

DESCRIPTION

TITLE OF THE INVENTION: RUBBER-BASED PRESSURE-SENSITIVE-ADHESIVE COMPOSITION, RUBBER-BASED PRESSURE-SENSITIVE-ADHESIVE LAYER, RUBBER-BASED PRESSURE-SENSITIVE-ADHESIVE LAYER ATTACHED OPTICAL FILM, OPTICAL MEMBER, IMAGE DISPLAY DEVICE, AND METHOD FOR PRODUCING RUBBER-BASED PRESSURE-SENSITIVE-ADHESIVE LAYER

TECHNICAL FIELD

[0001]

The present invention relates to a rubber-based pressure-sensitive-adhesive composition, and a rubber-based pressure-sensitive-adhesive layer formed using this rubber-based pressure-sensitive-adhesive composition. The invention also relates to a rubber-based pressure-sensitive-adhesive layer attached optical film, in which the rubber-based pressure-sensitive-adhesive layer is laid on/over an optical film, and an optical member including this rubber-based pressure-sensitive-adhesive layer attached optical film. The invention also relates to an image display device including the pressure-sensitive-adhesive layer attached optical film and/or the optical member. The invention further relates to a method for producing a rubber-based pressure-sensitive-adhesive layer.

BACKGROUND ART

[0002]

In recent years, an image display device such as a liquid crystal display device has been strongly required to be made lighter and thinner. A polarizing film and other various optical members used in the image display device have also been required to be made thinner and lighter.

[0003]

As a polarizing film, known is, for example, a single-side protected polarizing film having a polarizer and a protective film only on a single surface of the polarizer. Such a single-side protected polarizing film can be made thinner and lighter; however, the other single surface of the polarizer is not protected by any protective film, so that the polarizer of the single-side protected polarizing film has a problem of being easily deteriorated by water or others. In the same manner, even a double-side protected polarizing film, the polarizer thereof may be deteriorated by water or others when its protective films are made thin.

[0004]

An organic electroluminescence (EL) panel mounted on an organic electroluminescence display device is very weak against water and oxygen in the atmospheric air. Thus, usually, a barrier layer, or an optical film having a

barrier function is laid on the outer surface of the organic electroluminescence panel. The pressure-sensitive-adhesive layer for bonding thereof is required not to permeate water or others (low moisture permeability).

[0005]

Various optical members used in such an image display device are easily deteriorated by water or others in accordance with the raw material thereof. Thus, a pressure-sensitive-adhesive layer for bonding the optical members to an adherend has been required not to permeate water or others (low moisture permeability).

[0006]

As a material for forming such a low moisture permeability pressure-sensitive-adhesive layer, for example, the following are known: an adhesive composition for sealing which includes a hydrogenated cyclic olefin-based polymer, and a polyisobutylene resin (see, for example, Patent Document 1); a crosslinkable rubber composition including an uncrosslinked conjugated diene-based rubber having an unsaturated bond, and a hydrogen-abstraction type photopolymerization initiator (see, for example, Patent Document 2); and a pressure-sensitive-adhesive composition, which has a high barrier property, including a butyl rubber containing isoprene in a specified amount (see, for example, Patent Document 3).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0007]

Patent Document 1: JP-A-2009-524705

Patent Document 2: JP-A-2010-180370

Patent Document 3: JP-A-2015-522664

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0008]

It is stated that the pressure-sensitive adhesives or the like in Patent Documents 1 to 3 have, for example, a water barrier property and a gas barrier property.

However, when the pressure-sensitive-adhesive layers described in these documents are stored in a high-temperature environment, inconveniences that the layers are partially raised and separated, or peeled off may be caused. About Patent Document 1, this matter is not examined about the crosslinkage of the rubber-based resin.

Patent Documents 2 and 3 state that a rubber is crosslinked. However, the rubber that is a rubber having an unsaturated bond is crosslinked. This crosslinkage is a crosslinkage making use of unsaturated bonds in the rubber. When the proportion of the unsaturated bonds is small, such

a crosslinkage makes no improvement of the rubber in endurance since the crosslinkage density therein is low. When the proportion of the unsaturated bonds is large, remaining fractions of the unsaturated bonds are deteriorated by sunlight or the like, so that the rubber turns yellow or its main chain is cut. Consequently, the rubber may undergo a problem against practical use.

[0009]

Thus, an object of the present invention is to provide a rubber-based pressure-sensitive-adhesive composition capable of forming a rubber-based pressure-sensitive-adhesive layer which is low in moisture permeability and has such a high endurance that even in a high-temperature environment, inconveniences that the layer is partially raised and separated, peeled off or damaged into some other form can be restrained from being caused. Another object of the invention is to provide a rubber-based pressure-sensitive-adhesive layer formed, using this pressure-sensitive-adhesive composition, a pressure-sensitive-adhesive layer attached optical film, in which this rubber-based pressure-sensitive-adhesive layer is laid, and an optical member including this rubber-based pressure-sensitive-adhesive layer attached optical film. Still another object thereof is to provide an image display device including at least one selected from the group

consisting of the rubber-based pressure-sensitive-adhesive layer attached optical film, and the optical member. A further object thereof is to provide a method for producing the rubber-based pressure-sensitive-adhesive layer.

