative to the total amount of both the components.

[0025]

In addition, in the present invention, epoxy (meth)acrylate can be appropriately contained according to necessity. Said epoxy (meth)acrylate can include a compound obtained by reaction of an epoxy resin preferably having 2 or more epoxy groups in the molecule with a monocarboxylic acid compound having an ethylenically unsaturated group (preferably, (meth)acrylic acid). The epoxy resin to be a raw material includes a bisphenol type epoxy compound such as bisphenol A-type epoxy resin, bisphenol F-type epoxy resin, bisphenol S-type epoxy resin and an epoxy compound of 2,2-bis(4-hydroxyphenyl)-1,1,1,3,3,3-hexafluoropropane, a hydrogenated bisphenol type epoxy compound such as hydrogenated bisphenol A-type epoxy resin, hydrogenated bisphenol F-type epoxy resin, hydrogenated bisphenol S-type epoxy resin and an epoxy compound of hydrogenated 2,2-bis(4-hydroxyphenyl)-1,1,1,3,3,3-hexafluoropropane, a halogenated bisphenol type epoxy compound such as brominated bisphenol A-type epoxy resin and brominated bisphenol F-type epoxy resin, an alicyclic diglycidyl ether compound such as EO/PO-modified bisphenol type epoxy resin and a cyclohexanedimethanol diglycidyl ether compound, an aliphatic diglycidyl ether compound such as 1,6-hexanediol diglycidyl ether, 1,4-butanediol diglycidyl ether and diethylene glycol diglycidyl ether, a polysulfide type diglycidyl ether compound such as polysulfide diglycidyl ether, biphenol type epoxy resin, polyether type epoxy resin, and the like.

[0026]

Commercial products of these epoxy compounds include, for example, bisphenol A-type epoxy resin such as jER828, jER1001, jER1002, jER1003 and jER1004 (which are all manufactured by Japan Epoxy Resins Co., Ltd.), Epomic^{RTM} R-140, Epomic^{RTM} R-301 and Epomic R-304 (which are all manufactured by Mitsui Chemical, Inc.), DER-331, DER-332 and DER-324 (which are all manufactured by

The Dow Chemical Company), EPICLON 840 and EPICLON 850 (which are all manufactured by DIC Corporation), UVR-6410 (manufactured by Union Carbide Corporation), and YD-8125 (manufactured by Tohto Kasei Co., Ltd.), bisphenol F-type epoxy resin such as UVR-6490 (manufactured by Union Carbide Corporation), YDF-2001, YDF-2004 and YDF-8170 (which are all manufactured by Tohto Kasei Co., Ltd.), and EPICLON 830 and EPICLON 835 (which are all manufactured by DIC Corporation), hydrogenated bisphenol-A-type epoxy resin such as HBPA-DGE (manufactured by Maruzen Petrochemical Co., Ltd.) and RIKARESIN HBE-100 (manufactured by New Japan Chemical Co., Ltd.), brominated bisphenol-A-type epoxy resin such as DER-513, DER-514 and DER-542 (which are all manufactured by The Dow Chemical Company), PO-modified bisphenol A-type epoxy resin such as Epolite 3002 (manufactured by Kyoeisha Chemical Co., Ltd.), alicyclic epoxy resin such as Celloxide 2021 (manufactured by Daicel Chemical Industries Ltd.), RIKARESIN DME-100 (manufactured by New Japan Chemical Co., Ltd.), and EX-216 (manufactured by Nagase ChemteX Corporation), an aliphatic diglycidyl ether compound such as ED-503 (manufactured by ADEKA Corporation), RIKARESIN W-100 (manufactured by New Japan Chemical Co., Ltd.), EX-212, EX-214 and EX-850 (which are all manufactured by Nagase ChemteX Corporation), a polysulfide type diglycidyl ether compound such as FLEP-50 and FLEP-60 (which are all manufactured by Toray Thiokol Co., Ltd.), a biphenol type epoxy compound such as YX-4000 (manufactured by Japan Epoxy Resins Co., Ltd.), and a polyether type epoxy compound such as Epolite^{RTM} 100E and Epolite^{RTM} 200P (which are all manufactured by Kyoeisha Chemical Co., Ltd.).

