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DESCRIPTION

ANTI-GLARE HARD COAT FILM, METHOD FOR PRODUCING ANTI-GLARE HARD
COAT FILM, OPTICAL MEMBER, AND IMAGE DISPLAY DEVICE

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TECHNICAL FIELD

[0001] The present invention relates to an anti-glare hard coat film, a method for producing the anti-glare hard coat film, an optical member, and an image display device.

BACKGROUND ART

10 [0002] Anti-glare treatment is applied to various image display devices such as cathode ray tubes (CRTs), liquid crystal displays (LCDs), plasma display panels (PDPs), and electroluminescence displays (ELDs) in order to prevent a reduction in contrast due to reflection of external light such as fluorescent light and sunlight and reflected glare of images on the surface of the image display devices. In particular, as the screen size of image display devices increases, the number of image display devices equipped with anti-glare films is increasing.

15 [0003] There are many literatures described for anti-glare films, such as Patent Literature 1. Further, as the anti-glare film, an anti-glare hard coat film in which an anti-glare layer also serves as a hard coat layer is also used.

Citation List

20 Patent Literature

[0004] Patent Literature 1: JP 2004-110461

SUMMARY OF INVENTION

Technical Problem

25 [0005] From the viewpoint of visibility, the anti-glare hard coat film needs to be suppressed from reflected glare due to reflection of external light.

[0006] For example, in recent years, the demand for public information displays (PIDs) has increased. PIDs are often used outdoors. When a display (image display device) is used outdoors, reflected glare due to reflection of external light is more likely to occur than when it is used indoors. If reflected glare occurs, it may be difficult to visually recognize the image.

30 [0007] In addition, an anti-glare hard coat film is often produced by continuously coating a coating liquid (an anti-glare hard coat layer-forming material) on an elongated base while conveying the base. However, when the anti-glare hard coat film produced in such a manner is used for an image display device, display unevenness may occur. Examples of the display unevenness include a stripe pattern (hereinafter, also referred to as a "horizontal stripe") in the

conveying direction of the base (the longitudinal direction, hereinafter, also referred to as a "MD direction") and a stripe pattern (hereinafter, also referred to as a "vertical stripe") in a direction perpendicular to the MD direction (hereinafter, also referred to as a "TD direction"). Such display unevenness is more likely to occur when the distance for continuously coating the anti-glare hard coat layer-forming material is long.

[0008] With the foregoing in mind, it is an object of the present invention to provide an anti-glare hard coat film suppressed from reflected glare and suppressed or prevented from horizontal stripes and/or vertical stripes, a method for producing an anti-glare hard coat film, an optical member, and an image display device.

Solution to Problem

[0009] In order to achieve the above object, the present invention provides an anti-glare hard coat film, including: a translucent base (A); and an anti-glare hard coat layer (B), wherein the anti-glare hard coat layer (B) is laminated on the translucent base (A), the anti-glare hard coat layer (B) is formed of a resin layer and contains first particles and second particles inside the resin layer, a total mass of the first particles and the second particles is 2 to 25% by mass relative to a total mass of a resin forming the resin layer, asperities are formed on an outermost surface of the anti-glare hard coat film on a side of the anti-glare hard coat layer (B), a weight-average particle size of the first particles satisfies the following mathematical equation (1), a weight-average particle size of the second particles satisfies the following mathematical equation (2), and the asperities on the outermost surface satisfy the following mathematical equations (3) and (4):

$$3.0 < d1 \leq 8.5 [\mu\text{m}] \quad (1)$$

$$1.0 \leq d2 \leq 3.0 [\mu\text{m}] \quad (2)$$

$$\text{Ry: } 1.0 \leq \text{Ry} \leq 7.0 [\mu\text{m}] \quad (3)$$

$$\theta\text{a: } 1.0 \leq \theta\text{a} \leq 7.5 [^\circ] \quad (4)$$

where in the mathematical equation (1), d1 is the weight-average particle size [μm] of the first particles, in the mathematical equation (2), d2 is the weight-average particle size [μm] of the second particles, in the mathematical equation (3), Ry is a maximum height [μm] of a protruding part of the asperities, and in the mathematical equation (4), θa is an average tilt angle [$^\circ$] of the asperities.

[0010] The present invention also provides a method for producing the anti-glare hard coat film according to the present invention, including the step of: forming the anti-glare hard coat layer (B) on the translucent base (A) so as to satisfy the mathematical equations (1) to (4), wherein the

anti-glare hard coat layer (B)-forming includes the steps of: coating a coating liquid on the translucent base (A); and forming a coating film by drying the coated coating liquid, and the coating liquid contains the resin, the first particles, the second particles, and a solvent.

[0011] The present invention also provides an optical member including the anti-glare hard coat film according to the present invention.

[0012] The present invention also provides an image display device including the anti-glare hard coat film according to the present invention or the optical member according to the present invention.

Advantageous Effects of Invention

[0013] The present invention can provide an anti-glare hard coat film suppressed from reflected glare and suppressed or prevented from horizontal stripes and/or vertical stripes, a method for producing an anti-glare hard coat film, an optical member, and an image display device.

BRIEF DESCRIPTION OF DRAWINGS

[0014] [FIG. 1] FIG. 1 is a cross-sectional view showing an example of an anti-glare hard coat film of the present invention.

DESCRIPTION OF EMBODIMENTS

[0015] Next, the present invention is described in detail with reference to examples. The present invention, however, is not limited thereto.

