

Description

Title of Invention: PROTECTIVE FILM, POLARIZING PLATE, METHOD FOR MANUFACTURING POLARIZING PLATE, AND METHOD FOR MANUFACTURING IMAGE DISPLAY DEVICE

Technical Field

[0001] The present invention relates to a protective film, a polarizing plate, a method of producing a polarizing plate, and a method of producing an image display apparatus.

Background Art

[0002] Image display apparatus typified by a liquid crystal display apparatus and an electroluminescence (EL) display apparatus (e.g., an organic EL display apparatus or an inorganic EL display apparatus) have been rapidly gaining more widespread use. In general, a polarizing plate has been used in an image display panel to be mounted on the image display apparatus. Typically, a polarizing plate with a retardation layer obtained by integrating the polarizing plate and a retardation plate with each other has been widely used (for example, Patent Literature 1).

[0003] The polarizing plate is typically obtained by laminating a polarizer having a polarization function and a member for protecting the polarizer. In addition, the image

display panel is typically obtained by bonding the polarizing plate to a main body of an image display panel.

Citation List

Patent Literature

[0004] [PTL 1] JP 3325560 B2

Summary of Invention

Technical Problem

[0005] In a production process for each of the polarizing plate and the image display apparatus, the polarizing plate may be deformed by its handling, and hence an external appearance may be impaired. For example, the polarizing plate may have an indentation mark by its handling.

[0006] In view of the above-mentioned circumstances, a primary object of the present invention is to suppress the deformation of the polarizing plate in the production process.

Solution to Problem

[0007] According to an embodiment of the present invention, there is provided a protective film. The protective film includes: a substrate film having a first main surface and a second main surface facing each other; and a pressure-sensitive adhesive layer arranged on a first main surface side of the

substrate film. The protective film has a peel strength to an adherend having a water contact angle of 90° or more of 0.03 N/25 mm or more, and has a shear strength to the adherend in an in-plane direction of 35 N/100 mm² or less.

In one embodiment, the pressure-sensitive adhesive layer has a thickness of more than 10 μm .

In one embodiment, the pressure-sensitive adhesive layer contains an acrylic pressure-sensitive adhesive, the acrylic pressure-sensitive adhesive contains a (meth)acrylic polymer having a polar functional group, and a content of a monomer component having a polar functional group is 2 parts by weight or more with respect to 100 parts by weight of a monomer for forming the (meth)acrylic polymer.

According to another embodiment of the present invention, there is provided a polarizing plate. The polarizing plate includes: the above-mentioned protective film; a laminate film including a substrate and a surface-treated layer having a water contact angle of 90° or more; and a polarizer. The protective film is bonded to the surface-treated layer.

According to yet another embodiment of the present invention, there is provided a method of producing a polarizing

plate. The method of producing a polarizing plate includes: bonding the above-mentioned protective film to a surface-treated layer having a water contact angle of 90° or more of a laminate film including a substrate and the surface-treated layer; and laminating a polarizer on a substrate side of the laminate film.

According to yet another embodiment of the present invention, there is provided a method of producing an image display apparatus. The method of producing an image display apparatus includes laminating a polarizing plate obtained by the above-mentioned production method to a main body of an image display panel.

Advantageous Effects of Invention

[0008] According to the embodiment of the present invention, the occurrence of deformation of the polarizing plate can be suppressed.

Brief Description of Drawings

[0009] FIG. **1A** is a view for illustrating a production step 1 for a polarizing plate according to one embodiment of the present invention.

FIG. **1B** is a view for illustrating a step 2 subsequent to the step 1.

FIG. **1C** is a view for illustrating a step 3 subsequent to the step 2.

FIG. **2** is a schematic sectional view for illustrating a modification example of the polarizing plate.

FIG. **3** is a schematic sectional view for illustrating the overview of a state of an organic EL display apparatus according to one embodiment of the present invention in which the polarizing plate is arranged on an organic EL panel.

FIG. **4** is a view for describing a method of measuring a shear strength.

FIG. **5** is a view for describing a method of evaluating deformation.

Description of Embodiments

[0010] Embodiments of the present invention are described below with reference to the drawings. However, the present invention is not limited to these embodiments. In addition, for clearer illustration, some widths, thicknesses, shapes, and the like of respective portions may be schematically illustrated in the drawings in comparison to the embodiments. However, the

widths, the thicknesses, the shapes, and the like are each merely an example, and do not limit the understanding of the present invention.

[0011] (Definitions of Terms and Symbols)

The definitions of terms and symbols used herein are as described below.

(1) Refractive Indices (n_x , n_y , and n_z)

" n_x " represents a refractive index in a direction in which an in-plane refractive index is maximum (that is, slow axis direction), " n_y " represents a refractive index in a direction perpendicular to a slow axis in a plane (that is, fast axis direction), and " n_z " represents a refractive index in a thickness direction.

(2) In-plane Retardation (Re)

" $Re(\lambda)$ " refers to an in-plane retardation measured at 23°C with light having a wavelength of λ nm. For example, " $Re(550)$ " refers to an in-plane retardation measured at 23°C with light having a wavelength of 550 nm. The $Re(\lambda)$ is determined from the equation " $Re(\lambda) = (n_x - n_y) \times d$ " when the thickness of a layer (film) is represented by " d " (nm).

(3) Thickness Direction Retardation (R_{th})

"Rth(λ)" refers to a thickness direction retardation measured at 23°C with light having a wavelength of λ nm. For example, "Rth(550)" refers to a thickness direction retardation measured at 23°C with light having a wavelength of 550 nm. The Rth(λ) is determined from the equation "Rth(λ)=(n_x - n_z) $\times$ d" when the thickness of a layer (film) is represented by "d" (nm).

(4) Nz Coefficient

An Nz coefficient is determined from the equation "Nz=Rth/Re".

[0012] A method of producing a polarizing plate according to one embodiment of the present invention includes: bonding a protective film to a surface-treated layer of a laminate film including a substrate and the surface-treated layer; and laminating a polarizer on the substrate side of the laminate film.

[0013] FIG. **1A** to FIG. **1C** are each a view for illustrating a production step for a polarizing plate according to one embodiment of the present invention.

[0014] In FIG. **1A** for illustrating a step 1, there is illustrated a state in which a polarizer **30** is laminated on the substrate **21** side of a laminate film **20** including a substrate

21 and a surface-treated layer **22** and a protective layer **40** is laminated on the polarizer **30** to complete a laminated product **90**. The laminated product **90** includes the laminate film **20**, the polarizer **30**, and the protective layer **40** in the stated order. The substrate **21** of the laminate film **20** may function as a protective layer for the polarizer **30**. The protective layer **40** may function as a retardation layer (e.g., $\lambda/4$ plate). The laminated product **90** typically has an elongate shape, and can be wound into a roll shape. The term "elongate shape" as used herein refers to a long and thin shape in which a length is sufficiently large with respect to a width, and refers to, for example, a long and thin shape in which a length is 10 times or more, preferably 20 times or more as large as a width.

[0015] In FIG. **1B** for illustrating a step 2, there is illustrated a state in which a pressure-sensitive adhesive layer **50** is formed on the protective layer **40** side of the laminated product **90** to complete a polarizing plate **100**. Although not shown, a release liner is bonded to the surface of the pressure-sensitive adhesive layer **50** in practical use. When the release liner is used, for example, the pressure-sensitive adhesive layer **50** is protected, and the roll formation of the polarizing plate can be performed.

