

Description

Title of Invention: OPTICAL PRESSURE-SENSITIVE ADHESIVE SHEET

Technical Field

[0001]

The present invention relates to an optical pressure-sensitive adhesive sheet. More specifically, the present invention relates to an optical pressure-sensitive adhesive sheet for use in bonding of an optical member.

Background Art

[0002]

An image display apparatus like a liquid crystal display apparatus or an organic EL display apparatus is configured by an optical member laminate in which transparent cover members such as a polarizing film, a phase difference film and cover glass, and other various transparent optical members are laminated on an image display panel. An adhesive sheet made of a transparent pressure-sensitive adhesive layer is used for bonding of such optical members. In other words, an optical member laminate is produced by disposing a pressure-sensitive adhesive sheet between optical members to be bonded and

pressure-bonding the members (for example, Patent Literature 1).

Citation List

Patent Literature

[0003]

Patent Literature 1: Japanese Patent Laid-Open No.
2012-211305

Summary of Invention

Technical Problem

[0004]

Foreign substances may be attached on a surface of a pressing plate in pressure-bonding of the above optical member laminate, and a problem is that scars called white spots occur in a location where such foreign substances were present even in the optical member laminate released from pressure, resulting in deterioration in visibility of an image display apparatus.

[0005]

The present invention has been devised in view of the above circumstances, and an object thereof is to provide an optical pressure-sensitive adhesive sheet in which white spots hardly occur even if foreign substances are attached on a surface of a pressing plate in pressure-bonding of an optical member laminate.

[0006]

In an image display apparatus including a touch panel, a transparent and conductive printed layer of ITO (indium tin oxide) or the like patterned is formed on a surface of an optical member. Furthermore, silver and/or copper routing wiring is formed on a peripheral portion. Moreover, a black concealed portion is generally printed in the form of a frame on a circumferential portion of a transparent cover member. An optical pressure-sensitive adhesive sheet for bonding of an optical member provided with the printed layer and the wiring preferably has followability to steps so that no bubbles remain on steps.

Solution to Problem

[0007]

A first aspect of the present invention provides an optical pressure-sensitive adhesive sheet including a pressure-sensitive adhesive layer, wherein

the pressure-sensitive adhesive layer has a compressibility after 300 seconds from pressure release in the following compression test (hereinafter, sometimes simply referred to as "compressibility after pressure release") of the pressure-sensitive adhesive layer of 3.5% or less:

<Compression test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is pressurized at 0.35 MPa from above and below at 50°C for

10 seconds, and left to still stand for 300 seconds after pressure release.

[0008]

A configuration of the optical pressure-sensitive adhesive sheet according to the first aspect of the present invention, in which the pressure-sensitive adhesive layer has a compressibility after pressure release of 3.5% or less is preferable in that the occurrence of white spots can be suppressed in production of an optical member laminate with the optical pressure-sensitive adhesive sheet. The reason for the occurrence of white spots is considered because foreign substances, if attached onto a pressing plate in pressure-bonding of an optical member laminate, push such an optical member laminate to generate depressed portions, thereby causing such depressed portions to remain as pressing marks after pressure release. It is considered that, in a case where the pressure-sensitive adhesive layer has a compressibility after pressure release of 3.5% or less depressed portions due to the foreign substances hardly occur or, even if occur, are turned back to non-depressed portions to thereby hardly cause white spots to occur. The pressure-sensitive adhesive layer preferably has a compressibility after pressure release of 3% or less, more preferably 2.5% or less from the viewpoint that white spots are hardly caused to occur.

[0009]

A second aspect of the present invention provides an optical pressure-sensitive adhesive sheet including a pressure-sensitive adhesive layer, wherein

the pressure-sensitive adhesive layer has a strain after 6000 seconds from shear force release in the following shear test (hereinafter, sometimes simply referred to as "strain after shear force release") of the pressure-sensitive adhesive layer of 1.4% or less:

<Shear test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is subjected to a shear force in a torsional direction at 2000 Pa from above and below at 50°C for 4000 seconds, and left to still stand for 6000 seconds after shear force release.

[0010]

A configuration of the optical pressure-sensitive adhesive sheet according to the second aspect of the present invention, in which the pressure-sensitive adhesive layer has a strain after shear force release of 1.4% or less is preferable in that the occurrence of white spots can be suppressed in production of an optical member laminate with the pressure-sensitive adhesive sheet. It is considered that, in a case where the pressure-sensitive adhesive layer has a strain after shear force release of 1.4% or less depressed portions due to the foreign substances hardly occur or, even if

occur, are turned back to non-depressed portions to thereby hardly cause white spots to occur. The pressure-sensitive adhesive layer preferably has a strain after shear force release of 1.2% or less, more preferably 1% or less from the viewpoint that white spots are hardly caused to occur.

[0011]

In the optical pressure-sensitive adhesive sheet according to the first aspect of the present invention, a compressibility immediately after pressuring for 10 seconds in the compression test (hereinafter, sometimes simply referred to as "compressibility immediately after pressurizing") is preferably 20% or more. A configuration in which a compressibility immediately after pressurizing is 20% or more is preferable in that excellent followability to steps is exhibited in the pressure-sensitive adhesive layer of the optical pressure-sensitive adhesive sheet according to the first aspect of the present invention. The compressibility immediately after pressurizing is preferably 25% or more, more preferably 30% or more in that the optical pressure-sensitive adhesive sheet of the optical pressure-sensitive adhesive sheet according to the first aspect of the present invention exhibits excellent followability to steps.

[0012]

In the optical pressure-sensitive adhesive sheets according to the first and second aspects of the present invention, a gel fraction of the pressure-sensitive adhesive layer is preferably 73% or more. A configuration in which the gel fraction of the pressure-sensitive adhesive layer is 73% or more is preferable in that the compressibility after pressure release, the strain after shear force release, and the compressibility immediately after pressurizing (in particular, compressibility after pressure release and strain after shear force release) of the pressure-sensitive adhesive layer are adjusted in the predetermined ranges and the occurrence of white spots can be suppressed. The gel fraction of the pressure-sensitive adhesive layer is more preferably 75% or more, further preferably 77% or more in that the occurrence of white spots can be suppressed.

[0013]

A third aspect of the present invention provides an optical member laminate including the optical pressure-sensitive adhesive sheet according to the first and/or second aspect(s) of the present invention. The optical member laminate according to the third aspect of the present invention is preferably an image display apparatus. The optical member laminate (image display apparatus) according to the third aspect of the present invention is bonded with the optical pressure-sensitive adhesive sheet according to the first and/or second

aspect(s) of the present invention, and thus the occurrence of white spots can be suppressed even if foreign substances are attached onto a pressing plate in pressure-bonding of the optical member laminate and an optical member laminate (image display apparatus) excellent in visibility can be obtained.

Advantageous Effects of Invention

[0014]

An optical member laminate is produced by laminating an optical member with the optical pressure-sensitive adhesive sheet of the present invention, and thus the occurrence of white spots can be suppressed even if foreign substances are attached onto a pressing plate in pressure-bonding of the optical member laminate and an optical member laminate (image display apparatus) excellent in visibility can be obtained.

Brief Description of Drawings

[0015]

[Figure 1] Figure 1 is a schematic view for describing a compression test.

[Figure 2] Figure 2 is a schematic view for describing shear test.

[Figure 3] Figure 3 is a schematic cross-sectional view illustrating one example of an optical member laminate

(image display apparatus) with the optical pressure-sensitive adhesive sheet of the present invention.

Description of Embodiments

[0016]

An optical pressure-sensitive adhesive sheet according to a first aspect of the present invention includes a pressure-sensitive adhesive layer, wherein the pressure-sensitive adhesive layer has a compressibility (compressibility after pressure release) of the pressure-sensitive adhesive layer after 300 seconds from pressure release in the following compression test of 3.5% or less:

<Compression test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is pressurized at 0.35 MPa from above and below at 50°C for 10 seconds, and left to still stand for 300 seconds after pressure release.

[0017]

An optical pressure-sensitive adhesive sheet according to a second aspect of the present invention includes a pressure-sensitive adhesive layer, wherein the pressure-sensitive adhesive layer has a strain (strain after shear force release) of the pressure-sensitive adhesive layer after 6000 seconds from shear force release in the following shear test of 1.4% or less:

<Shear test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is subjected to a shear force in a torsional direction at 2000 Pa from above and below at 50°C for 4000 seconds, and left to still stand for 6000 seconds after shear force release.

[0018]

Herein, the optical pressure-sensitive adhesive sheet according to the first aspect of the present invention may be referred to as "optical pressure-sensitive adhesive sheet 1", and the optical pressure-sensitive adhesive sheet according to the second aspect of the present invention may be referred to as "optical pressure-sensitive adhesive sheet 2". The pressure-sensitive adhesive layer constituting the optical pressure-sensitive adhesive sheet 1 may be referred to as "pressure-sensitive adhesive layer 1", and the pressure-sensitive adhesive layer constituting the optical pressure-sensitive adhesive sheet 2 may be referred to as "pressure-sensitive adhesive layer 2". The optical pressure-sensitive adhesive sheets 1 and 2 may be collectively referred to as "the optical pressure-sensitive adhesive sheet of the present invention". The pressure-sensitive adhesive layers 1 and 2 may be collectively referred to as "the pressure-sensitive adhesive layer in the present invention". It is noted

that the "pressure-sensitive adhesive sheet" also encompasses the meaning of "pressure-sensitive adhesive tape". In other words, the optical pressure-sensitive adhesive sheet of the present invention may also be a pressure-sensitive adhesive tape having a tape form.

[0019]

The form of the optical pressure-sensitive adhesive sheet of the present invention is not particularly limited as long as an adhesive face to be laminated on an optical member is an adhesive face (pressure-sensitive adhesive layer surface) of the pressure-sensitive adhesive layer in the present invention. For example, there may be adopted a single-coated pressure-sensitive adhesive sheet in which only one face is an adhesive face, or a double-coated pressure-sensitive adhesive sheet in which both faces are adhesive faces. In a case where the optical pressure-sensitive adhesive sheet of the present invention is a double-coated pressure-sensitive adhesive sheet, the optical pressure-sensitive adhesive sheet of the present invention may have a form in which both adhesive faces are each provided by the pressure-sensitive adhesive layer in the present invention, or may have a form in which one adhesive face is provided by the pressure-sensitive adhesive layer in the present invention and other adhesive face is provided by a pressure-sensitive adhesive layer (other pressure-sensitive adhesive layer) other than the pressure-

sensitive adhesive layer in the present invention. A double-coated pressure-sensitive adhesive sheet is preferable from the viewpoint that objects are mutually laminated.

[0020]

The optical pressure-sensitive adhesive sheet of the present invention may be a so-called "substrate-less type" pressure-sensitive adhesive sheet including no substrate (substrate layer), or a pressure-sensitive adhesive sheet including a substrate. Herein, the "substrate-less type" pressure-sensitive adhesive sheet may be referred to as "substrate-less pressure-sensitive adhesive sheet", and the pressure-sensitive adhesive sheet including a substrate may be referred to as "pressure-sensitive adhesive sheet provided with a substrate". Examples of the substrate-less pressure-sensitive adhesive sheet include a double-coated pressure-sensitive adhesive sheet including only the pressure-sensitive adhesive layer in the present invention, and a double-coated pressure-sensitive adhesive sheet including the pressure-sensitive adhesive layer in the present invention and other pressure-sensitive adhesive layer (any pressure-sensitive adhesive layer other than the pressure-sensitive adhesive layer in the present invention). Examples of the pressure-sensitive adhesive sheet provided with a substrate include a single-coated pressure-sensitive adhesive sheet

including the pressure-sensitive adhesive layer in the present invention at one face side of the substrate, a double-coated pressure-sensitive adhesive sheet including the pressure-sensitive adhesive layer in the present invention at each of both faces of the substrate, and a double-coated pressure-sensitive adhesive sheet including the pressure-sensitive adhesive layer in the present invention at one face side of the substrate and including other pressure-sensitive adhesive layer at other face side. The above "substrate (substrate layer)" means a support, and corresponds to a portion to be laminated, together with the pressure-sensitive adhesive layer, onto an object in use (lamination) of the pressure-sensitive adhesive sheet for the object. A separator (release liner) to be separated in use (lamination) of the pressure-sensitive adhesive sheet is not included in the substrate.

[0021]

The thickness of the optical pressure-sensitive adhesive sheet of the present invention is not particularly limited, and is preferably 12 μm or more, preferably 15 μm or more, further preferably 20 μm or more, particularly preferably 50 μm or more. The thickness is preferably 500 μm or less in terms of optical properties, and is preferably 300 μm or less, further preferably 200 μm or less. The thickness of the release liner is not included in the thickness of the

optical pressure-sensitive adhesive sheet of the present invention.

[0022]

The haze (according to JIS K7136) of the optical pressure-sensitive adhesive sheet of the present invention is not particularly limited, and is preferably 1.0% or less, more preferably 0.8% or less. A haze of 1.0% or less is preferable because excellent transparency and excellent appearance are obtained. The haze can be, for example, measured by using a haze meter (trade name "HM-150" manufactured by Murakami Color Research Laboratory Co., Ltd.), with a sample obtained by allowing the pressure-sensitive adhesive sheet to still stand in an ordinary state (23°C, 50% RH) for at least 24 hours, then separating a separator when the separator is included, and laminating the resultant on slide glass (for example, one in which the total light transmittance is 91.8% and the haze is 0.4%).

[0023]

The total light transmittance (according to JIS K7361-1) in the visible light wavelength region, of the optical pressure-sensitive adhesive sheet of the present invention, is not particularly limited, and is preferably 85% or more, more preferably 88% or more. A total light transmittance of 85% or more is preferable because excellent transparency and excellent appearance are obtained. The total light transmittance can be, for

example, measured by using a haze meter (trade name "HM-150" manufactured by Murakami Color Research Laboratory Co., Ltd.), with a sample obtained by allowing the pressure-sensitive adhesive sheet to still stand in an ordinary state (23°C, 50% RH) for at least 24 hours, then separating a separator when the separator is included, and laminating the resultant on slide glass (for example, one in which the total light transmittance is 91.8% and the haze is 0.4%).

[0024]

The adhesive strength of the optical pressure-sensitive adhesive sheet of the present invention, at the side of the pressure-sensitive adhesive layer in the present invention, is not particularly limited, and is preferably 6 N/20 mm or more, more preferably 7 N/20 mm or more, further preferably 10 N/20 mm or more in terms of adhesion reliability. The adhesive strength corresponds to the peeling adhesive strength at 180°, and can be measured by peeling from an object (for example, glass plate, stainless plate, or one made of a plastic such as polycarbonate) according to JIS Z 0237 in conditions of a tensile speed of 300 mm/min and a tensile angle of 180° (degrees).

[0025]

(Pressure-sensitive adhesive layer of present invention)

In the optical pressure-sensitive adhesive sheet 1, the pressure-sensitive adhesive layer 1 has a compressibility (compressibility after pressure release) of the pressure-sensitive adhesive layer after 300 seconds from pressure release in the compression test of 3.5% or less. A configuration in which the pressure-sensitive adhesive layer 1 has a compressibility after pressure release of 3.5% or less is preferable in that the occurrence of white spots can be suppressed in production of an optical member laminate with the optical pressure-sensitive adhesive sheet 1. The reason for the occurrence of white spots is considered because foreign substances, if attached onto a pressing plate in pressure-bonding of an optical member laminate, push such an optical member laminate to generate depressed portions, thereby causing such depressed portions to remain as pressing marks after pressure release. It is considered that, in a case where the pressure-sensitive adhesive layer 1 has a compressibility after pressure release of 3.5% or less, depressed portions due to the foreign substances hardly occur or, even if occur, are turned back to non-depressed portions to thereby hardly cause white spots to occur. The compressibility after pressure release of the pressure-sensitive adhesive layer 1 is preferably 3% or less, more preferably 2.5% or less from the viewpoint that white spots are hardly caused to occur. The lower limit of the compressibility after pressure

release of the pressure-sensitive adhesive layer 1 is not particularly limited, and is preferably 0.1% or more, more preferably 0.5% or more from the viewpoint that followability to steps is excellent.

[0026]

The "compression test" is described with reference to the drawings. Figure 1 is a schematic view for describing a compression test, in which 10 represents a pressure-sensitive adhesive layer, and 11 and 12 each represent a parallel plate.

The pressure-sensitive adhesive layer 10 is a disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm and is configured from the pressure-sensitive adhesive layer 1, and the parallel plates 11 and 12 each have an upper face and a bottom face each having a diameter of 8 mm and are each formed from, for example, stainless steel (Figure 1(a)). The upper face of the parallel plate 11 and the bottom face of the parallel plate 12 are, respectively, aligned positionally and abutted with the bottom face and the upper face of the pressure-sensitive adhesive layer 10 (Figure 1(b)). Next, a pressure F1 of 0.35 MPa is applied from the parallel plates 11 and 12 toward the pressure-sensitive adhesive layer 10 at an ambient temperature of 50°C for 10 seconds (Figure 1(c)). Next, the parallel plates 11 and 12 are released from the pressure, and left to still stand for 300 seconds (Figure

1(d)). The "compressibility after pressure release" means the percentage (%) of the amount of change of the thickness of the pressure-sensitive adhesive layer 10 after 300 seconds from pressure release (Figure 1(d)) relative to the thickness (100%) of the pressure-sensitive adhesive layer 10 at the initial stage (Figure 1(b)).

[0027]

The pressure-sensitive adhesive layer 1 preferably has a compressibility (compressibility immediately after pressurizing) immediately after pressurizing for 10 seconds in the compression test of 20% or more. A configuration in which the compressibility immediately after pressurizing is 20% or more is preferable in that excellent followability to steps is exhibited in the pressure-sensitive adhesive layer 1 of the optical pressure-sensitive adhesive sheet 1. The compressibility immediately after pressurizing is preferably 25% or more, more preferably 30% or more in that the pressure-sensitive adhesive layer 1 exhibits excellent followability to steps. The upper limit value of the compressibility immediately after pressurizing of the pressure-sensitive adhesive layer 1 is not particularly limited, and is more preferably 34% or less, further preferably 33.5% or less from the viewpoint that the occurrence of white spots can be suppressed.

[0028]

The "compressibility immediately after pressurizing" means the percentage (%) of the amount of change of the thickness of the pressure-sensitive adhesive layer 10 immediately after pressurizing for 10 seconds (Figure 1(c)) relative to the thickness (100%) of the pressure-sensitive adhesive layer 10 at the initial stage (Figure 1(b)).

[0029]

The ratio of the compressibility after pressure release to the compressibility immediately after pressurizing (compressibility after pressure release/compressibility immediately after pressurizing), with respect to the pressure-sensitive adhesive layer 1, is not particularly limited, and is preferably 0.1 or less. A configuration in which the ratio (compressibility after pressure release/compressibility immediately after pressurizing) is 0.1 or less is preferable in that the occurrence of white spots can be suppressed in production of an optical member laminate with the optical pressure-sensitive adhesive sheet 1. The ratio (compressibility after pressure release/compressibility immediately after pressurizing) is more preferably 0.09 or less, further preferably 0.08 or less from the viewpoint that white spots are hardly caused to occur. The lower limit value of the ratio (compressibility after pressure release/compressibility

immediately after pressurizing) is not particularly limited, and may be 0.01 or more.

[0030]

The "compressibility after pressure release" and the "compressibility immediately after pressurizing" of the pressure-sensitive adhesive layer 1 can be adjusted by, for example, the gel fraction of the pressure-sensitive adhesive layer 1, physical properties such as elastic modulus, formulations (for example, the type and the molecular weight, the amount of use, the monomer formulation, and the type and the amount of a functional group, of a base polymer, as well as the type and the amount of a crosslinking agent) of a pressure-sensitive adhesive composition for forming the pressure-sensitive adhesive layer 1, and curing conditions (heating conditions, radiation irradiation conditions).

[0031]

In the optical pressure-sensitive adhesive sheet 2, the pressure-sensitive adhesive layer 2 preferably has a strain after 6000 seconds from shear force release in the shear test (strain after shear force release) of the pressure-sensitive adhesive layer of 1.4% or less. A configuration in which the pressure-sensitive adhesive layer 2 has a strain after shear force release of 1.4% or less is preferable in that the occurrence of white spots can be suppressed in production of an optical member laminate with the optical pressure-sensitive adhesive

sheet 2. It is considered that, in a case where the pressure-sensitive adhesive layer 2 has a strain after shear force release of 1.4% or less, depressed portions due to the foreign substances hardly occur or, even if occur, are turned back to non-depressed portions to thereby hardly cause white spots to occur. The strain after shear force release of the pressure-sensitive adhesive layer 2 is more preferably 1.2% or less, more preferably 1% or less from the viewpoint that white spots are hardly caused to occur. The lower limit of the strain after shear force release of the pressure-sensitive adhesive layer 2 is not particularly limited, and is preferably 0.1% or more, more preferably 0.15% or more from the viewpoint that followability to steps is excellent.

[0032]

The "shear test" is described with reference to the drawings. Figure 2 is a schematic view for describing the shear test, in which 20 represents a pressure-sensitive adhesive layer, and 21 and 22 each represent a parallel plate.

The pressure-sensitive adhesive layer 20 is a disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm and is configured from the pressure-sensitive adhesive layer 2, and the parallel plates 21 and 22 each have an upper face and a bottom face each having a diameter of 8 mm and are

each formed from, for example, stainless steel (Figure 2(a)). The upper face of the parallel plate 21 and the bottom face of the parallel plate 22 are, respectively, aligned positionally and abutted with the bottom face and the upper face of the pressure-sensitive adhesive layer 20 (Figure 2(b)). Next, a shear force F_2 in a torsional direction, of 2000 Pa, is applied from the parallel plates 21 and 22 toward the pressure-sensitive adhesive layer 20 at an ambient temperature of 50°C for 4000 seconds (Figure 2(c)). Next, the parallel plates 21 and 22 are released from the shear force, and left to still stand for 6000 seconds (Figure 2(d)). The "strain after shear force release" means the percentage (%) of the amount of change of the outer perimeter in the torsional direction of the pressure-sensitive adhesive layer 20 after 6000 seconds from shear force release (Figure 2(d)) relative to the outer perimeter (100%) of the pressure-sensitive adhesive layer 20 at the initial stage (Figure 2(b)).