MEANS FOR SOLVING THE PROBLEMS

[0010]

In order to solve the above-mentioned problems, the inventors have repeatedly made eager investigations to find out a rubber-based pressure-sensitive-adhesive composition described below, and then have achieved the present invention.

[0011]

The present invention relates to a rubber-based pressure-sensitive-adhesive composition, comprising a polyisobutylene, and a hydrogen-abstraction type photopolymerization initiator.

[0012]

The rubber-based pressure-sensitive-adhesive composition of the present invention preferably comprises a polyfunctional radical polymerizable compound in an amount of 20 parts or less by weight for 100 parts by weight of the polyisobutylene.

[0013]

In the rubber-based pressure-sensitive-adhesive

composition of the present invention, the polyfunctional radical polymerizable compound is preferably a compound having at least two (meth)acryloyl groups.

[0014]

In the rubber-based pressure-sensitive-adhesive composition of the present invention, the compound, which has at least two (meth)acryloyl groups, is preferably a bifunctional (meth)acrylate having two (meth)acryloyl groups, and/or a trifunctional (meth)acrylate having three (meth)acryloyl groups.

[0015]

In the rubber-based pressure-sensitive-adhesive composition of the present invention, the hydrogen-abstraction type photopolymerization initiator is preferably a benzophenone-based compound.

[0016]

In the rubber-based pressure-sensitive-adhesive composition of the present invention, the content of the hydrogen-abstraction type photopolymerization initiator is preferably from 0.001 to 10 parts by weight for 100 parts by weight of the polyisobutylene.

[0017]

The rubber-based pressure-sensitive-adhesive composition of the present invention preferably comprises at least one tackifier selected from the group consisting

of a tackifier containing a terpene skeleton and a tackifier containing a rosin skeleton, and hydrogenated products of these tackifiers.

[0018]

The rubber-based pressure-sensitive-adhesive composition of the present invention may be irradiated with an active energy ray to be crosslinked.

[0019]

In the rubber-based pressure-sensitive-adhesive composition of the present invention, the active energy ray is preferably an ultraviolet ray.

[0020]

In the rubber-based pressure-sensitive-adhesive composition of the present invention, a rubber-based pressure-sensitive-adhesive layer which is formed using the rubber-based pressure-sensitive-adhesive composition and which has a thickness of 50 μm preferably has a moisture permeability of 50 $\text{g}/(\text{m}^2 \cdot \text{day})$ or less at 40°C and 92% R.H.

[0021]

The present invention also relates to a rubber-based pressure-sensitive-adhesive layer, formed, using the rubber-based pressure-sensitive-adhesive composition of the present invention.

[0022]

The present invention also relates to a rubber-based

pressure-sensitive-adhesive layer attached optical film, comprising an optical film, and the rubber-based pressure-sensitive-adhesive layer of the present invention laid on/over the optical film.

[0023]

In the pressure-sensitive-adhesive layer attached optical film of the present invention, the optical film is preferably a polarizing film comprising a polarizer and a protective film on/over at least one surface of the polarizer.

[0024]

In the rubber-based pressure-sensitive-adhesive layer attached optical film of the present invention, the polarizing film is preferably a single-side protected polarizing film having the protective film on/over the single surface of the polarizer, and the rubber-based pressure-sensitive-adhesive layer is preferably laminated on a side of the polarizer that does not have the protective film.

[0025]

In the rubber-based pressure-sensitive-adhesive layer attached optical film of the present invention, the optical film is preferably a brightness enhancement film.

[0026]

The present invention also relates to an optical

member, comprising the rubber-based pressure-sensitive-adhesive layer of the present invention, and a film having a moisture permeability of 1 g/(m²•day) or less at 40°C and 92% R.H.

[0027]

The present invention also relates to an image display device, comprising at least one selected from the group consisting of the rubber-based pressure-sensitive-adhesive layer attached optical film of the present invention, and the optical member of the present invention.

[0028]

The present invention also relates to a method for producing a rubber-based pressure-sensitive-adhesive layer, comprising the step of radiating an active energy ray to the rubber-based pressure-sensitive-adhesive composition of the present invention to crosslink the polyisobutylene.

EFFECT OF THE INVENTION

[0029]

The rubber-based pressure-sensitive-adhesive composition of the present invention includes a polyisobutylene containing, in a main chain thereof, no double bond, and a hydrogen-abstraction type photopolymerization initiator. Thus, when the composition is irradiated with an active energy ray, a crosslinked

structure can be introduced into the composition. It is therefore possible to provide a rubber-based pressure-sensitive-adhesive layer which can restrain the generation of inconveniences (such as a partial raise and separation, or a peel of the layer), or which has a high endurance, even in a high-temperature environment while the layer keeps a low moisture permeability.

[0030]

The present invention can also provide a rubber-based pressure-sensitive-adhesive layer attached optical film, and an optical member which are remarkably good in endurance in a high-temperature environment and further in low moisture permeability; and an image display device remarkably good in optical reliabilities. Furthermore, the invention can provide a method for producing a rubber-based pressure-sensitive-adhesive layer producing the above-mentioned remarkably good advantageous effects.

BRIEF DESCRIPTION OF THE DRAWINGS

[0031]

Fig. 1 is a sectional view that schematically illustrates an embodiment of the pressure-sensitive adhesive layer attached polarizing film of the present invention.