[0016] In the anti-glare hard coat film of the present invention, for example, the total mass of the second particles may be 1% by mass or more relative to the total mass of the resin forming the resin layer. In the present invention, the terms "weight" and "mass" may be substituted for each other unless otherwise specified. For example, "parts by mass" may be read as "parts by weight," "parts by weight" may be read as "parts by mass", "% by mass " may be read as "% by weight", and "% by weight" may be read as "% by mass ".

[0017] In the anti-glare hard coat film of the present invention, for example, an external haze value due to the asperities may be 5% or more in the anti-glare hard coat film.

[0018] In the anti-glare hard coat film of the present invention, for example, the total mass of the first particles may be 2/3 or more of the total mass of the second particles.

[0019] In the anti-glare hard coat film of the present invention, for example, other layer may be further laminated on the surface of the anti-glare hard coat layer (B) on the side facing away from the translucent base (A).

[0020] In the anti-glare hard coat film of the present invention, for example, the anti-glare hard coat layer (B) and the other layer may be laminated in this order on the translucent base (A), asperities may be formed on the outermost surface of the other layer, and the asperities may

satisfy the mathematical equations (1) to (4).

[0021] In the method for producing an anti-glare hard coat film of the present invention, for example, in the coating liquid-coating, the coating liquid may be continuously coated 500 m or more with a width of 1000 mm or more.

5 [0022] In the anti-glare hard coat film production method of the present invention, for example, the anti-glare hard coat layer (B)-forming may further include the step of curing the coating film.

[0023] The optical member of the present invention may be a polarizing plate, for example.

[0024] The image display device of the present invention may be a public information display.

[0025] [1. Anti-glare hard coat film]

10 As described above, an anti-glare hard coat film of the present invention includes: a translucent base (A); and an anti-glare hard coat layer (B), wherein the anti-glare hard coat layer (B) is laminated on the translucent base (A), the anti-glare hard coat layer (B) is formed of a resin layer and contains first particles and second particles inside the resin layer, a total mass of the first particles and the second particles is 2 to 25% by mass relative to a total mass of a resin forming
15 the resin layer, asperities are formed on an outermost surface of the anti-glare hard coat film on a side of the anti-glare hard coat layer (B), a weight-average particle size of the first particles satisfies the following mathematical equation (1), a weight-average particle size of the second particles satisfies the following mathematical equation (2), and the asperities on the outermost surface satisfy the following mathematical equations (3) and (4):

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$$3.0 < d1 \leq 8.5 [\mu\text{m}] \quad (1)$$

$$1.0 \leq d2 \leq 3.0 [\mu\text{m}] \quad (2)$$

$$\text{Ry: } 1.0 \leq \text{Ry} \leq 7.0 [\mu\text{m}] \quad (3)$$

$$\theta\text{a: } 1.0 \leq \theta\text{a} \leq 7.5 [^\circ] \quad (4)$$

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where in the mathematical equation (1), d1 is the weight-average particle size [μm] of the first particles, in the mathematical equation (2), d2 is the weight-average particle size [μm] of the second particles, in the mathematical equation (3), Ry is a maximum height [μm] of a protruding part of the asperities, and in the mathematical equation (4), θa is an average tilt angle [$^\circ$] of the
30 asperities.

[0026] FIG. 1 is a cross-sectional view showing an example of the configuration of an anti-glare hard coat film of the present invention. As shown in FIG. 1, in this anti-glare hard coat film 10, an anti-glare hard coat layer (B) 12 is laminated on one surface of a translucent base (A) 11.

The anti-glare hard coat layer (B) 12 contains first particles 12b1 and second particles 12b2

35 inside a resin layer 12a. Asperities are formed on the outermost surface of the anti-glare hard

coat film 10 on the side of the anti-glare hard coat layer (B) 12 (the surface of the anti-glare hard coat layer (B) 12 on the side facing away from the translucent base (A) 11). The maximum height R_y of the protruding part of the asperities is $1.0\text{ }\mu\text{m}$ or more and $7.0\text{ }\mu\text{m}$ or less. The average tilt angle θ_a of the asperities is 1.0° or more and 7.5° or less. The weight-average particle size d_1 of the first particles 12b1 exceeds $3.0\text{ }\mu\text{m}$ and is $8.5\text{ }\mu\text{m}$ or less. The weight-average particle size d_2 of the second particles 12b2 is $1.0\text{ }\mu\text{m}$ or more and $3.0\text{ }\mu\text{m}$ or less.

[0027] FIG.1 is illustrative, and the present invention is not limited thereto. For example, the anti-glare hard coat film of the present invention may or may not contain fillers other than the first particles 12b1 and the second particles 12b2 in the resin layer 12a. The other filler is not particularly limited, and examples thereof include a thixotropy-imparting agent (thixotropic agent) and various metal oxide particles object to adjust refractive index and to impart anti-blocking properties. The anti-glare hard coat layer (B) 12 may be directly laminated on the translucent base (A) 11 without interposing any other layer as shown in FIG. 1, or may be laminated on the translucent base (A) 11 with one or two or more other layers interposed therebetween. Further, on the surface of the anti-glare hard coat layer (B) 12 facing away from the translucent base (A) 11, there may be no other layer as shown in FIG. 1, but one or two or more other layers may be laminated.