[0033]

The pressure-sensitive adhesive layer 2 preferably has a strain after 8000 seconds from shear force release in the shear test (herein, sometimes referred to as "strain after 8000 seconds from shear force release") of the pressure-sensitive adhesive layer of 1% or less. A configuration in which the pressure-sensitive adhesive layer 2 has a strain after 8000 seconds from shear force

release of 1% or less is preferable in that the occurrence of white spots can be suppressed in production of an optical member laminate with the optical pressure-sensitive adhesive sheet 2. It is considered that, in a case where the pressure-sensitive adhesive layer 2 has a strain after 8000 seconds from shear force release of 1% or less, depressed portions due to the foreign substances hardly occur or, even if occur, are turned back to non-depressed portions to thereby hardly cause white spots to occur. The strain after 8000 seconds of the shear force release of the pressure-sensitive adhesive layer 2 is more preferably 0.9% or less, further preferably 0.8% or less, or may be 0.7% or less from the viewpoint that white spots are hardly caused to occur. The lower limit of the strain after 8000 seconds from shear force release of the pressure-sensitive adhesive layer 2 is not particularly limited, and is preferably 0.05% or more, more preferably 0.08% or more from the viewpoint that followability to steps is excellent.

[0034]

The "strain after 8000 seconds from shear force release" means the percentage (%) of the amount of change of the outer perimeter in the torsional direction of the pressure-sensitive adhesive layer 20 after 8000 seconds from shear force release (after additional 2000 seconds from Figure 2(d)) relative to the outer perimeter (100%)

of the pressure-sensitive adhesive layer 20 at the initial stage (Figure 2(b)).

[0035]

The pressure-sensitive adhesive layer 2 preferably has a strain immediately after shear force application for 4000 seconds in the shear test (herein, sometimes referred to as "strain immediately after shear force") of 1% or more. A configuration in which the strain immediately after shear force is 1% or more is preferable in that excellent followability to steps is exhibited in the pressure-sensitive adhesive layer 2 of optical pressure-sensitive adhesive sheet 2. The strain immediately after shear force is more preferably 1.5% or more, further preferably 1.7% or more in that the pressure-sensitive adhesive layer 2 exhibits excellent followability to steps. The upper limit value of the strain immediately after shear force of the pressure-sensitive adhesive layer 2 is not particularly limited, and is preferably 5% or less, more preferably 4% or less from the viewpoint that the occurrence of white spots can be suppressed.

[0036]

The "strain immediately after shear force" means the percentage (%) of the amount of change of the outer perimeter in the torsional direction of the pressure-sensitive adhesive layer 20 immediately after shear force application for 4000 seconds (Figure 2(c)) relative to

the outer perimeter (100%) of the pressure-sensitive adhesive layer 20 at the initial stage (Figure 2(b)).

[0037]

The "strain after shear force release", the "strain after 8000 seconds from shear force release" and the "strain immediately after shear force" of the pressure-sensitive adhesive layer 2 can be adjusted by, for example, the gel fraction of the pressure-sensitive adhesive layer 2, physical properties such as elastic modulus, formulations (for example, the type and the molecular weight, the amount of use, the monomer formulation, and the type and the amount of a functional group, of a base polymer, as well as the type and the amount of a crosslinking agent) of a pressure-sensitive adhesive composition for forming the pressure-sensitive adhesive layer 2, and curing conditions (heating conditions, radiation irradiation conditions).

[0038]

The pressure-sensitive adhesive layer 1 may have the above properties (the strain after shear force release of 1.4% or less, preferably the strain after 8000 seconds from shear force release of 1% or less and the strain immediately after shear force of 1% or more) of the pressure-sensitive adhesive layer 2, and the pressure-sensitive adhesive layer 2 may have the above properties (the compressibility after pressure release is 3.5% or less, preferably the compressibility immediately after

pressurizing is 20% or more) of the pressure-sensitive adhesive layer 1. In other words, the optical pressure-sensitive adhesive sheet of the present invention preferably has a compressibility after pressure release of 3.5% or less (preferably a compressibility immediately after pressurizing of 20% or more) and preferably has a strain after shear force release of 1.4% or less (preferably a strain after 8000 seconds from shear force release of 1% or less and a strain immediately after shear force of 1% or more).

[0039]

In the optical pressure-sensitive adhesive sheet of the present invention (optical pressure-sensitive adhesive sheets 1 and 2), the gel fraction of the pressure-sensitive adhesive layer in the present invention (optical pressure-sensitive adhesive sheets 1 and 2) is preferably 73% or more. A configuration in which the gel fraction of the pressure-sensitive adhesive layer in the present invention is 73% or more is preferable in that the compressibility after pressure release, the compressibility immediately after pressurizing, the strain after shear force release, the strain after 8000 seconds from shear force release, the strain immediately after shear force (in particular, the compressibility after pressure release and the strain after shear force release) of the pressure-sensitive adhesive layer in the present invention are adjusted in

the predetermined ranges and the occurrence of white spots can be suppressed. The gel fraction of the pressure-sensitive adhesive layer in the present invention is more preferably 75% or more, further preferably 77% or more in that the occurrence of white spots can be suppressed. The upper limit value of the gel fraction of the pressure-sensitive adhesive layer in the present invention is not particularly limited, and is preferably 90% or less, more preferably 85% or less from the viewpoint that followability to steps is excellent. [0040]

The gel fraction (the proportion of a solvent-insoluble fraction) of the pressure-sensitive adhesive layer in the present invention can be determined as the ethyl acetate-insoluble fraction. Specifically, it is determined as the weight fraction (unit: % by weight) of a sample before immersion relative to the insoluble fraction after immersion of the pressure-sensitive adhesive layer in ethyl acetate at room temperature (23°C) for 7 days. More specifically, the gel fraction refers to the value calculated by the following "Method for measuring gel fraction".

(Method for measuring gel fraction)

About 1 g of the pressure-sensitive adhesive layer is collected, and the weight thereof is measured and defined as the "weight of the pressure-sensitive adhesive layer before immersion". Next, the pressure-sensitive

adhesive layer collected is immersed in 40 g of ethyl acetate for 7 days, thereafter a component not dissolved in ethyl acetate (portion not dissolved) is fully recovered, the entire portion not dissolved, recovered, is dried at 130°C for 2 hours for removal of ethyl acetate, and thereafter the weight is measured and defined as the "dry weight of the portion not dissolved" (the weight of the pressure-sensitive adhesive layer after immersion). The resulting numerical value is then plugged in the following expression for calculation.

$$\text{Gel fraction (\% by weight)} = [(\text{Dry weight of portion not dissolved}) / (\text{Weight of pressure-sensitive adhesive layer before immersion})] \times 100$$

[0041]

The gel fraction of the pressure-sensitive adhesive layer in the present invention can be adjusted by, for example, formulations (for example, the type and the molecular weight, the amount of use, the monomer formulation, and the type and the amount of a functional group, of a base polymer, as well as the type and the amount of a crosslinking agent) of a pressure-sensitive adhesive composition for forming the pressure-sensitive adhesive layer in the present invention, and curing conditions (heating conditions, radiation irradiation conditions).

[0042]

The storage elastic modulus (G'_{25}) at 25°C of the pressure-sensitive adhesive layer in the present invention is not particularly limited, and may be, for example, preferably 0.01 MPa or more, more preferably 0.05 MPa or more, further preferably 0.1 MPa or more. Such a configuration is preferable in that white spots are suppressed. The G'_{25} is not particularly limited, and is, for example, preferably 1 MPa or less, more preferably 0.8 MPa or less, further preferably 0.5 MPa or less from the viewpoint that followability to steps is excellent.

[0043]

The storage elastic modulus (G'_{85}) at 85°C of the pressure-sensitive adhesive layer in the present invention is not particularly limited, and may be, for example, preferably 0.001 MPa or more, more preferably 0.005 MPa or more, further preferably 0.01 MPa or more. Such a configuration is preferable in that white spots are suppressed. The G'_{85} is not particularly limited, and is, for example, preferably 0.5 MPa or less, more preferably 0.4 MPa or less, further preferably 0.3 MPa or less from the viewpoint that followability to steps is excellent.

[0044]

The loss tangent ($\tan \delta$) at 70°C of the pressure-sensitive adhesive layer in the present invention is not particularly limited, and may be, for example, preferably

0.32 or less, more preferably 0.3 or less, further preferably 0.28 or less. Such a configuration is preferable in that white spots are suppressed. The $\tan \delta$ is not particularly limited, and is, for example, 0.05 or more, preferably 0.08 or more, more preferably 0.1 or more from the viewpoint that followability to steps is excellent.

[0045]

The storage elastic moduli (G'_{25} , G'_{85}) and the loss tangent ($\tan \delta$) of the pressure-sensitive adhesive layer in the present invention are measured by dynamic viscoelasticity measurement in Examples described below. The storage elastic moduli (G'_{25} , G'_{85}) and the loss tangent ($\tan \delta$) of the pressure-sensitive adhesive layer in the present invention can be adjusted by, for example, formulations (for example, the type and the molecular weight, the amount of use, the monomer formulation, and the type and the amount of a functional group, of a base polymer, as well as the type and the amount of a crosslinking agent) of a pressure-sensitive adhesive composition for forming the pressure-sensitive adhesive layer in the present invention, and curing conditions (heating conditions, radiation irradiation conditions).

[0046]

The thickness of the pressure-sensitive adhesive layer in the present invention is not particularly limited, and is preferably 12 to 350 μm , more preferably

12 to 300 μm . A thickness equal to or more than a certain value is preferable because followability to steps and adhesion reliability are enhanced. A thickness equal to or less than a certain value is preferable because the occurrence of white spots is easily suppressed.

[0047]

The haze (according to JIS K7136) of the pressure-sensitive adhesive layer in the present invention is not particularly limited, and is preferably 1.0% or less, more preferably 0.8% or less. A haze of 1.0% or less is preferable because excellent transparency and excellent appearance are obtained. The haze can be, for example, measured by using a haze meter (trade name "HM-150" manufactured by Murakami Color Research Laboratory Co., Ltd.), with a sample obtained by allowing the pressure-sensitive adhesive layer (thickness: 100 μm) to still stand in an ordinary state (23°C, 50% RH) for at least 24 hours, and then laminating the resultant on slide glass (for example, one in which the total light transmittance is 91.8% and the haze is 0.4%).

[0048]

The total light transmittance (according to JIS K7361-1) in the visible light wavelength region of the optical pressure-sensitive adhesive layer in the present invention is not particularly limited, and is preferably 85% or more, more preferably 88% or more. A total light

transmittance of 85% or more is preferable because excellent transparency and excellent appearance are obtained. The total light transmittance can be, for example, measured by using a haze meter (trade name "HM-150" manufactured by Murakami Color Research Laboratory Co., Ltd.), with a sample obtained by allowing the pressure-sensitive adhesive layer (thickness: 100 μm) to still stand in an ordinary state (23°C, 50% RH) for at least 24 hours, then separating a separator when the separator is included, and laminating the resultant on slide glass (for example, one in which the total light transmittance is 91.8% and the haze is 0.4%).

[0049]

The pressure-sensitive adhesive constituting the pressure-sensitive adhesive layer in the present invention is not particularly limited, and examples include an acrylic pressure-sensitive adhesive, a rubber-based pressure-sensitive adhesive, a vinyl alkyl ether-based pressure-sensitive adhesive, a silicone-based pressure-sensitive adhesive, a polyester-based pressure-sensitive adhesive, a polyamide-based pressure-sensitive adhesive, a urethane-based pressure-sensitive adhesive, a fluorine-based pressure-sensitive adhesive, and an epoxy-based pressure-sensitive adhesive. In particular, the pressure-sensitive adhesive constituting the pressure-sensitive adhesive layer is preferably an acrylic pressure-sensitive adhesive in terms of transparency,

adhesiveness, weather resistance, cost, and ease of designing of the pressure-sensitive adhesive. In other words, the pressure-sensitive adhesive layer in the present invention is preferably an acrylic pressure-sensitive adhesive layer constituted from an acrylic pressure-sensitive adhesive. The pressure-sensitive adhesives can be used singly or in combinations of two or more thereof.

[0050]

The acrylic pressure-sensitive adhesive layer contains an acrylic polymer as a base polymer. The acrylic polymer is a polymer containing an acrylic monomer (monomer having a (meth)acryloyl group in its molecule) as a monomer component constituting the polymer. The acrylic polymer is preferably a polymer containing a (meth)acrylic acid alkyl ester as a monomer component constituting the polymer. The acrylic polymers can be used singly or in combinations of two or more thereof.

[0051]

The pressure-sensitive adhesive composition forming the pressure-sensitive adhesive layer in the present invention may be in any form. For example, the pressure-sensitive adhesive composition may be, for example, of an emulsion type, solvent type (solution type), active energy ray curing type, or hot melt type. In particular, a solvent type or active energy ray curing type pressure-sensitive adhesive composition is preferable in terms of

productivity and in terms of ease of obtaining of a pressure-sensitive adhesive layer excellent in optical properties and appearance properties. In particular, an active energy ray curing type pressure-sensitive adhesive composition is preferable from the viewpoint that the above various properties (in particular, the compressibility after pressure release, the strain after shear force release, the gel fraction, and the like) of the pressure-sensitive adhesive layer are easily controlled.

[0052]

In other words, the pressure-sensitive adhesive layer in the present invention preferably is an acrylic pressure-sensitive adhesive layer containing an acrylic polymer as a base polymer and is formed from an active energy ray curing type acrylic pressure-sensitive adhesive composition.

[0053]

Examples of the active energy ray include ionizing radiations such as α -ray, β -ray, γ -ray, neutron ray and electron beam, and ultraviolet light, and in particular, ultraviolet light is preferable. In other words, the active energy ray curing type pressure-sensitive adhesive composition is preferably an ultraviolet curing type pressure-sensitive adhesive composition.

[0054]

Examples of the pressure-sensitive adhesive composition (acrylic pressure-sensitive adhesive composition) forming the acrylic pressure-sensitive adhesive layer include an acrylic pressure-sensitive adhesive composition including an acrylic polymer as an essential component, or an acrylic pressure-sensitive adhesive composition including, as an essential component, a mixture (sometimes referred to as "monomer mixture") of monomeric substance(s) (monomer(s)) constituting the acrylic polymer or a partially polymerized product thereof. Examples of the former include a so-called solvent type acrylic pressure-sensitive adhesive composition. Examples of the latter include a so-called active energy ray curing type acrylic pressure-sensitive adhesive composition. The "monomer mixture" means a mixture including a monomer component constituting the polymer. The "partially polymerized product" may also be referred to as "prepolymer", and means a composition in which one or more monomer components in the monomer mixture are partially polymerized.

[0055]

The acrylic polymer is a polymerized product constituted (formed) with an acrylic monomer as an essential monomer component (monomeric substance component). The acrylic polymer is preferably a polymerized product constituted (formed) with a (meth)acrylic acid alkyl ester as an essential monomer

component. In other words, the acrylic polymer preferably includes a (meth)acrylic acid alkyl ester as a constituent unit. Herein, the "(meth)acrylic" represents "acrylic" and/or "methacrylic" (any one of or both "acrylic" and "methacrylic"), and the same applies to others. The acrylic polymer is herein constituted from one or more monomer components.

[0056]

Examples of the (meth)acrylic acid alkyl ester as an essential monomer component preferably include a (meth)acrylic acid alkyl ester having a straight or branched alkyl group. The (meth)acrylic acid alkyl esters can be used singly or in combinations of two or more thereof.

[0057]

The (meth)acrylic acid alkyl ester having a straight or branched alkyl group is not particularly limited, and examples include (meth)acrylic acid alkyl esters each having a straight or branched alkyl group having 1 to 20 carbon atoms, such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, n-butyl (meth)acrylate, isobutyl (meth)acrylate, s-butyl (meth)acrylate, t-butyl (meth)acrylate, pentyl (meth)acrylate, isopentyl (meth)acrylate, hexyl (meth)acrylate, heptyl (meth)acrylate, octyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, isooctyl (meth)acrylate, nonyl

(meth)acrylate, isononyl (meth)acrylate, decyl
(meth)acrylate, isodecyl (meth)acrylate, undecyl
(meth)acrylate, dodecyl (meth)acrylate, tridecyl
(meth)acrylate, tetradecyl (meth)acrylate, pentadecyl
(meth)acrylate, hexadecyl (meth)acrylate, heptadecyl
(meth)acrylate, octadecyl (meth)acrylate (stearyl
(meth)acrylate), isostearyl (meth)acrylate, nonadecyl
(meth)acrylate and eicosyl (meth)acrylate. In particular,
the (meth)acrylic acid alkyl ester having a straight or
branched alkyl group is preferably a (meth)acrylic acid
alkyl ester having a straight or branched alkyl group
having 4 to 18 carbon atoms, more preferably 2-ethylhexyl
acrylate (2EHA) or n-butyl acrylate (BA). The
(meth)acrylic acid alkyl esters having a straight or
branched alkyl group can be used singly or in
combinations of two or more thereof.

[0058]

The proportion of the (meth)acrylic acid alkyl ester
in all the monomer components (100% by weight)
constituting the acrylic polymer is not particularly
limited, and is preferably 50% by weight or more (for
example, 50 to 100% by weight), more preferably 53 to 90%
by weight, further preferably 55 to 85% by weight.

[0059]

The acrylic polymer may also include a
copolymerizable monomer as a monomer component
constituting the polymer, together with the (meth)acrylic

acid alkyl ester. In other words, the acrylic polymer may also include a copolymerizable monomer as a constituent unit. The copolymerizable monomers can be used singly or in combinations of two or more thereof.

[0060]

The copolymerizable monomer is not particularly limited, and examples preferably include a monomer having a nitrogen atom in its molecule and a monomer having a hydroxyl group in its molecule in terms of suppression of clouding and an enhancement in durability under a high humidity environment, adhesion reliability, compatibility with various additives such as an ultraviolet absorber, and transparency. In other words, the acrylic polymer preferably includes a monomer having a nitrogen atom in its molecule, as a constituent unit. The acrylic polymer preferably includes a monomer having a hydroxyl group in its molecule, as a constituent unit.

[0061]

The monomer having a nitrogen atom in its molecule is a monomer (monomeric substance) having at least one nitrogen atom in its molecule (in one molecule). Herein, the "monomer having a nitrogen atom in its molecule" may be referred to as "nitrogen atom-containing monomer". The nitrogen atom-containing monomer is not particularly limited, and examples preferably include a cyclic nitrogen-containing monomer and a (meth)acrylamide

compound. The nitrogen atom-containing monomers can be used singly or in combinations of two or more thereof.

[0062]

The cyclic nitrogen-containing monomer is not particularly limited as long as it has a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or a vinyl group, and also has a cyclic nitrogen structure. The cyclic nitrogen structure is preferably one having a nitrogen atom in a cyclic structure.

[0063]

Examples of the cyclic nitrogen-containing monomer include N-vinyl cyclic amide (lactam-based vinyl monomer), and a vinyl monomer having a nitrogen-containing heterocyclic ring.

[0064]

Examples of the N-vinyl cyclic amide include an N-vinyl cyclic amide represented by the following formula (1).

[0065]

[Formula 1]



In the formula (1), R^1 represents a divalent organic group.

[0066]

R¹ in the formula (1) is a divalent organic group, preferably a divalent saturated hydrocarbon group or an unsaturated hydrocarbon group, more preferably a divalent saturated hydrocarbon group (for example, an alkylene group having 3 to 5 carbon atoms).

[0067]

Examples of the N-vinyl cyclic amide represented by the formula (1) include N-vinyl-2-pyrrolidone, N-vinyl-2-piperidone, N-vinyl-3-morpholinone, N-vinyl-2-caprolactam, N-vinyl-1,3-oxazin-2-one, and N-vinyl-3,5-morpholinedione.

[0068]

Examples of the vinyl monomer having a nitrogen-containing heterocyclic ring include an acrylic monomer having a nitrogen-containing heterocyclic ring such as a morpholine ring, a piperidine ring, a pyrrolidine ring or a piperazine ring.

[0069]

The vinyl monomer having a nitrogen-containing heterocyclic ring is not particularly limited, and examples include (meth)acryloylmorpholine, N-vinylpiperazine, N-vinylpyrrole, N-vinylimidazole, N-vinylpyrazine, N-vinylmorpholine, N-vinylpyrazole, vinylpyridine, vinylpyrimidine, vinyloxazole, vinylisoxazole, vinylthiazole, vinylisothiazole, vinylpyridazine, (meth)acryloylpyrrolidone, (meth)acryloylpyrrolidine, and (meth)acryloylpiperidine.

[0070]

The vinyl monomer having a nitrogen-containing heterocyclic ring is, in particular, preferably an acrylic monomer having a nitrogen-containing heterocyclic ring, more preferably (meth)acryloylmorpholine, (meth)acryloylpyrrolidine or (meth)acryloylpiperidine.

[0071]

Examples of the (meth)acrylamide compound include (meth)acrylamide, N-alkyl(meth)acrylamide, and N,N-dialkyl(meth)acrylamide. Examples of the N-alkyl(meth)acrylamide include N-ethyl(meth)acrylamide, N-isopropyl(meth)acrylamide, N-n-butyl(meth)acrylamide, and N-octyl(meth)acrylamide. Furthermore, examples of the N-alkyl(meth)acrylamide include (meth)acrylamides each having an amino group, such as dimethylaminoethyl(meth)acrylamide, diethylaminoethyl(meth)acrylamide and dimethylaminopropyl(meth)acrylamide. Examples of the N,N-dialkyl(meth)acrylamide include N,N-dimethyl(meth)acrylamide, N,N-diethyl(meth)acrylamide, N,N-dipropyl(meth)acrylamide, N,N-diisopropyl(meth)acrylamide, N,N-di(n-butyl)(meth)acrylamide, and N,N-di(t-butyl)(meth)acrylamide.

