

DESCRIPTION

TITLE OF THE INVENTION: PRESSURE-SENSITIVE-ADHESIVE-LAYER
ATTACHED POLARIZING FILM, AND IMAGE DISPLAY DEVICE

TECHNICAL FIELD

[0001]

The present invention relates to a pressure-sensitive-adhesive-layer attached polarizing film used in an image display device. The invention also relates to an image display device in which the pressure-sensitive-adhesive-layer attached polarizing film is used. The image display device is, for example, a liquid crystal display device, an organic electroluminescent (EL) display device, a plasma display panel (PDP), or an electric paper piece.

BACKGROUND ART

[0002]

Liquid crystal display devices, organic EL display devices, etc. have an image-forming mechanism including polarizing elements as essential components. For example, therefore, in a liquid crystal display device, polarizing elements are essentially arranged on both sides of a liquid crystal cell, and generally, polarizing films are attached as the polarizing elements. Besides polarizing films, various optical elements for improving display quality have

become used in display panels such as liquid crystal panels and organic EL panels.

[0003]

A polarizing film used in such image display devices generally has a structure in which a polarizer is sandwiched between two protective films. As the protective films, triacetylcellulose (TAC) has been widely used.

[0004]

With a current such that image display devices are made lighter and thinner in recent years, individual members used in the image display devices are required to be made thinner, and a protective film for their polarizing film is also required to be made thinner. When the thickness of the protective film is made small, this film becomes incapable of making a sufficient cut of ultraviolet rays radiated into the image display devices. Consequently, there is caused a problem of accelerating an ultraviolet-induced deterioration of not only their polarizer but also other various optical members used in the image display devices, examples of these members including a liquid crystal panel and an organic electroluminescent element.

[0005]

In order to solve such a problem, for example, the following are known: a transparent double-sided pressure-

sensitive-adhesive sheet, for image display device, which is located between a surface protective panel in an image display device, and a viewing-side of a liquid crystal module therein in order to integrate these two members with each other, this pressure-sensitive-adhesive sheet having at least one ultraviolet absorbing layer, and having a light ray transmittance of 30% or less at a wavelength of 380 nm and a visible ray transmittance of 80% or more in wavelengths longer than a wavelength of 430 nm (see, for example, Patent Document 1); and a pressure-sensitive-adhesive sheet having a pressure-sensitive-adhesive layer including an acryl-based polymer and a triazine type ultraviolet absorbent (see, for example, Patent Document 2). Furthermore, about a pressure-sensitive-adhesive optical film in which a pressure-sensitive-adhesive layer is laid onto one surface or each surface of an optical film, it is known that an ultraviolet absorbing ability can be given to the pressure-sensitive-adhesive layer (see, for example, Patent Document 3).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0006]

Patent Document 1: JP-A-2012-211305

Patent Document 2: JP-A-2013-75978

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007]

In recent years, as described in Patent Documents 1 to 3, it has been known that a transparent pressure-sensitive-adhesive having an ultraviolet absorbing function is used to bond any two of various members used in an image display device onto each other. In this case, a layer of this pressure-sensitive-adhesive becomes uneven in thickness, and the yield of such image display devices is deteriorated and a problem is caused from the viewpoint of the workability of the pressure-sensitive-adhesive.

[0008]

Thus, an object of the present invention is to provide a pressure-sensitive-adhesive-layer attached polarizing film which can solve the problem of the lowering in the yield and which allows, even at a time when its polarizing film is thin, to give the pressure-sensitive-adhesive-layer attached polarizing film a sufficient ultraviolet-ray-cutting function. Another object of the invention is to provide an image display device in which this pressure-sensitive-adhesive-layer attached polarizing film is used.

MEANS FOR SOLVING THE PROBLEMS

[0009]

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

[0010]

The present invention relates to a pressure-sensitive-adhesive-layer attached polarizing film which is used nearer to a viewing-side of an image display device than an image display section in the image display device,

the pressure-sensitive-adhesive-layer attached polarizing film having a polarizing film, and respective pressure-sensitive-adhesive layers over both surfaces of the polarizing film,

the polarizing film having a polarizer, and respective transparent protective films over both surfaces of the polarizer,

the transparent protective film on the viewing-side of the polarizer having a transmittance 6% or more at a wavelength of 380 nm, and

the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film having an ultraviolet absorbing

function.

[0011]

In the pressure-sensitive-adhesive-layer attached polarizing film of the present invention, the transparent protective film on the viewing-side of the polarizer is preferably at least one film selected from the group consisting of triacetylcellulose films, acrylic films, polyethylene terephthalate films, and polyolefin films each having a cyclic or norbornene structure; and preferably has a thickness of 40 μm or less.

[0012]

In the pressure-sensitive-adhesive-layer attached polarizing film of the present invention, the thickness of the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film is preferably two or more times the thickness of the pressure-sensitive-adhesive layer on the image display section side of the polarizing film.

[0013]

In the pressure-sensitive-adhesive-layer attached polarizing film of the present invention, the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film preferably has a transmittance of 40% or less at a wavelength of 380 nm, and a transmittance of 30% or more at a wavelength of 400 nm.

[0014]

In the pressure-sensitive-adhesive-layer attached polarizing film of the present invention, the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film preferably has a b^* value of 3.0 or less.

[0015]

In the pressure-sensitive-adhesive-layer attached polarizing film of the present invention, the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film preferably comprises, as a base polymer, an acryl-based polymer.

[0016]

The pressure-sensitive-adhesive-layer attached polarizing film of the present invention is preferably used in a liquid crystal display device or an organic electroluminescent display device.

[0017]

The present invention also relates to an image display device, comprising the pressure-sensitive-adhesive-layer attached polarizing film, the pressure-sensitive-adhesive-layer attached polarizing film being used nearer to a viewing-side of the display device than the image display section.

EFFECT OF THE INVENTION

[0018]

The pressure-sensitive-adhesive-layer attached polarizing film of the present invention has a structure in which the pressure-sensitive-adhesive layer, which has an ultraviolet absorbing function, is beforehand laminated on the viewing-side of the polarizing film. Accordingly, the steps concerned can be removed, so that the problem of the lowering in the yield can be solved. Additionally, even when the polarizing film is thin, a sufficient ultraviolet-ray-cutting function can be given to the pressure-sensitive-adhesive-layer attached polarizing film. Furthermore, in the image display device of the present invention, the above-defined pressure-sensitive-adhesive-layer attached polarizing film is used, so that various optical members used in the image display device, typical examples of the members including a liquid crystal panel and an organic electroluminescent element, can be restrained from being deteriorated by ultraviolet rays.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

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

Fig. 2 is a sectional view which schematically

illustrates an embodiment of the image display device of the invention.

Fig. 3 is a sectional view which schematically illustrates an embodiment of the image display device of the invention.

Fig. 4 is a sectional view which schematically illustrates an embodiment of the image display device of the invention.

MODE FOR CARRYING OUT THE INVENTION

[0020]

1. Pressure-Sensitive-Adhesive-Layer Attached Polarizing Film

A pressure-sensitive-adhesive-layer attached polarizing film of the present invention is used nearer to a viewing-side of an image display device than an image display section in the image display device,

the pressure-sensitive-adhesive-layer attached polarizing film has a polarizing film, and respective pressure-sensitive-adhesive layers over both surfaces of the polarizing film,

the polarizing film has a polarizer, and respective transparent protective films over both surfaces of the polarizer,

the transparent protective film on the viewing-side

of the polarizer has a transmittance 6% or more at a wavelength of 380 nm, and

the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film has an ultraviolet absorbing function.

[0021]

As illustrated in Fig. 1, a pressure-sensitive-adhesive-layer attached polarizing film 1 of the present invention is sufficient to have a structure including a viewing-side pressure-sensitive-adhesive layer 2a/a viewing-side transparent protective film 3a/a polarizer 4/an image display section side transparent protective film 3b/an image display section side pressure-sensitive-adhesive layer 2b, and may have a structure which further includes, for example, a retardation film. Specifically, the pressure-sensitive-adhesive-layer attached polarizing film 1 may have, for example, a structure of the viewing-side pressure-sensitive-adhesive layer 2a/the viewing-side transparent protective film 3a/the polarizer 4/the image display section side transparent protective film 3b/the image display section side pressure-sensitive-adhesive layer 2b/a retardation film (not illustrated)/an image display section side pressure-sensitive-adhesive layer (not illustrated). The polarizing film 5 is composed of the viewing-side transparent protective film 3a/the polarizer

4/the image display section side transparent protective film 3b. Each of these layers will be described in detail hereinafter.

[0022]

(1) Viewing-Side Pressure-Sensitive-Adhesive Layer

In the present invention, the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film (viewing-side pressure-sensitive-adhesive layer) has an ultraviolet absorbing function. The viewing-side pressure-sensitive-adhesive layer is sufficient as long as it has an ultraviolet absorbing function, and the composition thereof is not particularly limited.

[0023]

For forming the viewing-side pressure-sensitive-adhesive layer, an appropriate pressure-sensitive-adhesive is usable. The species thereof is not particularly limited. Examples of the species of the pressure-sensitive-adhesive include rubbery, acryl-based, silicone-based, urethane-based, vinyl alkyl ether-based, polyvinyl alcohol-based, polyvinyl pyrrolidone-based, polyacrylamide-based, and cellulose-based pressure-sensitive-adhesives. Among these pressure-sensitive-adhesives, acryl-based pressure-sensitive-adhesives are preferred since the pressure-sensitive-adhesives are excellent in optical transparency, and show pressure-sensitive-adhesive

properties of appropriate tackiness, cohesive property and adhesion, and be excellent in weather resistance, heat resistance and others. The acryl-based pressure-sensitive-adhesive includes, as its base polymer, an acryl-based polymer.

[0024]

It is preferred to form a viewing-side pressure-sensitive-adhesive layer using the acryl-based pressure-sensitive-adhesive by polymerizing, through ultraviolet rays, an ultraviolet curable acryl-based pressure-sensitive-adhesive composition which includes alkyl-(meth)acrylate-containing monomer component(s) and/or a partially polymerized product of the monomer component(s), an ultraviolet absorbent, and one or more photopolymerization initiator (A) having an absorbing band in wavelengths of 400 nm or more. The pressure-sensitive-adhesive layer, which is formed by polymerizing, through the ultraviolet rays, the ultraviolet curable acryl-based pressure-sensitive-adhesive composition, can be formed also as a thick layer having a thickness of 150 μm or more. Thus, a pressure-sensitive-adhesive layer having a thickness in a wide range can be favorably formed.

[0025]

The alkyl (meth)acrylate is, for example, an alkyl (meth)acrylate having a linear or branched alkyl group of 1

to 24 carbon atoms at an ester end. Such alkyl (meth)acrylates may be used singly or in any combination of two or more thereof. The wording alkyl (meth)acrylate denotes an alkyl acrylate and/or an alkyl methacrylate. The word "(meth)" in the present invention has substantially the same meaning.

