

## DESCRIPTION

TITLE OF THE INVENTION: ORGANIC ELECTROLUMINESCENT DISPLAY  
DEVICE

### TECHNICAL FIELD

[0001]

The present invention relates to an organic electroluminescent (EL) display device (OLED).

### BACKGROUND ART

[0002]

In recent years, organic electroluminescent display devices, on each of which an organic electroluminescent panel is mounted, have been coming to be widely used for various articles such as portable telephones, car navigation devices, monitors for personal computers, and televisions. Usually, in any organic electroluminescent display device, a circularly polarizing plate (such as a laminate of a polarizing plate and a quarter wavelength plate) is disposed on a viewing side surface of the organic electroluminescent panel for inhibiting external light reflection at a metal electrode (cathode) from being viewed like a mirror surface. Moreover, a decorative panel or the like may be further stacked onto the circularly polarizing plate stacked on the viewing side surface of the organic electroluminescent panel. Any two of the circularly

polarizing plate, the decorative panel, and other constituent members of the organic electroluminescent display device are usually bonded to each other through a bonding material such as a pressure-sensitive-adhesive layer or adhesive layer.

[0003]

In an image display device such as an organic electroluminescent display device, ultraviolet rays radiated thereinto may deteriorate constituent members and others inside the image display device. Thus, it is known to lay therein a layer containing an ultraviolet absorbent to suppress the deterioration by effect of the ultraviolet rays. Specifically, known is, for example, a transparent double-sided pressure-sensitive-adhesive sheet, for image display device, having at least one ultraviolet absorbing layer, about this sheet the transmittance of a light ray having a wavelength of 380 nm being 30% or less, and the transmittance of visible light each having a wavelength longer than a wavelength of 430 nm being 80% or more (see, for example, Patent Document 1); or a pressure-sensitive adhesive sheet having a pressure-sensitive-adhesive layer containing an acryl-based polymer and a triazine-based ultraviolet absorbent (see, for example, Patent Document 2).

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0004]

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

[0005]

The pressure-sensitive adhesive sheet described in each of Patent Documents 1 and 2 is a sheet about which the transmittance of a light having a wavelength of 380 nm is controllable. However, when this pressure-sensitive adhesive sheet is used in an organic electroluminescent display device, its electroluminescent element may be unfavorably deteriorated by a long-term use of the device. Thus, the pressure-sensitive adhesive sheet is not a sufficient pressure-sensitive adhesive sheet. This drawback would be as follows: the pressure-sensitive adhesive sheet described in each of Patent Documents 1 and 2 can absorb the light, the wavelength of which is 380 nm; however, the sheet does not sufficiently absorb light in a wavelength range (from 380 nm to 430 nm) shorter in wavelength than a light emitting range (of wavelength longer than 430 nm) of the organic electroluminescent element, so that the transmitted light unfavorably deteriorate the organic electroluminescent element.

[0006]

Therefore, for suppressing the deterioration of the organic electroluminescent element, it is necessary an organic element display device having a mechanism capable of suppressing a transmission of light in a wavelength range (from 380 nm to 430 nm) shorter in wavelength than a light emitting range (of wavelength longer than 430 nm) of such an organic electroluminescent element, and ensuring the transmittance of visible light within the light emitting range of the organic electroluminescent element.

[0007]

Thus, an object of the present invention is to provide an organic electroluminescent display device having a mechanism capable of suppressing the deterioration of the organic electroluminescent.

#### MEANS FOR SOLVING THE PROBLEMS

[0008]

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

[0009]

The present invention relates to an organic electroluminescent display device, comprising: an optical laminated body which comprises a polarizer, a retardation film,

and one or more layers other than the polarizer and the retardation film; and an organic electroluminescent panel;

wherein an ultraviolet absorbent, and a colorant compound having an absorption spectrum having a maximum absorption wavelength present in a range of wavelengths from 380 nm to 430 nm are blended into different layers among the layers comprised in the optical laminated body; and

a layer having the ultraviolet absorbent is present nearer to a viewing side of the display device than a layer having the colorant compound.

[0010]

In the organic electroluminescent display device of the invention, the optical laminated body preferably comprises at least a pressure-sensitive-adhesive or adhesive layer, a transparent protective film, the polarizer, the retardation film, and a pressure-sensitive-adhesive layer in this order from the viewing side,

the ultraviolet absorbent is preferably blended into a layer which is nearer to the viewing side than the polarizer, and

the colorant compound is preferably blended into a layer which is nearer to an organic electroluminescent panel side of the display device than the polarizer.

[0011]

In the organic electroluminescent display device of the

invention, the ultraviolet absorbent is preferably blended into at least one selected from the group consisting of the pressure-sensitive-adhesive or adhesive layer, the transparent protective film, and the retardation film, and the colorant compound is preferably blended into the pressure-sensitive-adhesive layer.

[0012]

In the organic electroluminescent display device of the invention, the colorant compound is preferably an organic colorant compound.

[0013]

In the organic electroluminescent display device, the maximum absorption wavelength of the absorption spectrum of the ultraviolet absorbent is preferably present in a range of wavelengths from 300 nm to 400 nm.

#### EFFECT OF THE INVENTION

[0014]

In the organic electroluminescent display device of the present invention, the layer including the ultraviolet absorbent, and the layer including the colorant compound, the absorption spectrum of which has a maximum absorption wavelength present in a wavelength range from 380 nm to 430 nm, are present in the specified order. Consequently, the display device sufficiently absorbs light in a wavelength range (from

380 nm to 430 nm) shorter in wavelength than a light emitting range (of wavelength longer than 430 nm) of the organic electroluminescent element, so that the organic electroluminescent element can be restrained from being deteriorated. In the present invention, when the layer including the ultraviolet absorbent is present, in particular, nearer to the viewing side than the layer including the colorant compound, the colorant compound can be prevented from being deteriorated by the exposure of the compound to ultraviolet rays. Thus, the organic electroluminescent element can be restrained into a higher level from being deteriorated.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a sectional view which schematically illustrates an embodiment of an optical laminated body used in the present invention.

Fig. 2 is a sectional view which schematically illustrates an embodiment of the organic electroluminescent display device of the present invention.

#### MODE FOR CARRYING OUT THE INVENTION

[0016]

The organic electroluminescent display device of the present invention includes an optical laminated body which

comprises a polarizer, a retardation film, and one or more layers other than the polarizer and the retardation film; and an organic electroluminescent panel.

In the display device, an ultraviolet absorbent, and a colorant compound having an absorption spectrum having a maximum absorption wavelength present in a range of wavelengths from 380 nm to 430 nm are blended into different layers among the layers comprised in the optical laminated body; and

a layer having the ultraviolet absorbent is present nearer to a viewing side of the display device than a layer having the colorant compound.

[0017]

It is sufficient for an optical laminated body in the present invention to include a polarizer, a retardation film, and one or more layers other than the polarizer and the retardation film. The layer(s) different from these layers is/are not particularly limited. A preferred embodiment of the optical laminated body is illustrated in Fig. 1. However, in the present invention, the optical laminated body is not limited to this embodiment.

[0018]

As illustrated in Fig. 1, an optical laminated body 1 is preferably an optical laminated body in which a pressure-sensitive-adhesive or adhesive layer 2/a transparent protective film 3/a polarizer 4/a retardation film 5/a

pressure-sensitive-adhesive layer 6 are laminated onto each other in this order from the viewing side of the optical laminated body. The optical laminated body 1 may be an optical laminated body in which a pressure-sensitive-adhesive or adhesive layer 2/a (viewing side) transparent protective film 3/a polarizer 4/an organic electroluminescent panel side transparent protective film/an organic electroluminescent panel side first pressure-sensitive-adhesive layer (or adhesive layer)/a retardation film 5/an (organic electroluminescent panel side second)

pressure-sensitive-adhesive layer 6 are laminated onto each other in this order from the viewing side. Besides these layers, the optical laminated body may include, for example, functional layers such as a hard coat layer, an anti-glare layer and anti-reflection layer, a sensor layer, and a pressure-sensitive-adhesive layer or adhesive layer for laminating any two of these layers onto each other. The transparent protective film 4/the polarizer 5 may be called a polarizing film.

[0019]

In the present invention, it is sufficient that an ultraviolet absorbent and a colorant compound are blended into different layers of the layers included in the optical laminated body, and further it is sufficient that the layer including the ultraviolet absorbent is arranged nearer to a viewing side of

the display device than the layer including the colorant compound (the layer including the colorant compound is nearer to an organic electroluminescent panel side thereof than the layer including the ultraviolet absorbent). Out of all the layers, a layer into which each of the two is blended is not particularly limited. Moreover, in the optical laminated body, it is more preferred that the layer including the ultraviolet absorbent is arranged nearer to the viewing side than the polarizer, and the layer including the colorant compound is nearer to the organic element panel side than the polarizer. This structure allows to cut ultraviolet light in incident light radiated into the layer including the colorant compound by the layer including the ultraviolet absorbent and further decrease the quantity of the light by the polarizer to prevent the colorant compound from being deteriorated. Thus, the organic electroluminescent element can be restrained into a higher level from being deteriorated.

[0020]

The ultraviolet absorbent blended layer is specifically and preferably one or more layers selected from the group consisting of the pressure-sensitive-adhesive or adhesive layer 2, the transparent protective film 3, and the retardation film 5, more preferably the pressure-sensitive-adhesive or adhesive layer 2 or the transparent protective film 3, and in particular preferably the pressure-sensitive-adhesive or

adhesive layer 2. The ultraviolet absorbent may be blended into two or more layers of all the layers. The ultraviolet absorbent may be blended into, for example, both of the pressure-sensitive-adhesive or adhesive layer 2 and the transparent protective film 3. The colorant compound blended layer is specifically and preferably the retardation film 5 or the pressure-sensitive-adhesive layer 6, more preferably the pressure-sensitive-adhesive layer 6. The colorant compound may be blended into two or more layers of all the layers. The colorant compound may be blended into, for example, both of the retardation film 5 and the pressure-sensitive-adhesive layer 6. When plural pressure-sensitive-adhesive layers 6 are present, the colorant compound may be blended into two or more of the pressure-sensitive-adhesive layers 6. When the polarizing film is a double-side protected polarizing film, the colorant compound may be added to a transparent protective film nearer to the organic element panel side of the display device.