[0072]

Examples of the (meth)acrylamide compound also include various N-hydroxyalkyl(meth)acrylamides. Examples of such N-hydroxyalkyl(meth)acrylamide include

N-methylol(meth)acrylamide, N-(2-hydroxyethyl)(meth)acrylamide, N-(2-hydroxypropyl)(meth)acrylamide, N-(1-hydroxypropyl)(meth)acrylamide, N-(3-hydroxypropyl)(meth)acrylamide, N-(2-hydroxybutyl)(meth)acrylamide, N-(3-hydroxybutyl)(meth)acrylamide, N-(4-hydroxybutyl)(meth)acrylamide, and N-methyl-N-2-hydroxyethyl(meth)acrylamide.

[0073]

Examples of the (meth)acrylamide compound also include various N-alkoxyalkyl(meth)acrylamides. Examples of such N-alkoxyalkyl(meth)acrylamide include N-methoxymethyl(meth)acrylamide and N-butoxymethyl(meth)acrylamide.

[0074]

Examples of any nitrogen atom-containing monomer other than the cyclic nitrogen-containing monomer and the (meth)acrylamide monomer include an amino group-containing monomer, a cyano group-containing monomer, an imide group-containing monomer, and an isocyanate group-containing monomer. Examples of the amino group-containing monomer include aminoethyl (meth)acrylate, dimethylaminoethyl (meth)acrylate, dimethylaminopropyl (meth)acrylate, and t-butylaminoethyl (meth)acrylate. Examples of the cyano group-containing monomer include acrylonitrile and methacrylonitrile. Examples of the

imide group-containing monomer include maleimide-based monomers (for example, N-cyclohexylmaleimide, N-isopropylmaleimide, N-laurylmaleimide, and N-phenylmaleimide), itaconamide-based monomers (for example, N-methylitaconamide, N-ethylitaconamide, N-butylitaconamide, N-octylitaconamide, N-2-ethylhexylitaconamide, N-laurylitaconamide, and N-cyclohexylitaconamide), and succinimide-based monomers (for example, N-(meth)acryloyloxymethylene succinimide, N-(meth)acryloyl-6-oxyhexamethylene succinimide, and N-(meth)acryloyl-8-oxyoctamethylene succinimide). Examples of the isocyanate group-containing monomer include 2-(meth)acryloyloxyethyl isocyanate.

[0075]

In particular, the nitrogen atom-containing monomer is preferably a cyclic nitrogen-containing monomer, more preferably N-vinyl cyclic amide. More specifically, N-vinyl-2-pyrrolidone (NVP) is particularly preferable.

[0076]

In a case where the acrylic polymer contains the nitrogen atom-containing monomer as a monomer component constituting the polymer, the proportion of the nitrogen atom-containing monomer in all the monomer components constituting the acrylic polymer (100% by weight) is not particularly limited, and is preferably 1% by weight or more, more preferably 3% by weight or more, further preferably 5% by weight or more. A proportion of 1% by

weight or more is preferable because clouding is suppressed and durability is more enhanced under a high humidity environment and higher adhesion reliability can be obtained. The upper limit of the proportion of the nitrogen atom-containing monomer is preferably 30% by weight or less, more preferably 25% by weight or less, further preferably 20% by weight or less in that a pressure-sensitive adhesive layer having appropriate flexibility is obtained and a pressure-sensitive adhesive layer excellent in transparency is obtained.

[0077]

The acrylic pressure-sensitive adhesive composition may also include a nitrogen atom-containing monomer, in addition to the acrylic polymer, for the purpose of further enhancing the above effect by the nitrogen atom-containing monomer. In a case where the acrylic pressure-sensitive adhesive composition contains the nitrogen atom-containing monomer, in addition to the acrylic polymer, the content (amount of compounding) of the nitrogen atom-containing monomer is preferably 0.5 parts by weight or more, more preferably 1 part by weight or more, further preferably 2 parts by weight or more based on 100 parts by weight of the acrylic polymer. A content of 0.5 parts by weight or more is preferable because clouding is suppressed and durability is more enhanced under a high humidity environment and higher adhesion reliability can be obtained. The upper limit of

the content (amount of compounding) of the nitrogen atom-containing monomer is preferably 10 parts by weight, more preferably 8 parts by weight or less, further preferably 5 parts by weight or less in that a pressure-sensitive adhesive layer having appropriate flexibility is obtained and a pressure-sensitive adhesive layer excellent in transparency is obtained.

[0078]

The monomer having a hydroxyl group in its molecule is a monomer having at least one hydroxyl group in its molecule (in one molecule), and examples preferably include one having a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or a vinyl group, and also having a hydroxyl group. Herein, the nitrogen atom-containing monomer is not encompassed in the monomer having a hydroxyl group in its molecule. In other words, a monomer having both a nitrogen atom and a hydroxyl group in its molecule is herein encompassed in the "nitrogen atom-containing monomer". Herein, the "monomer having a hydroxyl group in its molecule" may be referred to as "hydroxyl group-containing monomer". The hydroxyl group-containing monomers can be used singly or in combinations of two or more thereof.

[0079]

Examples of the hydroxyl group-containing monomer include hydroxyl group-containing (meth)acrylic acid

esters such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, hydroxyoctyl (meth)acrylate, hydroxydecyl (meth)acrylate, hydroxylauryl (meth)acrylate and (4-hydroxymethylcyclohexyl) (meth)acrylate; vinyl alcohol; and allyl alcohol.

[0080]

In particular, the hydroxyl group-containing monomer is preferably a hydroxyl group-containing (meth)acrylic acid ester, more preferably 2-hydroxyethyl acrylate (HEA) or 4-hydroxybutyl acrylate (4HBA).

[0081]

In a case where the acrylic polymer contains the hydroxyl group-containing monomer as a monomer component constituting the polymer, the proportion of the hydroxyl group-containing monomer in all the monomer components constituting the acrylic polymer (100% by weight) is not particularly limited, and is preferably 0.5% by weight or more, more preferably 0.8% by weight or more, further preferably 1% by weight or more in that clouding is suppressed and durability is enhanced under a high humidity environment and higher adhesion reliability is obtained. The upper limit of the proportion of the hydroxyl group-containing monomer is preferably 40 parts by weight or less, more preferably 35 parts by weight or less, further preferably 30 parts by weight or less in

terms of an aggregation force and in terms of ease of obtaining of adhesiveness and adhesion reliability.

[0082]

The acrylic pressure-sensitive adhesive composition may also include a hydroxyl group-containing monomer, in addition to the acrylic polymer, for the purpose of further enhancing the above effect by the hydroxyl group-containing monomer. In a case where the acrylic pressure-sensitive adhesive composition contains the hydroxyl group-containing monomer, in addition to the acrylic polymer, the content (amount of compounding) of the hydroxyl group-containing monomer is preferably 1 part by weight or more, more preferably 3 parts by weight or more, further preferably 5 parts by weight or more based on 100 parts by weight of the acrylic polymer. A content of 5 parts by weight or more is preferable because clouding is suppressed and durability is more enhanced under a high humidity environment and higher adhesion reliability can be obtained. The upper limit of the content (amount of compounding) of the hydroxyl group-containing monomer is preferably 30 parts by weight or less, more preferably 25 parts by weight or less, further preferably 20 parts by weight or less in terms of an aggregation force and in terms of ease of obtaining of adhesiveness and adhesion reliability.

[0083]

The total of the nitrogen atom-containing monomer and the hydroxyl group-containing monomer in all the monomer components constituting the acrylic polymer (100% by weight) is not particularly limited, and is preferably 5% by weight or more, more preferably 10% by weight or more, further preferably 15% by weight or more in that clouding is suppressed and durability is more enhanced under a high humidity environment and high adhesion reliability is obtained. The upper limit of the total proportion is preferably 50% by weight or less, more preferably 40% by weight or less, further preferably 35% by weight or less in that a pressure-sensitive adhesive layer having appropriate flexibility is obtained and a pressure-sensitive adhesive layer excellent in transparency is obtained.

[0084]

In a case where the acrylic pressure-sensitive adhesive composition contains the nitrogen atom-containing monomer and/or the hydroxyl group-containing monomer, in addition to the acrylic polymer, the total content (total amount of compounding) of the nitrogen atom-containing monomer and the hydroxyl group-containing monomer is preferably 5 parts by weight or more, more preferably 8 parts by weight or more, further preferably 10 parts by weight or more based on 100 parts by weight of the acrylic polymer. A total content of 5 parts by weight or more is preferable because clouding is

suppressed and durability is more enhanced under a high humidity environment and higher adhesion reliability can be obtained. The upper limit of the total content (total amount of compounding) is preferably 30 parts by weight or less, more preferably 25 parts by weight or less, further preferably 20 parts by weight or less in that a pressure-sensitive adhesive layer having appropriate flexibility is obtained and a pressure-sensitive adhesive layer excellent in transparency is obtained.

[0085]

Examples of the copolymerizable monomer other than the nitrogen atom-containing monomer and the hydroxyl group-containing monomer further include an alicyclic structure-containing monomer. The alicyclic structure-containing monomer is not particularly limited as long as it has a polymerizable functional group having an unsaturated double bond, such as a (meth)acryloyl group or a vinyl group, and has an alicyclic structure. For example, an alkyl (meth)acrylate having a cycloalkyl group is encompassed in the alicyclic structure-containing monomer. The alicyclic structure-containing monomers can be used singly or in combinations of two or more thereof.

[0086]

The alicyclic structure in the alicyclic structure-containing monomer is a cyclic hydrocarbon structure, and preferably has 5 or more carbon atoms, more preferably 6

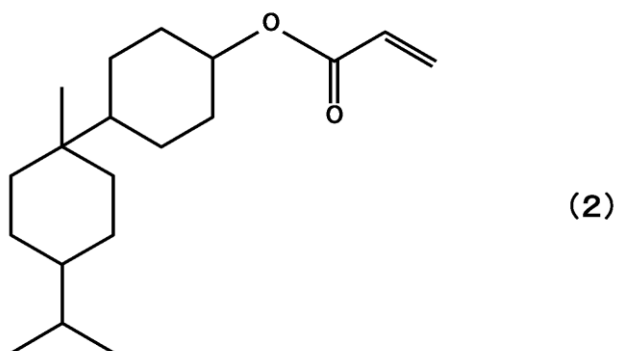
to 24 carbon atoms, further preferably 6 to 15 carbon atoms, particularly preferably 6 to 10 carbon atoms.

[0087]

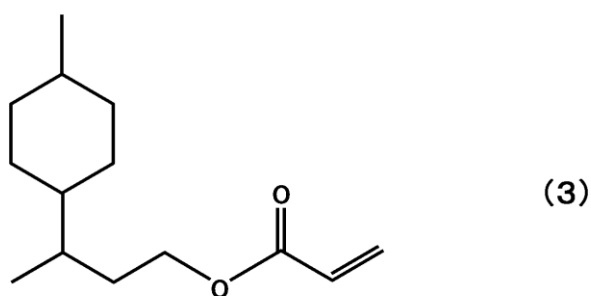
Examples of the alicyclic structure-containing monomer include (meth)acrylic monomers such as cyclopropyl (meth)acrylate, cyclobutyl (meth)acrylate, cyclopentyl (meth)acrylate, cyclohexyl (meth)acrylate, cycloheptyl (meth)acrylate, cyclooctyl (meth)acrylate, isobornyl (meth)acrylate, dicyclopentanyl (meth)acrylate, HMPA represented by the following formula (2), TMA-2 represented by the following formula (3), and HCPA represented by the following formula (4). In the following formula (4), a position of a linkage between a cyclohexyl ring and a structure formula in brackets, connected by a line, is not particularly limited. In particular, isobornyl (meth)acrylate is preferable.

[0088]

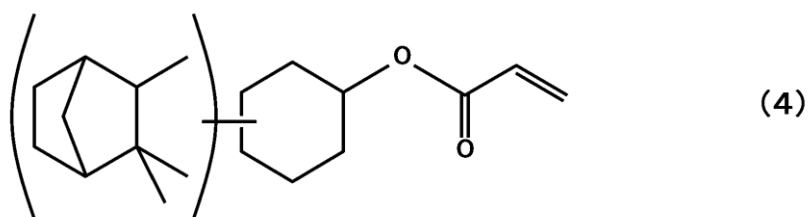
[Formula 2]



[Formula 3]



[Formula 4]



[0089]

In a case where the acrylic polymer contains the alicyclic structure-containing monomer as a monomer component constituting the polymer, the proportion of the alicyclic structure-containing monomer in all the monomer components constituting the acrylic polymer (100% by weight) is not particularly limited, and is preferably 10% by weight or more from the viewpoint that durability is enhanced and higher adhesion reliability is obtained. The upper limit of the proportion of the alicyclic structure-containing monomer is preferably 50% by weight or less, more preferably 40% by weight or less, further preferably 30% by weight or less in that a pressure-sensitive adhesive layer having appropriate flexibility is obtained.

[0090]

Examples of the copolymerizable monomer further include a polyfunctional monomer. Examples of the polyfunctional monomer include hexane diol di(meth)acrylate, butane diol di(meth)acrylate, (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, trimethylolpropane tri(meth)acrylate, tetramethylolmethane tri(meth)acrylate, allyl (meth)acrylate, vinyl (meth)acrylate, divinylbenzene, epoxy acrylate, polyester acrylate, and urethane acrylate. The polyfunctional monomers can be used singly or in combinations of two or more thereof.

[0091]

In a case where the acrylic polymer contains the polyfunctional monomer as a monomer component constituting the polymer, the proportion of the polyfunctional monomer in all the monomer components constituting the acrylic polymer (100% by weight) is not particularly limited, and is preferably 0.5% by weight or less (for example, more than 0% by weight and not more than 0.5% by weight), more preferably 0.2% by weight or less (for example, more than 0% by weight and not more than 0.2% by weight).

[0092]

Examples of the copolymerizable monomer include a (meth)acrylic acid alkoxyalkyl ester. The (meth)acrylic acid alkoxyalkyl ester is not particularly limited, and examples include 2-methoxyethyl (meth)acrylate, 2-ethoxyethyl (meth)acrylate, methoxytriethylene glycol (meth)acrylate, 3-methoxypropyl (meth)acrylate, 3-ethoxypropyl (meth)acrylate, 4-methoxybutyl (meth)acrylate, and 4-ethoxybutyl (meth)acrylate. In particular, the (meth)acrylic acid alkoxyalkyl ester is preferably an acrylic acid alkoxyalkyl ester, more preferably 2-methoxyethyl acrylate (MEA). The (meth)acrylic acid alkoxyalkyl esters can be used singly or in combinations of two or more thereof.

[0093]

In a case where the acrylic polymer includes the (meth)acrylic acid alkoxyalkyl ester, as a monomer component constituting the polymer, the ratio between the (meth)acrylic acid alkyl ester and the (meth)acrylic acid alkoxyalkyl ester is not particularly limited, and the [former:latter] (weight ratio) is preferably more than 100:0 and not more than 25:75, more preferably more than 100:0 and not more than 50:50.

[0094]

Other examples of the copolymerizable monomer include a carboxyl group-containing monomer, an epoxy group-containing monomer, a sulfonic acid group-containing monomer, a phosphoric acid group-containing

monomer, a (meth)acrylic acid ester having an aromatic hydrocarbon group, a vinyl ester compound, an aromatic vinyl compound, an olefin compound or a diene compound, a vinyl ether compound, and vinyl chloride. Examples of the carboxyl group-containing monomer include (meth)acrylic acid, itaconic acid, maleic acid, fumaric acid, crotonic acid, and isocrotonic acid, and examples of the carboxyl group-containing monomer also include acid anhydride group-containing monomers such as maleic anhydride and itaconic anhydride. Examples of the epoxy group-containing monomer include glycidyl (meth)acrylate and methylglycidyl (meth)acrylate. Examples of the sulfonic acid group-containing monomer include sodium vinylsulfonate. Examples of the (meth)acrylic acid ester having an aromatic hydrocarbon group include phenyl (meth)acrylate, phenoxyethyl (meth)acrylate, and benzyl (meth)acrylate. Examples of the vinyl ester compound include vinyl acetate and vinyl propionate. Examples of the aromatic vinyl compound include styrene and vinyltoluene. Examples of the olefin compound or the diene compound include ethylene, propylene, butadiene, isoprene, and isobutylene. Examples of the vinyl ether compound include vinyl alkyl ether.

[0095]

The acrylic polymer preferably includes no or substantially no acidic group-containing monomer, particularly preferably includes no or substantially no

carboxyl group-containing monomer as a monomer component constituting the polymer, in that an acrylic pressure-sensitive adhesive layer having excellent corrosion resistance is obtained. Examples of the acidic group-containing monomer include a carboxyl group-containing monomer, a sulfonic acid group-containing monomer, and a phosphoric acid group-containing monomer. Specifically, one in which the proportion of the acidic group-containing monomer in all the monomer components constituting the acrylic polymer (100% by weight) is 0.05% by weight or less (preferably 0.01% by weight or less) can be said to include substantially no acidic group-containing monomer.

[0096]

The acrylic polymer preferably includes a monomer whose homopolymer formed exhibits a high glass transition temperature (T_g) (hereinafter, sometimes referred to as "high- T_g monomer"), as a monomer component constituting the polymer, without any particular limitation. The high- T_g monomer is preferably used in the monomer component because a pressure-sensitive adhesive containing the acrylic polymer is harder and the optical pressure-sensitive adhesive sheet of the present invention is more enhanced in adhesion reliability at a high temperature.

[0097]

The glass transition temperature of the homopolymer formed of the high-Tg monomer is not particularly limited, and is, for example, 20°C or more, preferably 30°C or more, more preferably 90°C or more. In a case where the Tg of the high-Tg monomer is in the above range, the pressure-sensitive adhesive layer is increased in aggregation force.

[0098]

The high-Tg monomer may be the above monomer exemplified as the monomer included in the monomer component constituting the acrylic polymer, or may be any monomer other than such a monomer. In particular, the monomer component constituting the acrylic polymer preferably encompasses a monomer component which is a monomer exemplified as the monomer component constituting the acrylic polymer and which is also the high-Tg monomer. The high-Tg monomers may be adopted singly or in combinations of two or more thereof.

[0099]

The high-Tg monomer is not particularly limited, and examples include methyl methacrylate (Tg: 105°C), ethyl methacrylate (Tg: 65°C), cyclohexyl methacrylate (Tg: 83°C), isobornyl acrylate (Tg: 94°C), isobornyl methacrylate (Tg: 150°C), benzyl methacrylate (Tg: 54°C), glycidyl methacrylate (Tg: 46°C), stearyl methacrylate (Tg: 38°C), 3-hydroxypropyl methacrylate (Tg: 26°C), 2-hydroxyethyl methacrylate (Tg: 55°C), acrylic acid (Tg:

106°C), and methacrylic acid (Tg: 227°C). Examples include, besides the above, vinyl acetate (Tg: 32°C), acrylonitrile (Tg: 97°C), methacrylonitrile (Tg: 120°C), styrene (Tg: 80°C), 2-methylstyrene (Tg: 136°C), acrylamide (Tg: 165°C), and N-vinyl-2-pyrrolidone (NVP) (Tg: 80°C). In particular, NVP is preferable.

[0100]

In a case where the acrylic polymer contains the high-Tg monomer as a monomer component constituting the polymer, the proportion of the high-Tg monomer in all the monomer components constituting the acrylic polymer (100% by weight) is not particularly limited, and is preferably 1 to 50% by weight, more preferably 5 to 40% by weight, further preferably 10 to 30% by weight. The proportion of the high-Tg monomer is preferably in the above range because the optical pressure-sensitive adhesive sheet of the present invention is more enhanced in adhesion reliability at a high temperature. In a case where two or more of such high-Tg monomers are included in the monomer component constituting the polymer, the "proportion of the high-Tg monomer" corresponds to the total of the proportions of the two or more high-Tg monomers.

[0101]

The acrylic polymer is, among the above, preferably an acrylic polymer constituted from a monomer mixture including 50 to 90% by weight (preferably 55 to 85% by

weight) of a (meth)acrylic acid alkyl ester having a straight or branched alkyl group having 4 to 18 carbon atoms and 10 to 50% by weight (preferably 15 to 40% by weight) of one or more monomers selected from the nitrogen atom-containing monomer and the hydroxyl group-containing monomer, more preferably an acrylic polymer constituted from a monomer mixture including 50 to 90% by weight (preferably 55 to 85% by weight) of a (meth)acrylic acid alkyl ester having a straight or branched alkyl group having 4 to 18 carbon atoms, and 3 to 30% by weight (preferably 5 to 25% by weight) of the nitrogen atom-containing monomer and 0.8 to 25% by weight (preferably 1 to 15% by weight) of the hydroxyl group-containing monomer, in which the total of the proportions of the nitrogen atom-containing monomer and the hydroxyl group-containing monomer is 10 to 50% by weight (preferably 15 to 40% by weight). The proportion (% by weight) is a proportion based on all the monomer components constituting the acrylic polymer (100% by weight).

[0102]

The content of the base polymer (in particular, acrylic polymer) in the pressure-sensitive adhesive layer in the present invention is not particularly limited, and is preferably 50% by weight or more (for example, 50 to 100% by weight), more preferably 80% by weight or more (for example, 80 to 100% by weight), further preferably

90% by weight or more (for example, 90 to 100% by weight) based on 100% by weight of the total weight of the pressure-sensitive adhesive layer in the present invention.

[0103]

The weight average molecular weight (Mw) of the acrylic polymer is 100000 to 5000000, preferably 500000 to 4000000, more preferably 750000 to 3000000. A configuration in which the weight average molecular weight of the acrylic polymer is 100000 or more is preferable in that adhesive strength and retention properties are enhanced and resistance to foaming and peeling is enhanced. In this regard, a configuration in which the weight average molecular weight of the acrylic polymer is 5000000 or less is preferable in that adhesive strength is easily increased and resistance to foaming and peeling is enhanced.

[0104]

The weight average molecular weight (Mw) of the acrylic polymer can be determined in terms of polystyrene by a GPC method. For example, a high speed GPC apparatus "HPLC-8120GPC" manufactured by Tosoh Corporation can be used for measurement in the following conditions.

