

DESCRIPTION

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

TECHNICAL FIELD

[0001]

The present invention relates to a pressure-sensitive adhesive composition for an organic EL (electroluminescence) display device (OLED). Also, the present invention relates to a pressure-sensitive adhesive layer for an organic EL display device formed from the pressure-sensitive adhesive composition for an organic EL display device, and a pressure-sensitive adhesive layer attached polarizing film including the pressure-sensitive adhesive layer. Further, the present invention relates to an organic EL display device including the pressure-sensitive adhesive layer and/or the polarizing film.

BACKGROUND ART

[0002]

In recent years, organic EL display devices, on each

of which an organic EL 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 EL 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 EL 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 EL panel. Any two of the circularly polarizing plate, the decorative panel, and other constituent members of the organic EL 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 EL 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 absorber 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 absorber (see, for example, Patent Document 2).

[0004]

Further, the organic EL display device is used by combining touch panel having capacitive touch sensors. With the spread of capacitive touch sensors, the sensors with higher performances are required. Therefore, for the pressure-sensitive adhesive layer applied for capacitive touch sensors, higher performances are also required. However, by thinning modules in the organic EL display device, increasing the size of the display, and higher definition of the organic EL element, there is a concern that the driving noise during driving the display of the organic EL panel may adversely effect on the sensing of the capacitive touch sensor, and the malfunction may be occurred. The malfunction due to the driving noise may be happened when the dielectric constant of the pressure-

sensitive adhesive layer is high. Therefore, as the pressure-sensitive adhesive agent forming the pressure-sensitive adhesive layer having low dielectric constant, for example, a pressure-sensitive adhesive agent containing a (meth)acrylic polymer including an alkyl (meth)acrylate having a long chain alkyl group is used as the base polymer is proposed (see, for example, Patent Document 3).

According to the pressure-sensitive adhesive layer having low dielectric constant, the effect of the driving noise from the organic EL panel on the capacitive touch sensor can be decreased.

PRIOR ART DOCUMENTS

PATENT DOCUMENTS

[0005]

Patent Document 1: JP-A-2012-211305

Patent Document 2: JP-A-2013-75978

Patent Document 3: JP-A-2013-082880

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006]

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 EL display device, the its organic EL 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 EL element, so that the transmitted light unfavorably deteriorate the organic EL element.

[0007]

Therefore, for suppressing the deterioration of the organic EL element, it is necessary an organic element display device having a high transparent layer 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 EL element, and ensuring the transmittance of visible light within the light emitting range of the organic EL element.

[0008]

On the other hand, the organic EL display device is used for various applications. For example, when it is used for module devices for mobile applications, the resistance to drop impact is required. Therefore, the pressure-sensitive adhesive layer used for the organic EL display device is required to have a peel resistance to drop impact as the resistance to drop impact. In particular, since the pressure-sensitive adhesive layer having low dielectric constant described in Patent Document 3 has high glass transition temperature (T_g), the resistance to drop impact (peel resistance to drop impact) was not sufficient.

[0009]

Therefore, an object of the present invention is to provide a pressure-sensitive adhesive layer for an organic EL display device which is capable of suppressing deterioration of an organic EL element, while having high transparency, low dielectric characteristics being capable of decreasing the effect of the driving noise of the organic EL panel, and excellent peel resistance to drop impact.

[0010]

A further object of the invention is to provide a pressure-sensitive adhesive layer attached polarizing film including a polarizing film and a pressure-sensitive

adhesive layer for an organic EL display device. A still further object of the invention is to provide an organic EL display device including the pressure-sensitive adhesive layer and/or the pressure-sensitive adhesive layer attached polarizing film.

MEANS FOR SOLVING THE PROBLEMS

[0011]

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

[0012]

That is, the present invention relates to a pressure-sensitive adhesive layer for an organic EL display device, formed by a pressure-sensitive adhesive composition including a (meth)acrylic polymer and an ultraviolet absorber,

wherein the (meth)acrylic polymer is obtained by polymerizing a monomer component containing a monofunctional monomer component including an alkyl (meth)acrylate (A) having an alkyl group having 8 or less carbon atoms at an ester terminal, and an alkyl (meth)acrylate (B) having an alkyl group having 12 to 24

carbon atoms at an ester terminal;

wherein a percentage (a: wt%) of the alkyl (meth)acrylate (A) and a percentage (b: wt%) of the alkyl (meth)acrylate (B) based on 100 wt% of the monofunctional monomer component is satisfied with following equation (1) and equation (2):

$$\text{Equation (1): } 60 \leq \{(a) + (b)\}$$

$$\text{Equation (2): } 1.4 \leq \{(a) / (b)\} \leq 2; \text{ and}$$

wherein the pressure-sensitive adhesive layer has a peak value of $\text{Tan}\delta$ (T_g) from -20 to -5°C , as measured by dynamic viscoelasticity at a frequency of 1 Hz;

the pressure-sensitive adhesive layer has a transmittance of 10% or less at a wavelength of 380 nm and a transmittance of 85% or more at a wavelength of 450 nm; and

the pressure-sensitive adhesive layer has a total light transmittance of 85% or more, and has a haze of 1% or less.

[0013]

In the pressure-sensitive adhesive layer for an organic EL display device, a maximum absorption wavelength of an absorption spectrum of the ultraviolet absorber is preferably presented in a wavelength range of 300 to 400 nm.

[0014]

In the pressure-sensitive adhesive layer for an organic EL display device, the monofunctional monomer component further may contain at least one cohesive monomer selected from a cyclic nitrogen-containing monomer and an alicyclic structure-containing monomer. A percentage of the cohesive monomer in the monofunctional monomer component is preferably from 10 to 22 wt%.

[0015]

In the pressure-sensitive adhesive layer for an organic EL display device, the monofunctional monomer component further may contain a hydroxyl group-containing monomer. A percentage of the hydroxyl group-containing monomer in the monofunctional monomer component is preferably from 1.5 to 10 wt%.

[0016]

In the pressure-sensitive adhesive layer for an organic EL display device, the monomer component further may contain 3 parts by weight or less of a multifunctional monomer based on 100 parts by weight of the monofunctional monomer component.

[0017]

In the pressure-sensitive adhesive layer for an organic EL display device, the pressure-sensitive adhesive composition further may contain a colorant compound in which a maximum absorption wavelength of an absorption

spectrum is presented in a wavelength range of 380 to 430 nm.

[0018]

In the pressure-sensitive adhesive layer for an organic EL display device, the pressure-sensitive adhesive composition further may contain 3 parts by weight or less of a silane coupling agent based on 100 parts by weight of the monofunctional monomer component.

[0019]

In the pressure-sensitive adhesive layer for an organic EL display device, the pressure-sensitive adhesive composition further may contain 3 parts by weight or less of a crosslinker based on 100 parts by weight of the monofunctional monomer component.

[0020]

In the pressure-sensitive adhesive layer for an organic EL display device, the pressure-sensitive adhesive composition further may contain a photopolymerization initiator.

[0021]

In the pressure-sensitive adhesive layer for an organic EL display device, a dielectric constant at a frequency of 100 kHz is preferably 3.5 or less.

[0022]

In the pressure-sensitive adhesive layer for an

organic EL display device, a gel fraction is preferably from 50 to 95 wt%.

[0023]

In the pressure-sensitive adhesive layer for an organic EL display device, the pressure-sensitive adhesive layer preferably has a 180° peel adhesive strength to an alkaline-free glass (peel rate 300 mm/min) of 7 N/20 mm or more.

[0024]

The pressure-sensitive adhesive layer for an organic EL display device is preferably adopted a mode including a separator at least on one side of the pressure-sensitive adhesive layer.

[0025]

The present invention also related to a pressure-sensitive adhesive layer attached polarizing film for an organic EL display device, including a polarizing film and the above pressure-sensitive adhesive layer for an organic EL display device.

[0026]

In the pressure-sensitive adhesive layer attached polarizing film, preferably, the polarizing film includes a transparent protective film on one surface of a polarizer and a retardation film on another surface of the polarizer, and the pressure-sensitive adhesive layer for an organic EL

display device is provided on a surface opposite to a surface contacting with the polarizer of the retardation film and/or on a surface opposite to a surface contacting with the polarizer of the transparent protective film.

[0027]

The pressure-sensitive adhesive layer attached polarizing film, preferably includes a first pressure-sensitive adhesive layer, a transparent protective film, a polarizer, a second pressure-sensitive adhesive layer, a retardation film, and a third pressure-sensitive adhesive layer in this order, wherein at least one pressure-sensitive adhesive layer of the first pressure-sensitive adhesive layer, the second pressure-sensitive adhesive layer and the third pressure-sensitive adhesive layer is the above pressure-sensitive adhesive layer for an organic EL display device.

[0028]

In the pressure-sensitive adhesive layer attached polarizing film, preferably, the retardation film is a quarter wavelength plate, and the polarizing film is a circular polarizing film.

[0029]

The present invention also related to an organic EL display device including at least one of the above pressure-sensitive adhesive layer for an organic EL display

device, or at least one of the above pressure-sensitive adhesive layer attached polarizing film for an organic EL display device.

[0030]

The organic EL display device is preferably an organic EL display device with touch panel including an organic EL panel, a circular polarizing film provided in order from a viewing side of the organic EL panel, and a touch panel having at least one sensor film,

wherein the above pressure-sensitive adhesive layer for an organic EL display device is provided nearer the viewing side than the circular polarizing film while contacting with at least one sensor film.

[0031]

As described above, the pressure-sensitive adhesive layer for an organic EL display device is suitable used in the touch panel of the organic EL display device for providing so as to contact with at least one sensor film.

EFFECT OF THE INVENTION

[0032]

The pressure-sensitive adhesive composition forming the pressure-sensitive adhesive layer for the organic EL display device according to the present invention is formed from a pressure-sensitive adhesive composition containing

an ultraviolet absorber in addition to an acrylic polymer which is a base polymer. The ultraviolet absorber allows to suppress deterioration by ultraviolet rays because it does not penetrate a light from near ultraviolet to ultraviolet area. Further, the pressure-sensitive adhesive layer for the organic EL display device has high transparency and can suppress deterioration of organic EL elements without deteriorating the display properties of organic EL elements. Therefore, the organic EL display device including the pressure-sensitive adhesive layer for the organic EL display device and/or the pressure-sensitive adhesive layer attached polarizing film including the pressure-sensitive adhesive layer for the organic EL display device has excellent weather resistance and the product life can be increased.

