

DESCRIPTION

TITLE OF THE INVENTION: OPTICAL FILM FOR ORGANIC EL DISPLAY DEVICES, POLARIZING FILM FOR ORGANIC EL DISPLAY DEVICES, PRESSURE-SENSITIVE-ADHESIVE LAYER ATTACHED POLARIZING FILM FOR ORGANIC EL DISPLAY DEVICES, AND ORGANIC EL DISPLAY DEVICE

TECHNICAL FIELD

[0001]

The present invention relates to an optical film for organic EL display devices. The invention also relates to a polarizing film for organic EL display devices that includes a polarizer and the optical film for organic EL display devices; and further to a pressure-sensitive-adhesive layer attached polarizing film for organic EL display devices that is yielded by laying a pressure-sensitive-adhesive layer further to the polarizing film for organic EL display devices. The invention also relates to an organic EL display device, using the polarizing film for organic EL display devices or the pressure-sensitive-adhesive layer attached polarizing film for organic EL display devices.

BACKGROUND ART

[0002]

In recent years, organic EL (electro luminescence) display devices (OLEDs) in each of which an organic EL panel is mounted have come to be widely used for various articles such as portable telephones, car navigation systems, monitors for personal computers, and televisions. In organic EL display devices, a circularly polarizing plate is arranged on a viewing side surface of their organic EL panel in order to restrain the surface from being viewed like a mirror plane in the state that external light is reflected on their metal electrode (negative electrode). The circularly polarizing plate, and other constituent members for organic EL display devices are usually laminated onto each other through a joining material for a pressure-sensitive-adhesive layer, an adhesive layer or the like.

[0003]

The above-mentioned circularly polarizing plate is in general a laminate composed of a polarizing plate and a $\lambda/4$ plate. For example, the following is known: a laminate yielded by laminating two retardation layers each having a specified refractive index property onto a polarizer (see, for example, Patent Document 1).

[0004]

An organic EL element mounted on an organic EL display device as described above is very weak against

water and oxygen in the atmospheric air. Thus, on the front surface of its organic EL panel, a barrier layer or an optical film having a barrier function is usually laid. Moreover, water and others are required not to permeate the optical film included in the organic EL display device, pressure-sensitive-adhesive layers for bonding these films to each other, or the like (low-moisture-permeability).

[0005]

In recent years, attention has been paid, particularly, to a flexible organic EL display device as a bendable display device. In the flexible organic EL display device, as its outermost layer, not a glass piece but a film is used. As described above, however, any organic EL element is very weak against water and oxygen in the atmospheric air. Thus, when its outermost layer is changed from glass very good in low-moisture-permeability to a film, it is feared that the organic EL element is damaged. Accordingly, an optical film or pressure-sensitive-adhesive layer used in the flexible organic EL display device is required to be higher in low-moisture-permeability.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0006]

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007]

Patent Document 1 provides a retardation-layer attached polarizing plate for restraining its viewing angle property and display property from being changed, and never investigates the matter that low-moisture-permeability is given to its optical films such as its retardation film.

[0008]

It is supposed that the method for giving low-moisture-permeability to an optical film is, for example, a method of vapor-depositing a barrier layer onto a retardation film ($\lambda/4$ plate) constituting a circularly polarizing plate (anti-reflection film) used in an organic EL display device. However, in the method of vapor-depositing a barrier layer onto a retardation film, a sufficient advantage is not gained from the viewpoint of costs. Furthermore, when the barrier layer is vapor-deposited onto the retardation film, heat is given to the retardation film so that the retardation film may be broken or the retardation value thereof may be changed. Thus, this method is insufficient.

[0009]

Thus, an object of the present invention is to provide an optical film for organic EL display devices which has more excellent low-moisture-permeability without forming any barrier layer made of an inorganic substance formed by, for example, vapor deposition. Another object of the invention is to provide a polarizing film for organic EL display devices that includes a polarizer and the optical film for organic EL display devices; and a pressure-sensitive-adhesive layer attached polarizing film for organic EL display devices that has the polarizing film for organic EL display devices, and a pressure-sensitive-adhesive layer. Still another object of the invention is to provide an organic EL display device using the polarizing film for organic EL display devices, or the pressure-sensitive-adhesive layer attached polarizing film for organic EL display devices.

MEANS FOR SOLVING THE PROBLEMS

[0010]

In order to solve the above-mentioned problems, the inventors have repeatedly made eager investigations to find out an optical film for an organic EL display device described below, and then have achieved the present invention.

[0011]

The present invention relates to an optical film for organic EL display devices, comprising a retardation film functioning as a $\lambda/4$ plate, and a pressure-sensitive-adhesive/adhesive layer having a moisture permeability of 50 g/(m²·day) or less at 40°C, and 92% R.H..

[0012]

In the optical film of the invention for organic EL display devices, the pressure-sensitive-adhesive/adhesive layer is preferably made from a rubber-based pressure-sensitive-adhesive composition comprising polyisobutylene, and hydrogen-abstraction type photopolymerization initiator.

[0013]

The present invention also relates to a polarizing film for organic EL display devices, comprising a polarizer, and the optical film of the invention for organic EL display devices.

[0014]

In the polarizing film of the invention for organic EL display devices, the polarizer preferably has a thickness of 15 μm or less.

[0015]

The polarizing film of the invention for organic EL display devices may comprise the polarizer, the retardation film functioning as the $\lambda/4$ plate, and the pressure-

sensitive-adhesive/adhesive layer, the moisture permeability of which is 50 g/(m²•day) or less at 40°C, and 92% R.H., in this order. The polarizing film of the invention for organic EL display devices may comprise the polarizer, the pressure-sensitive-adhesive/adhesive layer, the moisture permeability of which is 50 g/(m²•day) or less at 40°C, and 92% R.H., and the retardation film functioning as the $\lambda/4$ plate in this order.

[0016]

The present invention also relates to a pressure-sensitive-adhesive layer attached polarizing film for organic EL display devices, comprising the polarizing film of the invention for organic EL display devices, and a pressure-sensitive-adhesive layer on a polarizer side of the polarizing film for organic EL display devices.

[0017]

The present invention further relates to an organic EL display device, comprising the polarizing film of the invention for organic EL display devices, or the pressure-sensitive-adhesive layer attached polarizing film of the invention for organic EL display devices.

EFFECT OF THE INVENTION

[0018]

The optical film of the present invention for organic

EL display devices has a retardation film, and a pressure-sensitive-adhesive/adhesive layer having specified moisture permeability. This structure makes it possible to express a very good low-moisture-permeability without forming any barrier layer made of an inorganic substance formed by, for example, vapor deposition. Together with a polarizer, the optical film of the invention for organic EL display devices can form an anti-reflection film of an organic EL display device (polarizing film for organic EL display devices). Moreover, the optical film of the invention for organic EL display devices is favorable from the viewpoint of costs.

[0019]

Additionally, the present invention can provide a polarizing film, for organic EL display devices, and a pressure-sensitive-adhesive layer attached polarizing film, for organic EL display devices, that are each very good in low-moisture-permeability.

[0020]

Furthermore, the present invention can provide an organic EL display device very good in optical reliability by use of the polarizing film for organic EL display devices, or the pressure-sensitive-adhesive layer attached polarizing film for organic EL display devices which further includes a pressure-sensitive-adhesive layer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a sectional view that schematically illustrates an embodiment of the optical film of the present invention for organic EL display devices.

Fig. 2 is a sectional view that schematically illustrates an embodiment of the optical film of the invention for organic EL display devices.

Fig. 3(a) is a sectional view that schematically illustrates an embodiment of the polarizing film of the invention for organic EL display devices. Fig. 3(b) is a sectional view that schematically illustrates an embodiment of the polarizing film of the invention for organic EL display devices.

Fig. 4 is a sectional view that schematically illustrates an embodiment of the pressure-sensitive-adhesive layer attached polarizing film of the invention for organic EL display devices.

MODE FOR CARRYING OUT THE INVENTION

[0022]

1. Optical Film for Organic EL Display Devices

The optical film of the present invention for organic EL display devices includes a retardation film functioning

as a $\lambda/4$ plate, and a pressure-sensitive-adhesive/adhesive layer having a moisture permeability of 50 g/(m²•day) or less at 40°C, and 92% R.H..

[0023]

As illustrated in Fig. 1, an optical film 1 of the present invention for organic EL display devices has a pressure-sensitive-adhesive/adhesive layer 2 on at least one surface of a retardation film 3a functioning as a $\lambda/4$ plate. In Fig. 1, an embodiment has been disclosed which has the pressure-sensitive-adhesive/adhesive layer 2 on only the one surface of the retardation film 3a. However, the optical film of the invention may have the pressure-sensitive-adhesive layer 2 on each of the two surfaces of the retardation film 3a. In Fig. 1, an embodiment has been illustrated in which the individual constituent elements are laminated onto each other to contact each other. However, the invention is not limited to such an embodiment. Thus, a different layer may be included between the individual layers. In each of Figs. 2 to 4, the same matter is true.

[0024]

As illustrated in Fig. 2, an optical film 1 of the present invention for organic EL display devices may include a second retardation film 3b in addition to the retardation film 3a (referred to also as a first

retardation film) functioning as a $\lambda/4$ plate.

Specifically, this optical film is composed of (the retardation film 3a functioning as a $\lambda/4$ plate)/an adhesive layer or pressure-sensitive-adhesive layer 4/the second retardation film 3b/a pressure-sensitive-adhesive/adhesive layer 2.

[0025]

The moisture permeability of the optical film for organic EL display devices is preferably 50 g/(m²•day) or less, more preferably 30 g/(m²•day) or less, even more preferably 20 g/(m²•day) or less, in particular preferably 15 g/(m²•day) or less. The lower limit value of the moisture permeability is not particularly limited. Ideally, it is preferred that the optical film never permeates water vapor (in other words, the moisture permeability is 0 g/(m²•day)). In a case where the moisture permeability of the optical film for organic EL display devices is in any one of the ranges, at the time of applying this optical film for organic EL display devices to an organic EL element the shift of water into the organic EL element can be restrained. As a result, the organic EL element can be favorably restrained from being deteriorated or damaged into any other form by water. The method for measuring the moisture permeability is measurable according to a method described in the item

EXAMPLES in the present document.

[0026]

Hereinafter, a description will be made about the individual constituent elements which constitute the optical film 1 of the present invention for organic EL display devices.

[0027]

(1) Retardation Film

(1-1) Retardation Film Functioning as $\lambda/4$ Plate

The retardation film 3a used in the present invention is a film which can function as a $\lambda/4$ plate. About this retardation film 3a, the in-plane retardation $R_e(550)$, which is measured using a light ray having a wavelength of 550 nm at 23°C, is preferably from 100 to 180 nm, more preferably from 110 to 170 nm, even more preferably from 120 to 160 nm, in particular preferably from 135 to 155 nm. The in-plane retardation R_e can be gained by the following:

$$R_e = (n_x - n_y) \times d$$

wherein "d" is the thickness (nm) of the film.

[0028]

The retardation film 3a typically has a refractive index ellipse of $n_x > n_y = n_z$ or $n_x > n_y > n_z$. The symbol n_x is the refractive index of the film in a direction in which the in-plane retardation is the largest (that is, a slow axis direction of the film); n_y is the refractive

index in an in-plane direction orthogonal to the slow axis direction of the film (that is, a fast axis direction thereof); and n_z is the refractive index in a thickness direction of the film. In the document DESCRIPTION, the case of $n_y = n_z$ includes not only a case where n_y is strictly equal to n_z but also a case where n_y is substantially equal to n_z .

[0029]

The N_z coefficient of the retardation film 3a is, for example, preferably from 0.9 to 2, more preferably from 1 to 1.5, more preferably from 1 to 1.3. The N_z coefficient is gained by the following: $N_z = R_{th}/R_e$. The symbol R_{th} is the retardation of the film in the thickness direction thereof, and is gained by the following: $R_{th} = (n_x - n_z) \times d$ wherein "d" is the thickness (nm) of the film.

[0030]

The thickness of the retardation film 3a can be appropriately set to give a desired in-plane retardation. The thickness is not particularly limited, and is, for example, preferably from 10 to 80 μm , more preferably from 10 to 60 μm , even more preferably from 30 to 55

[0031]

The retardation film 3a may show reverse wavelength dispersive property, by which the retardation value becomes larger as the wavelength of a light ray for the measurement

becomes larger, or normal wavelength dispersive property, by which the retardation value becomes smaller as the wavelength of a light ray for the measurement becomes larger. The film may show flat wavelength dispersive property, by which the retardation value is hardly changed as the wavelength of a light ray for the measurement is changed. The film is preferably a film showing flat wavelength dispersive property. By adopting a $\lambda/4$ plate having flat wavelength dispersive property, the optical film for organic EL display devices can realize a very good anti-reflection property and a reflective hue in an oblique direction thereof. The $\text{Re}(450)/\text{Re}(550)$ of the retardation film 3a is preferably from 0.85 to 1.03, and the $\text{Re}(650)/\text{Re}(550)$ is preferably from 0.98 to 1.02. $\text{Re}(\lambda)$ is the in-plane retardation of the film that is measured at 23°C, using a light ray having a wavelength of λ nm. For example, $\text{Re}(450)$ is the in-plane retardation of the film that is measured at 23°C, using a light ray having a wavelength of 450 nm.

[0032]

The retardation film 3a can be constituted by any appropriate resin film that can satisfy optical properties as described above. A resin of which the resin film is made may be any appropriate resin. The resin is specifically, for example, any cycloolefin based resin such

as polynorbornene, or any polycarbonate based resin, cellulose based resin, polyvinyl alcohol based resin or polysulfone based resin. Thereamong, polynorbornene and any polycarbonate based resin are preferred.

[0033]

The polynorbornene denotes a (co)polymer yielded by using a norbornene monomer having a norbornene ring as a portion or the whole of one or more starting materials (monomers).

[0034]

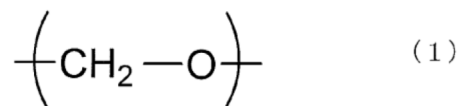
Various products are commercially available as the polynorbornene. Specific examples thereof include: products available under the product names "ZEONEX" and "ZEONOR" from Zeon Corporation; a product available under the product name "Arton" from JSR Corporation; a product available under the product name "TOPAS" from TICONA; and a product available under the product name "APEL" from Mitsui Chemicals, Inc.

[0035]

The polycarbonate based resin contains at least a constituent unit derived from a dihydroxy compound having a bond structure represented by the structural formula (1), and is produced by causing a dihydroxy compound including at least a dihydroxy compound having at least one bond structure " $\text{-CH}_2\text{-O-}$ " in a molecule thereof and a carbonic

acid diester to react with each other in the presence of a polymerization catalyst.