[0026]

Examples of the alkyl (meth)acrylate includes an alkyl (meth)acrylate having a branched alkyl group of 4 to 9 carbon atoms. These alkyl (meth)acrylates are each favorable since the resultant pressure-sensitive-adhesive layer easily takes a balance between its adhesive properties. Specific examples of the alkyl (meth)acrylate include n-butyl (meth)acrylate, s-butyl (meth)acrylate, t-butyl (meth)acrylate, isobutyl (meth)acrylate, n-pentyl (meth)acrylate, isopentyl (meth)acrylate, isohexyl (meth)acrylate, isoheptyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, and isononyl (meth)acrylate. These may be used singly or in any combination of two or more.

[0027]

In the present invention, the proportion of the above-mentioned alkyl (meth)acrylate having an alkyl group of 1 to 24 carbon atoms at an ester end, is preferably 40% or more by weight, more preferably 50% or more by weight,

even more preferably 60% or more by weight of the whole of one or more monofunctional monomer component(s) from which the (meth)acryl-based polymer is made.

[0028]

The above-mentioned monomer component(s) may include, as one of the monofunctional monomer component(s), a copolymerizable monomer other than the alkyl (meth)acrylate. The copolymerizable monomer is usable as the rest of the monomer component(s) that is other than the alkyl (meth)acrylate.

[0029]

As the copolymerizable monomer, the monomer component(s) may include, for example, a cyclic nitrogen-containing monomer. It is allowable to use, as the cyclic nitrogen-containing monomer, a monomer having a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or vinyl group, and further having a cyclic nitrogen structure without any especial limitation. The cyclic nitrogen structure is preferably a cyclic structure having therein one or more nitrogen atoms. Examples of the cyclic nitrogen-containing monomer include lactam-based vinyl monomers such as N-vinylpyrrolidone, N-vinyl- ϵ -caprolactam, and methylvinylpyrrolidone; vinyl monomers each having a nitrogen-containing heterocyclic ring such as

vinylpyridine, vinylpiperidone, vinylpyrimidine, vinylpiperazine, vinylpyrazine, vinylpyrrole, vinylimidazole, vinyloxazole, and vinylmorpholine. Other examples thereof include (meth)acrylic monomers each containing a heterocyclic ring such as a morpholine ring, a piperidine ring, a pyrrolidine ring, or a piperazine ring. Specific examples thereof include N-acryloylmorpholine, N-acryloylpiperidine, N-methacryloylpiperidine, and N-acryloylpyrrolidine. Among these cyclic nitrogen-containing monomers, lactam-based vinyl monomers are preferred.

[0030]

In the present invention, the proportion of the cyclic nitrogen-containing monomer is preferably from 0.5 to 50% by weight, more preferably from 0.5 to 40% by weight, even more preferably from 0.5 to 30% by weight of the whole of the monofunctional monomer component(s) from which the (meth)acryl-based polymer is made.

[0031]

The monomer component(s) used in the present invention may include, as one of the monofunctional monomer component(s), a hydroxyl-group-containing monomer. It is allowable to use, as the hydroxyl-group-containing monomer, a monomer having a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or

vinyl group, and further having a hydroxyl group with especial limitation. Examples of the hydroxyl-group-containing monomer include hydroxylalkyl (meth)acrylates such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, and 12-hydroxylauryl (meth)acrylate; and hydroxyalkylcycloalkane (meth)acrylates such as (4-hydroxymethylcyclohexyl)methyl (meth)acrylate. Other examples thereof include hydroxyethyl (meth)acrylamide, allyl alcohol, 2-hydroxyethyl vinyl ether, 4-hydroxybutyl vinyl ether, and diethylene glycol monovinyl ether. These monomers may be used singly or in combination. Thereamong, hydroxyalkyl (meth)acrylates are preferred.

[0032]

In the present invention, since the pressure-sensitive-adhesive composition is heightened in adhering strength and cohesive strength, the proportion of the hydroxyl-group-containing monomer is preferably 1% or more by weight, more preferably 2% or more by weight, even more preferably 3% or more by weight of the whole of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made. However, if the

proportion of the hydroxyl-group-containing monomer is too large, the pressure-sensitive-adhesive layer may be hardened to be lowered in adhering strength. Moreover, the pressure-sensitive-adhesive may become too high in viscosity or may be gelatinized. Thus, the proportion of the hydroxyl-group-containing monomer is preferably 30% or less by weight, more preferably 27% or less by weight, even more preferably 25% or less by weight of the whole of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made.

[0033]

The monomer component(s), from which the (meth)acryl-based polymer is made, may contain, as one of the monofunctional monomers, any other functional-group-containing monomer. The other functional-group-containing monomer is, for example, a carboxyl-group-containing monomer or a monomer having a cyclic ether group.

[0034]

It is allowable to use, as the carboxyl-group-containing monomer, a monomer having a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or vinyl group, and further having a carboxyl group without any especial limitation. Examples of the carboxyl-group-containing monomer include (meth)acrylic acid, carboxyethyl (meth)acrylate,

carboxypentyl (meth)acrylate, itaconic acid, maleic acid, fumaric acid, crotonic acid, and isocrotonic acid. These monomers are usable singly or in combination. Itaconic acid and maleic acid are each usable in the form of an anhydride thereof. Thereamong, acrylic acid and methacrylic acid are preferred, and acrylic acid is particularly preferred. For the monomer component(s) used in the production of the (meth)acryl-based polymer in the present invention, the carboxyl-group-containing monomer is arbitrarily usable. However, the carboxyl-group-containing monomer may not be used.

[0035]

It is allowable to use, as the monomer having a cyclic ether group, a monomer having a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or vinyl group, and further having a cyclic ether group such as an epoxy group or oxetane group without any especial limitation. Examples of the epoxy-group-containing monomer include glycidyl (meth)acrylate, 3,4-epoxycyclohexylmethyl (meth)acrylate, and 4-hydroxybutyl (meth)acrylate glycidyl ether. Examples of the oxetane-group-containing monomer include 3-oxetanylmethyl (meth)acrylate, 3-methyl-3-oxetanylmethyl (meth)acrylate, 3-ethyl-3-oxetanylmethyl (meth)acrylate, 3-butyl-3-oxetanylmethyl (meth)acrylate, and 3-hexyl-

3-oxetanylmethyl (meth)acrylate. These monomers may be used singly or in combination.

[0036]

In the present invention, the proportion of the carboxyl-group-containing monomer or the monomer having a cyclic ether group is preferably 30% or less by weight, more preferably 27% or less by weight, even more preferably 25% or less by weight of the whole of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made.

[0037]

With respect to the monomer component(s) from which the (meth)acryl-based polymer in the present invention is made, the copolymerizable monomer is, for example, an alkyl (meth)acrylate represented by $\text{CH}_2=\text{C}(\text{R}^1)\text{COOR}^2$ wherein R^1 represents hydrogen or a methyl group, and R^2 represents a substituted alkyl group of 1 to 3 carbon atoms, or a cyclic alkyl group.

[0038]

About the substituted alkyl group of 1 to 3 carbon atoms as R^2 , its substituent is preferably an aryl group of 3 to 8 carbon atoms or an aryloxy group of 3 to 8 carbon atoms. The aryl group is not limited, and is preferably a phenyl group.

[0039]

Examples of the monomer represented by $\text{CH}_2=\text{C}(\text{R}^1)\text{COOR}^2$ include phenoxyethyl (meth)acrylate, benzyl (meth)acrylate, cyclohexyl (meth)acrylate, 3,3,5-trimethylcyclohexyl (meth)acrylate, and isobornyl (meth)acrylate. These monomers may be used singly or in combination.

[0040]

In the present invention, the proportion of the (meth)acrylate represented by $\text{CH}_2=\text{C}(\text{R}^1)\text{COOR}^2$ may be 50% or less by weight of the whole of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made, and is preferably 45% or less by weight, more preferably 40% or less by weight, even more preferably 35% or less by weight thereof.

[0041]

The following may also be used as other copolymerizable monomer: vinyl acetate, vinyl propionate, styrene, α -methyl styrene; glycol acrylate-based monomers such as polyethylene glycol (meth)acrylate, polypropylene glycol (meth) acrylate, methoxy ethylene glycol (meth)acrylate, and methoxy polypropylene glycol (meth)acrylate; acrylate-based monomers such as tetrahydrofurfuryl (meth)acrylate, fluorine (meth)acrylate, silicone (meth)acrylate, and 2-methoxyethyl acrylate; and amide-group-containing monomers, amino-group-containing monomers, imide-group-containing monomers, N-

acryloylmorpholine, and vinyl ether monomers. Furthermore, the following may also be used as the copolymerizable monomer: terpene (meth)acrylate, dicyclopentanyl (meth)acrylate, or any other monomer having a cyclic structure.

[0042]

Furthermore, the copolymerizable monomer may be, for example, a silicon-atom-containing silane-based monomer. Examples of the silane-based monomer include 3-acryloxypropyltriethoxysilane, vinyltrimethoxysilane, vinyltriethoxysilane, 4-vinylbutyltrimethoxysilane, 4-vinylbutyltriethoxysilane, 8-vinyl-octyltrimethoxysilane, 8-vinyloctyltriethoxysilane, 10-methacryloyloxydecyltrimethoxysilane, 10-acryloyloxydecyltrimethoxysilane, 10-methacryloyloxydecyltriethoxysilane, and 10-acryloyloxydecyltriethoxysilane.

[0043]

The monomer component(s), from which the (meth)acryl-based polymer in the present invention is made, may optionally include a polyfunctional monomer beside the above-exemplified monofunctional monomers, so as to adjust the cohesive strength of the pressure-sensitive-adhesive.

[0044]

The polyfunctional monomer is a monomer having at

least two polymerizable functional groups each having an unsaturated double bond such as a (meth)acryloyl group or vinyl group. Examples thereof include ester compounds of a polyhydric alcohol with (meth)acrylic acid such as (poly)ethylene glycol di(meth)acrylate, (poly)propylene glycol di(meth)acrylate, neopentyl glycol di(meth)acrylate, pentaerythritol di(meth)acrylate, pentaerythritol tri(meth)acrylate, dipentaerythritol hexa(meth)acrylate, 1,2-ethylene glycol di(meth)acrylate, 1,6-hexanediol di(meth)acrylate, 1,12-dodecanediol di(meth)acrylate, trimethylolpropane tri(meth)acrylate, and tetramethylolmethane tri(meth)acrylate; and allyl (meth)acrylate, vinyl (meth)acrylate, divinylbenzene, epoxy acrylate, polyester acrylate, urethane acrylate, butyl di(meth)acrylate, and hexyl di(meth)acrylate. Thereamong, the following is preferably usable: trimethylolpropane tri(meth)acrylate, hexanediol di(meth)acrylate, or dipentaerythritol hexa(meth)acrylate. Such polyfunctional monomers may be used singly or in combination of two or more thereof.

