

Description

Title of Invention: STRESS DISTRIBUTING FILM, OPTICAL MEMBER, AND ELECTRONIC MEMBER

Technical Field

[0001]

The present invention relates to a stress distributing film, and an optical member and an electronic member each including the stress distributing film.

Background Art

[0002]

A pressure-sensitive adhesive film is sometimes bonded to the exposed surface side of an optical member or an electronic member, such as a touch panel using a LCD, the lens portion of a camera, or electronic equipment, for imparting rigidity or impact resistance (for example, Patent Literature 1). Such pressure-sensitive adhesive film typically has a base material layer and a pressure-sensitive adhesive layer.

[0003]

A load due to an indentation force may be applied to such optical member or electronic member as described above in various situations, for example, at the time of assembly, at the time of processing, at the time of transfer, and at the time of use, and a problem in

that the optical member or the electronic member is damaged by such load occurs.

Citation List

Patent Literature

[0004]

[PTL 1] JP 2014-234460 A

Summary of Invention

Technical Problem

[0005]

An object of the present invention is to provide a stress distributing film having an excellent stress distributing property. Another object of the present invention is to provide an optical member and an electronic member each including such stress distributing film.

Solution to Problem

[0006]

According to one embodiment of the present invention, there is provided a stress distributing film, including a laminate of a plastic film and a pressure-sensitive adhesive layer, in which an indentation energy required when a load is applied from a plastic film side of the laminate in a direction vertical to the laminate is 260 μ J or more.

[0007]

In one embodiment, the plastic film has a thickness of from 4 μm to 500 μm .

[0008]

In one embodiment, the pressure-sensitive adhesive layer has a thickness of from 1 μm to 300 μm .

[0009]

In one embodiment, the pressure-sensitive adhesive layer is formed of a pressure-sensitive adhesive composition, and the pressure-sensitive adhesive composition contains a polymer (A) having a monomer unit (I) derived from a (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety and a monomer unit (II) derived from a (meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof.

[0010]

In one embodiment, the pressure-sensitive adhesive composition satisfies a relationship of $([\text{NCO}] + [\text{epoxy}]) / ([\text{OH}] + [\text{COOH}]) < 0.05$, where [NCO] represents a molar content of an NCO group in the pressure-sensitive adhesive composition, [epoxy] represents a molar content of an epoxy group in the pressure-sensitive adhesive composition, [OH] represents

a molar content of a OH group in the pressure-sensitive adhesive composition, and [COOH] represents a molar content of a COOH group in the pressure-sensitive adhesive composition.

[0011]

In one embodiment, the pressure-sensitive adhesive composition contains an organic polyisocyanate-based cross-linking agent that is bifunctional or more and/or an epoxy-based cross-linking agent.

[0012]

In one embodiment, the pressure-sensitive adhesive composition contains a polymer (B) having a monomer unit derived from an alicyclic structure-containing (meth)acrylic acid ester represented by the general formula (1), the polymer having a weight-average molecular weight of 1,000 or more and less than 30,000:

$$\text{CH}_2=\text{C}(\text{R}^1)\text{COOR}^2\cdots (1)$$

in the general formula (1), R^1 represents a hydrogen atom or a methyl group, and R^2 represents a hydrocarbon group having an alicyclic structure.

[0013]

In one embodiment, the pressure-sensitive adhesive layer has a loss tangent $\tan\delta$ in an entire temperature region of from -40°C to 150°C of 0.10 or more.

[0014]

According to one embodiment of the present invention, there is provided an optical member, including the stress distributing film.

[0015]

According to one embodiment of the present invention, there is provided an electronic member, including the stress distributing film.

Advantageous Effects of Invention

[0016]

According to the present invention, the stress distributing film having an excellent stress distributing property can be provided. According to the present invention, the optical member and the electronic member each including such stress distributing film can also be provided.

Brief Description of Drawings

[0017]

FIG. 1 is a schematic sectional view of a stress distributing film according to one embodiment of the present invention.

FIG. 2 is a schematic sectional view of a stress distributing film according to another embodiment of the present invention.

Description of Embodiments

[0018]

In this description, the expression "(meth)acrylic" means "acrylic and/or methacrylic" and the expression "(meth)acrylate" means "acrylate and/or methacrylate". In addition, when the expression "weight" is used in this description, the expression may be replaced with "mass" that has been commonly used as an SI unit representing a weight.

[0019]

In this description, the expression "monomer unit (A) derived from (a)" means that the monomer unit (A) is a structural unit which is formed when an unsaturated double bond of the monomer (a) is cleaved by polymerization. The structural unit which is formed when an unsaturated double bond is cleaved by polymerization refers to a structural unit of -RpRqC-CRrRs- which is formed when an unsaturated double bond C=C of a structure of RpRqC=CRrRs (Rp, Rq, Rr, and Rs each represent any appropriate group bonded to a carbon atom through a single bond) is cleaved by polymerization.

[0020]

In this description, the content of a monomer unit in a polymer can be known by, for example, various structural analyses (such as NMR) of the polymer. In addition, even if various structural

analyses described above are not conducted, the content of a monomer unit derived from various monomers calculated based on a usage amount of the various monomers to be used for producing a polymer may be defined as the content of the monomer unit in the polymer. That is, the content of a monomer (m) in all the monomer components to be used for producing a polymer may be used as the content of a monomer unit derived from the monomer (m) in the polymer.

[0021]

<<<<Stress Distributing Film>>>>

A stress distributing film of the present invention includes a laminate of a plastic film and a pressure-sensitive adhesive layer. The number of the plastic films may be one, or may be two or more. The number of the pressure-sensitive adhesive layers may be one, or may be two or more.

[0022]

FIG. **1** is a schematic sectional view of a stress distributing film according to one embodiment of the present invention. In FIG. **1**, a stress distributing film **100** of the present invention is formed of a laminate of a plastic film **10** and a pressure-sensitive adhesive layer **20**. Any appropriate strong adhesion layer may be arranged on the surface of the pressure-sensitive adhesive layer **20**, though the layer is not shown in FIG. **1**.

[0023]

FIG. 2 is a schematic sectional view of a stress distributing film according to another embodiment of the present invention. In FIG. 2, the stress distributing film **100** of the present invention is formed of the pressure-sensitive adhesive layer **20**, the plastic film **10**, and the pressure-sensitive adhesive layer **20**, and has the pressure-sensitive adhesive layer **20**, the plastic film **10**, and the pressure-sensitive adhesive layer **20** in the stated order. That is, in FIG. 2, the stress distributing film **100** of the present invention is formed of the pressure-sensitive adhesive layer **20**, and the laminate of the plastic film **10** and the pressure-sensitive adhesive layer **20**. Any appropriate strong adhesion layer may be arranged on the surface of the pressure-sensitive adhesive layer **20** on one side or each of both sides, though the layer is not shown in FIG. 2.

[0024]

In the case of a form in which the pressure-sensitive adhesive layer is exposed as an outermost layer, any appropriate separator (release sheet) may be arranged on the exposed surface side.

[0025]

The indentation energy of the stress distributing film of the present invention required when a load is applied from the plastic film side of the laminate of the plastic film and the

pressure-sensitive adhesive layer in a direction vertical to the laminate is 260 μJ or more. A method of measuring the indentation energy is described later. The indentation energy is preferably from 260 μJ to 10,000 μJ , more preferably from 270 μJ to 9,000 μJ , still more preferably from 280 μJ to 8,000 μJ , particularly preferably from 290 μJ to 7,000 μJ . When the indentation energy falls within the range, a stress distributing film having an excellent stress distributing property can be provided.

[0026]

The thickness of the plastic film is preferably from 4 μm to 500 μm , more preferably from 10 μm to 400 μm , still more preferably from 15 μm to 350 μm , particularly preferably from 20 μm to 300 μm . When the thickness of the plastic film falls within the range, a stress distributing film having a more excellent stress distributing property can be provided.

[0027]

The thickness of the pressure-sensitive adhesive layer is preferably from 1 μm to 300 μm , more preferably from 2 μm to 250 μm , still more preferably from 4 μm to 200 μm , particularly preferably from 5 μm to 150 μm . When the thickness of the pressure-sensitive adhesive layer falls within the range, a stress distributing film having a more excellent stress distributing property can be provided.