[0036]



[0037]

A compound of any structure may be used as the dihydroxy compound having a bond structure represented by the structural formula (1) as long as the compound has two alcoholic hydroxy groups, contains a structure having a linking group "-CH₂-O-" in a molecule thereof, and can react with the carbonic acid diester in the presence of the polymerization catalyst to produce the polycarbonate resin. Two or more kinds of such compounds may be used in combination. In addition, a dihydroxy compound having no bond structure represented by the structural formula (1) may be used as a dihydroxy compound to be used in the polycarbonate resin in combination with the above-mentioned dihydroxy compound. The dihydroxy compound having a bond structure represented by the structural formula (1) is hereinafter abbreviated as "dihydroxy compound (A)" and the dihydroxy compound having no bond structure represented by the structural formula (1) is abbreviated as "dihydroxy compound (B)" in some cases.

[0038]

(Dihydroxy Compound (A))

The linking group " $\text{-CH}_2\text{-O-}$ " in the dihydroxy compound (A) means a structure that is bonded to an atom except a hydrogen atom to constitute a molecule. An atom to which at least an oxygen atom in the linking group can be bonded, or each of atoms to which a carbon atom and the oxygen atom therein can be simultaneously bonded, is most preferably a carbon atom. The number of the linking groups " $\text{CH}_2\text{-O-}$ " in the dihydroxy compound (A) is 1 or more, preferably from 2 to 4.

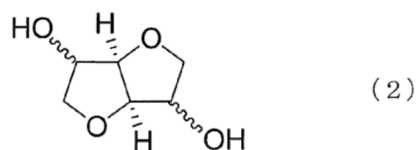
[0039]

More specific examples of the dihydroxy compound (A) include: compounds each having an aromatic group in a side chain and an ether group bonded to an aromatic group in a main chain, such as 9,9-bis(4-(2-hydroxyethoxy)phenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy-2-methyl)phenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3-methylphenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3-isopropylphenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3-isobutylphenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3-tert-butylphenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3-cyclohexylphenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3-phenylphenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3,5-dimethylphenyl)fluorene, 9,9-bis(4-(2-hydroxyethoxy)-3-tert-butyl-6-methylphenyl)fluorene, and 9,9-bis(4-(3-

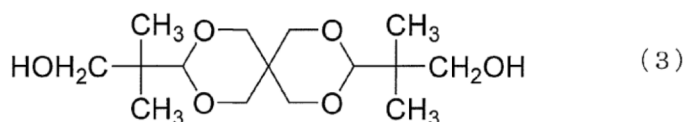
hydroxy-2,2-dimethylpropoxy)phenyl)fluorene;
 bis(hydroxyalkoxyaryl)alkanes, such as bis[4-(2-
 hydroxyethoxy)phenyl]methane, bis[4-(2-
 hydroxyethoxy)phenyl]diphenylmethane, 1,1-bis[4-(2-
 hydroxyethoxy)phenyl]ethane, 1,1-bis[4-(2-
 hydroxyethoxy)phenyl]-1-phenylethane, 2,2-bis[4-(2-
 hydroxyethoxy)phenyl]propane, 2,2-bis[4-(2-hydroxyethoxy)-
 3-methylphenyl]propane, 2,2-bis[3,5-dimethyl-4-(2-
 hydroxyethoxy)phenyl]propane, 1,1-bis[4-(2-
 hydroxyethoxy)phenyl]-3,3,5-trimethylcyclohexane, 1,1-
 bis[4-(2-hydroxyethoxy)phenyl]cyclohexane, 1,4-bis[4-(2-
 hydroxyethoxy)phenyl]cyclohexane, 1,3-bis[4-(2-
 hydroxyethoxy)phenyl]cyclohexane, 2,2-bis[4-(2-
 hydroxyethoxy)-3-phenylphenyl]propane, 2,2-bis[(2-
 hydroxyethoxy)-3-isopropylphenyl]propane, 2,2-bis[3-tert-
 butyl-4-(2-hydroxyethoxy)phenyl]propane, 2,2-bis[4-(2-
 hydroxyethoxy)phenyl]butane, 2,2-bis[4-(2-
 hydroxyethoxy)phenyl]-4-methylpentane, 2,2-bis[4-(2-
 hydroxyethoxy)phenyl]octane, 1,1-bis[4-(2-
 hydroxyethoxy)phenyl]decane, 2,2-bis[3-bromo-4-(2-
 hydroxyethoxy)phenyl]propane, and 2,2-bis[3-cyclohexyl-4-
 (2-hydroxyethoxy)phenyl]propane;
 bis(hydroxyalkoxyaryl)cycloalkanes, such as 1,1-bis[4-(2-
 hydroxyethoxy)phenyl]cyclohexane, 1,1-bis[3-cyclohexyl-4-
 (2-hydroxyethoxy)phenyl]cyclohexane, and 1,1-bis[4-(2-

hydroxyethoxy)phenyl]cyclopentane; dihydroxyalkoxydiaryl ethers, such as 4,4'-bis(2-hydroxyethoxy)diphenyl ether, 4,4'-bis(2-hydroxyethoxy)-3,3'-dimethyl diphenyl ether and 4,4'-dihydroxy-2,5-diethoxy diphenyl ether; bishydroxyalkoxyaryl sulfides, such as 4,4'-bis(2-hydroxyethoxyphenyl) sulfide and 4,4'-bis[4-(2-dihydroxyethoxy)-3-methylphenyl] sulfide; bishydroxyalkoxyaryl sulfoxides, such as 4,4'-bis(2-hydroxyethoxyphenyl) sulfoxide and 4,4'-bis[4-(2-dihydroxyethoxy)-3-methylphenyl] sulfoxide; bishydroxyalkoxyaryl sulfones, such as 4,4'-bis(2-hydroxyethoxyphenyl) sulfone and 4,4'-bis[4-(2-dihydroxyethoxy)-3-methylphenyl] sulfone; and 1,4-bishydroxyethoxybenzene, 1,3-bishydroxyethoxybenzene, 1,2-bishydroxyethoxybenzene, 1,3-bis[2-[4-(2-hydroxyethoxy)phenyl]propyl]benzene, 1,4-bis[2-[4-(2-hydroxyethoxy)phenyl]propyl]benzene, 4,4'-bis(2-hydroxyethoxy)biphenyl, 1,3-bis[4-(2-hydroxyethoxy)phenyl]-5,7-dimethyladamantane, and anhydrous sugar alcohols typified by the dihydroxy compound represented by the general formula (2); and compounds each having a cyclic ether structure, such as the spiroglycol represented by the general formula (3). These compounds may be used singly or in the form of a mixture of two or more thereof.

[0040]



[0041]



[0042]

Examples of the dihydroxy compound represented by the general formula (2) include isosorbide, isomannide, and isoidide, which are in a stereoisomeric relationship. These compounds may be used singly or in the form of a mixture of two or more thereof.

[0043]

As the dihydroxy compound (A), for example, any oxyalkylene glycol, or any diol having a cyclic ether structure may also be used preferably.

[0044]

Examples of the oxyalkylene glycols include diethylene glycol, triethylene glycol, tetraethylene glycol, and polyethylene glycol. Examples of the diol having a cyclic ether structure include spiroglycols and dioxane glycols.

[0045]

Among these dihydroxy compounds (A), isosorbide, which is yielded by dehydration-condensing sorbitol produced from various starches present abundantly as a resource and easily available, is preferred from the viewpoint of easy availability and producibility, and optical properties and shapability. Preferred is also 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene or polyethylene glycol.

[0046]

When the dihydroxy compound (A) is caused to react with a carbonic acid diester, which will be detailed, the form of the compound (A) is not particularly limited. The compound may be in a powder form, in a flake form, or in the form of a liquid state such as a molten state and an aqueous solution.

[0047]

(Dihydroxy Compound (B))

The dihydroxy compound (B) may be, for example, an alicyclic dihydroxy compound, an aliphatic dihydroxy compound or an aromatic dihydroxy compound.

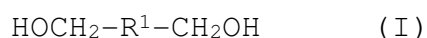
[0048]

The alicyclic dihydroxy compound is not particularly limited, and is preferably a compound containing a five-membered ring structure or six-membered ring structure. The six-membered ring structure may be fixed into a chair

form or a boat form through covalent bonding. When the alicyclic dihydroxy compound has a five-membered ring structure or six-membered ring structure, the resultant polycarbonate can be favorably made high in heat resistance. The number of carbon atoms contained in the alicyclic dihydroxy compound is usually 70 or less, preferably 50 or less, more preferably 30 or less. As this value becomes larger, the heat resistance becomes higher but the synthesis and purification of the compound become more difficult and costs further increase. As the number of the carbon atoms is smaller, the compound is more easily purified and is more available.

[0049]

Specific examples of the alicyclic dihydroxy compound containing a five-membered ring structure or a six-membered ring structure include alicyclic dihydroxy compounds each represented by the following general formula (I) or (II):



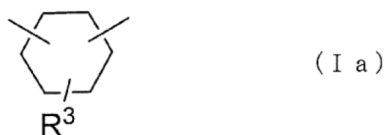
in the general formula (I) and the general formula (II), R^1 and R^2 each represent a cycloalkylene group having 4 to 20 carbon atoms.

[0050]

Cyclohexanedimethanol serving as the alicyclic dihydroxy compound represented by the above general formula

(I) encompasses various isomers in each of which R^1 in the general formula (I) is represented by the general formula (Ia), where R^3 represents a hydrogen atom or an alkyl group having 1 to 12 carbon atoms. Specific examples thereof include 1,2-cyclohexanedimethanol, 1,3-cyclohexanedimethanol, and 1,4-cyclohexanedimethanol.

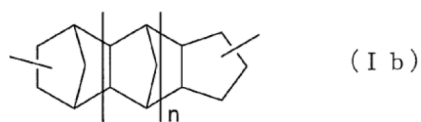
[0051]



[0052]

Tricyclodecanedimethanol or pentacyclopentadecanedimethanol serving as the alicyclic dihydroxy compound represented by the general formula (I) encompasses various isomers in each of which R^1 in the general formula (I) is represented by the general formula (Ib), where n represents 0 or 1.

[0053]



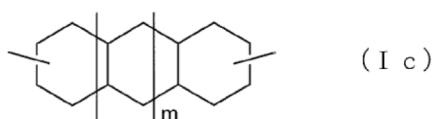
[0054]

Decalindimethanol or tricyclotetradecanedimethanol serving as the alicyclic dihydroxy compound represented by the general formula (I) encompasses various isomers in each

of which R¹ in the general formula (I) is represented by the general formula (Ic), where m represents 0 or 1.

Specific examples thereof include 2,6-decalindimethanol, 1,5-decalindimethanol, and 2,3-decalindimethanol.

[0055]



[0056]

Norbornanedimethanol serving as the alicyclic dihydroxy compound represented by the general formula (I) encompasses various isomers in each of which R¹ in the general formula (I) is represented by the general formula (Id). Specific examples thereof include 2,3-norbornanedimethanol and 2,5-norbornanedimethanol.

[0057]



[0058]

Adamantanedimethanol serving as the alicyclic dihydroxy compound represented by the general formula (I) encompasses various isomers in each of which R¹ in the general formula (I) is represented by the general formula (Ie). A specific example thereof is 1,3-

adamantanedimethanol.

[0059]

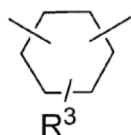


(I e)

[0060]

Cyclohexanediol serving as the alicyclic dihydroxy compound represented by the general formula (II) encompasses various isomers in each of which R^2 in the general formula (II) is represented by the general formula (IIa), where R^3 represents a hydrogen atom or an alkyl group having 1 to 12 carbon atoms. Specific examples thereof include 1,2-cyclohexanediol, 1,3-cyclohexanediol, 1,4-cyclohexanediol, and 2-methyl-1,4-cyclohexanediol.

[0061]

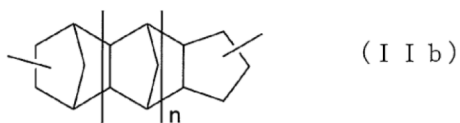


(I I a)

[0062]

Tricyclodecanediol or pentacyclopentadecanediol serving as the alicyclic dihydroxy compound represented by the general formula (II) encompasses various isomers in each of which R^2 in the general formula (II) is represented by the general formula (IIb), where n represents 0 or 1.

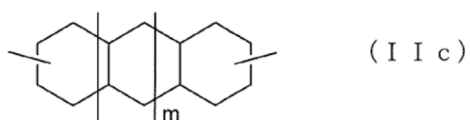
[0063]



[0064]

Decalindiol or tricyclotetradecanediol serving as the alicyclic dihydroxy compound represented by the general formula (II) encompasses various isomers in each of which R^2 in the general formula (II) is represented by the general formula (IIc), where m represents 0 or 1. As the decalindiol or the tricyclotetradecanediol, there may be specifically used, for example, 2,6-decalindiol, 1,5-decalindiol, or 2,3-decalindiol.

[0065]



[0066]

Norbornanediol serving as the alicyclic dihydroxy compound represented by the general formula (II) encompasses various isomers in each of which R^2 in the general formula (II) is represented by the general formula (IIId). As the norbornanediol, there may be specifically used, for example, 2,3-norbornanediol or 2,5-norbornanediol.

[0067]



(I I d)

[0068]

Adamantanediol serving as the alicyclic dihydroxy compound represented by the general formula (II) encompasses various isomers in each of which R^2 in the general formula (II) is represented by the general formula (IIe). As the adamantanediol, there may be specifically used, for example, 1,3-adamantanediol.

[0069]



(I I e)

[0070]

Among the specific examples of the alicyclic dihydroxy compound, in particular, cyclohexanedimethanols, tricyclodecanedimethanols, adamantanediols, and pentacyclopentadecanedimethanols are preferred, and 1,4-cyclohexanedimethanol, 1,3-cyclohexanedimethanol, 1,2-cyclohexanedimethanol, and tricyclodecanedimethanol are more preferred from the viewpoints of the ease of availability and the ease of handling.

[0071]

Examples of the aliphatic dihydroxy compound include

ethylene glycol, 1,3-propanediol, 1,2-propanediol, 1,4-butanediol, 1,3-butanediol, 1,2-butanediol, 1,5-heptanediol, and 1,6-hexanediol etc..