[0028] In the anti-glare hard coat film of the present invention, the "outermost surface on the side of the anti-glare hard coat layer (B)" is the outermost surface of the anti-glare hard coat film on the side of the anti-glare hard coat layer (B). Specifically, the "outermost surface on the side of the anti-glare hard coat layer (B)" is a surface of the anti-glare hard coat layer (B) on the side facing away from the translucent base (A) when the anti-glare hard coat film includes no other layer on the surface of the anti-glare hard coat layer (B) on the side facing away from the translucent base (A) (e.g., FIG. 1). The "outermost surface on the side of the anti-glare hard coat layer (B)" is the outermost surface of the other layer on the side facing away from the translucent base (A) when the anti-glare hard coat film includes other layer on the surface of the anti-glare hard coat layer (B) on the side facing away from the translucent base (A).

[0029] As described above, the anti-glare hard coat film of the present invention is suppressed from reflected glare and suppressed or prevented from horizontal stripes and/or vertical stripes. Specifically, for example, the anti-glare hard coat film of the present invention can prevent from reflected glare of external light outdoors or the like. The anti-glare hard coat film of the present invention has high quality display performance because horizontal stripes and vertical stripes are suppressed or prevented. Further, the anti-glare hard coat film of the present invention can be produced, for example, by continuously coating a coating liquid (an anti-glare hard coat layer

(B)-forming material) on the elongated translucent base (A). In other words, also by such a production method, an anti-glare hard coat film of the present invention suppressed from reflected glare and suppressed or prevented from horizontal stripes and/or vertical stripes can be produced.

5 [0030] The translucent base (A), the anti-glare hard coat layer (B), and the other layer will be described below with further examples.

[0031] The translucent base (A) is not particularly limited, and may be, for example, a transparent plastic film base. The transparent plastic film base is not particularly limited and preferably has superior light transmittance of visible light (preferably, light transmittance of 90%
10 or more) and superior transparency (preferably, haze value of 1% or less), and may be, for example, a transparent plastic film base described in JP 2008-90263 A. As the transparent plastic film base, a base having optically low birefringence is preferably used. The anti-glare hard coat film of the present invention can be used, for example, as a protective film in a polarizing plate, and in this case, a film formed of triacetyl cellulose (TAC), polycarbonate, an acrylic polymer,
15 polyolefin having a cyclic or norbornene structure, or the like is preferred as the transparent plastic film base. In the present invention, the transparent plastic film base may be a polarizer itself as described below. With such a configuration, it is possible to simplify the structure of the polarizing plate without the need for a protective layer made of TAC or the like, to reduce the number of steps of producing the polarizing plate or the image display device, and to improve
20 the production efficiency. Further, with such a configuration, the polarizing plate can be thinner. In the case where the transparent plastic film base is a polarizer, the anti-glare hard coat layer (B) and the anti-reflection layer (C) function as a protective layer. Further, with such a configuration, for example, the anti-glare hard coat film also functions as a cover plate in the case where the anti-glare film is bonded to the surface of the liquid crystal cell.

25 [0032] In the present invention, the thickness of the translucent base (A) is not particularly limited, and is, for example, in the range from 10 to 500 μm , from 20 to 300 μm , or from 30 to 200 μm from the viewpoint of strength, workability such as handleability, and film thinness, for example. The refractive index of the translucent base (A) is not particularly limited, and is in the range from 1.30 to 1.80 or from 1.40 to 1.70, for example.

30 [0033] In the anti-glare hard coat film of the present invention, for example, a resin contained in the translucent base (A) may contain an acrylic resin.

[0034] In the anti-glare hard coat film of the present invention, for example, the translucent base (A) may be an acrylic film.

[0035] As described above, asperities are formed on the outermost surface on the anti-glare

hard coat film of the present invention on the side of the anti-glare hard coat layer (B), and the maximum height R_y of the asperities is 1.0 μm or more and 7.0 μm or less. The maximum height R_y may be, for example, 1.5 μm or more, 2.0 μm or more, 2.5 μm or more, or 3.0 μm or more, and may be, for example, 6.5 μm or less, 6.0 μm or less, 5.5 μm or less, or 5.0 μm or less. From the viewpoint of suppressing reflected glare, it is preferable that the R_y be not too large. On the other hand, from the viewpoint of preventing the display from becoming blurred due to a too large haze value, it is preferable that R_y be not too large. In the present invention, the maximum height R_y is a numerical value based on JIS B 0601 (1994 edition). The method for measuring R_y is not particularly limited, and can be measured by, for example, a measurement method described in Examples described below.

[0036] Note that the numerical value of R_y can be controlled by, for example, the thickness of the anti-glare hard coat layer (B), the weight-average particle size of the first particles, and the content ratio of the first particles in the anti-glare hard coat layer (B), and the like. For example, if the thickness of the anti-glare hard coat layer (B) is the same, R_y tends to be larger as the weight-average particle size of the first particles is larger. Further, for example, if the thickness of the anti-glare hard coat layer (B) and the weight-average particle size of the first particles are the same, R_y tends to be larger as the content ratio of the first particles in the anti-glare hard coat layer (B) is smaller (i.e., as the average distance between the first particles is larger).