[0033]

Further, it is considered that for decreasing the dielectric constant, the dipole moment of the molecule is decreased and the molar volume is increased according to Clausius-Mossotti Equation. The acrylic polymer of the present invention includes the alkyl (meth)acrylate (B) having a long chain alkyl group as the monomer unit, and the dielectric constant of the pressure-sensitive adhesive layer can be decreased. The pressure-sensitive adhesive layer having low dielectric constant can decrease the

effect of the malfunction due to the effect of the driving noise from the organic EL panel on the capacitive touch sensor. Therefore, the pressure-sensitive adhesive layer of the present invention has rapid response speed, and thereby can be suitably applied to highly sensitive touch sensor.

[0034]

Further, the acrylic polymer of the present invention includes each monomer unit of two (meth)acrylates (A) and (B) having an alkyl group having different carbon atoms in a predetermined percentage. While the polymer includes the alkyl (meth)acrylate (B) having a long chain alkyl group as its monomer unit, the glass transition temperature (T_g) of the pressure-sensitive adhesive layer of the present invention is limited to be below -5°C . Therefore, according to the present invention, the pressure-sensitive adhesive layer having the resistance to drop impact (peel resistance to drop impact) while maintaining the pressure-sensitive adhesive characteristics as the pressure-sensitive adhesive layer and having low dielectric constant as described above. The pressure-sensitive adhesive layer of the present invention can provide a mobile module device having excellent peel resistance to drop impact by filling layer gaps between a printed glass (such as a cover glass) or an optical film in organic EL display device, capacitive

touch sensors and an air layer in the upper side of the organic EL display device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035]

Fig. 1(a) to (c) are each a schematic cross-sectional view of one embodiment of a pressure-sensitive adhesive layer attached polarizing film for an organic EL display device of the present invention.

Fig. 2 is a schematic cross-sectional view of one embodiment of the organic EL display device of the present invention.

Fig. 3 is a schematic cross-sectional view of one embodiment of the organic EL display device of the present invention.

Fig. 4 is a schematic cross-sectional view of one embodiment of the organic EL display device of the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0036]

1. Pressure-sensitive adhesive layer for organic EL display device

The pressure-sensitive adhesive layer for an organic EL display device according to the present invention is

formed from the pressure-sensitive adhesive composition containing the (meth)acrylic polymer and the ultraviolet absorber.

[0037]

(1) Partial polymerized product of monomer component, and (meth)acrylic polymer

The (meth)acrylic polymer contained in the pressure-sensitive adhesive composition is obtained by polymerizing a partial polymerized product of a monomer component or the monomer component itself, the monomer component containing a monofunctional monomer component being composed of (A) an alkyl (meth)acrylate having an alkyl group having carbon atoms of 8 or less at an ester terminal, and (B) an alkyl (meth)acrylate having an alkyl group having carbon atoms of 12 to 24 at an ester terminal. Note that the "alkyl (meth)acrylate" refers to an alkyl acrylate and/or an alkyl methacrylate, and that it means similar as the (meth) in the present invention.

[0038]

Further, the alkyl (meth)acrylate (A) and the alkyl (meth)acrylate (B) are used so that the percentage of the alkyl (meth)acrylate (A) (a: wt%) and the percentage of the alkyl (meth)acrylate (B) (b: wt%) in the 100 wt% of the monofunctional monomer component in the monomer component is satisfied with the equations (1) and (2).

Equation (1): $60 \leq \{(a) + (b)\}$

Equation (2): $1.4 \leq \{(a) / (b)\} \leq 2$

By using the alkyl (meth)acrylate (A) and the alkyl (meth)acrylate (B) within the range, these monomer unit can be introduced in the (meth)acrylic polymer in a good balance, and the low dielectric characteristics and the peel resistance to drop impact can be provided to the pressure-sensitive adhesive layer.

[0039]

The total $\{(a) + (b)\}$ of the percentage (a) of the alkyl (meth)acrylate (A) and the percentage (b) of the alkyl (meth)acrylate (B) in the Equation (1) is 60 wt% or more based on 100 wt% of the monofunctional monomer component in the monomer component. The total is preferably 65 wt% or more, and more preferably 70 wt% or more in terms of easier balancing adhesive characteristics and the resistance to drop impact. On the other hand, although the total may be 100 wt%, it is preferably 95 wt% or less, and more preferably 90 wt% or less in terms of securing the cohesive force and the point of crosslinking, securing the elastic modulus at high temperature, and wettability to an object to be adhered.

[0040]

Further, the ratio $\{(a) / (b)\}$ of the percentage (a) of the alkyl (meth)acrylate (A) and the percentage (b) of

the alkyl (meth)acrylate (B) in the Equation (2) is within a range of 1.4 to 2. In terms of a combination of decreasing the dielectric constant and the resistance to drop impact, the ratio is preferably from 1.5 to 2, and more preferably from 1.6 to 2.

[0041]

Also, the percentage (a) of the alkyl (meth)acrylate (A) is preferably from 30 to 60 wt%, and more preferably from 30 to 56 wt%. The percentage (b) of the alkyl (meth)acrylate (B) is preferably from 20 to 38 wt%, and more preferably from 22 to 36 wt%.

[0042]

<Alkyl (meth)acrylate (A)>

As the alkyl group having carbon atoms of 8 or less in the alkyl (meth)acrylate (A), a linear chain or branched chain can be used. However, the number of the carbon atoms in the alkyl group is preferably from 2 to 8, and more preferably from 4 to 8 in terms of providing adhesiveness to the pressure-sensitive adhesive layer and the resistance to drop impact. Further, the alkyl (meth)acrylate (A) is preferably an alkyl acrylate in terms of relatively lower glass transition temperature (T_g) and relatively lower radical polymerization reactivity. Further, for the alkyl (meth)acrylate (A), the T_g of the homopolymer is preferably from -90 to -20°C , more preferably from -85 to -30°C , and

further preferably from -80 to -40°C in terms of providing adhesiveness to the pressure-sensitive adhesive layer. The Tg of the homopolymer is a value measured by thermogravimetry differential thermal analysis (TG-DTA) (for measurement of Tg of the homopolymer, the same applies hereinafter).

[0043]

Examples of the alkyl (meth)acrylate (A) include methyl (meth)acrylate, ethyl (meth)acrylate, n-butyl (meth)acrylate, s-butyl (meth)acrylate, t-butyl (meth)acrylate, isobutyl (meth)acrylate, n-pentyl (meth)acrylate, isopentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, isoamyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, n-octyl (meth)acrylate, isooctyl (meth)acrylate, and n-nonyl (meth)acrylate. These can be used alone, or in combination.

[0044]

<Alkyl (meth)acrylate (B)>

As the alkyl group having carbon atoms of 12 to 24 in the alkyl (meth)acrylate (B), a linear chain or branched chain can be used. However, the group is preferably a branched chain in terms of satisfying low dielectric constant and suitable elastic modulus. More preferably, it is a branched chain alkyl group having carbon atoms of 14

to 22. If the group is a linear alkyl group, the group preferably has carbon atoms of 18 or more in terms of satisfying low dielectric constant and suitable elastic modulus. It is considered that the long chain alkyl group of the alkyl (meth)acrylate has an alkyl group having a branch, thereby the molar volume is increased and the dipole moment is decreased, and then a pressure-sensitive adhesive layer having both balances is obtained. The alkyl (meth)acrylate (B) is preferably an alkyl acrylate in terms of relatively lower glass transition temperature (T_g) and relatively lower radical polymerization reactivity. Further, for the alkyl (meth)acrylate (B), the T_g of the homopolymer is preferably from -80 to 0°C , more preferably from -75 to -5°C , and further preferably from -70 to -10°C in terms of providing low dielectric constant and suitable elastic modulus to the pressure-sensitive adhesive layer.

[0045]

Examples of the alkyl (meth)acrylate (B) include lauryl (meth)acrylate, isododecyl (meth)acrylate, tridecyl (meth)acrylate, isotridecyl (meth)acrylate, tetradecyl (meth)acrylate, pentadecyl (meth)acrylate, isopentadecyl (meth)acrylate, hexadecyl (meth)acrylate, heptadecyl (meth)acrylate, isohexadecyl (meth)acrylate, isoheptadecyl (meth)acrylate, stearyl (meth)acrylate, and isostearyl (meth)acrylate.

[0046]

<Copolymerizable monomer>

A copolymerizable monomer other than the alkyl (meth)acrylate (A) and (B) can be included in the monofunctional monomer of the monomer component. The copolymerizable monomer can be used as the remaining other than the alkyl (meth)acrylates (A) and (B) in the monofunctional monomer.

[0047]

As the copolymerizable monomer, for example, at least one cohesive monomer selected from a cyclic nitrogen-containing monomer and an alicyclic structure-containing monomer can be included. For the cohesive monomer, the homopolymer is preferred in terms of high Tg, low dielectric constant, securing the cohesive force, and maintaining high elastic modulus in high temperature area (80°C). For Tg of the homopolymer of the cohesive monomer, the Tg of the homopolymer is preferably from 0 to 200°C, more preferably from 5 to 180°C, and further preferably from 10 to 160°C.