In this regard, the superscript RTM represents a registered trademark (as is the same hereinafter).

[0027]

(D) photopolymerization initiator contained in the resin composition of the present invention includes 1-hydroxycyclohexylphenyl ketone (IRGACURE^{RTM} 184; manufactured by CIBA Speciality Chemicals),

1-[4-(2-hydroxyethoxy)-phenyl]-2-hydroxy-2-methyl-1-propan-1-one (IRGACURE^{RTM} 2959; manufactured by CIBA Speciality Chemicals), 2-hydroxy-1-{4-[4-(2-hydroxy-2-methyl-propionyl)-benzyl]-phenyl }-2-methyl-propan-1-one (IRGACURE^{RTM} 127; manufactured by CIBA Speciality Chemicals), 2,2-dimethoxy-2-phenylacetophenone (IRGACURE^{RTM} 651; manufactured by CIBA Speciality Chemicals), oligo [2-hydroxy-2-methyl-1-[4-(1-methylvinyl)phenyl]propanone] (Esacure ONE; manufactured by Lamberti), 2-hydroxy-2-methyl-1-phenyl-propan-1-one (DAROCUR^{RTM} 1173; manufactured by CIBA Speciality Chemicals), 2-methyl-1-[4-(methylthio)phenyl]-2-morpholinopropan-1-one (IRGACURE^{RTM} 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 (Lucirin TPO: manufactured by BASF), bis (2,4,6-trimethylbenzoyl)-phenyl phosphine oxide (IRGACURE^{RTM} 819; manufactured by CIBA Speciality Chemicals), bis(2,6-dimethoxy benzoyl)-2,4,4-trimethylpentylphosphineoxide and the like.

[0028]

These photopolymerization initiators can be used alone or as a mixture of a plurality thereof at an arbitrarily ratio, and also can be used in combination with a photopolymerization initiating auxiliary agent such as amines.

The content of (D) photopolymerization initiator to be used in the resin composition of the present invention is 1 to 15% by weight and preferably about 3 to 10% by weight.

The photopolymerization initiating auxiliary agent such as amines which can be used in the present invention includes, for example, diethanolamine, 2-dimethylaminoethylbenzoate, dimethylaminoacetophenone, p-dimethylaminobenzoic acid ethylester, p-dimethylaminobenzoic acid isoamylester and the like.

The content of the photopolymerization initiating auxiliary agent in the resin composition of the present invention is about 0 to 5% and more preferably about 0 to 3%. When using photopolymerization initiating auxiliaries in combination, it is preferably 0.05 to 5% by weight and particularly preferably about 0.1 to 3% by weight. Usually, it is unnecessary to use a photopolymerization initiating auxiliary agent in combination.

[0029]

In the resin composition of the present invention, phosphoric acid (meth)acrylate can be added if necessary. Phosphoric acid (meth)acrylate improves adhesiveness between aluminum, silver or a silver alloy and an adhesive cured product but possibly corrodes a metal film, whereby its use amount is limited. In addition, there is no problem if it is not contained.

[0030]

Further, in the present invention, in addition to the above-described components, an additive such as a silane coupling agent, a leveling agent, an antifoaming agent, a polymerization inhibitor, a light stabilizer (such as hindered amine-based), an antioxidant, an antistatic agent, a surface lubricant and a filler may be used in combination if necessary. As an example of such an additive, for example, the silane coupling agent includes KBM-502, KBM-503, KBM-5103, KBM-802 and KBM-803 manufactured by Shin-Etsu Chemical Co., Ltd.; and Z-6062, SH-6062 and SH-29PA manufactured by Toray Dow Corning Corporation, the leveling agent includes BYK-333, BYK-307, BYK-3500, BYK-3530 and BYK-3570 manufactured by BYK Japan KK, and the antioxidant includes LA-82 manufactured by ADEKA Corporation, and the like.

These additives may be contained in an amount of usually 0 to 10% and preferably about 0 to 5% relatively the total amount of the resin composition of the present invention. Usually, there is no problem if no additive is contained.

[0031]

The resin composition of the present invention can be obtained after the above

components are dissolved by mixing at ordinary temperature to 80°C, followed by filtration if necessary.