[0072]

Examples of the aromatic dihydroxy compound include 2,2-bis(4-hydroxyphenyl)propane [=bisphenol A], 2,2-bis(4-hydroxy-3,5-dimethylphenyl)propane, 2,2-bis(4-hydroxy-3,5-diethylphenyl)propane, 2,2-bis(4-hydroxy-(3,5-diphenyl)phenyl)propane, 2,2-bis(4-hydroxy-3,5-dibromophenyl)propane, 2,2-bis(4-hydroxyphenyl)pentane, 2,4'-dihydroxy-diphenylmethane, bis(4-hydroxyphenyl)methane, bis(4-hydroxy-5-nitrophenyl)methane, 1,1-bis(4-hydroxyphenyl)ethane, 3,3-bis(4-hydroxyphenyl)pentane, 1,1-bis(4-hydroxyphenyl)cyclohexane, bis(4-hydroxyphenyl) sulfone, 2,4'-dihydroxydiphenyl sulfone, bis(4-hydroxyphenyl) sulfide, 4,4'-dihydroxydiphenyl ether, 4,4'-dihydroxy-3,3'-dichlorodiphenyl ether, 9,9-bis(4-hydroxyphenyl)fluorene, and 9,9-bis(4-hydroxy-2-methylphenyl)fluorene etc..

[0073]

The exemplified compounds are examples of the alicyclic dihydroxy compound, the aliphatic dihydroxy compound and the aromatic dihydroxy compound, may be used in the present invention, and the dihydroxy compound is by no means limited thereto. These compounds may be used

singly or in the form of a mixture of two or more thereof.

[0074]

The use of any such dihydroxy compound (B) can provide effects, such as an improvement in flexibility, an improvement in heat resistance, and an improvement in formability, in accordance with applications.

[0075]

The proportion of the dihydroxy compound (A) in all dihydroxy compounds from which the polycarbonate based resin is made is not particularly limited, and is preferably 10 mol% or more, more preferably 40 mol% or more, even more preferably 60 mol% or more. The upper limit value thereof is preferably 100 mol% or less. If the content by percentage of constituent units originating from the dihydroxy compound (B) is too large in the polycarbonate resin, the retardation film may be lowered in performances such as optical properties.

[0076]

Furthermore, in the case of using the alicyclic dihydroxy compound, the aliphatic dihydroxy compound and/or the aromatic dihydroxy compound, the total proportion of the dihydroxy compound (A) and one or more of these dihydroxy compounds in all dihydroxy compounds from which the polycarbonate is made is not particularly limited, and is selectable as any proportion. The ratio between the

content of constituent units originating from the dihydroxy compound (A) and that of constituents originating from each of these dihydroxy compounds is not particularly limited, either, and is selectable as any ratio.

[0077]

(Carbonic Acid Diester)

Examples of the carbonic acid diester to be used in the method of producing the polycarbonate resin include, for example, diphenyl carbonate, substituted diphenyl carbonates typified by ditolyl carbonate, dimethyl carbonate, diethyl carbonate, and di-t-butyl carbonate. Thereamong, diphenyl carbonate and substituted diphenyl carbonates are preferred. Those carbonic acid diesters may be used singly or in the form of a mixture of two or more thereof.

[0078]

The carbonic acid diester is preferably used at a molar ratio of from 0.90 to 1.10 with respect to all the dihydroxy compounds to be used in the reaction, and is more preferably used at a molar ratio of from 0.96 to 1.04. When the molar ratio becomes less than 0.90, the amount of a terminal OH group of the produced polycarbonate resin increases, and hence there is a risk in that the thermal stability of the polymer deteriorates or a desired polymer is not obtained. When the molar ratio is larger than 1.10,

the rate of the transesterification reaction may be lowered under the same conditions, and the polycarbonate is not easily produced with a desired molecular weight.

Additionally, the amount of the remaining carbonic acid diester in the produced polycarbonate copolymer increases. This remaining carbonic acid diester may causes offensive odor when the polycarbonate is shaped, or offensive odor of the resultant shaped product.

[0079]

The glass transition temperature (T_g) of the polycarbonate based resin is preferably 45°C or higher, more preferably from 45 to 130°C since the resin is required to be flexible for the usage of the resin as a film.

[0080]

The polycarbonate based resin can be produced by subjecting dihydroxy compounds including the dihydroxy compound (A) to melt polymerization with a carbonic acid diester in the presence of a polymerization catalyst. The species and the addition amount of the polymerization catalyst may be any appropriate polymerization catalyst species and any appropriate addition amount that are each known in the prior art. Also about the melt polymerization, a manner known in the prior art is appropriately adoptable.

[0081]

The retardation film 3a is yielded, for example, by stretching a film made of any one of the above-mentioned resins. The method for forming the film using the resin may be any appropriate shaping and working method. Specific examples thereof include compression molding, transfer molding, injection molding, extrusion molding, blow molding, powder molding, and FRP molding methods; cast coating methods (such as flow casting); a calender molding method; and a hot press method. Among these methods, extrusion molding and cast coating methods are preferred since the methods make it possible to make the resultant film high in flatness and smoothness to give good optical uniformity to the film. Conditions for the forming may be appropriately set in accordance with the composition or the species of the used resin, properties desired for the resultant retardation film, and others. About the above-mentioned resins, many film products thereof are commercially available. Thus, any one of the commercially available films may be subjected, as it is, to stretching treatment.

[0082]

The stretch ratio of the film may be appropriately set in accordance with an in-plane retardation value and a thickness desired for the retardation film 3a, the species

of the used resin, the thickness of the used film, the stretching temperature, and others. Specifically, the stretch ratio is preferably from about 1.75 to 3.00, more preferably from about 1.80 to 2.80, even more preferably from about 1.85 to 2.60.

[0083]

The stretching temperature for the film may be appropriately set in accordance with an in-plane retardation value and a thickness desired for the retardation film 3a, the species of the used resin, the thickness of the used film, the stretch ratio, and others. Specifically, the stretching temperature is preferably from about 125°C to 150°C, more preferably from about 130°C to 140°C.

[0084]

Any appropriate method may be adopted as a method of stretching the film. Specifically, one kind of various stretching methods such as free-end stretching, fixed-end stretching, free-end shrinkage, and fixed-end shrinkage can be employed alone, or two or more kinds thereof can be employed simultaneously or sequentially. With regard to the stretching direction, the stretching can be performed in various directions or dimensions such as a horizontal direction, a vertical direction, a thickness direction, and a diagonal direction.

[0085]

In one embodiment, the retardation film 3a is formed by subjecting the resin film to a free-end uniaxial stretching or a fixed-end uniaxial stretching. A specific example of the free-end uniaxial stretching is a method of stretching the resin film between rolls different from each other in peripheral velocity while the resin film is run in a longitudinal direction thereof. A specific example of the fixed-end uniaxial stretching is a method of stretching the resin film into a width direction (transverse direction) thereof while the resin film is run in a longitudinal direction thereof.

[0086]

In another embodiment, the retardation film 3a is produced by obliquely stretching a resin film having an elongate shape in a direction at the specific angle with respect to its lengthwise direction in a continuous manner. Adopting the oblique stretching provides a stretched film having an elongate shape with an alignment angle of the specific angle (a slow axis in the direction at the specific angle) with respect to the lengthwise direction of the film, enables a roll-to-roll process upon, for example, its lamination with the polarizer, and can simplify a production process. The wording "roll-to-roll" denotes a manner of laminating the films onto each other in the state

of making longitudinal directions thereof consistent with each other while the films are carried on a roll.

[0087]

A stretching machine to be used in the oblique stretching is, for example, a tenter-type stretching machine capable of applying a feeding force or tensile force, or take-up force having different speeds on left and right sides in a lateral direction and/or a longitudinal direction. Although the tenter-type stretching machine comes in, for example, a lateral uniaxial stretching machine and a simultaneous biaxial stretching machine, any appropriate stretching machine may be used as long as the machine can obliquely stretch the resin film having an elongate shape in a continuous manner.

[0088]

The optical film of the present invention for organic display devices is a film having no barrier layer including an inorganic thin film. The retardation film 3a has no barrier layer including an inorganic thin film. Such an inorganic thin film is usually formed by, for example, sputtering. In the step of the formation, heat is generated. By laying the inorganic thin film onto the retardation film 3a, the retardation film 3a may be unfavorably changed in retardation value by heat, or the retardation film 3a may be unfavorably broken thereby. The

inorganic thin film may be a thin film including at least one inorganic compound selected from the group consisting of oxides, nitrides, hydrides, and composite compounds thereof. Examples of the inorganic compound of which the inorganic thin film is made include diamondlike carbon (DLC), silicon nitrides (SiN_x), silicon oxides (SiO_y), and aluminum oxides (AlO_z), and aluminum nitrides.

[0089]

(1-2) Second Retardation Film

The second retardation film 3b is preferably a retardation film showing a refractive index property showing a relationship of $n_z > n_x \geq n_y$. When the optical film or the polarizing film of the present invention has the second retardation film having this refractive index property, the optical film or the polarizing film can be decreased in angle dependency of reflected-light-absorbing effect to prevent reflected light rays reflected at various angles favorably from being emitted.

[0090]

The retardation value $R_{th}(550)$ of the second retardation film 3b in the thickness direction is preferably from -260 nm to -10 nm, more preferably from -230 nm to -15 nm, even more preferably from -215 nm to -20 nm. When this retardation is in any one of these ranges, favorably, the above-mentioned effect is remarkably

produced.

[0091]

In one embodiment, the second retardation film 3b has a refractive index showing a relationship of $n_x = n_y$. Herein, the case of " $n_x = n_y$ " includes not only a case where n_x is strictly equal to n_y but also a case where n_x is substantially equal to n_y . Specifically, it is meant that $Re(550)$ is less than 10 nm. In another embodiment, the second retardation film 3b has a refractive index showing a relationship of $n_x > n_y$. In this case, the in-plane retardation $Re(550)$ of the second retardation film 3b is preferably from 10 nm to 150 nm, more preferably from 10 nm to 80 nm.

[0092]

The second retardation film 3b may be made of any appropriate material, and is not particularly limited. The retardation film is preferably a liquid crystal layer fixed to homeotropic alignment. A liquid crystal material (liquid crystal compound) that can be subjected to homeotropic alignment may be a liquid crystal monomer or may be a liquid crystal polymer. Specific examples of the liquid crystal compound and a method of forming the liquid crystal layer include a liquid crystal compound and forming method described in paragraphs [0020] to [0042] of JP 2002-333642 A. In this case, the thickness of the layer is

preferably from 0.1 μm to 5 μm , more preferably from 0.2 μm to 3 μm .

[0093]

As another preferred specific example, the second retardation film 3b may be a retardation film formed of a fumaric acid diester-based resin described in JP 2012-32784 A. In this case, the thickness of the layer is preferably from 5 μm to 50 μm , more preferably from 10 μm to 35 μm .

[0094]

The in-plane retardation $(550)R_e$ of a laminated retardation film composed of the first retardation film 3a and the second retardation film 3b is preferably from 120 nm to 160 nm, more preferably from 130 nm to 150 nm, further preferably from 135 nm to 145 nm.

[0095]

The thickness direction retardation $R_{th}(550)$ of a laminated retardation film composed of the first retardation film 3a and the second retardation film 3b is preferably from 40 nm to 100 nm, more preferably from 50 nm to 90 nm, further preferably from 60 nm to 80 nm.

[0096]

The first retardation film 3a and the second retardation film 3b may be laminated onto each other through any adhesive layer or pressure-sensitive-adhesive layer 4. For the adhesive layer or pressure-sensitive-

adhesive layer 4, it is possible to use any one of the adhesive or pressure-sensitive adhesive layers described in the document DESCRIPTION. Preferred is, for example, an acryl-based pressure-sensitive adhesive including, as a base polymer thereof, a (meth)acryl-based polymer since the adhesive is very good in optical transparency, shows pressure-sensitive-adhesive properties of appropriate wettability, cohesive property and adhesion, and is very good in weather resistance, heat resistance and others. Moreover, any known adhesive layer or pressure-sensitive-adhesive layer is also usable.

[0097]

(2) Pressure-Sensitive-Adhesive/Adhesive Layer

It is sufficient for the pressure-sensitive-adhesive/adhesive layer used in the present invention to have a moisture permeability of 50 g/(m²·day) or less at 40°C and 92% R.H.. The composition thereof is not particularly limited. The "pressure-sensitive-adhesive/adhesive layer" denotes an adhesive layer or a pressure-sensitive-adhesive layer.

[0098]

The moisture permeability of the pressure-sensitive-adhesive/adhesive layer is 50 g/(m²·day) or less, preferably 30 g/(m²·day) or less, more preferably 20 g/(m²·day) or less, even more preferably 15 g/(m²·day) or

less. The lower limit value of the moisture permeability is not particularly limited. Ideally, it is preferred that the pressure-sensitive-adhesive/adhesive layer never permeates water vapor (in other words, the moisture permeability is 0 g/(m²•day)). In a case where the moisture permeability of the pressure-sensitive-adhesive/adhesive layer is in any one of the ranges, at the time of applying an optical film (retardation film) including the pressure-sensitive-adhesive/adhesive layer to an organic EL element the shift of water into the organic EL element can be restrained. As a result, the organic EL element can be favorably restrained from being deteriorated or damaged into any other form by water. The moisture permeability is the water vapor permeability (moisture permeability) of the pressure-sensitive-adhesive/adhesive layer the thickness of which is 50 μm at 40°C and 92% R.H., and is measurable by a method described in the item EXAMPLES.

[0099]

(2-1) Adhesive Layer

It is sufficient for the adhesive layer to have a moisture permeability of 50 g/(m²•day) or less at 40°C and 92% R.H.. The composition thereof is not particularly limited. The adhesive layer may be a layer made of any appropriate adhesive. Examples of such adhesive include a natural rubber adhesive, an α-olefin-based adhesive, a

urethane resin-based adhesive, an ethylene-vinyl acetate resin emulsion adhesive, an ethylene-vinyl acetate resin-based hot-melt adhesive, an epoxy resin-based adhesive, a vinyl chloride resin solvent-based adhesive, a chloroprene rubber-based adhesive, a cyanoacrylate-based adhesive, a silicone-based adhesive, a styrene-butadiene rubber solvent-based adhesive, a nitrile rubber-based adhesive, a nitrocellulose-based adhesive, a reactive hot-melt adhesive, a phenol resin-based adhesive, a modified silicone-based adhesive, a polyester-based hot-melt adhesive, a polyamide resin hot-melt adhesive, a polyimide-based adhesive, a polyurethane resin hot-melt adhesive, a polyolefin resin hot-melt adhesive, a polyvinyl acetate resin solvent-based adhesive, a polystyrene resin solvent-based adhesive, a polyvinyl alcohol-based adhesive, a polyvinylpyrrolidone resin-based adhesive, a polyvinyl butyral-based adhesive, a polybenzimidazole adhesive, a polymethacrylate resin solvent-based adhesive, a melamine resin-based adhesive, a urea resin-based adhesive, and a resorcinol-based adhesive. Such adhesives may be used singly or in the form of a mixture of two or more thereof.