[0045]

The use amount of the polyfunctional monomer(s), which is varied in accordance with the molecular weight thereof, the number of functional groups thereof and others, is preferably 3 parts or less by weight, more

preferably 2 parts or less by weight, even more preferably 1 part or less for 100 parts by weight of the whole of the monofunctional monomer(s). The lower limit thereof is not particularly limited, and is preferably 0 parts or more by weight, more preferably 0.001 part or more by weight. When the use amount of the polyfunctional monomer(s) is in any one of these ranges, the pressure-sensitive-adhesive composition can be improved in adhering strength.

[0046]

In the present invention, a partially polymerized product of the monomer component(s) is also usable.

[0047]

The ultraviolet absorbent in the the ultraviolet curable acryl-based pressure-sensitive-adhesive composition is not particularly limited. Examples thereof include any triazine-based ultraviolet absorbent, any benzotriazole-based ultraviolet absorbent, any benzophenone-based ultraviolet absorbent, any oxybenzophenone-based ultraviolet absorbent, any salicylate-based ultraviolet absorbent, and any cyanoacrylate-based ultraviolet absorbent. These may be used singly or in any combination of two or more thereof. Thereamong, any triazine-based ultraviolet absorbent and any benzotriazole-based ultraviolet absorbent are preferred. The ultraviolet absorbent is preferably an ultraviolet absorbent selected

from the group consisting of triazine-based ultraviolet absorbents each having, in a single molecule thereof, 2 hydroxyl groups or less, and benzotriazole-based ultraviolet absorbents each having, in a single molecule thereof, one benzotriazole skeleton since the ultraviolet absorbent is good in dissolubility into the monomer(s) used to form the ultraviolet curable acryl-based pressure-sensitive-adhesive composition, and further the ultraviolet absorbent is high in ultraviolet absorbing ability at wavelengths around 380 nm.

[0048]

Specific examples of the triazine-based ultraviolet absorbent, which has, in a single molecule thereof, 2 hydroxyl groups or less, include 2,4-bis-[[4-(4-ethylhexyloxy)-4-hydroxy]-phenyl]-6-(4-methoxyphenyl)-1,3,5-triazine (TINOSORB S, manufactured by BASF), 2,4-bis[2-hydroxy-4-butoxyphenyl]-6-(2,4-dibutoxyphenyl)-1,3,5-triazine (TINUVIN 460, manufactured by BASF), a reaction product (TINUVIN 400, manufactured by BASF) produced from 2-(4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine-2-yl)-5-hydroxyphenyl and [(C10-C16 (mainly C12-C13) alkyloxy)methyl]oxirane, 2-[4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine-2-yl]-5-[3-(dodecyloxy)-2-hydroxypropoxy]phenol), a reaction product (TINUVIN 405, manufactured by BASF) produced from 2-(2,4-

dihydroxyphenyl)-4,6-bis-(2,4-dimethylphenyl)-1,3,5-triazine and a (2-ethylhexyl) ester of glycidic acid, 2-(4,6-diphenyl-1,3,5-triazine-2-yl)-5-[(hexyl)oxy]-phenol (TINUVIN 1577, manufactured by BASF), 2-(4,6-diphenyl-1,3,5-triazine-2-yl)-5-[2-(2-ethylhexanoyloxy)ethoxy]-phenol (ADK STAB LA46, manufactured by ADEKA Corp.), and 2-(2-hydroxy-4-[1-octyloxycarbonylethoxy]phenyl)-4,6-bis(4-phenylphenyl)-1,3,5-triazine (TINUVIN 479, manufactured by BASF).

[0049]

Examples of the benzotriazole-based ultraviolet absorbent having, in a single molecule thereof, one benzotriazole skeleton include 2-(2H-benzotriazol-2-yl)-6-(1-methyl-1-phenylethyl)-4-(1,1,3,3-tetramethylbutyl)phenol (TINUVIN 928, manufactured by BASF), 2-(2-hydroxy-5-tert-butylphenyl)-2H-benzotriazole (TINUVIN PS, manufactured by BASF), an esterified product (TINUVIN 384-2, manufactured by BASF) produced from benzenepropanoic acid and 3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxy(C7-9 side chain and straight chain alkyl), 2-(2H-benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol (TINUVIN 900, manufactured by BASF), 2-(2H-benzotriazol-2-yl)-6-(1-methyl-1-phenylethyl)-4-(1,1,3,3-tetramethylbutyl)phenol (TINUVIN 928, manufactured by BASF), a reaction product (TINUVIN 1130, manufactured by

BASF) produced from methyl-3-(3-(2H-benzotriazol-2-yl)-5-tert-butyl-4-hydroxyphenyl)propionate/polyethylene glycol 300, 2-(2H-benzotriazol-2-yl)-p-cresol (TINUVIN P, manufactured by BASF), 2-(2H-benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol (TINUVIN 234, manufactured by BASF), 2-[5-chloro(2H)-benzotriazole-2-yl]-4-methyl-6-(tert-butyl)phenol (TINUVIN 326, manufactured by BASF), 2-(2H-benzotriazol-2-yl)-4,6-di-tert-pentylphenol (TINUVIN 328, manufactured by BASF), 2-(2H-benzotriazol-2-yl)-4-(1,1,3,3-tetramethylbutyl)phenol (TINUVIN 329, manufactured by BASF), a reaction product (TINUVIN 213, manufactured by BASF) produced from methyl 3-(3-(2H-benzotriazol-2-yl)-5-tert-butyl-4-hydroxyphenyl)propionate and polyethylene glycol 300, 2-(2H-benzotriazol-2-yl)-6-dodecyl-4-methylphenol (TINUVIN 571, manufactured by BASF), and 2-[2-hydroxy-3-(3,4,5,6-tetrahydrophthalimide-methyl)-5-methylphenyl]benzotriazole (SUMISORB 250, manufactured by Sumitomo Chemical Co., Ltd.).

[0050]

Examples of the benzophenone-based ultraviolet absorbent (benzophenone-based compound), or the oxybenzophenone-based ultraviolet absorbent (oxybenzophenone-based compound) include 2,4-dihydroxybenzophenone, 2-hydroxy-4-methoxybenzophenone, 2-hydroxy-4-methoxybenzophenone-5-sulfonic acid (anhydride

and trihydrate), 2-hydroxy-4-octyloxybenzophenone, 4-dodecyloxy-2-hydroxybenzophenone, 4-benzyloxy-2-hydroxybenzophenone, 2,2',4,4'-tetrahydroxybenzophenone, and 2,2'-dihydroxy-4,4-dimethoxybenzophenone.

[0051]

Examples of the salicylate-based ultraviolet absorbent (salicylate-based compound) include phenyl-2-acryloyloxybenzoate, phenyl-2-acryloyloxy-3-methylbenzoate, phenyl-2-acryloyloxy-4-methylbenzoate, phenyl-2-acryloyloxy-5-methylbenzoate, phenyl-2-methoxybenzoate, phenyl-2-hydroxybenzoate, phenyl-2-hydroxy-3-methylbenzoate, phenyl-2-hydroxy-4-methylbenzoate, phenyl-2-hydroxy-5-methylbenzoate, phenyl-2-hydroxy-3-methoxybenzoate, 2,4-di-tert-butylphenyl-3,5-di-tert-butyl-4-hydroxybenzoate (TINUVIN 120, manufactured by BASF).

[0052]

Examples of the cyanoacrylate-based ultraviolet absorbent (cyanoacrylate-based compound) include alkyl-2-cyanoacrylate, cycloalkyl-2-cyanoacrylate, alkoxyalkyl-2-cyanoacrylate, alkenyl-2-cyanoacrylate, and alkynyl-2-cyanoacrylate.

[0053]

The above-mentioned ultraviolet absorbents may be used singly, or in the form of a mixture of two or more

thereof. The total content of the absorbent(s) is preferably from about 0.1 to 5 parts by weight, more preferably about 0.5 to 3 parts by weight for 100 parts by weight of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made. When the addition amount of the ultraviolet absorbent(s) is set in any one of these ranges, favorably, the pressure-sensitive-adhesive layer can sufficiently exhibit an ultraviolet absorbing function and additionally the ultraviolet-ray-polymerization is not hindered.

[0054]

The ultraviolet curable acryl-based pressure-sensitive-adhesive composition used in the present invention preferably includes a photopolymerization initiator (A) having an absorbing band in wavelengths of 400 nm or more. In a case where a pressure-sensitive-adhesive composition includes an ultraviolet absorbent, at the time of polymerizing the composition by effect of ultraviolet rays the ultraviolet absorbent unfavorably absorbs the ultraviolet rays so that the composition is not sufficiently polymerized. However, ultraviolet curable acryl-based pressure-sensitive-adhesive composition used in the present invention including the photopolymerization initiator (A), which has an absorbing band in wavelengths of 400 nm or more, favorably allows to polymerize the

composition sufficiently although the composition includes the ultraviolet absorbent.

[0055]

Examples of the photopolymerization initiator (A), which has an absorbing band in wavelengths of 400 nm or more, include bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide (IRGACURE 819, manufactured by BASF), and 2,4,6-trimethylbenzoyl-diphenyl-phosphine oxide (LUCIRIN TPO, manufactured by BASF).

[0056]

Such photopolymerization initiators (A), which each have an absorbing band in wavelengths of 400 nm or more, may be used singly or in the form of a mixture of two or more thereof.

[0057]

The addition amount of the photopolymerization initiator(s) (A), which (each) has/have an absorbing band in wavelengths of 400 nm or more, is not particularly limited, and is preferably smaller than that of the ultraviolet absorbent. The addition amount is preferably from about 0.005 to 1 part by weight, more preferably from about 0.02 to 0.5 part by weight for 100 parts by weight of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made. When the addition amount of the photopolymerization initiator(s) (A) is in

any one of these ranges, the ultraviolet polymerization can be favorably advanced.

[0058]

The ultraviolet curable acryl-based pressure-sensitive-adhesive composition used in the present invention may include a photopolymerization initiator (B) having an absorbing band in wavelengths less than 400 nm. It is preferred that the photopolymerization initiator (B) has no absorption band in wavelengths of 400 nm or more. The photopolymerization initiator (B) is not particularly limited as far as the initiator is an initiator which is irradiated with ultraviolet rays to generate radicals to initiate photopolymerization, and which has an absorbing band in wavelengths less than 400 nm. Any one of such photopolymerization initiators that are ordinarily used is preferably usable. For example, any one of the following is usable: any benzoin ether-based photopolymerization initiator, any acetophenone-based photopolymerization initiator, any α -ketol-based photopolymerization initiator, any optically active oxime-based photopolymerization initiator, any benzoin-based photopolymerization initiator, any benzil-based photopolymerization initiator, any benzophenone-based photopolymerization initiator, any ketal-based photopolymerization initiator, any thioxanthone-based

photopolymerization initiator, and any acylphosphine oxide-based photopolymerization initiator.