[0048]

It is allowable to use, as the cyclic nitrogen-containing monomer, a monomer having a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or vinyl group, and further having a

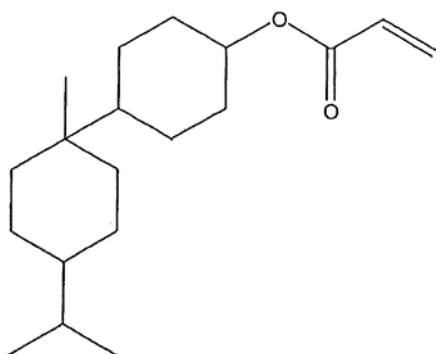
cyclic nitrogen structure without any especial limitation. The cyclic nitrogen structure is preferably a cyclic structure having therein one or more nitrogen atoms. Examples of the cyclic nitrogen-containing monomer include lactam-based vinyl monomers such as N-vinylpyrrolidone, N-vinyl- ϵ -caprolactam, and methylvinylpyrrolidone; vinyl monomers each having a nitrogen-containing heterocyclic ring such as vinylpyridine, vinylpiperidone, vinylpyrimidine, vinylpiperazine, vinylpyrazine, vinylpyrrole, vinylimidazole, vinyloxazole, and vinylmorpholine. Other examples thereof include (meth)acrylic monomers each containing a heterocyclic ring such as a morpholine ring, a piperidine ring, a pyrrolidine ring, or a piperazine ring. Specific examples thereof include N-acryloylmorpholine, N-acryloylpiperidine, N-methacryloylpiperidine, and N-acryloylpyrrolidine. Among these cyclic nitrogen-containing monomers, lactam-based vinyl monomers are preferred.

[0049]

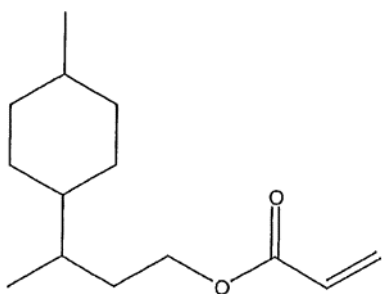
As the alicyclic structure-containing monomer, one having a polymerizable functional group having an unsaturated double bond such as a (meth)acryloyl group or a vinyl group and having an alicyclic structure can be used without particular limitation. The alicyclic structure is a cyclic hydrocarbon structure. In terms of decreasing

dielectric constant, it has preferably carbon atoms of 5 or more, more preferably carbon atoms of 6 to 24, further preferably carbon atoms of 8 to 20, and still further preferably carbon atoms of 10 to 18. Examples of the alicyclic structure-containing monomer include (meth)acrylic monomers including cyclopropyl (meth)acrylate, cyclobutyl (meth)acrylate, cyclopentyl (meth)acrylate, cyclohexyl (meth)acrylate, cycloheptyl (meth)acrylate, cyclooctyl (meth)acrylate, isobornyl (meth)acrylate, dicyclopentanyl (meth)acrylate, HPMPA (the following Chemical Formula 1), TMA-2 (the following Chemical Formula 2), and HCPA (the following Chemical Formula 3). Among them, cyclohexyl (meth)acrylate, HPMPA, TMA-2, and HCPA are preferred. In particular, cyclohexyl (meth)acrylate, HPMPA, and TMA-2 are preferred.

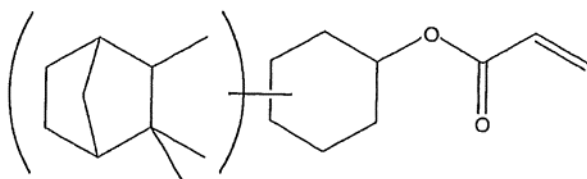
[Chemical Formula 1]



[Chemical Formula 2]



[Chemical Formula 3]



[0050]

The percentage of the cohesive monomer is preferably from 10 to 22 wt%, and more preferably from 12 to 20 wt% based on the total amount of the monofunctional monomer component.

[0051]

As the copolymerizable monomer in the monofunctional monomer, a hydroxyl group-containing monomer can be included. 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.

[0052]

The percentage of the hydroxyl group-containing monomer is typically preferably from 0.1 to 20 wt% based on the total amount of the monofunctional monomer in terms of increasing the adhesive strength and the cohesive force. In particular, in terms of satisfying good resistance to drop impact (peel resistance to drop impact) by controlling Tg of the pressure-sensitive adhesive layer within the range of the present invention, the percentage is preferably from 1.5 to 10 wt%. The percentage of the hydroxyl group-containing monomer is preferably 2 wt% or more, and more preferably 3 wt% or more. Higher the amount of the hydroxyl group can improve the adhesive strength (to a glass) and maintain high elastic modulus in high

temperature area (80°C), which is advantageous for preventing from peeling in a reliability test. On the other hand, if the amount of the hydroxyl group-containing monomer is too high, the dielectric constant tends to be increased, the pressure-sensitive adhesive layer is rigid, the adhesive strength may be decreased, the viscosity of the pressure-sensitive adhesive agent is too high, and the gelation may be occurred. Therefore, the hydroxyl group-containing monomer is preferably 9 wt% or less, more preferably 8 wt% or less, and further preferably 7 wt% or less based on the total amount of the monofunctional monomer component forming the (meth)acrylic polymer.

[0053]

Further, as the copolymerizable monomer in the monofunctional monomer, a functional group-containing monomer other than described above can be included. Examples include a carboxyl group-containing monomer, and a cyclic ether group-containing monomer.

[0054]

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 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.

[0055]

It is allowable to use, as the cyclic ether 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 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.

[0056]

The percentage of the carboxyl group-containing monomer, and the cyclic ether group-containing monomer is preferably 8 wt% or less, and more preferably 5 wt% or less based on the total amount of the monofunctional monomer. When the pressure-sensitive adhesive layer of the present invention is also used in the aspect contacting with the sensor film, the aspect without using the carboxyl group-containing monomer is preferably applied.

[0057]

As the copolymerizable monomer in the monofunctional monomer is, for example, an alkyl (meth)acrylate represented by $\text{CH}_2=\text{C}(\text{R}^1)\text{COOR}^2$ wherein R^1 represents hydrogen or a methyl group, and R^2 represents a substituted alkyl group of 1 to 3 carbon atoms, or a cyclic alkyl group.

[0058]

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

[0059]

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.

[0060]

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, from which the (meth)acryl-based polymer is made, and is preferably 10% or less by weight.

[0061]

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

[0062]

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.

[0063]

The monomer component, 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 force of the pressure-sensitive adhesive.

[0064]

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.

[0065]

The use amount of the polyfunctional monomer, 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. 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 is in any one

of these ranges, the pressure-sensitive adhesive composition can be improved in adhesive strength.

[0066]

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 radical 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.

[0067]

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

[0068]

When the (meth)acryl-based polymer is produced by a radical polymerization, the polymerization can be conducted by adding, to the monomer component, 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.

[0069]

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.

[0070]

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.

[0071]

Such polymerization initiators may be used singly or in the form of a mixture of two or more thereof. The amount of the initiators 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.

[0072]

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.

[0073]

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 in the monomer component is about 0.3 part or less by weight for 100 parts by weight of the whole of the monomer component.

[0074]

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.

[0075]

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.

[0076]

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

embodiment among the radial polymerizations.

[0077]

When the ultraviolet rays polymerization is conducted, a photopolymerization initiator is preferably incorporated into the monomer component since the incorporation produces an advantage that the polymerization period can be shortened. Therefore, when ultraviolet rays polymerization is performed, for example, the pressure-sensitive adhesive layer is preferably formed by ultraviolet rays polymerizing an ultraviolet ray curable acrylic pressure-sensitive adhesive composition including the partial polymerized product of a monomer component including the monofunctional monomer component including the alkyl (meth)acrylates (A) and (B) or the monomer component itself, the ultraviolet absorber, and photopolymerization initiator. The pressure-sensitive adhesive layer formed by ultraviolet rays polymerizing the ultraviolet ray curable acrylic pressure-sensitive adhesive composition is preferred because it can also be formed in a thick form having a thickness of 150 μm or more, and the pressure-sensitive adhesive layer having various thickness can be formed.

[0078]

Although the photopolymerization initiator is not particularly limited, preferred is one containing a

photopolymerization initiator (A) having an absorption band in a wavelength of 400 nm or more. When the pressure-sensitive adhesive composition includes the ultraviolet absorber, if ultraviolet rays polymerization is performed, the composition cannot be sufficiently polymerized because the ultraviolet absorber absorbs ultraviolet rays.

However, when the photopolymerization initiator (A) having an absorption band in a wavelength of 400 nm or more is used, it is preferred because the composition can be sufficiently polymerized regardless of containing the ultraviolet absorber.

[0079]

Examples of the photopolymerization initiator (A) having an absorption band in a wavelength of 400 nm or more include bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide (Irgacure819, manufactured by BASF), and 2,4,6-trimethylbenzoyl-diphenyl-phosphine oxide (LUCIRIN TPO, manufactured by BASF).

[0080]

The photopolymerization initiator (A) having an absorption band in a wavelength of 400 nm or more can be used alone, or in combination of two or more.

[0081]

Further, although the added amount of the photopolymerization initiator (A) having an absorption band

in a wavelength of 400 nm or more is not particularly limited, the added amount is preferably lower than that of the ultraviolet absorber described below. The added amount is preferably 2 parts by weight or less, more preferably from about 0.005 to 1 part by weight, and further preferably from about 0.02 to 0.8 parts by weight based on 100 parts by weight of the monofunctional monomer component forming the (meth)acrylic polymer. When the added amount of the photopolymerization initiator (A) is within the range, it is preferred because ultraviolet rays polymerization can be sufficiently performed.

[0082]

Further, a photopolymerization initiator (B) having an absorption band in a wavelength of less than 400 nm can be included in the photopolymerization initiator. The photopolymerization initiator (B) is not particularly limited as far as the initiator is an initiator which is irradiated with ultraviolet rays to generate radicals to initiate photopolymerization, and which has an absorbing band in wavelengths less than 400 nm. Any one of such photopolymerization initiators that are ordinarily used is preferably usable. For example, any one of the following is usable: any benzoin ether-based photopolymerization initiator, any acetophenone-based photopolymerization initiator, any α -ketol-based photopolymerization

initiator, any optically active oxime-based photopolymerization initiator, any benzoin-based photopolymerization initiator, any benzil-based photopolymerization initiator, any benzophenone-based photopolymerization initiator, any ketal-based photopolymerization initiator, any thioxanthone-based photopolymerization initiator, and any acylphosphine oxide-based photopolymerization initiator.

[0083]

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.