[0100]

The adhesives are classified into, for example, a thermosetting adhesive and a hot-melt adhesive depending on their adhesion forms. Such adhesives may be used alone or

in combination.

[0101]

When the thermosetting adhesive is heated, the adhesive thermally cures to solidify, thereby expressing its adhesive strength. Examples of the thermosetting adhesive include an epoxy-based thermosetting adhesive, a urethane-based thermosetting adhesive, and an acryl-based thermosetting adhesive. The curing temperature of the thermosetting adhesive is, for example, from 100°C to 200°C.

[0102]

When the hot-melt adhesive is heated, the adhesive melts or softens to thermally fuse with an adherend. After that, when the adhesive is cooled, the adhesive solidifies to adhere to the adherend. Examples of the hot-melt adhesive include a rubber-based hot-melt adhesive, a polyester-based hot-melt adhesive, a polyolefin-based hot-melt adhesive, an ethylene-vinyl acetate resin-based hot-melt adhesive, a polyamide resin hot-melt adhesive, and a polyurethane resin hot-melt adhesive. The hot-melt adhesive has a softening temperature (ring and ball method) of, for example, from 100°C to 200°C. In addition, the hot-melt adhesive has a melt viscosity of, for example, from 100 mPa·s to 30,000 mPa·s at 180°C.

[0103]

The thickness of the adhesive layer is not particularly limited, and is preferably about 0.01 to 10 μm , more preferably about 0.05 to 8 μm .

[0104]

(2-2) Pressure-Sensitive-Adhesive Layer

It is sufficient for the pressure-sensitive-adhesive layer to have a moisture permeability of 50 $\text{g}/(\text{m}^2 \cdot \text{day})$ or less at 40°C and 92% R.H.. The composition thereof is not particularly limited. The pressure-sensitive-adhesive layer may be a layer made of any appropriate pressure-sensitive-adhesive composition. Examples of the pressure-sensitive-adhesive composition include rubber-based, acryl-based, silicone based, urethane based, vinyl alkyl ether based, polyvinyl alcohol based, polyvinylpyrrolidone based, polyacrylamide based, and cellulose based pressure-sensitive adhesives. Thereamong, rubber-based pressure-sensitive-adhesive compositions are preferred from the viewpoint of moisture permeability.

[0105]

The rubber-based pressure-sensitive-adhesive compositions are each sufficient to include a rubber-based polymer. The composition thereof is not particularly limited.

[0106]

The rubber-based polymer used in the present

invention is a polymer showing rubber elasticity in a temperature range near room temperature. Specific examples thereof include styrene based thermoplastic elastomers, and isobutylene based polymers. In the present invention, it is preferred from the viewpoint of weather resistance to use polyisobutylene (PIB), which is a homopolymer made from isobutylene. The polyisobutylene is very good in light resistance since the polymer does not include, in a main chain thereof, any double bond.

[0107]

The polyisobutylene may be, for example, a commercially available product OPPANOL manufactured by the company BASF.

[0108]

The weight-average molecular weight (M_w) of the polyisobutylene is preferably 100000 or more, more preferably 300000 or more, even more preferably 600000 or more, in particular preferably 700000 or more. The upper limit of the weight-average molecular weight is not particularly limited, and is preferably 5000000 or less, more preferably 3000000 or less, even more preferably 2000000 or less. When the weight-average molecular weight of the polyisobutylene is adjusted to 100000 or more, the composition can be rendered a rubber-based pressure-sensitive-adhesive composition more remarkably good in

endurance when the resultant layer is stored at a high temperature.

[0109]

The content of the polyisobutylene is not particularly limited, and is preferably 50% or more by weight, more preferably 60% or more by weight, even more preferably 70% or more by weight, even more preferably 80% or more by weight, even more preferably 85% or more by weight, in particular preferably 90% or more by weight of the whole of solid in the rubber-based pressure-sensitive-adhesive composition. The upper limit of the content of the polyisobutylene is not particularly limited, and is preferably 99% or less by weight, more preferably 98% or less by weight. When the composition includes the polyisobutylene in a proportion in any one of these ranges, the composition is favorably remarkably good in low-moisture-permeability.

[0110]

The rubber-based pressure-sensitive-adhesive composition used in the present invention may include, for example, a polymer or elastomer besides the polyisobutylene. Specific examples thereof include isobutylene-based polymers such as a copolymer made from isobutylene and n-butylene, a copolymer made from isobutylene and isoprene (for example, butyl rubbers such

as regular butyl rubber, chlorinated butyl rubber, brominated butyl rubber, and any partially crosslinked butyl rubber), and any vulcanized product or modified product of any one of these rubbers (for example, a product yielded by modifying any one of these rubbers with a functional group such as a hydroxyl, carboxyl, amino or epoxy group); styrene-based thermoplastic elastomers such as styrene-ethylene-butylene-styrene block copolymer (SEBS), styrene-isoprene-styrene block copolymer (SIS), styrene-butadiene-styrene block copolymer (SBS), styrene-ethylene-propylene-styrene block copolymer (SEPS: hydrogenated product of SIS), styrene-ethylene-propylene block copolymer (SEP: hydrogenated product of styrene-isoprene block copolymer), styrene-isobutylene-styrene block copolymer (SIBS), and styrene-butadiene rubber (SBR); butyl rubber (IIR), butadiene rubber (BR), acrylonitrile-butadiene rubber (NBR), EPR (binary ethylene-propylene rubber), EPT (ternary ethylene-propylene rubber), acrylic rubber, and urethane rubber; polyurethane-based thermoplastic elastomers; polyester-based thermoplastic elastomers; blended thermoplastic elastomers such as a polymer blend of polypropylene and EPT (ternary ethylene-propylene rubber). These polymers or elastomers may each be added to the composition as far as the advantageous effects of the present invention are not damaged. The

amount thereof is preferably about 10 parts or less by weight for 100 parts by weight of the polyisobutylene. It is preferred from the viewpoint of the endurance of the composition that the composition contains none of the polymers or elastomers.

[0111]

The rubber-based pressure-sensitive-adhesive composition used in the present invention in particular preferably includes the polyisobutylene, and a hydrogen-abstraction type photopolymerization initiator.

[0112]

The hydrogen-abstraction type photopolymerization initiator is a material which is irradiated with an active energy ray to withdraw hydrogen from the polyisobutylene without being cleaved so as to allow to form reaction points in the polyisobutylene. By the formation of the reaction points, a crosslinking reaction of the polyisobutylene can be started.

[0113]

Besides the hydrogen-abstraction type photopolymerization initiator used in the present invention, as the photopolymerization initiator, known is also a cleavage type photopolymerization initiator which is irradiated with an active energy ray to be cleaved and decomposed so as to generate radicals. However, when the

cleavage type photopolymerization initiator is used for the polyisobutylene used in the present invention, the main chain of the polyisobutylene is unfavorably cut with the radical-generated photopolymerization initiator, so that the polyisobutylene cannot be crosslinked. In the present invention, the use of the hydrogen-abstraction type photopolymerization initiator allows to crosslink the polyisobutylene as described above.

[0114]

Examples of the hydrogen-abstraction type photopolymerization initiator include acetophenone, benzophenone-based compounds such as benzophenone, methyl o-benzoylbenzoate-4-phenylbenzophenone, 4,4'-dichlorobenzophenone, hydroxybenzophenone, 4,4'-dimethoxybenzophenone, 4,4'-dichlorobenzophenone, 4,4'-dimethylbenzophenone, 4-benzoyl-4'-methyl-diphenyl sulfide, acrylated benzophenone, 3,3',4,4'-tetra(t-butylperoxycarbonyl)benzophenone, and 3,3'-dimethyl-4-methoxybenzophenone; thioxanthone-based compounds such as 2-isopropylthioxanthone, 2,4-dimethylthioxanthone, 2,4-diethylthioxanthone, and 2,4-dichlorothioxanthone; aminobenzophenone-based compounds such as 4,4'-bis(dimethylamino)benzophenone, and 4,4'-diethylaminobenzophenone; 10-butyl-2-chloroacridone, 2-ethylanthraquinone, 9,10-phenanthrenequinone, and

camphorquinone; aromatic ketone compounds such as acetophenone, and 1-hydroxycyclohexyl phenyl ketone; aromatic aldehydes such as terephthalic aldehyde, and quinone-based aromatic compounds such as methyl anthraquinone. These compounds may be used singly or in the form of a mixture of two or more thereof. Thereamong, preferred are benzophenone-based compounds, and more preferred is benzophenone from the viewpoint of the reactivity thereof.

[0115]

The content of the hydrogen-abstraction type photopolymerization initiator is preferably from 0.001 to 10 parts by weight, more preferably from 0.005 to 10 parts by weight, even more preferably from 0.01 to 10 parts by weight for 100 parts by weight of the polyisobutylene. When the composition includes the hydrogen-abstraction type photopolymerization initiator in an amount in any one of these ranges, the crosslinking reaction can be favorably advanced to cause the resultant crosslinked product to have a desired density.

[0116]

In the present invention, a cleavage type photopolymerization initiator may be used together with the hydrogen-abstraction type photopolymerization initiator as far as the advantageous effects of the present invention

are not damaged. However, it is preferred not to use any cleavage type photopolymerization initiator for the same reason as described above.

[0117]

The rubber-based pressure-sensitive-adhesive composition used in the present invention may further include a polyfunctional radical polymerizable compound. In the invention, the polyfunctional radical polymerizable compound functions as a crosslinking agent for the polyisobutylene.

[0118]

The polyfunctional radical polymerizable compound is a compound having at least two radical-polymerizable functional groups each having an unsaturated double bond, such as (meth)acryloyl groups or vinyl groups. Specific examples of the polyfunctional radical polymerizable compound include esterified products each made from (meth)acrylic acid and a polyhydric alcohol such as tripropylene glycol di(meth)acrylate, tetraethylene glycol di(meth)acrylate, 1,6-hexanediol di(meth)acrylate, 1,9-nonanediol di(meth)acrylate, 1,10-decanediol di(meth)acrylate, 2-ethyl-2-butylpropanediol di(meth)acrylate, bisphenol A di(meth)acrylate, bisphenol A ethylene oxide adduct di(meth)acrylate, bisphenol A propylene oxide adduct di(meth)acrylate, bisphenol A

diglycidyl ether di(meth)acrylate, neopentyl glycol
 di(meth)acrylate, tricyclodecanedimethanol
 di(meth)acrylate, dioxane glycol di(meth)acrylate,
 trimethylolpropane tri(meth)acrylate, pentaerythritol
 tri(meth)acrylate, pentaerythritol tetra(meth)acrylate,
 dipentaerythritol penta(meth)acrylate, dipentaerythritol
 hexa(meth)acrylate, EO-modified diglycerin
 tetra(meth)acrylate; and 9,9-bis [4-(2-
 (meth)acryloyloxyethoxy)phenyl]fluorene. These compounds
 may be used singly or in the form of a mixture of two or
 more thereof. From the viewpoint of compatibility with the
 polyisobutylene, thereamong, preferred are esterified
 products each made from (meth)acrylic acid and a polyhydric
 alcohol. More preferred are bifunctional (meth)acrylates
 each having two (meth)acryloyl groups, and trifunctional
 (meth)acrylates each having three or more (meth)acryloyl
 groups. Particularly preferred are
 tricyclodecanedimethanol di(meth)acrylate, and
 trimethylolpropane tri(meth)acrylate.

[0119]

The content of the polyfunctional radical
 polymerizable compound is preferably 20 parts or less by
 weight, more preferably 15 parts or less by weight, even
 more preferably 10 parts or less by weight for 100 parts by
 weight of the polyisobutylene. The lower limit value of

the content of the polyfunctional radical polymerizable compound is not particularly limited, and is, for example, preferably 0.1 part or more by weight, more preferably 0.5 part or more by weight, even more preferably 1 part or more by weight for 100 parts by weight of the polyisobutylene. When the content of the polyfunctional radical polymerizable compound is in any one of these ranges, the resultant rubber-based pressure-sensitive-adhesive layer is favorable from the viewpoint of the endurance thereof.

[0120]

The molecular weight of the polyfunctional radical polymerizable compound is not particularly limited, and is, for example, preferably about 1000 or less, more preferably about 500 or less.

[0121]

The rubber-based pressure-sensitive-adhesive composition used in the present invention may include at least one tackifier selected from the group consisting of tackifiers each containing a terpene skeleton and tackifiers each containing a rosin skeleton, and hydrogenated products of these tackifiers. The matter that the rubber-based pressure-sensitive-adhesive composition contains the tackifier(s) favorably allows to form a rubber-based pressure-sensitive-adhesive layer having a high adhesion to various adherends, and a high endurance

even in a high-temperature environment.

[0122]

Examples of the tackifiers each containing a terpene skeleton include terpene polymers such as α -pinene polymer, β -pinene polymer, and dipentene polymer; and modified terpene resins in each of which the terpene polymers is modified (with, for example, phenol modified, styrene modified, an aromatic modified, added hydrogenation modified or a hydrocarbon modified). Examples of the modified terpene resins include terpene phenol resin, styrene modified terpene resin, aromatically modified terpene resin, and hydrogen-added terpene resin (hydrogenated terpene resin). Examples of the hydrogenated terpene resin referred to herein include a hydrogenated product of terpene polymer, and hydrogenated products of other modified terpene resins or terpene phenol resin. Thereamong, hydrogenated products of terpene phenol resins are preferred from the viewpoint of compatibility with the rubber-based pressure-sensitive-adhesive composition and pressure-sensitive-adhesive properties.

[0123]

Examples of the tackifiers each containing a rosin skeleton include rosin resin, polymerized rosin resin, hydrogenated rosin resin, rosin ester resin, hydrogenated rosin ester resin, and rosin phenol resin. Specifically,

the following may be used: gum rosin, wood rosin, tall oil rosin and other unmodified rosins (raw rosins); modified rosins each yielded by modifying one of these raw rosins by hydrogenation, disproportionation, polymerization, or any other chemical modification; and derivatives of these raw rosins or modified rosins.

[0124]

The tackifier may be a commercially available product, examples thereof including CLEARON series, and POLYESTER series manufactured by Yasuhara Chemical Co., Ltd.; and SUPER ESTER series, PENSEL series, and PINECRYSTAL series manufactured by Arakawa Chemical Industries, Ltd.

[0125]

When the tackifier is a hydrogenated product, the hydrogenation may be a partially hydrogenated product, in which a compound is partially hydrogenated, or a completely hydrogenated product, in which all double bonds of a compound are hydrogenated. In the present invention, the completely hydrogenated product is preferred from the viewpoint of pressure-sensitive-adhesive properties, weather resistance and hue thereof.