[0059]

Specific examples of the benzoin ether-based photopolymerization initiator include benzoin methyl ether, benzoin ethyl ether, benzoin propyl ether, benzoin isopropyl ether, benzoin isobutyl ether, 2,2-dimethoxy-1,2-diphenylethane-1-one, and anisole methyl ether.

[0060]

Examples of the acetophenone-based photopolymerization initiator include 2,2-diethoxyacetophenone, 2,2-dimethoxy-2-phenylacetophenone, 1-hydroxycyclohexyl phenyl ketone, 4-phenoxydichloroacetophenone, and 4-t-butyl-dichloroacetophenone.

[0061]

Examples of the α -ketol-based photopolymerization initiator include 2-methyl-2-hydroxypropiophenone, and 1-[4-(2-hydroxyethyl)phenyl]-2-hydroxy-2-methylpropane-1-one.

[0062]

An example of the optically active oxime-based photopolymerization initiator is 1-phenyl-1,2-propanedione-2-(o-ethoxycarbonyl)-oxime.

[0063]

An example of the benzoin-based photopolymerization

initiator is benzoin.

[0064]

Examples of the benzil-based photopolymerization initiator include benzil.

[0065]

Examples of the benzophenone-based photopolymerization initiator include benzophenone, benzoylbenzoic acid, 3,3'-dimethyl-4-methoxybenzophenone, polyvinylbenzophenone, and α -hydroxycyclohexyl phenyl ketone.

[0066]

Examples of the ketal-based photopolymerization initiator include benzyl dimethyl ketal.

[0067]

Examples of the thioxanthone-based photopolymerization initiator include thioxanthone, 2-chlorothioxanthone, 2-methylthioxanthone, 2,4-dimethylthioxanthone, isopropylthioxanthone, 2,4-dichlorothioxanthone, 2,4-diethylthioxanthone, 2,4-diisopropylthioxanthone, and dodecyl thioxanthone.

[0068]

Examples of the acylphosphine oxide-based photopolymerization initiator include 2,4,6-trimethylbenzoyl-diphenyl-phosphine oxide, and bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide.

[0069]

Such photopolymerization initiators (B), which each have an absorbing band in wavelengths less than 400 nm, may be used singly or in any combination of two or more thereof. The photopolymerization initiator(s) (B), which has/have an absorbing band in wavelengths less than 400 nm, may be added to the pressure-sensitive-adhesive composition as far as the advantageous effects of the present invention are not damaged. The addition amount thereof is preferably from about 0.005 to 0.5 part by weight, more preferably from about 0.02 to 0.1 part by weight for 100 parts by weight of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made.

[0070]

In the present invention, it is preferred to add the photopolymerization initiator (B), which has an absorbing band in wavelengths less than 400 nm, earlier to the monomer component(s); radiate ultraviolet rays to the resultant to polymerize the monomer component(s); add, to the resultant partially polymerized product (prepolymer composition) of the monomer component(s), a photopolymerization initiator (A) as described above, which has an absorbing band in wavelengths of 400 nm or more, and an ultraviolet absorbent; and polymerize the resultant by effect of ultraviolet rays. When the photopolymerization

initiator (A), which has an absorbing band in wavelengths of 400 nm or more, is added to the partially polymerized product (prepolymer composition) of the monomer component(s), in which the component(s) has/have been partially polymerized by effect of the ultraviolet rays, it is preferred to dissolve the photopolymerization initiator into the monomer(s) and subsequently add the resultant solution thereto.

[0071]

Furthermore, the ultraviolet curable acryl-based pressure-sensitive-adhesive composition used in the present invention may contain a silane coupling agent. The blend amount of the silane coupling agent is preferably 1 part or less by weight, more preferably from 0.01 to 1 part by weight, even more preferably from 0.02 to 0.6 part by weight for 100 parts by weight of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made.

[0072]

Examples of the silane coupling agent include epoxy-group-containing silane coupling agents such as 3-glycidoxypropyltrimethoxysilane, 3-glycidoxypropyltriethoxysilane, 3-glycidoxypropylmethyldiethoxysilane, and 2-(3,4-epoxycyclohexyl)ethyltrimethoxysilane; amino-group-

containing silane coupling agents such as 3-aminopropyltrimethoxysilane, N-2-(aminoethyl)-3-aminopropylmethyldimethoxysilane, 3-triethoxysilyl-N-(1,3-dimethylbutylidene)propylamine, and N-phenyl- γ -aminopropyltrimethoxysilane; (meth)acrylic-group-containing silane coupling agents such as 3-acryloxypropyltrimethoxysilane, and 3-methacryloxypropyltriethoxysilane; and isocyanate-group-containing silane coupling agents such as 3-isocyanatopropyltriethoxysilane.

[0073]

The ultraviolet curable acryl-based pressure-sensitive-adhesive composition used in the present invention may contain a crosslinking agent. Examples of the crosslinking agent include isocyanate-based crosslinking agents, epoxy-based crosslinking agents, silicone-based crosslinking agents, oxazoline-based crosslinking agents, aziridine-based crosslinking agents, silane-based crosslinking agents, alkyl-etherified melamine-based crosslinking agents, metal chelate-based crosslinking agents, and peroxide crosslinking agents. These crosslinking agents may be used singly or in any combination of two or more thereof. Thereamong, isocyanate-based crosslinking agents are preferred.

[0074]

The crosslinking agents may be used singly or in the form of a mixture of two or more thereof. The content of the whole of the crosslinking agent(s) is preferably 5 parts or less by weight, more preferably from 0.01 to 5 parts by weight, even more preferably from 0.01 to 4 parts by weight, in particular preferably from 0.02 to 3 parts by weight for 100 parts by weight of the monofunctional monomer component(s), from which the (meth)acryl-based polymer is made.

[0075]

The isocyanate-based crosslinking agents each denote a compound having, in a single molecule thereof, two or more isocyanate groups (the groups may be isocyanate-reproducing type functional groups yielded by protecting isocyanate groups temporarily with a blocking agent or temporarily through, for example, multimer conversion thereof). Examples of the isocyanate crosslinking agents include aromatic isocyanates such as tolylene diisocyanate and xylene diisocyanate; alicyclic isocyanates such as isophorone diisocyanate; and aliphatic isocyanates such as hexamethylene diisocyanate.

[0076]

More specific examples thereof include lower aliphatic polyisocyanates such as butylene diisocyanate and hexamethylene diisocyanate; alicyclic isocyanates such as

cyclopentylene diisocyanate, cyclohexylene diisocyanate, and isophorone diisocyanate; aromatic diisocyanates such as 2,4-tolylene diisocyanate, 4,4'-diphenylmethane diisocyanate, xylylene diisocyanate, and polymethylene polyphenyl isocyanate; isocyanate adducts such as a trimethylolpropane-tolylene diisocyanate trimer adduct (trade name: CORONATE L, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LTD.), a trimethylolpropane-hexamethylene diisocyanate trimer adduct (trade name: CORONATE HL, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LTD.), and an isocyanurate of hexamethylene diisocyanate (trade name: CORONATE HX, manufactured by NIPPON POLYURETHANE INDUSTRY CO., LTD.); a trimethylolpropane adduct of xylylene diisocyanate (trade name: D110N, manufactured by Mitsui Chemicals, Inc.) and a trimethylolpropane adduct of hexamethylene diisocyanate (trade name: D160N, manufactured by Mitsui Chemicals, Inc.); polyether polyisocyanate and polyester polyisocyanate; adducts thereof with various polyols; and polyisocyanates polyfunctionalized with an isocyanurate bond, a biuret bond, an allophanate bond, or the like.

[0077]

The ultraviolet curable acryl-based pressure-sensitive-adhesive composition used in the present invention may contain, besides the above-mentioned

components, an appropriate additive in accordance with the use of the composition. Examples thereof include tackifiers (each made of a material that is in a solid, semi-solid or liquid form at room temperature and that is made of, for example, a rosin derivative resin, a polyterpene resin, a petroleum resin or an oil-soluble phenol resin); fillers such as hollow glass balloons; plasticizers; antiaging agents; and antioxidants.

[0078]

In the present invention, it is preferred to adjust the ultraviolet curable acryl-based pressure-sensitive-adhesive composition to a viscosity suitable for works of this composition, such as an application thereof onto a substrate. The adjustment of the viscosity of the ultraviolet curable acryl-based pressure-sensitive-adhesive composition is made by, for example, the addition of a tackifying additive, any other polymer or polyfunctional monomer that may be of various types, or the like, or by a partial polymerization of one or more monomer component(s) in the ultraviolet curable acryl-based pressure-sensitive-adhesive composition. The partial polymerization may be performed before or after the addition of the tackifying additive, the other polymer or polyfunctional monomer, which may be of various types, or the like. The viscosity of the ultraviolet curable acryl-based pressure-sensitive-

adhesive composition is varied in accordance with, for example, the amount of the additive. Thus, when the monomer component(s) in the ultraviolet curable acryl-based pressure-sensitive-adhesive composition is/are partially polymerized, the polymerization rate cannot be specified. However, as a guide, the polymerization rate is preferably about 20% or less, more preferably from about 3 to 20%, even more preferably from about 5 to 15%. If the polymerization rate is more than 20%, the partially polymerized product is excessively high in viscosity not to be easily applied onto a substrate.

[0079]

The viewing-side pressure-sensitive-adhesive layer is formed by applying the ultraviolet curable acryl-based pressure-sensitive-adhesive composition onto at least one surface of a substrate, and then radiating ultraviolet rays, to the applied ultraviolet curable acryl-based pressure-sensitive-adhesive composition.

[0080]

The substrate is not particularly limited. Examples thereof include a release film, a transparent resin film substrate, and other various substrates. A polarizing film that will be detailed later is also usable suitably for the substrate. When the viewing-side pressure-sensitive-adhesive layer is formed on a substrate other than any

polarizing film, the viewing-side pressure-sensitive-adhesive layer can be bonded and transferred onto the polarizing film.

[0081]

The constituent material of the release film is, for example, a plastic film such as a 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.

[0082]

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.

[0083]

The thickness of the release film is usually from about 5 to 200 μm , preferably from about 5 to 100 μm . As required, the release film may be subjected to a release

treatment and an anti-pollution treatment with a silicone, fluoride, long-chain alkyl, or fatty acid amide release agent, a silica powder or the like, or subjected to an antistatic treatment of coating type, kneading and mixing type, vapor-deposition type, or the like. When a surface of the release film is appropriately subjected, particularly, to release treatment such as silicone treatment, long-chain alkyl treatment or fluorine treatment, the release film can be made higher in releasability from the pressure-sensitive-adhesive layer.