Column: TSKgel Super HZM-H/HZ4000/HZ3000/HZ2000

Solvent: tetrahydrofuran

Flow rate: 0.6 ml/min

[0105]

The glass transition temperature (T_g) of the acrylic polymer is not particularly limited, and is preferably -70 to 100°C, more preferably -65 to 50°C, further preferably -60 to 10°C. The glass transition temperature of the acrylic polymer is preferably -70°C or more because an aggregation force is enhanced and resistance to foaming and peeling is easily enhanced. The glass transition temperature of the acrylic polymer is preferably 100°C or less because the pressure-sensitive adhesive layer has appropriate flexibility to easily achieve favorable adhesive strength and favorable step absorbability and easily achieve excellent adhesion reliability.

[0106]

The glass transition temperature (T_g) of the acrylic polymer is a glass transition temperature (theoretical value) represented by the following FOX's expression.

$$1/T_g = W_1/T_{g1} + W_2/T_{g2} + \dots + W_n/T_{gn}$$

In the expression, T_g represents the glass transition temperature (unit: K) of the acrylic polymer, T_{gi} represents the glass transition temperature (unit: K) of a homopolymer formed from a monomer i , and W_i represents the weight fraction of the monomer i in the amount of all the monomer components ($i = 1, 2, \dots n$).

Any value described below can be adopted as the T_g of the homopolymer of a monomer constituting the acrylic polymer.

2-Ethylhexyl acrylate	-70°C
n-Hexyl acrylate	-65°C
n-Octyl acrylate	-65°C
Isononyl acrylate	-60°C
n-Nonyl acrylate	-58°C
n-Butyl acrylate	-55°C
Ethyl acrylate	-20°C
Lauryl acrylate	0°C
2-Ethylhexyl methacrylate	-10°C
Methyl acrylate	8°C
n-Butyl methacrylate	20°C
Methyl methacrylate	105°C
Acrylic acid	106°C
Methacrylic acid	228°C
Vinyl acetate	32°C
Styrene	100°C

[0107]

Any numerical value described in "Polymer Handbook" (vol. 3, John Wiley & Sons, Inc, 1989) can be adopted as the Tg of the homopolymer of a monomer not described above. Furthermore, any value (the peak top temperature of $\tan \delta$ in the viscoelasticity test) obtained by the above measurement method can be adopted as the Tg of the homopolymer of a monomer also not described in the Reference.

[0108]

The base polymer such as the acrylic polymer contained in the pressure-sensitive adhesive layer in the present invention is obtained by polymerizing the monomer component. The polymerization method is not particularly limited, and examples include a solution polymerization method, an emulsion polymerization method, a mass polymerization method, and a polymerization method with active energy ray irradiation (active energy ray polymerization method). In particular, a solution polymerization method and an active energy ray polymerization method are preferable and an active energy ray polymerization method is more preferable in terms of, for example, the transparency of the pressure-sensitive adhesive layer, and the cost.

[0109]

Various common solvents may be each used in polymerization of the monomer component. Examples of the solvent include organic solvents, for example, ester compounds such as ethyl acetate and n-butyl acetate; aromatic hydrocarbon compounds such as toluene and benzene; aliphatic hydrocarbon compounds such as n-hexane and n-heptane; alicyclic hydrocarbon compounds such as cyclohexane and methylcyclohexane; and ketone compounds such as methyl ethyl ketone and methyl isobutyl ketone. The solvents can be used singly or in combinations of two or more thereof.

[0110]

A polymerization initiator such as a thermal polymerization initiator or a photo-polymerization initiator (photoinitiator) may be used depending on the type of the polymerization reaction in polymerization of the monomer component. The polymerization initiators can be used singly or in combinations of two or more thereof.

[0111]

The thermal polymerization initiator is not particularly limited, and examples include an azo-based polymerization initiator, a peroxide-based polymerization initiator (for example, dibenzoyl peroxide and tert-butyl permaleate), and a redox-based polymerization initiator. In particular, the azo-based polymerization initiator disclosed in Japanese Patent Laid-Open No. 2002-69411 is preferable. Examples of the azo-based polymerization initiator include 2,2'-azobisisobutyronitrile (hereinafter, sometimes referred to as "AIBN"), 2,2'-azobis-2-methylbutyronitrile (hereinafter, sometimes referred to as "AMBN"), dimethyl 2,2'-azobis(2-methylpropionate), and 4,4'-azobis-4-cyanovaleric acid. The thermal polymerization initiators can be used singly or in combinations of two or more thereof.

[0112]

In a case where the azo-based polymerization initiator is used in formation of the acrylic polymer by polymerization, the amount of the azo-based polymerization initiator used is not particularly limited,

and is, for example, preferably 0.05 parts by weight or more, more preferably 0.1 parts by weight or more, and is preferably 0.5 parts by weight or less, more preferably 0.3 parts by weight or less, based on 100 parts by weight of all the monomer components constituting the acrylic polymer.

[0113]

The photo-polymerization initiator is not particularly limited, and examples include a benzoin ether-based photo-polymerization initiator, an acetophenone-based photo-polymerization initiator, an α -ketol-based photo-polymerization initiator, an aromatic sulfonyl chloride-based photo-polymerization initiator, a photoactive oxime-based photo-polymerization initiator, a benzoin-based photo-polymerization initiator, a benzil-based photo-polymerization initiator, a benzophenone-based photo-polymerization initiator, a ketal-based photo-polymerization initiator, and a thioxanthone-based photo-polymerization initiator. Other examples include an acyl phosphine oxide-based photo-polymerization initiator and a titanocene-based photo-polymerization initiator. Examples of the benzoin ether-based photo-polymerization initiator include benzoin methyl ether, benzoin ethyl ether, benzoin propyl ether, benzoin isopropyl ether, benzoin isobutyl ether, 2,2-dimethoxy-1,2-diphenylethan-1-one, and anisole methyl ether. Examples of the acetophenone-based photo-polymerization

initiator include 2,2-diethoxyacetophenone, 2,2-dimethoxy-2-phenylacetophenone, 1-hydroxycyclohexyl phenyl ketone, 4-phenoxydichloroacetophenone, and 4-(t-butyl)dichloroacetophenone. Examples of the α -ketol-based photo-polymerization initiator include 2-methyl-2-hydroxypropiophenone and 1-[4-(2-hydroxyethyl)phenyl]-2-methylpropan-1-one. Examples of the aromatic sulfonyl chloride-based photo-polymerization initiator include 2-naphthalenesulfonyl chloride. Examples of the photoactive oxime-based photo-polymerization initiator include 1-phenyl-1,1-propanedione-2-(O-ethoxycarbonyl)-oxime. Examples of the benzoin-based photo-polymerization initiator include benzoin. Examples of the benzil-based photo-polymerization initiator include benzil. Examples of the benzophenone-based photo-polymerization initiator include benzophenone, benzoylbenzoic acid, 3,3'-dimethyl-4-methoxybenzophenone, polyvinylbenzophenone, and α -hydroxycyclohexyl phenyl ketone. Examples of the ketal-based photo-polymerization initiator include benzil dimethyl ketal. Examples of the thioxanthone-based photo-polymerization initiator include thioxanthone, 2-chlorothioxanthone, 2-methylthioxanthone, 2,4-dimethylthioxanthone, isopropylthioxanthone, 2,4-diisopropylthioxanthone, and dodecylthioxanthone. Examples of the acyl phosphine oxide-based photo-polymerization initiator include 2,4,6-trimethylbenzoyl-diphenyl-phosphine oxide and bis(2,4,6-trimethylbenzoyl)-

phenylphosphine oxide. Examples of the titanocene-based photo-polymerization initiator include bis(η^5 -2,4-cyclopentadien-1-yl)-bis(2,6-difluoro-3-(1H-pyrrol-1-yl)-phenyl)titanium. The photo-polymerization initiators can be used singly or in combinations of two or more thereof. [0114]

In a case where the photo-polymerization initiator is used in formation of the acrylic polymer by polymerization, the amount of the photo-polymerization initiator used is not particularly limited, and is, for example, preferably 0.01 parts by weight or more, more preferably 0.1 parts by weight or more, and preferably 3 parts by weight or less, more preferably 1.5 parts by weight or less, based on 100 parts by weight of all the monomer components constituting the acrylic polymer. [0115]

In a case where the acrylic pressure-sensitive adhesive composition constituting the pressure-sensitive adhesive layer in the present invention contains an acrylic polymer as a base polymer, the composition preferably contains an acrylic oligomer having a weight average molecular weight of 1000 to 30000, together with the acrylic polymer. In a case where the acrylic oligomer is contained, adhesiveness of an object to an interface on the pressure-sensitive adhesive sheet is enhanced and thus strong adhesiveness is easily obtained and also excellent resistance to foaming and peeling is

easily obtained. Herein, the "acrylic oligomer having a weight average molecular weight of 1000 to 30000" may be simply referred to as "acrylic oligomer".

[0116]

Examples of the acrylic oligomer preferably include an acrylic oligomer constituted with a (meth)acrylic acid ester having a cyclic structure in its molecule, as an essential monomer component, and more preferably include an acrylic oligomer constituted with a (meth)acrylic acid ester having a cyclic structure in its molecule and a (meth)acrylic acid alkyl ester having a straight or branched alkyl group, as essential monomer components. In other words, examples of the acrylic oligomer preferably include an acrylic oligomer including a (meth)acrylic acid ester having a cyclic structure in its molecule, as a monomer unit, and more preferably include an acrylic oligomer including a (meth)acrylic acid ester having a cyclic structure in its molecule and a (meth)acrylic acid alkyl ester having a straight or branched alkyl group, as monomer units.

[0117]

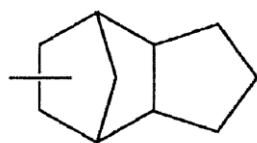
The cyclic structure (ring) of the (meth)acrylic acid ester having a cyclic structure in its molecule (in one molecule) (hereinafter, sometimes referred to as "ring-containing (meth)acrylic acid ester") may be any of an aromatic ring and a non-aromatic ring, and is not particularly limited. Examples of the aromatic ring

include aromatic carbon rings [for example, monocyclic carbon rings such as a benzene ring and condensed carbon rings such as a naphthalene ring], and various aromatic heterocyclic rings. Examples of the non-aromatic ring include non-aromatic aliphatic rings (non-aromatic alicyclic rings) [for example, cycloalkane rings such as a cyclopentane ring, a cyclohexane ring, a cycloheptane ring and a cyclooctane ring; and cycloalkene rings such as a cyclohexene ring], non-aromatic bridged rings [for example, bicyclic hydrocarbon rings in pinane, pinene, bornane, norbornane, norbornene, and the like; and tri- or higher cyclic aliphatic hydrocarbon rings (bridged hydrocarbon rings) in adamantane and the like], and non-aromatic heterocyclic rings [for example, an epoxy ring, an oxolane ring, and an oxetane ring].

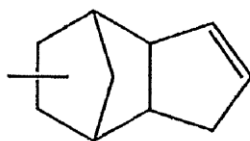
[0118]

Examples of the tri- or higher cyclic aliphatic hydrocarbon rings (tri- or higher cyclic bridged hydrocarbon rings) include a dicyclopentanyl group represented by the following formula (5a), a dicyclopentenyl group represented by the following formula (5b), an adamantyl group represented by the following formula (5c), a tricyclopentanyl group represented by the following formula (5d), and a tricyclopentenyl group represented by the following formula (5e).

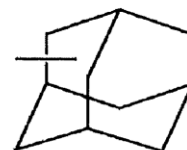
[Formula 5]



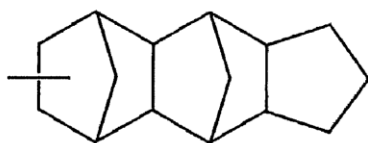
(5a)



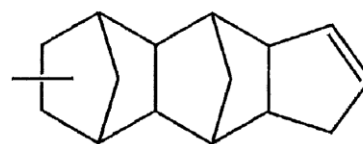
(5b)



(5c)



(5d)



(5e)

[0119]

In other words, examples of the ring-containing (meth)acrylic acid ester include (meth)acrylic acid cycloalkyl esters such as cyclopentyl (meth)acrylate, cyclohexyl acrylate (meth)acrylate, cycloheptyl (meth)acrylate and cyclooctyl (meth)acrylate; (meth)acrylic acid esters each having a bicyclic aliphatic hydrocarbon ring, such as isobornyl (meth)acrylate; (meth)acrylic acid esters each having a tri- or higher cyclic aliphatic hydrocarbon ring, such as dicyclopentanyl (meth)acrylate, dicyclopentanyloxyethyl (meth)acrylate, tricyclopentanyl (meth)acrylate, 1-adamantyl (meth)acrylate, 2-methyl-2-adamantyl (meth)acrylate and 2-ethyl-2-adamantyl (meth)acrylate; and (meth)acrylic acid esters each having an aromatic ring, for example, (meth)acrylic acid aryl esters such as

phenyl (meth)acrylate, (meth)acrylic acid aryloxyalkyl esters such as phenoxyethyl (meth)acrylate, and (meth)acrylic acid arylalkyl esters such as benzyl (meth)acrylate. In particular, the ring-containing (meth)acrylic acid ester is particularly preferably a non-aromatic ring-containing (meth)acrylic acid ester, more preferably cyclohexyl acrylate (CHA), cyclohexyl methacrylate (CHMA), dicyclopentanyl acrylate (DCPA), or dicyclopentanyl methacrylate (DCPMA), further preferably dicyclopentanyl acrylate (DCPA) or dicyclopentanyl methacrylate (DCPMA). The ring-containing (meth)acrylic acid esters may be used singly or in combinations of two or more thereof.

[0120]

The (meth)acrylic acid ester having a tri- or higher cyclic aliphatic hydrocarbon ring (in particular, tri- or higher cyclic bridged hydrocarbon ring) is preferably used as the above non-aromatic ring-containing (meth)acrylic acid ester in that in particular polymerization inhibition is hardly caused. In a case where a (meth)acrylic acid ester having the dicyclopentanyl group represented by the formula (5a), the adamantyl group represented by the formula (5c) or the tricyclopentanyl group represented by the formula (5d), having no unsaturated bond, is used, resistance to foaming and peeling can be more enhanced and furthermore

adhesiveness to a low-polar object of polyethylene, polypropylene or the like can be extremely enhanced.

[0121]

The content (proportion) of the ring-containing (meth)acrylic acid ester in all the monomer units of the acrylic oligomer (the amount of all the monomer components constituting the acrylic oligomer) is not particularly limited, and is preferably 10 to 90 parts by weight, more preferably 20 to 80 parts by weight based on the amount of all the monomer components constituting the acrylic oligomer (100 parts by weight). The content of the ring-containing (meth)acrylic acid ester is preferably 10 parts by weight or more because resistance to foaming and peeling is easily enhanced. The content is preferably 90 parts by weight or less because the pressure-sensitive adhesive layer has appropriate flexibility and is enhanced in, for example, adhesive strength and step absorbability.

[0122]

Examples of the (meth)acrylic acid alkyl ester having a straight or branched alkyl group, as a monomer unit of the acrylic oligomer, include (meth)acrylic acid alkyl esters each having an alkyl group having 1 to 20 carbon atoms, such as methyl (meth)acrylate, ethyl (meth)acrylate, propyl (meth)acrylate, isopropyl (meth)acrylate, butyl (meth)acrylate, isobutyl (meth)acrylate, s-butyl (meth)acrylate, t-butyl

(meth)acrylate, pentyl (meth)acrylate, isopentyl
(meth)acrylate, hexyl (meth)acrylate, heptyl
(meth)acrylate, octyl (meth)acrylate, 2-ethylhexyl
(meth)acrylate, isooctyl (meth)acrylate, nonyl
(meth)acrylate, isononyl (meth)acrylate, decyl
(meth)acrylate, isodecyl (meth)acrylate, undecyl
(meth)acrylate, dodecyl (meth)acrylate, tridecyl
(meth)acrylate, tetradecyl (meth)acrylate, pentadecyl
(meth)acrylate, hexadecyl (meth)acrylate, heptadecyl
(meth)acrylate, octadecyl (meth)acrylate, nonadecyl
(meth)acrylate and eicosyl (meth)acrylate. In particular,
methyl methacrylate (MMA) is preferable from the
viewpoint that compatibility with the acrylic polymer is
improved. The (meth)acrylic acid alkyl esters may be
used singly or in combinations of two or more thereof.
[0123]

The content (proportion) of the (meth)acrylic acid
alkyl ester having a straight or branched alkyl group in
all the monomer units of the acrylic oligomer (the amount
of all the monomer components constituting the acrylic
oligomer) is not particularly limited, and is preferably
10 to 90 parts by weight, more preferably 20 to 80 parts
by weight, further preferably 20 to 60 parts by weight
based on the amount of all the monomer components
constituting the acrylic oligomer (100 parts by weight),
in terms of resistance to foaming and peeling. The
content is preferably 10 parts by weight or more because

in particular adhesive strength to an object made of an acrylic resin or polycarbonate is easily enhanced.

[0124]

The monomer unit(s) of the acrylic oligomer may include, in addition to the ring-containing (meth)acrylic acid ester and the (meth)acrylic acid alkyl ester having a straight or branched alkyl group, a monomer (copolymerizable monomer) copolymerizable with these monomers. The content (proportion) of the copolymerizable monomer in all the monomer units of the acrylic oligomer (the amount of all the monomer components constituting the acrylic oligomer) is not particularly limited, and is preferably 49.9 parts by weight or less (for example, 0 to 49.9 parts by weight), more preferably 30 parts by weight or less based on the amount (100 parts by weight) of all the monomer components constituting the acrylic oligomer. The copolymerizable monomers may be used singly or in combinations of two or more thereof.

[0125]

Examples of the copolymerizable monomer (the copolymerizable monomer constituting the acrylic oligomer) as a monomer unit of the acrylic oligomer include (meth)acrylic acid alkoxyalkyl esters [for example, 2-methoxyethyl (meth)acrylate, 2-ethoxyethyl (meth)acrylate, (meth)acrylic acid methoxytriethylene glycol, 3-methoxypropyl (meth)acrylate, 3-ethoxypropyl

(meth)acrylate, 4-methoxybutyl (meth)acrylate and 4-ethoxybutyl (meth)acrylate]; hydroxyl group-containing monomers [for example, hydroxyalkyl (meth)acrylates such as 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 2-hydroxybutyl (meth)acrylate, 3-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate and 6-hydroxyhexyl (meth)acrylate, vinyl alcohol and allyl alcohol]; amide group-containing monomers [for example, (meth)acrylamide, N,N-dimethyl(meth)acrylamide, N-methylol(meth)acrylamide, N-methoxymethyl(meth)acrylamide, N-butoxymethyl(meth)acrylamide and N-hydroxyethyl(meth)acrylamide]; amino group-containing monomers [for example, aminoethyl (meth)acrylate, dimethylaminoethyl (meth)acrylate and t-butylaminoethyl (meth)acrylate]; cyano group-containing monomers [for example, acrylonitrile and methacrylonitrile]; sulfonic acid group-containing monomers [for example, sodium vinylsulfonate]; phosphoric acid group-containing monomers [for example, 2-hydroxyethyl acryloyl phosphate]; isocyanate group-containing monomers [for example, 2-methacryloyloxyethyl isocyanate], and imide group-containing monomers [cyclohexylmaleimide, isopropylmaleimide and the like].

[0126]

The acrylic oligomer is preferably an acrylic oligomer including a (meth)acrylic acid ester having a

cyclic structure in its molecule and a (meth)acrylic acid alkyl ester having a straight or branched alkyl group, as monomer units, as described above. In particular, an acrylic oligomer is preferable which includes the ring-containing (meth)acrylic acid ester and the (meth)acrylic acid alkyl ester having a straight or branched alkyl group, as monomer units. The amount of the ring-containing (meth)acrylic acid ester relative to the amount of all the monomer components constituting the acrylic oligomer in the acrylic oligomer including the ring-containing (meth)acrylic acid ester and the (meth)acrylic acid alkyl ester having a straight or branched alkyl group, as monomer units, (100 parts by weight) is not particularly limited, and is preferably 10 to 90 parts by weight, more preferably 20 to 80 parts by weight. The content of the (meth)acrylic acid alkyl ester having a straight or branched alkyl group is not particularly limited, and is preferably 10 to 90 parts by weight, more preferably 20 to 80 parts by weight, further preferably 20 to 60 parts by weight.

[0127]

Furthermore, examples of a particularly preferred specific configuration of the acrylic oligomer include an acrylic oligomer including (1) at least one monomer selected from the group consisting of dicyclopentanyl acrylate, dicyclopentanyl methacrylate, cyclohexyl acrylate and cyclohexyl methacrylate and (2) methyl

methacrylate, as monomer units. The content of (1) dicyclopentanyl acrylate, dicyclopentanyl methacrylate, cyclohexyl acrylate and cyclohexyl methacrylate (total amount in a case where two or more thereof are included) and the content of (2) methyl methacrylate, in all the monomer units of the acrylic oligomer, in the acrylic oligomer of the particularly preferred specific configuration are respectively 30 to 70 parts by weight and 30 to 70 parts by weight based on the amount of all the monomer components constituting the acrylic oligomer (100 parts by weight). Herein, the acrylic oligomer is not limited to one of the specific configurations.

[0128]

The acrylic oligomer can be obtained by polymerizing the monomer component according to a known or conventional polymerization method. Examples of the polymerization method of the acrylic oligomer include a solution polymerization method, an emulsion polymerization method, a mass polymerization method, and a polymerization method with active energy ray irradiation (active energy ray polymerization method). In particular, a mass polymerization method and a solution polymerization method are preferable, and a solution polymerization method is more preferable.

[0129]

Various common solvents may be each used in polymerization of the acrylic oligomer. Examples of the

solvent include organic solvents, for example, ester compounds such as ethyl acetate and n-butyl acetate; aromatic hydrocarbon compounds such as toluene and benzene; aliphatic hydrocarbon compounds such as n-hexane and n-heptane; alicyclic hydrocarbon compounds such as cyclohexane and methylcyclohexane; and ketone compounds such as methyl ethyl ketone and methyl isobutyl ketone. Such a solvents may be used singly or in combinations of two or more thereof.

[0130]

A known or conventional polymerization initiator (for example, a thermal polymerization initiator or a photo-polymerization initiator) may be used in polymerization of the acrylic oligomer. The polymerization initiators may be used singly or in combinations of two or more thereof.