[0016] In FIG. **1C** for illustrating a step 3, there is

illustrated a state in which a protective film **10** is bonded to the surface-treated layer **22** of the laminate film **20** of the polarizing plate **100**. A state in which the protective film (**10**) is bonded to the polarizing plate (**100**) is sometimes referred to as "polarizing plate (**110**) with a protective film."

[0017] The protective film **10** includes: a substrate film **11** having a first main surface **11a** and a second main surface **11b** facing each other; a pressure-sensitive adhesive layer **12** arranged on the first main surface **11a** side of the substrate film **11**; and a treatment layer **13** arranged on the second main surface **11b** side of the substrate film **11**. For example, the bonding of the protective film **10** to the laminate film **20** is performed while the films are roll conveyed (by a so-called roll-to-roll process).

[0018] The protective film **10** is bonded to the laminate film **20** in a peelable manner. The protective film **10** may be peeled before a polarizing plate to be obtained according to the embodiment of the present invention is used (e.g., before the polarizing plate is laminated on a main body of an image display panel) or in a production process for a final product (image display apparatus), or may be directly installed in the final product.

[0019] The order in which the respective members for forming the polarizing plate (polarizing plate with a protective film) are laminated is not particularly limited. For example, in the illustrated example, the protective film **10** is bonded to the laminate film **20** after the lamination of the laminate film **20** and the polarizer **30**, but the laminate film **20** and the polarizer **30** may be laminated after the protective film **10** is bonded to the laminate film **20**.

[0020] In the illustrated example, the polarizing plate **100** includes the protective layer **40** and the pressure-sensitive adhesive layer **50** in addition to the laminate film **20** and the polarizer **30**, but the polarizing plate **100** only needs to include at least the laminate film **20** and the polarizer **30**. Meanwhile, although not shown, the polarizing plate **100** may include any other member. In the example illustrated in FIG. **2**, the polarizing plate **100** (polarizing plate **110** with a protective film) further includes a retardation layer (e.g., $\lambda/4$ plate) **60** and a pressure-sensitive adhesive layer **52** in addition to the configuration illustrated in FIG. **1C**. Although not shown, a release liner is bonded to the surface of the pressure-sensitive adhesive layer **52** in practical use.

[0021] The above-mentioned respective members may be laminated via any appropriate adhesion layer. Specific examples

of the adhesion layer include an adhesive layer and a pressure-sensitive adhesive layer. For example, the polarizer and the protective layer are bonded to each other via an adhesive layer. Specifically, the polarizer and the protective layer are bonded to each other with an active energy ray-curable adhesive. The thickness of the active energy ray-curable adhesive after curing (thickness of the adhesive layer) is, for example, from 0.2 μm to 3.0 μm , preferably from 0.4 μm to 2.0 μm , more preferably from 0.6 μm to 1.5 μm .

[0022] [Polarizer]

The polarizer is typically a resin film containing a dichroic substance (e.g., iodine). Examples of the resin film include hydrophilic polymer films, such as a polyvinyl alcohol (PVA)-based film, a partially formalized PVA-based film, and an ethylene-vinyl acetate copolymer-based partially saponified film.

[0023] The thickness of the polarizer is preferably 18 μm or less, more preferably 15 μm or less, still more preferably 12 μm or less. Meanwhile, the thickness of the polarizer is preferably 1 μm or more.

[0024] The polarizer preferably shows absorption dichroism at any wavelength in the wavelength range of from 380 nm to 780 nm. The single layer transmittance of the polarizer is, for

example, from 41.5% to 46.0%, preferably from 42.0% to 46.0%, more preferably from 44.5% to 46.0%. The polarization degree of the polarizer is preferably 97.0% or more, more preferably 99.0% or more, still more preferably 99.9% or more.

[0025] The polarizer may be produced by any appropriate method. Specifically, the polarizer may be produced from a single-layer resin film, or may be produced by using a laminate of two or more layers.

[0026] A method of producing the polarizer from the single-layer resin film typically includes subjecting the resin film to dyeing treatment with a dichroic substance, such as iodine or a dichroic dye, and stretching treatment. As the resin film, there is used, for example, a hydrophilic polymer film, such as a polyvinyl alcohol (PVA)-based film, a partially formalized PVA-based film, or an ethylene-vinyl acetate copolymer-based partially saponified film. The method may further include insolubilizing treatment, swelling treatment, cross-linking treatment, or the like. Such production method is well known and commonly used in the art, and hence detailed description thereof is omitted.

[0027] The polarizer obtained by using the laminate may be produced, for example, by using a laminate of a resin substrate

and a resin film or a resin layer (typically, a PVA-based resin layer). Specifically, the polarizer may be produced, for example, by: applying a PVA-based resin solution to the resin substrate; drying the solution to form the PVA-based resin layer on the resin substrate, to thereby provide the laminate of the resin substrate and the PVA-based resin layer; and stretching and dyeing the laminate to turn the PVA-based resin layer into the polarizer. In this embodiment, a PVA-based resin layer containing a halide and a PVA-based resin is preferably formed on one side of the resin substrate. The stretching typically includes stretching the laminate under a state in which the laminate is immersed in an aqueous solution of boric acid. Further, the stretching may further include in-air stretching of the laminate at high temperature (e.g., 95°C or more) before the stretching in the aqueous solution of boric acid as required. In addition, in this embodiment, the laminate is preferably subjected to drying shrinkage treatment, which includes heating the laminate, while conveying the laminate in its lengthwise direction, to shrink the laminate by 2% or more in its widthwise direction. The production method of this embodiment typically includes subjecting the laminate to in-air auxiliary stretching treatment, dyeing treatment, underwater stretching treatment, and drying shrinkage treatment in the stated order. When the auxiliary stretching is introduced, even in the case where PVA is applied onto a thermoplastic resin substrate, the

crystallinity of PVA can be improved, and hence high optical characteristics can be achieved. In addition, when the alignment property of PVA is improved in advance simultaneously with the crystallinity improvement, problems, such as a reduction in alignment property of PVA and the dissolution thereof, can be prevented at the time of the immersion of the laminate in water in the subsequent dyeing step or stretching step, and hence high optical characteristics can be achieved. Further, in the case where the PVA-based resin layer is immersed in a liquid, the disturbance of the alignment of the molecules of PVA and reductions in alignment properties thereof can be suppressed, and hence high optical characteristics can be achieved, as compared to the case where the PVA-based resin layer is free of any halide. Further, high optical characteristics can be achieved by shrinking the laminate in its widthwise direction through the drying shrinkage treatment. A polarizing plate may be obtained by laminating a protective layer on the peeled surface on which the resin substrate has been peeled from the resultant laminate of the resin substrate and the polarizer, or on the surface on the opposite side to the peeled surface. Details about such method of producing the polarizer are described in, for example, JP 2012-73580 A or JP 6470455 B1, the description of which is incorporated herein by reference in its entirety.

[0028] [Protective layer]

The protective layer may be formed of any appropriate film that may be used as a protective layer for a polarizer. Specific examples of a material serving as a main component of the film include: a cellulose-based resin such as triacetylcellulose (TAC); a polyester-based resin; a polyvinyl alcohol-based resin; a polycarbonate-based resin; a polyamide-based resin; a polyimide-based resin; a polyethersulfone-based resin; a polysulfone-based resin; a polystyrene-based resin; a cycloolefin-based resin such as polynorbornene; a polyolefin-based resin; a (meth)acrylic resin; and an acetate-based resin.