Fig. 2 is a sectional view that schematically

illustrates an embodiment of the optical member of the present invention.

Fig. 3 is a sectional view that schematically illustrates an embodiment of the optical member of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0032]

1. Rubber-Based Pressure-Sensitive-Adhesive Composition

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

[0033]

(1) Polyisobutylene

The polyisobutylene (PIB) is a homopolymer of isobutylene, and may be, for example, a commercially available product OPPANOL manufactured by the company BASF. The present invention makes use of the polyisobutylene, which has, in a main chain thereof, no double bond; thus, the composition is remarkably good in weather resistance.

[0034]

The weight-average molecular weight (Mw) 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.

[0035]

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.

[0036]

The rubber-based pressure-sensitive-adhesive composition of 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.

[0037]

(2) Hydrogen-Abstraction Type Photopolymerization Initiator

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.

[0038]

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.

[0039]

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.

[0040]

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.

[0041]

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.

[0042]

(3) Polyfunctional Radical Polymerizable Compound

The rubber-based pressure-sensitive-adhesive composition of 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.

[0043]

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 (meth)acryloyl groups.

Particularly preferred are tricyclodecanedimethanol di(meth)acrylate, and trimethylolpropane tri(meth)acrylate.

[0044]

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.

[0045]

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.

[0046]

(4) Tackifier

The rubber-based pressure-sensitive-adhesive composition of 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.

[0047]

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.

[0048]

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.

[0049]

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.

[0050]

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.

[0051]

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.

[0052]

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 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.

[0053]

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.

[0054]

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.

[0055]

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 of 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.

[0056]

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.

[0057]

(5) Other Additives

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.

[0058]

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.

[0059]

An additive other than the above-mentioned additives

may be added to the rubber-based pressure-sensitive-adhesive composition of 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.

[0060]

2. Rubber-Based Pressure-Sensitive-Adhesive Layer

The rubber-based pressure-sensitive-adhesive layer of the present invention is a layer formed, using the rubber-based pressure-sensitive-adhesive composition. The method of the present invention for producing the rubber-based pressure-sensitive-adhesive layer will be described later.

[0061]

The thickness of the rubber-based 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 50 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.

[0062]

The moisture permeability of the rubber-based pressure-sensitive-adhesive layer of the present invention is not particularly limited, and is preferably 50 $\text{g}/(\text{m}^2\cdot\text{day})$ or less, more preferably 30 $\text{g}/(\text{m}^2\cdot\text{day})$ or less, even more preferably 20 $\text{g}/(\text{m}^2\cdot\text{day})$ or less, in particular preferably 15 $\text{g}/(\text{m}^2\cdot\text{day})$ or less. The lower limit value of the moisture permeability is not particularly limited. Ideally, this layer does not transmit water vapor at all (in other words, the moisture permeability is 0 $\text{g}/(\text{m}^2\cdot\text{day})$). When the moisture permeability of the rubber-based pressure-sensitive-adhesive layer is in any one of the ranges, the following can be favorably attained: when the pressure-sensitive-adhesive layer is applied to an optical film such as a polarizing film, water is restrained from being shifted to the optical film; consequently, the optical film is restrained from being deteriorated or

damaged in any other manner by water. The moisture permeability is the water-vapor transmissibility (moisture permeability) of a rubber-based pressure-sensitive-adhesive layer under conditions of 40°C temperature and 92% R.H. when the thickness of this layer is 50 μm , and is measurable by a method in the item EXAMPLES.

[0063]

The gel fraction in the pressure-sensitive-adhesive layer of 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%, in particular preferably from about 60 to 85%. 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.

[0064]

3. Method for Producing Rubber-Based Pressure-Sensitive-Adhesive Layer

The method of the present invention for producing a rubber-based pressure-sensitive-adhesive layer includes the step of radiating an active energy ray to the above-defined rubber-based pressure-sensitive-adhesive composition to crosslink the polyisobutylene.

[0065]

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, 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.

[0066]

The method for applying the rubber-based 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.

[0067]

In the producing method of the present invention, the active energy ray is radiated onto the applied layer of the rubber-based pressure-sensitive-adhesive composition; when the rubber-based pressure-sensitive-adhesive composition contains an organic solvent as a diluting agent, it is preferred to remove the solvent and others by, for example, heating and drying after the application and before the radiation of the active energy ray.

[0068]

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.

[0069]

Examples of the active energy ray include visible

rays, ultraviolet rays, and an electron beam. Thereamong, ultraviolet rays are preferred.

[0070]

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.

[0071]

The support may be, for example, a release-treated sheet (separator).

[0072]

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.

[0073]

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.

[0074]

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.

[0075]

The thickness and the moisture permeability of a rubber-based pressure-sensitive-adhesive layer yielded by the producing method of the present invention are as described above.

[0076]

4. Pressure-Sensitive-Adhesive Layer Attached Optical Film

The rubber-based pressure-sensitive-adhesive layer attached optical film of the present invention has an optical film, and the above-defined rubber-based pressure-sensitive-adhesive layer laid on/over the optical film.