[0131]

Examples of the thermal polymerization initiator include azo-based initiators such as 2,2'-azobisisobutyronitrile (AIBN), 2,2'-azobis-2-methylbutyronitrile (AMBN), dimethyl 2,2'-azobis(2-methylpropionate), 4,4'-azobis-4-cyanovaleric acid, 2,2'-azobis(4-methoxy-2,4-dimethylvaleronitrile), 2,2'-azobis(2,4-dimethylvaleronitrile), 1,1'-azobis(cyclohexane-1-carbonitrile) and 2,2'-azobis(2,4,4-trimethylpentane); and peroxide-based initiators such as benzoyl peroxide, t-butyl hydroperoxide, di-t-butyl

peroxide, t-butylperoxybenzoate, dicumyl peroxide, 1,1-bis(t-butylperoxy)-3,3,5-trimethylcyclohexane and 1,1-bis(t-butylperoxy)cyclododecane. In a case where solution polymerization is performed, an oil-soluble polymerization initiator is preferably used. The thermal polymerization initiators may be used singly or in combinations of two or more thereof.

[0132]

The amount of the thermal polymerization initiator used is not particularly limited, and is, for example, 0.1 to 15 parts by weight based on 100 parts by weight of all the monomer units of the acrylic oligomer (the amount of all the monomer components constituting the acrylic oligomer).

[0133]

The photo-polymerization initiator is not particularly limited, and examples include the same photo-polymerization initiators as the above exemplified photo-polymerization initiators for use in formation of the acrylic polymer by polymerization. The amount of the photo-polymerization initiator used is not particularly limited, and is appropriately selected.

[0134]

A chain transfer agent may be used in polymerization of the acrylic oligomer in order to adjust the molecular weight (specifically, in order to adjust the weight average molecular weight to 1000 to 30000). Examples of

the chain transfer agent include 2-mercaptoethanol, α -thioglycerol, 2,3-dimercapto-1-propanol, octylmercaptan, t-nonylmercaptan, dodecylmercaptan (laurylmercaptan), t-dodecylmercaptan, glycidylmercaptan, thioglycolic acid, methyl thioglycolate, ethyl thioglycolate, propyl thioglycolate, butyl thioglycolate, t-butyl thioglycolate, 2-ethylhexyl thioglycolate, octyl thioglycolate, isooctyl thioglycolate, decyl thioglycolate, dodecyl thioglycolate, ethylene glycol thioglycolic acid esters¥, neopentyl glycol thioglycolic acid esters¥, pentaerythritol thioglycolic acid ester, and an α -methylstyrene dimer. In particular, α -thioglycerol and methyl thioglycolate are preferable and α -thioglycerol is particularly preferable from the viewpoint that whitening of the pressure-sensitive adhesive sheet due to humidification is suppressed. The chain transfer agents may be used singly or in combinations of two or more thereof.

[0135]

The content (amount used) of the chain transfer agent is not particularly limited, and is preferably 0.1 to 20 parts by weight, more preferably 0.2 to 15 parts by weight, further preferably 0.3 to 10 parts by weight based on 100 parts by weight of all the monomer units of the acrylic oligomer (the amount of all the monomer components constituting the acrylic oligomer). The content (amount used) of the chain transfer agent is in the above range, and thus an acrylic oligomer can be

easily obtained in which the weight average molecular weight is controlled to 1000 to 30000.

[0136]

The weight average molecular weight (Mw) of the acrylic oligomer is 1000 to 30000, preferably 1000 to 20000, more preferably 1500 to 10000, further preferably 2000 to 8000. The weight average molecular weight of the acrylic oligomer is 1000 or more, and thus adhesive strength and retention properties are enhanced and resistance to foaming and peeling is enhanced. In this regard, the weight average molecular weight of the acrylic oligomer is 30000 or less, and thus adhesive strength is easily increased and resistance to foaming and peeling is enhanced.

[0137]

The weight average molecular weight (Mw) of the acrylic oligomer can be determined in terms of polystyrene by a GPC method. For example, a high speed GPC apparatus "HPLC-8120GPC" manufactured by Tosoh Corporation can be used for measurement in the following conditions.

Column: TSKgel Super HZM-H/HZ4000/HZ3000/HZ2000

Solvent: tetrahydrofuran

Flow rate: 0.6 ml/min

[0138]

The glass transition temperature (Tg) of the acrylic oligomer is not particularly limited, and is preferably

20 to 300°C, more preferably 30 to 300°C, further preferably 40 to 300°C. The glass transition temperature of the acrylic oligomer is preferably 20°C or more because resistance to foaming and peeling is easily enhanced. The glass transition temperature of the acrylic oligomer is preferably 300°C or less because the pressure-sensitive adhesive layer has appropriate flexibility to easily achieve favorable adhesive strength and favorable step absorbability and easily achieve excellent adhesion reliability.

[0139]

The glass transition temperature (T_g) of the acrylic oligomer is a glass transition temperature (theoretical value) represented by the following expression.

$$1/T_g = W_1/T_{g1} + W_2/T_{g2} + \dots + W_n/T_{gn}$$

In the expression, T_g represents the glass transition temperature (unit: K) of the acrylic oligomer, T_{gi} represents the glass transition temperature (unit: K) of a homopolymer formed from a monomer i , and W_i represents the weight fraction of the monomer i in the amount of all the monomer components ($i = 1, 2, \dots n$).

Any value described in Table 1 below can be adopted as the T_g of the homopolymer of a monomer constituting the acrylic oligomer. Any numerical value described in "Polymer Handbook" (vol. 3, John Wiley & Sons, Inc, 1989) can be adopted as the T_g of the homopolymer of a monomer not described in Table 1. Furthermore, any value (the

peak top temperature of $\tan \delta$ in the viscoelasticity test) obtained by the above measurement method can be adopted as the T_g of the homopolymer of a monomer also not described in the Reference.

[0140]

[Table 1]

Table 1

	Formulation	T_g [°C]
Homopolymer	Methyl methacrylate (MMA)	105
	Dicyclopentanyl methacrylate (DCPMA)	175
	Dicyclopentanyl acrylate (DCPA)	120
	Isobornyl methacrylate (IBXMA)	173
	Isobornyl acrylate (IBXA)	97
	Cyclohexyl methacrylate (CHMA)	66
	1-Adamantyl methacrylate (ADMA)	250
	1-Adamantyl acrylate (ADA)	153
Copolymer	DCPMA/MMA = 60/40	144

In Table 1, a copolymer "DCPMA/MMA=60/40" means a copolymer of 60 parts by weight of DCPMA and 40 parts by weight of MMA.

[0141]

In a case where the acrylic pressure-sensitive adhesive composition contains the acrylic polymer and the acrylic oligomer, the content of the acrylic oligomer is not particularly limited, and is preferably 1 to 30 parts by weight, more preferably 2 to 20 parts by weight, further preferably 2 to 10 parts by weight based on 100 parts by weight of the acrylic polymer. In other words,

the content of the acrylic oligomer in the acrylic pressure-sensitive adhesive composition is not particularly limited, and is preferably 1 to 30 parts by weight, more preferably 2 to 20 parts by weight, further preferably 2 to 10 parts by weight based on 100 parts by weight of all the monomer units of the acrylic polymer. The content of the acrylic oligomer in the acrylic pressure-sensitive adhesive composition is not particularly limited, and is, for example, preferably 1 to 30 parts by weight, more preferably 2 to 20 parts by weight, further preferably 2 to 10 parts by weight based on 100 parts by weight of the monomer mixture. The content of the acrylic oligomer is preferably 1 part by weight or more because excellent adhesiveness and excellent resistance to foaming and peeling are easily obtained. The content of the acrylic oligomer is preferably 30 parts by weight or less because excellent transparency and adhesion reliability are easily obtained. [0142]

The method for producing the above acrylic pressure-sensitive adhesive composition containing the acrylic polymer and the acrylic oligomer is not particularly limited. For example, the production is made through addition of the acrylic oligomer and, if necessary, an additive and the like to a monomer component mixture constituting the acrylic polymer or a partially polymerized product of the monomer component mixture

constituting the acrylic polymer (a monomer mixture forming the acrylic polymer or a partially polymerized product thereof), and mixing of the resultant.

[0143]

It is preferable to introduce a crosslinked structure into the acrylic polymer in the pressure-sensitive adhesive layer in the present invention from the viewpoint that the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges.

The acrylic polymer into which the crosslinked structure is introduced is obtained by, for example, a method including introducing a branched structure (crosslinked structure) by including a polyfunctional compound in a polymerization component of the polymer.

[0144]

The method for including a polyfunctional compound in a polymerization component of the acrylic polymer may be performed by a reaction of the total amount of the monomer component constituting the acrylic polymer and the polyfunctional compound for introduction of a crosslinked structure, at one time, or polymerization at multiple stages. The method for performing polymerization at multiple stages is preferably a method in which a monofunctional monomer constituting a base

polymer is polymerized (preliminarily polymerized) to prepare a partially polymerized product (prepolymer composition) and a polyfunctional compound such as polyfunctional (meth)acrylate is added to the prepolymer composition to polymerize (mainly polymerize) the prepolymer composition and the polyfunctional monomer. The prepolymer composition is a partially polymerized product including a polymerized product low in degree of polymerization and an unreacted monomer.

[0145]

A branching point (crosslinking point) with the polyfunctional compound can be uniformly introduced into the acrylic polymer by preliminarily polymerizing a constituent component of the acrylic polymer. The pressure-sensitive adhesive layer can also be formed by coating a substrate with a mixture (pressure-sensitive adhesive composition) of a low-molecular weight polymer or a partially polymerized product with an unpolymerized monomer component, and then performing main polymerization on the substrate. Since a low polymerized composition, for example, the prepolymer composition is low in viscosity and excellent in coatability, a method in which actual polymerization is performed on the substrate after coating with a pressure-sensitive adhesive composition being a mixture of the prepolymer composition and the polyfunctional compound not only can allow the pressure-sensitive adhesive layer to be

enhanced in productivity, but also can allow the thickness of the pressure-sensitive adhesive layer to be uniform.

[0146]

Examples of the polyfunctional compound for use in introduction of a crosslinked structure include a compound containing two or more polymerizable functional groups (ethylenically unsaturated groups) each having an unsaturated double bond, in one molecule. A polyfunctional (meth)acrylate is preferable as the polyfunctional compound because of being easily copolymerized with the monomer component of the acrylic polymer. In a case where a branched (crosslinked) structure is introduced by active energy ray polymerization (photo-polymerization), a polyfunctional acrylate is preferable.

[0147]

Examples of the polyfunctional (meth)acrylate include hexane diol di(meth)acrylate, butane diol di(meth)acrylate, polyethylene glycol di(meth)acrylate, polypropylene glycol di(meth)acrylate, polytetramethylene glycol di(meth)acrylate, bisphenol A ethylene oxide-modified di(meth)acrylate, bisphenol A propylene oxide-modified di(meth)acrylate, alkane diol di(meth)acrylates (for example, hexane diol di(meth)acrylate and butane diol di(meth)acrylate), tricyclodecanedimethanol di(meth)acrylate, ethoxylated isocyanuric acid

tri(meth)acrylate, pentaerythritol tri(meth)acrylate,
pentaerythritol di(meth)acrylate, trimethylolpropane
tri(meth)acrylate, ditrimethylolpropane
tetra(meth)acrylate, ethoxylated pentaerythritol
tetra(meth)acrylate, pentaerythritol tetra(meth)acrylate,
dipentaerythritol poly(meth)acrylate, dipentaerythritol
hexa(meth)acrylate, neopentyl glycol di(meth)acrylate,
glycerin di(meth)acrylate, epoxy (meth)acrylate,
butadiene (meth)acrylate, and isoprene (meth)acrylate.
[0148]

In a case where the acrylic polymer includes the
polyfunctional (meth)acrylate as a polymerizable compound,
the content (amount of compounding) of the polyfunctional
(meth)acrylate is preferably 0.01 parts by weight or more,
more preferably 0.03 parts by weight or more, further
preferably 0.06 parts by weight or more, particularly
preferably 0.08 parts by weight or more based on 100
parts by weight of the acrylic polymer. The upper limit
of the content (amount of compounding) of the
polyfunctional (meth)acrylate is preferably 1 part by
weight or less, more preferably 0.5 parts by weight or
less, further preferably 0.3 parts by weight or less.
The content (amount of compounding) of the polyfunctional
(meth)acrylate is in the above range, and thus an
appropriate crosslinked structure is formed in the
pressure-sensitive adhesive layer in the present
invention and the above various physical properties (in

particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges.

[0149]

A crosslinked structure with a urethane-based segment can be introduced by using urethane (meth)acrylate having a (meth)acryloyl group at a terminal of a urethane chain, as the polyfunctional (meth)acrylate. The acrylic polymer is crosslinked with the urethane-based segment, and thus the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges. The urethane-based segment is a molecule chain having a urethane bond, and the crosslinked structure with the urethane-based segment is introduced by covalently binding each of both terminals of the urethane-based segment to the acrylic polymer. The urethane-based segment is typically obtained by a reaction of a diol and a diisocyanate, and includes a polyurethane chain.

[0150]

The molecular weight of the polyurethane chain in the urethane-based segment is preferably 5000 to 30000, more preferably 6000 to 23000, further preferably 7000 to

20000. As the molecular weight of the polyurethane chain in the urethane-based segment is higher, the distance between crosslinking points is longer. In a case where the molecular weight of the polyurethane chain is in the above range, a polymer into which the crosslinked structure is introduced has proper aggregation properties and fluidity, and thus the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges. [0151]

In a case where the molecular weight of the polyurethane chain is low and the distance between crosslinking points is short, the $\tan \delta$ tends to be decreased according to an increase in aggregation force, and the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention tend to be easily controlled in desired ranges. On the other hand, in a case where the molecular weight of the polyurethane chain is high and the distance between crosslinking points is long, the storage elastic modulus tends to be lower and followability to steps tends to be enhanced. Even in a case where the molecular weight of the polyurethane chain is high, the storage elastic

modulus can be increased by increasing the amount of the urethane-based segment and thus increasing the gel fraction. It is noted that a polyurethane chain high in molecular weight is low in compatibility with the acrylic polymer and thus a pressure-sensitive adhesive may be increased in haze to result in a reduction in transparency as the amount of the urethane-based segment is increased.

[0152]

In a case where the amount of the urethane-based segment is increased, the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges, according to an increase in gel fraction. On the other hand, in a case where the amount of the urethane-based segment is increased, a pressure-sensitive adhesive may be deteriorated in followability to steps to result in a reduction in transparency and an increase in haze. Therefore, the amount of the urethane-based segment is preferably 0.5 parts by weight or more, more preferably 1 part by weight or more, further preferably 1.5 parts by weight or more based on 100 parts by weight of the acrylic polymer from the viewpoint that the gel fraction is increased to form an appropriate crosslinked structure in the pressure-sensitive adhesive layer in the present

invention and the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges. In this regard, the amount of the urethane-based segment is preferably 20 parts by weight or less, more preferably 10 parts by weight or less, further preferably 5 parts by weight or less based on 100 parts by weight of the acrylic polymer from the viewpoint that the pressure-sensitive adhesive layer in the present invention has appropriate flexibility and is enhanced in followability to steps. In this regard, the amount of the urethane-based segment in the polyfunctional (meth)acrylate may be 1.6 parts by weight or more or 1.7 parts by weight or more, and may be 4 parts by weight or less or 3 parts by weight or less, based on 100 parts by weight of the acrylic polymer.

[0153]

In a case where the acrylic pressure-sensitive adhesive composition constituting the pressure-sensitive adhesive layer in the present invention contains urethane (meth)acrylate, the content is not particularly limited, and is preferably 0.5 parts by weight or more, more preferably 1 part by weight or more, further preferably 1.7 parts by weight or more based on 100 parts by weight of the acrylic polymer from the viewpoint that an

appropriate crosslinked structure is formed in the pressure-sensitive adhesive layer in the present invention and the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges. The content of the urethane (meth)acrylate is preferably 20 parts by mass or less, more preferably 10 parts by mass or less, further preferably 5 parts by mass or less based on 100 parts by mass of the acrylic polymer from the viewpoint that the pressure-sensitive adhesive layer in the present invention has appropriate flexibility and followability to steps is enhanced and from the viewpoint of handleability of the optical pressure-sensitive adhesive sheet of the present invention.

[0154]

The acrylic pressure-sensitive adhesive composition preferably includes, in addition to the urethane (meth)acrylate, the above-mentioned polyfunctional (meth)acrylate (except for urethane (meth)acrylate. The same applies hereinafter.) used in combination from the viewpoint that an appropriate crosslinked structure is formed in the pressure-sensitive adhesive layer in the present invention, the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of

the pressure-sensitive adhesive layer in the present invention are controlled in desired ranges and the occurrence of white spots is easily suppressed. In a case where the acrylic pressure-sensitive adhesive composition include the urethane (meth)acrylate and the polyfunctional (meth)acrylate, the total content is preferably 1 part by mass or more, more preferably 1.5 parts by mass or more, further preferably 1.8 parts by mass or more based on 100 parts by mass of the acrylic polymer from the viewpoint that an appropriate crosslinked structure is formed in the pressure-sensitive adhesive layer in the present invention and the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges. The total content of the urethane (meth)acrylate and the polyfunctional (meth)acrylate is preferably 20 parts by mass or less, more preferably 10 parts by mass or less, further preferably 5 parts by mass or less based on 100 parts by mass of the acrylic polymer from the viewpoint that the pressure-sensitive adhesive layer in the present invention has appropriate flexibility and is enhanced in followability to steps and from the viewpoint of handleability of the optical pressure-sensitive adhesive sheet of the present invention.

[0155]

In a case where the acrylic pressure-sensitive adhesive composition includes the urethane (meth)acrylate and the polyfunctional (meth)acrylate, the content of the urethane (meth)acrylate is preferably 200 parts by weight or less, more preferably 500 parts by weight or more, further preferably 700 parts by weight or more, and preferably 3000 parts by weight or less, more preferably 2800 parts by weight or less, further preferably 2500 parts by weight or less based on 100 parts by weight of the polyfunctional (meth)acrylate. The content of the urethane (meth)acrylate is in the range, and thus an appropriate crosslinked structure is formed in the pressure-sensitive adhesive layer in the present invention, the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges and the occurrence of white spots is easily suppressed.

[0156]

Examples of the diol for use in formation of the polyurethane chain include low-molecular weight diols such as ethylene glycol, diethylene glycol, propylene glycol, butylene glycol and hexamethylene glycol; and high-molecular weight diols such as polyester polyol,

polyether polyol, polycarbonate polyol, acrylic polyol, epoxy polyol and caprolactone polyol.

[0157]

The diisocyanate for use in formation of the polyurethane chain may be any of aromatic and aliphatic diisocyanates. An isocyanate compound derivative can also be used as the diisocyanate. Examples of the isocyanate compound derivative include a polyisocyanate dimer, an isocyanate trimer (isocyanurate), polymeric MDI, an adduct with trimethylolpropane, a biuret-modified product, an allophanate-modified product, and a urea-modified product. An urethane prepolymer having an isocyanate group at a terminal may also be used as a diisocyanate component.

[0158]

A polyether urethane having a polyether polyol as a diol component and/or a polyester urethane having a polyester polyol as a diol component is preferably included as the polyurethane chain exemplified because of being high in compatibility with the acrylic polymer. In particular, in a case where a crosslinked structure is introduced by the polyester urethane, the storage elastic modulus at ordinary temperature tends to be increased and the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention tend to

be easily controlled in desired ranges. One reason is, for example, because a polyester has a rigid molecular structure as compared with a polyether and the like. It is considered that, if a crosslinked structure is introduced by a rigid segment, polymer movement is restricted to result in an increase in storage elastic modulus and, on the other hand, the distance between crosslinking points in a polymer is retained and thus impact resistance and followability to steps are exhibited.

[0159]

The crosslinked structure with the urethane-based segment can be introduced into the acrylic polymer by using a compound having a functional group copolymerizable with the monomer component constituting the acrylic polymer, at a terminal of the polyurethane chain, or a compound having a functional group reactive with a carboxyl group, a hydroxyl group or the like included in the acrylic polymer, at a terminal of the polyurethane chain. The crosslinked structure with the urethane-based segment is preferably introduced by using, as the polyfunctional (meth)acrylate, an urethane di(meth)acrylate having a (meth)acryloyl group at each of both terminals of a polyurethane chain because a crosslinking point is easily uniformly introduced into the acrylic polymer and compatibility between the acrylic polymer and the urethane-based segment is excellent.

[0160]

The urethane di(meth)acrylate having a (meth)acryloyl group at each of both terminals is obtained by using, for example, a (meth)acrylic compound having a hydroxyl group, in addition to a diol component, in formation of polyurethane by polymerization. Preferably, an isocyanate-terminated polyurethane is synthesized by a reaction of a diol and a diisocyanate in isocyanate excess and thereafter a (meth)acrylic compound having a hydroxyl group is added to thereby react a terminal isocyanate group of the polyurethane with a hydroxyl group of the (meth)acrylic compound, from the viewpoint of control of the chain length (molecular weight) of the urethane-based segment.

[0161]

A polyurethane chain having an isocyanate group at a terminal is obtained by reacting a polyhydric alcohol and a polyisocyanate compound so that the polyisocyanate compound is excessive. In order to obtain the isocyanate-terminated polyurethane, a diol component and a diisocyanate component may be used so that the NCO/OH (equivalent ratio) is preferably 1.1 to 2.0, more preferably 1.15 to 1.5. A diol component and a diisocyanate component may be mixed and reacted at a substantially equivalent and thereafter an additional diisocyanate component may be loaded.

[0162]

Examples of the (meth)acrylic compound having a hydroxyl group include hydroxyethyl (meth)acrylate, hydroxypropyl (meth)acrylate, hydroxybutyl (meth)acrylate, hydroxyhexyl (meth)acrylate, hydroxymethylacrylamide, and hydroxyethylacrylamide.