The viscosity of the resin composition of the present invention, by measurement using a B-type viscometer at 25°C, is 10 to 800 mPa·s, preferably 30 to 500 mPa·s, more preferably 30 to 400 mPa·s and further preferably 50 to 300 mPa·s.

As an example of the resin composition of the present invention, an ultraviolet-curable resin composition can be included in which (A) component is 5 to 90% by weight, (B) component and/or (C) component is 5 to 90% by weight and (D) component is 1 to 15% by weight relative to the whole resin composition, and the total amount of (A) to (D) is 100%.

[0032]

As a preferable composition example in the preferable resin composition of the present invention, the below-described resin compositions can be included.

(I)

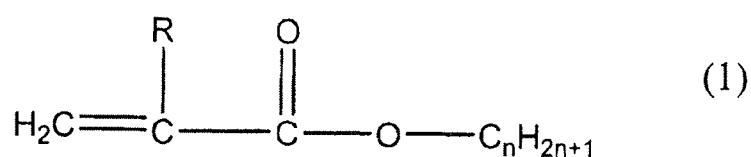
A resin composition wherein (i) (A) component is 5 to 90% by weight, (ii) (B) component or (C) component or the total of both (B) and (C) is 5 to 90% by weight and the total amount of (A) to (C) components is 85 to 99% by weight and (iii) (D) component is 1 to 15% by weight, relative to the total amount of the resin composition.

(II)

As a more preferable example of the resin compositions, a resin composition wherein (i) (A) component is 10 to 40% by weight, (ii) (B) component or (C) component or the total of both (B) and (C) is 50 to 90% by weight and the total amount of (A) to (C) components is 90 to 99% by weight, and (iii) (D) component is 1 to 10% by weight.

(III)

The resin composition according to the above-described (I) or (II), wherein (A) component is a (meth)acrylate having an aliphatic chain represented by the following formula (1):



wherein, R is H or CH₃ and n represents an integer number of 10 to 25.

[0033]

(IV)

The resin composition according to the above-described (III), wherein (A) component is a C10 to C25 alkyl (meth)acrylate having a branched chain.

(V)

The resin composition according to the above-described (IV), wherein the C10 to C25 alkyl (meth)acrylate having a branched chain is at least one kind selected from the group consisting of isodecyl acrylate, isolauryl (meth)acrylate, isostearyl (meth)acrylate, isocetyl (meth)acrylate and isobehenyl (meth)acrylate.

(VI)

The resin composition according to the above-described (IV), wherein the C10 to C25 alkyl (meth)acrylate having a branched chain is at least one kind selected from the group consisting of isodecyl acrylate, isostearyl (meth)acrylate and isocetyl (meth)acrylate.

(VII)

The resin composition according to the above-described (IV), wherein the C10 to C25 alkyl (meth)acrylate having a branched chain is isostearyl (meth)acrylate.

(VIII)

The resin composition according to any one of the above-described (I) to (VII), wherein (B) component is at least one kind of (meth)acrylate monomer selected from the group consisting of isobornyl (meth)acrylate, propylene oxide-modified neopentyl glycol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate and hydroxypivalaldehyde-modified trimethylolpropane di(meth)acrylate.

[0034]

(IX)

The resin composition according to the above-described (VIII), wherein (B) component is either isobornyl (meth)acrylate or hydroxypivalaldehyde-modified trimethylolpropane di(meth)acrylate.

(X)

The resin composition according to any one of the above-described (I) to (IX), wherein (C) component is urethane (meth)acrylate obtained by reaction organic polyisocyanate with a hydroxy (meth)acrylate compound.

(XI)

The resin composition according to the above-described (X), wherein the hydroxy (meth)acrylate compound is a hydroxy-substituted C2 to C10 aliphatic (meth)acrylate.

(XII)

The resin composition according to any one of the above-described (I) to (XI), wherein (B) component is contained in an amount of 50 to 90% relative to the total amount of the resin composition.

(XIII)

The resin composition according to any one of the above-described (I) to (XII), wherein the content of (C) component is 0 to 50% relative to the total amount of (B) component and (C) component.

[0035]

The resin composition of the present invention is suitable for a resin composition for a transparent intermediate layer of a multilayer optical disk.