[0021]

Hereinafter, a detailed description will be made about various materials used in the present invention, and the individual layers of the optical laminated body.

[0022]

#### (1) Ultraviolet Absorbent

The ultraviolet absorbent is not particularly limited. Examples thereof include any triazine-based ultraviolet

absorber, any benzotriazole-based ultraviolet absorber, any benzophenone-based ultraviolet absorber, any oxybenzophenone-based ultraviolet absorber, any salicylate-based ultraviolet absorber, and any cyanoacrylate-based ultraviolet absorber. These may be used singly or in any combination of two or more thereof. Among these absorbents, any triazine-based ultraviolet absorber and any benzotriazole-based ultraviolet absorber 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 acryl-based pressure-sensitive-adhesive composition, and further the ultraviolet absorbent is high in ultraviolet absorbing ability at wavelengths around 380 nm.

[0023]

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.), 2-(2-hydroxy-4-[1-octyloxycarbonylethoxy]phenyl)-4,6-bis(4-phenylphenyl)-1,3,5-triazine (TINUVIN 479, manufactured by BASF), and 6',6',6''-(1,3,5-triazine-2,4,6-triyl)tris(3-hexyloxy-2-methylphenol) (LA-F70, manufactured by ADEKA Corp.).

[0024]

Examples of the benzotriazole-based ultraviolet absorber 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)phe  
 nol (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-t-butyl-4-hydroxypheny  
 l)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)phe  
 nol (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),  
2-[2-hydroxy-3-(3,4,5,6-tetrahydrophthalimide-methyl)-5-methylphenyl]benzotriazole (SUMISORB 250, manufactured by Sumitomo Chemical Co., Ltd.), and  
2-(2-hydroxy-3-tert-butyl-5-methylphenyl)-5-chlorobenzotriazole (SeeSorb 703, manufactured by Shipro Kasei Kaisha Ltd., or KEMISORB 73, manufactured by Shipro Kasei Kaisha Ltd.).  
[0025]

Examples of the benzophenone-based ultraviolet absorber (benzophenone-based compound), or the oxybenzophenone-based ultraviolet absorber (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, 2,2'-dihydroxy-4,4-dimethoxybenzophenone, 2,2',4,4'-tetrahydroxybenzophenone (SeeSorb 106, manufactured by Shipro Kasei Kaisha Ltd.), and 2,2'-dihydroxy-4-methoxybenzophenone (KEMISORB 111, manufactured by Chemipro Kasei Kaisha Ltd.).

[0026]

Examples of the salicylate-based ultraviolet absorber (salicylate-based compound) include phenyl-2-acryloyloxybenzoate, phenyl-2-acryloyloxy-3-methylbenzoate, phenyl-2-acryloyloxy-4-methylbenzoate, phenyl-2-acryloyloxy-5-methylbenzoate, phenyl-2-acryloyloxy-3-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).

[0027]

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

[0028]

The maximum absorption wavelength of the absorption spectrum of the ultraviolet absorber is present preferably in a wavelength range of 300 nm to 400 nm, more preferably in a wavelength range of 300 nm to 380 nm. The maximum absorption wavelength denotes the following when plural absorption

maximums are present within a wavelength range from 300 nm to 460 nm in a spectroscopic absorption spectrum of a compound: a wavelength of an absorption maximum showing the largest absorbance, among these absorption maximums.

[0029]

Ultraviolet absorbents as described above may be used singly or in the form of a mixture of two or more thereof. The content of the whole thereof is preferably from about 0.1 to 10% by weight, more preferably from about 0.1 to 8% by weight based on the total weight (100% by weight) of the ultraviolet absorbent added layer. When the addition amount of the ultraviolet absorbent(s) is set into any one of these ranges, the ultraviolet absorbent added layer can favorably exhibit an ultraviolet absorbing function sufficiently. When the ultraviolet absorbent is added to two or more layers of all the layers, the ultraviolet absorbent amount in each of the two or more layers is preferably set into any one of the ranges.

[0030]

In the case of the ultraviolet-absorbent-addition to the pressure-sensitive-adhesive or adhesive layer 2, the above-mentioned ultraviolet absorbents may be used singly or in the form of a mixture of two or more thereof. The content of the whole of the ultraviolet absorbent(s) is preferably from about 0.1 to 8 parts by weight, more preferably from about 0.5 to 5 parts by weight based on 100 parts by weight of

monofunctional monomer component(s) from which a base polymer for forming the pressure-sensitive-adhesive or adhesive layer 2 is made. When the addition amount of the ultraviolet absorbent(s) is set into any one of these ranges, the pressure-sensitive-adhesive layer can favorably exhibit an ultraviolet absorbing function sufficiently; additionally at the time of ultraviolet polymerization of the monomer component(s), the polymerization favorably undergoes no hindrance. When the ultraviolet absorbent(s) is/are added to two or more layers of all the layers, the ultraviolet absorbent amount in each of the two or more layers is preferably set into any one of the ranges.

[0031]

## (2) Colorant compound

It is sufficient for the colorant compound used in the present invention to be a compound about which the maximum absorption wavelength of its absorption spectrum is present in a wavelength range of 380 nm to 430 nm. The compound is not particularly limited. About the absorption spectrum of the colorant compound, the maximum absorption wavelength is more preferably present in a wavelength range of 380 nm to 420 nm. The maximum absorption wavelength denotes the following when plural absorption maximums are present within a wavelength range from 300 nm to 460 nm in a spectroscopic absorption spectrum of a compound: a wavelength of an absorption maximum

showing the largest absorbance, out of these absorption maximums. Moreover, the colorant compound is not particularly limited as far as the compound has the above-mentioned wavelength property. The compound is preferably a material which neither has fluorescent nor phosphorescent performance (photoluminescence) not to hinder display characteristics of the organic electroluminescent element.

[0032]

The half value width of the colorant compound is not particularly limited, and is preferably from 80 nm or less, more preferably from 5 nm to 70 nm, even more preferably from 10 nm to 60 nm. When the half value width of the colorant compound is in any one of these ranges, favorably, a resultant layer containing the colorant compound sufficiently absorbs light in the range that does not affect the light emission of the organic electroluminescent element while a control can be made to cause this layer to transmit light rays having wavelengths longer than 430 nm sufficiently. The method for measuring the half value width is according to a method described below.

<Method of Measuring Half Value Width>

Using an ultraviolet-visible spectrophotometer (U-4100, manufactured by Hitachi High-Tech Science Corp.), the half value width of a colorant compound was measured from a transmission/absorption spectrum of a solution of the colorant compound under conditions described below. From the spectral

spectrum, which is a spectral spectrum obtained by making a measurement to adjust the concentration of the solution to set the absorbance thereof to 1.0 at the maximum absorption wavelength, the interval (full width at half maximum) between two wavelength points showing 50% of the peak value of the spectrum was gained. The resultant value was defined as the half value wavelength of this colorant compound.

(Measurement Conditions)

Solvent: toluene or chloroform,

Cell: quartz cell, and

Optical path length: 10 mm.

[0033]

The colorant compound may be any compound as far as the compound is a compound about which the maximum absorption wavelength of its absorption spectrum is present in a wavelength range of 380 nm to 430 nm. The structure thereof and other factors thereof are not particularly limited. Examples of the colorant compound include organic colorant compounds and inorganic colorant compounds. Thereamong, organic colorant compounds are preferred from the viewpoint of the dispersibility thereof in the base polymer or other resin components, and the maintenance of the transparency of the resultant layer. The organic colorant compound is preferably a material having neither fluorescent nor phosphorescent performance (photoluminescence).

[0034]

Examples of the organic colorant compounds include azomethine-based compounds, indole-based compounds, cinnamic acid-based compounds, pyrimidine-based compounds and porphyrin-based compounds.

[0035]

The organic colorant compounds are preferably commercially available products. Specific examples of the indole-based compounds include BONASORB UA 3911 ((trade name) manufactured by Orient Chemical Industries Co., Ltd.; maximum absorption wavelength of absorption spectrum: 398 nm, half value width: 48 nm), BONASORB UA 3912 ((trade name), Orient Chemical Industries Co., Ltd.; maximum absorption wavelength of the absorption spectrum: 386 nm, half value width: 53 nm). Examples of the cinnamic acid-based compound include SOM-5-0106 ((trade name) manufactured by Orient Chemical Industries Co., Ltd.; maximum absorption wavelength of absorption spectrum: 416 nm, half value width: 50 nm). Examples of the porphyrin-based compounds include FDB-001 ((trade name) manufactured by Yamada Chemical Industry Co., Ltd.; maximum absorption wavelength of the absorption spectrum: 420 nm, half value width: 14 nm).

[0036]

These colorant compounds may be used singly or in the form of a mixture of two or more thereof. The content of the whole of the colorant compound(s) is preferably from about 0.01 to

10 % by weight, more preferably from about 0.02 to 7 % by weight based on the total weight (100% by weight) of the colorant compounds added layer. When the addition amount of the colorant compound(s) is set into any one of these ranges, the colorant compound(s) can sufficiently absorb light rays in the range that does not affect the light emission of the organic electroluminescent element. Thus, the use of the resultant layer containing the colorant compound(s) favorably makes it possible for deterioration of the organic electroluminescent element to be suppressed.

[0037]

In the case of the colorant-compound-addition to the pressure-sensitive-adhesive layer 6, the above-mentioned colorant compounds may be used singly or in the form of a mixture of two or more thereof. The content of the whole of the colorant compound(s) is preferably from about 0.01 to 10 parts by weight, more preferably from about 0.02 to 5 parts by weight based on 100 parts by weight of monofunctional monomer component(s) from which a base polymer for forming the pressure-sensitive-adhesive or adhesive layer is made. When the addition amount of the colorant compound(s) is set into any one of these ranges, the pressure-sensitive-adhesive layer can sufficiently absorb light in the range that does not affect the light emission of the organic electroluminescent element so that the organic electroluminescent element can be favorably

restrained from being deteriorated. When the colorant compound(s) is/are added to two or more layers of all the layers, the colorant compound amount in each of the two or more layers is preferably set into any one of the ranges.