[0163]

The urethane (meth)acrylate here used may be any commercially available product sold from various companies such as Arakawa Chemical Industries, Ltd., Shin-Nakamura Chemical Co., Ltd., Toagosei Co., Ltd., Kyoeisha Chemical Co., Ltd., Nippon Kayaku Co., Ltd., Nippon Synthetic Chemical Industry Co., Ltd., Negami Chemical Industrial Co., Ltd., and Daicel-Allnex Ltd. The weight average molecular weight of the urethane (meth)acrylate is preferably 5000 to 30000, more preferably 6000 to 23000, further preferably 7000 to 20000.

[0164]

The glass transition temperature of the urethane (meth)acrylate is preferably 0°C or less, more preferably -10°C or less, further preferably -20°C or less. A urethane (meth)acrylate low in Tg is used to thereby obtain a pressure-sensitive adhesive which is excellent in low-temperature adhesive strength even when the aggregation force of a base polymer is enhanced by introduction of the crosslinked structure with the urethane-based segment. The lower limit of the glass

transition temperature of the urethane (meth)acrylate is not particularly limited, and is preferably -100°C or more, more preferably -90°C or more, further preferably -80°C or more from the viewpoint that a pressure-sensitive adhesive excellent in high-temperature retention strength is obtained.

[0165]

In a case where the crosslinked structure with the urethane-based segment is introduced into the acrylic polymer by using the urethane (meth)acrylate, the glass transition temperature of the urethane-based segment of the base polymer is substantially equal to the glass transition temperature of the urethane (meth)acrylate.

[0166]

The pressure-sensitive adhesive layer in the present invention preferably contains an ultraviolet absorber (UVA) without any particular lamination. In a case where the pressure-sensitive adhesive layer in the present invention contains an ultraviolet absorber, an optical member laminate (image display apparatus) including the optical pressure-sensitive adhesive sheet of the present invention tends to be enhanced in durability. The ultraviolet absorbers can be used singly or in combinations of two or more thereof.

[0167]

The ultraviolet absorber is not particularly limited, and examples include a benzotriazole-based ultraviolet

absorber, a hydroxyphenyltriazine-based ultraviolet absorber, a benzophenone-based ultraviolet absorber, a salicylic acid ester-based ultraviolet absorber, a cyanoacrylate-based ultraviolet absorber, and an oxybenzophenone-based ultraviolet absorber.

[0168]

Examples of the benzotriazole-based ultraviolet absorber (benzotriazol-based compound) include 2-(2-hydroxy-5-tert-butylphenyl)-2H-benzotriazole (trade name "TINUVIN PS", manufactured by BASF SE), an ester compound (trade name "TINUVIN 384-2", manufactured by BASF SE) of benzenepropanoic acid and 3-(2H-benzotriazol-2-yl)-5-(1,1-dimethylethyl)-4-hydroxy (C7-9 branched and linear alkyl), a mixture (trade name "TINUVIN 109", manufactured by BASF SE) of octyl 3-[3-tert-butyl-4-hydroxy-5-(5-chloro-2H-benzotriazol-2-yl)phenyl]propionate and 2-ethylhexyl-3-[3-tert-butyl-4-hydroxy-5-(5-chloro-2H-benzotriazol-2-yl)phenyl]propionate, 2-(2H-benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol (trade name "TINUVIN 900", manufactured by BASF SE), 2-(2H-benzotriazol-2-yl)-6-(1-methyl-1-phenylethyl)-4-(1,1,3,3-tetramethylbutyl)phenol (trade name "TINUVIN 928", manufactured by BASF SE), a reaction product (trade name "TINUVIN 1130", manufactured by BASF SE) of methyl 3-(3-(2H-benzotriazol-2-yl)-5-tert-butyl-4-hydroxyphenyl)propionate/polyethylene glycol 300, 2-(2H-benzotriazol-2-yl)-p-cresol (trade name "TINUVIN P",

manufactured by BASF SE), 2-(2H-benzotriazol-2-yl)-4,6-bis(1-methyl-1-phenylethyl)phenol (trade name "TINUVIN 234", manufactured by BASF SE), 2-[5-chloro-2H-benzotriazol-2-yl]-4-methyl-6-(tert-butyl)phenol (trade name "TINUVIN 326", manufactured by BASF SE), 2-(2H-benzotriazol-2-yl)-4,6-di-tert-pentylphenol (trade name "TINUVIN 328", manufactured by BASF SE), 2-(2H-benzotriazol-2-yl)-4-(1,1,3,3-tetramethylbutyl)phenol (trade name "TINUVIN 329", manufactured by BASF SE), 2,2'-methylenebis[6-(2H-benzotriazol-2-yl)-4-(1,1,3,3-tetramethylbutyl)phenol] (trade name "TINUVIN 360", manufactured by BASF SE), a reaction product (trade name "TINUVIN 213", manufactured by BASF SE) of 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 (trade name "TINUVIN 571", manufactured by BASF SE), 2-[2-hydroxy-3-(3,4,5,6-tetrahydrophthalimide-methyl)-5-methylphenyl]benzotriazole (trade name "Sumisorb 250", manufactured by Sumitomo Chemical Co., Ltd.), and 2,2'-methylenebis[6-(2H-benzotriazol-2-yl)-4-tert-octylphenol] (trade name "Adekastab LA-31", manufactured by Adeka Corporation).

[0169]

Examples of the hydroxyphenyltriazine-based ultraviolet absorber (hydroxyphenyltriazine-based compound) include a reaction product (trade name "TINUVIN

400", manufactured by BASF SE) of 2-(4,6-bis(2,4-dimethylphenyl)-1,3,5-triazin-2-yl)-5-hydroxyphenyl and [(C10-C16 (mainly C12-C13) alkyloxy)methyl]oxirane, 2-[4,6-bis(2,4-dimethylphenyl)-1,3,5-triazin-2-yl]-5-[3-(dodecyloxy)-2-hydroxypropoxy]phenol), a reaction product (trade name "TINUVIN 405", manufactured by BASF SE) of 2-(2,4-dihydroxyphenyl)-4,6-bis-(2,4-dimethylphenyl)-1,3,5-triazine and (2-ethylhexyl)-glycidic acid ester, 2,4-bis(2-hydroxy-4-butoxyphenyl)-6-(2,4-dibutoxyphenyl)-1,3,5-triazine (trade name "TINUVIN 460", manufactured by BASF SE), 2-(4,6-diphenyl-1,3,5-triazin-2-yl)-5-[(hexyl)oxy]-phenol (trade name "TINUVIN 1577", manufactured by BASF SE), 2-(4,6-diphenyl-1,3,5-triazin-2-yl)-5-[2-(2-ethylhexanoyloxy)ethoxy-phenol (trade name "Adekastab LA-46", manufactured by Adeka Corporation), 2-(2-hydroxy-4-[1-octyloxycarbonylethoxyphenyl)-4,6-bis(4-phenylphenyl)-1,3,5-triazine (trade name "TINUVIN 479", manufactured by BASF SE), 2,4,6-tris(2-hydroxy-4-[1-(2-ethylhexyloxycarbonyl)ethoxyphenyl)-1,3,5-triazine (trade name "TINUVIN 477", manufactured by BASF SE), and 2,4-bis(2-hydroxy-4-[2-ethylhexyloxy]phenyl)-6-(4-methoxyphenyl)-1,3,5-triazine (trade name "Tinosorb S", manufactured by Iwase Cosfa Co., Ltd.).

[0170]

Examples of the benzophenone-based ultraviolet absorber (benzophenone-based compound) and 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 trihydride), 2-hydroxy-4-octyloxybenzophenone, 4-dodecyloxy-2-hydroxybenzophenone, 4-benzyloxy-2-hydroxybenzophenone, 2,2'-dihydroxy-4-methoxybenzophenone (trade name "KEMISORB 111", manufactured by Chemipro Kasei Kaisha, Ltd.), 2,2',4,4'-tetrahydroxybenzophenone (trade name "SEESORB 106", manufactured by Shipro Kasei Kaisha, Ltd.), and 2,2'-dihydroxy-4,4'-dimethoxybenzophenone.

[0171]

Examples of the salicylic acid ester-based ultraviolet absorber (salicylic acid ester-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, and 2,4-di-tert-butylphenyl 3,5-di-tert-butyl-4-hydroxybenzoate (trade name "TINUVIN 120", manufactured by BASF SE).

[0172]

Examples of the cyano acrylate-based ultraviolet absorber (cyano acrylate-based compound) include alkyl 2-

cyano acrylate, cycloalkyl 2-cyano acrylate, alkoxyalkyl 2-cyano acrylate, alkenyl 2-cyano acrylate, and alkynyl 2-cyano acrylate.

[0173]

The ultraviolet absorber is preferably at least one ultraviolet absorber selected from the group consisting of a benzotriazole-based ultraviolet absorber, a benzophenone-based ultraviolet absorber and a hydroxyphenyltriazine-based ultraviolet absorber, more preferably a benzotriazole-based ultraviolet absorber or a benzophenone-based ultraviolet absorber because a pressure-sensitive adhesive layer not only having high ultraviolet absorbability, but also having excellent optical characteristics and high transparency is easily obtained, and such an ultraviolet absorber has excellent photostability. In particular, a benzotriazole-based ultraviolet absorber is preferable in which a phenyl group having a group having 6 or more carbon atoms and a hydroxyl group as substituents is bound to a nitrogen atom constituting a benzotriazole ring.

[0174]

The ultraviolet absorber preferably has an absorbance A of 0.5 or less as determined as follows from the viewpoint of obtaining higher ultraviolet absorbability.

Absorbance A: absorbance measured by irradiating a 0.08% toluene solution of the ultraviolet absorber with light at a wavelength of 400 nm.

[0175]

In a case where the pressure-sensitive adhesive layer in the present invention contains the ultraviolet absorber, the content of the ultraviolet absorber in the pressure-sensitive adhesive layer (in particular, acrylic pressure-sensitive adhesive layer) in the present invention is not particularly limited, and is preferably 0.01 parts by weight or more, more preferably 0.05 parts by weight or more, further preferably 0.1 parts by weight or more based on 100 parts by weight of the base polymer from the viewpoint that an optical member laminate (image display apparatus) including the optical pressure-sensitive adhesive sheet of the present invention is enhanced in durability. The upper limit of the content of the ultraviolet absorber is preferably 10 parts by weight or less, more preferably 9 parts by weight or less, further preferably 8 parts by weight or less based on 100 parts by weight of the base polymer from the viewpoint that the occurrence of a yellowing phenomenon of an pressure-sensitive adhesive due to addition of the ultraviolet absorber is suppressed and excellent optical characteristics, high transparency and excellent appearance properties are obtained.

[0176]

The pressure-sensitive adhesive layer in the present invention may contain an antioxidant. In a case where the pressure-sensitive adhesive layer in the present invention contains an antioxidant, in particular, the pressure-sensitive adhesive layer preferably contains the antioxidant together with the ultraviolet absorber. The antioxidant can capture any radical generated in photooxidation and thus can allow the pressure-sensitive adhesive layer to be enhanced in resistance to light (in particular, ultraviolet light). The antioxidants can be used singly or in combinations of two or more thereof.

[0177]

The antioxidant is not particularly limited, and examples include a phenol-based antioxidant (phenol-based compound), a phosphorus-based antioxidant (phosphorus-based compound), a thioether-based antioxidant (thioether-based compound), and an amine-based antioxidant (amine-based compound) (in particular, a hindered amine-based antioxidant (hindered amine-based compound)).

[0178]

Examples of the phenol-based antioxidant (phenol-based compound) include 2,6-di-tert-butyl-4-methylphenol, 4-hydroxymethyl-2,6-di-tert-butylphenol, 2,6-di-tert-butyl-4-ethylphenol, butylated hydroxyanisole, n-octadecyl 3-(4-hydroxy-3,5-di-tert-butylphenyl)propionate, distearyl(4-hydroxy-3-methyl-5-tert-butyl)benzylmalonate,

tocopherol, 2,2'-methylenebis(4-methyl-6-tert-butylphenol), 2,2'-methylenebis(4-ethyl-6-tert-butylphenol), 4,4'-methylenebis(2,6-di-tert-butylphenol), 4,4'-butylidenebis(6-tert-butyl-m-cresol), 4,4'-thiobis(6-tert-butyl-m-cresol), styrenated phenol, N,N'-hexamethylenebis(3,5-di-tert-butyl-4-hydroxyhydrocinnamide, calcium bis(3,5-di-tert-butyl-4-hydroxybenzylphosphonic acid ethyl ester), 1,1,3-tris(2-methyl-4-hydroxy-5-tert-butylphenyl)butane, 1,3,5-trimethyl-2,4,6-tris(3,5-di-tert-butyl-4-hydroxybenzyl)benzene, tetrakis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionyloxymethyl]methane, 1,6-hexane diol-bis[3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate], 2,2'-methylenebis(4-methyl-6-cyclohexylphenol), 2,2'-methylenebis[6-(1-methylcyclohexyl)-p-cresol], 1,3,5-tris(4-tert-butyl-3-hydroxy-2,6-dimethylbenzyl)isocyanuric acid, 1,3,5-tris(3,5-di-tert-butyl-4-hydroxybenzyl)isocyanuric acid, triethylene glycol-bis[3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionate], 2,2'-oxamidobis[ethyl3-(3,5-di-tert-butyl-4-hydroxyphenyl)propionate], 6-(4-hydroxy-3,5-di-tert-butylanilino)-2,4-dioctylthio-1,3,5-triazine, bis[2-tert-butyl-4-methyl-6-(2-hydroxy-3-tert-butyl-5-methylbenzyl)phenyl]terephthalate, 3,9-bis{2-[3-(3-tert-butyl-4-hydroxy-5-methylphenyl)propionyloxy]-1,1-dimethylethyl}-2,4,8,10-tetraoxaspiro[5.5]undecane, and 3,9-bis{2-[3-(3,5-di-tert-butyl-4-

hydroxyphenyl)propionyloxy]-1,1-dimethylethyl}-2,4,8,10-tetraoxaspiro[5.5]undecane.

[0179]

Examples of the phosphorus-based antioxidant (phosphorus-based compound) include trisnonylphenyl phosphite, tris(2,4-di-tert-butylphenyl)phosphite, tris[2-tert-butyl-4-(3-tert-butyl-4-hydroxy-5-methylphenylthio)-5-methylphenyl]phosphite, tridecyl phosphite, octyldiphenyl phosphite, di(decyl)monophenyl phosphite, di(tridecyl)pentaerythritol diphosphite, distearyl pentaerythritol diphosphite, di(nonylphenyl)pentaerythritol diphosphite, bis(2,4-di-tert-butylphenyl)pentaerythritol diphosphite, bis(2,6-di-tert-butyl-4-methylphenyl)pentaerythritol diphosphite, bis(2,4,6-tri-tert-butylphenyl)pentaerythritol diphosphite, tetra(tridecyl)isopropylidenediphenol diphosphite, tetra(tridecyl)-4,4'-n-butylidenebis(2-tert-butyl-5-methylphenol)diphosphite, hexa(tridecyl)-1,1,3-tris(2-methyl-4-hydroxy-5-tert-butylphenyl)butane triphosphite, tetrakis(2,4-di-tert-butylphenyl)biphenylene diphosphonite, 9,10-dihydro-9-oxa-10-phosphaphenanthrene-10-oxide, and tris(2-[(2,4,8,10-tetrakis-tert-butyl)dibenzo[d,f][1,3,2]dioxaphosphopin-6-yl)oxy]ethyl)amine.

[0180]

Examples of the thioether-based antioxidant (thioether-based compound) include dialkyl thiodipropionate compounds such as dilauryl, dimyristyl, and distearyl thiodipropionates; and β -alkylmercaptopropionic acid ester compounds of polyols, such as tetrakis[methylene(3-dodecylthio)propionate]methane.

[0181]

Examples of the amine-based antioxidant (amine-based compound) include a polymerized product (trade name "TINUVIN 622", manufactured by BASF SE) of dimethyl succinate and 4-hydroxy-2,2,6,6-tetramethyl-1-piperidineethanol, a 1:1 reaction product (trade name "TINUVIN 119", manufactured by BASF SE) of a polymerized product of dimethyl succinate and 4-hydroxy-2,2,6,6-tetramethyl-1-piperidineethanol with N,N',N'',N'''-tetrakis-(4,6-bis-(butyl-(N-methyl-2,2,6,6-tetramethylpiperidine-4-yl)amino)-triazin-2-yl)-4,7-diazadecane-1,10-diamine, a polycondensate (trade name "TINUVIN 2020", manufactured by BASF SE) of dibutylamine · 1,3-triazine · N,N'-bis(2,2,6,6-tetramethyl-4-piperidyl-1,6-hexamethylenediamine and N-(2,2,6,6-tetramethyl-4-piperidyl)butylamine, poly[{6-(1,1,3,3-tetramethylbutyl)amino-1,3,5-triazin-2-4-diyl}{2,2,6,6-tetramethyl-4-piperidyl}imino]hexamethylene{(2,2,6,6-tetramethyl-4-piperidyl)imino} (trade name "TINUVIN 944", manufactured by BASF SE), a mixture (trade name "TINUVIN

765", manufactured by BASF SE) of bis(1,2,2,6,6-pentamethyl-4-piperidyl)sebacate and methyl 1, 2,2,6,6-pentamethyl-4-piperidylsebacate, bis(2,2,6,6-tetramethyl-4-piperidyl)sebacate (trade name "TINUVIN 770", manufactured by BASF SE), decanedioic acid bis(2,2,6,6-tetramethyl-1-(octyloxy)-4-piperidiny) ester, a reaction product (trade name "TINUVIN 123", manufactured by BASF SE) of 1,1-dimethylethyl hydroperoxide and octane, bis(1,2,2,6,6-pentamethyl-4-piperidyl)[[3,5-bis(1,1-dimethylethyl)-4-hydroxyphenyl]methyl]butylmalonate (trade name "TINUVIN 144", manufactured by BASF SE), a reaction product (trade name "TINUVIN 152", manufactured by BASF SE) of a reaction product of cyclohexane and peroxy N-butyl 2,2,6,6-tetramethyl-4-piperidineamine-2,4,6-trichloro-1,3,5-triazine, with 2-aminoethanol, a mixture (trade name "TINUVIN 292", manufactured by BASF SE) of bis(1,2,2,6,6-pentamethyl-4-piperidyl)sebacate and methyl 1,2,2,6,6-pentamethyl-4-piperidylsebacate, and a mixed esterified product (trade name "Adekastab LA-63P", manufactured by Adeka Corporation) of 1,2,3,4-butanetetracarboxylic acid with 1,2,2,6,6-pentamethyl-4-piperidinol and 3,9-bis(2-hydroxy-1,1-dimethylethyl)-2,4,8,10-tetraoxaspiro[5.5]undecane. The amine-based stabilizer is particularly preferably a hindered amine-based stabilizer.

[0182]

In a case where the pressure-sensitive adhesive layer in the present invention contains the antioxidant, the content of the antioxidant in the pressure-sensitive adhesive layer (in particular, acrylic pressure-sensitive adhesive layer) in the present invention is not particularly limited, and is preferably 0.1 parts by weight or more, more preferably 0.2 parts by weight or more based on 100 parts by weight of the base polymer from the viewpoint that resistance to light is easily exhibited. The upper limit of the content is preferably 5 parts by weight or less, more preferably 3 parts by weight or less based on 100 parts by weight of the base polymer from the viewpoint that coloration due to the antioxidant by itself hardly occurs and high transparency is easily obtained and from the viewpoint of optical characteristics.

[0183]

Formation of the pressure-sensitive adhesive layer in the present invention is not particularly limited, and a crosslinking agent (other crosslinking agent) other than the polyfunctional compound may be used. For example, the acrylic polymer in the acrylic pressure-sensitive adhesive layer can be crosslinked to control the gel fraction. Such other crosslinking agents can be used singly or in combinations of two or more thereof.

[0184]

Such other crosslinking agent is not particularly limited, and examples include an isocyanate-based crosslinking agent, an epoxy-based crosslinking agent, a melamine-based crosslinking agent, a peroxide-based crosslinking agent, a urea-based crosslinking agent, a metal alkoxide-based crosslinking agent, a metal chelate-based crosslinking agent, a metal salt-based crosslinking agent, a carbodiimide-based crosslinking agent, an oxazoline-based crosslinking agent, an aziridine-based crosslinking agent, and an amine-based crosslinking agent. In particular, an isocyanate-based crosslinking agent and an epoxy-based crosslinking agent are preferable, and an isocyanate-based crosslinking agent is more preferable. [0185]

Examples of the isocyanate-based crosslinking agent (polyfunctional isocyanate compound) include lower aliphatic polyisocyanate compounds such as 1,2-ethylene diisocyanate, 1,4-butylene diisocyanate and 1,6-hexamethylene diisocyanate; alicyclic polyisocyanate compounds such as cyclopentylene diisocyanates, cyclohexylene diisocyanates, isophorone diisocyanate, hydrogenated tolylene diisocyanate and hydrogenated xylene diisocyanate; and aromatic polyisocyanate compounds such as 2,4-tolylene diisocyanate, 2,6-tolylene diisocyanate, 4,4'-diphenylmethane diisocyanate and xylylene diisocyanate. Examples of the isocyanate-based crosslinking agent also include commercially available

products such as a trimethylolpropane/tolylene diisocyanate adduct (trade name "Coronate L", manufactured by Nippon Polyurethane Industry Co., Ltd.), a trimethylolpropane/hexamethylene diisocyanate adduct (trade name "Coronate HL", manufactured by Nippon Polyurethane Industry Co., Ltd.) and a trimethylolpropane/xylylene diisocyanate adduct (trade name "Takenate D-110N", manufactured by Mitsui Chemicals, Inc.).

[0186]

Examples of the epoxy-based crosslinking agent (polyfunctional epoxy compound) include not only N,N,N',N'-tetraglycidyl-m-xylene diamine, diglycidylaniline, 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane, 1,6-hexane diol diglycidyl ether, neopentyl glycol diglycidyl ether, ethylene glycol diglycidyl ether, propylene glycol diglycidyl ether, polyethylene glycol diglycidyl ether, polypropylene glycol diglycidyl ether, sorbitol polyglycidyl ether, glycerol polyglycidyl ether, pentaerythritol polyglycidyl ether, polyglycerol polyglycidyl ether, sorbitan polyglycidyl ether, trimethylolpropane polyglycidyl ether, adipic acid diglycidyl ester, o-phthalic acid diglycidyl ester, triglycidyl-tris(2-hydroxyethyl)isocyanurate, resorcin diglycidyl ether and bisphenol-S-diglycidyl ether, but also an epoxy-based resin having two or more epoxy groups

in its molecule. Examples of the epoxy-based crosslinking agent also include commercially available products such as trade name "Tetrad C" (manufactured by Mitsubishi Gas Chemical Company, Inc.).