[0037] As described above, the average tilt angle θ_a of the asperities on the outermost surface of the anti-glare hard coat film of the present invention on the side of the anti-glare hard coat layer (B) is 1.0° or more and 7.5° or less. The average tilt angle θ_a may be, for example, 1.5° or more, 2.0° or more, 2.5° or more, or 3.0° or more, and may be, for example, 6.5° or less, 6.0° or less, 5.5° or less, or 5.0° or less. From the viewpoint of suppressing reflected glare, it is preferable that θ_a be large. On the other hand, from the viewpoint of preventing the display from becoming blurred due to a too large haze value, it is preferable that θ_a be not too large. The average tilt angle θ_a is a value defined by the following mathematical equation (5). The average tilt angle θ_a can be measured, for example, by the method described in Examples to be described below.

$$\text{Average tilt angle } \theta_a = \tan^{-1} \Delta a \quad (5)$$

[0038] In the mathematical equation (5), as shown in the following mathematical equation (6), Δa denotes a value obtained by dividing the sum ($h_1 + h_2 + h_3 \dots + h_n$) of the differences (heights h) between adjacent peaks and the lowest point of the valley formed therebetween by the standard length L of the roughness curve defined in JIS B 0601 (1994 edition). The

roughness curve is a curve obtained by removing the surface waviness components with longer wavelengths than the predetermined one from the profile curve using a retardation compensation high-pass filter. The profile curve denotes a profile that appears at the cut surface when an object surface was cut in a plane perpendicular to the object surface.

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$$\Delta a = (h_1 + h_2 + h_3 \dots + h_n) / L \quad (6)$$

[0039] For example, as described above, the anti-glare hard coat film of the present invention may have an external haze value of 5% or more caused by the asperities on the outermost surface on the side of the anti-glare hard coat layer (B). In the case of a high anti-glare film, the overall appearance may be blurred and a black-and-white shading pattern (e.g., the aforementioned horizontal stripes, vertical stripes, etc.) may likely to occur. From the viewpoint of suppressing or preventing this, and from the viewpoint of suppressing reflected glare, it is preferable that the external haze value be as large as possible. On the other hand, from the viewpoint of suppressing or preventing deterioration of display performance (e.g., blurring of an image, deterioration of contrast in a dark place, or the like.), it is preferable that the external haze value be not too large. The external haze value is not particularly limited, and may be, for example, 5% or more, 10% or more, 15% or more, or 20% or more, and may be, for example, 50% or less, 45% or less, 40% or less, or 35% or less. In the present invention, the method for measuring the external haze value is not particularly limited, and the external haze value can be measured by, for example, the following measurement methods (1) to (3):

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(1) The total haze value of the anti-glare hard coat film of the present invention is measured according to JIS K 7136.

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(2) A translucent pressure-sensitive adhesive is laminated on the surface of the anti-glare hard coat layer (B) of the anti-glare hard coat film of (1) on the side facing away from the translucent base (A), and a COP film (produced by Zeon Corporation, trade name: ZEONOR film) is further bonded thereon to prepare a laminate. The inner haze value of the anti-glare hard coat film of (1) can be obtained by the same method as the measurement method of the total haze value according to JIS K 7136 (i.e., the measurement method of (1)). This inner haze value is a haze value obtained by removing the effect of the asperities on the outermost surface of the anti-glare hard coat film on the side of the anti-glare hard coat layer (B) from the total haze value of (1).

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(3) A numerical value obtained by subtracting the inner haze value measured in (2) from the total

haze value measured in (1) is used as the external haze value of the anti-glare hard coat film of (1).

[0040] In the anti-glare hard coat film of the present invention, for example, the resin contained in the anti-glare hard coat layer (B) may contain an acrylate resin (also referred to as an acrylic resin).

[0041] In the anti-glare hard coat film of the present invention, for example, the resin contained in the anti-glare hard coat layer (B) may contain an urethane acrylate resin.

[0042] In the anti-glare hard coat film of the present invention, for example, the resin contained in the anti-glare hard coat layer (B) may be a copolymer of a curable urethane acrylate resin and a polyfunctional acrylate.

[0043] In the anti-glare hard coat film of the present invention, for example, the anti-glare hard coat layer (B) is formed by using an anti-glare hard coat layer-forming material containing a resin and a filler, and the anti-glare hard coat layer (B) may have a flocculated portion forming a convex portion on the surface of the anti-glare hard coat layer (B) by flocculating the fillers. In addition, in the flocculated portion forming the convex portion, the fillers may be present in the state of being gathered in one direction in an in-plane direction of the anti-glare hard coat layer (B). In the image display device of the present invention, for example, the anti-glare hard coat film of the present invention may be disposed such that the one direction in which the fillers are gathered coincides with the long side direction of the black matrix pattern. Examples of the filler include the first particles, the second particles, and thixotropy-imparting agent.

[0044] The anti-glare hard coat layer (B) contains the first particles and the second particles as described above. The first particles and the second particles may, for example, form asperities on the anti-glare hard coat layer (B) to impart anti-glare properties and further serve to control the external haze value of the anti-glare hard coat layer (B). As described above, the first particles have a weight-average particle size greater than the second particles. The reason why the use of both the first particles and the second particles can suppress or prevent the horizontal stripes and vertical stripes is considered as follows, for example. First, the first particles can develop high anti-glare properties. However, when only the first particles are used, unevenness in the distribution of the first particles may cause unevenness in the density of black-and-white of display (e.g., the aforementioned horizontal stripes, vertical stripes, etc.). Here, by further adding the second particles, it is possible to increase the scattering degree of the low scattering part corresponding to the "black" part of black-and-white, which causes a defect in display. As a result, the scattering difference between the "black" part and the normal part is reduced, and the appearance quality can be maintained even when the coating liquid (the anti-glare hard coat layer

(B)-forming material) is continuously coated. Further, it is considered that, by adding the second particles, the distribution itself of the first particles tends to be nearly uniform, and therefore, the horizontal stripes and vertical stripes can be suppressed or prevented. This mechanism, however, is an example of presumable mechanisms, and does not limit the present invention.