[0084]

The transparent resin film substrate is not particularly limited, and may be a resin film which has transparency and may be of various types. The resin film is a single-layer film. Examples of the material of the film include polyester-based resins such as polyethylene terephthalate and polyethylene naphthalate, acetate-based resins, polyethersulfone-based resins, polycarbonate-based resins, polyamide-based resins, polyimide-based resins, polyolefin-based resins, (meth)acryl-based resins, polyvinyl chloride-based resins, polyvinylidene chloride resins, polystyrene resins, polyvinyl alcohol-based resins, polyarylate-based resins, and polyphenylene sulfide-based resins. Thereamong, particularly preferred are polyester-based resins, polyimide-based resins and polyethersulfone-

based resins.

[0085]

The thickness of the film substrate is preferably from 15 μm to 200 μm , more preferably from 25 μm to 188 μm .

[0086]

The method for applying the ultraviolet curable acryl-based pressure-sensitive-adhesive composition onto the substrate is not particularly limited, and may be an appropriate known method, such as 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, or a die coater.

[0087]

The illuminance of the radiated ultraviolet rays to the ultraviolet curable acryl-based pressure-sensitive-adhesive composition is preferably 5 mW/cm^2 or more. If the illuminance of the ultraviolet rays is less than 5 mW/cm^2 , the polymerization reaction period may become long to deteriorate the layer in productivity. The illuminance of the ultraviolet rays is preferably 200 mW/cm^2 or less. If the illuminance of the ultraviolet rays is more than 200 mW/cm^2 , the photopolymerization initiator is abruptly consumed so that the polymer may be lowered in molecular weight. Consequently, the holding strength may be lowered,

particularly, at high temperatures. The integrated value of the ultraviolet rays is preferably from 100 mJ/cm² to 5000 mJ/cm².

[0088]

An ultraviolet lamp used in the present invention is not particularly limited, and is preferably an LED lamp. The LED lamp is a lamp lower in radiated heat than other ultraviolet lamps. Thus, the LED lamp allows to control the temperature of the pressure-sensitive-adhesive layer in the polymerization into a low level. Consequently, the polymer can be prevented from being lowered in molecular weight, and the pressure-sensitive-adhesive layer can be prevented from being lowered in cohesive strength. Additionally, when the pressure-sensitive-adhesive composition is made into a pressure-sensitive-adhesive sheet, the holding strength at high temperatures can be made high. Plural ultraviolet lamps may be combined with each other. The ultraviolet rays may be intermittently radiated to set a period when the ultraviolet rays are radiated and a period when no ultraviolet rays are radiated.

[0089]

In the present invention, the final polymerization rate of the monomer component(s) in the ultraviolet curable acryl-based pressure-sensitive-adhesive composition is

preferably 90% or more, more preferably 95% or more, even more preferably 98% or more.

[0090]

In the present invention, the wavelength of a peak of the ultraviolet rays radiated to the ultraviolet curable acryl-based pressure-sensitive-adhesive composition is in a range preferably from 200 to 500 nm, more preferably from 300 to 450 nm. If the peak wavelength of the ultraviolet rays is more than 500 nm, the photopolymerization initiator may not be decomposed so that no polymerization reaction is initiated. If the peak wavelength of the ultraviolet rays is less than 200 nm, the polymer chain may be cleaved so that the resultant may be lowered in adhesive property.

[0091]

The reaction is hindered by oxygen in air. Thus, in order to shut out oxygen, it is preferred to form, for example, a release film onto an applied layer made of the acryl-based pressure-sensitive-adhesive composition, or to conduct the photopolymerization reaction in the atmosphere of nitrogen. The release film may be a release film as described above. When the release film is used, this release film may be used, as it is, as a separator for a pressure-sensitive-adhesive-layer attached polarizing film.

[0092]

In order that the layer can ensure an ultraviolet

absorbing function, the thickness of the viewing-side pressure-sensitive-adhesive layer is preferably 2 times or more, more preferably 5 times or more, even more preferably 10 times or more the thickness of the pressure-sensitive-adhesive layer on the image display section side (image display section side pressure-sensitive-adhesive layer) of the polarizing film, which will be detailed later.

Specifically, the thickness of the viewing-side pressure-sensitive-adhesive layer is preferably 50 μm or more, more preferably 100 μm or more, even more preferably 150 μm or more. The upper limit value of the thickness of the viewing-side pressure-sensitive-adhesive layer is not particularly limited, and is preferably 10 mm or less. If the thickness of the pressure-sensitive-adhesive layer is more than 10 mm, the layer does not transmit ultraviolet rays easily so that a long time is required for the polymerization of the monomer component(s). Accordingly, the productivity may be unfavorably poor.

[0093]

When the ultraviolet curable acryl-based pressure-sensitive-adhesive composition used in the present invention contains a photopolymerization initiator (B), it is preferred to produce the ultraviolet curable acryl-based pressure-sensitive-adhesive composition by radiating ultraviolet rays to a composition which includes one or

more monomer components including an alkyl (meth)acrylate and the photopolymerization initiator (B) (referred to also as "pre-addition polymerization initiator") to produce a partially polymerized product of the monomer component(s), and then adding, to the partially polymerized product of the monomer component(s), an ultraviolet absorbent, and a photopolymerization initiator (A) having an absorption band in wavelengths of 400 nm or more (referred to also as "post-addition polymerization initiator"). The polymerization rate of the partially polymerized product is preferably about 20% or less, more preferably from about 3 to 20%, even more preferably from about 5 to 15%. Conditions for radiating the ultraviolet rays are as described above.

[0094]

When a pressure-sensitive-adhesive layer is formed as described above, using the ultraviolet curable acryl-based pressure-sensitive-adhesive composition containing the photopolymerization initiator (B), the polymerization rate of the monomer component(s) can be raised and further the pressure-sensitive-adhesive layer that has been finally formed can be improved in ultraviolet absorbing function by polymerizing the component(s) at two stages as described above.

[0095]

The gel fraction in the viewing-side pressure-sensitive-adhesive layer of the present invention is not particularly limited, and is preferably 50% or more, more preferably 75% or more, even more preferably 85% or more. If the gel fraction in the viewing-side pressure-sensitive-adhesive layer is small, the layer is poor in cohesive strength. If the gel fraction in the viewing-side pressure-sensitive-adhesive layer is too large, the layer is poor in adhering strength.

[0096]

The transmissible b^* value of the viewing-side pressure-sensitive-adhesive layer is not particularly limited, and is preferably 3.0 or less, more preferably 1.5 or less, even more preferably 0.5 or less. The b^* value denotes a b^* value (chromaticity) in an $L^*a^*b^*$ color coordinate system according to JIS Z8729, and is measurable, using, for example, a spectrophotometer (product name: U4100, manufactured by Hitachi High-Technologies Corp.).

[0097]

At a wavelength of 380 nm, the transmittance of the viewing-side pressure-sensitive-adhesive layer is preferably 40% or less, more preferably 20% or less, even more preferably 8% or less. When the transmittance at the wavelength of 380 nm is in any one of the ranges, this

layer can block incident ultraviolet rays sufficiently to restrain deteriorations of the liquid crystal panel, the organic electroluminescent element, the polarizer, and other optical members in the present invention.

[0098]

At a wavelength of 400 nm, the transmittance of the viewing-side pressure-sensitive-adhesive layer is preferably 30% or more, preferably 50% or more, more preferably 70% or more. When the transmittance at the wavelength of 400 nm is in any one of the ranges, this layer can transmit incident ultraviolet rays sufficiently so that the image display device can favorably ensure a sufficient viewability.

[0099]

(2) Image Display Section Side Pressure-Sensitive-Adhesive Layer

The pressure-sensitive-adhesive layer on/over the image display section side surface (image display section side pressure-sensitive-adhesive layer) of the polarizing film is not particularly limited. It is allowable to use a composition equivalent to the ultraviolet curable acryl-based pressure-sensitive-adhesive composition detailed about the viewing-side pressure-sensitive-adhesive layer. An ordinarily used pressure-sensitive-adhesive layer is usable which may be of various types.

[0100]

For forming the image display section side surface pressure-sensitive-adhesive layer, an appropriate pressure-sensitive adhesive is usable. The species thereof is not particularly limited. Examples of the pressure-sensitive-adhesive include rubbery pressure-sensitive-adhesives, acryl-based pressure-sensitive-adhesives, silicone-based pressure-sensitive-adhesives, urethane-based pressure-sensitive-adhesives, vinyl alkyl ether-based pressure-sensitive-adhesives, polyvinyl alcohol-based pressure-sensitive-adhesives, polyvinyl pyrrolidone-based pressure-sensitive-adhesives, polyacrylamide-based pressure-sensitive-adhesives, and cellulose-based pressure-sensitive-adhesives. Among these pressure-sensitive adhesives, acryl-based pressure-sensitive adhesives are preferably used since the adhesives are excellent in optical transparency, show pressure-sensitive-adhesive properties of appropriate tackiness, cohesive property and adhesion, and are excellent in weather resistance, heat resistance and others.

[0101]

The acryl-based pressure-sensitive-adhesives each include, as a base polymer thereof, an acryl-based polymer having a main skeleton made of monomer units of an alkyl (meth)acrylate. Examples of the alkyl (meth)acrylate, from

which the main skeleton of the acryl-based polymer is made, include the same as used in the ultraviolet curable acryl-based pressure-sensitive-adhesive composition of which the viewing-side pressure-sensitive-adhesive layer is made. A monomer copolymerizable therewith, and the proportion thereof may be same as used in the above-mentioned ultraviolet curable acryl-based pressure-sensitive-adhesive composition.

[0102]

The acryl-based polymer can be produced by various known methods. For example, a radical polymerization is appropriately selectable, examples thereof including bulk polymerization, solution polymerization and suspension polymerization. A radical polymerization initiator therefor may be a known polymerization initiator that may be of various types, such as azo and peroxide types. The reaction temperature and the reaction time are usually set into a range from about 50 to 80°C and a range from 1 to 8 hours, respectively. Among the above-mentioned production methods, solution polymerization is preferred. A solvent for the acryl-based polymer is generally, for example, ethyl acetate or toluene. The concentration in the solution is usually set to a range from about 20 to 80% by weight.

[0103]

The pressure-sensitive adhesive may be rendered a pressure-sensitive-adhesive composition containing a crosslinking agent. Examples of the crosslinking agent are the same as described above. Particularly preferred are isocyanate-based crosslinking agents. The blend ratio between the acryl-based polymer and the crosslinking agent is not particularly limited. Usually, the amount of (any solid in) the crosslinking agent is preferably from about 0.001 to 20 parts by weight, more preferably from about 0.01 to 15 parts by weight for 100 parts by weight of (any solid in) the acryl-based polymer.

[0104]

Furthermore, various additives are optionally usable in the pressure-sensitive-adhesive as far as the use results in departure from the objects of the present invention. Examples of the additives include a tackifier, a plasticizer, fillers such as glass fiber, glass beads, metal powder and other inorganic powders, a pigment, a colorant, a filler, an antioxidant, an ultraviolet absorbent, and a silane coupling agent. By incorporating fine particles into the pressure-sensitive-adhesive layer, the pressure-sensitive-adhesive layer may be rendered, for example, a pressure-sensitive-adhesive layer showing light diffusing performance. Examples of the silane coupling agent may be the same as described above.