[0077]

In a method for forming the rubber-based pressure-sensitive-adhesive layer on/over the optical film, the rubber-based pressure-sensitive-adhesive composition is applied to on/over the optical film, and then an active energy ray is radiated to the resultant, so that the rubber-based pressure-sensitive-adhesive layer can be formed on/over the optical film. As described above, the rubber-based pressure-sensitive-adhesive layer is formed on a support or the like, and the rubber-based pressure-sensitive-adhesive layer is transferred onto the optical film, so that a rubber-based pressure-sensitive-adhesive layer attached optical film can also be formed. In this case, the release-treated sheet, which is used to produce the rubber-based pressure-sensitive adhesive layer attached polarizing film, is usable, as it is, as the separator of the rubber-based pressure-sensitive adhesive layer attached polarizing film, so that the process can be simplified.

[0078]

The optical film may be an optical film used to form

various image display devices, such as a liquid crystal display device. The species thereof is not particularly limited. The optical film is, for example, a polarizing film. In general, a polarizing film is a product which has a polarizer and a protective film on a single or each surface of the polarizer. In the present invention, however, the optical film is preferably a single-surface-protected polarizing film from the viewpoint of making the image display device thinner.

[0079]

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.

[0080]

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.

[0081]

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

polarizing film thinner. 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.

[0082]

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) 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.

[0083]

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.

[0084]

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.

[0085]

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.

[0086]

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.

[0087]

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.

[0088]

As illustrated in Fig. 1, when a polarizing film 2 is, for example, a single-surface-protected polarizing film having a polarizer 4 and a protective film 5 only on a single surface thereof, it is preferred that a pressure-sensitive-adhesive layer 3, which is the above-defined pressure-sensitive-adhesive layer, is formed on a side of the polarizer 4 that does not have the protective film 5 (that is, the polarizer 4 side). In this case, it is not necessarily essential that the polarizer 4 and the pressure-sensitive-adhesive layer 3 contact each other. In order that the advantageous effects of the present invention can be remarkably produced, these members preferably contact each other. This structure allows to restrain water and others from being shifted to the polarizer to restrain the polarizer of the single-surface-protected polarizing film from being deteriorated.

[0089]

Examples of an optical film other than the polarizing plate film include a reflector, an anti-transmissible plate, retardation films (examples thereof including a half wavelength plate and a quarter wavelength plate), a viewing angle compensation film, a brightness enhancement film, and any other optical film that becomes an optical layer that may be used to form a liquid crystal display device or the

like. Thereamong, a brightness enhancement film is preferably usable as the optical film. These films may be used singly as the optical film. Alternatively, when put into practical use, one or more of these layers may be laminated onto the polarizing film, so as to be used.

[0090]

An anchor layer or a transparent resin layer may be formed on the surface of the optical film or polarizer, or the pressure-sensitive adhesive layer may be formed onto the surface after the surface is subjected to easy facilitating treatment such as corona treatment or plasma treatment. The surface of the pressure-sensitive adhesive layer may be subjected to easy facilitating treatment.

[0091]

5. Optical Member

The optical member of the present invention may be an optical member including the above-defined pressure-sensitive-adhesive layer attached optical film, and a brightness enhancement film (hereinafter referred to as a "first optical member"); or an optical member including the above-defined pressure-sensitive-adhesive layer, and a film having a moisture permeability of $1 \text{ g}/(\text{m}^2 \cdot \text{day})$ or less at 40°C and 92% R.H. (hereinafter referred to as a "second optical member").

[0092]

The first optical member is a member in which a brightness enhancement film is further laminated onto the above-defined pressure-sensitive-adhesive layer attached optical film through a pressure-sensitive-adhesive layer. The pressure-sensitive-adhesive layer attached optical film in the first optical member is preferably a pressure-sensitive-adhesive layer attached polarizing film. For example, as illustrated in Fig. 2, the first optical member may be an optical member 10 having a polarizing film 2, a pressure-sensitive-adhesive layer 3, and a brightness enhancement film 6. This optical member 10 may have any other layer. As illustrated in Fig. 3, for example, a prism sheet 7 may be further laminated through a pressure-sensitive-adhesive layer (not illustrated) on a side of a brightness enhancement film 6 as described above that does not have a pressure-sensitive-adhesive layer 3. The prism sheet 7 typically has a substrate and a prism section. In each of Figs. 2 and 3, a single-surface-protected polarizing film has been illustrated in the same manner as in Fig. 1. However, the polarizing film of the first optical member may be a double-surface-protected polarizing film. Such an optical film is preferably used as a polarizing plate on a backlight side of a liquid crystal display device.

[0093]

The brightness enhancement film 6 may be a reflecting type polarizing plate. The reflecting type polarizing plate is a linearly polarized light separating type polarizing plate. Typical examples thereof include a grid type polarizing plate, a multi-thin-layer laminated polarizing plate made of two or more materials different from each other in refractive index, a thin film of evaporated multilayers different from each other in refractive index, a birefringence-layer multi-thin-layer laminated product made of two or more materials different from each other in refractive index, a product yielded by drawing two or more resin-laminated products in which two or more resins having, therebetween, a refractive index difference are used, and a polarizing plate for reflecting/transmitting a linearly polarized light ray in axial directions orthogonal to each other so as to separate the ray (linearly polarized light ray separating type reflective polarizing plate). Thereamong, a linearly polarized light ray separating type reflective polarizing plate is preferably used. Such a reflective polarizing plate may be, for example, a commercially available product with a trade name of "D-BEF", manufactured by the company 3M, or with a trade name of "NIPOX APCF", manufactured by Nitto Denko Corp.