[0038]

### (3) Optical Laminated Body

The optical laminated body used in the present invention is preferably the optical laminated body (in Fig. 1) as described above, in which the pressure-sensitive-adhesive or adhesive layer 2/the transparent protective film 3/the polarizer 4/the retardation film 5/the pressure-sensitive-adhesive layer 6 are laminated onto each other in this order from the viewing side of the laminated body. The optical laminated body may be the other optical laminated body as described above, in which the pressure-sensitive-adhesive or adhesive layer 2/the (viewing side) transparent protective film 3/the polarizer 4/the organic electroluminescent panel side transparent protective film/the organic electroluminescent panel side first pressure-sensitive-adhesive layer (or adhesive layer)/the retardation film 5/the (organic electroluminescent panel side second) pressure-sensitive-adhesive layer 6 are laminated onto each other in this order from the viewing side. Besides these layers, the optical laminated body may include, for example, functional layers such as a hard coat layer, an

anti-glare layer and anti-reflection layer, a sensor layer, and a pressure-sensitive-adhesive layer or adhesive layer for laminating any two of these layers onto each other.

[0039]

#### (3-1) Pressure-Sensitive-Adhesive or Adhesive Layer 2

In the present invention, the "pressure-sensitive-adhesive or adhesive layer" denotes a pressure-sensitive-adhesive layer or an adhesive layer.

[0040]

##### (3-1-1) Adhesive Layer

The adhesive layer may be a layer including any appropriate adhesive. Examples of the adhesive include natural rubber adhesives,  $\alpha$ -olefin-based adhesives, urethane resin-based adhesives, ethylene/vinyl acetate resin emulsion adhesives, ethylene/vinyl acetate resin-based hot-melt adhesives, epoxy resin-based adhesives, vinyl chloride resin solvent-type adhesives, chloroprene rubber-based adhesives, cyanoacrylate-based adhesives, silicone-based adhesives, styrene-butadiene solvent-type adhesives, nitrile rubber-based adhesives, nitrocellulose-based adhesives, reactive hot-melt adhesives, phenolic resin-based adhesives, modified silicone-based adhesives, polyester-based hot-melt adhesives, polyamide resin hot-melt adhesives, polyimide-based adhesives, polyurethane resin hot-melt adhesives, polyolefin resin hot-melt adhesives, polyvinyl

acetate solvent-type adhesives, polystyrene resin solvent-type adhesives, polyvinyl alcohol-based adhesives, polyvinyl pyrrolidone resin-based adhesives, polyvinyl butyral-based adhesives, polybenzimidazole adhesives, polymethacrylate resin solvent-type adhesives, melamine resin-based adhesives, urea resin-based adhesives, and resorcinol-based adhesives. Such adhesives may be used singly or in the form of a mixture of two or more thereof.

[0041]

When the adhesives are classified in accordance with the bonding form thereof, the adhesives may, for example, thermosetting adhesives and hot-melt adhesives. Such adhesives may be used singly, or in any combination of two or more thereof.

[0042]

The thermosetting adhesives are each heated to be thermally cured to be solidified to express adhering strength. Examples of the thermosetting adhesives include epoxy-based thermosetting adhesives, urethane-based thermosetting adhesives, and acrylic thermosetting adhesives. The curing temperature of the thermosetting adhesives is, for example, from 100 to 200°C.

[0043]

The hot-melt adhesives are each heated to be melted or softened to adhere thermally onto an adherend, and then cooled

to be solidified to be bonded to the adherend. Examples of the hot-melt adhesives include rubber-based hot-melt adhesives, polyester-based hot-melt adhesives, polyolefin-based hot-melt adhesives, ethylene-vinyl acetate resin-based hot-melt adhesives, polyamide resin hot-melt adhesives, and polyurethane resin hot-melt adhesives. The softening temperature (according to a ring and ball method) of the hot-melt adhesives is, for example, from 100 to 200°C. The melt viscosity of the hot-melt adhesives is, for example, from 100 to 30000 mPa·s at 180°C.

[0044]

The thickness of the adhesive layer is not particularly limited, and is, for example, preferably from about 0.01 to 10  $\mu\text{m}$ , more preferably from about 0.05 to 8  $\mu\text{m}$ .

[0045]

#### (3-1-2) Pressure-Sensitive-Adhesive Layer

The species of the pressure-sensitive-adhesive composition from which the pressure-sensitive-adhesive layer is made, is not particularly limited. Examples of the species of the pressure-sensitive-adhesive composition 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. In the present invention, the pressure-sensitive-adhesive composition is preferably an acryl-based pressure-sensitive-adhesive composition including, as its base polymer, a (meth)acryl-based polymer.

[0046]

The acryl-based pressure-sensitive-adhesive composition preferably includes, for example, a partially polymerized product of one or more monomer components which include an alkyl (meth)acrylate, and/or a (meth)acryl-based polymer yielded from the monomer component(s). The acryl-based pressure-sensitive-adhesive composition may include an ultraviolet absorbent or a colorant compound.

[0047]

(Partially Polymerized Product of Monomer Component(s), and (Meth)acryl-based polymer)

The above-mentioned acryl-based pressure-sensitive-adhesive composition includes a partially polymerized product of one or more monomer component(s) which include an alkyl (meth)acrylate, and/or a (meth)acryl-based polymer yielded from the monomer component(s).

[0048]

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.

[0049]

The alkyl (meth)acrylate may be the above-mentioned alkyl (meth)acrylate having a linear or branched alkyl group of 1 to 24 carbon atoms. Thereamong, preferred is an alkyl (meth)acrylate having an alkyl group of 1 to 9 carbon atoms, more preferred is 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 having a branched alkyl group of 4 to 9 carbon atoms, 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.

[0050]

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 components from which the (meth)acryl-based polymer is made.

[0051]

The above-mentioned monomer component(s) may include, as one of the monofunctional monomer components, 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.

[0052]

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- $\epsilon$ -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.

[0053]

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.

[0054]

The monomer component(s) used in the present invention may include, as one of the monofunctional monomer components, 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.

[0055]

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.

[0056]

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.

[0057]

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.

[0058]

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-oxetanylmethyl (meth)acrylate, 3-ethyl-oxetanylmethyl (meth)acrylate,

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

[0059]

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.

[0060]

Among the monomer components, 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  $\text{R}^1$   
represents hydrogen or a methyl group, and  $\text{R}^2$  represents a  
substituted alkyl group of 1 to 3 carbon atoms, or a cyclic alkyl  
group.

[0061]

About the substituted alkyl group of 1 to 3 carbon atoms  
as  $\text{R}^2$ , 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.

[0062]

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.

[0063]

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.

[0064]

The following may also be used as other copolymerizable monomer: vinyl acetate, vinyl propionate, styrene,  $\alpha$ -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.

[0065]

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.

[0066]

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.

[0067]

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.

[0068]

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.

[0069]

For the production of the (meth)acryl-based polymer, a known producing method is appropriately selectable, examples thereof including solution polymerization, ultraviolet (UV) polymerization, other radial ray polymerizations, bulk polymerization, emulsion polymerization, and various other radical polymerizations. The resultant (meth)acryl-based polymer may be any one of a random copolymer, a block copolymer, a graft copolymer and others.

[0070]

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

[0071]

When the (meth)acryl-based polymer is produced by a radical polymerization, the polymerization can be conducted by adding, to the monomer component(s), a polymerization initiator, a chain transfer agent, an emulsifier, and others that are used in the radical polymerization. The polymerization initiator, the chain transfer agent, the emulsifier, and the others, which are used in the radical polymerization, are not particularly limited, and may be appropriately selected to be used. The

weight-average molecular weight of the (meth)acryl-based polymer is controllable in accordance with the respective use amounts of the polymerization initiator and the chain transfer agent, and conditions for the reaction. Correspondingly to the species of these substances, the use amounts are appropriately adjusted.

[0072]

For example, in the solution polymerization, a used polymerization solvent is, for example, ethyl acetate or toluene. In a specific example of the solution polymerization, reaction is conducted in the presence of an added polymerization initiator under a gas flow of an inert gas such as nitrogen usually under reaction conditions of a temperature of about 50 to 70°C and a period of about 5 to 30 hours.

[0073]

Examples of a thermal polymerization initiator used in, for example, the solution polymerization include, but are not limited to, azo initiators such as 2,2'-azobisisobutyronitrile, 2,2'-azobis-2-methylbutyronitrile, 2,2'-azobis(2-methylpropionic acid) dimethyl, 4,4'-azobis-4-cyanovaleric acid, azobisisovaleronitrile, 2,2'-azobis(2-amidinopropane)dihydrochloride, 2,2'-azobis[2-(5-methyl-2-imidazoline-2-yl)propane]dihydrochloride, 2,2'-azobis(2-methylpropionamidine)disulfate, 2,2'-azobis(N,N'-dimethyleneisobutylamidine), and

2,2'-azobis[N-(2-carboxyethyl)-2-methylpropionamidine]hydrate (VA-057, manufactured by Wako Pure Chemical Industries, Ltd.); persulfates such as potassium persulfate and ammonium persulfate; peroxide initiators such as di(2-ethylhexyl)peroxydicarbonate, di(4-tert-butylcyclohexyl)peroxydicarbonate, di-sec-butylperoxydicarbonate, tert-butylperoxyneodecanoate, tert-hexylperoxypivalate, tert-butylperoxypivalate, dilauroyl peroxide, di-n-octanoyl peroxide, 1,1,3,3-tetramethylbutylperoxy-2-ethyl hexanoate, di(4-methylbenzoyl) peroxide, dibenzoyl peroxide, tert-butylperoxyisobutylate, 1,1-di(tert-hexylperoxy)cyclohexane, tert-butylhydroperoxide, and hydrogen peroxide; and redox system initiators of a combination of a peroxide and a reducing agent, such as a combination of a persulfate and sodium hydrogen sulfite and a combination of a peroxide and sodium ascorbate.

[0074]

Such polymerization initiators may be used singly or in the form of a mixture of two or more thereof. The amount of the initiator(s) is preferably about 1 part or less by weight, more preferably from about 0.005 to 1 part by weight, even more preferably from about 0.02 to 0.5 part by weight for 100 parts by weight of the whole of the monomer component(s).

[0075]

When 2,2'-azobisisobutyronitrile is used as the polymerization initiator or one of the polymerization initiators, the use amount of the polymerization initiator is preferably about 0.2 part or less by weight, more preferably from about 0.06 to 0.2 part by weight for 100 parts by weight of the whole of the monomer component(s).