[0126]

The tackifier preferably has a cyclohexanol skeleton from the viewpoint of pressure-sensitive-adhesive

properties thereof. Details of a principle thereof are unclear; however, the principle would be based on the matter that the cyclohexanol skeleton results in a better balance of compatibility between the tackifier and the polyisobutylene, which is a base polymer, than a phenol skeleton. The tackifier containing a cyclohexanol skeleton is preferably, for example, a hydrogenated product of terpene phenol resin, rosin phenol resin or the like, more preferably a completely hydrogenated product of terpene phenol resin, rosin phenol resin or the like.

[0127]

The softening point (softening temperature) of the tackifier is not particularly limited, and is, for example, preferably about 80°C or higher, more preferably about 100°C or higher. When the softening point of the tackifier is 80°C or higher, the tackifier does not soften even at a high temperature, so that this tackifier can favorably keep pressure-sensitive-adhesive properties. The upper limit value of the softening point of the tackifier is not particularly limited. However, if the softening point becomes too high, the tackifier may become higher in molecular weight to be deteriorated in the compatibility to cause inconveniences, such as whitening, unfavorably. The upper limit value of the softening point of the tackifier is, for example, preferably about 200°C or lower, more

preferably about 180°C or lower. The softening point of the tackifier that is referred to herein is defined as a value measured by a softening point testing method (ring and ball method) prescribed in any one of JIS K5902 and JIS K2207.

[0128]

The weight-average molecular weight (M_w) of the tackifier is not particularly limited, and is preferably 50000 or less, preferably 30000 or less, more preferably 10000 or less, even more preferably 8000 or less, in particular preferably 5000 or less. The lower limit value of the weight-average molecular weight of the tackifier is not particularly limited, and is preferably 500 or more, more preferably 1000 or more, even more preferably 2000 or more. When the weight-average molecular weight of the tackifier is in any one of these ranges, the tackifier is favorably good in compatibility with the polyisobutylene not to cause inconveniences such as whitening.

[0129]

The addition amount of the tackifier is preferably 40 parts or less by weight, more preferably 30 parts or less by weight, even more preferably 20 parts or less by weight for 100 parts by weight of polyisobutylene. The lower limit value of the addition amount of the tackifier is not particularly limited, and is preferably 0.1 part or more by

weight, more preferably 1 part or more by weight, even more preferably 5 parts or more by weight. It is preferred to set the use amount of the tackifier into any one of the ranges in order that the composition can improve the pressure-sensitive-adhesive properties. If the use amount of the tackifier is over these ranges to result in a large-amount addition thereof, the pressure-sensitive adhesive unfavorably tends to be lowered in cohesive power.

[0130]

A tackifier other than the tackifiers each containing a terpene skeleton and the tackifiers each containing a rosin skeleton may be added to the rubber-based pressure-sensitive-adhesive composition used in the present invention. This tackifier may be a petroleum-based resin tackifier. Examples of the petroleum-based resin tackifier include aromatic petroleum resins, aliphatic petroleum resins, alicyclic petroleum resins (aliphatic cyclic petroleum resins), aliphatic/aromatic petroleum resins, aliphatic/alicyclic petroleum resins, hydrogenated petroleum resins, coumarone-based resins, and coumarone indene-based resins.

[0131]

The petroleum-based resin tackifier may be used as far as the advantageous effects of the present invention are not damaged. The tackifier may be used, for example,

in an amount of about 30 parts or less by weight for 100 parts by weight of the polyisobutylene.

[0132]

An organic solvent may be added as a diluent to the rubber-based pressure-sensitive-adhesive composition. The diluent is not particularly limited. Examples thereof include toluene, xylene, n-heptane, and dimethyl ether. These may be used singly or in the form of a mixture of two or more thereof. Thereamong, toluene is preferred.

[0133]

The addition amount of the diluent is not particularly limited, and is preferably from about 50 to 95 % by weight, more preferably from about 70 to 90 % by weight in the rubber-based pressure-sensitive-adhesive composition. From the viewpoint of the paintability of the composition onto a support and others, the addition amount of the diluent in the ranges is preferred.

[0134]

An additive other than the above-mentioned additives may be added to the rubber-based pressure-sensitive-adhesive composition used in the present invention as far as the advantageous effects of the invention are not damaged. Examples of the additive(s) include a softener, a crosslinking agent (such as polyisocyanate, epoxy compounds, and alkyl etherized melamine compounds), a

filler, an antiaging agent and an ultraviolet absorbent. The species, the combination, the addition amount, and other factors of the additive(s) added in the rubber-based pressure-sensitive-adhesive composition may be appropriately set in accordance with a purpose thereof. The content amount (total amount) of the additive(s) in the rubber-based pressure-sensitive-adhesive composition is preferably 30% or less by weight, more preferably 20% or less by weight, even more preferably 10% or less by weight.

[0135]

The pressure-sensitive-adhesive layer used in the present invention can be formed, using the above-mentioned pressure-sensitive-adhesive composition. A producing method thereof is not particularly limited. This layer can be formed, for example, by applying the pressure-sensitive-adhesive composition onto, for example, a support that may be of various types, and then subjecting the resultant to, for example, heating and drying, or the radiation of an active energy ray.

[0136]

When the above-mentioned rubber-based pressure-sensitive-adhesive composition includes polyisobutylene, it is preferred to radiate an active energy ray to the pressure-sensitive-adhesive composition to crosslink the polyisobutylene. In the radiation of the active energy

ray, usually, the above-defined rubber-based pressure-sensitive-adhesive composition is applied onto, for example, a support that may be of various types, and the active energy ray is radiated onto the resultant applied layer. About the radiation of the active energy ray, the active energy ray may be directly radiated onto the applied layer (without bonding any other member or the like to this layer). Alternatively, the radiation may be performed after an optical film, or a member that may be of various types is bonded onto the applied layer. An example of the optical film is a separator, and an example of the member is a glass piece. In the case where the radiation is performed after the optical film or the member, which may be of various types, is bonded onto the applied layer, the active energy ray may be radiated across the optical film or the member, which may be of various types. Alternatively, after the optical film or the member, which may be of various types, is peeled off from the applied layer, the active energy ray may be radiated onto the applied layer from its film- or member-peeled surface.

[0137]

The method for applying the pressure-sensitive-adhesive composition may be a method of various types. Specific examples thereof include roll coating, kiss roll coating, gravure coating, reverse coating, roll brushing,

spray coating, dip roll coating, bar coating, knife coating, air knife coating, curtain coating, lip coating, and an extrusion coating method through, for example, a die coater.

[0138]

When the applied layer of the pressure-sensitive-adhesive composition is heated and dried, the heating and drying temperature is preferably from about 30 to 200°C, more preferably from 40 to 180°C, even more preferably from 80 to 150°C. When the heating temperature is set in any one of these ranges, a pressure-sensitive-adhesive layer can be yielded which has very good pressure-sensitive-adhesive properties. About the drying period, a suitable period is appropriately adoptable. The drying period is preferably from about 5 seconds to 20 minutes, more preferably from 30 seconds to 10 minutes, even more preferably from 1 to 8 minutes.

[0139]

Also in the case of radiating an active energy ray to the applied layer of the pressure-sensitive-adhesive composition, it is preferred that when the adhesive or pressure-sensitive-adhesive composition contains an organic solvent as a diluent, the organic solvent and others are removed, for example, by heating and drying after the applying of the composition and before the radiation of the

active energy ray.

[0140]

The heating and drying temperature is not particularly limited, and is preferably from about 30 to 90°C, more preferably from about 60 to 80°C to reduce the quantity of the remaining solvent. About the drying period, a suitable period may be appropriately adopted. The drying period is preferably from about 5 seconds to 20 minutes, more preferably from 30 seconds to 10 minutes, even more preferably from 1 to 8 minutes.

[0141]

Examples of the active energy ray include visible rays, ultraviolet rays, and an electron beam. Thereamong, ultraviolet rays are preferred.

[0142]

Conditions for the ultraviolet ray radiation are not particularly limited. Thus, arbitrary appropriate conditions may be set in accordance with the composition of the rubber-based pressure-sensitive-adhesive composition to be crosslinked. For example, the integrated quantity of the radiated ray is preferably from 100 to 2000 mJ/cm².

[0143]

The support may be, for example, a release-treated sheet (separator) and above-mentioned retardation film.

[0144]

The constituent material of the separator is, for example, a plastic film such as polyethylene, polypropylene, polyethylene terephthalate or polyester film, a porous material such as paper, cloth or nonwoven fabric, a net, a foamed sheet or a metal foil piece; a laminate composed of two or more of these examples; or any other appropriate thin sheet piece. The plastic film is preferred since the film is excellent in surface smoothness.

[0145]

Examples of the plastic film include a polyethylene film, a polypropylene film, a polybutene film, a polybutadiene film, a polymethylpentene film, a polyvinyl chloride film, a vinyl chloride copolymer film, a polyethylene terephthalate film, a polybutylene terephthalate film, a polyurethane film, and an ethylene-vinyl acetate copolymer film.

[0146]

The thickness of the separator is usually from about 5 to 200 μm , preferably from about 5 to 100 μm . As required, the separator may be subjected to release treatment with a silicone-based, fluorine-containing compound-based, long-chain alkyl-based or aliphatic acid amide-based release agent, or with silica powder; or to antifouling treatment or antistatic treatment of, for

example, a applying type, a material-kneading-in type or a vapor deposition type. When a surface of the separator is appropriately subjected, particularly, to release treatment such as silicone treatment, long-chain alkyl treatment or fluorine treatment, the separator can be made higher in releasability from the pressure-sensitive adhesive layer.

[0147]

When the pressure-sensitive-adhesive/adhesive layer is formed onto a release-treated sheet (separator), the pressure-sensitive-adhesive layer can be transferred onto a retardation film to form a pressure-sensitive-adhesive/adhesive layer attached optical film of the present invention. In this case, the release-treated sheet, which is used to produce the pressure-sensitive-adhesive layer attached optical film, is usable, as it is, as a separator for a rubber-based pressure-sensitive-adhesive layer attached optical film. Thus, the production thereof can be simplified from the viewpoint of a process therefor.

[0148]

The thickness of the pressure-sensitive-adhesive layer of the present invention is not particularly limited, and may be appropriately set in accordance with the usage thereof. The thickness is preferably 250 μm or less, more preferably 100 μm or less, more preferably 55 μm or less.

The lower limit value of the thickness of the pressure-sensitive-adhesive layer is not particularly limited, and is preferably 1 μm or more, more preferably 5 μm or more from the viewpoint of the endurance of the layer.

[0149]

The gel fraction in the pressure-sensitive-adhesive layer used in the present invention is not particularly limited, and is preferably from about 10 to 98%, more preferably from about 25 to 98%, even more preferably from about 45 to 90%. When the gel fraction is in any one of the ranges, this layer can favorably attain compatibility between endurance and adhesive strength. The gel fraction is measurable by a method in the item EXAMPLES.

[0150]

(3) Other Layers

The retardation film, which functions as a $\lambda/4$ plate and is included in the optical film of the present invention for organic EL display device, and the pressure-sensitive-adhesive/adhesive layer, which has a moisture permeability of 50 $\text{g}/(\text{m}^2 \cdot \text{day})$ or less at 40°C and 92% R.H., may be laminated to each other to contact each other, or to have another layer between these members.

[0151]

Examples of the other layer include an adhesive layer or pressure-sensitive-adhesive layer other than the above-

mentioned pressure-sensitive-adhesive/adhesive layer (that is, an adhesive layer or pressure-sensitive-adhesive layer having a moisture permeability more than 50 g/(m²·day) at 40°C and 92% R.H.); and an undercoat layer (primer layer), and other intervening layers.

[0152]

The adhesive layer is formed, using an adhesive. The species of the adhesive is not particularly limited. Thus, the adhesive layer may be of various types. The adhesive layer is not particularly limited as far as this layer is optically transparent. The adhesive may be in various forms, such as water-based, solvent-based, hot-melt, and active energy ray curable forms. A water-based adhesive or active energy ray curable adhesive is preferred.

[0153]

At the time of laminating the retardation film and the pressure-sensitive-adhesive/adhesive layer to each other, an adhesion-facilitating layer may be laid between these members. The adhesion-facilitating layer may be made of a resin that may be of various types, which has, for example, a polyester, polyether, polycarbonate, polyurethane, silicone, polyamide, polyimide or polyvinyl alcohol skeleton. Such polymers may be used alone or in any combination of two or more thereof. In the formation of the adhesion-facilitating layer, an additive different

from the polymer(s) may be added thereto. Specifically, for example, the following may be used: a tackifier, an ultraviolet absorbent, an antioxidant, and stabilizers such as a heat-resistant stabilizer.

[0154]

The optical film of the present invention is used for organic EL display devices. The optical film is usable together with a polarizer, which will be detailed later, to constitute an anti-reflection film for organic EL display devices (a polarizing film for organic EL display devices).

[0155]

2. Polarizing Film for Organic EL Display Devices

The polarizing film of the present invention for organic EL display devices includes a polarizer, and the above-defined optical film for organic EL display devices.

[0156]

About the polarizing film of the present invention for organic EL display devices, the structure thereof is not particularly limited as far as the structure includes a polarizer and the above-defined optical film for organic EL display devices. The structure is, for example a structure having a polarizer, the retardation film 3a, and the pressure-sensitive-adhesive/adhesive layer 2 in this order; or a structure having a polarizer, the pressure-sensitive-adhesive/adhesive layer 2, and the retardation film 3a in

this order.

[0157]

The polarizer 5a is usable as a single-surface-protected polarizing film in which the polarizer 5a has, on a single surface thereof, a protective film; or a double-surface-protected polarizing film in which the polarizer 5a has, on both surfaces thereof, protective films, respectively.

[0158]

With reference to Figs. 3, the following will describe, in more detail, the structure of the polarizing film of the present invention for organic EL display devices.

[0159]

When the polarizing film is used as a single-surface-protected polarizing film 5A including the polarizer 5a, the polarizing film can be rendered, as illustrated in Fig. 3(a) a polarizing film composed of a protective film 5b/the polarizer 5a/an adhesive layer or a pressure-sensitive-adhesive layer 4/a retardation film 3a/a pressure-sensitive-adhesive/adhesive layer 2. When the polarizing film is used as a double-side-protected polarizing film 5B including the polarizer 5a, the polarizing film can be rendered, as illustrated in Fig. 3(b) a polarizing film composed of a protective film 5b/the polarizer 5a/a

protective film 5b/an adhesive layer or a pressure-sensitive-adhesive layer 4/a retardation film 3a/a pressure-sensitive-adhesive/adhesive layer 2.