5 [0045] In the present invention, the weight-average particle size d_1 of the first particles exceeds $3.0\text{ }\mu\text{m}$ and is $8.5\text{ }\mu\text{m}$ or less, as described above. The weight-average particle size d_1 of the first particles may be, for example, $3.5\text{ }\mu\text{m}$ or more, $4.0\text{ }\mu\text{m}$ or more, $4.5\text{ }\mu\text{m}$ or more, or $5.0\text{ }\mu\text{m}$ or more, and may be, for example, $8.0\text{ }\mu\text{m}$ or less, $7.5\text{ }\mu\text{m}$ or less, $7.0\text{ }\mu\text{m}$ or less, or $6.5\text{ }\mu\text{m}$ or less.

10 [0046] In the present invention, the weight-average particle size d_2 of the second particles is $1.0\text{ }\mu\text{m}$ or more and $3.0\text{ }\mu\text{m}$ or less as described above. The weight-average particle size d_2 of the second particles may be, for example, $1.2\text{ }\mu\text{m}$ or more, $1.4\text{ }\mu\text{m}$ or more, $1.6\text{ }\mu\text{m}$ or more, or $1.8\text{ }\mu\text{m}$ or more, and may be, for example, $2.8\text{ }\mu\text{m}$ or less, $2.5\text{ }\mu\text{m}$ or less, $2.2\text{ }\mu\text{m}$ or less, or $2.0\text{ }\mu\text{m}$ or less.

15 [0047] In the present invention, the weight-average particle size of the first particles and the second particles can be measured by the Coulter counter method, for example. For example, a particle size distribution measurement apparatus (trade name: COULTER MULTISIZER, produced by Beckman Coulter, Inc.) using a pore electrical resistance method is employed to measure an electrical resistance of an electrolyte corresponding to the volume of the particles when the particles pass through the pores. Thus, the number and volume of fine particles are
20 measured and then the weight-average particle size is calculated.

[0048] The shape of the first particles and the second particles is not particularly limited and may be, for example, an approximately spherical shape in the form of a bead or an indefinite shape such as a powder, and is preferably an approximately spherical shape. The shape of the first particles and the second particles is more preferably an approximately spherical shape with
25 an aspect ratio of 1.5 or less. Most preferably, the particles are spherical particles.

[0049] In the anti-glare hard coat film of the present invention, the content ratio of the first particles may be, for example, 1.0% by mass or more, 1.5% by mass or more, 2.0% by mass or more, or 2.5% by mass or more, and may be, for example, 20.0% by mass or less, 18.0% by mass or less, 16.0% by mass or less, or 14.0% by mass or less relative to the total mass of the
30 resin forming the resin layer of the anti-glare hard coat layer (B). The content ratio of the first particles may be appropriately set, for example, from the viewpoint of adjusting the R_y and θ_a , or from the viewpoint of adjusting other surface profile parameters to a desired range. From the viewpoint of preventing the anti-glare properties from being insufficient, it is preferable that the content ratio of the first particles be not too low, and from the viewpoint of preventing excessive

white blur, it is preferable that the content ratio of the first particles be not too high.

[0050] In the anti-glare hard coat film of the present invention, the content ratio of the second particles may be, for example, 1.0% by mass or more, 1.5% by mass or more, 2.0% by mass or more, or 2.5% by mass or more, and may be, for example, 15.0% by mass or less, 12.0% by mass or less, 10.0% by mass or less, or 7.0% by mass or less relative to the total mass of the resin forming the resin layer of the anti-glare hard coat layer (B). From the viewpoint of avoiding the risk of occurrence of MD stripes and/or vertical stripes, it is preferable that the content ratio of the second particles be not too low, and from the viewpoint of preventing excessive white blur and avoiding the risk of occurrence of defects due to excessive flocculation, it is preferable that the content ratio of the second particles be not too high.

[0051] The total mass of the first particles and the second particles may be, for example, 3.5% by mass or more, 4.0% by mass or more, 4.5% by mass or more, 5% by mass or more, 5.5% by mass or more, 6.0% by mass or more, or 6.5% by mass or more, and may be, for example, 25.0% by mass or less, 23.0% by mass or less, 22% by mass or less, 21% by mass or less, 20% by mass or less, 18.0% by mass or less, 16.0% by mass or less, 14.0% by mass or less, or 12.0% by mass or less relative to the total mass of the resin forming the resin layer. From the viewpoint of preventing the anti-glare properties from being insufficient, it is preferable that the total mass (content ratio) of the first particles and the second particles be not too low. On the other hand, from the viewpoint of preventing excessive white blur and avoiding the risk of occurrence of defects due to excessive flocculation, it is preferable that the total mass (content ratio) of the first particles and the second particles be not too high.

[0052] Further, as described above, it is preferable that the total mass of the first particles be $\frac{2}{3}$ or more of the total the mass of the second particles for the reason that it is easy to design a desired R_y and θ_a with particles having a certain size or more. On the other hand, it is preferable that the total mass of the first particles be 10 times or less of the total mass of the second particles for the reason of avoiding asperities to be formed depending on the particle size of the second particles. The total mass of the first particles may be, for example, 1 or more times, 2 or more times, 3 or more times, or 4 or more times, and, for example, 9 or less times, 8 or less times, 7 or less times, or 6 or less times of the total mass of the second particles.