[0084]

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.

[0085]

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

[0086]

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

[0087]

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

[0088]

Examples of the benzil-based photopolymerization initiator include benzil.

[0089]

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

[0090]

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

[0091]

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.

[0092]

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

[0093]

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 initiators(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 0.2 part by weight for 100 parts by weight of the monofunctional monomer component, from which the (meth)acryl-based polymer is made.

[0094]

In the present invention, when the ultraviolet rays polymerization of the monofunctional monomer component 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; irradiate ultraviolet rays thereto to yield a partially polymerized product (prepolymer composition) of the monomer component, in which the monomer component 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 absorber 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, in which the monomer component has/have been partially polymerized, it is preferred to attain this addition after the photopolymerization initiator is dissolved into the monomer.

[0095]

The weight average molecular weight of the (meth)acrylic polymer according to the present invention is preferably from 400,000 to 3,000,000, and more preferably from 600,000 to 2,500,000. When the weight average molecular weight is more than 400,000, the durability of the pressure-sensitive adhesive layer is satisfied and the cohesive force of the pressure-sensitive adhesive layer is decreased, and thereby the formation of the pressure-sensitive adhesive residue can be prevented. On the other

hand, if the weight average molecular weight is beyond 3,000,000, the laminating properties and the pressure-sensitive adhesive force tend to be decreased. Further, the viscosity of the pressure-sensitive adhesive agent is too high in a solution system, and then the application may be difficult. Note that the weight average molecular weight is a value measured by a gel permeation chromatography (GPC) and calculated by polystyrene conversion. Note that the molecular weight is difficult to be measured for the (meth)acrylic polymer obtained by radiation polymerization.

[0096]

<Measurement of weight average molecular weight>

The weight average molecular weight of the resulting (meth)acrylic polymer was measured by a gel permeation chromatography (GPC). As a sample, a filtrate obtained by dissolving a sample in tetrahydrofuran to form a 0.1 wt% solution, leaving overnight, and filtering with 0.45 μm membrane filter.

- Analyzing device: manufactured by Tosoh Corporation, HLC-8120GPC

- Column: manufactured by Tosoh Corporation, : GM7000HXL+GMHXL+GMHXL

- Column size; each 7.8 mm ϕ $\times$ 30 cm, total 90 cm

- Eluent: tetrahydrofuran (concentration 0.1 wt%)

- Flow rate: 0.8 ml/min
- Inlet pressure: 1.6 MPa
- Detector: differential refractometer (RI)
- column temperature: 40°C
- injected amount: 100 µl
- Eluent: tetrahydrofuran
- Detector: differential refractometer
- Standard sample: polystyrene

[0097]

(2) Ultraviolet Absorber

The ultraviolet absorber 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 absorber is preferably an ultraviolet absorber selected from the group consisting of triazine-based ultraviolet absorbers each having, in a single molecule thereof, 2 hydroxyl groups or less, and benzotriazole-based ultraviolet absorbers each having, in a

single molecule thereof, one benzotriazole skeleton since the ultraviolet absorber is good in dissolubility into the monomer used to form the acryl-based pressure-sensitive adhesive composition, and further the ultraviolet absorber is high in ultraviolet absorbing ability at wavelengths around 380 nm.

[0098]

Specific examples of the triazine-based ultraviolet absorber, which has, in a single molecule thereof, 2 hydroxyl groups or less, include 2,4-bis-[[4-(4-ethylhexyloxy)-4-hydroxy}-phenyl]-6-(4-methoxyphenyl)-1,3,5-triazine (TINOSORB S, manufactured by BASF), 2,4-bis[2-hydroxy-4-butoxyphenyl]-6-(2,4-dibutoxyphenyl)-1,3,5-triazine (TINUVIN 460, manufactured by BASF), a reaction product (TINUVIN 400, manufactured by BASF) produced from 2-(4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine-2-yl)-5-hydroxyphenyl and [(C10-C16 (mainly C12-C13) alkyloxy)methyl]oxirane, 2-[4,6-bis(2,4-dimethylphenyl)-1,3,5-triazine-2-yl]-5-[3-(dodecyloxy)-2-hydroxypropoxy]phenol), a reaction product (TINUVIN 405, manufactured by BASF) produced from 2-(2,4-dihydroxyphenyl)-4,6-bis-(2,4-dimethylphenyl)-1,3,5-triazine and a (2-ethylhexyl) ester of glycidic acid, 2-(4,6-diphenyl-1,3,5-triazine-2-yl)-5-[(hexyl)oxy]-phenol (TINUVIN 1577, manufactured by BASF), 2-(4,6-diphenyl-

1,3,5-triazine-2-yl)-5-[2-(2-ethylhexanoyloxy)ethoxy]-phenol (ADK STAB LA46, manufactured by ADEKA Corp.), and 2-(2-hydroxy-4-[1-octyloxycarbonylethoxy]phenyl)-4,6-bis(4-phenylphenyl)-1,3,5-triazine (TINUVIN 479, manufactured by BASF).

[0099]

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)phenol (TINUVIN 900, manufactured by BASF), 2-(2H-benzotriazol-2-yl)-6-(1-methyl-1-phenylethyl)-4-(1,1,3,3-tetramethylbutyl)phenol (TINUVIN 928, manufactured by BASF), a reaction product (TINUVIN 1130, manufactured by BASF) produced from methyl-3-(3-(2H-benzotriazol-2-yl)-5-tert-butyl-4-hydroxyphenyl)propionate/polyethylene glycol 300, 2-(2H-benzotriazol-2-yl)-p-cresol (TINUVIN P, manufactured by BASF), 2-(2H-benzotriazol-2-yl)-4,6-bis(1-methyl-1-

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

[0100]

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, and 2,2'-dihydroxy-4,4-dimethoxybenzophenone.

[0101]

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).

[0102]

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.

[0103]

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 320 nm to 380 nm. The measurement method of the maximum absorption wavelength is as same as the measurement method of the colorant compound described

below.

[0104]

The ultraviolet absorber can be used alone, or in combination of two or more by mixing them. The total content is preferably from 0.1 to 5 parts by weight, and more preferably from 0.5 to 3 parts by weight based on 100 parts by weight of the monofunctional monomer component forming the (meth)acrylic polymer. When the added amount of the ultraviolet absorber is within the range, it is preferred because the ultraviolet rays absorbing properties of the pressure-sensitive adhesive layer can be sufficiently exerted, and when ultraviolet rays polymerization is performed, the polymerization is not disturbed.

[0105]

(3) Colorant compound

Further, a colorant compound in which the maximum absorption wavelength of the absorption spectrum is presented in a wavelength range of 380 to 430 nm can be included in the pressure-sensitive adhesive composition of the present invention. 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.

[0106]

The colorant compound used in the present invention is not particularly limited as long as the maximum absorption wavelength of the absorption spectrum is presented in a wavelength range of 380 to 430 nm. The maximum absorption wavelength of the absorption spectrum of the colorant compound is preferably presented in a wavelength range of 380 to 420 nm. In the present invention, by using the colorant compound and the ultraviolet absorber in combination, light within an area (wavelength from 380 nm to 430 nm) that does not affect the illumination of the organic EL element can be sufficiently absorbed, and the illumination area (longer wavelength side than 430 nm) of the organic EL element can be sufficiently penetrated, and therefore the deterioration of the organic EL element due to light from outside can be suppressed. Further, although the colorant compound is not particularly limited as long as it has the wavelength properties as described above, preferred is a material without having fluorescence and phosphorescence properties (photoluminescence) so that the display characteristics of the organic EL element is not disturbed.

[0107]

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 EL 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.

[0108]

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.

[0109]

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

[0110]

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).

[0111]

The colorant compound can be used alone, or in combination of two or more by mixing them. The total content is preferably from 0.01 to 10 parts by weight, and more preferably from 0.02 to 5 parts by weight based on 100 parts by weight of the monofunctional monomer component forming the (meth)acrylic polymer. When the added amount of the colorant compound is within the range, it is preferred because light within an area that does not affect the illumination of the organic EL element can be sufficiently absorbed, the deterioration of the organic EL

element can be suppressed by using the pressure-sensitive adhesive layer formed from the pressure-sensitive adhesive composition.

[0112]

(4) 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 3 part or less by weight, more preferably from 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, from which the (meth)acryl-based polymer is made.

[0113]

Examples of the silane coupling agent include epoxy-group-containing silane coupling agents such as 3-glycidoxypropyltrimethoxysilane, 3-glycidoxypropyltriethoxysilane, 3-glycidoxypropylmethyldiethoxysilane, and 2-(3,4-epoxycyclohexyl)ethyltrimethoxysilane; amino-group-containing silane coupling agents such as 3-aminopropyltrimethoxysilane, N-2-(aminoethyl)-3-aminopropylmethyldimethoxysilane, 3-triethoxysilyl-N-(1,3-dimethylbutylidene)propylamine, and N-phenyl- γ -

aminopropyltrimethoxysilane; (meth)acrylic-group-containing silane coupling agents such as 3-acryloxypropyltrimethoxysilane, and 3-methacryloxypropyltriethoxysilane; and isocyanate-group-containing silane coupling agents such as 3-isocyanatopropyltriethoxysilane.

[0114]

(5) 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.

[0115]

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

[0116]

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.

[0117]

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.

[0118]

(6) 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; light stabilizer (HALS) and antioxidants. Further, an anti-rust agent (a benzotriazole-based compound) is preferably included for suppressing the corrosion of the conductive metals and routing wires. These additives are preferably included in a range of 1 part by weight or less based on 100 parts by weight of the monofunctional monomer component.

[0119]

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 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 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.

[0120]

2. Pressure-sensitive adhesive layer for organic EL display device

The pressure-sensitive adhesive layer for the organic EL display device according to the present invention is formed by the pressure-sensitive adhesive composition for the organic EL display device described above.