[0160]

In each of these structures (in the case of using only the retardation film 3a), the angle made between the absorption axis of the polarizer 5a and the slow axis of the retardation film 3a is preferably from 35 to 55°, more preferably from 38 to 52°, even more preferably from 40 to 50°, even more preferably from 42 to 48°, in particular preferably from 44 to 46°. When the angle is in any one of these ranges, the polarizing film favorably realizes a desired circularly polarizing function. When any angle is referred to as in the document DESCRIPTION, the angle includes both of a clockwise angle, and a counterclockwise angle unless evidently described otherwise.

[0161]

About each of the above-mentioned structures, the case of using only the first retardation film 3a as a retardation film has been given as an example. However, the structure may be a structure using the second retardation film 3b, as described above. In this case, the above-mentioned structures are turned into the following structures, respectively: a protective film 5b/a polarizer 5a/an adhesive layer or a pressure-sensitive-adhesive layer

4/a retardation film 3a/an adhesive layer or a pressure-sensitive-adhesive layer 4/a retardation film 3b/a pressure-sensitive-adhesive/adhesive layer 2; and a protective film 5b/a polarizer 5a/a protective film 5b/an adhesive layer or a pressure-sensitive-adhesive layer 4/a retardation film 3a/an adhesive layer or a pressure-sensitive-adhesive layer 4/a retardation film 3b/a pressure-sensitive-adhesive/adhesive layer 2.

[0162]

In each of these structures (in the case of using the retardation films 3a and 3b), the angle made between the absorption axis of the polarizer 5a and the slow axis of the first retardation film 3a is preferably from 65 to 85°, more preferably from 72 to 78°, even more preferably from 74 to 76°. The angle made between the absorption axis of the polarizer 5a and the slow axis of the second retardation film 3b is preferably from 10 to 20°, more preferably from 13 to 17°, even more preferably from 14 to 16°. When the two retardation films are located to have axial angles as described above, a circularly polarizing plate is favorably gained which has an especially good circularly polarizing property (and thus having an especially good anti-reflection property) in a broad frequency band.

[0163]

Hereinafter, a description will be made about the individual constituent elements used in the polarizing film of the present invention for organic EL display devices.

[0164]

(Optical Film for Organic EL Display Devices)

The optical film for organic EL display devices may be the above-mentioned optical film.

[0165]

(Polarizer)

The polarizer is not particularly limited, and may be a polarizer of various types. For example, the polarizer may be a product produced by a process including adsorbing a dichroic material such as iodine or a dichroic dye to a hydrophilic polymer film such as a polyvinyl alcohol-based film, a partially-formalized polyvinyl alcohol-based film, or a partially-saponified, ethylene-vinyl acetate copolymer-based film and uniaxially stretching the film, or may be a polyene-based oriented film such as a film of a dehydration product of polyvinyl alcohol or a dehydrochlorination product of polyvinyl chloride. Among these polarizers, a polarizer including a polyvinyl alcohol-based film and a dichroic material such as iodine is preferred. The thickness of these polarizers is not particularly limited, and is generally from about 5 to 80 μm .

[0166]

The polarizer yielded by dyeing a polyvinyl alcohol based film with iodine, and then stretching the resultant uniaxially may be produced, for example, by immersing a polyvinyl alcohol into an aqueous solution of iodine to dye the polyvinyl alcohol, and then stretching the resultant into a length 3 to 7 times the original length. If necessary, the film may also be immersed in an aqueous solution of potassium iodide or the like optionally containing boric acid, zinc sulfate, zinc chloride, or other materials. If necessary, the polyvinyl alcohol-based film may be further immersed in water for washing before it is dyed. If the polyvinyl alcohol-based film is washed with water, dirt and any anti-blocking agent can be cleaned from the surface of the polyvinyl alcohol-based film, and the polyvinyl alcohol-based film can also be allowed to swell so that unevenness such as uneven dyeing can be effectively prevented. The film may be stretched before, while, or after it is dyed with iodine. The film may also be stretched in an aqueous solution of boric acid, potassium iodide, or the like or in a water bath.

[0167]

In the present invention, a thin polarizer of 15 μm or less thickness is preferably used for making the polarizing film thinner, a thin polarizer of 10 μm or less

thickness is more preferably used. For making the polarizing film thinner, the thickness is preferably from 1 to 7 μm . Such a thin polarizer is preferred in the point that the polarizer is small in thickness unevenness, excellent in visibility, and small in dimension change to be excellent in endurance and further the thickness of the polarizing film is also made smaller.

[0168]

Typical examples of the thin polarizer include thin polarizing membranes described in JP-A-S51-069644, JP-A-2000-338329, WO2010/100917 pamphlet, JP-A-2014-59328 and JP-A-2012-73563. These thin polarizing membranes can each be yielded by a producing method including the step of stretching a polyvinyl alcohol-based resin (hereinafter referred to as a PVA-based resin) layer and a resin substrate for stretching in a laminated state, and the step of dyeing the laminate. This producing method makes it possible to stretch the laminate, even when the PVA-based resin layer is thin, without causing any inconvenience, such as breaking, by the stretching based on the supporting of the PVA-based resin layer on the resin substrate for stretching.

[0169]

The thin polarizing membranes are preferably polarizing membranes each yielded by the following

producing method, among producing methods including the step of stretching the members concerned in the laminate state and the step of dyeing the laminate, since the laminate can be stretched into a large stretch ratio to improve the resultant in polarizing performance: a producing method including the step of stretching the laminating in an aqueous solution of boric acid, as is described in a pamphlet of WO 2010/100917, or JP-A-2014-059328 or JP-A-2012-073563; and the membranes are in particular preferably membranes each yielded by a producing method including the step of stretching the laminate supplementally in the air before the stretching in the aqueous solution of boric acid, as is described in JP-A-2014-059328, or JP-A-2012-073563.

[0170]

(Protective Film)

The material for forming the protective film laid on the single or each side of the polarizer is preferably a material excellent in transparency, mechanical strength, thermal stability, water blocking performance, isotropy, and others. Examples thereof include polyester-based polymers such as polyethylene terephthalate, and polyethylene naphthalate; cellulose-based polymers such as diacetylcellulose, and triacetylcellulose; acryl-based polymers such as polymethyl methacrylate; styrene-based

polymers such as polystyrene, and acrylonitrile/styrene copolymer (AS resin); and polycarbonate-based polymers. Other examples of the material for forming the protective film include polyethylene, polypropylene, cyclic or norbornene-structure-containing polyolefins, polyolefin-based polymers such as ethylene/propylene copolymer, vinyl chloride-based polymers, amide-based polymers such as nylon and aromatic polyamides, imide-based polymers, sulfone-based polymers, polyethersulfone-based polymers, polyetheretherketone-based polymers, polyphenylene sulfide-based polymers, vinyl alcohol-based polymers, vinylidene chloride-based polymers, vinylbutyral-based polymers, arylate-based polymers, polyoxymethylene-based polymers, and epoxy-based polymers; and blends of two or more of these polymers. The protective film may also be formed in the form of a cured layer of a thermosetting resin or an ultraviolet curable resin of, for example, acryl-based, urethane-based, acrylic urethane-based, epoxy-based or silicone-based resin. When protective films are laid, respectively, on both sides of the polarizer, protective films made of the same polymeric material may be used on the front and rear sides, or protective films made of, for example, different polymeric materials may be used on the two sides.

[0171]

The thickness of the protective film may be appropriately determined, and is generally from about 1 to 500 μm from the viewpoint of the strength, the handleability and other workabilities, the thin film property, and other properties of the film.

[0172]

The polarizer and the protective film are usually bonded to each other through, for example, a water-based adhesive. Examples of the water-based adhesive include isocyanate-based adhesives, polyvinyl alcohol-based adhesives, gelatin-based adhesives, vinyl-containing latex-based adhesives, water-based polyurethanes, and water-based polyesters. The adhesive for the polarizer and the protective film is, besides these adhesives, an ultraviolet-ray curing-type adhesive, or an electron-beam curing-type adhesive. The electron-beam curing-type adhesive for polarizing films shows an adhesion suitable for the above-mentioned various protective films. A metal compound filler may be incorporated into the adhesive used in the present invention.

[0173]

A hard coat layer or a treatment may be applied onto the surface of the protective film onto which no polarizer is bonded, examples of the treatment including an anti-reflection treatment, or a treatment for sticking-

prevention, diffusion or anti-glaring.

[0174]

(Adhesive Layer or Pressure-Sensitive-Adhesive Layer)

The adhesive layer or pressure-sensitive-adhesive layer 4, which is used to bond the polarizing film 5 and the retardation film 3a to each other, or bond the retardation film 3a and the retardation film 3b to each other, is not particularly limited, and may be favorably any one of the adhesive layers or pressure-sensitive-adhesive layers described in the document DESCRIPTION. Specifically, for bonding the retardation film 3a to the retardation film 3b, for example, an acryl-based pressure-sensitive adhesive including, as a base polymer thereof, a (meth)acryl-based polymer is preferred since this pressure-sensitive adhesive is very good in optical transparency, shows pressure-sensitive-adhesive properties of appropriate wettability, cohesive property and adhesion, and is very good in weather resistance, heat resistance and others. For bonding the polarizing film 5 to the retardation film 3a, for example, the above-mentioned water-based adhesive may be given, which is used to bond the polarizer and the protective film to each other. Specifically, a polyvinyl alcohol adhesive is preferred.

[0175]

(Other Layers)

The polarizing film of the present invention for organic EL display devices may include an adhesive layer or pressure-sensitive-adhesive layer other than the above-defined adhesive layer or pressure-sensitive-adhesive layer; an undercoat layer (primer layer), and other intervening layers; and an adhesion-facilitating layer. The intervening layer and the adhesion-facilitating layer may each be the same intervening layer or adhesion-facilitating layer as described above.

[0176]

A function layer may be laid in the polarizing film of the present invention for organic EL display devices. The laying of the function layer favorably makes it possible to restrain the generation of through-cracks, nano-slits, and other defects generated in the polarizer. The function layer may be formed, using a forming-material that may be of various types. The function layer can be formed, for example, by applying a resin material onto the polarizer.

[0177]

Examples of the resin material, which forms the function layer, include polyester based resin, polyether based resin, polycarbonate based resin, polyurethane based resin, silicone based resin, polyamide based resin, polyimide based resin, PVA based resin, and acryl-based

resin. These resins may be used alone or in any combination of two or more thereof. Among these resins, preferred are one or more selected from polyurethane based resin and polyvinyl alcohol (PVA) based resin, and more preferred is PVA based resin. The form of the resin may be any one of water-based and solvent-based forms. About the form of the resin, the water-based resin is preferred. PVA based resin is preferred. As the water-based resin, an aqueous solution of acryl-based resin or an aqueous solution of urethane resin is usable.

[0178]

If the function layer is too thick, this layer is lowered in optical reliability and water resistance. Thus, the thickness of the function layer is preferably 15 μm or less, more preferably 10 μm or less, even more preferably 8 μm or less, even more preferably 6 μm or less, even more preferably 5 μm or less, in particular preferably 3 μm or less. In the meantime, the thickness of the function layer is preferably 0.2 μm or more, more preferably 0.5 μm or more, even more preferably 0.7 μm or more. The function layer having such a thickness can be favorably restrained from being cracked.

[0179]

The total thickness of the above-defined polarizing film (including, besides a polarizer and a transparent

protective film, an intervening layer and a function layer) is preferably from 3 to 115 μm , more preferably from 43 to 60 μm , even more preferably from 14 to 48 μm to make the polarizing film thinner.

[0180]

The polarizing film of the present invention for organic EL display devices makes use of the optical film for organic EL display devices to be very good in low-moisture-permeability. The polarizing film of the invention for organic EL display devices is bonded to an organic EL element through the pressure-sensitive-adhesive/adhesive layer 2. Thus, the pressure-sensitive-adhesive/adhesive layer 2 is arranged near the organic EL element, so that the shift of water and others to the organic EL element can be sufficiently restrained.

[0181]

3. Pressure-Sensitive-Adhesive Layer Attached Polarizing Film for Organic EL Display Devices

The pressure-sensitive-adhesive layer attached polarizing film of the present invention has the above-defined polarizing film for organic EL display devices, and further has a pressure-sensitive-adhesive layer on a polarizer side of this polarizing film.

[0182]

As illustrated in Fig. 4, a pressure-sensitive-

adhesive layer attached polarizing film 8 of the present invention for organic EL display devices is a product having a polarizing film 6 of the invention for organic EL display devices, and a pressure-sensitive-adhesive layer 7 on a polarizing-film-5-side of this polarizing film 6.

[0183]

The polarizing film for organic EL display devices may be the same as described above.

[0184]

The pressure-sensitive-adhesive layer 7 is not particularly limited, and may be any known pressure-sensitive-adhesive layer. The pressure-sensitive-adhesive layer may also be the same low-moisture-permeability pressure-sensitive-adhesive layer as described above. As such a pressure-sensitive-adhesive layer, specifically, the following is appropriately selectable to be used: a pressure-sensitive-adhesive layer including, as its base polymer, one or more out of (meth)acryl-based polymers, silicone based polymers, polyester, polyurethane, polyamide, polyether, fluorine-contained polymers, and rubber-based polymers. Among such pressure-sensitive adhesives, preferred is an acryl-based pressure-sensitive adhesive including, as its base polymer, a (meth)acryl-based polymer since the adhesive is very good in optical transparency, shows pressure-sensitive-adhesive properties

of appropriate wettability, cohesive property and adhesion, and is very good in weather resistance and heat resistance.

[0185]

The (meth)acryl-based polymer is not particularly limited, and is, for example, a polymer yielded by polymerizing monomer components including an alkyl (meth)acrylate having an ester group having, at a terminal thereof, an alkyl group having 4 to 24 carbon atoms. The wording "alkyl (meth)acrylate" denotes an alkyl acrylate and/or an alkyl methacrylate. In the present invention, the expression "(meth)" has substantially the same meanings.

[0186]

Examples of the alkyl (meth)acrylate include (meth)acrylates each having a linear or branched alkyl group of 4 to 24 carbon atoms. Thereamong, an alkyl (meth)acrylate having a linear or branched alkyl group of 4 to 9 carbon atoms is preferred since the resultant polymer easily takes a good balance between pressure-sensitive-adhesive properties. These alkyl (meth)acrylate may be used alone or in a mixture of two or more.