[0053] The materials of the first particles and the second particles are not particularly limited, and each of them may be inorganic particles or organic particles, or inorganic particles and organic particles may be used in combination, for example. The inorganic particles are not particularly limited, and examples thereof include silicon oxide particles, titanium oxide particles, aluminium oxide particles, zinc oxide particles, tin oxide particles, calcium carbonate

particles, barium sulfate particles, talc particles, kaolin particles, and calcium sulfate particles. The organic particles are not particularly limited, and examples thereof include a polymethyl methacrylate resin powder (PMMA particles), a silicone resin powder, a polystyrene resin powder, a polycarbonate resin powder, an acrylic styrene resin powder, a benzoguanamine resin powder, a melamine resin powder, a polyolefin resin powder, a polyester resin powder, a polyamide resin powder, a polyimide resin powder, and a polyfluoroethylene resin powder. One kind of the inorganic particles and organic particles may be used alone, or two or more kinds of the same may be used in combination. One kind of the first particles may be used alone, or two or more kinds of the same may be used in combination. One kind of the second particles may be used alone, or two or more kinds of the same may be used in combination.

[0054] The refractive indices of the first particles and the second particles are not particularly limited, and may be, for example, 1.3 or more, 1.4 or more, 1.5 or more, or 1.6 or more, and may be, for example, 2.0 or less, 1.9 or less, 1.8 or less, or 1.7 or less.

[0055] The anti-glare hard coat layer (B) is formed, for example, by coating a coating liquid containing the resin, the first particles, the second particles, and a solvent on the surface of the translucent base (A) to form a coating film, and then removing the solvent from the coating film, as will be described below. Examples of the resin include a heat-curable resin and an ionizing radiation-curable resin which is cured by ultraviolet rays and/or light. As the resin, a commercially available heat-curable resin and/or an ultraviolet-curable resin can also be used.

[0056] As the heat-curable resin and/or the ultraviolet-curable resin, a curable compound having at least one of an acrylate group and a methacrylate group cured by, for example, heat, light (ultraviolet or the like), and/or an electron beam can be used, and examples thereof include a silicone resin, a polyester resin, a polyether resin, an epoxy resin, an urethane resin, an alkyd resin, a spiroacetal resin, a polybutadiene resin, a polythiol polyene resin, and an oligomer and/or a prepolymer of acrylate and/or methacrylate of a polyfunctional compound such as a polyhydric alcohol. One kind of them may be used alone or two or more kinds of them may be used in combination.

[0057] As the resin, a reactive diluent having at least one of an acrylate group and a methacrylate group can be used, for example. As the reactive diluent, reactive diluents described in JP 2008-88309 A can be used, and examples thereof include monofunctional acrylate, monofunctional methacrylate, polyfunctional acrylate, and polyfunctional methacrylate. As the reactive diluent, acrylate having a trifunctional group or more or methacrylate having a trifunctional group or more is preferable because the hardness of the anti-glare hard coat layer (B) can be superior. Examples of the reactive diluent also include butanediol glycerin ether

diacrylate, acrylate of isocyanuric acid, and methacrylate of isocyanuric acid. One kind of them may be used alone or two or more kinds of them may be used in combination.

[0058] As described above, the anti-glare hard coat layer (B) may or may not contain a thixotropy-imparting agent. By containing the thixotropy-imparting agent, the flocculated state of the first particles and the second particles can be easily controlled. The thixotropy-imparting agent may be at least one selected from the group consisting of, for example, organoclay, oxidized polyolefin, and denatured urea. Further, the thixotropy-imparting agent may be, for example, a thickener.

[0059] The organoclay is preferably layered clay which has been subjected to an organification treatment in order to improve affinity with the resin. The organoclay may be prepared in-house or a commercially available product. Examples of the commercially available product include LUCENTITE SAN, LUCENTITE STN, LUCENTITE SEN, LUCENTITE SPN, SOMASIF ME-100, SOMASIF MAE, SOMASIF MTE, SOMASIF MEE, and SOMASIF MPE (trade names, produced by CO-OP CHEMICAL Co. Ltd.); S-BEN, S-BEN C, S-BEN E, S-BEN W, S-BEN P, S-BEN WX, S-BEN N-400, S-BEN NX, S-BEN NX80, S-BEN NO12S, S-BEN NEZ, S-BEN NO12, S-BEN NE, S-BEN NZ, S-BEN NZ70, ORGANAIT, ORGANAIT D, and ORGANAIT T (trade names, produced by HOJUN Co., Ltd.); KUNIPIA F, KUNIPIA G, and KUNIPIA G4 (trade names, produced by Kunimine Industries, Co. Ltd.); and TIXOGEL VZ, CLAYTONE HT, and CLAYTONE 40 (trade names, produced by Rockwood Additives Limited).

[0060] The oxidized polyolefin may be prepared in-house or a commercially available product. Examples of the commercially available product include DISPARON 4200-20 (trade name, produced by Kusumoto Chemicals, Ltd.) and FLOWNON SA300 (trade name, produced by KYOEISHA CHEMICAL Co., LTD).

[0061] The denatured urea is a reactant of an isocyanate monomer or an adduct thereof and organic amine. The denatured urea may be prepared in-house or a commercially available product. The commercially available product can be, for example, BYK410 (produced by BYK-Chemie Corporation).

[0062] One kind of the thixotropy-imparting agents may be used alone, or two or more kinds of the same may be used in combination.

[0063] In the anti-glare hard coat film of the present invention, for example, the thixotropy-imparting agent may be contained in an amount of 0.2 to 5% by mass or 0.4 to 4% by mass relative to the total mass of the resin forming the resin layer of the anti-glare hard coat layer (B).