[0121]

The thickness of the pressure-sensitive adhesive layer of the present invention is preferably 12 μm or more, more preferably 50 μm or more, further preferably 100 μm or more, and even further preferably 150 μm or more in terms of securing the absorbing function of light having a wavelength of less than 430 nm. Although the upper limit

of the thickness of the pressure-sensitive adhesive layer is not particularly limited, it is preferably 1 mm or less, more preferably 300 μm or less, and further preferably 250 μm or less. If the thickness of the pressure-sensitive adhesive layer is beyond 1 mm, it is not preferred that ultraviolet rays is difficult to be penetrated, the polymerization of the monomer component takes longer, and there may be problems for the processability and the winding during steps, and transportability, and the productivity may be deteriorated.

[0122]

Further, the pressure-sensitive adhesive layer of the present invention has a $\tan\delta$ peak value (T_g) of -20°C to -5°C , preferably from -19°C to -6°C , and further preferably from -18°C to -7°C , as measured by dynamic viscoelasticity at a frequency of 1 Hz. If the T_g is higher than -5°C , since the pressure-sensitive adhesive layer is rigid and has less flexibility, the peel resistance to drop impact is not satisfied. On the other hand, if the T_g is lower than -20°C , the layer is too soft, and then the elastic modulus at high temperature is difficult to be secured.

[0123]

Further, the pressure-sensitive adhesive layer of the present invention has a transmittance of 10% or less at a wavelength of 380 nm and a transmittance of 85% or more at

a wavelength of 450 nm.

[0124]

The transmittance of the pressure-sensitive adhesive layer at a wavelength of 380 nm is preferably 5% or less, and more preferably 2% or less. When the transmittance of the pressure-sensitive adhesive layer is within the range, the layer can sufficiently absorb light within an area that does not affect the illumination of the organic EL element, and the deterioration of the organic EL element can be suppressed.

[0125]

The transmittance of the pressure-sensitive adhesive layer at a wavelength of 450 nm is preferably 88% or more, more preferably 89% or more, and further preferably 90% or more. When the transmittance of the pressure-sensitive adhesive layer is within the range, light can be sufficiently penetrated in the illumination area of the organic EL element (longer wavelength side than 430 nm), and thereby the organic EL display device including the pressure-sensitive adhesive layer can sufficiently emit light.

[0126]

Further, since the pressure-sensitive adhesive layer of the present invention has the transmittance described above, light within an area that does not affect the

illumination of the organic EL element can be sufficiently absorbed, and the illumination area (longer wavelength side than 430 nm) of the organic EL element can be sufficiently penetrated, and the deterioration of the organic EL element due to light from outside can be suppressed.

[0127]

Further, the pressure-sensitive adhesive layer of the present invention has a total light transmittance of 85% or more. The total light transmittance is preferably 88% or more, more preferably 89% or more, and further preferably 90% or more. Further, the haze is from 0 to 1%, preferably 0.8% or less, and more preferably 0.6% or less. When the total light transmittance and the haze are within the range, the pressure-sensitive adhesive layer has high transparency. Regardless of the thickness of the pressure-sensitive adhesive layer of the present invention, the total light transmittance and the haze preferably satisfy the ranges, preferably satisfy the ranges when the thickness of the pressure-sensitive adhesive layer is from 12 to 250 μm , and particularly preferably satisfy the ranges when the thickness of the pressure-sensitive adhesive layer is from 12 μm to 1 mm.

[0128]

Further, for the pressure-sensitive adhesive layer of the present invention, the dielectric constant at a

frequency of 100 kHz is preferably 3.5 or less, more preferably 3.3 or less, further preferably 3.2 or less, and still further preferably 3.0 or less.

[0129]

Further, although the gel fraction of the pressure-sensitive adhesive layer according to the present invention is not particularly limited, it is preferably from 50 to 95 wt%. The gel fraction is more preferably 75% or more, and further preferably 85% or more. By adjusting the gel fraction of the pressure-sensitive adhesive layer within the range, the cohesive force of the pressure-sensitive adhesive layer can be secured, which is preferred in terms of the processability and handling properties.

[0130]

The pressure-sensitive adhesive layer of the present invention preferably has a 180° peel adhesive strength to an alkaline-free glass (peel rate 300 mm/min) of 7 N/20 mm or more in terms of preventing the film from peeling in a reliability test and preventing from peeling at drop impact. The adhesive strength is preferably 8 N/20 mm or more, and more preferably 10 N/20 mm or more. On the other hand, the adhesive strength is preferably 30 N/20 mm or less, and more preferably 28 N/20 mm or less in terms that the processing is difficult because of adhering on a blade during processing and the broken pieces of the adhesive

agent are generated and contaminated in the process.

[0131]

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.

[0132]

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. A conductive layer can be provided on the surface providing the pressure-sensitive adhesive layer of the substrate and/or its opposite surface for preventing static electricity.

[0133]

Further, the pressure-sensitive adhesive layer formed

on the release film (separator) can be used as a sheet form by further providing a release film (separator), in a form of the release film (separator) / the pressure-sensitive adhesive layer/ the release film (separator).

[0134]

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.

[0135]

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.

[0136]

The thickness of the release film is usually from about 5 to 200 μm , preferably from about 5 to 100 μm . As

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

[0137]

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.

[0138]

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

[0139]

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.

[0140]

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.

[0141]

When the pressure-sensitive adhesive composition is an ultraviolet ray curable 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/cm² or more. If the illuminance of the ultraviolet rays is less than 5 mW/cm², the polymerization reaction period may become long to deteriorate the layer in productivity. The illuminance of the ultraviolet rays is preferably 200 mW/cm² or less. If the illuminance of the ultraviolet rays is more than 200 mW/cm², 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/cm².

[0142]

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 force.

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.

[0143]

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

[0144]

In the present invention, the wavelength of a peak of the ultraviolet rays radiated to the ultraviolet ray curable 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.

[0145]

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 curable 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.

[0146]

When the ultraviolet ray curable pressure-sensitive adhesive composition used in the present invention contains the photopolymerization initiator (B), it is preferred to produce the ultraviolet ray curable 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, and

then adding, to the partially polymerized product of the monomer component, an ultraviolet absorber 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.

[0147]

When a pressure-sensitive adhesive layer is formed as described above, using the ultraviolet ray curable pressure-sensitive adhesive composition containing the photopolymerization initiator (B), the polymerization rate of the monomer component 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 at two stages as described above.

[0148]

3. Pressure-sensitive adhesive layer attached polarizing film for organic EL display device

The pressure-sensitive adhesive layer attached polarizing film for the organic EL display device is

characterized in that it includes a polarizing film and the pressure-sensitive adhesive layer for the organic EL display device.

[0149]

As the pressure-sensitive adhesive layer for the organic EL display device, the layer described above can be suitably used. Further, when the pressure-sensitive adhesive layer is formed on a substrate other than the polarizing film, the pressure-sensitive adhesive layer can be transferred by laminating the pressure-sensitive adhesive layer to the polarizing film. Further, the release film itself can be used as the separator of the pressure-sensitive adhesive layer attached polarizing film, and thereby the processing steps can be simplified.

[0150]

Although the polarizing film is not particularly limited, example includes one including the polarizer and the transparent protective film on at least one surface of the polarizer.

[0151]

(1) Polarizer

The polarizer is not particularly limited, and may be a polarizer of various types. For example, the polarizer may be a product produced by a process including adsorbing a dichroic material such as iodine or a dichroic dye to a

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

[0152]

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.

[0153]

In the present invention, a thin polarizer of 10 μm or less thickness may be used. For making the polarizing film thinner, the thickness is preferably from 1 to 7 μm . Such a thin polarizer is preferred in the point that the polarizer is small in thickness unevenness, excellent in visibility, and small in dimension change to be excellent in endurance and further the thickness of the polarizing film is also made smaller.

[0154]

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.

[0155]

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.

[0156]

(2) Transparent Protective Film

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 ray curable resin of, for example, acryl-based, urethane-based, acrylic urethane-based, epoxy-based or silicone-based resin.

[0157]

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

[0158]

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 curable 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.

[0159]

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

[0160]

Further, as the transparent protective film, one having a retardation and being capable of functioning as a compensation layer can be used. When the transparent protective film having a retardation is used, the retardation properties can be suitably adjusted to a value required for the optical compensation. As the retardation film, a stretch film can be suitably used. 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.

[0161]

When the polarizing film used in the present invention is used as the circular polarized plate for preventing the reflection of the organic EL display device, the retardation film is preferably a quarter wavelength plate in which the in-plane retardation of the transparent protective film is a quarter wavelength (about 100 to 170 nm).

[0162]

When the retardation film is used as the transparent protective film, one in which the transparent protective film is provided on one surface of the polarizer and the retardation film is provided on the other surface of the polarizer can be suitably used. Further, in the case, the position on which the pressure-sensitive adhesive layer is provided is not particularly limited. Although the pressure-sensitive adhesive layer may be provided on a surface opposite to the surface contacting with the

polarizer of the transparent protective film, or on a surface opposite to the surface contacting with the polarizer of the retardation film, in terms of preventing the deterioration of the organic EL element, it is preferably provided on at least one surface or both surfaces.

[0163]

An example of the specific configuration of the pressure-sensitive adhesive layer attached polarizing film for the organic EL display device according to the present invention is shown Fig. 1(a) to (c). As the pressure-sensitive adhesive layer attached polarizing film 1 for the organic EL display device can be mentioned by laminating each layers in the following order: as shown in Fig. 1(a), pressure-sensitive adhesive layer 2/transparent protective film 3/polarizer 4/retardation film 5; as shown in Fig. 1(b), transparent protective film 3/polarizer 4/retardation film 5/pressure-sensitive adhesive layer 2; and as shown in Fig. 1(c), pressure-sensitive adhesive layer 2/transparent protective film 3/polarizer 4/retardation film 5/pressure-sensitive adhesive layer 2. In Figs. 1(a) and (b), the pressure-sensitive adhesive layer 2 is the pressure-sensitive adhesive layer for the organic EL display device of the present invention. In Fig. 1(c), at least one of two pressure-sensitive adhesive layers 2 is the pressure-

sensitive adhesive layer for the organic EL display device of the present invention, both two pressure-sensitive adhesive layer 2 may be the pressure-sensitive adhesive layer for the organic EL display device of the present invention. Further, in Fig. 1, although the polarizing film 6 is a one surface protected polarizing film being composed of the polarizer 4 and the transparent protective film 3, the film is not limited thereto. The film may be a both surface protected polarizing film further having a transparent protective film between the polarizer 4 and the retardation film 5. Further, as described above, a various functional layer such as a hard coat layer can be formed on a surface which does not contact with the polarizer 4 of the transparent protective film 3.