[0076]

Examples of the chain transfer agent include laurylmercaptan, glycidylmercaptan, mercaptoacetic acid, 2-mercaptoethanol, thioglycolic acid, 2-ethylhexyl thioglycolate, and 2,3-dimercapto-1-propanol. Such chain transfer agents may be used singly or in the form of a mixture of two or more thereof. The content of the whole of the agent(s) in the monomer component(s) is about 0.3 part or less by weight for 100 parts by weight of the whole of the monomer component(s).

[0077]

When the emulsion polymerization is conducted, examples of the emulsifier used therein include anionic emulsifiers such as sodium laurylsulfate, ammonium laurylsulfate, sodium dodecylbenzenesulfonate, ammonium polyoxyethylene alkyl ether sulfate, and sodium polyoxyethylene alkyl phenyl ether sulfate; and nonionic emulsifiers such as polyoxyethylene alkyl ethers, polyoxyethylene alkyl phenyl ethers, polyoxyethylene fatty acid esters, and polyoxyethylene-polyoxypropylene block polymers. These emulsifiers may be used singly, or in any

combination of two or more thereof.

[0078]

Specific examples of a reactive emulsifier include AQUALONs HS-10, HS-20, KH-10, BC-05, BC-10, and BC-20 (each manufactured by Dai-Ichi Kogyo Seiyaku Co., Ltd.); and ADEKA REASOAP SE10N (manufactured by ADEKA Corp.) as an emulsifier to which a radical polymerizable functional group such as a propenyl group or allyl ether group is introduced. The use amount of the emulsifier(s) is preferably 5 parts or less by weight for 100 parts by weight of the whole of the monomer component(s).

[0079]

When the (meth)acryl-based polymer is produced by a radial ray polymerization, the above-mentioned monomer component(s) is/are polymerized by radiating an electron beam, ultraviolet rays (UV), or other radial rays to the monomer component(s). In this way, the polymer can be produced. Thereamong, an ultraviolet polymerization is preferred. Hereinafter, a description will be made about the ultraviolet polymerization, which is a preferred embodiment among the radial polymerizations.

[0080]

When the ultraviolet polymerization is conducted, a photopolymerization initiator is preferably incorporated into the monomer component(s) since the incorporation produces an

advantage that the polymerization period can be shortened.

[0081]

The photopolymerization initiator may be a photopolymerization initiator (B) having an absorption band in wavelengths less than 400 nm. The photopolymerization initiator (B) preferably has no absorption band in wavelengths from 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  $\alpha$ -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.

[0082]

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.

[0083]

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.

[0084]

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

[0085]

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

[0086]

An example of the benzoin-based photopolymerization initiator is benzoin.

[0087]

Examples of the benzil-based photopolymerization

initiator include benzil.

[0088]

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

[0089]

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

[0090]

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.

[0091]

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

[0092]

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 parts 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. [0093]

When the pressure-sensitive-adhesive layer includes the ultraviolet absorbent (or the colorant compound) and ultraviolet polymerization is performed therefor, it is preferred to form this layer by ultraviolet-polymerizing, for example, an ultraviolet-ray curing-type acrylic pressure-sensitive-adhesive composition which includes one or more monomer components including the above-mentioned alkyl (meth)acrylate and/or a partially polymerized product of the monomer component(s), and which also includes the ultraviolet absorbent (or the colorant compound) and one or more photopolymerization initiators. The pressure-sensitive-adhesive layer, which is formed by ultraviolet-polymerizing the ultraviolet-ray curing-type acrylic pressure-sensitive-adhesive composition, can also be formed as a layer as thick as 150  $\mu\text{m}$  or more. Thus, pressure-sensitive-adhesive layers having a thickness in a

broad range can be favorably formed.

[0094]

The photopolymerization initiator(s) at this time preferably include(s) a photopolymerization initiator (A) having an absorption band in wavelengths of 400 nm or more. In a case where ultraviolet polymerization is performed when the pressure-sensitive-adhesive composition contains the ultraviolet absorbent (or the colorant compound), the ultraviolet absorbent (or the colorant compound) unfavorably absorbs ultraviolet rays so that the polymerization may not be sufficiently attained. However, the photopolymerization initiator (A), which has an absorption band in wavelengths from 400 nm or more, allows to attain the polymerization sufficiently even when the composition contains the ultraviolet absorbent (or the colorant compound).

[0095]

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).

[0096]

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.

[0097]

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 or the colorant compound, which will be detailed later. The addition amount is preferably from about 0.005 to 1 part by weight, more preferably from about 0.02 to 0.8 part by weight for 100 parts by weight of the monofunctional monomer(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.

[0098]

When the pressure-sensitive-adhesive layer includes the ultraviolet absorbent (or the colorant compound) and ultraviolet polymerization is performed therefor, it is preferred to add a photopolymerization initiator (B) having an absorption band in wavelengths less than 400 nm earlier to the monomer component(s); irradiate ultraviolet rays thereto to yield a partially polymerized product (prepolymer composition) of the monomer component(s), in which the monomer component(s) has/have been partially polymerized; and then add, to this product, the above-mentioned photopolymerization initiator

(A), which has an absorption band in wavelengths of 400 nm or more, and the ultraviolet absorbent (or the colorant compound) to ultraviolet-polymerize the resultant. When the photopolymerization initiator (A), which has an absorption 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 monomer component(s) has/have been partially polymerized, it is preferred to attain this addition after the photopolymerization initiator is dissolved into the monomer(s).

[0099]

(Silane Coupling Agent)

Furthermore, the pressure-sensitive-adhesive composition of 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.

[0100]

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- $\gamma$ -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.

[0101]

(Crosslinking Agent)

The pressure-sensitive-adhesive composition of 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.

[0102]

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.

[0103]

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.

[0104]

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.

[0105]

(Other Additives)

The pressure-sensitive-adhesive composition of 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. [0106]

In the present invention, it is preferred to adjust the pressure-sensitive-adhesive composition into a viscosity at which the composition is properly worked, for example, the composition is properly applied onto a substrate. The adjustment of the viscosity of the pressure-sensitive-adhesive composition is attained, for example, by adding, to the composition, for example, a polymer or polyfunctional monomer that may be of various types, such as a tackifying additive, or by polymerizing the monomer component(s) partially in the pressure-sensitive-adhesive composition. The partial polymerization may be performed before or after the addition of the polymer or polyfunctional monomer, which may be of various types and may be a tackifying additive. The viscosity of the pressure-sensitive-adhesive composition is varied in accordance with the quantity of the additive, or other factors. Thus, when the monomer component(s) in the pressure-sensitive-adhesive composition is/are partially polymerized, the polymerization rate thereof cannot be

determined without reservation. 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 composition becomes too high in viscosity not to be easily applied onto a substrate.

[0107]

(Method for Forming Pressure-Sensitive-Adhesive Layer)

The method for forming the pressure-sensitive-adhesive layer is not particularly limited, and may be any method usable ordinarily in the present field. Specifically, the pressure-sensitive-adhesive layer may be formed by applying the pressure-sensitive-adhesive composition onto at least a single surface of a substrate, and then drying an applied film made of the pressure-sensitive-adhesive composition or then radiating an active energy ray, such as an ultraviolet ray, onto the composition. The pressure-sensitive-adhesive layer formed on the substrate may also be transferred onto, for example, a polarizing film.

[0108]

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.

[0109]

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.

[0110]

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.

[0111]

The thickness of the release film is usually from about 5 to 200  $\mu\text{m}$ , preferably from about 5 to 100  $\mu\text{m}$ . 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.

[0112]

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.

[0113]

The thickness of the film substrate is preferably from 15  $\mu\text{m}$  to 200  $\mu\text{m}$ , more preferably from 25  $\mu\text{m}$  to 188  $\mu\text{m}$ .

[0114]

The method for applying the 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.

[0115]

When the pressure-sensitive-adhesive layer is formed by drying an applied film made of the pressure-sensitive-adhesive composition, conditions (temperature and period) for the drying are not particularly limited. The conditions may be appropriately set in accordance with the composition, and the concentration of the pressure-sensitive-adhesive composition, and other factors. The temperature is, for example, from about 60 to 170°C, preferably from 60 to 150°C, and the period is from 1 to 60 minutes, preferably from 2 to 30 minutes.

[0116]

When the pressure-sensitive-adhesive composition is an ultraviolet-ray curing-type pressure-sensitive-adhesive composition and an applied film made of the pressure-sensitive-adhesive composition is irradiated with ultraviolet rays to form a layer, the illuminance of the radiated ultraviolet rays is preferably 5 mW/cm<sup>2</sup> or more. If the illuminance of the ultraviolet rays is less than 5 mW/cm<sup>2</sup>, the polymerization reaction period may become long to deteriorate the layer in productivity. The illuminance of the

ultraviolet rays is preferably 200 mW/cm<sup>2</sup> or less. If the illuminance of the ultraviolet rays is more than 200 mW/cm<sup>2</sup>, 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 to 5000 mJ/cm<sup>2</sup>.

[0117]

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.

[0118]

In the present invention, the final polymerization rate of the monomer component(s) in the ultraviolet-ray curing-type pressure-sensitive-adhesive composition is preferably 90% or more, more preferably 95% or more, even more preferably 98% or more.

[0119]

In the present invention, the wavelength of a peak of the ultraviolet rays radiated to the ultraviolet-ray-curing-type pressure-sensitive-adhesive composition is in a range preferably from 200 nm to 500 nm, more preferably from 300 nm 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.

[0120]

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 film made of the ultraviolet-ray-curing-type 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.

[0121]

When the ultraviolet-ray-curing-type pressure-sensitive-adhesive composition used in the present invention contains an ultraviolet absorbent (or a colorant compound), it is preferred to produce the ultraviolet-ray-curing-type 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 (or a colorant compound) 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.

[0122]

When a pressure-sensitive-adhesive layer is formed as described above, using the ultraviolet-ray-curing-type

pressure-sensitive-adhesive composition containing the ultraviolet absorbent (or the colorant compound), 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.

[0123]

The thickness of the pressure-sensitive-adhesive layer is preferably 12  $\mu\text{m}$  or more, more preferably 50  $\mu\text{m}$  or more, even more preferably 100  $\mu\text{m}$  or more, in particular preferably 150  $\mu\text{m}$  or more. The upper limit value of the thickness of the pressure-sensitive-adhesive layer is not particularly limited, and is preferably 1 mm or less. If the thickness of the pressure-sensitive-adhesive layer is more than 1 mm, the layer does not transmit ultraviolet rays easily so that a long time is required for the polymerization of the monomer component(s). Additionally, problems are caused against the workability of the layer, the winding thereof in the process, and the transportability thereof so that the productivity may be unfavorably poor.