In the case of DVD, a transparent resin intermediate layer is formed (1) by coating the resin composition of the present invention at least either on a substrate where a first transparent resin substrate, a first recording layer and a first translucent reflection film layer are laminated or on a transparent resin stamper by a method such as spin coating method, screen printing method and roll coating method, followed by lamination and irradiation with ultraviolet rays from the transparent resin stamper side.

Or it can be also formed (2) by coating the resin composition of the present invention on a transparent resin stamper by the above method, followed by ultraviolet curing and then laminating with a substrate where a first transparent resin substrate, a first recording layer and a first translucent reflection film layer are laminated, using an arbitrarily ultraviolet-curable resin. The forming method (1) is preferable due to potential reduction in production cost because the production process can be shortened. Also in the case of Blu-ray disc, a transparent resin intermediate layer is formed in the same manner as that for DVD. Generally, polycarbonate resin is used for a 0.6 mm first transparent resin substrate of DVD or HD-DVD and for a 1.1 mm resin substrate of Blu-ray disc.

[0036]

The transparent resin stamper includes, for example, stampers of acrylic-based resin, methacryl-based resin, polycarbonate resin, polyolefin-based resin (particularly amorphous polyolefin), polyester-based resin, polystyrene resin, epoxy resin and the like. Among them, amorphous polyolefin is preferable in terms of detachability after curing a 2P agent, low moisture absorbency, shape stability and the like, and polycarbonate resin is preferable in terms of material cost. The 2P curing-type resin composition of the present invention can be used for both transparent resin stampers.

The ultraviolet-curable resin composition of the present invention gives a cured product by irradiation of active energy rays. Said active energy ray includes, for example, ultraviolet to near ultraviolet light rays. The light source of said light ray includes, for example, a low pressure, high pressure or ultrahigh pressure mercury lamp, a metal halide lamp, a (pulse) xenon lamp, an electrodeless lamp, an ultraviolet light-emitting diode and the like. The above cured product is encompassed within the present invention.

[0037]

In the recording layer formed on the transparent resin intermediate layer of the above cured product, any of an organic coloring matter and a phase change material can be used. For example, the organic coloring matter includes metal-containing

azo-based, polymethine-based and phthalocyanine-based ones, and the phase change material includes one where any one or more kinds of In, Ag, Au, Bi, Se, Al, P, Ge, Si, C, V, W, Ta, Zn, Ti, Ce, Tb, Sn and Pb are added to Sb and Te.

In addition, the resin composition of the present invention can be used in any of the optical disk and the Blu-ray disc having a structure where a polycarbonate substrate is laminated.

[0038]

The coating method includes, for example, spin coating method, 2P method, roll coating method, screen printing method and the like.

[0039]

In addition, an around 400 nm blue laser is used for reading and/or writing in a next-generation high-density optical disk, whereby the transmittance ratio at 405 nm in a cured product having a film thickness of 90 to 100 μm and preferably 100 μm is preferably 80% or more and more preferably 90% or more.

The transmittance ratio can be determined by making a 100 μm film and measuring an absorbance value at 405 nm of said film using a spectrophotometer (U-3310, manufactured by Hitachi High-Technologies Corporation).

Examples

[0040]

Hereinafter, the present invention will be more specifically explained with reference to Examples.

In this regard, each viscosity value described in Table 1 is a value measured by a B-type viscometer at 25°C. In addition, each transmittance ratio value described in Table 1 is a value measured with a spectrophotometer (product number: U-3310, manufactured by Hitachi High-Technologies Corporation) after making a cured film having a thickness of 100 μm .

Examples and Test Examples

With regard to each resin composition of Examples 1 to 6 and Comparative

Examples 1 to 4, the constitutional material, the use amount and the evaluation result in each described item are shown in Table 1. In this regard, “part(s)” in the description means “part(s) by weight”.