[0187]

The monomer components for forming the (meth)acryl-based polymer may include, as a monofunctional monomer, a copolymerizable monomer other than the alkyl

(meth)acrylate. Such copolymerizable monomers, for example, may include a cyclic nitrogen-containing monomer, a hydroxyl group-containing monomer, a carboxyl group-containing monomer, and a cyclic ether group-containing monomer.

[0188]

If necessary, the monomer component used to form the (meth)acryl-based polymer may contain a polyfunctional monomer for controlling the cohesive strength of the pressure-sensitive adhesive in addition to the monofunctional monomers. The polyfunctional monomer is a monomer having at least two polymerizable functional groups with an unsaturated double bond such as (meth)acryloyl group or vinyl group, and examples thereof include dipentaerythritol hexa(meth)acrylate, 1,6-hexanediol di(meth)acrylate and trimethylolpropane tri(meth)acrylate. The polyfunctional monomer can be used alone or in combination of two or more.

[0189]

The (meth)acryl-based polymer described above can be produced using a method appropriately selected from known production methods, such as solution polymerization, radiation polymerization such as ultraviolet ray polymerization, bulk polymerization, and various radical polymerization methods including emulsion polymerization.

The resultant (meth)acryl-based polymer may be any of a random copolymer, a block copolymer, a graft copolymer, or any other form.

[0190]

A polymerization initiator, a chain transfer agent, an emulsifier and others that are used in each of the radical polymerizations are not particularly limited; and these are appropriately selectable from known ones used ordinarily in the present field, so as to be used. Also, the weight average molecular weight of the (meth)acryl-based polymer may be controlled by the reaction conditions including the amount of addition of the polymerization initiator or the chain transfer agent. The amount of the addition may be controlled as appropriate depending on the type of these materials.

[0191]

In the invention, the (meth)acryl-based polymer preferably has a weight average molecular weight of 400,000 to 4,000,000. When the weight average molecular weight is more than 400,000, the pressure-sensitive adhesive layer can have satisfactory durability and can have a cohesive strength small enough to suppress adhesive residue. On the other hand, if the weight average molecular weight is more than 4,000,000, bonding ability may tend to be lower. In this case, the pressure-sensitive adhesive may form a

solution with too high a viscosity, which may be difficult to apply. As used herein, the term "weight average molecular weight" refers to a polystyrene-equivalent weight average molecular weight, which is determined using gel permeation chromatography (GPC). It should be noted that the molecular weight of the (meth)acryl-based polymer obtained by radiation polymerization would be difficult to measure.

[0192]

The pressure-sensitive adhesive composition used in the present invention may contain a crosslinking agent. Examples of the crosslinking agents include an isocyanate crosslinking agent, an epoxy crosslinking agent, a silicone crosslinking agent, an oxazoline crosslinking agent, an aziridine crosslinking agent, a silane crosslinking agent, an alkyl etherified melamine crosslinking agent, a metallic chelate crosslinking agent and a peroxide. Such crosslinking agents may be used alone or in combination of two or more. An isocyanate crosslinking agent or an epoxy crosslinking agent is preferably used as the crosslinking agent.

[0193]

These crosslinking agents may be used alone or in a mixture of two or more. The total content of the crosslinking agent(s) is preferably 0.01 to 10 parts by

weight based on 100 parts by weight of the (meth)acryl-based polymer.

[0194]

The pressure-sensitive adhesive composition used in the present invention may contain a (meth)acryl-based oligomer in view of improving adhesive strength. The pressure-sensitive adhesive composition used in the present invention may further contain a silane coupling agent for improving water resistance at the interface between the pressure-sensitive adhesive layer and a hydrophilic adherend, such as glass, bonded thereto.

[0195]

The pressure-sensitive adhesive composition used in the present invention may also contain any other known additive. For example, a polyether compound such as a polyalkylen glycol exemplified a polypropylene glycol, a powder such as a colorant and a pigment, a dye, a surfactant, a plasticizer, a tackifier, a surface lubricant, a leveling agent, a softening agent, an antioxidant, an age resister, a light stabilizer, an ultraviolet absorbing agent, a polymerization inhibitor, an inorganic or organic filler, a metal powder, or a particle- or foil-shaped material may be added as appropriate depending on the intended use. A redox system including an added reducing agent may also be used in the controllable

range.

[0196]

The method for forming the pressure-sensitive-adhesive layer 7 may be a known method.

[0197]

4. Organic EL Display Device

The organic EL display device of the present invention has the above-defined polarizing plate for organic EL display devices, or the above-defined pressure-sensitive-adhesive layer attached polarizing plate.

[0198]

The organic EL display device of the present invention is a device including the polarizing plate of the invention for organic EL display devices, or the pressure-sensitive-adhesive layer attached polarizing plate of the invention, and can be bonded to an organic EL element through the pressure-sensitive-adhesive/adhesive layer 2. Other constituents of the organic EL display device of the present invention may be the same as those that conventional organic EL display devices have.

[0199]

The organic EL display device of the present invention includes the above-defined polarizing plate for organic EL display devices or the above-defined pressure-sensitive-adhesive layer attached polarizing plate; thus,

this organic EL display device has a high optical reliability.

EXAMPLES

[0200]

Hereinafter, the present invention will be specifically described by way of working examples thereof. However, the invention is not limited to these examples. In each of the examples, the word "part(s)" and the symbol "%" are part(s) by weight and % by weight, respectively.

[0201]

Production Example 1 (Production of First Retardation Layer)

37.5 Parts by mass of isosorbide (ISB), 91.5 parts by mass of 9,9-bis[4-(2-hydroxyethoxy)phenyl]fluorene (BHEPF), 8.4 parts by mass of polyethylene glycol (PEG) having an average molecular weight of 400, 105.7 parts by mass of diphenyl carbonate (DPC), and 0.594 part by mass of (a 0.2 mass % aqueous solution of) cesium carbonate as a catalyst were loaded into a reaction vessel. Under a nitrogen atmosphere, as a first step of a reaction, the heating medium temperature of the reaction vessel was set to 150°C, and the raw materials were dissolved while being stirred as required (for about 15 minutes).

[0202]

Next, a pressure in the reaction vessel was increased from normal pressure to 13.3 kPa, and produced phenol was extracted to the outside of the reaction vessel while the heating medium temperature of the reaction vessel was increased to 190°C in 1 hour. A temperature in the reaction vessel was held at 190°C for 15 minutes. After that, as a second step, the pressure in the reaction vessel was set to 6.67 kPa, the heating medium temperature of the reaction vessel was increased to 230°C in 15 minutes, and the produced phenol was extracted to the outside of the reaction vessel. The temperature was increased to 250°C in 8 minutes because the stirring torque of a stirring machine increased. In order for the produced phenol to be further removed, the pressure in the reaction vessel was reduced to 0.200 kPa or less. After the stirring torque had reached a predetermined value, the reaction was completed, and a produced reaction product was extruded into water and then pelletized. Thus, a polycarbonate resin A including structural units derived from dihydroxy compounds at a ratio "BHEPF/ISB/PEG" of 42.9 mol%/52.8 mol%/4.3 mol% was obtained. The resultant polycarbonate resin A had a glass transition temperature of 126°C and a reduced viscosity of 0.372 dL/g. The resultant polycarbonate resin A was dried in a vacuum at 80°C for 5 hours. After that, a polycarbonate resin film having a length of 3 m, a width of

300 mm, and a thickness of 120 μm was produced by using a film-producing apparatus including a uniaxial extruder (manufactured by Isuzu Kakoki, screw diameter: 25 mm, cylinder preset temperature: 220°C), a T-die (width: 300 mm, preset temperature: 220°C), a chill roll (preset temperature: 120 to 130°C), and a rolling machine. The resultant polycarbonate resin film had a water absorption rate of 1.2%.

[0203]

The resultant polycarbonate resin film was cut into a piece measuring 300 mm long by 300 mm wide, and the piece was subjected to longitudinal stretching with Lab Stretcher KARO IV (manufactured by Bruckner) at a temperature of 136°C and a ratio of 2 times to provide a retardation film. The resultant retardation film had an $\text{Re}(550)$ of 141 nm and an $\text{Rth}(550)$ of 141 nm (n_x : 1.5969, n_y : 1.5942, n_z : 1.5942), and showed a refractive index characteristic of $n_x > n_y = n_z$. In addition, the resultant retardation film had a ratio “ $\text{Re}(450)/\text{Re}(550)$ ” of 0.89. Further, the film showed a retardation fluctuation by an environmental test of 5 nm.

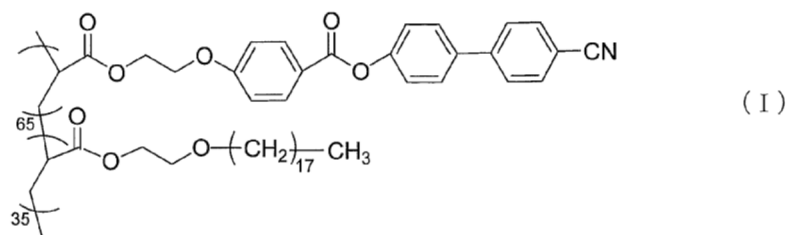
[0204]

Production Example 2 (Production of Second Retardation Layer (Second Retardation Film))

20 Parts by weight of a side chain-type liquid crystal polymer represented by the following chemical

formula (I) (numerical values "65" and "35" in the formula each represent the mole percent of a monomer unit, which is represented in the form of a block polymer for convenience: weight-average molecular weight: 5,000), 80 parts by weight of a polymerizable liquid crystal showing a nematic liquid crystal phase (manufactured by BASF: trade name "Paliocolor LC242"), and 5 parts by weight of a photopolymerization initiator (manufactured by Ciba Specialty Chemicals Inc.: trade name "IRGACURE 907") were dissolved in 200 parts by weight of cyclopentanone to prepare a liquid crystal application liquid. Then, the application liquid was applied to a base material film (norbornene-based resin film: manufactured by ZEON CORPORATION, trade name "ZEONEX") with a bar coater, and was then dried by heating at 80°C for 4 minutes to align the liquid crystal. The liquid crystal layer was cured by irradiating the liquid crystal layer with UV light. Thus, a cured liquid crystal layer (thickness: 0.58 μm) serving as a second retardation layer was formed on the base material. The layer had an $R_e(550)$ of 0 nm and an $R_{th}(550)$ of -71 nm (n_x : 1.5326, n_y : 1.5326, n_z : 1.6550), and showed a refractive index characteristic of $n_z > n_x = n_y$.

[0205]



[0206]

Production Example 3 (Production of Retardation Film A)

The second retardation layer (cured liquid crystal layer) yielded in Production Example 2 was bonded to the first retardation film yielded in Production Example 1 through an acryl-based pressure-sensitive adhesive, and then the base material film was removed therefrom to yield a laminate (retardation film A) in which the cured liquid crystal layer has been transferred on the first retardation film. The resultant retardation film A had a structure composed of the first retardation film/the acryl-based pressure-sensitive-adhesive layer/the second retardation layer. The resultant retardation film A had an Re(550) of 141 nm, and an Rth(550) of 70 nm.

[0207]

Production Example 4 (Production of Retardation film B)

A longitudinal norbornene based resin film (trade name: ZEONOR, manufactured by Nippon Zeon Co., Ltd.; thickness: 50 μ m) was stretched 1.52 times to yield a retardation film B (thickness: 35 μ m) having an Re(550) of

140 nm.

[0208]

Production Example 5 (Production of Retardation film C)

The retardation film A was used as a substrate, and a sputtering target including Al, SiO₂ and ZnO was used to form a first oxide layer (thickness: 30 nm) onto the first retardation film of the substrate by a DC magnetron sputtering method. Next, a Si target was used to form a second oxide layer (thickness: 50 nm) onto the first oxide layer of the laminate composed of the substrate/the first oxide layer. In this way, a retardation film C was produced which had a structure of the second retardation layer/the acryl-based pressure-sensitive-adhesive layer/the first retardation film/the first oxide layer (AZO)/the second oxide layer (SiO₂).

[0209]

Production Example 6 (Production of Optical Film Laminate)

Supplemental stretching in the air at a stretching temperature of 130°C was initially used to stretch a laminate in which a polyvinyl alcohol (PVA) layer of 9 μm thickness was formed on an amorphous polyethylene terephthalate (PET) substrate, thereby producing a stretched laminate. Next, the stretched laminate was dyed to produce a colored laminate. The colored laminate was further stretched into a total stretch ratio of 5.94 in an

aqueous solution of boric acid at a stretching temperature of 65°C to produce an optical film laminate including the PVA layer of 5 μm thickness, which had been stretched in the state of being integrated with the amorphous PET substrate. This two-stage stretching resulted in the production of an optical film laminate including the PVA layer of 5 μm thickness. This laminate was a laminate in which PVA molecules in the PVA layer formed on the amorphous PET substrate was aligned to a high degree; and in which a highly functional polarizing membrane (polarizer) was configured in which iodine adsorbed by the dyeing was aligned, in the form of a polyiodide ion complex, to a high degree into one direction.

[0210]

Production Example 7 (Production of Rubber-Based Pressure-Sensitive-Adhesive Composition)

A toluene solution (pressure-sensitive adhesive solution) into which the following were blended was prepared to give a solid content of 15% by weight: 100 parts by weight of a polyisobutylene (trade name: OPPANOL B80, manufactured by the company BASF; Mw: about 750000); 5 parts by weight of tricyclodecanedimethanol diacrylate (trade name: NK ESTER A-DCP, which is a bifunctional acrylate and is manufactured by Shin-Nakamura Chemical Co., Ltd.; molecular weight: 304) as a polyfunctional radical

polymerizable compound; 0.5 parts by weight of benzophenone (manufactured by Wako Pure Chemical Industries, Ltd.) as a hydrogen-abstraction type photopolymerization initiator; and 10 parts by weight of completely hydrogenated terpene phenol. In this way, a rubber-based pressure-sensitive-adhesive composition (solution) was prepared.

[0211]

Production Example 8 (Production of Rubber-Based Pressure-Sensitive-Adhesive Composition)

A toluene solution (pressure-sensitive adhesive solution) into which the following were blended was prepared to give a solid content of 15% by weight: 100 parts by weight of a polyisobutylene (trade name: OPPANOL B80, manufactured by the BASF; Mw: about 750000); 10 parts by weight of tricyclodecanedimethanol diacrylate (trade name: NK ESTER A-DCP, which is a bifunctional acrylate and is manufactured by Shin-Nakamura Chemical Co., Ltd.; molecular weight: 304) as a polyfunctional radical polymerizable compound; 0.5 parts by weight of benzophenone (manufactured by Wako Pure Chemical Industries, Ltd.) as a hydrogen-abstraction type photopolymerization initiator; and 10 parts by weight of completely hydrogenated terpene phenol. In this way, a rubber-based pressure-sensitive-adhesive composition (solution) was prepared.