[0124]

The gel fraction in the pressure-sensitive-adhesive layer of the present invention is not particularly limited, and is preferably 35% or more, more preferably 50% or more, even

more preferably 75% or more, in particular preferably 85% or more. If the gel fraction in the pressure-sensitive-adhesive layer is small, the layer may undergo problems against the workability and handleability.

[0125]

About the pressure-sensitive-adhesive layer, the haze value is preferably 2% or less, more preferably from 0 to 1.5%, even more preferably from 0 to 1% when the thickness thereof is 25  $\mu\text{m}$ . When the haze is in any one of these ranges, the pressure-sensitive-adhesive layer favorably has a high transparency.

[0126]

When the pressure-sensitive adhesive layer is exposed, the pressure-sensitive adhesive layer may be protected by a release film until it is actually used.

[0127]

### (3-2) Polarizing Film

The above-mentioned polarizing film may be a polarizing film having a polarizer, and a transparent protective film on at least one surface of the polarizer.

[0128]

#### (3-2-1) Polarizer 4

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  $\mu\text{m}$ .

[0129]

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 polyvinyl alcohol 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.

[0130]

In the present invention, a thin polarizer of 10  $\mu\text{m}$  or less thickness may be used. For making the polarizing film thinner, the thickness is preferably from 1 to 7  $\mu\text{m}$ . 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.

[0131]

Typical examples of the thin polarizer include thin polarizing membranes described in JP-A-S51-069644, JP-A-2000-338329, WO2010/100917 pamphlet, 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) 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 PVA-based resin layer is thin, without causing any inconvenience, such as breaking, by the stretching based on the supporting of the PVA-based resin layer on the resin substrate for stretching.

[0132]

The thin polarizing membranes are preferably polarizing membranes each yielded by the following producing method, among producing methods including the step of stretching the members concerned in the laminate state and the step of dyeing the laminate, since the laminate can be stretched into a large stretch ratio to improve the resultant in polarizing performance: a producing method including the step of stretching the laminating in an aqueous solution of boric acid, as is described in WO 2010/100917 pamphlet, WO2010/100917 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.

[0133]

### (3-2-2) Transparent Protective Film 3

The transparent protective film 3 used in the present invention is a film arranged on the viewing side of the polarizer

4. However, a transparent protective film may be arranged on the organic electroluminescent panel side of the polarizer 4. [0134]

As the 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 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.

[0135]

The thickness of the protective film may be appropriately determined, and is generally from about 1 to 500  $\mu\text{m}$  from the viewpoint of the strength, the handleability and other workabilities, the thin film property, and other properties of the film.

[0136]

The polarizer and the transparent 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 transparent protective film is, besides these adhesives, an ultraviolet-ray curing-type adhesive, or an electron-beam curing-type adhesive.

The electron-beam curing-type adhesive for polarizing films shows an adhesion suitable for the above-mentioned various viewing side transparent protective films. A metal compound filler may be incorporated into the adhesive used in the present invention.

[0137]

A functional layers such as a hard coat layer, anti-reflection layer and sticking-prevention layer may be formed onto the surface of the transparent protective film onto which no polarizer is bonded. A treatment for diffusion or anti-glaring may be applied onto the surface of the transparent protective film onto which no polarizer is bonded.

[0138]

The hard coat layer is preferably a cured coat film made of a curing-type resin such as a melamine-based resin, a urethane-based resin, an alkyd-based resin, an acryl-based resin or a silicone-based resin. The thickness of the hard coat layer is preferably from 0.1 to 30  $\mu\text{m}$ .

[0139]

An ultraviolet absorbent, a light stabilizer (HALS), an antioxidant and/or a colorant compound may be added to one or more of the function layers.

[0140]

### (3-3) Retardation Film 5

As the retardation film, a retardation film satisfying

the following relationship is selected in accordance with various use of the polarizing film to be used:  $n_x = n_y > n_z$ ,  $n_x > n_y > n_z$ ,  $n_x > n_y = n_z$ ,  $n_x > n_z > n_y$ ,  $n_z = n_x > n_y$ ,  $n_z > n_x > n_y$ , or  $n_z > n_x = n_y$  in which  $n_x$  represents the refractive index of the film in the slow axis direction thereof;  $n_y$  represents the refractive index thereof in the fast axis direction in the plane; and  $n_z$  represents the refractive index in the thickness direction. The case of  $n_x = n_y$  includes not only a case where  $n_x$  and  $n_y$  are completely equal to each other but also a case where  $n_x$  and  $n_y$  are substantially equal to each other. Moreover, the case of  $n_y = n_z$  includes not only a case where  $n_y$  and  $n_z$  are completely equal to each other but also a case where  $n_y$  and  $n_z$  are substantially equal to each other.

[0141]

In the present invention, the retardation film is preferably a quarter wavelength plate in which  $1/4$  wavelength (about 100 nm to 170 nm) is set to the front-surface retardation, so as to be used in the organic electroluminescent display device. When the polarizing film and the quarter wavelength plate are laminated onto each other, the resultant favorably functions as a circularly polarizing film for anti-reflection of the organic electroluminescent display device.

[0142]

Specifically, about external light radiated into this organic electroluminescent display device, the polarizing film

transmits only its linearly polarized component. This linearly polarized ray generally turns to an elliptically polarized ray through the retardation film. When the retardation plate is, particularly, a quarter wavelength plate and further the angle made between the polarizing film and the retardation film is  $\pi/4$ , the linearly polarized ray turns to a circularly polarized ray.

[0143]

This circularly polarized ray is transmitted through the transparent substrate, transparent electrode and organic thin film in the organic electroluminescent panel, and then reflected on a metal electrode therein to be again transmitted through the organic thin film, transparent electrode and transparent substrate. Subsequently, the ray again turns to a linearly polarized ray through the retardation film. This linearly polarized ray is orthogonal to the polarization direction of the polarizing film, so that this ray cannot be transmitted through the polarizing plate. As a result, a mirror plane of the metal electrode can be completely shielded.

[0144]

#### (3-4) Pressure-Sensitive-Adhesive Layer 6

The pressure-sensitive-adhesive layer 6 (organic electroluminescent panel side pressure-sensitive-adhesive layer) used in the present invention may be a layer equivalent to the pressure-sensitive-adhesive layer of the

above-mentioned pressure-sensitive-adhesive or adhesive layer. Among such layers, preferred is an acrylic pressure-sensitive-adhesive layer made of a (meth)acrylic pressure-sensitive-adhesive composition containing, as a base polymer thereof, a (meth)acryl-based polymer. The method for producing the pressure-sensitive-adhesive layer, and preferred embodiments thereof may be the same as described above.

[0145]

The thickness of the pressure-sensitive-adhesive layer is not particularly limited, and is preferably from about 10 to 75  $\mu\text{m}$ , more preferably from about 12 to 50  $\mu\text{m}$ .

[0146]

#### (3-5) Other Layers

Examples of the (organic electroluminescent panel side) transparent protective film are equivalent to those of the transparent protective film 3. As the organic electroluminescent panel side first pressure-sensitive-adhesive layer (or adhesive layer), all the pressure-sensitive-adhesive layers and adhesive layers in the document DESCRIPTION are preferably usable.

[0147]

#### (4) Transmittance of Layer Including Ultraviolet Absorbent

At a wavelength of 380 nm, the transmittance of the layer including the ultraviolet absorbent is preferably 9% or less,

more preferably 7% or less, even more preferably 5% or less, in particular preferably 3% or less. When the transmittance at the wavelength of 380 nm is in any one of the ranges, the layer including the ultraviolet absorbent can block ultraviolet rays radiated thereinto at a higher level, so that the organic electroluminescent element can be remarkably restrained from being deteriorated.

[0148]

At a wavelength of 450 nm, the transmittance of the layer including the ultraviolet absorbent is preferably 60% or more, more preferably 70% or more, even more preferably 75% or more. When the transmittance at the wavelength of 450 nm is in any one of the ranges, the layer including the ultraviolet absorbent can sufficiently transmit light emitted from the organic electroluminescent element, so that the organic electroluminescent display device can favorably ensure a sufficient display performance.

[0149]

#### (5) Transmittance of Layer Including Colorant Compound

When the pressure-sensitive adhesive layer includes a colorant compound, at a wavelength of 400 nm the transmittance of the layer including the colorant compound is preferably 50% or less, more preferably 35% or less, even more preferably 20% or less. When the transmittance at the wavelength of 400 nm is in any one of the ranges, the pressure-sensitive-adhesive

layer can block ultraviolet rays radiated thereinto at a higher level, so that the organic electroluminescent element can be remarkably restrained from being deteriorated.

[0150]

At a wavelength of 450 nm, the transmittance of the layer including the colorant compound is preferably 60% or more, more preferably 70% or more, even more preferably 75% or more. When the transmittance at the wavelength of 450 nm is in any one of the ranges, the layer including the colorant compound can sufficiently transmit light emitted from the organic electroluminescent element, so that the organic electroluminescent display device can favorably ensure a sufficient display performance.

[0151]

#### (6) Transmittance of Optical Laminated Body

At a wavelength of 380 nm, the transmittance of the optical laminated body is preferably 9% or less, more preferably 7% or less, even more preferably 5% or less, in particular preferably 3% or less. When the transmittance at the wavelength of 380 nm is in any one of the ranges, the optical laminated body can block ultraviolet rays radiated thereinto at a higher level. Thus, favorably, the organic electroluminescent element can be remarkably restrained from being deteriorated.

[0152]

At a wavelength of 400 nm, the transmittance of the

optical laminated body is preferably 20% or less, more preferably 15% or less, even more preferably 10% or less. When the transmittance at the wavelength of 400 nm is in any one of the ranges, the optical laminated body can block ultraviolet rays radiated thereinto at a higher level. Thus, favorably, the organic electroluminescent element can be remarkably restrained from being deteriorated.

[0153]

At a wavelength of 450 nm, the transmittance of the optical laminated body is preferably 25% or more, more preferably 30% or more, even more preferably 33% or more. When the transmittance at the wavelength of 450 nm is in any one of the ranges, the optical laminated body can sufficiently transmit light emitted from the organic electroluminescent element, so that the organic electroluminescent display device can favorably ensure a sufficient display performance.