[0041]

[Table 1]

Table 1. Resin composition and evaluation result

	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comp. Ex. 1	Comp. Ex. 2	Comp. Ex. 3	Comp. Ex. 4
Component (A) (Part(s))										
I S A	16					16				
I C A		16								
I D A			16							
S A				16						
C A					16					
Component (B) (Part(s))										
IBA			39							
R-604	79	63	40	40	40	63	79	79	79	79
R-684				39						
NPG-2P					39					
FA-512A							16			
THE-330								16		
RP-1040									16	
DPHA										16
Component (C) (Part(s))										
U X-5000		16								
C 1						16				
Component (D) (Part(s))										
IRGACURE 184D	5	5	5	5	5	5	5	5	5	5
(Detachability)										
Detachment strength (kgf)	0.9	0.8	0.7	1.3	1.2	0.7	2.0	2.6	2.4	1.3
Detachability judgment	○	○	○	○	○	○	×	×	×	○
(Warp)										
Warp variation when curing (degree)	-0.08	-0.09	-0.08	-0.06	-0.06	-0.08	-0.09	-0.15	-0.18	-0.36
Warp judgment	○	○	○	○	○	○	○	×	×	×
(Durability test / Warp)										
Warp variation after durability test	-0.45	-0.49	-0.34	-0.29	-0.27	-0.41	-0.50	-0.66	-0.82	-1.21
Warp judgment	○	○	○	○	○	○	×	×	×	×

Comp. Ex.: Comparative Example

[0042]

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

ISA: isostearyl acrylate, manufactured by Shin-Nakamura Chemical Co., Ltd.

ICA: isocetyl acrylate, manufactured by Kyoeisha Chemical Co., Ltd.

IDA: isodecyl acrylate, manufactured by Kyoeisha Chemical Co., Ltd.

SA: stearyl acrylate, manufactured by NOF corporation.

CA: cetyl acrylate, manufactured by NOF corporation.

IBA: isobornyl acrylate, manufactured by Osaka Organic Chemical Industry Ltd.

R-604: hydroxypivalaldehyde-modified trimethylolpropane diacrylate, manufactured by Nippon Kayaku Co., Ltd.

R-684: tricyclodecanedimethylol diacrylate, manufactured by Nippon Kayaku Co., Ltd.

NPG-2P: propylene oxide-modified neopentyl glycol diacrylate, manufactured by Dai-ichi Kogyo Seiyaku Co., Ltd.

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

THE-330: hydroxypivalaldehyde-modified trimethylolpropane acrylate, manufactured by Nippon Kayaku Co., Ltd.

RP-1040: pentaerythritol ethylene oxide-modified tetraacrylate, manufactured by Nippon Kayaku Co., Ltd.

DPHA: dipentaerythritol hexane acrylate, manufactured by Nippon Kayaku Co., Ltd.

UX-5000: 6 functional urethane acrylate, manufactured by Nippon Kayaku Co., Ltd.

IRGACURE^{RTM} 184: 1-hydroxycyclohexylphenyl ketone, manufactured by CIBA Speciality Chemicals.

C1: urethane acrylate obtained by reaction isophorone diisocyanate with hydroxyethyl acrylate at a molar ratio of 1:2.

[0043]

(Production of a sample for evaluation)

Using each obtained ultraviolet-curable resin composition, a sample disk for evaluation was made by the method according to the following 1 to 3.

1. A polycarbonate stamper was mounted on a transparent resin made on the inner periphery of a polycarbonate substrate (a first substrate) having a diameter 120 mm / thickness 0.6 mm where an azo-based coloring matter layer as a recording layer, a reflective film layer and a ZnS·SiO₂ layer as a dielectric layer had been formed, without having any bubbles in, followed by spin coating at 2000 rpm for 4 seconds to laminate.
2. By 400 mJ/cm² irradiation from the side of the polycarbonate stamper with a high pressure mercury lamp (80 W/cm), the second ultraviolet-curable resin composition was cured.
3. Using a disk detachment apparatus (manufactured by Origin Electric Co. Ltd.), said polycarbonate stamper (transparent resin stamper) was detached to make a sample disk for evaluation.

[0044]

(a) Detachability Test

Using a disk detachment apparatus (manufactured by Origin Electric Co. Ltd.), the test was conducted by measuring the strength of detachment from the polycarbonate stamper when making a sample disk (diameter 120 mm: radius 60 mm) for the above-described evaluation, with a measuring equipment (FGC-5B, manufactured by Nidec-Shimpo Corporation).

Judgment of good detachment was conducted according to the following criteria.

○···1.5 kgf or less of detachment strength.