[0105]

The image display section side pressure-sensitive-adhesive layer can be formed by applying the pressure-sensitive-adhesive onto a substrate that may be of various types, such as a polarizing film or a release film, and then drying the resultant. When a pressure-sensitive-adhesive layer is formed onto a substrate that may be of various types, such as a release film, this pressure-sensitive-adhesive layer may be bonded and transferred onto a polarizing film. Examples of the method of applying this pressure-sensitive-adhesive, and this substrate, which may be of various types, may be the same as described about the above-mentioned method of applying the ultraviolet curable acryl-based pressure-sensitive-adhesive composition, and the above-mentioned substrate.

[0106]

In this applying step, the application amount is controlled to cause a formed pressure-sensitive-adhesive layer to have a predetermined thickness (the thickness after the resultant would be dried). The thickness of the image display section side pressure-sensitive-adhesive layer is not particularly limited, and is preferably $1/2$ or less of the thickness of the viewing-side pressure-sensitive-adhesive layer, preferably $1/5$ or less thereof, preferably $1/10$ or less thereof. Specifically, the

thickness of the image display section side pressure-sensitive-adhesive layer is preferably from about 1 to 100 μm , more preferably from about 3 to 50 μm , even more preferably from about 5 to 30 μm .

[0107]

In the formation of the image display section side pressure-sensitive-adhesive layer, the applied pressure-sensitive-adhesive is dried. The drying temperature and the drying period are not particularly limited, and are appropriately set. The temperature and the period are, for example, preferably from about 80 to 200°C and from 0.5 to 10 minutes.

[0108]

When the image display section side pressure-sensitive-adhesive layer is exposed, the pressure-sensitive-adhesive layer may be protected by a release film until it is actually used. The release film is usable, as it is, as a separator for the pressure-sensitive-adhesive-layer attached polarizing film, so that the process can be simplified.

[0109]

(3) Polarizing Film

The polarizing film used in the present invention has a polarizer, and respective transparent protective films on/over both surface of this polarizer, and the transparent

protective film on the viewing-side of the polarizer (viewing-side transparent protective film) has a transmittance 6% or more at a wavelength of 380 nm.

[0110]

(3-1) Viewing-Side Transparent Protective Film

At a wavelength of 380 nm, the transmittance of the viewing-side transparent protective film used in the present invention is 6% or more, preferably 10% or more, even more preferably 15% or more. The upper limit value of the transmittance at the wavelength of 380 nm is not particularly limited, and is preferably 90% or less, more preferably 30% or less. When the transmittance of the viewing-side transparent protective film at the wavelength of 380 nm is in any one of the ranges, the polarizing film can favorably attain a sufficient ultraviolet absorbing ability by combining the viewing-side transparent protective film made thin with the (ultraviolet-absorbent-containing) viewing-side pressure-sensitive-adhesive layer. Even when the viewing-side transparent protective film has no ultraviolet absorbing ability, the polarizing film sufficiently supplements ultraviolet absorbing ability by ultraviolet-ray-absorption of the viewing-side pressure-sensitive-adhesive layer. Thus, the polarizing film has a sufficient ultraviolet absorbing ability when the transmittance of the viewing-side transparent protective

film at the wavelength of 380 nm is 90% or less. When the transmittance of the viewing-side pressure-sensitive-adhesive layer is 40% or less at the wavelength of 380 nm, it is preferred from the viewpoint of the ultraviolet absorbing ability that the transmittance of the viewing-side transparent protective film is 30% or less at the wavelength of 380 nm.

[0111]

A material which forms the viewing-side transparent protective film is preferably a material excellent in transparency, mechanical strength, thermal stability, water blocking performance, isotropy, and others. Examples of the material 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 transparent 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 transparent 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. The viewing-side transparent protective film is preferably, among such films, at least one film selected from the group consisting of triacetylcellulose films, acrylic films (acryl-based-polymer-used films), polyethylene terephthalate films, and polyolefin films each having a cyclic or norbornene structure, and is more preferably any triacetylcellulose film.

[0112]

The thickness of the viewing-side transparent protective film is not particularly limited, and is preferably 40 μm or less, more preferably 35 μm or less, even more preferably 30 μm or less. The lower limit value of the thickness of the viewing-side transparent protective film is not particularly limited, and is preferably 1 μm or more. When the thickness of the viewing-side transparent

protective film is in any one of the ranges, the polarizing film can be favorably made sufficiently thin and further a polarizer-protecting function of this protective film is not damaged.

[0113]

The polarizer that will be detailed later and the viewing-side 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 viewing-side transparent protective film is, besides these adhesives, an ultraviolet curable adhesive, or an electron-beam curable adhesive. The electron-beam curable adhesive for polarizing films shows an adhesion suitable for the above-mentioned various viewing-side transparent protective films. A metal compound filler may be incorporated into the adhesive used in the present invention.

[0114]

A hard coat layer or a treatment may be applied onto the surface of the viewing-side transparent 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.

[0115]

(3-2) 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 .

[0116]

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.

[0117]

In the present invention, a thin polarizer of 10 μm or less thickness may be 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.

[0118]

Typical examples of the thin polarizer include thin polarizing membranes described in JP-A-S51-069644, JP-A-2000-338329, WO2010/100917 pamphlet, JP-B1-4751481, 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 this 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.

[0119]

The thin polarizing membranes are preferably polarizing membranes each yielded by the following producing method, out of 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 WO 2010/100917 pamphlet, JP-B1-4751481, 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-B1-4751481, or JP-A-2012-073563.

[0120]

(3-3) Image Display Section Side Transparent Protective Film

As the image display section side transparent protective film, a transparent protective film that has been conventionally used is appropriately usable. Specific examples of the transparent protective film preferably include transparent protective films made from a material excellent in transparency, mechanical strength, thermal stability, water blocking performance, isotropy, and others. Examples of the material 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 polymer for forming the transparent

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 transparent 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.

[0121]

The thickness of the image display section side 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.

[0122]

The polarizer and the image display section side transparent protective film are usually bonded to each

other through, for example, a water-based adhesive.

Examples of the water-based adhesive may be a water-based adhesive as described above.

[0123]

A hard coat layer or a treatment may be applied onto the surface of the image display section side transparent 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.

[0124]

2. Image Display Device

The image display device of the present invention is an image display device in which the pressure-sensitive-adhesive-layer attached polarizing film of the invention is used.

[0125]

As illustrated in Figs. 2 to 4, specific examples of the structure of the image display device are image display devices in which the following layers are laminated onto each other in the order of the described layers:

a cover glass or cover plastic 6/a viewing-side pressure-sensitive-adhesive layer 2a/a viewing-side transparent protective film 3a/a polarizer 4/an image display section side transparent protective film 3b/an image display

section side pressure-sensitive-adhesive layer 2b/a liquid crystal display device (LCD) or organic electroluminescent display device (OLED) 7 (Fig. 2);

a cover glass or cover plastic 6/a pressure-sensitive-adhesive layer 8a/a sensor layer 9/a viewing-side pressure-sensitive-adhesive layer 2a/a viewing-side transparent protective film 3a/a polarizer 4/an image display section side transparent protective film 3b/an image display section side pressure-sensitive-adhesive layer 2b/a liquid crystal display device (LCD) or organic electroluminescent display device (OLED) 7 (Fig. 3); and

a cover glass or cover plastic 6/a pressure-sensitive-adhesive layer 8a/a sensor layer 9/a pressure-sensitive-adhesive layer 8b/a sensor layer 9/a viewing-side pressure-sensitive-adhesive layer 2a/a viewing-side transparent protective film 3a/a polarizer 4/an image display section side transparent protective film 3b/an image display section side pressure-sensitive-adhesive layer 2b/a liquid crystal display device (LCD) or organic electroluminescent display device (OLED) 7 (Fig. 4). The pressure-sensitive-adhesive-layer attached polarizing film 1 of the present invention denotes, in each of the above-mentioned structures, a part of "the viewing-side pressure-sensitive-adhesive layer 2a/the viewing-side transparent protective film 3a/the polarizer 4/the image display section side

transparent protective film 3b/the image display section side pressure-sensitive-adhesive layer 2b". The image display device may include, besides these members, a retardation film and others. When the image display device includes a retardation film, the retardation film may be laminated specifically into between the image display section side pressure-sensitive-adhesive layer 2b, and the liquid crystal display device (LCD) or organic electroluminescent display device (OLED) 7 through a pressure-sensitive-adhesive layer. In the laminating between any two of the individual layers, a pressure-sensitive-adhesive layer and/or an adhesive layer is/are appropriately usable.

[0126]

Examples of the image display device include liquid crystal display devices, organic electroluminescent (EL) display devices, plasma display panels (PDP), and electronic paper pieces. Thereamong, preferred are liquid crystal display devices and organic electroluminescent (EL) display devices each having a structure as described above.

EXAMPLES

[0127]

Hereinafter, the present invention will be specifically described by way of examples thereof.

However, the invention is not limited by these examples. In each of the examples, the word "part(s)" and the symbol "%" represent "part(s) by weight" and "% by weight", respectively. The following estimations were made on each of the items in Examples and so on.

[0128]

Production Example 1 (Production of Acryl-based Pressure-Sensitive-Adhesive Composition (a-1))

As photopolymerization initiators, the following were blended into a monomer mixture of 78 parts by weight of 2-ethylhexyl acrylate (2EHA), 18 parts by weight of N-vinyl-2-pyrrolidone (NVP), and 4 parts by weight of 2-hydroxyethyl acrylate (HEA): 0.035 part by weight of 1-hydroxycyclohexyl phenyl ketone (trade name: IRGACURE 184, manufactured by BASF, which has an absorption band at wavelengths of 200 nm to 370 nm); and 0.035 part by weight of 2,2-dimethoxy-1,2-diphenylethane-1-one (trade name: IRGACURE 651, manufactured by BASF, which has an absorption band at wavelengths of 200 nm to 380 nm). Thereafter, ultraviolet rays were radiated to the blend until the viscosity (measuring conditions: 10 rpm and a measuring temperature of 30°C, using a BH viscometer and a No. 5 rotor) turned to about 20 Pa·s. In this way, a prepolymer composition in which the monomer components were partially polymerized was yielded (polymerization rate: 8%). Next,

to the prepolymer composition were added 0.15 part by weight of hexanediol diacrylate (HDDA); and 0.3 part by weight of a silane coupling agent (trade name: KBM-403, manufactured by Shin-Etsu Chemical Co., Ltd.). These components were then mixed with each other to yield an acryl-based pressure-sensitive-adhesive composition (a-1).