[0029] The thickness of the protective layer is preferably from 5 μm to 80 μm , more preferably from 10 μm to 40 μm , still more preferably from 15 μm to 35 μm .

[0030] In one embodiment, it is preferred that the protective layer **40** arranged on the side of the polarizer **30** on which the laminate film **20** is not arranged be optically isotropic. The phrase "be optically isotropic" as used herein means that the layer has an in-plane retardation $R_e(550)$ of from 0 nm to 10 nm, and a thickness direction retardation $R_{th}(550)$ of from -10 nm to +10 nm.

[0031] [Laminate Film]

The above-mentioned laminate film includes a substrate and a surface-treated layer formed on the substrate. The substrate may function as a protective layer for the polarizer, and the details thereof are as described above. A polarizing plate to be obtained according to the embodiment of the present invention is typically arranged on the viewer side of an image display apparatus, and the laminate film is arranged on the viewer side. In one embodiment, the surface-treated layer of the laminate film is positioned on the outermost surface of the image display apparatus. Accordingly, a layer subjected to surface treatment, such as hard coat (HC) treatment, antireflection treatment, anti-sticking treatment, antiglare treatment, or antifouling treatment, is formed on the substrate (protective layer on the viewer side).

[0032] In one embodiment, the surface-treated layer has an antiglare function and an antireflection function. Specifically, the surface-treated layer includes an antiglare layer and an antireflection layer in the stated order from the substrate side. The antiglare layer typically contains a resin and a filler. Specifically, an antiglare property is obtained by incorporating the filler into the resin to produce a fine uneven shape on the surface of the layer (antiglare layer) to be obtained. When the antiglare layer is arranged, ambient light, such as a fluorescent lamp or sunlight, can be scattered

on, for example, the surface of the image display apparatus, to suppress reflection of an image, and hence a contrast reduction can be prevented. The antireflection layer may reduce the reflection of the surface of the antiglare layer. The reflectance of the laminate film on the surface-treated layer side is preferably 3% or less, more preferably 1% or less.

[0033] The antireflection layer may be obtained by, for example, drying and curing a coating film obtained by applying an application liquid for forming an antireflection layer onto the antiglare layer. The application liquid for forming an antireflection layer may contain, for example, a resin component (curable compound), a fluorine-containing additive, hollow particles, solid particles, and a solvent, and may be obtained by, for example, mixing those components.

[0034] A curing mechanism of the resin component (curable compound) in the application liquid for forming an antireflection layer is, for example, a thermosetting type or a photocurable type. A curable compound having at least one of an acrylate group or a methacrylate group is used as the resin component, and examples thereof include oligomers and prepolymers of acrylates or methacrylates of a silicone resin, a polyester resin, a polyether resin, an epoxy resin, a urethane resin, an alkyd resin, a spiroacetal resin, a polybutadiene resin,

a polythiol polyene resin, and a polyfunctional compound such as a polyhydric alcohol. Those components may be used alone or in combination thereof.

[0035] For example, a reactive diluent having at least one of an acrylate group or a methacrylate group may also be used as the resin component. For example, a reactive diluent described in JP 2008-88309 A may be used as the reactive diluent, and examples thereof include a monofunctional acrylate, a monofunctional methacrylate, a polyfunctional acrylate, and a polyfunctional methacrylate. A tri- or higher functional acrylate and a tri- or higher functional methacrylate are each preferably used as the reactive diluent from the viewpoint of obtaining excellent hardness. Further examples of the reactive diluent include butanediol glycerol ether diacrylate, an acrylate of isocyanuric acid, and a methacrylate of isocyanuric acid. Those components may be used alone or in combination thereof. For curing the resin component, a curing agent may be used, for example. A known polymerization initiator (e.g., thermal polymerization initiator or photopolymerization initiator) may be used as the curing agent.

[0036] The fluorine-containing additive may be, for example, an organic compound containing fluorine or an inorganic compound containing fluorine. Examples of the organic compound

containing fluorine include a fluorine-containing antifouling coating agent, a fluorine-containing acrylic compound, or a fluorine-silicon-containing acrylic compound. A commercially available product may be used as the organic compound containing fluorine. Specific examples of the commercially available product include: "KY-1203" (product name) manufactured by Shin-Etsu Chemical Co., Ltd.; and "MEGAFACE" (product name) manufactured by DIC Corporation. The content of the fluorine-containing additive may be, for example, 0.05 part by weight or more, 0.1 part by weight or more, 0.15 part by weight or more, 0.20 part by weight or more, or 0.25 part by weight or more, and may be 20 parts by weight or less, 15 parts by weight or less, 10 parts by weight or less, 5 parts by weight or less, or 3 parts by weight or less with respect to 100 parts by weight of the resin component.

[0037] For example, silica particles, acrylic particles, and acrylic-styrene copolymer particles are used as the hollow particles. Commercially available products (e.g., "THRULYA 5320" and "THRULYA 4320" (product names) manufactured by JGC Catalysts and Chemicals Ltd.) may be used as hollow silica particles. The weight-average particle diameter of the hollow particles may be, for example, 30 nm or more, 40 nm or more, 50 nm or more, 60 nm or more, or 70 nm or more, and may be 150 nm or less, 140 nm or less, 130 nm or less, 120 nm or less, or 110

nm or less. The shape of each of the hollow particles is not particularly limited, but is preferably a substantially spherical shape. Specifically, the aspect ratio of each of the hollow particles is preferably 1.5 or less. The content of the hollow particles may be, for example, 30 parts by weight or more, 50 parts by weight or more, 70 parts by weight or more, 90 parts by weight or more, or 100 parts by weight or more, and may be 300 parts by weight or less, 270 parts by weight or less, 250 parts by weight or less, 200 parts by weight or less, or 180 parts by weight or less with respect to 100 parts by weight of the above-mentioned resin component.

[0038] For example, silica particles, zirconia particles, and titania particles are used as the solid particles. Commercially available products (e.g., "MEK-AC-2140Z", "MIBK-ST", and "IPA-ST" (product names) manufactured by Nissan Chemical Industries, Ltd.) may be used as solid silica particles. The weight-average particle diameter of the solid particles may be, for example, 5 nm or more, 10 nm or more, 15 nm or more, 20 nm or more, or 25 nm or more, and may be 330 nm or less, 250 nm or less, 200 nm or less, 150 nm or less, or 100 nm or less. The shape of each of the hollow particles is not particularly limited, but is preferably a substantially spherical shape. Specifically, the aspect ratio of each of the hollow particles is preferably 1.5 or less. The content of the solid particles may be, for

example, 5 parts by weight or more, 10 parts by weight or more, 15 parts by weight or more, 20 parts by weight or more, or 25 parts by weight or more, and may be 150 parts by weight or less, 120 parts by weight or less, 100 parts by weight or less, or 80 parts by weight or less with respect to 100 parts by weight of the resin component.