[0094]

The film having a moisture permeability of 1 g/(m²•day) or less at 40°C and 92% R.H., which is used for the second optical member, is, for example, a barrier layer used in an organic electroluminescence element. The barrier layer used in the organic electroluminescence element is, for example, a polymer layer made of trifluoroethylene, polytrifluorochloroethylene (PCTFE), polyimide, polycarbonate, polyethylene terephthalate, an alicyclic polyolefin or an ethylene-vinyl alcohol copolymer; a laminated body made of two or more of these layers; or a product in which a film-forming method such as sputtering is used to coat the polymer layer with an inorganic thin film made of, for example, silicon oxide, silicon nitride, aluminum oxide, or diamond-like carbon. An optical member having such a low moisture permeability film is usable suitably for an organic electroluminescence device. Specifically, the optical member is usable as a sealing member for an organic electroluminescence element.

[0095]

6. Image Display Device

The image display device of the present invention includes one or more selected from the group consisting of the above-defined pressure-sensitive-adhesive layer attached polarizing film, and the above-defined optical member. Examples of the image display device include a

liquid crystal display device, and an organic electroluminescence display device.

[0096]

The image display device of the present invention is sufficient to include the pressure-sensitive-adhesive layer attached optical film or optical member of the invention. Other structures of this device may be the same as in any conventional image display device.

[0097]

The image display device of the present invention includes the above-defined pressure-sensitive-adhesive layer attached optical film or optical member; thus, this device has high optical reliabilities.

EXAMPLES

[0098]

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.

[0099]

Production Example 1 (Production of Polarizing Film (1))

In order to produce a thin polarizing membrane, 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 4 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.

[0100]

While a polyvinyl alcohol-based adhesive was applied onto the outer surface of the polarizing membrane (polarizer, thickness: 5 μm) of the optical film laminate, which was related to the polarizer, to give an adhesive

layer thickness of 0.1 μm , a transparent protective film (film yielded by applying corona treatment to a (meth)acryl-based resin film having a thickness of 20 μm and having a lactone ring structure) was bonded onto the polarizing membrane. The resultant was then dried at 50°C for 5 minutes. Next, the amorphous PET substrate was peeled therefrom to produce a thin-polarizer-used single-side-protected polarizing film (polarizing film (1)).

[0101]

Production Example 2 (Production of Polarizing Film (2))

A polyvinyl alcohol film of 30 μm thickness was drawn three times between rolls different from each other in speed ratio while dyed in an iodine solution having a concentration of 0.3% at 30°C for one minute. Thereafter, while the film was immersed in an aqueous solution containing boric acid in a concentration of 4% and potassium iodide in a concentration of 10% at 60°C for 0.5 minute, the film was drawn into a total draw ratio of 6 times. Next, the film was immersed in an aqueous solution containing potassium iodide in a concentration of 1.5% at 30°C for 10 seconds to be cleaned. The film was then dried at 50°C for 4 minutes to yield a polarizer of 12 μm thickness. A 25- μm thickness triacetylcellulose film was bonded onto one of the surfaces of the polarizer, and further a 13- μm thickness cycloolefin-based resin film was

bonded onto the opposite surface of the polarizer, using a polyvinyl alcohol-based adhesive) (thickness of each of the resultant adhesive layers: 0.1 μm), to yield each double-surface protected film (polarizing film (2)). The triacetylcellulose film was a saponified film having a single surface subjected to hard coat treatment. The polarizing film (2) had a structure of "hard coat layer/triacetylcellulose film/adhesive layer/polarizer/adhesive layer/cycloolefin-based resin film".

[0102]

Production Example 3 (Production of Polarizing film (3))

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 (A).

[0103]

The resultant pressure-sensitive adhesive composition (solution) 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 155°C for 3 minutes to form an acryl-based pressure-sensitive adhesive layer (A) of 20 μm thickness. In this way, a pressure-sensitive adhesive sheet was produced which was composed of the polyester film/the acryl-based pressure-sensitive adhesive layer (A).

[0104]

The pressure-sensitive adhesive layer of the pressure-sensitive adhesive sheet was bonded onto the protective film (20- μm thickness (meth)acrylic resin film

having the lactone ring structure and subjected to corona treatment) of the polarizing film (1) yielded in Production Example 1 to yield polarizing film (3) having a structure of "polyester film (separator)/acryl-based pressure-sensitive adhesive layer (A)/protective film/adhesive layer/polarizer".

[0105]

Example 1

(Preparation of Rubber-Based Composition)

A toluene solution (pressure-sensitive adhesive solution) into which the following components were blended was adjusted to give a solid content of 15% by weight, so as to prepare a rubber-based pressure-sensitive adhesive composition (solution): 100 parts by weight of a polyisobutylene (trade name: OPPANOL B80, manufactured by the BASF; Mw: about 750000); 5 parts by weight of tricyclodecanedimethanol diacrylate (trade name: NK ESTER A-DCP, manufactured by Shin-Nakamura Chemical Co., Ltd.: a bifunctional acrylate; molecular weight: 304) as a polyfunctional radical polymerizable compound; and 0.5 part by weight of benzophenone (manufactured by Wako Pure Chemical Industries, Ltd.) which is a hydrogen-abstraction type photopolymerization initiator.