[0028]

Any appropriate plastic film may be adopted as the plastic film to the extent that the effects of the present invention are not impaired. Such plastic film has, for example, a compressive strength in conformity with ASTM D695 of preferably from 100 kg/cm² to 3,000 kg/cm², more preferably from 200 kg/cm² to 2,900 kg/cm², still more preferably from 300 kg/cm² to 2,800 kg/cm², particularly preferably from 400 kg/cm² to 2,700 kg/cm². Specific examples of such plastic film include a polyester-based resin, a polyolefin-based resin, a polyamide-based resin, and a polyimide-based resin. Examples of the polyester-based resin include polyethylene terephthalate, polybutylene terephthalate, and polyethylene naphthalate. Examples of the polyolefin-based resin include a homopolymer of an olefin monomer and a copolymer of olefin monomers. Specific examples of the polyolefin-based resin include: homopolypropylene; propylene-based copolymers such as block, random, and graft copolymers each including an ethylene component as a copolymer component; reactor TPO; ethylene-based polymers such as low density, high density, linear low density, and ultra low density polymers; and ethylene-based copolymers such as an ethylene-propylene copolymer, an ethylene-vinyl acetate copolymer, an ethylene-methyl acrylate copolymer, an ethylene-ethyl acrylate copolymer, an ethylene-butyl acrylate copolymer, an ethylene-methacrylic acid copolymer, and an ethylene-methyl methacrylate copolymer.

[0029]

The plastic film may contain any appropriate additive as required. Examples of the additive that can be contained in the plastic film include an antioxidant, a UV absorbing agent, a light stabilizer, an antistatic agent, a filler, and a pigment. The kind, number, and amount of the additive that can be contained in the plastic film can be appropriately set depending on purposes.

[0030]

Any pressure-sensitive adhesive layer may be adopted as the pressure-sensitive adhesive layer to the extent that the effects of the present invention are not impaired. Examples of such pressure-sensitive adhesive layer include a pressure-sensitive adhesive layer formed of an acrylic pressure-sensitive adhesive, a pressure-sensitive adhesive layer formed of a rubber-based pressure-sensitive adhesive, a pressure-sensitive adhesive layer formed of a silicone-based pressure-sensitive adhesive, and a pressure-sensitive adhesive layer formed of a urethane-based pressure-sensitive adhesive.

[0031]

The pressure-sensitive adhesive layer is preferably formed of a pressure-sensitive adhesive composition.

[0032]

The pressure-sensitive adhesive layer is obtained, for example, as described below. The pressure-sensitive adhesive composition is applied onto any appropriate base material, and is dried as required to form the pressure-sensitive adhesive layer on the base material. After that, the base material is peeled. Thus, the pressure-sensitive adhesive layer is obtained. In addition, for example, when the pressure-sensitive adhesive composition is applied onto any appropriate plastic film, and is dried as required to form the pressure-sensitive adhesive layer on the plastic film, and the plastic film is left without being treated, a stress distributing film including the pressure-sensitive adhesive layer and the plastic film is obtained. In addition, for example, when the pressure-sensitive adhesive composition is applied onto any appropriate base material, and is dried as required to form the pressure-sensitive adhesive layer on the base material, and the pressure-sensitive adhesive layer obtained by peeling the base material is mounted on the plastic film, a stress distributing film including the pressure-sensitive adhesive layer and the plastic film is obtained. In addition, for example, when the pressure-sensitive adhesive composition is applied onto any appropriate base material, and is dried as required to form the pressure-sensitive adhesive layer on the base material, and the pressure-sensitive adhesive layer formed on the base material is transferred onto the plastic film, a stress distributing film

including the pressure-sensitive adhesive layer and the plastic film is obtained.

[0033]

As a method of applying the pressure-sensitive adhesive composition, for example, there are given roll coating, gravure coating, reverse coating, roll brush coating, spray coating, and air-knife coating methods, and extrusion coating using a die coater or the like.

[0034]

Such pressure-sensitive adhesive composition preferably contains a polymer (A) having a monomer unit (I) derived from a (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety and a monomer unit (II) derived from a (meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof.

[0035]

The content of the polymer (A) in the pressure-sensitive adhesive composition is preferably from 80 wt% to 100 wt%, more preferably from 85 wt% to 100 wt%, still more preferably from 90 wt% to 100 wt%, particularly preferably from 92.5 wt% to 100 wt%, most preferably from 95 wt% to 100 wt%. When the content of the polymer (A) in the pressure-sensitive adhesive composition falls

within the range, a stress distributing film having a more excellent stress distributing property can be provided.

[0036]

The polymer (A) has the monomer unit (I) derived from the (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety. The number of kinds of the monomer units (I) each derived from the (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety in the polymer (A) may be only one, or may be two or more.

[0037]

The content of the monomer unit (I) derived from the (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety in the polymer (A) is preferably from 90 wt% to 99.5 wt%, more preferably from 91 wt% to 99 wt%, still more preferably from 92 wt% to 98.5 wt%, particularly preferably from 93 wt% to 98.2 wt%, most preferably from 94 wt% to 98 wt%. When the content of the monomer unit (I) derived from the (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety in the polymer (A) falls within the range, a stress distributing film having a more excellent stress distributing property can be provided.

[0038]

Examples of the (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety include methyl (meth)acrylate, ethyl (meth)acrylate, n-butyl (meth)acrylate, s-butyl (meth)acrylate, t-butyl (meth)acrylate, isobutyl (meth)acrylate, hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, n-octyl (meth)acrylate, isooctyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, n-decyl (meth)acrylate, isodecyl (meth)acrylate, n-dodecyl (meth)acrylate, n-tridecyl (meth)acrylate, and n-tetradecyl (meth)acrylate.

[0039]

The polymer (A) has the monomer unit (II) derived from the (meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof. The number of kinds of the monomer units (II) each derived from the (meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof in the polymer (A) may be only one, or may be two or more. When the polymer (A) has the monomer unit (II) derived from the (meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof, a stress distributing film having a more excellent stress distributing property can be provided.

[0040]

The content of the monomer unit (II) derived from the

(meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof in the polymer (A) is preferably from 0.5 wt% to 10 wt%, more preferably from 1 wt% to 9 wt%, still more preferably from 1.5 wt% to 8 wt%, particularly preferably from 1.8 wt% to 7 wt%, most preferably from 2 wt% to 6 wt%. When the content of the monomer unit (II) derived from the (meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof in the polymer (A) falls within the range, a stress distributing film having a more excellent stress distributing property can be provided.

[0041]

Examples of the (meth)acrylic acid ester having a OH group in a molecule thereof include 2-hydroxyethyl (meth)acrylate, 2-hydroxypropyl (meth)acrylate, 4-hydroxybutyl (meth)acrylate, 6-hydroxyhexyl (meth)acrylate, 8-hydroxyoctyl (meth)acrylate, 10-hydroxydecyl (meth)acrylate, 12-hydroxylauryl (meth)acrylate, (4-hydroxymethylcyclohexyl)methyl acrylate, N-methylol (meth)acrylamide, vinyl alcohol, allyl alcohol, 2-hydroxyethyl vinyl ether, 4-hydroxybutyl vinyl ether, and diethylene glycol monovinyl ether.

[0042]

Examples of the (meth)acrylic acid ester having a COOH group in a molecule thereof include (meth)acrylic acid, carboxyethyl (meth)acrylate, carboxypentyl (meth)acrylate, itaconic acid,

maleic acid, fumaric acid, crotonic acid, and isocrotonic acid.

[0043]

The polymer (A) may have a monomer unit (III) derived from any other monomer. The number of kinds of the monomer units (III) each derived from the other monomer in the polymer (A) may be only one, or may be two or more.

[0044]

Examples of the other monomer include a cyano group-containing monomer, a vinyl ester monomer, an aromatic vinyl monomer, an amide group-containing monomer, an imide group-containing monomer, an amino group-containing monomer, an epoxy group-containing monomer, a vinyl ether monomer, N-acryloylmorpholine, a sulfo group-containing monomer, a phosphoric acid group-containing monomer, and an acid anhydride group-containing monomer.

[0045]

The pressure-sensitive adhesive composition satisfies a relationship of $([\text{NCO}] + [\text{epoxy}]) / ([\text{OH}] + [\text{COOH}]) < 0.05$, where $[\text{NCO}]$ represents a molar content of an NCO group in the pressure-sensitive adhesive composition, $[\text{epoxy}]$ represents a molar content of an epoxy group in the pressure-sensitive adhesive composition, $[\text{OH}]$ represents a molar content of a OH group in the pressure-sensitive adhesive composition, and $[\text{COOH}]$ represents a molar content of a

COOH group in the pressure-sensitive adhesive composition. When the ratio " $([\text{NCO}] + [\text{epoxy}]) / ([\text{OH}] + [\text{COOH}])$ " falls within the range, a stress distributing film having a more excellent stress distributing property can be provided. When no NCO group is present in the pressure-sensitive adhesive composition, $[\text{NCO}] = 0$, and when no epoxy group is present in the pressure-sensitive adhesive composition, $[\text{epoxy}] = 0$. That is, a lower limit value for the ratio " $([\text{NCO}] + [\text{epoxy}]) / ([\text{OH}] + [\text{COOH}])$ " is 0.