[0129]

Production Example 2 (Production of Acryl-based Pressure-Sensitive-Adhesive Composition (a-2))

Into a four-necked flask were charged 67 parts by weight of butyl acrylate (BA), 14 parts by weight of cyclohexyl acrylate (CHA), 27 parts by weight of 4-hydroxybutyl acrylate (4HBA), and 0.05 part by weight of 2,2-dimethoxy-1,2-diphenylethan-1-one (trade name: IRGACURE 651 having an absorption band at wavelengths from 200 to 380 nm, manufactured by BASF Japan Ltd.) and 0.05 part by weight of 1-hydroxy-cyclohexyl-phenyl-ketone (trade name: IRGACURE 184 having an absorption band at wavelengths from 200 to 370 nm, manufactured by BASF Japan Ltd.) as photopolymerization initiators. This system was exposed to ultraviolet rays in a nitrogen atmosphere to photopolymerize the monomer components in a partial quantity thereof. In this way, a partially polymerized product (monomer syrup) was yielded which had a polymerization rate of 10%. Next, to the partially

polymerized product were added 0.15 part by weight of dipentaerythritol penta- and hexa-acrylates (DPHA) and 0.3 part by weight of a silane coupling agent (trade name: KBM-403, manufactured by Shin-Etsu Chemical Co., Ltd.), and these components were mixed with each other. The mixture was irradiated with ultraviolet rays to yield an acryl-based pressure-sensitive-adhesive composition (a-2).

[0130]

Production Example 3 (Production of Image Display Section Side Pressure-Sensitive-Adhesive Layer (B-1))

Into a separable flask equipped with a thermostat, a stirrer, a reflux condenser, and a nitrogen gas introducing tube were charged 95 parts by weight of butyl acrylate, 5 parts by weight of acrylic acid, 0.2 part by weight of azobisisobutyronitrile as a polymerization initiator, and 233 parts by weight of ethyl acetate, and then nitrogen gas was caused to flow thereinto while the charged components were stirred. In this way, the flask was purged with nitrogen over 1 hour. Thereafter, the flask was heated to 60°C to cause the components to react with each other for 7 hours to yield an acryl-based polymer having a weight-average molecular weight (Mw) of about 1100000.

To the acryl-based polymer solution (the solid content therein was regarded as 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 a pressure-sensitive-adhesive composition (solution).

The obtained pressure-sensitive-adhesive composition solution was applied onto a separator (polyethylene terephthalate film having a surface subjected to release treatment) having a thickness of 38 μm to give a thickness of 12 μm after the resultant would be dried. The resultant was dried at 100°C for 3 minutes to remove the solvent to yield pressure-sensitive-adhesive layer. Thereafter, the workpiece was heated at 50°C for 48 hours to be subjected to crosslinking treatment. Hereinafter, the pressure-sensitive-adhesive layer will be referred to as the "image display section side pressure-sensitive-adhesive layer (B-1)".

[0131]

Production Example 4 (Production of Image Display Section Side Pressure-Sensitive-Adhesive Layer (B-2))

The pressure-sensitive-adhesive composition solution yielded in Production Example 3 was applied onto a separator (polyethylene terephthalate film having a surface subjected to release treatment) having a thickness of 38 μm

to give a thickness of 15 μm after the resultant would be dried. The resultant was dried at 100°C for 3 minutes to remove the solvent to yield pressure-sensitive-adhesive layer. Thereafter, the workpiece was heated at 50°C for 48 hours to be subjected to crosslinking treatment.

Hereinafter, the pressure-sensitive-adhesive layer will be referred to as the “image display section side pressure-sensitive-adhesive layer (B-2)”.

[0132]

Example 1

(Production of Pressure-Sensitive-Adhesive Composition with ultraviolet absorbing function)

The following were added to the obtained acryl-based pressure-sensitive-adhesive composition (a-1): 1.4 part by weight of 2,4-bis-[[4-(4-ethylhexyloxy)-4-hydroxy}-phenyl]-6-(4-methoxyphenyl)-1,3,5-triazine (trade name: Tinosorb S, manufactured by BASF Japan Ltd.) dissolved in butyl acrylate to give a solid content of 15%; 0.2 part by weight of bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide (trade name: IRGACURE 819, manufactured by BASF Japan Ltd., and having an absorption band in wavelengths of 200 nm to 450 nm). These components were then stirred to yield a pressure-sensitive-adhesive composition with ultraviolet absorbing function.

[0133]

The pressure-sensitive-adhesive composition with ultraviolet absorbing function was applied onto a release film, which was a film subjected to release treatment, to give a thickness of 150 μm after a pressure-sensitive-adhesive layer would be formed. Next, a release film was bonded onto an outer surface of the pressure-sensitive-adhesive composition layer. Thereafter, the resultant was irradiated with ultraviolet rays under the following conditions: illuminance: 6.5 mW/cm^2 , and light quantity: 1500 mJ/cm^2 . In this way, the pressure-sensitive-adhesive composition layer was optically cured to form viewing-side pressure-sensitive-adhesive layer (A-1).

[0134]

(Production of Polarizing Film (P-1))

By using a polyvinyl alcohol-based adhesive, a triacetylcellulose film having a thickness of 25 μm was bonded onto the viewing-side of a polarizer made of a stretched polyvinyl alcohol film impregnated with iodine and having a thickness of 12 μm . By using a polyvinyl alcohol-based adhesive, an acrylic film having a thickness of 20 μm was laminated onto an image display section side surface of the polarizer to produce a polarizing film (P-1). The polarization degree of the polarizing film was 99.995.

[0135]

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

The viewing-side pressure-sensitive-adhesive layer (A-1) was laminated onto the viewing-side (that is, the outer surface of the triacetylcellulose film, the thickness of which was 25 μm) of the polarizing film (P-1). The image display section side pressure-sensitive-adhesive layer (B-1) was laminated onto an image display section side surface (that is, the outer surface of the acrylic film, the thickness of which was 20 μm) of the polarizing film (P-1). Furthermore, the following were laminated thereonto to form a pressure-sensitive-adhesive-layer attached polarizing film: a retardation film (thickness: 56 μm ; material: polycarbonate); and the image display section side pressure-sensitive-adhesive layers (B-2). The resultant pressure-sensitive-adhesive-layer attached polarizing film had a structure of viewing-side pressure-sensitive-adhesive layer (A-1)/polarizing film (P-1)/image display section side pressure-sensitive-adhesive layer (B-1)/retardation film/image display section side pressure-sensitive-adhesive layer (B-2).

[0136]

Examples 2 to 10

In each of the examples, each pressure-sensitive-adhesive-layer attached polarizing film was formed in the

same way as in Example 1 except that the addition amount of the ultraviolet absorbent, and/or the thickness of the viewing-side pressure-sensitive-adhesive layer after the formation of this layer were changed as shown in Table 1.

[0137]

Examples 11 to 13

A pressure-sensitive-adhesive-layer attached polarizing film was formed in the same way as in Examples 1 to 3 except that the retardation film and the image display section side pressure-sensitive-adhesive layer (B-2) were not formed.

[0138]

Comparative Examples 1 to 4

In each of the examples, each pressure-sensitive-adhesive-layer attached polarizing film was formed in the same way as in Examples 11 and 1 except that the species of the used polarizing film was changed as shown in Table 1, and no viewing-side pressure-sensitive-adhesive layer was formed. Each of the polarizing films (P-2) was as described below.

[0139]

(Production of Polarizing Film (P-2))

By using a polyvinyl alcohol-based adhesive, a triacetylcellulose film having a thickness of 60 μm was bonded onto the viewing-side of a polarizer made of a

stretched polyvinyl alcohol film impregnated with iodine and having a thickness of 12 μm . By using a polyvinyl alcohol-based adhesive, a triacetylcellulose film having a thickness of 40 μm was laminated onto an image display section side surface of the polarizer to produce a polarizing film (P-2). The polarization degree of the polarizing film was 99.995.

[0140]

Comparative Examples 5 to 8

In each of the examples, each pressure-sensitive-adhesive-layer attached polarizing film was formed in the same way as in Examples 11 and 1 except that the following were set or changed as shown in Table 1: the species of the acryl-based pressure-sensitive-adhesive composition for forming the viewing-side pressure-sensitive-adhesive layer; and the addition amount of the ultraviolet absorbers.

[0141]

About the resultant pressure-sensitive-adhesive layers and pressure-sensitive-adhesive-layer attached polarizing films, the following evaluations were made:

[0142]

<Polymerization Rate>

From one of the viewing-side pressure-sensitive-adhesive layers used in each of the working examples and the comparative examples, the release film was peeled off,

and then only the viewing-side pressure-sensitive-adhesive layer was put onto an aluminum petri dish the weight of which had been measured. A measurement was made about the weight of the "aluminum petri dish + viewing-side pressure-sensitive-adhesive layer". In this way, the weight of the pressure-sensitive-adhesive layer which had not yet been dried was gained. This system was dried at 130°C for 2 hours, and then cooled at ambient temperature for about 20 minutes. A measurement was again made about the weight of the "aluminum petri dish + pressure-sensitive-adhesive" to gain the weight of the viewing-side pressure-sensitive-adhesive layer after the drying. The polymerization rate was then calculated in accordance with the following calculation expression:

[Math. 1]

$$\text{Polymerization rate (\%)} = \frac{(\text{weight of pressure-sensitive-adhesive layer after drying thereof})}{(\text{weight of pressure-sensitive-adhesive layer before drying thereof})} \times 100$$

[0143]

<Gel Fraction>

A piece of about 0.1 g was collected from one of the viewing-side pressure-sensitive-adhesive layers used in each of the working examples and the comparative examples, and the piece was wrapped with a porous tetrafluoroethylene sheet (trade name: NTF 1122, manufactured by Nitto Denko Corp.) having an average pore size diameter of 0.2 μm.

Thereafter, the resultant was tied with a kite string. At this time, the weight (Z g) of the resultant product was measured. This weight was defined as the before-immersion weight of the product. The before-immersion weight was the total weight of the viewing-side pressure-sensitive-adhesive layer (the pressure-sensitive-adhesive layer piece collected as described above), the tetrafluoroethylene sheet, and the kite string. The total weight (Y g) of the tetrafluoroethylene sheet and the kite string was also measured. Next, the product (called a "sample"), in which the viewing-side pressure-sensitive-adhesive layer was wrapped with the tetrafluoroethylene sheet and further tied with the kite string, was put into a 50-mL vessel filled with ethyl acetate. The vessel was then allowed to stand still at 23°C for 7 days. Thereafter, the sample was taken out from the vessel (after the ethyl acetate treatment), and shifted to a cup made of aluminum. The sample was then dried in a drying machine at 130°C for 2 hours to remove ethyl acetate. The weight (X g) of the sample was then measured. This weight was defined as the after-immersion of the sample. In accordance with an expression described below, the gel fraction in the sample was calculated out.

$$\text{Gel fraction (\% by weight)} = (X - Y)/(Z - Y) \times 100$$

[0144]

<Transmittance and b* Value of Viewing-Side Pressure-

Sensitive-Adhesive Layer>

The release films of any one of the viewing-side pressure-sensitive-adhesive layers which were used in each of the working examples and the comparative examples were peeled off, and then the viewing-side pressure-sensitive-adhesive layer was fitted to a measuring tool. The transmittance thereof was measured, using a spectrophotometer (production name: U4100, manufactured by Hitachi High-Technologies Corp.).