[0106]

(Rubber-Based Pressure-Sensitive Adhesive Sheet Formation)

The resultant rubber-based pressure-sensitive adhesive composition (solution) 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 80°C for 3 minutes to form a rubber-based pressure-sensitive adhesive layer. In this way, a pressure-sensitive adhesive sheet was produced in which the thickness of the rubber-based pressure-sensitive adhesive layer was 50 μm . Moreover, to this pressure-sensitive adhesive surface of this pressure-sensitive adhesive sheet was bonded 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, to bring the release-treated surface into contact with the rubber-based pressure-sensitive adhesive layer. The polyester films, with which the two surfaces of the rubber-based pressure-sensitive adhesive layer were coated, respectively, functioned as release liners (separators).

[0107]

One of the separators was peeled off. At room temperature, ultraviolet rays were radiated onto the workpiece from the separator-peeled surface side thereof to

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

[0108]

Examples 2 to 22, and Comparative Examples 1 to 3 and 5

In each of the examples, each rubber-based pressure-sensitive adhesive sheet was produced in the same way as in Example 1 except that a composition and a film thickness shown in Table 1 were used.

[0109]

Comparative Example 4

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

The acryl-based pressure-sensitive adhesive composition (A) produced in Production Example 3 was applied onto a release-treated surface of a 38- μ m 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 μ m. The 38- μ m 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 rubber-based pressure-sensitive adhesive layer were coated, respectively, functioned as release liners (separators).

[0110]

About the pressure-sensitive adhesive composition and the pressure-sensitive adhesive sheets yielded in the working examples and the comparative examples, evaluations described below were made. Table 1 shows the results of the evaluation.

[0111]

<Endurance 1 (Polarizing Film (1))>

The polarizing film (1) yielded in Production Example 1 and one of the pressure-sensitive adhesive sheets yielded in each of the working examples and the comparative examples were laminated onto each other to bring the polarizer of the polarizing film (1) into contact with the pressure-sensitive adhesive layer of the pressure-sensitive

adhesive sheet to yield a pressure-sensitive-adhesive layer attached polarizing film. The release liner of the pressure-sensitive adhesive layer was caused to remain as a separator. The resultant pressure-sensitive-adhesive layer attached polarizing film had a structure of "protective film/adhesive layer/polarizer/pressure-sensitive adhesive layer/separator".

[0112]

The separator was peeled off from the resultant pressure-sensitive-adhesive layer attached polarizing film. This test piece was bonded onto a glass plate. This was put in an environment of 95°C temperature for 500 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.

[0113]

<Endurance 2 (Polarizing Film (2))>

The polarizing film (2) yielded in Production Example 2 and one of the pressure-sensitive adhesive sheets yielded in each of the working examples and the comparative examples were laminated onto each other to bring the cycloolefin-based resin film of the polarizing film (2) into contact with the pressure-sensitive adhesive layer of the pressure-sensitive adhesive sheet to yield a pressure-sensitive-adhesive layer attached polarizing film. The release liner of the pressure-sensitive adhesive layer was caused to remain as a separator. The resultant pressure-sensitive-adhesive layer attached polarizing film had a structure of "hard coat layer/triacetylcellulose film/adhesive layer/polarizer/adhesive layer/cycloolefin-based resin film/pressure-sensitive adhesive layer/separator".

[0114]

The separator was peeled off from the resultant pressure-sensitive-adhesive layer attached polarizing film. This test piece was bonded onto a glass plate. This was put in an environment of 95°C temperature for 500 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 same evaluating criterion as used in the <Endurance 1> test.

[0115]

<Endurance 3 (Polarizing Film (3))>

The pressure-sensitive adhesive layer of one of the pressure-sensitive adhesive sheets yielded in each of the working examples and the comparative examples was laminated onto a 20- μ m thickness linearly polarized light separating film (trade name: D-BEF, manufactured by the company 3M) to yield a pressure-sensitive-adhesive layer attached brightness enhancement film.

[0116]

The pressure-sensitive-adhesive layer attached brightness enhancement film and one of the polarizing films (3) yielded in Production Example 3 were laminated onto each other to bring the pressure-sensitive adhesive layer of the pressure-sensitive-adhesive layer attached brightness enhancement film into contact with the polarizer of the polarizing film (3) yielded in Production Example 3 to yield a pressure-sensitive-adhesive layer attached polarizing film. The release liner of the pressure-sensitive adhesive layer was caused to remain as a separator. The resultant pressure-sensitive-adhesive layer attached polarizing film had a structure of "polyester film (separator)/acryl-based pressure-sensitive adhesive layer (A)/protective film/adhesive layer/polarizer/pressure-sensitive adhesive layer yielded in the working example or

comparative example/brightness enhancement film".

[0117]

The separator was peeled off from the resultant pressure-sensitive-adhesive layer attached polarizing film. This test piece was bonded onto a glass plate. This was put in an environment of 95°C temperature for 500 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 same evaluating criterion as used in the <Endurance 1> test.

[0118]

In each of the <Endurance 1> and <Endurance 2> tests, the lamination of the polarizing film onto the adherend (glass plate) in the endurance test was attained, using the one pressure-sensitive adhesive layer yielded in each of the working examples and the comparative examples. However, in the <Endurance 3> test, the adherend (glass plate) in the endurance test, and the polarizing film were laminated onto each other, using the acryl-based pressure-sensitive adhesive layer (A) yielded in Production Example 3.