[0187]

In a case where other crosslinking agent is used for formation of the pressure-sensitive adhesive layer in the present invention, the amount of such other crosslinking agent used is not particularly limited, and is preferably 0.001 parts by weight or more, more preferably 0.01 parts by weight or more based on 100 parts by weight of the base polymer from the viewpoint that sufficient adhesion reliability is obtained. The upper limit of the amount used is preferably 10 parts by weight or less, more preferably 5 parts by weight or less based on 100 parts by weight of the base polymer from the viewpoint that appropriate flexibility is obtained in the pressure-sensitive adhesive layer to allow for an enhancement in adhesive strength.

[0188]

The pressure-sensitive adhesive layer (in particular, acrylic pressure-sensitive adhesive layer) in the present invention may contain a silane coupling agent from the viewpoint that adhesion reliability under a humidification condition is enhanced, in particular, from the viewpoint that adhesion reliability to glass is enhanced. The silane coupling agents can be used singly

or in combinations of two or more thereof. In a case where the pressure-sensitive adhesive layer contains the silane coupling agent, adhesiveness, in particular, adhesiveness to glass, under a humidification condition, can be enhanced.

[0189]

The silane coupling agent is not particularly limited, and examples include γ -glycidoxypropyltrimethoxysilane, γ -glycidoxypropyltriethoxysilane, γ -aminopropyltrimethoxysilane, and N-phenyl-aminopropyltrimethoxysilane. Examples of the silane coupling agent also include commercially available products such as trade name "KBM-403" (manufactured by Shin-Etsu Chemical Co., Ltd.). In particular, the silane coupling agent is preferably γ -glycidoxypropyltrimethoxysilane.

[0190]

In a case where the pressure-sensitive adhesive layer in the present invention contains the silane coupling agent, the content of the silane coupling agent in the pressure-sensitive adhesive layer (in particular, acrylic pressure-sensitive adhesive layer) in the present invention is not particularly limited, and is preferably 0.01 parts by weight or more, more preferably 0.02 parts by weight or more based on 100 parts by weight of the base polymer. The upper limit of the content of the

silane coupling agent is preferably 1 part by weight or less, more preferably 0.5 parts by weight or less based on 100 parts by weight of the base polymer.

[0191]

The pressure-sensitive adhesive layer in the present invention preferably further contains a rust inhibitor. The pressure-sensitive adhesive layer preferably contains a rust inhibitor in that an excellent corrosion-prevention effect to metal wiring can be obtained.

[0192]

A rust inhibitor is a compound for preventing a metal from rusting and/or corroding. The rust inhibitor is not particularly limited, and examples include an amine compound, a benzotriazol-based compound, and a nitrite compound. Other examples include ammonium benzoate, ammonium phthalate, ammonium stearate, ammonium palmitate, ammonium oleate, ammonium carbonate, dicyclohexylamine benzoate, urea, urotropine, thiourea, phenyl carbamate, and cyclohexyl ammonium-N-cyclohexyl carbamate (CHC). The rust inhibitors can be used singly or in combinations of two or more thereof.

[0193]

Examples of the amine compound include hydroxy group-containing amine compounds such as 2-amino-2-methyl-1-propanol, monoethanolamine, monoisopropanolamine, diethylethanolamine, ammonia and ammonia water; cyclic amines such as morpholine; cyclic alkylamine compounds

such as cyclohexylamine; and straight alkylamines such as 3-methoxypropylamine. Examples of the nitrite compound include dicyclohexylammonium nitrite (DICHAN), diisopropylammonium nitrite (DIPAN), sodium nitrite, potassium nitrite, and calcium nitrite.

[0194]

The content of the rust inhibitor is not particularly limited, and is preferably 0.02 to 15 parts by weight based on 100 parts by weight of the base polymer. A content of 0.02 parts by weight or more is preferable because favorable corrosion-prevention performance is easily obtained. In this regard, a content of less than 15 parts by weight is preferable because transparency is easily ensured and adhesion reliability such as resistance to foaming and peeling is easily ensured.

[0195]

In particular, the rust inhibitor is preferably a benzotriazol-based compound in terms of compatibility with the base polymer, and transparency. In particular, the rust inhibitor is preferably a benzotriazol-based compound from the viewpoint that properties such as adhesion reliability, transparency and corrosion-prevention ability can be obtained at high levels in a well-balanced manner, and from the viewpoint that excellent appearance properties can be obtained.

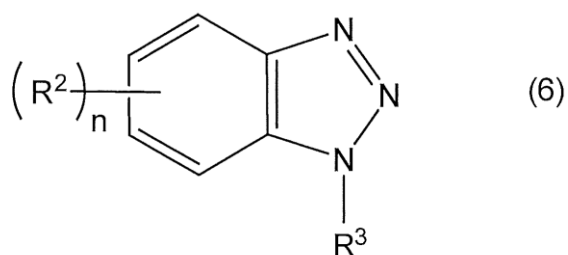
[0196]

The content of the benzotriazol-based compound is not particularly limited, and is preferably 0.02 to 3 parts by weight, more preferably 0.02 to 2.5 parts by weight, further preferably 0.02 to 2 parts by weight based on 100 parts by weight of the base polymer. The amount of the benzotriazol-based compound is equal to or less than a certain value, and thus adhesion reliability such as resistance to foaming and peeling can be certainly ensured and furthermore an increase in haze of the pressure-sensitive adhesive sheet can also be certainly prevented.

[0197]

The benzotriazol-based compound is not particularly limited as long as it is a compound having a benzotriazole backbone, and preferably has a structure represented by the following formula (6) from the viewpoint that a more excellent corrosion-prevention effect is obtained.

[Formula 6]



Herein, in the formula (6), R^2 and R^3 are the same or different, R^2 is a substituent on a benzene ring and

represents a substituent such as an alkyl group having 1 to 6 carbon atoms, an alkoxy group having 1 to 6 carbon atoms, an aryl group having 6 to 14 carbon atoms, an amino group, a mono- or di-C₁₋₁₀ alkylamino group, an amino-C₁₋₆ alkyl group, a mono- or di-C₁₋₁₀ alkylamino-C₁₋₆ alkyl group, a mercapto group, an alkoxycarbonyl group having 1 to 6 carbon atoms, or an alkoxy group having 1 to 6 carbon atoms, n is an integer of 0 to 4 and, when n is 2 or more, n's R² may be the same or different, and R³ represents a hydrogen atom, or a substituent such as an alkyl group having 1 to 12 carbon atoms, an alkoxy group having 1 to 12 carbon atoms, an aryl group having 6 to 14 carbon atoms, an amino group, a mono- or di-C₁₋₁₀ alkylamino group, an amino-C₁₋₆ alkyl group, a mono- or di-C₁₋₁₀ alkylamino-C₁₋₆ alkyl group, a mercapto group, an alkoxycarbonyl group having 1 to 12 carbon atoms, or an alkoxy group having 1 to 12 carbon atoms.

[0198]

R² is preferably an alkyl group, an alkoxycarbonyl group or the like having 1 to 3 carbon atoms, more preferably a methyl group from the viewpoint that a more excellent corrosion-prevention effect is obtained. In addition, n is preferably 0 or 1.

R³ is preferably, for example, a hydrogen atom, or a mono- or di-C₁₋₁₀ alkylamino-C₁₋₆ alkyl group, more preferably a hydrogen atom or a di-C₁₋₈ alkylamino C₁₋₄ alkyl group, from the same viewpoint.

[0199]

The pressure-sensitive adhesive layer in the present invention may include a chain transfer agent in order to easily control the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) in desired ranges. Examples of the chain transfer agent include 2-mercaptoethanol, α -thioglycerol, 2,3-dimercapto-1-propanol, octylmercaptan, t-nonylmercaptan, dodecylmercaptan(laurylmercaptan), t-dodecylmercaptan, glycidylmercaptan, thioglycolic acid, methyl thioglycolate, ethyl thioglycolate, propyl thioglycolate, butyl thioglycolate, t-butyl thioglycolate, 2-ethylhexyl thioglycolate, octyl thioglycolate, isooctyl thioglycolate, decyl thioglycolate, dodecyl thioglycolate, ethylene glycol thioglycolic acid ester, neopentyl glycol thioglycolic acid ester, pentaerythritol thioglycolic acid ester, and an α -methylstyrene dimer. In particular, an α -methylstyrene dimer is preferable. The chain transfer agents may be used singly or in combinations of two or more thereof.

[0200]

The content (amount used) of the chain transfer agent is not particularly limited, and is preferably 0.1 to 20 parts by weight, more preferably 0.2 to 15 parts by weight, further preferably 0.3 to 10 parts by weight based on 100 parts by weight of all the monomer units of

the acrylic oligomer (the amount of all the monomer components constituting the acrylic oligomer). The content (amount used) of the chain transfer agent is in the above range, and thus the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) of the pressure-sensitive adhesive layer in the present invention are easily controlled in desired ranges.

[0201]

The pressure-sensitive adhesive layer in the present invention may include a polymerization initiator (for example, a thermal polymerization initiator or a photo-polymerization initiator) in order to easily control the above various physical properties (in particular, compressibility after pressure release, strain after shear force release, and gel fraction) in desired ranges. The polymerization initiators may be used singly or in combinations of two or more thereof. The polymerization initiator is not particularly limited, and examples include photo-polymerization initiators and the thermal polymerization initiators which are the same as the photo-polymerization initiators and the thermal polymerization initiators exemplified above, for use in formation of the acrylic polymer by polymerization or in polymerization of the acrylic oligomer.

[0202]

The amount of the polymerization initiator used is not particularly limited, and is, for example, 0.1 to 15 parts by weight based on 100 parts by weight of all the monomer units of the acrylic polymer (the amount of all the monomer components constituting the acrylic polymer).
[0203]

The pressure-sensitive adhesive layer in the present invention may further contain, if necessary, additive(s) such as a crosslinking accelerator, a tackifier resin (a rosin derivative, a polyterpene resin, a petroleum resin, an oil-soluble phenol, and/or the like), an antiaging agent, a filler, a colorant (a pigment, a dye, and/or the like), a plasticizer, a softener, a surfactant, and/or an antistatic agent as long as the effects of the present invention are not impaired. Such additive(s) can be used singly or in combinations of two or more thereof.
[0204]

The method for producing the pressure-sensitive adhesive layer (in particular, acrylic pressure-sensitive adhesive layer) in the present invention is not particularly limited, and examples include a method in which a substrate or a release liner is coated with the pressure-sensitive adhesive composition and the resulting pressure-sensitive adhesive composition layer is dried and cured, and a method in which a substrate or a release liner is coated with the pressure-sensitive adhesive composition and the resulting pressure-sensitive adhesive

composition layer is irradiated with active energy ray and thus cured. If necessary, furthermore heating and drying may also be made.

[0205]

Examples of the active energy ray include ionizing radiations such as α -ray, β -ray, γ -ray, neutron ray and electron beam, and ultraviolet light, and in particular, ultraviolet light is preferable. The irradiation energy, the irradiation time, the irradiation method and the like of the active energy ray are not particularly limited.

[0206]

The pressure-sensitive adhesive composition can be produced by a known or conventional method. For example, an active energy ray curing type acrylic pressure-sensitive adhesive composition can be produced by mixing, if necessary, an additive (for example, a crosslinking agent of the urethane (meth)acrylate or the polyfunctional (meth)acrylate) with the acrylic monomer mixture or the partially polymerized product thereof.

[0207]

A known coating method may be utilized for coating with the pressure-sensitive adhesive composition. For example, a coater such as a gravure roll coater, a reverse roll coater, a kiss roll coater, a dip roll coater, a bar coater, a knife coater, a spray coater, a comma coater, or a direct coater may be used.

[0208]

In particular, in a case where the pressure-sensitive adhesive layer is formed by an active energy ray curing type pressure-sensitive adhesive composition, the active energy ray curing type pressure-sensitive adhesive composition preferably contains a photo-polymerization initiator. The active energy ray curing type pressure-sensitive adhesive composition, when contains an ultraviolet absorber, preferably includes at least a photo-polymerization initiator having light absorption characteristics in a wide wavelength range, as the photo-polymerization initiator. For example, it is preferable to include at least a photo-polymerization initiator having light absorption characteristics of not only ultraviolet light, but also visible light. The reason is because, while there is a concern about inhibition of curing by active energy ray due to the action of the ultraviolet absorber, the photo-polymerization initiator having light absorption characteristics in a wide wavelength range is included to thereby allow high photo-curing properties to be easily obtained in the pressure-sensitive adhesive composition.

[0209]

(Substrate)

In a case where the optical pressure-sensitive adhesive sheet of the present invention is a pressure-sensitive adhesive sheet provided with a substrate, the substrate is not particularly limited and examples

include various optical films such as a plastic film, an antireflective (AR) film, a polarizing plate, and a phase difference plate. Examples of the materials for the plastic film and the like include plastic materials, for example, polyester-based resins such as polyethylene terephthalate (PET), acrylic resins such as polymethyl methacrylate (PMMA), polycarbonate, triacetyl cellulose (TAC), polysulfone, polyarylate, polyimide, polyvinyl chloride, polyvinyl acetate, polyethylene, polypropylene, ethylene-propylene copolymers, and cyclic olefin-based polymers such as trade name "Arton" (cyclic olefin-based polymer, manufactured by JSR Corporation) and trade name "Zeonor" (cyclic olefin-based polymer, manufactured by Zeon Corporation). Such plastic materials can be used singly or in combinations of two or more thereof. The "substrate" is a portion to be laminated on an object (such as an optical member), together with the pressure-sensitive adhesive layer, in lamination of the pressure-sensitive adhesive sheet onto the object. A release liner to be separated in use (in lamination) of the pressure-sensitive adhesive sheet is not included in the "substrate".

[0210]

The substrate is preferably transparent. The total light transmittance (according to JIS K 7361-1) in the visible light wavelength region, of the substrate, is not particularly limited, and is preferably 85% or more, more

preferably 88% or more. The haze (according to JIS K 7136) of the substrate is not particularly limited, and is preferably 1.5% or less, more preferably 1.0% or less.
[0211]

The thickness of the substrate is not particularly limited, and is, for example, preferably 12 to 75 μm . The substrate may have any form of a single layer and multiple layers. A surface of the substrate may be appropriately subjected to a known or conventional surface treatment, for example, a physical treatment such as a corona discharge treatment or a plasma treatment, and/or a chemical treatment such as an undercoat treatment.

[0212]

(Release liner)

The optical pressure-sensitive adhesive sheet of the present invention may be provided with a release liner (separator) on a surface (adhesive face) of the pressure-sensitive adhesive layer, until usage. In a case where the optical pressure-sensitive adhesive sheet of the present invention is a double-coated pressure-sensitive adhesive sheet, adhesive faces may be protected by respective such two release liners, or may be protected by such one release liner in which both faces are release faces, in the form of being wound in a roll shape (wound article). The release liner is used as a protective material of the pressure-sensitive adhesive layer, and

separated in lamination onto an object. In a case where the optical pressure-sensitive adhesive sheet of the present invention is a substrate-less pressure-sensitive adhesive sheet, the release liner also serves as a support of the pressure-sensitive adhesive layer. Herein, the release liner does not necessarily have to be provided.

[0213]

The release liner here used can be conventional release paper and is not particularly limited, and examples include a substrate having a release-treated layer, a low-adhesive substrate including a fluoropolymer, and a low-adhesive substrate including a non-polar polymer. Examples of the substrate having a release-treated layer include a plastic film and paper which are each surface-treated by a release treatment agent such as a silicone-based, long-chain alkyl, fluorine-based, or molybdenum sulfide agent. With respect to the low-adhesive substrate including a fluoropolymer, examples of the fluoropolymer include polytetrafluoroethylene, polychlorotrifluoroethylene, polyvinyl fluoride, polyvinylidene fluoride, a tetrafluoroethylene-hexafluoropropylene copolymer, and a chlorofluoroethylene-vinylidene fluoride copolymer. Examples of the non-polar polymer include olefin-based resins (for example, polyethylene and polypropylene). The release liner can be formed by a known or

conventional method. The thickness of the release liner is also not particularly limited.

[0214]

The optical pressure-sensitive adhesive sheet of the present invention is preferably produced by a known or conventional production method without any particular limitation. For example, the optical pressure-sensitive adhesive sheet of the present invention, which is a substrate-less pressure-sensitive adhesive sheet, is obtained by forming the pressure-sensitive adhesive layer in the present invention on the release liner according to the above method. The optical pressure-sensitive adhesive sheet of the present invention, which is a pressure-sensitive adhesive sheet provided with a substrate, may be obtained by directly forming the pressure-sensitive adhesive layer in the present invention on a surface of the substrate (direct method), or may be obtained by forming the pressure-sensitive adhesive layer in the present invention on the release liner once, and then transferring (laminating) the resultant on the substrate to thereby provide the pressure-sensitive adhesive layer in the present invention on the substrate (transfer method).

[0215]

(Optical member laminate, image display apparatus)

The optical pressure-sensitive adhesive sheet of the present invention is used in an optical application.

More specifically, it is used in an application for lamination onto an optical member of a product (optical product) in which the optical member is used. When the optical pressure-sensitive adhesive sheet of the present invention is laminated onto an optical member having a film formed by a layer (metal wiring layer) in which metal wiring including silver and copper is printed, the lamination may be made so that an adhesive face of the pressure-sensitive adhesive layer in the present invention is brought into contact with the metal wiring layer (direct lamination) or the lamination may be made onto a layer (for example, an optical member other than the metal wiring layer) other than the metal wiring layer. The optical pressure-sensitive adhesive sheet of the present invention is preferably used in particular in an application for lamination onto the metal wiring layer. Examples of the metal wiring layer include a layer in which a metal fine line including silver is mesh-printed, a film (silver nanowire film) formed by a metal fine line (nanowire) including silver, and routing wiring of silver and copper disposed on a peripheral portion.

[0216]

The optical member refers to a member having optical characteristics (for example, polarization properties, photorefractive properties, light scattering properties, light reflective properties, light permeability, light absorption properties, light diffraction properties,

optical rotation, and visibility). A base plate constituting the optical member is not particularly limited, examples include a base plate constituting equipment (optical equipment) such as a display apparatus (image display apparatus) or an input unit, or a base plate for use in such equipment, and examples include a polarizing plate, a wavelength plate, a phase difference plate, an optical compensation film, a brightness enhancement film, a light guide plate, a reflective film, an antireflective film, a hard coating film (film in which at least one face of a plastic film such as a PET film is subjected to a hard coating treatment), a transparent conductive film, a design film, a decorative film, a surface protection plate, a prism, a lens, a color filter, and a transparent base plate (a glass base plate, for example, a glass sensor, a display panel (for example, LCD) made of glass, and a glass plate with a transparent electrode), as well as a base plate in which any of the above is laminated (these may be collectively referred as "functional film"). Such a film may have, for example, a printed layer and/or a conductive polymer layer. The "plate" and the "film" each encompass, for example, plate-shaped, film-shaped, and sheet-shaped forms, and, for example, the "polarizing film" encompasses a "polarizing plate" and a "polarizing sheet".

[0217]

Examples of the optical member also include a touch sensor and a film sensor. More specifically, examples include a film having an ITO (indium tin oxide) layer on a surface thereof; a film having a zinc oxide (ZnO) layer on a surface thereof; a film using a metal nanoparticle, for example, a film obtained by coating a surface thereof with a metal nanoparticle-containing liquid and a film obtained by mesh-printing on a surface thereof with a metal nanoparticle-containing liquid; a film using a carbon nanotube, for example, a film obtained by coating a surface thereof with a carbon nanotube-containing dispersion liquid and a film obtained by mesh-printing on a surface thereof with a carbon nanotube-containing liquid: a film using graphene, for example, a film having a graphene layer on a surface thereof; and a transparent conductive film, for example, a film using a conductive polymer, for example, a film having a conductive polymer layer on a surface thereof and a film obtained by mesh-printing with a conductive polymer-containing liquid. Other examples include a film using a metal (in particular, copper), for example, a film in which a mesh-shaped metal fine line pattern is applied to the film and a film having a metal layer. Furthermore, examples include a silver nanowire film. The optical member, in which the optical pressure-sensitive adhesive sheet of the present invention is laminated, has a silver nanowire layer.

[0218]

Examples of the display panel include a liquid crystal display panel, an organic EL (electroluminescence) display panel, a PDP (plasma display panel), and an electron paper. Examples of the input unit include a touch panel. Examples also include so-called in-cell type display panel and on-cell type display panel each provided with a display panel and an input unit integrated.

[0219]

The base plate constituting the optical member is not particularly limited, and examples include respective base plates (for example, sheet-shaped, film-shaped, and plate-shaped base plates) made of, for example, glass, an acrylic resin, polycarbonate, polyethylene terephthalate, a cycloolefin polymer, and a metal thin film. The "optical member" in the present invention also encompasses any member (for example, a design film, a decorative film, and a surface protection film) which serves for decoration or protection with visibility being kept in a display apparatus or an input unit, as described above.

[0220]

The optical member laminate of the present invention is produced by laminating the optical member with the optical pressure-sensitive adhesive sheet of the present invention. For example, in a case where the optical

pressure-sensitive adhesive sheet of the present invention is a double-coated pressure-sensitive adhesive sheet having a release sheet on each of both faces, one release sheet can be separated and the optical member can be laminated, and another release sheet can be separated and another optical member can be laminated. When the optical member includes at least one display panel, the optical member laminate is an image display apparatus.