[0064] The maximal thickness (D_B) of the anti-glare hard coated layers (B) is not particularly

limited, and may be, for example, 2 μm or more, 3 μm or more, 4 μm or more, or 5 μm or more, and may be, for example, 20 μm or less, 18 μm or less, 16 μm or less, or 14 μm or less.

[0065] The ratio d_1/D_B between the maximum thickness (D_B) of the anti-glare hard coat layer (B) and the weight-average particle size (d_1) of the first particles is not particularly limited, and may be, for example, 0.2 or more, 0.4 or more, 0.6 or more, or 0.8 or more, and may be, for example, 2.0 or less, 1.8 or less, 1.6 or less, or 1.4 or less. For example, when d_1/D_B is large, as described above, R_y and θ_a tend to be large.

[0066] In the anti-glare hard coat film according to the present invention, for example, the anti-glare hard coat layer (B) may have a flocculated portion forming a convex portion on the surface of the anti-glare hard coat layer (B) by flocculating the fillers, and in the flocculated portion forming the convex portion, the fillers may be present in the state of being gathered in one direction in an in-plane direction of the anti-glare hard coat layer (B). As a result, for example, the reflected glare of the fluorescent light can be prevented. However, the anti-glare hard coat film of the present invention is not limited thereto.

[0067] Further, the anti-glare hard coat film of the present invention may include, for example, an intermediate layer containing a resin derived from the translucent base (A) and a resin derived from the anti-glare hard coat layer (B) between the translucent base (A) and the anti-glare hard coat layer (B). By controlling the thickness of the intermediate layer, it is possible to control the surface profile of the anti-glare hard coat layer (B). For example, increasing the thickness of the intermediate layer tends to increase the R_y and θ_a , and decreasing the thickness of the intermediate layer tends to decrease the R_y and θ_a .

[0068] In the present invention, the mechanism by which the intermediate layer (also referred to as a permeable layer and a compatibility layer) is formed is not particularly limited, and is formed, for example, in the drying in the method for producing an anti-glare hard coat film of the present inventor. Specifically, for example, in the drying, a coating liquid for forming the anti-glare hard coat layer (B) penetrates into the translucent base (A), and the intermediate layer containing a resin derived from the translucent base (A) and a resin derived from the anti-glare hard coat layer (B) is formed. The resin contained in the intermediate layer is not particularly limited, and for example, a resin contained in the translucent base (A) and a resin contained in the anti-glare hard coat layer (B) may be simply mixed (compatible). In addition, in the resin contained in the intermediate layer, for example, at least one of a resin contained in the translucent base (A) and a resin contained in the anti-glare hard coat layer (B) may be chemically changed by heating, light irradiation, or the like.

[0069] The thickness ratio R of the intermediate layer defined by the mathematical equation (7)

below is not particularly limited, and may be, for example, in the range from 0.10 to 0.80, for example, and may be 0.15 or more, 0.20 or more, 0.25 or more, 0.30 or more, 0.40 or more, or 0.45 or more, and may be, for example, 0.75 or less, 0.70 or less, 0.65 or less, 0.60 or less, 0.50 or less, 0.40 or less, 0.45 or less, or 0.30 or less. The thickness ratio R of the intermediate layer
 5 may be, for example, in the range from 0.15 to 0.75, 0.20 to 0.70, 0.25 to 0.65, 0.30 to 0.60, 0.40 to 0.50, 0.45 to 0.50, 0.15 to 0.45, 0.15 to 0.40, 0.15 to 0.30, or 0.20 to 0.30. The intermediate layer can be checked, and the thickness thereof can be measured, by observing the cross section of the anti-glare hard coat film using a transmission electron microscope (TEM), for example.

$$10 \quad R = [D_C / (D_C + D_B)] \quad (7)$$

In the mathematical equation (7), D_B is the thickness [μm] of the anti-glare layer (B), and D_C is the thickness [μm] of the intermediate layer.

[0070] The surface profile of the anti-glare hard coat layer (B) can also be designed by
 15 controlling the flocculated state of the fillers contained in the anti-glare hard coat layer-forming material. The flocculated state of the fillers can be controlled by, for example, the material of the filler (e.g., a chemical modification state of the surfaces of fine particles, an affinity for a solvent or a resin), the type, combination, or the like of a resin (binder) or a solvent. Further, the flocculated state of the fine particles can be precisely controlled by the thixotropy-imparting
 20 agent.

[0071] While the convex portions in the anti-glare hard coat film of the present invention may be gradual convex portions which can prevent the generation of a projection as a defect in outward appearance on the surface of the anti-glare hard coat layer (B), the present invention is not limited thereto. In addition, in the anti-glare hard coat film of the present invention, for
 25 example, some of the particles may be present in positions in which the particles directly or indirectly overlap in the thickness direction of the anti-glare hard coat layer (B), for example.

[0072] The other layer is not particularly limited, and examples thereof include a low refractive index layer, an antireflection layer, a high refractive index layer, a hard coat layer, and a pressure-sensitive adhesive layer, as described above. The other layer may be a single layer or
 30 the other layer may include a plurality of layers, and in the case of a plurality of layers, one kind of the layers or two or more kinds of the same may be used. For example, the other layer may be a thin optical film whose thickness and refractive index are controlled strictly or the one including two or more of the thin optical films laminated together.