[0154]

#### (7) Organic Electroluminescent Display Device

The organic electroluminescent display device of the present invention is a display device including an optical laminated body 1 and an organic electroluminescent panel, and may include other layers. Specifically, as illustrated in Fig. 2, the display device may be an organic electroluminescent display device 10 in which a cover member 7/a pressure-sensitive-adhesive or adhesive layer 2/a protective

film 3/a polarizer 4/a retardation film 5/a pressure-sensitive-adhesive layer 6/an organic electroluminescent panel 8 are laminated onto each other in this order from the viewing side of the display device. The display device may be an organic electroluminescent display device in which the cover member 7/the pressure-sensitive-adhesive or adhesive layer 2/the (viewing side) protective film 3/the polarizer 4/an organic electroluminescent panel side protective film/an organic electroluminescent panel side first pressure-sensitive-adhesive layer (or adhesive layer)/the retardation film 5/the (organic electroluminescent panel side second) pressure-sensitive-adhesive layer 6/the organic electroluminescent panel 8 are laminated onto each other in this order from the viewing side of the display device. The display device may have a structure including, besides these layers or members, for example, functional layers such as a hard coat layer, an anti-glare layer and anti-reflection layer, a sensor layer, and a pressure-sensitive-adhesive layer or adhesive layer for laminating any two of these layers onto each other.

[0155]

The cover member is not particularly limited, and is preferably a cover member used ordinarily in the present field. Examples thereof include a cover glass, and a cover plastic. The organic electroluminescent panel is not particularly limited, and may be an organic electroluminescent panel used

ordinarily in the present field. An example thereof is a panel having a substrate, plural organic electroluminescent elements arranged side by side on the substrate, a protective layer laid on the organic electroluminescent elements, and a sealing film laid on the protective layer.

#### EXAMPLES

[0156]

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.

[0157]

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

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 15 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).

[0158]

#### Production Example 2 (Production of Pressure-Sensitive-Adhesive Layer (B1))

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 resultant 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  $\mu\text{m}$  to give a thickness of 12  $\mu\text{m}$  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 "pressure-sensitive-adhesive layer (B1)".

[0159]

Production Example 3 (Production of Pressure-Sensitive

#### Adhesive Layer (B1-1) Including Colorant Compound)

In Production Example 2, to the acryl-based polymer solution (the solid content therein was regarded as 100 parts by weight) were added, together with an isocyanate-based crosslinking agent and a silane coupling agent, 1.5 parts by weight (solid weight) of a product BONASORB UA3911 ((trade name), manufactured by Orient Chemical Industries Co., Ltd.: an indole-based compound: a "colorant compound (c1)" in Table 1; maximum absorption wavelength of its absorption spectrum: 398 nm; half value width: 48 nm) dissolved as a colorant compound into toluene to give a solid content of 1%. In this way, a pressure-sensitive-adhesive composition (solution) was prepared.

The resultant 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  $\mu\text{m}$  to give a thickness of 15  $\mu\text{m}$  after the resultant would be dried. The resultant was dried at 100°C for 3 minutes to remove the solvent to yield a 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 "pressure-sensitive-adhesive layer (B1-1)". The addition amount of the colorant compound was 1.5% by weight of the total (100% by weight) of the

pressure-sensitive-adhesive layer (B1-1).

[0160]

Production Example 4 (Production of Pressure-Sensitive Adhesive Layer (B1-2) Including Colorant Compound)

A pressure-sensitive-adhesive layer was formed in the same way as in Production Example 3 except that the addition amount of the colorant compound (c) was changed to 2.5 parts by weight (solid weight). Hereinafter, the pressure-sensitive-adhesive layer will be referred to as the "pressure-sensitive-adhesive layer (B1-2)". The addition amount of the colorant compound was 2.5% by weight of the total (100% by weight) of the pressure-sensitive-adhesive layer (B1-2).

[0161]

Production Example 5 (Production of Pressure-Sensitive Adhesive Layer (B1-3) Including Colorant Compound)

A pressure-sensitive-adhesive layer was formed in the same way as in Production Example 3 except that the colorant compound (c) was changed to a cinnamic acid-based compound (trade name: SOM-5-0106, manufactured by Orient Chemical Industries Co., Ltd.: an "ultraviolet absorbent (c3)" in Table 1; maximum absorption wavelength of its absorption spectrum: 416 nm; half value width: 50 nm) in amount of 1.0 part by weight. Hereinafter, the pressure-sensitive-adhesive layer will be referred to as the "pressure-sensitive-adhesive layer (B1-3)".

The addition amount of the colorant compound was 1.0% by weight of the total (100% by weight) of the pressure-sensitive-adhesive layer (B1-3).

[0162]

Production Example 6 (Production of Pressure-Sensitive-Adhesive Layer (B2))

The pressure-sensitive-adhesive composition solution yielded in Production Example 2 was applied onto a separator (polyethylene terephthalate film having a surface subjected to release treatment) having a thickness of 38  $\mu\text{m}$  to give a thickness of 23  $\mu\text{m}$  after the resultant layer would be dried. The layer was dried at 100°C for 3 minutes to remove the solvent to yield a pressure-sensitive-adhesive layer. Thereafter, the layer 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 "pressure-sensitive-adhesive layer (B2)".

[0163]

Production Example 7 (Production of Pressure-Sensitive-Adhesive Layer (B2-1) Including Colorant Compound)

The following were added to the acryl-based polymer solution (the solid content therein was regarded as 100 parts by weight) yielded in Production Example 2 to prepare a pressure-sensitive-adhesive composition (solution): 1.0 part

by weight (solid weight) of a product BONASORB UA3912 ((trade name), manufactured by Orient Chemical Industries Co., Ltd.: an indole-based compound; a "colorant compound (c2)" in Table 1; maximum absorption wavelength of its absorption spectrum: 386 nm; half value width: 53 nm) dissolved as a colorant compound into toluene to give a solid content of 5%; 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.).

The 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  $\mu\text{m}$  to give a thickness of 23  $\mu\text{m}$  after the resultant layer would be dried. The layer was dried at 100°C for 3 minutes to remove the solvent to yield a pressure-sensitive-adhesive layer. Thereafter, the layer 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 "pressure-sensitive-adhesive layer (B2-1)". The addition amount of the colorant compound was 1.0% by weight of the total (100% by weight) of the pressure-sensitive-adhesive layer (B2-1).

[0164]

#### Production Example 8 (Production of Protective Film (C1))

A biaxial kneader was used to mix 100 parts by weight of an imidated MS resin described in Production Example 1 of JP-A-2010-284840, and 0.65 part by weight of 6,6',6''-(1,3,5-triazine-2,4,6-triyl)tris(3-hexyloxy-2-methylphenol) (trade name: LA-F70, manufactured by ADEKA Corp.: an "ultraviolet absorbent (b1) in Table 1; the maximum absorption wavelength of its absorption spectrum: 357 nm) with each other at 220°C to produce resin pellets. The resultant resin pellets were dried at 100.5 kPa and 100°C for 12 hours, and then a uniaxial extruder was used to extrude the pellets through a T die at a dice temperature of 270°C to form the pellets into a film form (thickness: 160 μm). Furthermore, the film was drawn (into a thickness of 80 μm) in the transporting direction of the film in an atmosphere of 150°C temperature. Next, the film was drawn in a direction orthogonal to the film transporting direction in an atmosphere of 150°C temperature to yield a substrate film A ((meth)acryl-based resin film) of 40 μm thickness. The transmittance of the resultant substrate film A was 7% about a light ray having a wavelength of 380 nm, and the transmittance thereof was 68% about a light ray having a wavelength of 400 nm.

[0165]

The following were mixed with 100 parts by weight of an ultraviolet-ray curing-type resin (trade name: UNIDIC 17-806,

manufactured by DIC Corp.; solid content: 80%; solvent: butyl acetate) including 13 parts of triacrylate isocyanurate, 16 parts of pentaerythritol triacrylate, 62 parts of dipentaerythritol hexaacrylate, and 9 parts of isophorone diisocyanate polyurethane: 1.5 parts 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.: an "ultraviolet absorbent (b2)" in Table 1; maximum absorption wavelength of its absorption spectrum: 346 nm); 5 parts by weight of a leveling agent (trade name: GRADIC PC-4100, manufactured by DIC Corp.); and 3 parts 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 from 200 to 450 nm). The resultant was diluted with methyl isobutyl ketone to give a solid concentration of 50% to prepare a composition for hard coat layer formation. This composition for hard coat layer formation was applied to the yielded substrate film A to form a coat layer. This coat layer was heated at 120°C for 1 minute. The heated coat layer was irradiated with ultraviolet rays giving an integrated light quantity of 500 mJ/cm<sup>2</sup> from a high-pressure mercury lamp to cure the coat layer. In this way, a hard coat layer of 7 μm thickness was formed. Hereinafter, this surface-treatment-layer attached protective film layer

was referred to as the "protective film layer(C1)". The addition amount of the ultraviolet absorbent was 0.77% by weight of the total (100% by weight) of the protective film (C1).  
[0166]

#### Production Example 9 (Production of Protective Film (C2-1))

Into methylene chloride were dissolved 100 parts by weight of an imidated MS resin described in Production Example 1 of JP-A-2010-284840 to produce a 12% by weight dope solution. Thereto was added 0.3 part by weight of a cinnamic acid-based compound (trade name: SOM-5-0106, manufactured by Orient Chemical Industries Co., Ltd.: an "ultraviolet absorbent (c3)" in Table 1; maximum absorption wavelength of its absorption spectrum: 416 nm; half value width: 50 nm). Thereafter, this pressure-sensitive-adhesive composition solution was applied onto a glass plate subjected to release treatment to give a thickness of 40  $\mu\text{m}$  after the resultant would be dried. This workpiece was dried at 100°C for 3 minutes to remove the solvent to yield a protective film (C2-1) of 40  $\mu\text{m}$  thickness. The transmittance of the resultant protective film (C2-1) was 14% about a light ray having a wavelength of 380 nm. The transmittance thereof was 2.6% about a light ray having a wavelength of 400 nm. The addition amount of the colorant compound was 0.3% by weight of the total (100% by weight) of the protective film (C2-1).