[0221]

Next, an aspect is described in which the optical pressure-sensitive adhesive sheet of the present invention is used in an optical member laminate. Figure 3 illustrates one example of the aspect in which the optical pressure-sensitive adhesive sheet of the present invention is used in an optical member laminate (in particular, image display apparatus). The aspect in which the optical pressure-sensitive adhesive sheet of the present invention is used in an optical member laminate is not limited to the aspect of Figure 3. Figure 3 is also a schematic cross-sectional view illustrating one example of an image display apparatus in which the optical pressure-sensitive adhesive sheet of the present invention is used. The image display apparatus of Figure 3 has a structure of an optical member laminate in which the optical member is laminated with the optical pressure-sensitive adhesive sheet of the present invention being interposed. In Figure 3, 3

represents an optical member laminate (image display apparatus), 31 represents a transparent cover member, 32 represents the optical pressure-sensitive adhesive sheet (pressure-sensitive adhesive layer) of the present invention, 33 represents a polarizing film, 34 represents an image display panel (on-cell type organic EL panel), 35 represents a metal wiring (copper wiring), 36 and 37 each represent a pressing plate, and 38 represents foreign substances. The transparent cover member 31 is cover glass or a cover lens (see Figure 3(a)).

[0222]

In the optical member laminate 3 (image display apparatus), the transparent cover member 31, the optical pressure-sensitive adhesive sheet 32, the polarizing film 33, and the image display panel 34 (on-cell type organic EL panel) are laminated in the listed order. The optical member laminate 3 is obtained by pressure-bonding from above and below by the pressing plates 36 and 37 (see Figure 1(b)). In the pressure-bonding, the optical pressure-sensitive adhesive sheet 32 is excellent in followability to steps, thus is sufficiently followed to steps formed by the metal wiring 35 (copper wiring), and packed in voids without any bubbles remaining.

[0223]

If, for example, the foreign substances 38 are attached onto the pressing plate 37 in the pressure-bonding, the polarizing film 33 and the image display

panel 34 are pushed to generate depressed portions, and the depressed portions are absorbed due to flexibility of the optical pressure-sensitive adhesive sheet 32 (see Figure 1(b)).

[0224]

In a case where the pressure from the pressing plates 36 and 37 is released, the depressed portions are easily turned back to thereby allow the depressed portions to disappear or allow few depressed portions to remain, thereby hardly causing white spots to occur, because the optical pressure-sensitive adhesive sheet 32 is configured from the optical pressure-sensitive adhesive sheet of the present invention (see Figure 1(c)).

Examples

[0225]

Hereinafter, the present invention is more specifically described based on Examples, but the present invention is not limited to these Examples.

[0226]

(Production Example)

[Production of acrylic oligomer]

60 parts by weight of dicyclopentanyl methacrylate (DCPMA), 40 parts by weight of methyl methacrylate (MMA), 3.5 parts by weight of α -thioglycerol as a chain transfer agent, and 100 parts by weight of toluene as a polymerization solvent were mixed, and stirred at 70°C for 1 hour under a nitrogen atmosphere. Next, 0.2 parts

by weight of 2,2'-azobisisobutyronitrile (AIBN) as a thermal polymerization initiator was loaded, and the resulting mixture was reacted at 70°C for 2 hours and then heated to 80°C and reacted for 2 hours. Thereafter, the reaction liquid was heated to 130°C, toluene, the chain transfer agent and unreacted monomers were removed by drying, and thus a solid acrylic oligomer was obtained. The weight average molecular weight of the acrylic oligomer was 5100.

[0227]

(Example 1)

After 0.05 parts by weight of a photo-polymerization initiator (trade name "Omnirad 184", manufactured by BASF SE) and 0.05 parts by weight of a photo-polymerization initiator (trade name "Omnirad 651", manufactured by BASF SE) were compounded with a monomer mixture of 78 parts by weight of n-butyl acrylate (BA), 16 parts by weight of N-vinyl-2-pyrrolidone(NVP) and 6 parts by weight of 4-hydroxybutyl acrylate (4HBA), the resultant was irradiated with ultraviolet light until the viscosity (BH viscometer No. 5 rotor, 10 rpm, measurement temperature 30°C) was about 20 Pa·s, and thus a prepolymer composition in which the monomer component was partially polymerized was obtained.

To the prepolymer composition were added 3 parts by weight of N-vinyl-2-pyrrolidone(NVP), 8 parts by weight of 4-hydroxybutyl acrylate (4HBA), 0.7 parts by weight of

a diluted liquid of an ultraviolet absorber (UVA) (trade name "Tinosorb S", manufactured by Iwase Cosfa Co., Ltd.), 0.4 parts by weight of a photo-polymerization initiator (trade name "Omnirad 819", manufactured by BASF SE), 5.8 parts by weight of the acrylic oligomer prepared in the Production Example, 1.7 parts by weight of urethane acrylate (trade name "UN350", manufactured by Negami Chemical Industrial Co., Ltd.), 0.1 parts by weight of trimethylolpropane triacrylate (TMPTA), 0.5 parts by weight of an antioxidant (trade name "Irganox 1010", manufactured by BASF SE), 0.15 parts by weight of 1,2,3-benzotriazole (trade name "BT-120", manufactured by Johoku Chemical Co., Ltd.), 0.07 parts by weight of a chain transfer agent (α -methylstyrene dimer: α -MSD), and 0.35 parts by weight of a silane coupling agent (trade name "KBM-403", manufactured by Shin-Etsu Chemical Co., Ltd.), the resultant was mixed, and thus an acrylic pressure-sensitive adhesive composition was obtained.

A polyethylene terephthalate (PET)-based release liner (manufactured by Nitto Denko Corporation, thickness: 125 μ m) was coated with the acrylic pressure-sensitive adhesive composition, and thus a pressure-sensitive adhesive composition layer was formed. Next, a PET-based release liner (manufactured by Nitto Denko Corporation, thickness: 125 μ m) was provided on the pressure-sensitive adhesive composition layer to cover the pressure-sensitive adhesive composition layer for

oxygen insulation. Thus, a laminate (laminate (I)) having a configuration of [release liner/pressure-sensitive adhesive composition layer/release liner] was obtained.

Next, laminate (I) was irradiated with ultraviolet light at an illumination level of 3 mW/cm² by a black light (manufactured by Toshiba Corporation) through an upper face (release liner side) of laminate (I) for 300 seconds. Furthermore, the laminate was subjected to a drying treatment with a drier at 90°C for 2 minutes to volatilize the remaining monomer, and thus a double-coated pressure-sensitive adhesive sheet (substrate-less pressure-sensitive adhesive sheet) was produced which had a configuration of [release liner/pressure-sensitive adhesive layer/release liner] and in which both adhesive faces were protected by the release liners. The thickness of the double-coated pressure-sensitive adhesive sheet (the thickness thereof excluding the release liners) was 50 μm.

[0228]

(Example 2)

A double-coated pressure-sensitive adhesive sheet (substrate-less pressure-sensitive adhesive sheet) was produced in the same manner as in Example 1 except that the amount of the trimethylolpropane triacrylate (TMPTA) used was 0.08 parts by weight and no chain transfer agent was compounded.

[0229]

(Example 3)

A double-coated pressure-sensitive adhesive sheet (substrate-less pressure-sensitive adhesive sheet) was produced in the same manner as in Example 1 except that the amount of the trimethylolpropane triacrylate (TMPTA) used was 0.2 parts by weight.

[0230]

(Example 4)

After 0.035 parts by weight of a photo-polymerization initiator (trade name "Omnirad 184", manufactured by BASF SE) and 0.035 parts by weight of a photo-polymerization initiator (trade name "Omnirad 651", manufactured by BASF SE) were compounded with a monomer mixture of 78 parts by weight of 2-ethylhexyl acrylate (2EHA), 18 parts by weight of N-vinyl-2-pyrrolidone (NVP) and 4 parts by weight of 2-hydroxyethyl acrylate (HEA), the resultant was irradiated with ultraviolet light until the viscosity (BH viscometer No.5 rotor, 10 rpm, measurement temperature 30°C) was about 20 Pa·s, and thus a prepolymer composition in which the monomer component was partially polymerized was obtained.

To the prepolymer composition were added 17.6 parts by weight of 2-hydroxyethyl acrylate (HEA), 0.7 parts by weight of a diluted liquid of an ultraviolet absorber (UVA) (trade name "Tinosorb S", manufactured by Iwase Cosfa Co., Ltd.), 0.12 parts by weight of a photo-

polymerization initiator (trade name "Omnirad 819", manufactured by BASF SE), 7 parts by weight of the acrylic oligomer prepared in the Production Example, 0.088 parts by weight of hexane diol diacrylate (HDDA), and 0.35 parts by weight of a silane coupling agent (trade name "KBM-403", manufactured by Shin-Etsu Chemical Co., Ltd.), the resultant was mixed, and thus an acrylic pressure-sensitive adhesive composition was obtained.

A polyethylene terephthalate (PET)-based release liner (manufactured by Nitto Denko Corporation, thickness: 125 μm) was coated with the acrylic pressure-sensitive adhesive composition, and thus a pressure-sensitive adhesive composition layer was formed. Next, a PET-based release liner (manufactured by Nitto Denko Corporation, thickness: 125 μm) was provided on the pressure-sensitive adhesive composition layer to cover the pressure-sensitive adhesive composition layer for oxygen insulation. Thus, a laminate (laminate (II)) having a configuration of [release liner/pressure-sensitive adhesive composition layer/release liner] was obtained.

Next, laminate (II) was irradiated with ultraviolet light at an illumination level of 3 mW/cm² by a black light (manufactured by Toshiba Corporation) through an upper face (release liner side) of laminate (II) for 300 seconds. Furthermore, the laminate was subjected to a drying treatment with a drier at 90°C for 2 minutes to

volatilize the remaining monomer, and thus a double-coated pressure-sensitive adhesive sheet (substrate-less pressure-sensitive adhesive sheet) was produced which had a configuration of [release liner/pressure-sensitive adhesive layer/release liner] and in which both adhesive faces were protected by the release liners. The thickness of the double-coated pressure-sensitive adhesive sheet (the thickness thereof excluding the release liners) was 50 μm .

[0231]

(Comparative Example 1)

A double-coated pressure-sensitive adhesive sheet (substrate-less pressure-sensitive adhesive sheet) was produced in the same manner as in Example 1 except that no trimethylolpropane triacrylate (TMPTA) was compounded.

[0232]

(Comparative Example 2)

A double-coated pressure-sensitive adhesive sheet (substrate-less pressure-sensitive adhesive sheet) was produced in the same manner as in Example 1 except that the amount of the trimethylolpropane triacrylate (TMPTA) used was 1.2 parts by weight.

[0233]

(Comparative Example 3)

A double-coated pressure-sensitive adhesive sheet (substrate-less pressure-sensitive adhesive sheet) was produced in the same manner as in Example 1 except that

the amount of the trimethylolpropane triacrylate (TMPTA) used was 0.05 parts by weight.

[0234]

(Evaluation)

Each of the double-coated pressure-sensitive adhesive sheets obtained in Examples and Comparative Examples was evaluated as follows. The results were shown in Table 2.

[0235]

(1) Gel fraction

About 1 g of the pressure-sensitive adhesive layer was collected, and the weight thereof was measured and defined as the "weight of the pressure-sensitive adhesive layer before immersion". Next, the pressure-sensitive adhesive layer collected was immersed in ethyl acetate 40 g for 7 days, thereafter a component not dissolved in ethyl acetate (portion not dissolved) was fully recovered, the entire portion not dissolved, recovered, was dried at 130°C for 2 hours for removal of ethyl acetate, and thereafter the weight was measured and defined as the "dry weight of the portion not dissolved" (the weight of the pressure-sensitive adhesive layer after immersion). The resulting numerical value was then plugged in the following expression for calculation.

Gel fraction (% by weight) = [(Dry weight of portion not dissolved)/(Weight of pressure-sensitive adhesive layer before immersion)] × 100

[0236]

(2) Dynamic viscoelasticity measurement

One in which ten of the pressure-sensitive adhesive sheets were laminated and the thickness was about 1 mm was adopted as a measurement sample. "Advanced Rheometric Expansion System (ARES)" manufactured by Rheometric Scientific Ltd. was used to perform dynamic viscoelasticity measurement in the following conditions. (Measurement conditions)

Deformation mode: torsion

Measurement frequency: 1 Hz

Rate of temperature rise: 5°C/min

Shape: parallel plate, 8 mmφ

[0237]

(3) Compressibility after pressure release, and compressibility immediately after pressurizing

The pressure-sensitive adhesive layer from each of the double-coated pressure-sensitive adhesive sheets obtained in Examples and Comparative Examples was laminated at 1 mm and cut out to a disk having a diameter of 8 mm, and thus each sample was obtained. The "compressibility after pressure release" and the "compressibility immediately after pressurizing" were determined according to the form illustrated in Figure 1. Specifically, "Advanced Rheometric Expansion System (ARES)" manufactured by Rheometric Scientific Ltd., including parallel plates 11 and 12 each having a

diameter of 8 mm, was used, and the upper face of the parallel plate 11 and the bottom face of the parallel plate 12 were respectively aligned positionally and abutted with the bottom face and the upper face of the pressure-sensitive adhesive layer of such each sample (Figure 1(b)). Next, a pressure F_1 of 0.35 MPa was applied from the parallel plates 11 and 12 toward the pressure-sensitive adhesive layer 10 at an ambient temperature of 50°C for 10 seconds (Figure 1(c)). Next, the parallel plates 11 and 12 were released from the pressure, and left to still stand for 300 seconds (Figure 1(d)). The percentage (%) of the amount of change of the thickness of the pressure-sensitive adhesive layer after 300 seconds from pressure release (Figure 1(d)) relative to the thickness (100%) of the pressure-sensitive adhesive layer at the initial stage (Figure 1(b)) was calculated as the "compressibility after pressure release", and the percentage (%) of the amount of change of the thickness of the pressure-sensitive adhesive layer immediately after pressurizing for 10 seconds (Figure 1(c)) relative to the thickness (100%) of the pressure-sensitive adhesive layer at the initial stage (Figure 1(b)) was calculated as the "compressibility immediately after pressurizing".

[0238]

(4) Strains after 6000 seconds and 8000 seconds from shear force release, and strain immediately after shear force

The pressure-sensitive adhesive layer from each of the double-coated pressure-sensitive adhesive sheets obtained in Examples and Comparative Examples was laminated at 1 mm and cut out to a disk having a diameter of 8 mm, and thus each sample was obtained. The "compressibility after pressure release" was determined according to the form illustrated in Figure 2. Specifically, "Advanced Rheometric Expansion System (ARES)" manufactured by Rheometric Scientific Ltd., including parallel plates 21 and 22 each having a diameter of 8 mm, was used, and the upper face of the parallel plate 21 and the bottom face of the parallel plate 22 were respectively aligned positionally and abutted with the bottom face and the upper face of the pressure-sensitive adhesive layer of such each sample (Figure 2(b)). Next, a shear force F_2 in a torsional direction, of 2000 Pa, was applied from the parallel plates 21 and 22 toward the pressure-sensitive adhesive layer at an ambient temperature of 50°C for 4000 seconds (Figure 2(c)). Next, the parallel plates 21 and 22 were released from the shear force, and left to still stand for 6000 and 8000 seconds (Figure 2(d)). The percentage (%) of the amount of change of the outer perimeter in the torsional direction of the pressure-sensitive adhesive

layer 20 after 6000 seconds from shear force release and that after 8000 seconds from shear force release (Figure 2(d)), relative to the outer perimeter (100%) of the pressure-sensitive adhesive layer at the initial stage (Figure 2(a)), were respectively calculated as the "strain after shear force release (6000 seconds)" and the "strain after shear force release (8000 seconds)", and the percentage (%) of the amount of change of the outer perimeter in the torsional direction of the pressure-sensitive adhesive layer 20 immediately after shear force application for 4000 seconds (Figure 2(c)) relative to the outer perimeter (100%) of the pressure-sensitive adhesive layer 20 at the initial stage (Figure 2(a)) was calculated as the "strain immediately after shear force".

[0239]

(5) Evaluation of white spots

Each of the double-coated pressure-sensitive adhesive sheets obtained in Examples and Comparative Examples was used, a PET film (Lumirror S10, manufactured by Toray Industries, Inc., thickness: 50 μm) and a glass base plate (Eagle XG, manufactured by Corning Incorporated, thickness: 0.7 mm) were laminated thereon and the resultant was pressure-bonded in an autoclave (50°C, 0.5 atm) for 15 minutes, and thus an optical member laminate including PET film/pressure-sensitive adhesive layer/glass base plate was produced.

A probe having a diameter of 1 mm was applied at a load of 1 N through the PET film of the optical member laminate by use of SAICAS (precise oblique cutting apparatus) in the following conditions for 180 seconds.

Apparatus: SAICAS DN-20 model manufactured by Daipia Wintes Co., Ltd.

Indenter: spherical indenter (radius: 500 μm)

Vertical speed: 5.0 $\mu\text{m}/\text{sec}$

Vertical load: 1 N

Retention time: 180 seconds

[0240]

The following Wyko (surface roughness meter) was used to measure depth (T0) immediately after probe indentation and depths (T6, T24) after 6 hours and 24 hours after probe indentation, of depressed portions. In addition, the presence of white spots after 24 hours was visually confirmed.

Apparatus: Wyko NT9100 manufactured by Veeco Instruments Inc.

Measurement type: VSI system

Objective lens: 2.5×

FOX lens: 1.0×

Measurement area: 2.5 mm × 1.9 mm

[0241]

[Table 2]

(Table 2)

	Example 1	Example 2	Example 3	Example 4	Comparative Example 1	Comparative Example 2	Comparative Example 3
Physical properties	Gel fraction (5)	78.2	85.6	83.3	88	60.2	65.2
	Storage elastic modulus (25°C)(MPa)	0.22	0.23	0.23	0.12	0.21	0.23
	Storage elastic modulus (85°C)(MPa)	0.07	0.13	0.09	0.11	0.06	0.06
	Loss tangent (70°C)	0.28	0.17	0.2	0.18	0.4	0.37
Compression test	Compressibility (%) immediately after pressurizing	33.1	32.2	31.2	33.4	36.8	34.6
	Compressibility (%) after pressure release	2.4	1.4	1.2	1.4	5.6	4.6
	Compressibility after pressure release/Compressibility immediately after pressurizing	0.073	0.043	0.038	0.042	0.152	0.133
	Strain immediately after shear force	3.5	2	1.9	3.8	9.6	8.3
Shear test	Strain after 6000 seconds after shear force release	0.7	0.3	0.3	0.3	2.3	2
	Strain after 8000 seconds after shear force release	0.6	0.3	0.2	0.1	1.7	1.5
White spot	T0 (μm)	74.9	61.3	60.7	68	77.2	76.7
	T6 (μm)	2.2	2.2	1.9	2.2	3.6	2.9
	T24 (μm)	2	1.9	1.7	1.9	3.1	2.85
	White spot	No	No	No	No	Yes	Yes

[0242]

Hereinafter, variations of the present invention are noted.

[Note 1] An optical pressure-sensitive adhesive sheet including a pressure-sensitive adhesive layer, wherein

the pressure-sensitive adhesive layer has a compressibility of the pressure-sensitive adhesive layer after 300 seconds from pressure release in the following compression test of 3.5% or less:

<Compression test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is pressurized at 0.35 MPa from above and below at 50°C for 10 seconds, and left to still stand for 300 seconds after pressure release.

[Note 2] An optical pressure-sensitive adhesive sheet including a pressure-sensitive adhesive layer, wherein

the pressure-sensitive adhesive layer has a strain of the pressure-sensitive adhesive layer after 6000 seconds from shear force release in the following shear test of 1.4% or less:

<Shear test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is subjected to a shear force in a torsional direction at 2000 Pa from above and below at 50°C for 4000 seconds,

and left to still stand for 6000 seconds after shear force release.

[Note 3] The optical pressure-sensitive adhesive sheet described in Note 1, wherein a compressibility immediately after pressurizing for 10 seconds in the compression test is 20% or more.

[Note 4] The optical pressure-sensitive adhesive sheet described in any one of Notes 1 to 3, wherein a gel fraction of the pressure-sensitive adhesive layer is 73% or more.

[Note 5] An optical member laminate including the optical pressure-sensitive adhesive sheet described in any one of Notes 1 to 4.

[Note 6] The optical member laminate described in Note 5, wherein the optical member laminate is an image display apparatus.

Reference Signs List

[0243]

10 pressure-sensitive adhesive layer

11, 12 parallel plate

20 pressure-sensitive adhesive layer

21, 22 parallel plate

3 optical member laminate (image display apparatus)

31 transparent cover member

32 optical pressure-sensitive adhesive sheet (pressure-sensitive adhesive layer)

33 polarizing film

34 image display panel (on-cell type organic EL panel)

35 metal wiring (copper wiring)

36, 37 pressing plate

38 foreign substance

Claims

[Claim 1]

An optical pressure-sensitive adhesive sheet comprising a pressure-sensitive adhesive layer, wherein the pressure-sensitive adhesive layer has a compressibility of the pressure-sensitive adhesive layer after 300 seconds from pressure release in the following compression test of 3.5% or less:

<Compression test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is pressurized at 0.35 MPa from above and below at 50°C for 10 seconds, and left to still stand for 300 seconds after pressure release.

[Claim 2]

An optical pressure-sensitive adhesive sheet comprising a pressure-sensitive adhesive layer, wherein the pressure-sensitive adhesive layer has a strain of the pressure-sensitive adhesive layer after 6000 seconds from shear force release in the following shear test of 1.4% or less:

<Shear test>

A disk-shaped pressure-sensitive adhesive layer having a thickness of 1 mm and a diameter of 8 mm is subjected to a shear force in a torsional direction at 2000 Pa from above and below at 50°C for 4000 seconds,

and left to still stand for 6000 seconds after shear force release.

[Claim 3]

The optical pressure-sensitive adhesive sheet according to claim 1, wherein a compressibility immediately after pressurizing for 10 seconds in the compression test is 20% or more.

[Claim 4]

The optical pressure-sensitive adhesive sheet according to any one of claims 1 to 3, wherein a gel fraction of the pressure-sensitive adhesive layer is 73% or more.

[Claim 5]

An optical member laminate comprising the optical pressure-sensitive adhesive sheet according to any one of claims 1 to 4.

[Claim 6]

The optical member laminate according to claim 5, wherein the optical member laminate is an image display apparatus.