[0039] Any appropriate solvent may be used as the solvent. Examples of the solvent include: alcohols, such as methanol, ethanol, isopropyl alcohol, butanol, tertiary butyl alcohol (TBA), and 2-methoxyethanol; ketones, such as acetone, methyl ethyl ketone, methyl isobutyl ketone (MIBK), and cyclopentanone; esters, such as methyl acetate, ethyl acetate, butyl acetate, and propylene glycol monomethyl ether acetate (PMA); ethers, such as diisopropyl ether and propylene glycol monomethyl ether; glycols, such as ethylene glycol and propylene glycol; cellosolves such as ethyl cellosolve and butyl cellosolve; aliphatic hydrocarbons such as hexane, heptane, and octane; and aromatic hydrocarbons, such as benzene, toluene, and xylene. Those solvents may be used alone or in combination thereof. For example, the content of the solvent may be set so that the ratio of the weight of the solid content with respect to the total weight of the application liquid for forming an antireflection layer becomes, for example, 0.1 wt% or more, 0.3 wt% or more, 0.5 wt% or more, 1.0 wt% or more, or 1.5 wt% or more, and may be

set so that the ratio becomes 20 wt% or less, 15 wt% or less, 10 wt% or less, 5 wt% or less, or 3 wt% or less.

[0040] A known application method, such as fountain coating, die coating, spin coating, spray coating, gravure coating, roll coating, or bar coating, may be used as a method of applying the application liquid for an antireflection layer. The drying temperature of the coating film is, for example, from 30°C to 200°C, and the drying time thereof is, for example, from 30 seconds to 90 seconds. The curing of the coating film may be performed by, for example, heating or photoirradiation (typically, UV irradiation). For example, a high-pressure mercury lamp is used as a light source of the photoirradiation. The irradiation amount of the UV irradiation is preferably from 50 mJ/cm² to 500 mJ/cm² as an integrated exposure at a UV wavelength of 365 nm.

[0041] The surface-treated layer may preferably have an antifouling property. Specifically, the surface-treated layer may contain at least one of fluorine or silicon. Meanwhile, such surface-treated layer may reduce the adhesiveness with the protective film.

[0042] The thickness of the surface-treated layer is, for example, from 1 μm to 20 μm, preferably from 2 μm to 15 μm, more

preferably from 3 μm to 10 μm .

[0043] The water contact angle of the surface of the surface-treated layer (laminate film) is 90° or more, preferably 93° or more. Meanwhile, the water contact angle of the surface of the surface-treated layer (laminate film) is, for example, 125° or less.

[0044] [Retardation Layer]

The above-mentioned retardation layer may be a single layer, or may have a laminated structure (e.g., a two-layer structure). The retardation layer may include any appropriate material. Specifically, the retardation layer may be a resin film (stretched film of a resin film), may be an alignment fixed layer of a liquid crystal compound, or may be a combination thereof. The resin film typically contains a resin containing at least one bonding group selected from the group consisting of: a carbonate bond; and an ester bond. In other words, the resin film contains a polycarbonate-based resin, a polyester-based resin, or a polyester carbonate-based resin.

[0045] The retardation layer may have any appropriate optical characteristics in accordance with, for example, applications. In one embodiment, the retardation layer includes a first retardation layer that may function as a $\lambda/4$ plate. The

first retardation layer typically shows a relationship of a refractive index characteristic of $n_x > n_y = n_z$. The in-plane retardation $Re(550)$ of the retardation layer is preferably from 100 nm to 190 nm, more preferably from 110 nm to 170 nm, still more preferably from 120 nm to 160 nm. The equation " $n_y = n_z$ " as used herein encompasses not only a case in which the n_y and the n_z are completely equal to each other, but also a case in which the n_y and the n_z are substantially equal to each other. Accordingly, the n_y may be larger than the n_z , or the n_y may be smaller than the n_z to the extent that the effect of the present invention is not impaired.

[0046] The N_z coefficient of the first retardation layer is preferably from 0.9 to 1.5, more preferably from 0.9 to 1.3. The first retardation layer may show such a reverse wavelength dispersion characteristic that its retardation value increases with an increase in wavelength of measurement light. In this case, the ratio $Re(450)/Re(550)$ of the retardation layer is preferably 0.8 or more and less than 1, more preferably 0.8 or more and 0.95 or less.

[0047] When the first retardation layer includes a resin film, its thickness is preferably 10 μm or more and 70 μm or less, more preferably 20 μm or more and 60 μm or less.

[0048] [Protective Film]

The above-mentioned protective film includes: a substrate film having a first main surface and a second main surface facing each other; and a pressure-sensitive adhesive layer arranged on the first main surface side of the substrate film.

[0049] The substrate film for forming the protective film is formed of any appropriate resin. Examples of a material for forming the substrate film include: an ester-based resin such as a polyethylene terephthalate (PET)-based resin; a cycloolefin-based resin such as a norbornene-based resin; an olefin-based resin such as a polypropylene resin; a polyamide-based resin; a polycarbonate-based resin; and a copolymer resin thereof. An ester-based resin (e.g., a polyethylene terephthalate-based resin) is preferably used.

[0050] The thickness of the substrate film is preferably from 10 μm to 150 μm , more preferably from 20 μm to 100 μm , still more preferably from 30 μm to 50 μm .

[0051] The peel strength of the protective film to an adherend having a water contact angle of 90° or more is 0.03 N/25 mm or more. When such peel strength is satisfied, in a production process for each of the polarizing plate and the image display apparatus, lifting or peeling of the protective

film from the adherend is prevented, and the peel strength may contribute to improvement in yield. Meanwhile, the peel strength of the protective film to the adherend having a water contact angle of 90° or more is, for example, 0.09 N/25 mm or less, and may be 0.08 N/25 mm or less.

[0052] The above-mentioned adherend is typically the polarizing plate. Specifically, the adherend is the above-mentioned laminate film (surface-treated layer of the laminate film).

[0053] The shear strength of the protective film to the above-mentioned adherend in an in-plane direction is 35 N/100 mm² or less, preferably 30 N/100 mm² or less. When such shear strength is satisfied, in the production process for each of the polarizing plate and the image display apparatus, deformation of the polarizing plate by handling can be suppressed. Specifically, when an external force is locally applied to the polarizing plate from the protective film side thereof, a binding force owing to the deviation in a shear direction that may occur at an interface between the protective film and the adherend (polarizing plate) can be weakened, and deformation (e.g., an indentation mark) can be suppressed. Alternatively, deformation that has occurred once may return to its original state. Meanwhile, the shear strength of the protective film to the

adherend in the in-plane direction is, for example, 10 N/100 mm² or more, and may be 15 N/100 mm² or more.

[0054] The thickness of the pressure-sensitive adhesive layer for forming the protective film is, for example, more than 10 μm , preferably 13 μm or more. Meanwhile, the thickness of the pressure-sensitive adhesive layer for forming the protective film is, for example, 30 μm or less, preferably 27 μm or less. In one embodiment, the above-mentioned shear strength is controlled by adjusting the thickness of the pressure-sensitive adhesive layer. For example, the above-mentioned shear strength may be satisfied while the adhesiveness to the adherend having a water contact angle of 90° or more is secured by adjusting the thickness of the pressure-sensitive adhesive layer.

[0055] The pressure-sensitive adhesive layer for forming the protective film typically contains an acrylic pressure-sensitive adhesive. The acrylic pressure-sensitive adhesive preferably contains a (meth)acrylic polymer having a polar functional group. A typical example of the (meth)acrylic polymer having a polar functional group is a polymer of a monomer having a polar functional group and an alkyl (meth)acrylate. The term "(meth)acrylate" refers to acrylate and/or methacrylate.

[0056] Examples of the monomer having a polar functional group include a carboxyl group-containing monomer and a hydroxyl group-containing monomer. Those monomers may be used alone or in combination thereof. Of those, a carboxyl group-containing monomer is preferably used.