[0164]

Further, when the retardation film is laminated to the polarizer via the pressure-sensitive adhesive layer, the pressure-sensitive adhesive layer may be the pressure-sensitive adhesive layer for the organic EL display device of the present invention. That is, the pressure-sensitive adhesive layer attached polarizing film for the organic EL display device includes a first pressure-sensitive adhesive layer, a transparent protective film, a polarizer, a second pressure-sensitive adhesive layer, a retardation film, and a third pressure-sensitive adhesive layer in the order,

wherein at least one pressure-sensitive adhesive layer of the first pressure-sensitive adhesive layer, the second pressure-sensitive adhesive layer and the third pressure-sensitive adhesive layer may be the pressure-sensitive adhesive layer for the organic EL display device.

[0165]

4. Organic EL display device

The organic EL display device of the present invention is characterized in that it uses at least one of the pressure-sensitive adhesive layers for the organic EL display device of the present invention and/or the pressure-sensitive adhesive layer attached polarizing film for organic EL display device of the present invention.

[0166]

As an example of the specific configuration of the organic EL display device, for example, as shown in Figs. 2 and 3, examples of the organic EL display device in which each layer is laminated in the following order include: cover glass or cover plastics 7/pressure-sensitive adhesive layer 2b/transparent protective film 3/polarizer 4/retardation film 5/pressure-sensitive adhesive layer 2a/organic EL display panel (OLED element panel) 8 (Fig. 2); cover glass or cover plastics 7/adhesive layer 9/transparent protective film 3/polarizer 4/retardation film 5/pressure-sensitive adhesive layer 2a/organic EL

display panel 8 (Fig. 3).

[0167]

Further, the organic EL display device can be used as the organic EL display device with touch panel including a touch panel further including at least one sensor film. For example, as shown in Fig. 4, example of the organic EL display device in which each layer is laminated in the following order includes: cover glass or cover plastics 7/pressure-sensitive adhesive layer 2c/sensor film 10/pressure-sensitive adhesive layer 2b/transparent protective film 3/polarizer 4/retardation film 5/pressure-sensitive adhesive layer 2a/organic EL display panel 8 (Fig. 4).

[0168]

Among the pressure-sensitive adhesive layers 2 in each component, at least one is the pressure-sensitive adhesive layer of the present invention. All pressure-sensitive adhesive layers 2 may be the pressure-sensitive adhesive layer of the present invention. Further, the organic EL display device of the present invention may be a protective film or various functional layer such as a hard coat layer in addition to them as described above. Further, a pressure-sensitive adhesive layer and/or an adhesive layer can be suitably used in the lamination of each layers. As the pressure-sensitive adhesive layer

other than the pressure-sensitive adhesive layer of the present invention, conventional pressure-sensitive adhesive layers used in the art can be suitably used.

[0169]

The pressure-sensitive adhesive layer for the organic EL display device according to the present invention is suitably used in the organic EL display device with touch panel including the organic EL panel, the circular polarizing film provided in order from the viewing side of the organic EL panel, and a touch panel having at least one sensor film, as shown in Fig. 4. In particular, the pressure-sensitive adhesive layer for the organic EL display device of the present invention is suitably used when it is provided nearer the viewing side than the circular polarizing film, and provided to contact with at least one sensor film forming the touch panel. In Fig. 4, the pressure-sensitive adhesive layer for the organic EL display device of the present invention is suitably used as the pressure-sensitive adhesive layer 2c and/or the pressure-sensitive adhesive layer 2b contacting with the sensor film 10. In particular, it is suitably used as the pressure-sensitive adhesive layer 2b. Note that the pressure-sensitive adhesive layer 2b may be applied to the pressure-sensitive adhesive layer attached polarizing film as shown in Fig. 1(a), or it may be applied to the

pressure-sensitive adhesive layer in a layer gap between the sensor film and the circular polarizing film.

[0170]

Apart from that, in Fig. 4, even if two or more sensor films 10 is used, the pressure-sensitive adhesive layer for the organic EL display device of the present invention is also suitably used. For example, in the configuration of cover glass or cover plastics 7/pressure-sensitive adhesive layer 2c/sensor film 10/pressure-sensitive adhesive layer 2b'/sensor film 10'/pressure-sensitive adhesive layer 2b/transparent protective film 3/polarizer 4/retardation film 5/pressure-sensitive adhesive layer 2a/organic EL display panel 8, the pressure-sensitive adhesive layer 2b' is suitably applied as the pressure-sensitive adhesive layer for the organic EL display device of the present invention, in addition to the pressure-sensitive adhesive layer 2c and/or the pressure-sensitive adhesive layer 2b.

[0171]

Note that the sensor film 10 is the capacitive touch sensor (film) in Fig. 4, and it is a transparent conductive film in which a transparent conductive layer is provided on a glass plate or a transparent plastics film (in particular, PET film). Contacting the pressure-sensitive adhesive layer for the organic EL display device with the

sensor film means contacting with the transparent conductive layer.

[0172]

Examples of the transparent conductive layer include a thin film of ITO film (indium tin oxide), ZnO, SnO, and CTO (cadmium tin oxide). Apart from that, the transparent conductive layer can be formed by silver, copper, CNT (carbon nanotube, and the like). As the transparent conductive layer, an Ag nanowire, or a metal mesh sensor such as Ag/Cu can be applied. Further, in Fig. 4, in the capacitive touch panel including at least one sensor film 10, routing wires formed by a thin film of copper or a silver paste may be included at the terminal of the sensor film.

[0173]

As described above, the pressure-sensitive adhesive layer for the organic EL display device of the present invention can be used as the pressure-sensitive adhesive layer for the touch panel used for providing so as to contact with at least one sensor film in a touch panel which is not necessarily for the organic EL display device, in addition that it can be used as the pressure-sensitive adhesive layer for the touch panel used for providing so as to contact with at least one sensor film in the touch panel for the organic EL display device having the configuration

described above.

EXAMPLES

[0174]

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.

[0175]

Example 1

(Preparation of acrylic pressure-sensitive adhesive composition)

To a monomer mixture being composed of 49 parts by weight of 2-ethylhexyl acrylate (2EHA), 30 parts by weight of isostearyl acrylate (ISTA), 18 parts by weight of N-vinyl-2-pyrrolidone (NVP), and 3 parts by weight of 4-hydroxybutyl acrylate (4HBA), as the photopolymerization initiator, 0.035 parts by weight of 1-hydroxycyclohexyl phenyl ketone (Trade name: Irgacure 184, having an absorption band in a wavelength of 200 to 370 nm, manufactured by BASF) and 0.035 parts by weight of 2,2-dimethoxy-1,2-diphenylethan-1-one (Trade name: Irgacure 651, having an absorption band in a wavelength of 200 to

380 nm, manufactured by BASF) were added. After that, it was irradiated with ultraviolet rays until the viscosity (measurement condition: BH viscometer, No. 5 rotor, 10 rpm, measurement temperature 30°C) was about 20 Pa•s to obtain a prepolymer composition in which a part of the monomer mixture was polymerized (polymerization percentage: 9%). Next, to the prepolymer composition were added 0.065 parts by weight of hexanediol diacrylate (HDDA), 0.3 parts by weight of a silane coupling agent (Trade name: KBM-403, manufactured by Shin-Etsu Chemical Co., Ltd.), 0.8 parts by weight (weight of solid content) of 2,4-bis-[[4-(4-ethylhexyloxy)-4-hydroxy}-phenyl]-6-(4-methoxyphenyl)-1,3,5-triazine (Trade name: Tinosorb S ultraviolet absorber (a), manufactured by BASF Japan) dissolved in the monomer mixture of the same percentage as described above so that the solid content was 10%, and 0.10 parts by weight of bis(2,4,6-trimethylbenzoyl)-phenylphosphine oxide (Trade name: Irgacure 819, manufactured by BASF Japan) based on 100 parts by weight of the monofunctional monomer component in the obtained acrylic pressure-sensitive adhesive composition, and stirred to obtain an acrylic pressure-sensitive adhesive composition.

[0176]

(Formation of adhesive layer)

The acrylic pressure-sensitive adhesive composition

was applied on a release-treated film of a release film so that the thickness after forming the pressure-sensitive adhesive layer was 100 μm . Next, a release film was applied on the surface of the pressure-sensitive adhesive composition. Next, a pressure-sensitive adhesive layer was formed by irradiating with ultraviolet rays in a condition of illuminance: 6.5 mW/cm², light intensity: 1,500 mJ/cm², peak wavelength: 350 nm and photo-curing the pressure-sensitive adhesive composition.

[0177]

Examples 2 to 4 and Comparative Examples 1 to 3

Acrylic pressure-sensitive adhesive compositions were prepared as similar in Example 1, except that the type and the used amount of each components were changed as shown in Table 1 in the preparation of the acrylic pressure-sensitive adhesive composition in Example 1. Further, the pressure-sensitive adhesive layer was formed as similar in Example 1, except that the acrylic pressure-sensitive adhesive composition was used and the thickness of the pressure-sensitive adhesive layer was changed as shown in Table 1.

[0178]

(Production of Polarizing Film (P))

By using a polyvinyl alcohol-based adhesive, a cycloolefin polymer (COP) film having a thickness of 25 μm

was bonded onto the viewing side of a polarizer made of a stretched polyvinyl alcohol film impregnated with iodine and having a thickness of 5 μm . By using a polyvinyl alcohol-based adhesive, a retardation film (thickness: 56 μm , material: polycarbonate) was laminated onto an organic EL display panel side surface of the polarizer to produce a polarizing film (P). The polarization degree thereof was 99.995.