[0046]

The pressure-sensitive adhesive composition preferably contains an organic polyisocyanate-based cross-linking agent that is bifunctional or more and/or an epoxy-based cross-linking agent. The number of kinds of the organic polyisocyanate-based cross-linking agents that are bifunctional or more and/or the epoxy-based cross-linking agents that may be incorporated into the pressure-sensitive adhesive composition of the present invention may be only one, or may be two or more.

[0047]

The total content of the organic polyisocyanate-based cross-linking agent that is bifunctional or more and the epoxy-based cross-linking agent in the pressure-sensitive adhesive composition is preferably from 0.001 part by weight to 0.4 part by weight, more preferably from 0.0025 part by weight to 0.3 part by weight, still

more preferably from 0.005 part by weight to 0.2 part by weight, particularly preferably from 0.0075 part by weight to 0.15 part by weight, most preferably from 0.01 part by weight to 0.1 part by weight with respect to 100 parts by weight of the polymer (A). When the total content of the organic polyisocyanate-based cross-linking agent that is bifunctional or more and the epoxy-based cross-linking agent in the pressure-sensitive adhesive composition of the present invention falls within the range with respect to 100 parts by weight of the polymer (A), a stress distributing film having a more excellent stress distributing property can be provided.

[0048]

Examples of the organic polyisocyanate-based cross-linking agent that is bifunctional or more include: lower aliphatic polyisocyanates, such as butylene diisocyanate and hexamethylene diisocyanate; alicyclic isocyanates, such as cyclopentylene diisocyanate, cyclohexylene diisocyanate, and isophorone diisocyanate; aromatic isocyanates, such as 2,4-tolylene diisocyanate, 4,4'-diphenylmethane diisocyanate, and xylylene diisocyanate; and isocyanate adducts, such as a trimethylolpropane/tolylene diisocyanate trimer adduct (e.g., manufactured by Nippon Polyurethane Industry, product name: "Coronate L"), a trimethylolpropane/hexamethylene diisocyanate trimer adduct (e.g., manufactured by Nippon Polyurethane Industry, product name: "Coronate HL"), and an isocyanurate body of

hexamethylene diisocyanate (e.g., manufactured by Nippon Polyurethane Industry, product name: "Coronate HX").

[0049]

Examples of the epoxy-based cross-linking agent include bisphenol A, an epichlorohydrin-type epoxy-based resin, ethylene glycidyl ether, polyethylene glycol diglycidyl ether, glycerin diglycidyl ether, glycerin triglycidyl ether, 1,6-hexanediol glycidyl ether, trimethylolpropane triglycidyl ether, diglycidylaniline, diamine glycidyl amine, N,N,N',N'-tetraglycidyl-m-xylenediamine (e.g., manufactured by Mitsubishi Gas Chemical Company, product name: "TETRAD-X"), and 1,3-bis(N,N-diglycidylaminomethyl)cyclohexane (e.g., manufactured by Mitsubishi Gas Chemical Company, product name: "TETRAD-C").

[0050]

The pressure-sensitive adhesive composition may contain a polymer (B) having a monomer unit derived from an alicyclic structure-containing (meth)acrylic acid ester represented by the general formula (1), the polymer having a weight-average molecular weight of 1,000 or more and less than 30,000:



in the general formula (1), R^1 represents a hydrogen atom or a methyl group, and R^2 represents a hydrocarbon group having an alicyclic

structure.

[0051]

The number of kinds of the polymers (B) may be only one, or may be two or more.

[0052]

The weight-average molecular weight of the polymer (B) is preferably from 1,000 to 30,000, more preferably from 1,250 to 25,000, still more preferably from 1,500 to 20,000, particularly preferably from 1,750 to 15,000, most preferably from 2,000 to 10,000. When the weight-average molecular weight of the polymer (B) falls within the range, a stress distributing film having a more excellent stress distributing property can be provided even in the case where the amount of the cross-linking agent is increased.

[0053]

The content of the polymer (B) in the pressure-sensitive adhesive composition is preferably from 0.5 part by weight to 50 parts by weight, more preferably from 1 part by weight to 45 parts by weight, still more preferably from 2 parts by weight to 40 parts by weight, particularly preferably from 3 parts by weight to 35 parts by weight, most preferably from 4 parts by weight to 30 parts by weight with respect to 100 parts by weight of the polymer (A). When the content of the polymer (B) in the pressure-sensitive adhesive

composition falls within the range with respect to 100 parts by weight of the polymer (A), a stress distributing film having a more excellent stress distributing property can be provided even in the case where the amount of the cross-linking agent is increased.

[0054]

The content of the monomer unit derived from the alicyclic structure-containing (meth)acrylic acid ester represented by the general formula (1) in the polymer (B) is preferably from 40 wt% to 99.5 wt%, more preferably from 42.5 wt% to 99 wt%, still more preferably from 45 wt% to 98.5 wt%, particularly preferably from 47.5 wt% to 98 wt%, most preferably from 50 wt% to 97.5 wt%. When the content of the monomer unit derived from the alicyclic structure-containing (meth)acrylic acid ester represented by the general formula (1) in the polymer (B) falls within the range, a stress distributing film having a more excellent stress distributing property can be provided even in the case where the amount of the cross-linking agent is increased.

[0055]

Examples of the alicyclic structure-containing (meth)acrylic acid ester represented by the general formula (1) include cyclohexyl (meth)acrylate, dicyclopentanyl (meth)acrylate, dicyclopentanyloxyethyl methacrylate, dicyclopentanyloxyethyl acrylate, tricyclopentanyl methacrylate, tricyclopentanyl

acrylate, 1-adamantyl methacrylate, 1-adamantyl acrylate, 2-methyl-2-adamantyl methacrylate, 2-methyl-2-adamantyl acrylate, 2-ethyl-2-adamantyl methacrylate, and 2-ethyl-2-adamantyl acrylate.

[0056]

The polymer (B) may have a monomer unit (IV) derived from any other monomer. The number of kinds of the monomer units (IV) each derived from the other monomer in the polymer (B) may be only one, or may be two or more.

[0057]

Examples of the other monomer that may be contained in the polymer (B) include methyl (meth)acrylate, ethyl (meth)acrylate, n-butyl (meth)acrylate, s-butyl (meth)acrylate, t-butyl (meth)acrylate, isobutyl (meth)acrylate, hexyl (meth)acrylate, 2-ethylhexyl (meth)acrylate, n-octyl (meth)acrylate, isooctyl (meth)acrylate, n-nonyl (meth)acrylate, isononyl (meth)acrylate, n-decyl (meth)acrylate, isodecyl (meth)acrylate, n-dodecyl (meth)acrylate, n-tridecyl (meth)acrylate, n-tetradecyl (meth)acrylate, acrylic acid, methacrylic acid, carboxyethyl acrylate, carboxypentyl acrylate, itaconic acid, maleic acid, fumaric acid, crotonic acid, and isocrotonic acid.

[0058]

The polymer (A) and the polymer (B) may each be produced by any appropriate method to the extent that the effects of the present invention are not impaired. Examples of such production method include solution polymerization, emulsion polymerization, bulk polymerization, suspension polymerization, and photopolymerization (active energy ray polymerization). Of those production methods, solution polymerization is preferred from the viewpoints of cost and productivity. The polymer (A) to be obtained may be any one of, for example, a random copolymer, a block copolymer, an alternating copolymer, and a graft copolymer. The polymer (B) to be obtained may be any one of, for example, a random copolymer, a block copolymer, an alternating copolymer, and a graft copolymer.

[0059]

A method for the solution polymerization is, for example, a method involving dissolving a monomer component, a polymerization initiator, and the like in a solvent, and heating the solution to polymerize the component to provide a polymer solution.

[0060]

A heating temperature at the time of the polymerization by the heating in the solution polymerization is, for example, from 50°C to 90°C. A heating time in the solution polymerization is, for example, from 1 hour to 24 hours.