[0057] The above-mentioned carboxyl group-containing monomer is a compound having a carboxyl group, and having a polymerizable unsaturated double bond, such as a (meth)acryloyl group or a vinyl group. Specific examples of the carboxyl group-containing monomer include (meth)acrylic acid, carboxyethyl (meth)acrylate, carboxypentyl (meth)acrylate, itaconic acid, maleic acid, fumaric acid, and crotonic acid. Of those, acrylic acid is preferably used.

[0058] The content of a monomer component having a polar functional group in the above-mentioned (meth)acrylic polymer having a polar functional group is preferably 2 parts by weight or more, more preferably 2.5 parts by weight or more with respect to 100 parts by weight of a monomer for forming the (meth)acrylic polymer. According to such polymer, the above-mentioned peel strength can be satisfactorily achieved. Meanwhile, the content of the monomer component having a polar functional group is, for example, 10 parts by weight or less, preferably 5 parts by weight or less, still more preferably 3 parts by weight or less with

respect to 100 parts by weight of the monomer for forming the (meth)acrylic polymer. According to such polymer, the above-mentioned shear strength can be satisfactorily achieved.

[0059] An example of the alkyl group in the alkyl (meth)acrylate is a linear or branched alkyl group having 1 to 18 carbon atoms. Specific examples of the alkyl group include a methyl group, an ethyl group, a propyl group, an isopropyl group, a butyl group, an isobutyl group, an amyl group, a hexyl group, a cyclohexyl group, a heptyl group, a 2-ethylhexyl group, an isooctyl group, a nonyl group, a decyl group, an isodecyl group, a dodecyl group, an isomyristyl group, a lauryl group, a tridecyl group, a pentadecyl group, a hexadecyl group, a heptadecyl group, and an octadecyl group. Those groups may be used alone or in combination thereof. The average number of carbon atoms of the alkyl group is preferably from 3 to 10. Of those, a 2-ethylhexyl group is preferred.

[0060] The content of the alkyl (meth)acrylate in the above-mentioned (meth)acrylic polymer having a polar functional group is, for example, from 10 parts by weight to 90 parts by weight, preferably from 20 parts by weight to 80 parts by weight, more preferably from 30 parts by weight to 70 parts by weight with respect to 100 parts by weight of the monomer for forming the (meth)acrylic polymer.

[0061] In one embodiment, the (meth)acrylic polymer contains a structural unit derived from any other copolymerizable monomer. Examples of the other copolymerizable monomer include vinyl esters, such as vinyl acetate and vinyl propionate. Those monomers may be used alone or in combination thereof. Of those, vinyl acetate is preferably used.

[0062] The content of the other copolymerizable monomer in the above-mentioned (meth)acrylic polymer having a polar functional group is, for example, 5 parts by weight or more and 60 parts by weight or less, preferably 15 parts by weight or more and 55 parts by weight or less, more preferably 25 parts by weight or more and 50 parts by weight or less with respect to 100 parts by weight of the monomer for forming the (meth)acrylic polymer.

[0063] The weight-average molecular weight M_w of the above-mentioned (meth)acrylic polymer having a polar functional group is, for example, from 30×10^4 to 60×10^4 , preferably from 40×10^4 to 50×10^4 .

[0064] The (meth)acrylic polymer having a polar functional group has a glass transition temperature (T_g) of preferably -15°C or less, more preferably -20°C or less, still more

preferably -25°C or less. According to such polymer, the above-mentioned shear strength can be satisfactorily achieved. Meanwhile, the (meth)acrylic polymer having a polar functional group has a Tg of, for example, -70°C or more, and may be -60°C or more, or may be -50°C or more.

[0065] The above-mentioned Tg (unit: K) may be determined by Fox's equation: $1/T_g = \sum (W_i/T_{gi})$. In Fox's equation, Tg represents the glass transition temperature (unit: K) of the copolymer, W_i represents the weight fraction (copolymerization ratio on a weight basis) of a monomer "i" in the copolymer, and T_{gi} represents the glass transition temperature (unit: K) of the homopolymer of the monomer "i". A value described in any known material may be adopted as the glass transition temperature of the homopolymer.

[0066] The glass transition temperature of the homopolymer of the monomer is typically as described below.

2-Ethylhexyl acrylate: -70°C

Vinyl acetate: 32°C

Acrylic acid: 106°C

2-Hydroxyethyl acrylate: 15°C

4-Hydroxybutyl acrylate: -40°C

[0067] A cross-linking agent may be incorporated into the acrylic pressure-sensitive adhesive. Typically, the cross-linking agent is incorporated in a post-cross-linking reaction form thereof into the acrylic pressure-sensitive adhesive in the pressure-sensitive adhesive layer to be obtained. The incorporation of the cross-linking agent can, for example, impart a moderate cohesive strength to the acrylic pressure-sensitive adhesive. Examples of the cross-linking agent include an isocyanate-based cross-linking agent, an epoxy-based cross-linking agent, a silicone-based cross-linking agent, an oxazoline-based cross-linking agent, an aziridine-based cross-linking agent, a silane-based cross-linking agent, an alkyl-etherified melamine-based cross-linking agent, a metal chelate-based cross-linking agent, a peroxide, and a polyfunctional monomer. Those cross-linking agents may be used alone or in combination thereof.

[0068] The blending amount of the cross-linking agent is, for example, from 0.1 part by weight to 10 parts by weight, preferably from 1 part by weight to 8 parts by weight with respect to 100 parts by weight of the (meth)acrylic polymer having a polar functional group.

[0069] The acrylic pressure-sensitive adhesive may contain any appropriate additive. Examples of the additive include a

leveling agent, a cross-linking aid, a tackifier, a plasticizer, a pigment, a dye, a filler, an age resistor, a conductive material, an antistatic agent, a UV absorber, a light stabilizer, a release modifier, a softener, a surfactant, a flame retardant, and an antioxidant. In one embodiment, the acrylic pressure-sensitive adhesive is substantially free of additives. Specifically, the content of the additive is preferably 0.01 part by weight or less, more preferably 0.001 part by weight or less with respect to 100 parts by weight of the (meth)acrylic polymer having a polar functional group. For example, the use of the additive may be suppressed by adjusting the kind and the content of the monomer for forming the (meth)acrylic polymer to control the peel strength, and hence adhesion of dirt to the adherend (polarizing plate) can be prevented.

[0070] The surface resistance value of the protective film (surface resistance value of the surface on a second main surface side of the substrate film) is preferably $1.0 \times 10^8 \ \Omega/\square$ or more, more preferably $1.0 \times 10^9 \ \Omega/\square$ or more. Such surface resistance value can be satisfactorily achieved by arranging a treatment layer on the second main surface side of the substrate film as illustrated in FIG. **1C**. Meanwhile, the surface resistance value of the protective film is, for example, $1.0 \times 10^{13} \ \Omega/\square$ or less, preferably $1.0 \times 10^{12} \ \Omega/\square$ or less, more preferably $1.0 \times 10^{11} \ \Omega/\square$ or less.

[0071] The above-mentioned treatment layer typically contains an antistatic agent. Specifically, the above-mentioned treatment layer may be formed by applying an application liquid containing an antistatic agent and a solvent (e.g., an organic solvent or an aqueous solvent such as water) to the substrate film and drying the application liquid. Examples of the antistatic agent include a quaternary ammonium cation-containing polymer and a polyaniline sulfonic acid-based antistatic agent, and a quaternary ammonium cation-containing polymer is preferably used.