[0179]

(Producing pressure-sensitive adhesive layer attached polarizing film)

The pressure-sensitive adhesive layer obtained in Examples or Comparative Examples was laminated on the viewing side of the polarizing film (P) (that is, a surface of cycloolefin polymer (COP) having a thickness of 25 μm) to form a pressure-sensitive adhesive layer attached polarizing film.

[0180]

The following evaluations were performed for the pressure-sensitive adhesive layer and the pressure-sensitive adhesive layer attached polarizing film obtained in Examples or Comparative Examples. The results are shown in Table 1.

[0181]

<Tg Measurement of adhesive layer by dynamic

viscoelasticity>

A pressure-sensitive adhesive laminate layer having a thickness of about 2 mm was produced by laminating the pressure-sensitive adhesive layer obtained in Examples or Comparative Examples. The pressure-sensitive adhesive laminate layer was punched into a disc having a diameter of 7.9 mm, and the disc was sandwiched with parallel plates for fixing. The loss modulus G'' and the storage modulus G' were measured by a dynamic viscoelasticity measuring device (ARES, manufactured by Rheometrics) in measurement conditions described below. The ratio of loss modulus to storage modulus (G''/G') = peak value of $\tan\delta$ was recorded as T_g of the pressure-sensitive adhesive layer.

- Measurement: shear mode
- Temperature range: -50°C to 150°C
- Temperature elevation rate: $5^{\circ}\text{C}/\text{min}$
- Frequency: 1 Hz

The storage modulus G' (25°C) is preferably 5.0×10^4 Pa or more and 2.5×10^5 Pa or less. The storage modulus G' (80°C) is preferably 1.2×10^4 Pa or more and 1.0×10^5 Pa or less. Satisfying that the storage modulus G' (25°C) is 5.0×10^4 Pa or more is preferred for securing the processability during punching processing. Satisfying that the storage modulus G' (25°C) is 2.5×10^5 Pa or less is preferred for securing the followingness to the level

difference of the decoration printing for cover glass and the like. Satisfying that the storage modulus G' (80°C) is 1.2×10^4 Pa or more is preferred for high temperature reliability and suppressing peeling of the film during charging. Satisfying that the storage modulus G' (80°C) is 1.0×10^5 Pa or less is preferred because an air bubble generated by adhering while autoclave (pressured degassing) processing can be effectively removed.

[0182]

<Measurement of transmittance and hue of the pressure-sensitive adhesive layer containing colorant absorbing agent and ultraviolet absorber>

From the pressure-sensitive adhesive layer obtained in Examples or Comparative Examples, one release film was removed, the pressure-sensitive adhesive layer was applied to a slide glass (Trade name: Shiro Kemma No. 1, thickness: 0.8 to 1.0 mm, total light transmittance: 92%, haze: 0.2%, manufactured by Matsunami Glass Ind., Ltd.). Further, the other release film was removed, the same slide glass was applied, and the autoclave treatment (50°C , 0.5 MPa, 15 min) was performed to produce a test piece having a layer configuration of slide glass/ pressure-sensitive adhesive layer/slide glass. The formed test piece was measured by a spectrophotometer (Trade name: U4100, manufactured by Hitachi High-Technologies Corporation). The transmittance

in a wavelength within a range of 350 nm to 780 nm was measured. The transmittances at a wavelength of 380 nm and 450 nm were shown in Table 1.

[0183]

<Total light transmittance, haze>

From the pressure-sensitive adhesive layer obtained in Examples or Comparative Examples, one release film was removed, the pressure-sensitive adhesive layer was applied to a slide glass (Trade name: Shiro Kemma No. 1, thickness: 0.8 to 1.0 mm, total light transmittance: 92%, haze: 0.2%, manufactured by Matsunami Glass Ind., Ltd.). Further, the other release film was removed to produce a test piece having the layer configuration of pressure-sensitive adhesive layer/slide glass. The total light transmittance in visible light area and the haze of the test piece were measured by using a haze meter (apparatus name: HM-150, manufactured by Murakami Color Research Laboratory).

[0184]

<Evaluation of dielectric constant>

The pressure-sensitive adhesive layer obtained in Examples or Comparative Examples (obtained by removing the silicone-treated PET film from the pressure-sensitive adhesive sheet) was sandwiched between a copper foil and an electrode. A dielectric constant at a frequency of 100 kHz was measured by the following apparatus. Three samples

were produced and measured, and the average of the measurements of the three samples was considered as the dielectric constant.

Note that the dielectric constant of the pressure-sensitive adhesive layer at a frequency of 100 kHz was measured by the following conditions according to JIS K 6911.

Measurement method: capacitance method (apparatus: Agilent Technologies 4294A Precision Impedance Analyzer)

Electrode configuration: 12.1mm Φ , aluminum plates having a thickness of 0.5 mm

Counter electrode :3oz copper plate

Measurement environment: 23 $\pm$ 1°C, 52 $\pm$ 1% RH

[0185]

<Measurement of gel fraction>

A predetermined amount (first weight W1) was removed from the pressure-sensitive adhesive layer obtained in Examples or Comparative Examples, immersed in ethyl acetate solution. After leaving at room temperature for 1-week, undissolved fraction was removed. The weight after drying (W2) was measured, and calculated as follows.

$$\text{gel fraction (\%)} = (W2 / W1) \times 100$$

[0186]

<Adhesiveness>

A sheet sample having a length of 100 mm and width of

20 mm was cut from the pressure-sensitive adhesive layer obtained in Examples or Comparative Examples. Next, the release film on each side of the pressure-sensitive adhesive layer was removed, a PET film (Trade name: Lumilar S-10, thickness: 25 μ m, manufactured by Toray Industries, Inc.) was applied (backed). Next, the other release film was removed, and the pressure-sensitive adhesive layer was pressure bonded on a glass plate (Trade name: Soda lime glass #0050, manufactured by Matsunami Glass Ind., Ltd.) as the test plate in a pressure bonding condition of 2 kg rollers and 1 round to produce a sample being composed of test plate/ pressure-sensitive adhesive layer/PET film. For the obtained sample, the autoclave treatment (50°C, 0.5 MPa, 15 min) was performed, and then cooled for 30 min in an atmosphere of 23°C, 50% R.H. After cooling, a 180° peel adhesive strength (N/20 mm) was measured by peeling the pressure-sensitive adhesive sheet (pressure-sensitive adhesive layer/PET film) from the test plate by using a tensile tester (apparatus name: Autograph AG-IS, manufactured by SHIMADZU CORPORATION) in a condition that the tensile speed was 300 mm/min and the peel angle was 180° in an atmosphere of 23°C, 50% R.H. according to JIS Z0237.

[0187]

<Resistance to drop impact test>

A substrate side of a cycloolefin polymer (COP) film (thickness 55 μm) having a conductive ITO layer on one side was entirely applied to one surface of a chemically strengthened glass (length 100 mm, width 100 mm, and thickness 1.3 mm) via the same size of an acrylic pressure-sensitive adhesive layer having a thickness of 25 μm . Further, the pressure-sensitive adhesive layer formed in Examples or Comparative Examples was cut into a size of the length 50 mm and the width 50 mm, laminated on the ITO layer side of the COP film with ITO layer so that the center part of the ITO layer side is overlapped with the center part of the pressure-sensitive adhesive layer, and then a center part of a black colored acrylic plate (length 110 mm, width 120 mm, thickness 1 mm) was laminated on the center part described above to produce a test piece (chemically strengthened glass/ pressure-sensitive adhesive layer/COP film with conductive ITO layer (thickness 55 μm)/ pressure-sensitive adhesive layer of Examples or Comparative Examples/acrylic plate). For the obtained test piece, the autoclave treatment (50°C, 0.5 MPa, 15 min) was performed, and then cooled for 24 hours in an atmosphere of 23°C, 50% R.H. The test piece so produced was fixed at both width sides of the acrylic plate on a foundation positioned horizontally so that the surface of the length and width is perpendicular to the foundation. On the other

hand, a pivot was defined on the upper part from the point on which the test piece was positioned (the upper part which is 53 cm from the center part of the test piece). One end of a string having a length of 53 cm was fixed to the pivot, and 113 g of a lead ball was fixed to the other end of the string.

The resistance to drop impact test was performed by dropping the lead ball from the height as same as the pivot in a pendulum way, and colliding the ball with the acrylic plate side of the fixed test piece (the center part of the surface of the length and width). The collision was repeated twenty times, and the peeling distance was measured. The peeling distance is a distance in which peeling was observed from the edge or the corner part of the pressure-sensitive adhesive layer in the test piece of Examples or Comparative Examples. The test was considered as pass when the maximum value of the peeling distance is 5 mm or less.

[0188]

[Table 1]