[0167]

#### Production Example 10 (Production of Protective Film (C2-2))

A protective film (C2-2) was yielded in the same way as Production Example 9 except that as the colorant compound (c), the following was used in an amount of 1.3 parts by weight: a product BONASORB UA3912 ((trade name), manufactured by Orient Chemical Industries Co., Ltd.: an indole compound: a "colorant compound (c2)" in Table 1; maximum absorption wavelength of its absorption spectrum: 386 nm; half value width: 53 nm). The transmittance of the resultant protective film (C2-2) was 0.3% about a light ray having a wavelength of 380 nm. The transmittance thereof was 0.8% about a light ray having a wavelength of 400 nm. The addition amount of the colorant compound was 1.3% by weight of the total (100% by weight) of the protective film (C2-2).

[0168]

#### Example 1

##### (Production of Pressure-Sensitive-Adhesive Composition (A1))

The following were added to the acryl-based pressure-sensitive-adhesive composition (a) (the amount of the monomer components from which an acryl-based polymer was made was regarded as 100 parts by weight) yielded in Production Example 1: 1.4 part by weight (solid 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.: an "ultraviolet absorbent

(b2)" in Table 1; maximum absorption wavelength of absorption spectrum: 346 nm) dissolved in butyl acrylate to give a solid content of 15%; and 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 (A1).

[0169]

(Production of Pressure-Sensitive-Adhesive Layer (A1))

The pressure-sensitive-adhesive composition (A1) was applied onto a release film, which was a film subjected to release treatment, to give a thickness of 150  $\mu\text{m}$  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<sup>2</sup>, light quantity: 1500 mJ/cm<sup>2</sup>; and peak wavelength: 350 nm. In this way, the pressure-sensitive-adhesive composition layer was optically cured to form pressure-sensitive-adhesive layer (A1). The addition amount of the ultraviolet absorbent was 1.4% by weight of the total (100% by weight) of the pressure-sensitive-adhesive layer (A1).

[0170]

(Production of Polarizing Film (P1))

By using a polyvinyl alcohol-based adhesive, a cycloolefin polymer film having a thickness of 25  $\mu\text{m}$  was bonded onto the viewing side of a polarizer made of a stretched polyvinyl alcohol film impregnated with iodine and having a thickness of 5  $\mu\text{m}$ . By using a polyvinyl alcohol-based adhesive, an acrylic film having a thickness of 20  $\mu\text{m}$  was laminated onto an organic electroluminescent display panel side surface of the polarizer to produce a polarizing film (P1). The single transmittance Y value of the polarizing film was 42.4%, and the polarization degree thereof was 99.995.

[0171]

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

The pressure-sensitive-adhesive layer (A1) was laminated onto the viewing side (that is, the outer surface of the cycloolefin polymer film, the thickness of which was 25  $\mu\text{m}$ ) of the polarizing film (P1). The pressure-sensitive-adhesive layer (B1-1) yielded in Production Example 3 was laminated onto an organic electroluminescent display panel side surface (that is, the outer surface of the acrylic film, the thickness of which was 20  $\mu\text{m}$ ) of the polarizing film (P). Furthermore, the following were laminated thereonto to form a pressure-sensitive-adhesive-layer attached polarizing film: a retardation film (thickness: 56  $\mu\text{m}$ ; material: polycarbonate);

and the pressure-sensitive-adhesive layer (B2-1) yielded in Production Example 7. The resultant pressure-sensitive-adhesive-layer attached polarizing film had a structure of pressure-sensitive-adhesive layer (A1)/cycloolefin polymer film/polarizer/acrylic film/pressure-sensitive-adhesive layer (B1-1)/retardation film/pressure-sensitive-adhesive layer (B2-1).

[0172]

#### Example 2

(Production of Pressure-Sensitive-Adhesive Composition (A2))

Into the acryl-based pressure-sensitive-adhesive composition (a) yielded in Production Example 1 were added 1.5 parts by weight (solid weight) of 2-(2H-benzotriazol-2-yl)-6-(1-methyl-1-phenylethyl)-4-(1,1,3,3-tetramethylbutyl)phenol (trade name: TINUVIN 928, manufactured by BASF Japan Ltd.: an "ultraviolet absorbent b3" in Table 1; maximum absorption wavelength of its absorption spectrum: 349 nm), and 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 from 200 to 450 nm). These components were stirred to yield a pressure-sensitive-adhesive composition (A2).

[0173]

(Production of Pressure-Sensitive-Adhesive Layer (A2))

The pressure-sensitive-adhesive composition (A2) yielded as described above was applied onto a release film, which was a film subjected to release treatment, to give a thickness of 150  $\mu\text{m}$  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<sup>2</sup>, light quantity: 1500 mJ/cm<sup>2</sup>; and peak wavelength: 350 nm. In this way, the pressure-sensitive-adhesive composition layer was optically cured to form a pressure-sensitive-adhesive layer (A2). The addition amount of the ultraviolet absorbent was 1.5% by weight of the total (100% by weight) of the pressure-sensitive-adhesive layer (A2).

[0174]

(Production of Polarizing Film (P2))

By using a polyvinyl alcohol-based adhesive, a cycloolefin polymer film having a thickness of 25  $\mu\text{m}$  was bonded onto the viewing side of a polarizer made of a stretched polyvinyl alcohol film impregnated with iodine and having a thickness of 5  $\mu\text{m}$ . By using a polyvinyl alcohol-based adhesive, a protective film (C2-1) yielded in Production Example 9 was laminated onto an organic electroluminescent display panel side surface of the polarizer to produce a polarizing film (P2). The single transmittance Y value of the polarizing film was 42.5%,

and the polarization degree thereof was 99.995.

[0175]

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

The produced pressure-sensitive-adhesive layer (A2) was laminated onto the viewing side of the polarizing films (P2) (that is, the outer surface of the cycloolefin polymer film, the thickness of which was 25  $\mu\text{m}$ ). The pressure-sensitive-adhesive layer (B1) yielded in Production Example 2 was laminated onto the organic electroluminescent panel side surface of the polarizing film (P) (that is, the outer surface of the protective film (C2-1)). Furthermore, a retardation film (thickness: 56  $\mu\text{m}$ ; material: polycarbonate), and the pressure-sensitive-adhesive layer (B2) yielded in Production Example 6 were laminated thereonto to form a pressure-sensitive-adhesive-layer attached polarizing film. The resultant pressure-sensitive-adhesive-layer attached polarizing film had a structure of the pressure-sensitive-adhesive layer (A2)/the cycloolefin polymer film/the polarizer/the protective film (C2-1)/the pressure-sensitive-adhesive layer (B1)/the retardation film/the pressure-sensitive-adhesive layer (B2).

[0176]

Example 3

(Production of Pressure-Sensitive-Adhesive Composition (A3))

Into the acryl-based pressure-sensitive-adhesive composition (a) yielded in Production Example 1 were added 0.7 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.: an "ultraviolet absorbent (b2)" in Table 1; maximum absorption wavelength of its absorption spectrum: 346 nm) dissolved in butyl acrylate to give a solid content of 15%, and 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 from 200 to 450 nm). These components were stirred to yield a pressure-sensitive-adhesive composition (A3).

[0177]

(Production of Pressure-Sensitive-Adhesive Layer (A3))

The pressure-sensitive-adhesive composition (A3) was applied onto a release film, which was a film subjected to release treatment, to give a thickness of 150  $\mu\text{m}$  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<sup>2</sup>, light quantity: 1500 mJ/cm<sup>2</sup>; and peak wavelength: 350 nm. In this way, the

pressure-sensitive-adhesive composition layer was optically cured to form a pressure-sensitive-adhesive layer (A3). The addition amount of the ultraviolet absorbent was 0.7% by weight of the total (100% by weight) of the pressure-sensitive-adhesive layer (A3).

[0178]

(Production of Polarizing Film (P3))

By using a polyvinyl alcohol adhesive, the protective film (C1) produced in Production Example 8 was bonded onto the viewing side of a polarizer made of a drawn polyvinyl alcohol film impregnated with iodine and having a thickness of 5  $\mu\text{m}$  to bring the substrate film A side thereof into contact with the polarizer. By using a polyvinyl alcohol adhesive, the organic electroluminescent side protective film (C2-2) yielded in Production Example 10 was laminated onto the organic electroluminescent panel side of the polarizer to yield a polarizing film (P3). The single transmittance Y value of the polarizing film was 42.4%, and the polarization degree thereof was 99.995.

[0179]

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

The produced pressure-sensitive-adhesive layer (A3) was laminated onto the viewing side of the polarizing film (P3) (that is, the outer surface of the protective film (C1)). The

pressure-sensitive-adhesive layer (B1-2) yielded in Production Example 4 was laminated onto the organic electroluminescent panel side of the polarizing film (P) (that is, the outer surface of the protective film (C2-2)). Furthermore, a retardation film (thickness: 56  $\mu\text{m}$ ; material: polycarbonate), and the pressure-sensitive-adhesive layer (B2) yielded in Production Example 6 were laminated thereonto to form a pressure-sensitive-adhesive-layer attached polarizing film. The resultant pressure-sensitive-adhesive-layer attached polarizing film had a structure of the pressure-sensitive-adhesive layer (A3)/the protective film (C1)/the polarizer/the protective film (C2-2)/the pressure-sensitive-adhesive layer (B1-2)/the retardation film/the organic electroluminescent panel side pressure-sensitive-adhesive layer (B2).

[0180]

#### Comparative Example 1

The produced pressure-sensitive-adhesive layer (A3) yielded in Example 3 was laminated onto the viewing side of the polarizing film (P1) (that is, the outer surface of the cycloolefin polymer film, the thickness of which was 25  $\mu\text{m}$ ) yielded in Example 1. The pressure-sensitive-adhesive layer (B1) yielded in Production Example 2 was laminated onto the organic electroluminescent panel side surface of the polarizing film (P) (that is, the outer surface of the acrylic film, the

thickness of which was 20  $\mu\text{m}$ ). Furthermore, a retardation film (thickness: 56  $\mu\text{m}$ ; material: polycarbonate), and the pressure-sensitive-adhesive layer (B2) yielded in Production Example 6 were laminated thereonto to form a pressure-sensitive-adhesive-layer attached polarizing film. The resultant pressure-sensitive-adhesive-layer attached polarizing film had a structure of the pressure-sensitive-adhesive layer (A3)/the cycloolefin polymer film/the polarizer/the acrylic film/the pressure-sensitive-adhesive layer (B1)/the retardation film/the organic electroluminescent display panel side pressure-sensitive-adhesive layer (B2).