[0145]

<Residual Stress>

From any one of the viewing-side pressure-sensitive-adhesive layers which were used in each of the working examples and the comparative examples, a piece of 30 mm width and 50 mm length was cut out, and made into a cylindrical form to be made into a test sample. This test sample was set onto chucks having an interval of 20 mm therebetween. The test sample was pulled at a tensile speed of 200 mm/minute over a distance of 60 mm (300%) (after the pulling, the interval between the chucks was 80 mm). At the position where the test sample had been pulled over the distance of 60 mm, the test sample was fixed (held) for 300 seconds. After the 300 seconds, the stress value (N) thereof was measured. In accordance with the following expression, the residual stress thereof was

gained.

Residual stress after 300 seconds = stress value (N)
after 300 seconds/(4 × test sample thickness/10).

[0146]

<Optical Reliability>

Glass pieces (trade name: S200200, manufactured by Matsunami Glass Ind., Ltd; thickness: 1.3 mm; size: 45 mm x 50 mm) were bonded, respectively, to both surfaces of each of some of the pressure-sensitive-adhesive-layer attached polarizing films yielded in each of the working examples and some of the comparative examples. The resultant was subjected to autoclave treatment (air pressure: 0.5 MPa; temperature: 50°C) for 15 minutes. In each of Comparative Examples 1 to 4, the same glass piece as described above was bonded to the polarizing film, or the image-display-section-side pressure-sensitive-adhesive layer on the retardation-film-side of each of some of the pressure-sensitive-adhesive-layer attached polarizing films. The resultant was subjected to the same autoclave treatment as described above. Thereafter, the resultant samples were put, respectively, into various reliability conditions described below. An ultraviolet-visible near-infrared spectrophotometer (product name: V7100, manufactured by JASCO Corp.) was then used to measure the transmittance of each of the samples. The quantity of a change in the

transmittance of the sample from the initial value thereof was gained. The sample was evaluated in accordance with the following evaluating criterion.

(Various Reliability Conditions)

Condition 1: 85°C for 500 hours

Condition 2: 60°C and 95% for 500 hours

Condition 3: heat shock (HS) of “-40°C to 85°C” × 300 cycles

Condition 4: UV radiation for 100 hours; illuminance: 500 W/cm² (at 300 to 700 nm), environment temperature: 60 to 65°C, and environment humidity: 50%

(Evaluation Criterion)

○: the transmittance change quantity is 2.0% or less.

△: the transmittance change quantity is more than 2.0% and 3.0% or less.

×: the transmittance change quantity is more than 3.0%.

[0147]

<Adhesive Residual Stains, Dimension Precision, and End-Portion External-Appearance>

One of the pressure-sensitive-adhesive-layer attached polarizing films yielded in each of the working examples, and the comparative examples was cut into a size of 25 mm × 30 mm with a Super-Cutter. Thereafter, an end surface

processor (manufactured by Megaro Technica Co., Ltd.) was used to cut and shave four side surfaces of the cut piece, by 0.05 mm depth, to prepare a sample. About adhesive residual strains thereon, the side surfaces of the sample were visually observed to check whether or not the sample had adhesive residual strains. About the dimension precision thereof, and the external appearance of the end portions, the sample was observed through an optical microscope, and then evaluated in accordance with the following evaluation criteria:

(Dimension Precision)

○: within ± 0.3 mm

×: outside ± 0.3 mm

(End-Portion External Appearance)

○: the end portions were not sticky when touched with fingers.

×: the end portions were sticky when touched with fingers.

[Table 1]

	Constituents										Evaluation results										
	Polarizing film		Viewing-side pressure-sensitive-adhesive layer				Image-display-cell-side pressure-sensitive-adhesive layer				Evaluations of viewing-side pressure-sensitive-adhesive layer						Optical reliability			Dimension precision	End-Portion External appearance
Species	Transmittance (%) of viewing-side protective film at 380 nm	Acryl-based pressure-sensitive adhesive composition species	Ultraviolet absorbent addition amount (parts)	Polymerization rate (%)	Thickness (μm)	Thickness (μm)	B-1	B-2	Transmittance (%) at 380 nm	Transmittance (%) at 400 nm	b* value	Residual stress (N/cm ²)	Gel fraction (%)	85°C	60°C/5% HS	UV	Pasty stain				
Example 1	P-1	17	a-1	1.4	98.6	150	12	15	0.2	62.5	0.78	12	86	○	○	○	○	None	○		
Example 2	P-1	17	a-1	0.9	98.6	150	12	15	1.3	68.9	0.69	12	86	○	○	○	○	None	○		
Example 3	P-1	17	a-1	0.6	98.5	150	12	15	4.3	77.4	0.46	11	87	○	○	○	○	None	○		
Example 4	P-1	17	a-1	2.0	98.9	150	12	15	0.0	42.3	1.82	11	89	○	○	○	○	None	○		
Example 5	P-1	17	a-1	3.0	98.4	150	12	15	0.0	32.3	2.17	11	89	○	○	○	○	None	○		
Example 6	P-1	17	a-1	0.6	97.7	50	12	15	36.9	87.5	0.3	12	85	○	○	○	○	None	○		
Example 7	P-1	17	a-1	0.6	97.8	75	12	15	20.9	84.5	0.25	11	85	○	○	○	○	None	○		
Example 8	P-1	17	a-1	0.6	98.3	100	12	15	11.9	81.6	0.31	12	85	○	○	○	○	None	○		
Example 9	P-1	17	a-1	0.6	98.5	200	12	15	1.7	71.0	0.64	12	86	○	○	○	○	None	○		
Example 10	P-1	17	a-1	0.6	98.4	250	12	15	0.0	65.7	0.73	12	86	○	○	○	○	None	○		
Example 11	P-1	17	a-1	1.4	98.6	150	12	-	0.2	62.5	0.78	12	86	○	○	○	○	None	○		
Example 12	P-1	17	a-1	0.9	98.6	150	12	-	1.3	68.9	0.69	12	86	○	○	○	○	None	○		
Example 13	P-1	17	a-1	0.6	98.5	150	12	-	4.3	77.4	0.46	11	87	○	○	○	○	None	○		
Comparative Example 1	P-1	17	-	-	-	-	12	-	-	-	-	-	-	○	○	○	△	None	○		
Comparative Example 2	P-1	17	-	-	-	-	12	15	-	-	-	-	-	○	○	○	△	None	○		
Comparative Example 3	P-2	4	-	-	-	-	12	-	-	-	-	-	-	○	○	○	○	None	○		
Comparative Example 4	P-2	4	-	-	-	-	12	15	-	-	-	-	-	○	○	○	○	None	○		
Comparative Example 5	P-1	17	a-1	0	98.5	150	12	-	90	92.0	0.2	13	89	○	○	○	△	None	○		
Comparative Example 6	P-1	17	a-1	0	98.5	150	12	15	90	92.0	0.2	13	89	○	○	○	△	None	○		
Comparative Example 7	P-1	17	a-2	0	98.5	150	12	-	90	92.0	0.2	13	89	○	○	○	△	None	○		
Comparative Example 8	P-1	17	a-2	0	98.5	150	12	15	90	92.0	0.2	13	89	○	○	○	△	None	○		

[0149]

In Table 1, P-1 represents the polarizing film (P-1); P-2 represents the polarizing film (P-2); a-1 represents the acryl-based pressure-sensitive-adhesive composition (a-1) yielded in Production Example 1; a-2 represents the acryl-based pressure-sensitive-adhesive composition (a-2) yielded in Production Example 2; B-1 represents the image display section side pressure-sensitive-adhesive layer (B-1) yielded in Production Example 3; and B-2 represents the image display section side pressure-sensitive-adhesive layer (B-2) yielded in Production Example 4.

DESCRIPTION OF REFERENCE SIGNS

[0150]

- 1: Pressure-sensitive-adhesive-layer attached polarizing film
- 2a: Viewing-side pressure-sensitive-adhesive layer
- 2b: Image display section side pressure-sensitive-adhesive layer
- 3a: Viewing-side transparent protective film
- 3b: Image display section side transparent protective film
- 4: Polarizer
- 5: Polarizing film
- 6: Cover glass or cover plastic

7: Liquid crystal display device (LCD) or organic electroluminescent display device (OLED)

8a and 8b: pressure-sensitive-adhesive layers

9: Sensor layer

CLAIMS

1. A pressure-sensitive-adhesive-layer attached polarizing film for use nearer to a viewing-side of an image display device than an image display section in the image display device,

the pressure-sensitive-adhesive-layer attached polarizing film comprising a polarizing film, and pressure-sensitive-adhesive layers on both surfaces of the polarizing film,

the polarizing film comprising a polarizer, and transparent protective films on both surfaces of the polarizer, wherein the transparent protective films on both surfaces of the polarizer are bonded to the polarizer through a water-based adhesive,

the transparent protective film on the viewing-side of the polarizer having a thickness of 40 μm or less; and a transmittance 6% or more at a wavelength of 380 nm, and

the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film having an ultraviolet absorbing function.

2. The pressure-sensitive-adhesive-layer attached polarizing film according to claim 1,

wherein the transparent protective film on the

viewing-side of the polarizer is at least one film selected from the group consisting of triacetylcellulose films, acrylic films, polyethylene terephthalate films, and polyolefin films each having a cyclic or norbornene structure.

3. The pressure-sensitive-adhesive-layer attached polarizing film according to claim 1 or 2,

wherein the thickness of the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film is two or more times the thickness of the pressure-sensitive-adhesive layer on the image display section side of the polarizing film.

4. The pressure-sensitive-adhesive-layer attached polarizing film according to any one of claims 1 to 3,

wherein the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film has a transmittance of 40% or less at a wavelength of 380 nm, and a transmittance of 30% or more at a wavelength of 400 nm.

5. The pressure-sensitive-adhesive-layer attached polarizing film according to any one of claims 1 to 4,

wherein the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film has a b^* value of 3.0

or less.

6. The pressure-sensitive-adhesive-layer attached polarizing film according to any one of claims 1 to 5,
wherein the pressure-sensitive-adhesive layer on the viewing-side of the polarizing film comprises, as a base polymer, an acryl-based polymer.

7. The pressure-sensitive-adhesive-layer attached polarizing film according to any one of claims 1 to 6,
for use in a liquid crystal display device or an organic electroluminescent display device.

8. An image display device, comprising the pressure-sensitive-adhesive-layer attached polarizing film according to any one of claims 1 to 7,
wherein the pressure-sensitive-adhesive-layer attached polarizing film is arranged nearer to a viewing-side of the display device than the image display section of the display device.