[0119]

<Gel Fraction>

A measurement was beforehand made about the total weight (W_a (mg)) of a kite string and a porous membrane

made of tetrafluoroethylene resin and having a pore diameter of 0.2 μm (trade name: NITTOFLON NTF 1122, manufactured by Nitto Denko Corp.). From one of the resultant pressure-sensitive adhesive sheets, a piece of about one gram of the pressure-sensitive-adhesive layer was collected. The piece was wrapped into a purse form with the porous membrane. Its mouth was tied with the kite string, and the weight (W_b (mg)) of the wrapper was measured. This wrapper was put into a screw bottle of 50 mL volume, and the screw bottle was filled with toluene. This was then allowed to stand still at room temperature for 7 days. Thereafter, the wrapper was taken out and then dried at 130°C for 2 hours. The weight (W_c (mg)) of the wrapper was then measured. In accordance with an expression described below, the gel fraction in this sample was calculated out.

$$\text{Gel fraction (\%)} = (W_c - W_a) / (W_b - W_a) \times 100$$

[0120]

<Moisture Permeability>

Using each of the pressure-sensitive adhesive compositions yielded in each of the working examples and the comparative examples, in accordance with a method stated in Example, a pressure-sensitive adhesive sheet was formed in which the thickness of a pressure-sensitive adhesive layer was 50 μm . One of the release liners of the

pressure-sensitive adhesive sheet was peeled off to make the pressure-sensitive adhesive surface exposed. By effect of this pressure-sensitive adhesive surface, the pressure-sensitive adhesive sheet was bonded onto a triacetylcellulose film (TAC film, manufactured by Konica Minolta, Ltd.; thickness: 25 μm). The other release liner was peeled off to yield a measuring sample.

Next, this measuring sample was used to measure the moisture permeability (water vapor transmissibility) thereof in accordance with 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.

In the measurement, a constant-temperature and constant-humidity chamber was used.

[0121]

[Table 1]

	Polyisobutylene		Other Polymer	Tackifier		Polyfunctional radical polymerizable compound				Photopolymerization Initiators		Film thickness (μm) of pressure-sensitive adhesive layer	Evaluation results				
	OPPANOL B80 (parts by weight)	OPPANOL B100 (parts by weight)		Completely hydrogenated terpene phenol (A) (parts by weight)	Completely hydrogenated terpene phenol (B) (parts by weight)	A-DCP (bifunctional) (parts by weight)	DCP (bifunctional) (parts by weight)	A-TMPTA (trifunctional) (parts by weight)	Benzophenone (part(s) by weight)	IRGACURE 184 (parts by weight)	Endurance (at 95°C for 500 hours)			Gel fraction (%)	Moisture permeability (g/(m ² ·day) (50 μm) at 40°C and 92% R.H. for 24 hours)		
											Endurance (1)		Endurance (2)			Endurance (3)	
Example 1	100	-	-	-	5	-	-	0.5	-	-	50	○	○	○	70	10	
Example 2	100	-	-	-	-	-	-	0.5	-	-	50	○	○	○	35	9	
Example 3	100	-	-	-	10	-	-	0.5	-	-	50	○	○	○	80	10	
Example 4	100	-	-	-	5	-	-	0.2	-	-	50	○	○	○	46	10	
Example 5	100	-	-	-	5	-	-	1	-	-	50	○	○	○	80	10	
Example 6	100	-	-	-	5	-	-	0.5	-	-	23	○	○	○	68	11	
Example 7	100	-	-	-	-	-	-	0.5	-	-	23	○	○	○	33	10	
Example 8	100	-	-	-	10	-	-	0.5	-	-	23	○	○	○	70	10	
Example 9	100	-	-	-	5	-	-	0.5	-	-	12	○	○	○	69	9	
Example 10	100	-	-	-	-	-	-	0.5	-	-	12	○	○	○	29	9	
Example 11	100	-	-	-	10	-	-	0.5	-	-	12	○	○	○	74	10	
Example 12	100	-	-	10	5	-	-	0.5	-	-	50	○	○	○	61	14	
Example 13	100	-	-	-	-	-	-	0.5	-	-	50	○	○	○	77	11	
Example 14	100	-	-	10	-	-	-	0.5	-	-	50	○	○	○	68	15	
Example 15	100	-	-	10	5	-	-	0.01	-	-	50	○	○	○	33	11	
Example 16	-	100	-	10	5	-	-	0.5	-	-	50	○	○	○	64	13	
Example 17	100	-	-	-	5	-	-	0.5	-	-	50	○	○	○	65	12	
Example 18	100	-	-	10	5	-	-	3	-	-	50	○	○	○	67	12	
Example 19	100	-	-	10	5	-	-	3	-	-	50	○	○	○	65	13	
Example 20	100	-	-	10	-	5	-	0.5	-	-	50	○	○	○	65	12	
Example 21	100	-	-	10	-	10	-	0.5	-	-	50	○	○	○	72	14	
Example 22	100	-	-	10	-	10	-	3	-	-	50	○	○	○	74	12	
Comparative example 1	100	-	-	-	-	-	-	-	-	-	50	×	×	×	0	9	
Comparative example 2	100	-	-	10	-	-	-	-	-	-	50	×	×	×	0	11	
Comparative example 3	100	-	-	10	-	5	-	-	-	-	50	×	×	×	0	12	
Comparative example 4	-	-	100	-	-	-	-	-	-	-	50	○	○	○	77	1000	
Comparative example 5	100	-	-	-	5	-	-	-	-	3	50	×	×	×	7	11	

[0122]

In Table 1, notations are as follows:

<Polyisobutylene>

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

OPPANOL B100: polyisobutylene (Mw: about 1680000, manufactured by the BASF).