[0061]

Any appropriate solvent may be used as the solvent to be used in the solution polymerization to the extent that the effects of the present invention are not impaired. Examples of such solvent include organic solvents, for example: aromatic hydrocarbons, such as toluene, benzene, and xylene; esters, such as ethyl acetate and n-butyl acetate; aliphatic hydrocarbons, such as n-hexane and n-heptane; alicyclic hydrocarbons, such as cyclohexane and methylcyclohexane; and ketones, such as methyl ethyl ketone and methyl isobutyl ketone. The number of kinds of the solvents may be only one, or may be two or more.

[0062]

A polymerization initiator may be used in the production of the polymer (A) or the polymer (B). The number of kinds of such polymerization initiators may be only one, or may be two or more. Examples of such polymerization initiator include: azo-based initiators, such as 2,2'-azobisisobutyronitrile, 2,2'-azobis(2-amidinopropane) dihydrochloride, 2,2'-azobis[2-(5-methyl-2-imidazolin-2-yl)propane] dihydrochloride, 2,2'-azobis(2-methylpropionamidine) disulfate, 2,2'-azobis(N,N'-dimethyleneisobutylamidine), and 2,2'-azobis[N-(2-carboxyethyl)-2-methylpropionamidine] hydrate (VA-057 manufactured by Wako Pure Chemical Industries, Ltd.); persulfates, such as potassium persulfate and ammonium persulfate;

peroxide-based initiators, such as di(2-ethylhexyl) peroxydicarbonate, di(4-t-butylcyclohexyl) peroxydicarbonate, di-sec-butyl peroxydicarbonate, t-butyl peroxyneodecanoate, t-hexyl peroxy-pivalate, t-butyl peroxy-pivalate, dilauroyl peroxide, di-n-octanoyl peroxide, 1,1,3,3-tetramethylbutyl peroxy-2-ethylhexanoate, di(4-methylbenzoyl) peroxide, dibenzoyl peroxide, t-butyl peroxyisobutyrate, 1,1-di(t-hexylperoxy)cyclohexane, t-butyl hydroperoxide, and hydrogen peroxide; and redox-based initiators each obtained by combining a peroxide and a reducing agent, such as a combination of a persulfate and sodium hydrogen sulfite, and a combination of a peroxide and sodium ascorbate.

[0063]

Any appropriate usage amount may be adopted as the usage amount of the polymerization initiator to the extent that the effects of the present invention are not impaired. Such usage amount is, for example, preferably from 0.01 part by weight to 5 parts by weight with respect to 100 parts by weight of the monomer component.

[0064]

A chain transfer agent may be used in the production of the polymer (A) or the polymer (B). The number of kinds of such chain transfer agents may be only one, or may be two or more. Examples of such chain transfer agent include lauryl mercaptan, glycidyl

mercaptan, mercaptoacetic acid, 2-mercaptoethanol, thioglycolic acid, methyl thioglycolate, 2-ethylhexyl thioglycolate, and 2,3-dimercapto-1-propanol.

[0065]

Any appropriate usage amount may be adopted as the usage amount of the chain transfer agent to the extent that the effects of the present invention are not impaired. Such usage amount is, for example, preferably from 0.01 part by weight to 5 parts by weight with respect to 100 parts by weight of the monomer component.

[0066]

Any appropriate other additive that may be generally used in a polymerization reaction may be used in the production of the polymer (A) or the polymer (B).

[0067]

The pressure-sensitive adhesive composition of the present invention may contain a cross-linking catalyst. Any appropriate cross-linking catalyst may be adopted as the cross-linking catalyst to the extent that the effects of the present invention are not impaired. Examples of such cross-linking catalyst include metal-based cross-linking catalysts (in particular, tin-based cross-linking catalysts), such as tetra-n-butyl titanate, tetraisopropyl titanate, n-acetyl ferric iron, butyltin oxide, and

dioctyltin dilaurate. The number of kinds of the cross-linking catalysts may be only one, or may be two or more.

[0068]

Any appropriate usage amount may be adopted as the usage amount of the cross-linking catalyst to the extent that the effects of the present invention are not impaired. Such usage amount is, for example, preferably from 0.001 part by weight to 0.05 part by weight with respect to 100 parts by weight of the monomer component.

[0069]

The pressure-sensitive adhesive composition may contain any appropriate other additive to the extent that the effects of the present invention are not impaired. Examples of such other additive include a silane coupling agent, a cross-linking retarder, an emulsifier, a colorant, powder of a pigment or the like, a dye, a surfactant, a plasticizer, a tackifier, a surface lubricant, a levelling agent, a softening agent, an antioxidant, an age inhibitor, a light stabilizer, a UV absorbing agent, a polymerization inhibitor, an inorganic filler, an organic filler, metal powder, a particle, and a foil. The number of kinds of such other additives may be only one, or may be two or more.

[0070]

The pressure-sensitive adhesive layer preferably has a loss

tangent $\tan\delta$ in an entire temperature region of from -40°C to 150°C of 0.10 or more. When the loss tangent $\tan\delta$ of the pressure-sensitive adhesive layer in the entire temperature region of from -40°C to 150°C is 0.10 or more, a stress distributing film having a more excellent stress distributing property can be provided. A method of measuring the loss tangent $\tan\delta$ is described later.

[0071]

An upper limit for the loss tangent $\tan\delta$ of the pressure-sensitive adhesive layer in the entire temperature region of from -40°C to 150°C is preferably 2.40 or less, more preferably 2.20 or less, still more preferably 2.00 or less, particularly preferably 1.80 or less. When the upper limit for the loss tangent $\tan\delta$ falls within the range, a stress distributing film having a more excellent stress distributing property can be provided.

[0072]

A lower limit for the loss tangent $\tan\delta$ of the pressure-sensitive adhesive layer in the entire temperature region of from -40°C to 150°C is preferably 0.12 or more, more preferably 0.14 or more, still more preferably 0.16 or more, particularly preferably 0.18 or more. When the lower limit for the loss tangent $\tan\delta$ falls within the range, a stress distributing film having a more excellent stress distributing property can be provided.

[0073]

<<<<Optical Member and Electronic Member>>>>

The stress distributing film of the present invention has an excellent stress distributing property. Accordingly, the film can be suitably used as a protective material intended for, for example, the protection of an optical member or an electronic member from impact from the outside. That is, an optical member of the present invention includes the stress distributing film of the present invention. In addition, an electronic member of the present invention includes the stress distributing film of the present invention.

Examples

[0074]

Now, the present invention is described specifically by way of Examples. However, the present invention is by no means limited to Examples. Test and evaluation methods in Examples and the like are as described below. The term "part(s)" in the following description means "part(s) by weight" unless otherwise specified, and the term "%" in the following description means "wt%" unless otherwise specified.

[0075]

<Measurement of Weight-average Molecular Weight>

The weight-average molecular weight (M_w) of a polymer was

measured through use of a GPC device (HLC-8220GPC) manufactured by Tosoh Corporation. The weight-average molecular weight (Mw) was determined as a value in terms of polystyrene.

Measurement conditions are as follows.

Sample concentration: 0.2 wt% (THF solution)

Sample injection volume: 10 μ l eluting solution

THF flow rate: 0.6 ml/min

Measurement temperature: 40°C

Sample column: TSK guard column Super HZ-H (single)+TSKgel Super HZM-H (double)

Reference column: TSKgel Super H-RC (single)

Detector: differential refractometer (refractive index (RI) detector)

[0076]

<Production of Pressure-sensitive Adhesive Sheet (A)>

(Examples 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, and 26, and Comparative Examples 1, 3, 5, and 7)

An obtained pressure-sensitive adhesive composition was applied to a base material formed of a polyester resin "Lumirror S10" (thickness: 50 μ m, manufactured by Toray Industries, Inc.) with a fountain roll so that its thickness after drying became 10 μ m, and the composition was dried under the conditions of a drying temperature of 130°C and a drying time of 30 seconds to be cured. Thus, a pressure-sensitive adhesive layer was produced on the base

material. Next, one surface of a base material formed of a polyester resin having a thickness of 25 μm was subjected to a silicone treatment, and the silicone-treated surface was bonded to the surface of the pressure-sensitive adhesive layer. Thus, a pressure-sensitive adhesive sheet (A) was obtained.