×···1.5 kgf or more of detachment strength.

[0045]

(b) Warp Test

The warp numerical value of each resin layer was measured using MT-146 (manufactured by Dr. Schenk) which is an apparatus for measuring mechanical

properties of an optical disk after coating each resin composition on the inner periphery of a polycarbonate substrate (a first substrate) having a diameter 120 mm/thickness 0.6 mm where an azo-based coloring matter layer as a recording layer, a reflective film layer and a dielectric layer as a $\text{ZnS} \cdot \text{SiO}_2$ layer had been formed, by a spin coater so that the film thickness was $10 \pm 3 \mu\text{m}$ after curing. The warp value is larger on the more outer periphery, so evaluation was conducted on a warp value (angle) at 56 mm from the center of the disk which is near the most outer periphery.

The initial warp was calculated from the below (Mathematical Formula 1).

(Mathematical Formula 1): Warp variation (degree) when curing = warp (degree) of disk after coating and curing of ultraviolet-curable resin composition - warp (degree) of disk before coating of ultraviolet-curable resin composition

The warp is shown in a unit of degree.

○···The warp variation when curing is less than ± 0.1 degree.

×···The warp variation when curing is ± 0.1 degree or more.

[0046]

(c) Durability Test

In durability test, the sample disk made in the process of the warp test was left under the conditions of a high temperature and a high humidity of 80°C and 85% for 96 hours and further stored for 24 hours at room temperature, after which the warp angle was compared with the warp angle before the test (before leaving under high temperature and high humidity), followed by calculation of the variation of the warp angle. The warp value is larger on the more outer periphery, so evaluation was conducted on a warp value (angle) at 56 mm from the center of the disk which is near the most outer periphery. In this regard, MT-146 manufactured by (Dr. Schenk) which is an apparatus for measuring mechanical properties of an optical disk was used in the measurement.

The variation (degree) between the warp after durability test and the initial warp was calculated from the below (Mathematical Formula 2).

(Mathematical Formula 2): Warp variation after durability test = warp (degree) of disk

after durability test - warp (degree) of disk before test

○··· The warp variation after durability test is less than ± 0.5 degree.

×··· The warp variation after durability test is ± 0.5 degree or more.

[0047]

As is clear from Table 1, Examples 1 to 6 as the ultraviolet-curable resin compositions of the present invention and cured products thereof have less warp variation even after leaving under high temperature and high humidity (after durability test), compared with Comparative Examples 1 to 4 not using a (meth)acrylate having an aliphatic chain. In addition, Comparative Example 2 and Comparative Example 3 using a plurality of polyfunctional acrylate monomers have a high detachment strength and a low detachability, and Comparative Example 4 has a high detachability but a large warp variation after durability test as described above and a larger warp when curing as described below.

That is, with regard to warp variation when curing, the ultraviolet-curable resin compositions of the present invention have 0.08 to 0.09 degrees thereof, which are much smaller variations. Comparative Example 1 has an equal variation of warp when curing but a low detachability from a resin stamper and also a larger warp variation after durability test. Comparative Example 2, Comparative Example 3 and Comparative Example 4 have 0.15 to 0.36 degrees of warp variation when curing, which are relatively larger variations.

In addition, with regard to viscosity, the ultraviolet-curable resin compositions of the present invention have a viscosity within the range of 30 to 500 mPa·s, which is a viscosity suitable for forming a resin layer. Further, the cured products thereof have a light transmittance ratio of over 90% and thus they are excellent in terms of light permeability.

As is clear from the above, the ultraviolet-curable resin composition of the present invention is suitable for directly forming a transparent resin layer (intermediate resin layer) having a bump pattern made with a stamper, particularly a polycarbonate stamper on a reflecting layer or a dielectric layer on a disk substrate,

and it is a resin composition very useful for uniformly forming a recording layer and a reflective film layer on said bump pattern.