<Other Polymer>

Acryl-based resin: acryl-based pressure-sensitive adhesive composition yielded in Comparative Example 4.

<Tackifier>

Completely hydrogenated terpene phenol (A): completely hydrogenated terpene phenol having a softening point of 135°C and a hydroxyl value of 160, and

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

<Polyfunctional Radical Polymerizable Compound>

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

DCP: tricyclodecanedimethanol diacrylate (trade name: NK ESTER DCP, manufactured by Shin-Nakamura Chemical Co., Ltd.: a bifunctional methacrylate; molecular weight: 332),

and

A-TMPTA: trimethylolpropane triacrylate (trade name: NK ESTER A-TMPT, manufactured by Shin-Nakamura Chemical Co., Ltd.: a trifunctional acrylate; molecular weight: 296).

<Photopolymerization Initiator>

Benzophenone: hydrogen-abstraction type photopolymerization initiator, and

IRGACURE 184: cleavage type photopolymerization initiator: 1-hydroxycyclohexyl phenyl ketone (manufactured by the BASF).

DESCRIPTION OF REFERENCE SIGNS

[0123]

- 1 pressure-sensitive adhesive layer attached polarizing film
- 2 polarizing film
- 3 pressure-sensitive adhesive layer
- 4 polarizer
- 5 protective film
- 6 brightness enhancement film
- 7 prism sheet
- 10 optical member

CLAIMS

1. A rubber-based pressure-sensitive-adhesive layer attached optical film, comprising an optical film, and a rubber-based pressure-sensitive-adhesive layer laid on/over the optical film, wherein the rubber-based pressure-sensitive-adhesive layer is formed using a rubber-based pressure-sensitive-adhesive composition, comprising a polyisobutylene, and a hydrogen-abstraction type photopolymerization initiator.

2. The rubber-based pressure-sensitive-adhesive layer attached optical film according to claim 1, wherein the rubber-based pressure-sensitive-adhesive composition comprises a polyfunctional radical polymerizable compound in an amount of 20 parts or less by weight for 100 parts by weight of the polyisobutylene.

3. The rubber-based pressure-sensitive-adhesive layer attached optical film according to claim 2, wherein the polyfunctional radical polymerizable compound is a compound having at least two (meth)acryloyl groups.

4. The rubber-based pressure-sensitive-adhesive layer attached optical film according to claim 3, wherein

the compound, which has at least two (meth)acryloyl groups, is a bifunctional (meth)acrylate having two (meth)acryloyl groups, and/or a trifunctional (meth)acrylate having three (meth)acryloyl groups.

5. The rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 4, wherein the hydrogen-abstraction type photopolymerization initiator is a benzophenone-based compound.

6. The rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 5, wherein the content of the hydrogen-abstraction type photopolymerization initiator is from 0.001 to 10 parts by weight for 100 parts by weight of the polyisobutylene.

7. The rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 6, wherein the rubber-based pressure-sensitive-adhesive composition comprises at least one tackifier selected from the group consisting of a tackifier containing a terpene skeleton and a tackifier containing a rosin skeleton, and hydrogenated products of these

tackifiers.

8. The rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 7, wherein the rubber-based pressure-sensitive-adhesive composition is crosslinkable by irradiating with an active energy ray.

9. The rubber-based pressure-sensitive-adhesive layer attached optical film according to claim 8, wherein the active energy ray is an ultraviolet ray.

10. The rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 9, wherein the rubber-based pressure-sensitive-adhesive layer has a thickness of 50 μm and a moisture permeability of 50 $\text{g}/(\text{m}^2\cdot\text{day})$ or less at 40°C and 92% R.H.

11. The rubber-based pressure-sensitive-adhesive layer attached optical film according to claim 1, wherein the optical film is a polarizing film comprising a polarizer and a protective film on/over at least one surface of the polarizer.

12. The rubber-based pressure-sensitive-adhesive

layer attached optical film according to claim 11, wherein the polarizing film is a single-side protected polarizing film having the protective film on/over the single surface of the polarizer, and the rubber-based pressure-sensitive-adhesive layer is laminated on a side of the polarizer that does not have the protective film.

13. The rubber-based pressure-sensitive-adhesive layer attached optical film according to claim 1, wherein the optical film is a brightness enhancement film.

14. The rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 13, wherein the optical film has a moisture permeability of $1 \text{ g}/(\text{m}^2 \cdot \text{day})$ or less at 40°C and 92% R.H.

15. An image display device, comprising the rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 14.

16. A method for producing the rubber-based pressure-sensitive-adhesive layer attached optical film according to any one of claims 1 to 14, comprising the step of radiating an active energy ray to the rubber-based pressure-sensitive-adhesive composition to crosslink the

polyisobutylene.