(Examples 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24, and Comparative Examples 2, 4, 6, and 8)

An obtained pressure-sensitive adhesive composition was applied to a base material formed of a polyester resin "Lumirror S10" (thickness: 38 μm , manufactured by Toray Industries, Inc.) with a fountain roll so that its thickness after drying became 22 μm , and the composition was dried under the conditions of a drying temperature of 130°C and a drying time of 30 seconds to be cured. Thus, a pressure-sensitive adhesive layer was produced on the base material. Next, one surface of a base material formed of a polyester resin having a thickness of 25 μm was subjected to a silicone treatment, and the silicone-treated surface was bonded to the surface of the pressure-sensitive adhesive layer. Thus, a pressure-sensitive adhesive sheet (A) was obtained.

[0077]

<Measurement of Indentation Energy>

An indentation energy was calculated with "SAICAS MODEL DN-20" manufactured by Daipia Wintes Co., Ltd. at a measurement temperature

of 25°C and an indentation speed of 5 $\mu\text{m}/\text{sec}$ in accordance with the following procedures.

(Procedure 1)

The pressure-sensitive adhesive layer side of the resultant pressure-sensitive adhesive sheet (A) was bonded to a flat indenter (load detection side). The base material side of the pressure-sensitive adhesive sheet (A) bonded to the flat indenter was indented into a spherical indenter, and an indentation depth (μm) when a load of 20 N was detected was calculated.

(Procedure 2)

The pressure-sensitive adhesive layer side of the resultant pressure-sensitive adhesive sheet (A) was bonded to a slide glass. A spherical indenter was indented from the base material side (load detection side) of the pressure-sensitive adhesive sheet (A) bonded to the slide glass to the indentation depth determined in the procedure 1.

When a vertical load applied to the spherical indenter was represented by $y=f(x)$ (x : indentation depth), an indentation energy W (μJ) until the application of a load of 20 N to the pressure-sensitive adhesive layer side of the pressure-sensitive adhesive sheet (A) was calculated by the following equation (r represents an indentation depth when a load of 20 N is applied to the pressure-sensitive adhesive

layer side of the pressure-sensitive adhesive sheet (A)).

$$W(\mu J) = \int_0^r f(x) \cdot dx$$

[0078]

<Production of Pressure-sensitive Adhesive Sheet (B)>

One surface of a polyester film having a thickness of 38 μm (product name: MRF, manufactured by Mitsubishi Polyester Film, Inc.), the film serving as a base material, was subjected to a release treatment with a silicone, and an obtained pressure-sensitive adhesive composition was applied to the release-treated surface with a fountain roll so that its thickness after drying became 50 μm . The composition was dried under the conditions of a drying temperature of 130°C and a drying time of 3 minutes to be cured. Thus, a pressure-sensitive adhesive layer was produced on the base material. Next, one surface of a polyester film having a thickness of 38 μm (product name: MRF, manufactured by Mitsubishi Polyester Film, Inc.) was subjected to a release treatment with a silicone, and the surface of the pressure-sensitive adhesive layer was covered with the film so that the release-treated surface of the film was on a pressure-sensitive adhesive layer side. Thus, a pressure-sensitive adhesive sheet (B) was produced.

[0079]

<Measurement of Glass Transition Temperature (T_g), Storage Modulus of Elasticity, Loss Modulus of Elasticity, and $\tan\delta$ (Loss Tangent)>

The above-mentioned parameters were determined with a dynamic viscoelasticity-measuring apparatus (manufactured by Rheometrics, ARES) by the following method.

Only the pressure-sensitive adhesive layer was removed from the resultant pressure-sensitive adhesive sheet (B), and was laminated to have a thickness of about 2 mm. The laminate was punched into a diameter of 7.9 mm to produce a columnar pellet, and the pellet was defined as a measurement sample. The measurement sample was fixed to the jig of a parallel plate having a diameter of 7.9 mm, and the temperature dependence of each of the storage modulus of elasticity G' and loss modulus of elasticity G'' of the sample was measured with the dynamic viscoelasticity-measuring apparatus, followed by the calculation of its $\tan\delta$ from an equation " $\tan\delta = G''/G'$." The temperature at which the resultant $\tan\delta$ curve showed a local maximum was defined as the glass transition temperature (T_g) ($^{\circ}\text{C}$) of the sample.

Measurement conditions are as described below.

Measurement:	Shear mode
Temperature range:	-70°C to 150°C
Rate of temperature increase:	$5^{\circ}\text{C}/\text{min}$
Frequency:	1 Hz

[0080]

[Production Example 1]: (Meth)acrylic Polymer (1)

100 Parts by weight of 2-ethylhexyl acrylate (manufactured by Nippon Shokubai Co., Ltd.), 4 parts by weight of 2-hydroxyethyl acrylate (manufactured by Toagosei Co., Ltd.), 0.2 part by weight of 2,2'-azobisisobutyronitrile (manufactured by Wako Pure Chemical Industries, Ltd.) serving as a polymerization initiator, and 156 parts by weight of ethyl acetate were loaded into a four-necked flask including a stirring blade, a temperature gauge, a nitrogen gas-introducing tube, and a condenser. While the mixture was gently stirred, a nitrogen gas was introduced into the flask. While a liquid temperature in the flask was kept at around 65°C, a polymerization reaction was performed for 6 hours. Thus, a solution (40 wt%) of a (meth)acrylic polymer (1) having a weight-average molecular weight of 550,000 was prepared.

[0081]

[Production Example 2]: (Meth)acrylic Polymer (2)

100 Parts by weight of 2-ethylhexyl acrylate (manufactured by Nippon Shokubai Co., Ltd.), 10 parts by weight of 4-hydroxybutyl acrylate (manufactured by Osaka Organic Chemical Industry Ltd.), 0.02 part by weight of acrylic acid (manufactured by Toagosei Co., Ltd.), 0.2 part by weight of 2,2'-azobisisobutyronitrile (manufactured by Wako Pure Chemical Industries, Ltd.) serving as a polymerization initiator, and 156 parts by weight of ethyl acetate

were loaded into a four-necked flask including a stirring blade, a temperature gauge, a nitrogen gas-introducing tube, and a condenser. While the mixture was gently stirred, a nitrogen gas was introduced into the flask. While a liquid temperature in the flask was kept at around 65°C, a polymerization reaction was performed for 6 hours. Thus, a solution (40 wt%) of a (meth)acrylic polymer (2) having a weight-average molecular weight of 540,000 was prepared.

[0082]

[Production Example 3]: (Meth)acrylic Polymer (3)

99 Parts by weight of butyl acrylate (manufactured by Nippon Shokubai Co., Ltd.), 1 part by weight of 4-hydroxybutyl acrylate (manufactured by Osaka Organic Chemical Industry Ltd.), 1 part by weight of 2,2'-azobisisobutyronitrile (manufactured by Wako Pure Chemical Industries, Ltd.) serving as a polymerization initiator, and 156 parts by weight of ethyl acetate were loaded into a four-necked flask including a stirring blade, a temperature gauge, a nitrogen gas-introducing tube, and a condenser. While the mixture was gently stirred, a nitrogen gas was introduced into the flask. While a liquid temperature in the flask was kept at around 60°C, a polymerization reaction was performed for 7 hours. Thus, a solution (39 wt%) of a (meth)acrylic polymer (3) having a weight-average molecular weight of 1,600,000 was prepared.

[0083]

[Production Example 4]: (Meth)acrylic Polymer (4)

92 Parts by weight of butyl acrylate (manufactured by Nippon Shokubai Co., Ltd.), 5 parts by weight of N-acryloylmorpholine (manufactured by Kohjin), 2.9 parts by weight of acrylic acid (manufactured by Toagosei Co., Ltd.), 0.1 part by weight of 2,2'-azobisisobutyronitrile (manufactured by Wako Pure Chemical Industries, Ltd.) serving as a polymerization initiator, and 200 parts by weight of ethyl acetate were loaded into a four-necked flask including a stirring blade, a temperature gauge, a nitrogen gas-introducing tube, and a condenser. While the mixture was gently stirred, a nitrogen gas was introduced into the flask. While a liquid temperature in the flask was kept at around 55°C, a polymerization reaction was performed for 8 hours. Thus, a solution (33 wt%) of a (meth)acrylic polymer (4) having a weight-average molecular weight of 1,800,000 was prepared.