[0181]

#### Comparative Example 2

##### (Production of Pressure-Sensitive-Adhesive Layer)

A pressure-sensitive-adhesive composition (A4) was yielded in the same way as in Example 1 except that in the Production of the item (Production of Pressure-Sensitive-Adhesive Composition (A1)) of Example 1, the ultraviolet absorbent (b2) was not incorporated. Moreover, a pressure-sensitive-adhesive layer (A4) having a thickness of 150  $\mu\text{m}$  was yielded in the same way as in Example 1 except that in the Production of the item (Production of Pressure-Sensitive-Adhesive Composition (A1)) of Example 1, the pressure-sensitive-adhesive composition (A4) was used.

[0182]

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

The pressure-sensitive-adhesive layer (A4) was laminated onto the viewing side of the polarizing films (P1) (that is, the outer surface of the cycloolefin polymer film, the thickness of which was 25  $\mu\text{m}$ ) yielded in Example 1. The pressure-sensitive-adhesive layer (B1-3) yielded in Production Example 5 was laminated onto the organic electroluminescent panel side surface of the polarizing film (P) (that is, the outer surface of the acrylic film, the thickness of which was 20  $\mu\text{m}$ ). Furthermore, a retardation film (thickness: 56  $\mu\text{m}$ ; material: polycarbonate), and the pressure-sensitive-adhesive layer (B2) yielded in Production Example 6 were laminated thereonto to form a pressure-sensitive-adhesive-layer attached polarizing film. The resultant pressure-sensitive-adhesive-layer attached polarizing film had a structure of the pressure-sensitive-adhesive layer (A4)/the cycloolefin polymer film /the polarizer/the acrylic film/the pressure-sensitive-adhesive layer (B1-3)/the retardation film/the pressure-sensitive-adhesive layer (B2).

[0183]

About the resultant individual layers, and optical laminated bodies (pressure-sensitive-adhesive-layer attached

polarizing films), the following evaluations were made.

[0184]

<Transmittance Measurement of Layers Including Ultraviolet Absorbent>

The release films of any one of the layers including the ultraviolet absorbent (pressure-sensitive-adhesive layers) which were yielded in each of the working examples and the comparative examples were peeled off, and then the remaining layer was fitted to a measuring tool. The transmittance thereof was measured, using a spectrophotometer (production name: U4100, manufactured by Hitachi High-Technologies Corp.). The measured transmittance was the transmittance in the range of wavelengths from 350 to 780 nm. In the case of the protective film including the ultraviolet absorbent in Example 3, the transmittance thereof was measured in the same way as in the case of the pressure-sensitive-adhesive layers except that the protective film was fitted to the measuring tool to interpose a film holder therebetween.

[0185]

<Transmittance Measurement of Layers Including Colorant Compound>

The release films of any one of the layers each including the colorant compound (pressure-sensitive-adhesive layers) yielded in each of the working examples and the comparative examples were peeled off, and then the remnant was fitted to

a measuring tool. The transmittance thereof was measured, using the spectrophotometer (production name: U4100, manufactured by Hitachi High-Technologies Corp.). The measured transmittance was the transmittance in the range of wavelengths from 350 to 780 nm. In the case of the protective film including the colorant compound in each of Examples 2 and 3, the transmittance thereof was measured in the same way as in the case of the pressure-sensitive-adhesive layers except that the protective film was fitted to the measuring tool to interpose a film holder therebetween.

[0186]

<Transmittance Measurement of  
Pressure-Sensitive-Adhesive-Layer Attached Polarizing Films>

The release films of any one of the pressure-sensitive-adhesive-layer attached polarizing films yielded in each of the working examples and the comparative examples were peeled off, and then the remnant was fitted to a measuring tool. The transmittance thereof was measured, using the spectrophotometer (production name: U4100, manufactured by Hitachi High-Technologies Corp.). The measured transmittance was the transmittance in the range of wavelengths from 350 nm to 780 nm.

[0187]

[Table 1]

|                       | Respective structures and properties of individual layers |                        |                                        |                                   |                      |                             |                             |                             |                                                 |                        |                                                       |     |                      |                             |                             | Evaluation results          |                             |                                                                                          |                             |  |
|-----------------------|-----------------------------------------------------------|------------------------|----------------------------------------|-----------------------------------|----------------------|-----------------------------|-----------------------------|-----------------------------|-------------------------------------------------|------------------------|-------------------------------------------------------|-----|----------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------------------------------------------------------------------|-----------------------------|--|
|                       | Ultraviolet absorbent added layer (on viewing side)       |                        |                                        |                                   |                      |                             |                             |                             |                                                 |                        | Colorant compound added layer (on display panel side) |     |                      |                             |                             |                             |                             | Pressure-sensitive-adhesive layer attached polarizing film for organic EL display device |                             |  |
|                       | Layer to which ultraviolet absorbent is to be added       | Ultraviolet absorbent  |                                        |                                   | Sheet thickness (μm) | Transmittance (%) at 380 nm | Transmittance (%) at 400 nm | Transmittance (%) at 450 nm | Layer to which Colorant compound is to be added | Colorant compound      |                                                       |     | Sheet thickness (μm) | Transmittance (%) at 380 nm | Transmittance (%) at 400 nm | Transmittance (%) at 450 nm | Transmittance (%) at 380 nm | Transmittance (%) at 400 nm                                                              | Transmittance (%) at 450 nm |  |
| Species               |                                                           | Added amount (part(s)) | Added proportion (%) in whole of layer | Species                           |                      |                             |                             |                             |                                                 | Added amount (part(s)) | Added proportion (%) in whole of layer                |     |                      |                             |                             |                             |                             |                                                                                          |                             |  |
| Example 1             | Pressure-sensitive-adhesive layer A1                      | b2                     | 1.4                                    | 1.4                               | 150                  | 0.2                         | 62.5                        | 92.2                        | Pressure-sensitive-adhesive layer B1-1          | c1                     | 1.5                                                   | 1.5 | 15                   | 1.9                         | 0.5                         | 90.5                        | 0.0                         | 0.0                                                                                      | 36.1                        |  |
|                       |                                                           |                        |                                        |                                   |                      |                             |                             |                             | Pressure-sensitive-adhesive layer B2-1          | c2                     | 1.0                                                   | 1.0 | 23                   | 2.9                         | 7.2                         | 92.6                        |                             |                                                                                          |                             |  |
| Example 2             | Pressure-sensitive-adhesive layer A2                      | b3                     | 1.5                                    | 1.5                               | 150                  | 0.8                         | 70.0                        | 92.2                        | Protective film C2-1                            | c3                     | 0.3                                                   | 0.3 | 40                   | 14.0                        | 2.6                         | 75.0                        | 0.0                         | 0.5                                                                                      | 30.0                        |  |
| Example 3             | Pressure-sensitive-adhesive layer A3                      | b2                     | 0.7                                    | 0.7                               | 150                  | 2.7                         | 76.5                        | 92.3                        | Pressure-sensitive-adhesive layer B1-2          | c1                     | 2.5                                                   | 2.5 | 15                   | 0.2                         | 0.0                         | 89.9                        | 0.0                         | 0.0                                                                                      | 34.6                        |  |
|                       | Protective film C1                                        | b1/<br>b2              | 0.65/<br>(1.5)                         | 0.55/<br>(0.22)<br>Total:<br>0.77 | 40/(7)               | 4.0                         | 66.0                        | 92.2                        | Protective film C2-2                            | c2                     | 1.3                                                   | 1.3 | 40                   | 0.3                         | 0.8                         | 92.5                        |                             |                                                                                          |                             |  |
| Comparative example 1 | Pressure-sensitive-adhesive layer A3                      | b2                     | 0.7                                    | 0.7                               | 150                  | 2.7                         | 76.5                        | 92.3                        | -                                               | -                      | -                                                     | -   | 15                   | 92.1                        | 92.6                        | 92.6                        | 0.4                         | 23.9                                                                                     | 40.3                        |  |
| Comparative example 2 | -                                                         | -                      | -                                      | -                                 | 150                  | 91.9                        | 92.2                        | 92.3                        | Pressure-sensitive-adhesive layer B1-3          | c3                     | 1.0                                                   | 1.0 | 15                   | 8.9                         | 1.0                         | 71.2                        | 0.6                         | 0.3                                                                                      | 28.5                        |  |

## DESCRIPTION OF REFERENCE SIGNS

[0188]

- 1: Optical laminated body
- 2: Pressure-sensitive-adhesive or adhesive layer
- 3: Transparent protective film
- 4: Polarizer
- 5: Retardation film
- 6: Pressure-sensitive-adhesive layer
- 7: Cover member
- 8: Organic electroluminescent panel
- 10: Organic electroluminescent display device

## CLAIMS

1. An organic electroluminescent display device, comprising: an optical laminated body which comprises a polarizer, a retardation film, and one or more layers other than the polarizer and the retardation film; and an organic electroluminescent panel;

wherein an ultraviolet absorbent, and a colorant compound having an absorption spectrum having a maximum absorption wavelength present in a range of wavelengths from 380 nm to 430 nm are blended into different layers among the layers comprised in the optical laminated body; and

a layer having the ultraviolet absorbent is present nearer to a viewing side of the display device than a layer having the colorant compound.

2. The organic electroluminescent display device according to claim 1, wherein the optical laminated body comprises at least a pressure-sensitive-adhesive or adhesive layer, a transparent protective film, the polarizer, the retardation film, and a pressure-sensitive-adhesive layer in this order from the viewing side,

the ultraviolet absorbent is blended into a layer which is nearer to the viewing side than the polarizer, and

the colorant compound is blended into a layer which is

nearer to an organic electroluminescent panel side of the display device than the polarizer.

3. The organic electroluminescent display device according to claim 2, wherein the ultraviolet absorbent is blended into at least one selected from the group consisting of the pressure-sensitive-adhesive or adhesive layer, the transparent protective film, and the retardation film, and the colorant compound is blended into the pressure-sensitive-adhesive layer.

4. The organic electroluminescent display device according to any one of claims 1 to 3, wherein the colorant compound is an organic colorant compound.

5. The organic electroluminescent display device according to any one of claims 1 to 4, wherein the maximum absorption wavelength of the absorption spectrum of the ultraviolet absorbent is present in a range of wavelengths from 300 nm to 400 nm.