[0072] Examples of a quaternary ammonium cation in the quaternary ammonium cation-containing polymer includes a trimethylammonium cation, a triethylammonium cation, a tripropylammonium cation, a methyldiethylammonium cation, an ethyldimethylammonium cation, a methyldipropylammonium cation, a dimethylbenzylammonium cation, a diethylbenzylammonium cation, a methyldibenzylammonium cation, and an ethyldibenzylammonium cation. Of these, a trimethylammonium cation is preferably used.

[0073] The method of producing an image display apparatus according to one embodiment of the present invention includes bonding the above-mentioned polarizing plate (polarizing plate with a protective film) to a main body of an image display panel.

The following description is given by taking an organic EL display as an example of the image display apparatus.

[0074] FIG. 3 is a schematic sectional view for illustrating an overview of a state of an organic EL display apparatus according to one embodiment of the present invention in which the polarizing plate is arranged on an organic EL panel. The organic EL panel **200** includes an organic EL panel main body **70** and a polarizing plate **110** with a protective film. The polarizing plate **110** with a protective film is arranged so that the polarizer **30** is on the organic EL panel main body **70** side relative to the laminate film **20**. Specifically, the polarizing plate **100** is bonded to the organic EL panel main body **70** via the pressure-sensitive adhesive layer **52**.

[0075] The organic EL panel main body **70** includes a substrate **71** and an upper structural layer **72** including a circuit layer including a thin film transistor (TFT) or the like, an organic light-emitting diode (OLED), a sealing film for sealing the OLED, and the like. For example, when a flexible substrate (e.g., resin substrate) is used as the substrate **71**, the organic EL display apparatus to be obtained can be curved, bent, folded, wound, or the like.

[0076] Although not shown, when the organic EL panel main

body **70** is used as an image display apparatus for mobile device applications, the organic EL panel main body **70** may typically include a touch panel. When the protective film **10** that may be positioned on an outermost surface of the organic EL panel **200** may satisfy the above-mentioned surface resistance value ($1.0 \times 10^8 \Omega/\square$ or more), occurrence of a touch panel sensor error is suppressed in a production step for an organic EL display apparatus, and hence production efficiency may be improved. Herein, the touch panel sensor error refers to a phenomenon in which a screen does not respond or hardly responds even when the screen is touched with a finger when operability of the touch panel is observed in a production process (e.g., examination step) for an image display panel (image display apparatus).

Examples

[0077] The present invention is specifically described below by way of Examples. However, the present invention is not limited to these Examples. A thickness, a water contact angle, and a surface resistance value are values measured by the following measurement methods. In addition, the terms "part(s)" and "%" in Examples and Comparative Examples are by weight unless otherwise stated.

1. Thickness

A thickness of 10 μm or less was measured with a scanning

electron microscope (manufactured by JEOL Ltd., product name: "JSM-7100F"). A thickness of more than 10 μm was measured with a digital micrometer (manufactured by Anritsu Corporation, product name: "KC-351C").

2. Water Contact Angle

A water contact angle of a laminate film on its surface-treated layer side was measured. Specifically, the measurement was performed under an environment at 23°C and 50%RH by a drop method with a contact angle meter (manufactured by Kyowa Interface Science Co., Ltd., product name: "Model DMO-501", control box: "DMC-2", control and analysis software: "FAMAS (version 5.0.30)"). The dropping amount of distilled water was set to 2 μL , and a contact angle was calculated by a $\theta/2$ method from an image 5 seconds after the dropping.

3. Surface Resistance Value

A surface resistance value was measured by an eddy current method with a noncontact surface resistance meter available under the product name "EC-80" from Napson Corporation. The measurement was performed at a temperature of 23°C.

[0078] [Example 1]

(Production of Polarizer)

An elongate roll of a polyvinyl alcohol (PVA)-based resin

film (manufactured by Kuraray Co., Ltd., product name: "PE3000") having a thickness of 30 μm was uniaxially stretched in its lengthwise direction with a roll stretching machine so that the total stretching ratio became 5.9 times. Simultaneously with the stretching, the film was subjected to swelling treatment, dyeing treatment, cross-linking treatment, and washing treatment in the stated order. After that, the film was finally subjected to drying treatment to produce a polarizer having a thickness of 12 μm .

In the swelling treatment, the film was stretched at a ratio of 2.2 times while being treated with pure water at 20°C. Next, in the dyeing treatment, the film was stretched at a ratio of 1.4 times while being treated in an aqueous solution at 30°C containing iodine and potassium iodide at a weight ratio of 1:7, whose iodine concentration had been adjusted so that the polarizer to be obtained had a single layer transmittance of 45.0%. Next, two-stage cross-linking treatment was adopted as the cross-linking treatment. In the first-stage cross-linking treatment, the film was stretched at a ratio of 1.2 times while being treated in an aqueous solution at 40°C having dissolved therein boric acid and potassium iodide. The boric acid content and potassium iodide content of the aqueous solution of the first-stage cross-linking treatment were set to 5.0 wt% and 3.0 wt%, respectively. In the second-stage cross-linking treatment,

the film was stretched at a ratio of 1.6 times while being treated in an aqueous solution at 65°C having dissolved therein boric acid and potassium iodide. The boric acid content and potassium iodide content of the aqueous solution of the second-stage cross-linking treatment were set to 4.3 wt% and 5.0 wt%, respectively. Next, in the washing treatment, the film was treated in a potassium iodide aqueous solution at 20°C. The potassium iodide content of the aqueous solution of the washing treatment was set to 2.6 wt%. Finally, the film was subjected to the drying treatment at 70°C for 5 minutes. Thus, the polarizer was obtained.

[0079] (Production of Laminated Product)

A TAC film (thickness: 25 μm , FUJIFILM Corporation, product name: "TJ25UL") was bonded to one side of the resultant polarizer via a UV-curable adhesive, and a TAC film (lamine film, thickness: 32 μm) having formed thereon a surface-treated layer was bonded to the other side of the polarizer via a UV-curable adhesive. Thus, a laminated product was obtained. The TAC film having formed thereon a surface-treated layer is a film obtained by forming a surface-treated layer (thickness: 7 μm , water contact angle: 93.3°) on the TAC film (thickness: 25 μm , FUJIFILM Corporation, product name: "TJ25UL"). The surface-treated layer was formed by a procedure described below.

[0080] <Surface-treated Layer>

1. Formation of Antiglare Layer

A mixture containing 50 parts by weight of a UV-curable urethane acrylate resin (manufactured by The Nippon Synthetic Chemical Industry Co., Ltd., product name: "UV1700TL", solid content: 80%) and 50 parts by weight of a polyfunctional acrylate containing pentaerythritol triacrylate as a main component (manufactured by Osaka Organic Chemical Industry Ltd., product name: "Viscoat #300", solid content: 100%) was prepared. 4 Parts by weight of cross-linked polymethyl methacrylate particles (manufactured by Sekisui Kasei Co., Ltd., product name: "TECHPOLYMER", weight-average particle diameter: 3 μ m, refractive index: 1.525), 1.5 parts by weight of synthetic smectite (manufactured by Co-op Chemical Co., Ltd., product name: "Lucentite SAN") serving as organic clay (thixotropy-imparting agent), 3 parts by weight of a photopolymerization initiator (manufactured by BASF SE, product name: "OMNIRAD 907"), and 0.15 part by weight of a leveling agent (manufactured by Kyoeisha Chemical Co., Ltd., product name: "LE303", solid content: 40%) were mixed with respect to 100 parts by weight of the resin solid content of the mixture. Herein, the organic clay was diluted with toluene so that its solid content became 6% before use.