[0084]

[Production Example 5]: (Meth)acrylic Polymer (5)

95 Parts by weight of butyl acrylate (manufactured by Nippon Shokubai Co., Ltd.), 5 parts by weight of acrylic acid (manufactured by Toagosei Co., Ltd.), 0.2 part by weight of 2,2'-azobisisobutyronitrile (manufactured by Wako Pure Chemical Industries, Ltd.) serving as a polymerization initiator, and 156 parts by weight of ethyl acetate were loaded into a four-necked flask including a stirring blade, a temperature gauge, a nitrogen

gas-introducing tube, and a condenser. While the mixture was gently stirred, a nitrogen gas was introduced into the flask. While a liquid temperature in the flask was kept at around 63°C, a polymerization reaction was performed for 10 hours. Thus, a solution (40 wt%) of a (meth)acrylic polymer (5) having a weight-average molecular weight of 700,000 was prepared.

[0085]

[Production Example 6]: Alicyclic Structure-containing (Meth)acrylic Polymer (6)

95 Parts by weight of cyclohexyl methacrylate (glass transition temperature of a homopolymer (polycyclohexyl methacrylate): 66°C) and 5 parts by weight of acrylic acid serving as monomer components, 3 parts by weight of 2-mercaptoethanol serving as a chain transfer agent, 0.2 part by weight of 2,2'-azobisisobutyronitrile serving as a polymerization initiator, and 103.2 parts by weight of toluene serving as a polymerization solvent were loaded into a separable flask, and the mixture was stirred for 1 hour while a nitrogen gas was introduced into the flask. After oxygen in a polymerization system had been removed as described above, a temperature in the system was increased to 70°C, and the mixture was subjected to a reaction for 3 hours. Further, the mixture was subjected to a reaction at 75°C for 2 hours. Thus, a solution (50 wt%) of a (meth)acrylic polymer (6) having a weight-average molecular weight of 4,000 was obtained.

[0086]

[Production Example 6]: Alicyclic Structure-containing (Meth)acrylic Polymer (7)

100 Parts by weight of toluene, 60 parts by weight of dicyclopentanyl methacrylate (DCPMA) (product name: FA-513M, manufactured by Hitachi Chemical Company, Ltd.), 40 parts by weight of methyl methacrylate (MMA), and 3.5 parts by weight of methyl thioglycolate serving as a chain transfer agent were loaded into a four-necked flask including a stirring blade, a temperature gauge, a nitrogen gas-introducing tube, a condenser, and a dropping funnel. Then, the mixture was stirred at 70°C under a nitrogen atmosphere for 1 hour. After that, 0.2 part by weight of 2,2'-azobisisobutyronitrile serving as a polymerization initiator was loaded into the mixture, and the whole was subjected to a reaction at 70°C for 2 hours. Subsequently, the resultant was subjected to a reaction at 80°C for 4 hours, and was then subjected to a reaction at 90°C for 1 hour. Thus, a solution (51 wt%) of a (meth)acrylic polymer (7) having a weight-average molecular weight of 4,000 was obtained.

[0087]

[Examples 1 and 2]

The solution of the (meth)acrylic polymer (1) was diluted with ethyl acetate so that a total solid content became 25 wt% with respect

to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (1) containing an acrylic resin was obtained. The results are shown in Table 1.

[0088]

[Examples 3 and 4]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, and nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.01 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (2) containing an acrylic resin was obtained. The results are shown in Table 1.

[0089]

[Examples 5 and 6]

CORONATE L (manufactured by Nippon Polyurethane Industry Co.,

Ltd.) serving as a cross-linking agent, and nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.1 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (3) containing an acrylic resin was obtained. The results are shown in Table 1.

[0090]

[Examples 7 and 8]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst, and the solution of the (meth)acrylic polymer (6) were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.05 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), the amount of the cross-linking catalyst was 0.005 part by

weight in terms of a solid content with respect thereto, and the amount of the solution of the (meth)acrylic polymer (6) was 5 parts by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (4) containing an acrylic resin was obtained. The results are shown in Table 1.

[0091]

[Examples 9 and 10]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst, and the solution of the (meth)acrylic polymer (6) were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.1 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto, and the amount of the solution of the (meth)acrylic polymer (6) was 5 parts by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (5) containing an acrylic

resin was obtained. The results are shown in Table 1.

[0092]

[Examples 11 and 12]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst, and the solution of the (meth)acrylic polymer (6) were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.3 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto, and the amount of the solution of the (meth)acrylic polymer (6) was 5 parts by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (6) containing an acrylic resin was obtained. The results are shown in Table 1.

[0093]

[Examples 13 and 14]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, nacem ferric iron

(manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst, and the solution of the (meth)acrylic polymer (7) were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.1 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto, and the amount of the solution of the (meth)acrylic polymer (7) was 5 parts by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (7) containing an acrylic resin was obtained. The results are shown in Table 1.

[0094]

[Examples 15 and 16]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst, and the solution of the (meth)acrylic polymer (7) were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.3 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer

(1), the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto, and the amount of the solution of the (meth)acrylic polymer (7) was 5 parts by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (8) containing an acrylic resin was obtained. The results are shown in Table 1.

[0095]

[Examples 17 and 18]

The solution of the (meth)acrylic polymer (2) was diluted with ethyl acetate so that a total solid content became 25 wt% with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (2), followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (9) containing an acrylic resin was obtained. The results are shown in Table 2.

[0096]

[Examples 19 and 20]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) and TETRAD-C (manufactured by Mitsubishi Gas Chemical Company) each serving as a cross-linking agent, and nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the

(meth)acrylic polymer (2). The amount of CORONATE L was 0.1 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (2), the amount of TETRAD-C was 0.05 part by weight in terms of a solid content with respect thereto, and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (10) containing an acrylic resin was obtained. The results are shown in Table 2.

[0097]

[Examples 21 and 22]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, and nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the (meth)acrylic polymer (3). The amount of the cross-linking agent was 0.02 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (3), and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a

disper. Thus, a pressure-sensitive adhesive composition (11) containing an acrylic resin was obtained. The results are shown in Table 2.

[0098]

[Examples 23 and 24]

TETRAD-C (manufactured by Mitsubishi Gas Chemical Company) serving as a cross-linking agent, and nace ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the (meth)acrylic polymer (5). The amount of the cross-linking agent was 0.075 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (5), and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (12) containing an acrylic resin was obtained. The results are shown in Table 2.

[0099]

[Example 25]

100 Parts by weight of HYBRAR 5125 (manufactured by Kuraray Co., Ltd.) was diluted with toluene so that a total solid content became 25 wt%. Thus, a pressure-sensitive adhesive composition (13)

containing a rubber-based resin was obtained. The results are shown in Table 2.

[0100]

[Example 26]

100 Parts by weight of HYBRAR 5127 (manufactured by Kuraray Co., Ltd.) was diluted with toluene so that a total solid content became 25 wt%. Thus, a pressure-sensitive adhesive composition (14) containing a rubber-based resin was obtained. The results are shown in Table 2.

[0101]

[Comparative Examples 1 and 2]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) serving as a cross-linking agent, and nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the (meth)acrylic polymer (1). The amount of the cross-linking agent was 0.5 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (1), and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (C1)

containing an acrylic resin was obtained. The results are shown in Table 2.

[0102]

[Comparative Examples 3 and 4]

CORONATE L (manufactured by Nippon Polyurethane Industry Co., Ltd.) and TETRAD-C (manufactured by Mitsubishi Gas Chemical Company) each serving as a cross-linking agent, and nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the (meth)acrylic polymer (2). The amount of CORONATE L was 0.45 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (2), the amount of TETRAD-C was 0.3 part by weight in terms of a solid content with respect thereto, and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (C2) containing an acrylic resin was obtained. The results are shown in Table 2.

[0103]

[Comparative Examples 5 and 6]

CORONATE L (manufactured by Nippon Polyurethane Industry Co.,

Ltd.) serving as a cross-linking agent, and nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst were added to the solution of the (meth)acrylic polymer (4). The amount of the cross-linking agent was 0.3 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (4), and the amount of the cross-linking catalyst was 0.005 part by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (C3) containing an acrylic resin was obtained. The results are shown in Table 2.

[0104]

[Comparative Examples 7 and 8]

TETRAD-C (manufactured by Mitsubishi Gas Chemical Company) serving as a cross-linking agent, nacem ferric iron (manufactured by Nihon Kagaku Sangyo Co., Ltd.) serving as a cross-linking catalyst, and the solution of the (meth)acrylic polymer (6) were added to the solution of the (meth)acrylic polymer (5). The amount of the cross-linking agent was 0.075 part by weight in terms of a solid content with respect to 100 parts by weight of the solid content of the solution of the (meth)acrylic polymer (5), the amount of the cross-linking catalyst was 0.005 part by weight in terms of

a solid content with respect thereto, and the amount of the solution of the (meth)acrylic polymer (6) was 20 parts by weight in terms of a solid content with respect thereto. The mixture was diluted with ethyl acetate so that a total solid content became 25 wt%, followed by stirring with a disper. Thus, a pressure-sensitive adhesive composition (C4) containing an acrylic resin was obtained. The results are shown in Table 2.