[0212]

Production Example 9 (Production of Acryl-based Pressure-Sensitive Adhesive Composition)

Into a separable flask equipped with a thermostat, a stirrer, a reflux condenser, and a nitrogen gas introducing pipe were charged 99 parts by weight of butyl acrylate (BA) and 1 part by weight of 4-hydroxybutyl acrylate (4HBA) as monomer components, 0.2 part by weight of azoisobutyronitrile as a polymerization initiator, and ethyl acetate as a polymerization solvent to give a solid concentration of 20%. Thereafter, while the liquid was stirred, nitrogen gas was caused to flow into the flask to purge the inside thereof with nitrogen over about one hour. Thereafter, the flask was heated to 60°C to cause the monomer components to react with each other for 7 hours to yield an acryl-based polymer having a weight-average molecular weight (Mw) of 1100000. Into the acryl-based polymer solution (solid weight: 100 parts by weight) were added 0.8 part by weight of trimethylolpropane tolylene diisocyanate (trade name: CORONATE L, manufactured by Nippon Polyurethane Industry Co., Ltd.) as an isocyanate-based crosslinking agent, and 0.1 part by weight of a silane coupling agent (trade name: KBM-403, manufactured by Shin-Etsu Chemical Co., Ltd.) to prepare an acryl-based pressure-sensitive adhesive composition.

[0213]

(Production of Acryl-based Pressure-Sensitive Adhesive Layer)

The acryl-based pressure-sensitive adhesive composition produced above was applied onto a release-treated surface of a 38- μm thickness polyester film (trade name: DIAFOIL MRF, manufactured by Mitsubishi Plastics, Inc.), this surface being a surface subjected to release treatment with silicone, to form an applied layer. Next, the applied layer was dried at 120°C for 3 minutes to form a pressure-sensitive adhesive layer. In this way, a pressure-sensitive adhesive sheet was produced in which the thickness of the pressure-sensitive adhesive layer was 50 μm . The 38- μm thickness polyester film (trade name: DIAFOIL MRF, manufactured by Mitsubishi Plastics, Inc.), this surface being a surface subjected to release treatment with silicone, was bonded onto the pressure-sensitive adhesive surface of the pressure-sensitive adhesive sheet to bring the release-treated surface into contact with the pressure-sensitive adhesive layer. In this way, acryl-based pressure-sensitive adhesive sheet was yielded. The polyester films, with which the two surfaces of the pressure-sensitive adhesive layer were coated, respectively, functioned as release liners (separators).

[0214]

Example 1

(Production of Pressure-Sensitive Adhesive Sheet)

The rubber-based pressure-sensitive-adhesive composition (solution) yielded in Production Example 7 was applied onto a single surface of a 38- μm thickness polyester film (trade name: DIAFOIL MRF, manufactured by Mitsubishi Plastics, Inc.), this surface being a surface subjected to release treatment with silicone, to form an applied layer. Next, the applied layer was dried at 80°C for 3 minutes to form a pressure-sensitive-adhesive layer. In this way, a pressure-sensitive adhesive sheet was produced in which the thickness of the pressure-sensitive-adhesive layer was 50 μm . Moreover, the 38- μm thickness polyester film (trade name: DIAFOIL MRF, manufactured by Mitsubishi Plastics, Inc.), this surface being a surface subjected to release treatment with silicone, was bonded onto the pressure-sensitive-adhesive surface of the pressure-sensitive adhesive sheet to cause the release-treated surface and the pressure-sensitive-adhesive layer to contact each other. The polyester films, with which both surfaces of the pressure-sensitive-adhesive layer were coated, functioned as release liners (separators).

[0215]

One of the separators was peeled, and ultraviolet rays were radiated to the workpiece from the separator-peeled surface thereof at room temperature to yield a

pressure-sensitive adhesive sheet composed of the rubber-based pressure-sensitive-adhesive layer/the separator. About the ultraviolet ray radiation, the light quantity was 1000 mJ/cm² in a UVA band.

[0216]

(Production of Pressure-Sensitive-Adhesive Layer Attached Retardation Film)

The rubber pressure-sensitive adhesive sheet yielded as described was bonded onto the second retardation layer of the retardation film A yielded in Production Example 3 to yield a laminate composed of the retardation film A/the rubber-based pressure-sensitive-adhesive layer/the separator.

[0217]

(Method for Producing Polarizing Film)

While a polyvinyl alcohol based adhesive was applied into a thickness of 0.1 μm onto the front surface of the polarizing membrane (polarizer; thickness: 5 μm) of the optical film laminate yielded in Production Example 6, a protective film (triacetylcellulose (TAC) film (trade name: KC4UYW, manufactured by Konica Minolta Inc.; thickness: 40 μm) was bonded thereto. Thereafter, this workpiece was dried at 50°C for 5 minutes. Next, the amorphous PET substrate was peeled off therefrom to produce a single-surface-protected polarizing film using the thin polarizer.

The retardation film A of the laminate was bonded to the polarizing membrane side of the resultant single-surface-protected polarizing film through a polyvinyl alcohol based adhesive. At this time, the bonding was attained to give an angle of 45° as a counterclockwise angle of the slow axis of the retardation film A to the absorption axis of the polarizer. The resultant polarizing film had a structure composed of the TAC film/the adhesive layer/the polarizer/the resultant adhesive layer/the retardation film A/the rubber-based pressure-sensitive-adhesive layer/the separator.

[0218]

Example 2

(Production of Pressure-Sensitive-Adhesive Layer Attached Retardation Film)

The same way as in Example 1 was performed except that as the retardation film, the retardation film B yielded in Production Example 4 was used. In this way, a laminate was yielded which was composed of the retardation film B/the rubber-based pressure-sensitive-adhesive layer/the separator.

[0219]

(Method for Producing Polarizing Film)

A polarizing film was produced in the same way as in Example 1 except that the resultant laminate was used. The

resultant polarizing film had a structure composed of the TAC film/the adhesive layer/the polarizer/the adhesive layer/the retardation film B/the rubber-based pressure-sensitive-adhesive layer/the separator.

[0220]

Comparative Example 1

(Production of Pressure-Sensitive-Adhesive Layer Attached Retardation Film)

The same way as in Example 1 was performed except that instead of the rubber-based pressure-sensitive-adhesive layer, the acryl-based pressure-sensitive-adhesive layer yielded in Production Example 9 was used. In this way, a laminate was yielded which was composed of the retardation film A/the acryl-based pressure-sensitive-adhesive layer/the separator.

[0221]

(Method for Producing Polarizing Film)

A polarizing film was produced in the same way as in Example 1 except that the resultant laminate was used. The resultant polarizing film had a structure composed of the TAC film/the adhesive layer/the polarizer/the adhesive layer/the retardation film A/the acryl-based pressure-sensitive-adhesive layer/the separator.

[0222]

Measurements described below were made, using the

pressure-sensitive-adhesive composition, the laminate, and the polarizing film yielded in each of the working examples and the comparative example. The evaluation results are shown in Table 1.

[0223]

<Measurement of Moisture Permeability of Pressure-Sensitive-Adhesive Layer>

A triacetylcellulose film (TAC film, manufactured by Konica Minolta, Inc.; thickness: 25 μm) was bonded onto the pressure-sensitive-adhesive surface of the pressure-sensitive adhesive sheet (thickness of its pressure-sensitive-adhesive layer: 50 μm) yielded in each of the working examples and the comparative example. Thereafter, the release liner of the pressure-sensitive adhesive sheet was peeled off therefrom to yield a measuring sample.

Next, this measuring sample was used to measure the moisture permeability (water vapor permeability) thereof by a moisture permeability testing method (cup method according to JIS Z 0208) under the following conditions:

Measuring temperature: 40°C,

Relative humidity: 92%, and

Measuring period: 24 hours.

When the measurement was made, a thermostat was used.

[0224]

<Measurement of Moisture Permeability of Pressure-

Sensitive-Adhesive Layer Attached Retardation Film>

The separator was peeled off from the laminate yielded in each of the working examples and Comparative Example 1, so that the pressure-sensitive adhesive surface thereof was exposed. In this way, a measuring sample was prepared. Next, this measuring sample was used to measure the moisture permeability (water vapor permeability) thereof by a moisture permeability testing method (cup method according to JIS Z 0208) under the following conditions:

Measuring temperature: 40°C,

Relative humidity: 92%, and

Measuring period: 24 hours.

When the measurement was made, a thermostat was used.

[0225]

<Endurance>

The separator was peeled off from the pressure-sensitive-adhesive layer attached polarizing film yielded in each of the working examples and the comparative example. This test piece was bonded onto a glass plate. This was put in an environment of 85°C temperature for 300 hours. Thereafter, the state thereof was observed with the naked eyes or through a loupe (x 20). The state was evaluated in accordance with the following evaluating criterion:

⊙: even when the sample is observed through the loupe, it is not found out that inconveniences (such as foaming and peel) are not caused.

○: such inconveniences cannot be verified with the naked eyes; however, an observation thereof with the loupe demonstrates the generation of slight inconveniences that do not cause any problem against the use of the sample.

×: inconveniences can be verified with the naked eyes.

[0226]

<Viewing Angle Property>

The polarizing film yielded in each of the working examples and the comparative example was cut into a size of 50 mm x 50 mm. From an organic EL display (product name: 15EL9500, manufactured by the company LG), an organic EL panel was taken out. A polarizing film attached to this organic EL panel was peeled and taken off. Instead of this polarizing film, the cut-out polarizing film was bonded thereto to yield an organic EL panel. In Table is shown a result obtained by measuring the reflected hue of this organic EL panel. The "viewing angle property" shows, in an xy chromaticity chart of a CIE standard colorimetric system, the between-two-point distance Δ_{xy} between a reflected hue of a panel in the front-direction thereof, and a reflected hue of the panel in an oblique direction

thereof (maximum value or minimum value at a polar angle of 45°).

The resultant organic EL panel was caused to display a black image to measure the reflected hue thereof, using a viewing angle measuring and evaluating device conoscope, manufactured by Auoronic-MERCHERS GmbH.

O: the distance is 0.07 or less to show a good reflection property. The device is usable as an organic EL device.

x: the distance is more than 0.07 to show a bad reflection property. The device is not usable as an organic EL device.

[Table 1]

	Pressure-sensitive adhesive layer						Retardation film	Evaluation results			
	Rubber-based polymer	Acryl-based polymer	Polyfunctional radical polymerizable compound	Photopolymerization initiator	Tackifier	Film thickness (μm)	Species	Moisture permeability (40°C, 92%RH x 24 h) (g/(m ² ·day))		Endurance	Veiling angle property
	OPPANOL B80		A-DCP bifunctional	Benzophenone hydrogen-abstraction type	Completely hydrogenated terpene phenol			Pressure-sensitive adhesive layer (50 μm)	Pressure-sensitive adhesive layer attached retardation film		
Example 1	100	-	5	0.5	10	50	A	10	10	⊙	○
Example 2	100	-	5	0.5	10	50	B	10	9	⊙	○
Comparative Example 1	-	100	-	-	-	50	A	1000	65	⊙	○

[0228]

In Table 1, representations are as follows:

<Rubber-Based Polymer>

OPPANOL B80: polyisobutylene (manufactured by the BASF; Mw: about 750000)

<Acryl-based Polymer>

Acryl-based pressure-sensitive-adhesive composition yielded in Production Example 9

<Polyfunctional Radical Polymerizable Compound>

A-DCP: tricyclodecanedimethanol diacrylate (trade name: NK ESTER A-DCP, which is a bifunctional acrylate and manufactured by Shin-Nakamura Chemical Co., Ltd.; molecular weight: 304)

<Photopolymerization Initiator>

Benzophenone: hydrogen-abstraction type photopolymerization initiator

<Tackifier>

Completely hydrogenated terpene phenol: completely hydrogenated terpene phenol having a softening point of 160°C and a hydroxyl value of 60

DESCRIPTION OF REFERENCE SIGNS

[0229]

- 1 Optical Film for Organic EL Display Devices
- 2 Pressure-Sensitive-Adhesive/Adhesive Layer

- 3a Retardation Film Functioning $\lambda/4$ Plate (First Retardation Film)
- 3b Retardation Film Functioning $\lambda/2$ Plate (Second Retardation Film)
- 4 Adhesive Layer or Pressure-Sensitive-Adhesive Layer
- 5A Single-Sided Protected Polarizing Film
- 5B Double-Side-Protected Polarizing Film
- 5a Polarizer
- 5b Protective Film
- 6 Polarizing Film for Organic EL Display Devices
- 7 Pressure-Sensitive-Adhesive Layer
- 8 Pressure-Sensitive-Adhesive Layer Attached Polarizing Film for Organic EL Display Devices

CLAIMS

1. An optical film for organic EL display devices, comprising a retardation film functioning as a $\lambda/4$ plate, and a pressure-sensitive-adhesive/adhesive layer having a moisture permeability of 50 g/(m²•day) or less at 40°C, and 92% R.H., wherein the pressure-sensitive-adhesive/adhesive layer is made from a rubber-based pressure-sensitive-adhesive composition comprising polyisobutylene, and hydrogen-abstraction type photopolymerization initiator.

2. The optical film for organic EL display devices according to claim 1, wherein the rubber-based pressure-sensitive-adhesive composition comprises a polyfunctional radical polymerizable compound.

3. A polarizing film for organic EL display devices, comprising a polarizer, and the optical film recited in claim 1 or 2 for organic EL display devices.

4. The polarizing film for organic EL display devices according to claim 3, wherein the polarizer has a thickness of 15 μm or less.

5. The polarizing film for organic EL display

devices according to claim 3 or 4, which comprises the polarizer, the retardation film functioning as the $\lambda/4$ plate, and the pressure-sensitive-adhesive/adhesive layer, the moisture permeability of which is 50 g/(m²•day) or less at 40°C, and 92% R.H., in this order.

6. The polarizing film for organic EL display devices according to claim 3 or 4, which comprises the polarizer, the pressure-sensitive-adhesive/adhesive layer, the moisture permeability of which is 50 g/(m²•day) or less at 40°C, and 92% R.H., and the retardation film functioning as the $\lambda/4$ plate in this order.

7. A pressure-sensitive-adhesive layer attached polarizing film for organic EL display devices, comprising the polarizing film recited in any one of claims 3 to 6 for organic EL display devices, and a pressure-sensitive-adhesive layer on a polarizer side of the polarizing film for organic EL display devices.

8. An organic EL display device, comprising the polarizing film recited in any one of claims 3 to 6 for organic EL display devices, or the pressure-sensitive-adhesive layer attached polarizing film recited in claim 7.