The resultant mixture was diluted with a mixed solvent of

toluene/ethyl acetate/cyclopentanone (CPN) (weight ratio: 35/41/24) so that its solid content concentration became 40 wt%. Thus, a material for forming an antiglare layer (application liquid) was prepared.

[0081] The resultant material (application liquid) for forming an antiglare layer was applied onto the TAC film (thickness: 25 μm , FUJIFILM Corporation, product name: "TJ25UL"). After that, the application film was irradiated with UV light having a wavelength of 365 nm with a high-pressure mercury lamp so that an integrated light quantity became 300 mJ/cm^2 . Further, the film was dried by heating at 80°C for 60 seconds to form an antiglare layer having a thickness of 7 μm .

[0082] 2. Formation of Antireflection Layer

100 Parts by weight of a polyfunctional acrylate containing pentaerythritol triacrylate as a main component (manufactured by Osaka Organic Chemical Industry Ltd., product name: "Viscoat #300", solid content: 100 wt%), 100 parts by weight of hollow nanosilica particles (manufactured by JGC Catalysts and Chemicals Ltd., product name: "THRULYA 5320", solid content: 20 wt%, weight-average particle diameter: 75 nm), solid nanosilica particles (manufactured by Nissan Chemical Industries, Ltd., product name: "MEK-2140Z-AC", solid content: 30 wt%, weight-average particle diameter: 10 nm), 12 parts by

weight of a fluorine-containing additive (manufactured by Shin-Etsu Chemical Co., Ltd., product name: "KY-1203", solid content: 20 wt%), and 3 parts by weight of a photopolymerization initiator (manufactured by BASF SE, product name: "OMNIRAD 907", solid content: 100 wt%) were mixed. A mixed solvent obtained by mixing TBA, MIBK, and PMA at a weight ratio of 60:25:15 was added as a solvent to the mixture so that the total solid content became 4 wt%, and the resultant was then stirred. Thus, an application liquid for forming an antireflection layer was prepared.

[0083] The resultant application liquid for forming an antireflection layer was applied onto the above-mentioned antiglare layer with a wire bar. The applied application liquid was dried by heating at 80°C for 1 minute to form a coating film. The resultant coating film was subjected to curing treatment by irradiation with UV light at an integrated light quantity of 300 mJ/cm² with a high-pressure mercury lamp to form an antireflection layer having a thickness of 0.1 μm.

Thus, a surface-treated layer was formed.

[0084] (Production of Laminate I)

An acrylic pressure-sensitive adhesive layer (thickness: 12 μm) was formed on the TAC film side of the resultant laminated product, and a release liner was bonded to the surface of the

formed pressure-sensitive adhesive layer. Next, a protective film was bonded to the laminate film side of the resultant laminated product to provide a laminate I. The protective film used was produced by a procedure described below.

[0085] <Protective Film>

An antistatic layer containing a quaternary ammonium cation-containing polymer was formed on one side of a PET film (thickness: 38 μm , manufactured by Mitsubishi Chemical Corporation, product name: "Diafoil T100M38"). The following pressure-sensitive adhesive composition A was applied to the side of the PET film on which the antistatic layer was not formed. The composition was heated at 130°C for 1 minute to form a pressure-sensitive adhesive layer having a thickness of 13 μm . Thus, a protective film having a surface resistance value of $2.0 \times 10^9 \Omega/\square$ was obtained.

[0086] <Pressure-sensitive Adhesive Composition A>

A monomer composition containing 54.1 parts by weight of 2-ethylhexyl acrylate, 43.2 parts by weight of vinyl acetate, and 2.7 parts by weight of acrylic acid was polymerized to provide an acrylic polymer (T_g : -32°C). 100 Parts by weight of the resultant acrylic polymer, 4 parts by weight of an epoxy-based cross-linking agent (manufactured by Mitsubishi Gas Chemical Company, Inc., product name: "TETRAD-C"), and toluene

serving as a solvent were mixed to produce a pressure-sensitive adhesive composition A.

[0087] (Production of Laminate II)

An acrylic pressure-sensitive adhesive layer having a thickness of 15 μm was formed on the surface of a resin film (manufactured by Teijin Limited, "PURE-ACE RM-147") having a thickness of 52 μm for forming a retardation layer. A polyethylene terephthalate film (thickness: 38 μm , manufactured by Mitsubishi Chemical Polyester Film Co., Ltd., "MRF 38") treated with a silicone-based release agent was bonded as a release liner to the surface of the pressure-sensitive adhesive layer. Thus, a laminate II was obtained.

[0088] (Production of Polarizing Plate with Protective Film)

The release liner of the above-mentioned laminate I was peeled, and the laminate I was bonded to the retardation layer side of the above-mentioned laminate II. Thus, a polarizing plate with a protective film was obtained.

The bonding of the respective components was performed while the components were roll conveyed.

[0089] [Example 2]

A polarizing plate with a protective film was obtained in the same manner as in Example 1 except that the thickness of the pressure-sensitive adhesive layer of the protective film was set to 15 μm .

[0090] [Example 3]

A polarizing plate with a protective film was obtained in the same manner as in Example 1 except that the thickness of the pressure-sensitive adhesive layer of the protective film was set to 18 μm .

[0091] [Example 4]

A polarizing plate with a protective film was obtained in the same manner as in Example 1 except that the thickness of the pressure-sensitive adhesive layer of the protective film was set to 23 μm .

[0092] [Example 5]

A polarizing plate with a protective film was obtained in the same manner as in Example 1 except that the thickness of the pressure-sensitive adhesive layer of the protective film was set to 28 μm .

[0093] [Comparative Example 1]

A polarizing plate with a protective film was obtained in

the same manner as in Example 1 except that the thickness of the pressure-sensitive adhesive layer of the protective film was set to 5 μm .

[0094] [Comparative Example 2]

A polarizing plate with a protective film was obtained in the same manner as in Example 1 except that the thickness of the pressure-sensitive adhesive layer of the protective film was set to 10 μm .

[0095] [Comparative Example 3]

A polarizing plate with a protective film was obtained in the same manner as in Example 1 except that: the pressure-sensitive adhesive layer for forming the protective film was formed of the following pressure-sensitive adhesive composition B; and the thickness of the pressure-sensitive adhesive layer was set to 10 μm .

[0096] <Pressure-sensitive Adhesive Composition B>

A monomer composition containing 96.2 parts by weight of 2-ethylhexyl acrylate and 3.8 parts by weight of 2-hydroxyethyl acrylate was polymerized to provide an acrylic polymer (T_g : -66°C). 100 Parts by weight of the resultant acrylic polymer, 3 parts by weight of an aromatic polyisocyanate (manufactured by Tosoh Corporation, product name: "CORONATE L") serving as a

cross-linking agent, 0.02 part by weight of dioctyltin dilaurate (manufactured by Tokyo Fine Chemical Co., Ltd., product name: "EMBILIZER OL-1") serving as a cross-linking aid, 0.5 part by weight of polyoxypropylene glycol (manufactured by Sanyo Chemical Industries, Ltd., product name: "SANNIX PP-3000") serving as a peeling aid, and toluene serving as a solvent were mixed. Thus, a pressure-sensitive adhesive composition B was produced.