Table 1

Name	Exempl e 1	Exempl e 2	Exempl e 3	Exempl e 4	Exempl e 5	Exempl e 6	Exempl e 7	Exempl e 8	Exempl e 9	Exempl e 10	Exempl e 11	Exempl e 12	Exempl e 13	Exempl e 14	Exempl e 15	Exempl e 16
Polymer (A)	(Meth)acryli c polymer (1)	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	(Meth)acryli c polymer (2)															
	(Meth)acryli c polymer (3)															
	(Meth)acryli c polymer (4)															
	(Meth)acryli c polymer (5)															
	(Meth)acryli c polymer (6)						5	5	5	5	5	5				
	(Meth)acryli c polymer (7)												5	5	5	5
Cross-linki ng agent	C/L			0.01	0.01	0.1	0.05	0.05	0.10	0.10	0.30	0.30	0.10	0.10	0.30	0.30
	TEFRAD-C 5125															
Elastomer	5127															
	Molar ratio ([NCO]+[epoxy])/([OH]+[COO H])	0	0	0.001	0.001	0.01	0.005	0.005	0.01	0.01	0.03	0.03	0.01	0.01	0.03	0.03
Catalyst	Nacem ferric iron			0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Pressure-sensitive adhesive thickness (um)	10	22	10	22	10	22	10	22	10	22	10	22	10	22	10	22
PET-based film thickness (um)	50	38	50	38	50	38	50	38	50	38	50	38	50	38	50	38
Indentation energy (uJ)	322	311	302	294	289	281	355	341	335	321	337	323	290	281	326	314
Tg (tanδ peak top temperature: °C)	-43	+	-43	+	-48	+	-42	+	-40	+	-39	+	-40	+	-41	+
tanδ	-70°C	0.35	+	0.28	+	0.48	+	0.25	+	0.18	+	0.19	+	0.21	+	0.20
	-60°C	0.75	+	0.64	+	1.08	+	0.59	+	0.44	+	0.46	+	0.51	+	0.52
	-50°C	1.49	+	1.40	+	1.71	+	1.23	+	1.08	+	1.10	+	1.22	+	1.19
	-40°C	1.69	+	1.73	+	1.50	+	1.69	+	1.64	+	1.60	+	1.74	+	1.66
	-30°C	1.20	+	1.25	+	1.10	+	1.34	+	1.39	+	1.37	+	1.35	+	1.32
	-20°C	0.88	+	0.93	+	0.80	+	1.03	+	1.07	+	1.04	+	1.00	+	0.98
	-10°C	0.65	+	0.75	+	0.61	+	0.79	+	0.80	+	0.79	+	0.77	+	0.76
	0°C	0.55	+	0.57	+	0.51	+	0.62	+	0.66	+	0.62	+	0.60	+	0.58
	10°C	0.50	+	0.51	+	0.47	+	0.54	+	0.54	+	0.51	+	0.49	+	0.48

20°C	0.50	←	0.49	←	0.45	←	0.51	←	0.47	←	0.44	←	0.46	←	0.42	←
30°C	0.52	←	0.49	←	0.46	←	0.52	←	0.47	←	0.40	←	0.46	←	0.39	←
40°C	0.56	←	0.52	←	0.47	←	0.54	←	0.48	←	0.39	←	0.47	←	0.38	←
50°C	0.61	←	0.55	←	0.47	←	0.57	←	0.49	←	0.36	←	0.47	←	0.36	←
60°C	0.67	←	0.58	←	0.48	←	0.60	←	0.51	←	0.35	←	0.49	←	0.34	←
70°C	0.74	←	0.63	←	0.48	←	0.64	←	0.53	←	0.33	←	0.50	←	0.32	←
80°C	0.81	←	0.68	←	0.48	←	0.68	←	0.55	←	0.31	←	0.51	←	0.30	←
90°C	0.89	←	0.74	←	0.47	←	0.72	←	0.57	←	0.29	←	0.52	←	0.28	←
100°C	0.96	←	0.79	←	0.47	←	0.76	←	0.58	←	0.25	←	0.53	←	0.27	←
110°C	0.97	←	0.76	←	0.45	←	0.76	←	0.59	←	0.25	←	0.54	←	0.26	←
120°C	0.97	←	0.72	←	0.44	←	0.75	←	0.60	←	0.23	←	0.54	←	0.24	←
130°C	0.98	←	0.68	←	0.42	←	0.75	←	0.60	←	0.21	←	0.54	←	0.22	←
140°C	0.99	←	0.64	←	0.39	←	0.74	←	0.60	←	0.20	←	0.53	←	0.21	←
150°C	0.99	←	0.59	←	0.34	←	0.73	←	0.60	←	0.18	←	0.53	←	0.19	←

[0106]

Table 2

Name	Product name	Examp le 17	Examp le 18	Examp le 19	Examp le 20	Examp le 21	Examp le 22	Examp le 23	Examp le 24	Examp le 25	Examp le 26	Compa rativ e Examp le 1	Compa rativ e Examp le 2	Compa rativ e Examp le 3	Compa rativ e Examp le 4	Compa rativ e Examp le 5	Compa rativ e Examp le 6	Compa rativ e Examp le 7	Compa rativ e Examp le 8
Polymer (A)	(Meth)acrylic polymer (1)											100	100						
	(Meth)acrylic polymer (2)	100	100	100	100									100	100				
	(Meth)acrylic polymer (3)					100	100												
	(Meth)acrylic polymer (4)															100	100		
	(Meth)acrylic polymer (5)							100	100									100	
Polymer (B)	(Meth)acrylic polymer (6)																	20	20
	(Meth)acrylic polymer (7)																		
	Cross-linking agent			0.1	0.1	0.02	0.02					0.50	0.50	0.45	0.45	0.3	0.3		
Elastomer	TEPRAD-C			0.05	0.05			0.075	0.075					0.3	0.3			0.075	0.075
	5125									100									
Molar ratio ([NCO]+[epoxy])/([OH]+[C OOH])	5127										100								
	Nacem ferric iron	0	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	0.05	0.05	0.05	0.05	0.03	0.03	0.01	0.01
Catalyst				0.005	0.005	0.005	0.005	0.005	0.005	0.005	-	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Pressure-sensitive adhesive thickness (um)	10	22	22	10	22	10	22	10	22	10	10	10	22	10	22	10	22	10	22
PET-based film thickness (um)	50	38	38	50	38	50	38	50	38	50	50	50	38	50	38	50	38	50	38
Indentation energy (uJ)	317	308	291	282	273	262	270	262	262	338	345	243	232	248	241	243	228	240	227
Tg (tanδ peak top temperature: °C)	-45	←	-43	←	-38	←	-25	←	←	-3	20	-39	←	-43	←	-14	←	-7	←
tanδ	-70°C	0.35	←	0.29	←	0.04	←	0.04	←	1.47	1.19	0.22	←	0.26	←	0.01	←	0.05	←
	-60°C	0.84	←	0.71	←	0.05	←	0.03	←	1.17	0.80	0.52	←	0.65	←	0.07	←	0.06	←
	-50°C	1.59	←	1.44	←	0.24	←	0.07	←	1.04	0.75	1.24	←	1.34	←	0.13	←	0.05	←
	-40°C	1.63	←	1.71	←	2.39	←	0.30	←	0.93	0.61	1.73	←	1.62	←	0.38	←	0.12	←
	-30°C	1.15	←	1.20	←	1.45	←	1.54	←	0.48	0.52	1.31	←	1.19	←	1.48	←	0.31	←
	-20°C	0.85	←	0.88	←	0.71	←	1.69	←	0.30	0.47	0.96	←	0.83	←	1.48	←	0.82	←