	Pressure-sensitive adhesive composition										Evaluation										
	Monomer component					UV absorber		Colorant compound	Additive		Pressure-sensitive adhesive layer										
	Monofunctional monomer component (wt%)					Multifunctional monomer (parts by weight)	Type (parts by weight)	Added amount (parts by weight)	Type and added amount of photopolymerization initiator having an absorption band in a wavelength of 400 nm or more (parts by weight)	Type and added amount of silane coupling agent (parts by weight)	Peak of dynamic viscoelasticity Tanδ (Tg) [°C]	Thickness (μm)	UV absorption capability (Transmittance)		Optical properties		Dielectric constant 100 kHz	Gel fraction [%]	180° peel adhesive strength [N/20 mm]	Results of drop impact test	
	Type and percentage (a) of the alkyl (meth) acrylate (A) having not more than C8	Type and percentage (b) of the hydroxyl group-containing monomer	Type and percentage of (a)/(b)	(a)	(b)								%T 380 nm	%T 450 nm	Total light transmittance [%]	Haze [%]					
	2EHA	ISTA	NVP	4HBA	HDHA	1.63	0.065	a	0.8	—	Irg819	KBM-403	100	7.1	92.1	92.3	0.3	3.2	92.2	13.0	Pass
Example 1	49	30	18	3	0.065	1.63	0.065	a	0.8	—	Irg819	KBM-403	100	7.1	92.1	92.3	0.3	3.2	92.2	13.0	Pass
Example 2	2EHA	ISTA	NVP	4HBA	DPHA	1.70	0.100	a	1.7	—	Irg819	KBM-403	50	6.8	92.1	92.3	0.3	3.4	82.5	12.3	Pass
	51	30	16	3	0.100	1.70	0.100	a	1.7	—	Irg819	KBM-403	50	6.8	92.1	92.3	0.3	3.4	82.5	12.3	Pass
Example 3	2EHA	ISTA	NVP	4HBA	HDHA	1.52	0.100	b	1.5	—	Irg819	KBM-403	150	0.8	92.1	92.3	0.3	3.4	90.6	14.6	Pass
	50	33	14	3	0.100	1.52	0.100	b	1.5	—	Irg819	KBM-403	150	0.8	92.1	92.3	0.3	3.4	90.6	14.6	Pass
Example 4	2EHA	ISTA	NVP	4HBA	HDHA	1.63	0.065	a	1.0	c	Irg819	KBM-403	150	0.1	90.1	92.3	0.3	3.2	91.2	14.2	Pass
	49	30	18	3	0.065	1.63	0.065	a	1.0	c	Irg819	KBM-403	150	0.1	90.1	92.3	0.3	3.2	91.2	14.2	Pass
Comparative Example 1	2EHA	ISTA	NVP	4HBA	TMPTA	1.00	0.035	—	—	—	—	KBM-403	150	90.3	92.1	92.3	0.4	3.0	80.7	18.8	Failure
	40.5	40.5	18	1	0.035	1.00	0.035	—	—	—	—	KBM-403	150	90.3	92.1	92.3	0.4	3.0	80.7	18.8	Failure
Comparative Example 2	2EHA	—	NVP	HEA	HDHA	—	0.080	a	0.7	—	Irg819	KBM-403	150	3.1	92.1	92.3	0.3	4.1	86.1	17.2	Pass
	67	—	15	18	0.080	—	0.080	a	0.7	—	Irg819	KBM-403	150	3.1	92.1	92.3	0.3	4.1	86.1	17.2	Pass
Comparative Example 3	2EHA	ISTA	NVP	4HBA	TMPTA	1.53	0.070	—	—	—	—	KBM-403	100	90.1	92.1	92.3	0.3	3.1	85.7	10.4	Failure
	49	32	18	1	0.070	1.53	0.070	—	—	—	—	KBM-403	100	90.1	92.1	92.3	0.3	3.1	85.7	10.4	Failure

[0189]

In Table 1,

2EHA represents 2-ethyl hexyl acrylate;

ISTA represents isostearyl acrylate;

NVP represents N-vinyl-2-pyrrolidone;

4HBA represents 4-hydroxybutyl acrylate;

HEA represents 2-hydroxyethyl acrylate;

HDDA represents hexanediol diacrylate;

DPHA represents dipentaerythritol hexaacrylate;

TMPTA represents trimethylolpropane triacrylate;

Ultraviolet absorber (a) represents 2,4-bis-[[4-(4-ethylhexyloxy)-4-hydroxy}-phenyl]-6-(4-methoxyphenyl)-1,3,5-triazine (Trade name: Tinosorb S, maximum absorption wavelength of absorption spectrum: 346 nm, manufactured by BASF Japan);

Ultraviolet absorber (b) represents 2-(2H-benzotriazol-2-yl)-6-(1-methyl-1-phenylethyl)-4-(1,1,3,3-tetramethylbutyl)phenol (Trade name: Tinuvin 928, maximum absorption wavelength of absorption spectrum: 349 nm, manufactured by BASF Japan);

The colorant compound (c) represents BONASORB UA3911 (Trade name, indole-based compound, maximum absorption wavelength of absorption spectrum: 398 nm, half width: 48 nm, manufactured by ORIENT CHEMICAL INDUSTRIES CO., LTD.);

Irg 819 represents bis(2,4,6-trimethylbenzoyl)-

phenylphosphine oxide (Trade name: Irgacure 819,
manufactured by BASF Japan);

KBM-403 represents a silane coupling agent (Trade
name: KBM-403, manufactured by Shin-Etsu Chemical Co.,
Ltd.).

DESCRIPTION OF REFERENCE SIGNS

[0190]

- 1 Pressure-sensitive adhesive layer attached
polarizing film for organic EL display device
- 2 Pressure-sensitive adhesive layer (a, b, c)
- 3 Transparent protective film
- 4 Polarizer
- 5 Retardation film
- 6 Polarizing film
- 7 Cover glass or cover plastics
- 8 Organic EL panel
- 9 Adhesive layer
- 10 Sensor film

CLAIMS

1. A pressure-sensitive adhesive layer for an organic EL display device, formed by a pressure-sensitive adhesive composition comprising a (meth)acrylic polymer and an ultraviolet absorber,

wherein the (meth)acrylic polymer is obtained by polymerizing a monomer component containing a monofunctional monomer component including an alkyl (meth)acrylate (A) having an alkyl group having 8 or less carbon atoms at an ester terminal, and an alkyl (meth)acrylate (B) having an alkyl group having 12 to 24 carbon atoms at an ester terminal;

wherein a percentage (a: wt%) of the alkyl (meth)acrylate (A) and a percentage (b: wt%) of the alkyl (meth)acrylate (B) based on 100 wt% of the monofunctional monomer component is satisfied with following equation (1) and equation (2):

$$\text{Equation (1): } 60 \leq \{(a) + (b)\}$$

$$\text{Equation (2): } 1.4 \leq \{(a) / (b)\} \leq 2; \text{ and}$$

wherein the pressure-sensitive adhesive layer has a peak value of $\text{Tan}\delta$ (T_g) from -20 to -5°C , as measured by dynamic viscoelasticity at a frequency of 1 Hz;

the pressure-sensitive adhesive layer has a transmittance of 10% or less at a wavelength of 380 nm and

a transmittance of 85% or more at a wavelength of 450 nm;
and

the pressure-sensitive adhesive layer has a total light transmittance of 85% or more, and has a haze of 1% or less.

2. The pressure-sensitive adhesive layer for an organic EL display device according to claim 1, wherein a maximum absorption wavelength of an absorption spectrum of the ultraviolet absorber is presented in a wavelength range of 300 to 400 nm.

3. The pressure-sensitive adhesive layer for an organic EL display device according to claim 1 or 2, wherein the monofunctional monomer component further contains at least one cohesive monomer selected from a cyclic nitrogen-containing monomer and an alicyclic structure-containing monomer.

4. The pressure-sensitive adhesive layer for an organic EL display device according to claim 3, wherein a percentage of the cohesive monomer in the monofunctional monomer component is from 10 to 22 wt%.

5. The pressure-sensitive adhesive layer for an

organic EL display device according to any one of claims 1 to 4, wherein the monofunctional monomer component further contains a hydroxyl group-containing monomer.

6. The pressure-sensitive adhesive layer for an organic EL display device according to claim 5, wherein a percentage of the hydroxyl group-containing monomer in the monofunctional monomer component is from 1.5 to 10 wt%.

7. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 6, wherein the monomer component further contains 3 parts by weight or less of a multifunctional monomer based on 100 parts by weight of the monofunctional monomer component.

8. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 7, wherein the pressure-sensitive adhesive composition further contains a colorant compound in which a maximum absorption wavelength of an absorption spectrum is presented in a wavelength range of 380 to 430 nm.

9. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1

to 8, wherein the pressure-sensitive adhesive composition further contains 3 parts by weight or less of a silane coupling agent based on 100 parts by weight of the monofunctional monomer component.

10. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 9, wherein the pressure-sensitive adhesive composition further contains 3 parts by weight or less of a crosslinker based on 100 parts by weight of the monofunctional monomer component.

11. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 10, wherein the pressure-sensitive adhesive composition further contains a photopolymerization initiator.

12. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 11, wherein a dielectric constant at a frequency of 100 kHz is 3.5 or less.

13. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 12, wherein a gel fraction is from 50 to 95 wt%.

14. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 13, wherein the pressure-sensitive adhesive layer has a 180° peel adhesive strength to an alkaline-free glass (peel rate 300 mm/min) of 7 N/20 mm or more.

15. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 14, comprising a separator at least on one side of the pressure-sensitive adhesive layer.

16. A pressure-sensitive adhesive layer attached polarizing film for an organic EL display device, comprising a polarizing film and the pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 15.

17. The pressure-sensitive adhesive layer attached polarizing film according to claim 16, wherein the polarizing film includes a transparent protective film on one surface of a polarizer and a retardation film on another surface of the polarizer, and the pressure-sensitive adhesive layer for an organic EL display device is provided on a surface opposite to a surface contacting

with the polarizer of the retardation film and/or on a surface opposite to a surface contacting with the polarizer of the transparent protective film.

18. The pressure-sensitive adhesive layer attached polarizing film according to claim 16, comprising a first pressure-sensitive adhesive layer, a transparent protective film, a polarizer, a second pressure-sensitive adhesive layer, a retardation film, and a third pressure-sensitive adhesive layer in this order, wherein at least one pressure-sensitive adhesive layer of the first pressure-sensitive adhesive layer, the second pressure-sensitive adhesive layer and the third pressure-sensitive adhesive layer is the pressure-sensitive adhesive layer for an organic EL display device.

19. The pressure-sensitive adhesive layer attached polarizing film according to claim 17 or 18, wherein the retardation film is a quarter wavelength plate, and the polarizing film is a circular polarizing film.

20. An organic EL display device comprising at least one of the pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 14, or at least one of the pressure-sensitive adhesive layer

attached polarizing film for an organic EL display device according to any one of claim 16 to 19.

21. The organic EL display device according to claim 20, wherein the organic EL display device is an organic EL display device with touch panel comprising an organic EL panel, a circular polarizing film provided in order from a viewing side of the organic EL panel, and a touch panel having at least one sensor film,

wherein the pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 14 is provided nearer the viewing side than the circular polarizing film while contacting with at least one sensor film.

22. The pressure-sensitive adhesive layer for an organic EL display device according to any one of claims 1 to 15, wherein in the touch panel of the organic EL display device according to claim 21, the pressure-sensitive adhesive layer is used for providing so as to contact with at least one sensor film.