[0097] [Comparative Example 4]

A polarizing plate with a protective film was obtained in the same manner as in Example 1 except that: the pressure-sensitive adhesive layer for forming the protective film was formed of the following pressure-sensitive adhesive composition C; and the thickness of the pressure-sensitive adhesive layer was set to 23 μm .

[0098] <Pressure-sensitive Adhesive Composition C>

A monomer composition containing 96.2 parts by weight of 2-ethylhexyl acrylate and 3.8 parts by weight of 2-hydroxyethyl acrylate was polymerized to provide an acrylic polymer (T_g : -66°C). 100 Parts by weight of the resultant acrylic polymer, 5 parts by weight of an aliphatic polyisocyanate (manufactured by Tosoh Corporation, product name: "CORONATE HX") serving as a cross-linking agent, 0.03 part by weight of dioctyltin dilaurate

(manufactured by Tokyo Fine Chemical Co., Ltd., product name: "EMBILIZER OL-1") serving as a cross-linking aid, 0.3 part by weight of an ammonium polyoxyethylene alkyl propenyl phenyl ether sulfate (manufactured by DKS Co. Ltd., product name: "AQUALON HS-10") serving as a peeling aid, and toluene serving as a solvent were mixed. Thus, a pressure-sensitive adhesive composition C was produced.

[0099] The polarizing plates with protective films of Examples and Comparative Examples were subjected to the following evaluations. The evaluation results are summarized in Table 1.

<Evaluations>

1. Shear Strength (In-plane Direction)

A shear strength of the protective film to the polarizing plate was measured with a universal tension and compression testing machine (manufactured by Shimadzu Corporation, product name: "AUTOGRAPH AG-X plus"). Specifically, as illustrated in FIG. 4, under a state in which one end (10 mm×10 mm) of a sample obtained by cutting out the resultant protective film into a size of 10 mm in width by 50 mm in length was bonded to the central portion of the upper end of the polarizing plate (surface-treated layer side) cut out into a size of 70 mm long by 100 mm wide, the other end (10 mm×10 mm) of the sample and

the central portion of the lower end of the polarizing plate were clamped by chucks. The sample was pulled in its length direction under the conditions of an initial chuck-to-chuck distance of 60 mm and a tensile rate of 0.06 mm/min, and the maximum value when the sample was pulled by 2.0 mm was determined as a shear strength (unit: N/100 mm²). The measurement was performed under an environment at 23°C and 50%RH.

2. Deformation

As illustrated in FIG. 5, the resultant polarizing plate (test piece having a size of 60 mm long by 60 mm wide) S with a protective film was mounted on the upper surface of a test plate P including the upper surface having formed therein a recess having a size of 25 mm long by 25 mm wide by 1 mm deep so that its release liner was positioned on a test plate P side. Under this state, a rod having a radius of 8 mm was indented from the upper surface (protective film side) of the polarizing plate S with a protective film toward the bottom surface of the central portion of the recess of the test plate P. The state was kept for 1.0 second, and whether an indentation mark remained on the polarizing plate S with a protective film when the rod was released from the polarizing plate S with a protective film was observed.

(Evaluation Criteria)

Satisfactory: No indentation mark remains.

Unsatisfactory: An indentation mark remains.

3. Peel Strength

A sample obtained by cutting out the resultant polarizing plate with a protective film into a size of 50 mm in width by 100 mm in length was measured for a peel strength (unit: N/25 mm) when peeled in its length direction at a peel rate of 300 mm/min and a peel angle of 180° with a universal tension testing machine (manufactured by Shimadzu Corporation, product name: "AUTOGRAPH AG-X plus"). Specifically, the peel strength of the protective film to the polarizing plate (surface-treated layer) was measured. The measurement was performed under an environment at 23°C and 50%RH.

4. Adhesiveness

Whether lifting or peeling of the protective film occurred in the polarizing plate with a protective film during the roll conveyance was observed.

(Evaluation Criteria)

Satisfactory: No lifting or peeling of the protective film occurs.

Unsatisfactory: Lifting or peeling of the protective film occurs.

[0100]

Table 1

	Thickness μm	Shear strength N/100 mm ²	Deformation	Peel strength N/25 mm	Adhesiveness
Example 1	13	28.2	Satisfactory	0.05	Satisfactory
Example 2	15	27.7	Satisfactory	0.05	Satisfactory
Example 3	18	24.0	Satisfactory	0.05	Satisfactory
Example 4	23	19.5	Satisfactory	0.06	Satisfactory
Example 5	28	15.5	Satisfactory	0.09	Satisfactory
Comparative Example 1	5	41.2	Unsatisfactory	0.04	Satisfactory
Comparative Example 2	10	36.4	Unsatisfactory	0.05	Satisfactory
Comparative Example 3	10	41.2	Unsatisfactory	0.01	Unsatisfactory
Comparative Example 4	23	13.4	Satisfactory	0.01	Unsatisfactory

[0101] In each of Comparative Examples 1 to 3, in the evaluation of the deformation, the polarizing plate (polarizing plate with a protective film) was deformed by the indentation. The deformation was not recovered, and the indentation mark remained.

Industrial Applicability

[0102] The polarizing plate to be obtained according to the embodiment of the present invention may be suitably used as a polarizing plate of an image display apparatus. Typical examples of the image display apparatus include a liquid crystal display apparatus, an organic EL display apparatus, and an inorganic EL

display apparatus.

Reference Signs List

[0103]	10	protective film
11		substrate film
12		pressure-sensitive adhesive layer
13		treatment layer
20		laminate film
21		substrate (protective layer)
22		surface-treated layer
30		polarizer
40		protective layer
50		pressure-sensitive adhesive layer
52		pressure-sensitive adhesive layer
60		retardation layer
90		laminated product
100		polarizing plate
110		polarizing plate with protective film
200		image display panel (organic EL panel)

Claims

[Claim 1] A protective film, comprising:

a substrate film having a first main surface and a second main surface facing each other; and

a pressure-sensitive adhesive layer arranged on a first main surface side of the substrate film,

wherein the protective film has a peel strength to an adherend having a water contact angle of 90° or more of 0.03 N/25 mm or more, and

wherein the protective film has a shear strength to the adherend in an in-plane direction of 35 N/100 mm² or less.

[Claim 2] The protective film according to claim 1, wherein the pressure-sensitive adhesive layer has a thickness of more than 10 μm .

[Claim 3] The protective film according to claim 1 or 2,

wherein the pressure-sensitive adhesive layer contains an acrylic pressure-sensitive adhesive,

wherein the acrylic pressure-sensitive adhesive contains a (meth)acrylic polymer having a polar functional group, and

wherein a content of a monomer component having a polar functional group is 2 parts by weight or more with respect to 100 parts by weight of a monomer for forming the (meth)acrylic polymer.

[Claim 4] A polarizing plate, comprising:

the protective film of any one of claims 1 to 3;

a laminate film including a substrate and a surface-treated layer having a water contact angle of 90° or more; and

a polarizer,

wherein the protective film is bonded to the surface-treated layer.

[Claim 5] A method of producing a polarizing plate, comprising:

bonding the protective film of any one of claims 1 to 3 to a surface-treated layer having a water contact angle of 90° or more of a laminate film including a substrate and the surface-treated layer; and

laminating a polarizer on a substrate side of the laminate film.

[Claim 6] A method of producing an image display apparatus, comprising laminating a polarizing plate obtained by the production method of claim 5 to a main body of an image display panel.