Industrial Applicability

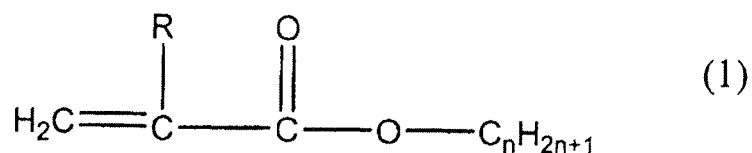
[0048]

The ultraviolet-curable resin composition of the present invention and a cured product thereof is excellent in detachability from a resin stamper and useful as a 2P agent having less warp variation when curing and after leaving a multilayer disk under high temperature and high humidity. In addition, it can provide an ultraviolet-curable resin which allows to omit an adhesive layer and form an intermediate resin layer with one liquid thereof.

Claims

1. An ultraviolet-curable resin composition for a multilayer optical disk, characterized by containing (A) a (meth)acrylate having an aliphatic chain, (B) a (meth)acrylate monomer and/or (C) a urethane (meth)acrylate, and (D) a photopolymerization initiator.
2. The ultraviolet-curable resin composition for a multilayer optical disk according to Claim 1, wherein the (A) (meth)acrylate having an aliphatic chain is one kind or two kinds or more selected from the group consisting of lauryl (meth)acrylate, stearyl (meth)acrylate, cetyl (meth)acrylate, behenyl (meth)acrylate, isolauryl (meth)acrylate, isostearyl (meth)acrylate, isocetyl (meth)acrylate and isobehenyl (meth)acrylate.
3. The ultraviolet-curable resin composition for a multilayer optical disk according to Claim 1, wherein the (B) (meth)acrylate monomer is one kind or two kinds or more selected from the group consisting of isobornyl (meth)acrylate, propylene oxide-modified neopentyl glycol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate and hydroxypivalaldehyde-modified trimethylolpropane di(meth)acrylate.
4. The ultraviolet-curable resin composition for a multilayer optical disk according to any one of Claims 1 to 3, wherein (A) component is 5 to 90% by weight, (B) component and/or (C) component is 5 to 90% by weight and (D) component is 1 to 15% by weight, relative to the whole resin composition.
5. An optical disk having a cured product obtained by irradiating the resin composition according to Claim 1 with ultraviolet rays.
6. An ultraviolet-curable resin composition containing:
 - (A) a (meth)acrylate having an aliphatic chain represented by the following formula

(1):



wherein, R represents H or CH₃ and n represents an integer number of 10 to 25,
and

(B) at least one kind of (meth)acrylate monomer selected from the group consisting of isobornyl (meth)acrylate, propylene oxide-modified neopentyl glycol di(meth)acrylate, tricyclodecanedimethylol di(meth)acrylate and hydroxypivalaldehyde-modified trimethylolpropane di(meth)acrylate, or

(C) a urethane (meth)acrylate obtained by reaction of organic polyisocyanate with a hydroxy (meth)acrylate compound,

and

(D) a photopolymerization initiator,

wherein

(i) (A) component is 5 to 90% by weight,

(ii) (B) component or (C) component or the total of both (B) and (C) is 5 to 90% by weight, and the total amount of (A) to (C) components is 85 to 99% by weight, and

(iii) (D) component is 1 to 15% by weight

relative to the total amount of the resin composition.

7. The ultraviolet-curable resin composition according to Claim 6, wherein the aliphatic chain of the (meth)acrylate having an aliphatic chain is an aliphatic chain having a branched chain.

8. The ultraviolet-curable resin composition according to Claim 7, wherein the (meth)acrylate having an aliphatic chain is at least one kind selected from the group consisting of isodecyl acrylate, isolauryl (meth)acrylate, isostearyl (meth)acrylate,

isocetyl (meth)acrylate and isobehenyl (meth)acrylate.

9. The ultraviolet-curable resin composition according to Claim 6, the organic polyisocyanate is at least one kind of diisocyanate selected from the group consisting of isophorone diisocyanate, hexamethylene diisocyanate, tolylene diisocyanate, xylene diisocyanate and diphenylmethane-4,4'-diisocyanate, or dicyclopentanyl isocyanate.

10. The ultraviolet-curable resin composition according to Claim 6, wherein the hydroxy (meth)acrylate compound is a hydroxy-substituted C2 to C10 aliphatic (meth)acrylate.

11. Use of the ultraviolet-curable resin composition according to Claim 6, for an intermediate resin layer of a multilayer disk.

12. A multilayer disk having a cured product layer of the ultraviolet-curable resin composition according to Claim 6.