-10°C	0.67	←	0.66	←	0.37	←	0.94	←	1.16	0.46	0.71	←	0.55	←	1.69	←	1.42	←
0°C	0.54	←	0.51	←	0.21	←	0.59	←	0.89	0.39	0.51	←	0.33	←	0.92	←	1.36	←
10°C	0.50	←	0.50	←	0.18	←	0.37	←	0.40	1.00	0.39	←	0.22	←	0.55	←	1.05	←
20°C	0.51	←	0.45	←	0.17	←	0.31	←	0.20	1.30	0.34	←	0.15	←	0.32	←	0.74	←
30°C	0.54	←	0.49	←	0.18	←	0.27	←	0.14	0.56	0.29	←	0.11	←	0.20	←	0.57	←
40°C	0.58	←	0.50	←	0.20	←	0.29	←	0.14	0.25	0.26	←	0.08	←	0.15	←	0.45	←
50°C	0.64	←	0.50	←	0.22	←	0.29	←	0.14	0.18	0.23	←	0.05	←	0.14	←	0.38	←
60°C	0.71	←	0.51	←	0.24	←	0.29	←	0.16	0.15	0.20	←	0.04	←	0.13	←	0.36	←
70°C	0.78	←	0.50	←	0.26	←	0.30	←	0.17	0.16	0.17	←	0.03	←	0.13	←	0.36	←
80°C	0.85	←	0.50	←	0.28	←	0.30	←	0.18	0.20	0.15	←	0.02	←	0.13	←	0.37	←
90°C	0.95	←	0.49	←	0.29	←	0.31	←	0.22	0.25	0.13	←	0.02	←	0.13	←	0.37	←
100°C	1.04	←	0.48	←	0.31	←	0.30	←	0.25	0.24	0.11	←	0.02	←	0.12	←	0.39	←
110°C	1.04	←	0.28	←	0.28	←	0.30	←	0.29	0.28	0.10	←	0.02	←	0.12	←	0.39	←
120°C	1.05	←	0.26	←	0.26	←	0.29	←	0.45	0.41	0.08	←	0.01	←	0.11	←	0.40	←
130°C	1.05	←	0.24	←	0.24	←	0.28	←	0.63	0.52	0.07	←	0.01	←	0.11	←	0.40	←
140°C	1.06	←	0.21	←	0.21	←	0.27	←	0.80	0.66	0.07	←	0.01	←	0.10	←	0.39	←
150°C	1.07	←	0.19	←	0.19	←	0.27	←	1.02	0.86	0.06	←	0.01	←	0.10	←	0.40	←

[0107]

[Example 27]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (1) obtained in each of Examples 1 and 2, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0108]

[Example 28]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (2) obtained in each of Examples 3 and 4, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0109]

[Example 29]

The polyester film was peeled from one surface of each of the

pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (4) obtained in each of Examples 7 and 8, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0110]

[Example 30]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (7) obtained in each of Examples 13 and 14, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0111]

[Example 31]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (9) obtained in each of Examples 17 and 18,

and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0112]

[Example 32]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (10) obtained in each of Examples 19 and 20, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0113]

[Example 33]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (11) obtained in each of Examples 21 and 22, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto

pressure-sensitive adhesive sheets was obtained.

[0114]

[Example 34]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (12) obtained in each of Examples 23 and 24, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0115]

[Example 35]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (13) obtained in Example 25, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0116]

[Example 36]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (14) obtained in Example 26, and the remainder was bonded to a polarizing plate serving as an optical member (manufactured by Nitto Denko Corporation, product name: "TEG1465DUHC"). Thus, an optical member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0117]

[Example 37]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (1) obtained in each of Examples 1 and 2, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0118]

[Example 38]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (2) obtained in each of Examples 3 and 4, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECTRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0119]

[Example 39]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (4) obtained in each of Examples 7 and 8, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECTRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0120]

[Example 40]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive

adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (7) obtained in each of Examples 13 and 14, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0121]

[Example 41]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (9) obtained in each of Examples 17 and 18, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0122]

[Example 42]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (10) obtained in each of Examples 19 and 20,

and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0123]

[Example 43]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (11) obtained in each of Examples 21 and 22, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0124]

[Example 44]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (12) obtained in each of Examples 23 and 24, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product

name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0125]

[Example 45]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (13) obtained in Example 25, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

[0126]

[Example 46]

The polyester film was peeled from one surface of each of the pressure-sensitive adhesive sheet (A) and the pressure-sensitive adhesive sheet (B) each obtained from the pressure-sensitive adhesive composition (14) obtained in Example 26, and the remainder was bonded to a conductive film serving as an electronic member (manufactured by Nitto Denko Corporation, product name: "ELECRYSTA V270L-TFMP"). Thus, an electronic member having bonded thereto pressure-sensitive adhesive sheets was obtained.

Industrial Applicability

[0127]

The stress distributing film of the present invention can be suitably used as a protective material intended for, for example, the protection of an optical member or an electronic member from impact from the outside.

Reference Signs List

[0128]

- 10** plastic film
- 20** pressure-sensitive adhesive layer
- 100** stress distributing film

Claims

[Claim 1]

A stress distributing film, comprising a laminate of a plastic film and a pressure-sensitive adhesive layer, wherein

the plastic film has a thickness of from 15 μm to 300 μm ;

the pressure-sensitive adhesive layer has a thickness of from 1 μm to 300 μm ;

the pressure-sensitive adhesive layer is formed of a pressure-sensitive adhesive composition;

the pressure-sensitive adhesive composition contains a polymer (A) having a monomer unit (I) derived from a (meth)acrylic acid alkyl ester having an alkyl group having 1 to 20 carbon atoms as an alkyl ester moiety and a monomer unit (II) derived from a (meth)acrylic acid ester having a OH group and/or a COOH group in a molecule thereof or a rubber-based resin, and wherein the pressure-sensitive adhesive composition does not contain a polymer (B) having a monomer unit derived from an alicyclic structure-containing (meth)acrylic acid ester represented by the general formula (1), the polymer having a weight-average molecular weight of 1,000 or more and less than 30,000:



in the general formula (1), R^1 represents a hydrogen atom or a methyl group, and R^2 represents a hydrocarbon group having an alicyclic structure;

the pressure-sensitive adhesive composition satisfies a

relationship of $([\text{NCO}] + [\text{epoxy}]) / ([\text{OH}] + [\text{COOH}]) < 0.05$, where $[\text{NCO}]$ represents a molar content of an NCO group in the pressure-sensitive adhesive composition, $[\text{epoxy}]$ represents a molar content of an epoxy group in the pressure-sensitive adhesive composition, $[\text{OH}]$ represents a molar content of a OH group in the pressure-sensitive adhesive composition, and $[\text{COOH}]$ represents a molar content of a COOH group in the pressure-sensitive adhesive composition;

an indentation energy required when a load is applied from a plastic film side of the laminate in a direction vertical to the laminate is from 260 μJ to 7000 μJ ;

the indentation energy is measured "SAICAS MODEL DN-20" manufactured by Daipia Wintes Co., Ltd. at a measurement temperature of 25°C and an indentation speed of 5 $\mu\text{m}/\text{sec}$ in accordance with the following procedures:

(a procedure 1)

the pressure-sensitive adhesive layer side of the laminate was bonded to a flat indenter (load detection side), the plastic film side of the laminate bonded to the flat indenter was indented into a spherical indenter, and an indentation depth (μm) when a load of 20 N was detected was calculated; and

(a procedure 2)

the pressure-sensitive adhesive layer side of the laminate was bonded to a slide glass, a spherical indenter was indented from the plastic film side (load detection side) of the laminate bonded to the slide glass to the indentation depth determined in the procedure

1; and

when a vertical load applied to the spherical indenter was represented by $y=f(x)$ (x : indentation depth), the indentation energy W (μJ) until the application of a load of 20 N to the pressure-sensitive adhesive layer side of the laminate was calculated by the following equation:

$$W(\mu\text{J}) = \int_0^r f(x) \cdot dx$$

wherein r represents an indentation depth when a load of 20 N is applied to the pressure-sensitive adhesive layer side of the laminate.

[Claim 2]

The stress distributing film according to claim 1, wherein the plastic film has a thickness of from 20 μm to 300 μm .

[Claim 3]

The stress distributing film according to claim 1 or 2, wherein the pressure-sensitive adhesive layer has a thickness of from 1 μm to 150 μm .

[Claim 4]

The stress distributing film according to any one of claims

1 to 3, wherein the pressure-sensitive adhesive composition contains an organic polyisocyanate-based cross-linking agent that is bifunctional or more and/or an epoxy-based cross-linking agent.

[Claim 5]

The stress distributing film according to any one of claims 1 to 4, wherein the pressure-sensitive adhesive layer has a loss tangent $\tan\delta$ in an entire temperature region of from -40°C to 150°C of 0.10 or more.

[Claim 6]

An optical member, comprising the stress distributing film of any one of claims 1 to 5.

[Claim 7]

An electronic member, comprising the stress distributing film of any one of claims 1 to 5.