[0073] [2. Production method of anti-glare hard coat film]

A method for producing the anti-glare hard coat film of the present invention is not particularly limited and the anti-glare hard coat film may be produced by any method, and is preferably produced by the anti-glare hard coat film production method of the present invention.

[0074] The anti-glare hard coat film production method can be performed, for example, as follows.

[0075] First, the anti-glare hard coat layer (B) is formed on the translucent base (A) so as to satisfy the mathematical equations (1) to (4) (anti-glare hard coat layer (B)-forming). Thereby, a laminate of the translucent base (A) and the anti-glare hard coat layer (B) is produced. The anti-glare hard coat layer (B)-forming includes the steps of: coating a coating liquid (anti-glare hard coat layer (B)-forming material) on the translucent base (A); and forming a coating film by drying the coated coating liquid as described above. Further, for example, as described above, the anti-glare hard coat layer (B)-forming may further include the step of: curing the coating film. While the curing may be carried out, for example, after the drying, the present invention is not limited thereto. The curing can be performed, for example, by heating, light irradiation, or the like. The light is not particularly limited, and may be, for example, ultraviolet rays or the like. The light source of the light irradiation is not particularly limited, and may be, for example, a high-pressure mercury lamp or the like.

[0076] The coating liquid includes the resin, the first particles, the second particles, and a solvent as described above. The coating liquid may be, for example, an anti-glare hard coat layer-forming material (coating liquid) containing the resin, the first particles, the second particles, the thixotropy-imparting agent, and the solvent.

[0077] The coating liquid preferably exhibits thixotropy, and the T_i value defined by the following mathematical equation is preferably in the range from 1.3 to 3.5, more preferably in the range from 1.4 to 3.2, and still more preferably in the range from 1.5 to 3.

$$T_i \text{ value} = \beta_1 / \beta_2$$

In the above mathematical equation, β_1 is a viscosity at the shear rate of 20 (1/s) measured using RHEOSTRESS RS6000 produced by HAAKE, and β_2 is a viscosity at the shear rate of 200 (1/s) measured using RHEOSTRESS RS6000 produced by HAAKE.

[0078] When the T_i value is 1.3 or more, problems of a defect in outward appearance and deterioration in characteristics of anti-glare properties and white blur are unlikely to occur. When the T_i value is 3.5 or less, a problem that the particles are in the dispersed state in which the particles are not flocculated or the like is unlikely to occur.

[0079] Further, while the coating liquid may or may not contain a thixotropy-imparting agent, it is preferable to contain a thixotropy-imparting agent because it tends to exhibit thixotropy.

Further, as described above, when the coating liquid contains the thixotropy-imparting agent, an effect (thixotropy effect) of preventing sedimentation of the particles can be obtained. Further, it is also possible to freely control the surface profile of the anti-glare hard coat film in a wider range by shear flocculation of the thixotropy-imparting agent itself.

[0080] The solvent is not particularly limited, and various solvents can be used. One kind of the solvents may be used alone or two or more kinds of the same may be used in combination. In order to obtain the anti-glare hard coat film of the present invention, an optimum solvent type and solvent ratio may be appropriately selected in accordance with the composition of the resin, the kinds of the particles and the thixotropy-imparting agents, and the contents thereof. The solvent is not particularly limited, and examples thereof include alcohols such as methanol, ethanol, isopropyl alcohol (IPA), butanol, t-butyl alcohol (TBA), and 2-methoxyethanol; ketones such as acetone, methylethylketone, methylisobutylketone, and cyclopentanone; esters such as methyl acetate, ethyl acetate, and butyl acetate; ethers such as diisopropyl ether and propyleneglycol monomethylether; glycols such as ethyleneglycol and propyleneglycol; 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. Further, for example, the solvent may contain a hydrocarbon solvent and a ketone solvent. The hydrocarbon solvent may be, for example, an aromatic hydrocarbon. The aromatic hydrocarbon may be, for example, at least one selected from the group consisting of toluene, o-xylene, m-xylene, p-xylene, ethylbenzene, and benzene. The ketone solvent may be, for example, at least one selected from the group consisting of cyclopentanone, acetone, methyl ethyl ketone, methyl isobutyl ketone, diethyl ketone, cyclohexanone, isophorone, and acetophenone. It is preferable that the solvent include, for example, the hydrocarbon solvent (e.g., toluene) in order to dissolve a thixotropy-imparting agent (e.g., a thickener). The solvent may be, for example, a solvent obtained by mixing the hydrocarbon solvent and the ketone solvent in a mass ratio of 90:10 to 10:90. The mass ratio of the hydrocarbon solvent to the ketone solvent may be, for example, 80:20 to 20:80, 70:30 to 30:70, or 40:60 to 60:40, and the like. In this case, for example, the hydrocarbon solvent may be toluene and the ketone solvent may be methyl ethyl ketone. Further, the solvent may include toluene, and may further include at least one selected from the group consisting of ethyl acetate, butyl acetate, IPA, methyl isobutyl ketone, methyl ethyl ketone, methanol, ethanol, and TBA.

[0081] In the case where an acrylic film is employed as the translucent base (A) to form an

intermediate layer (permeable layer), a good solvent for an acrylic film (acrylic resin) can be suitably used, for example. As a solvent thereof, for example, a solvent containing a hydrocarbon solvent and a ketone solvent may be used as described above. The hydrocarbon solvent may be, for example, an aromatic hydrocarbon. The aromatic hydrocarbon may be, for example, at least one selected from the group consisting of toluene, o-xylene, m-xylene, p-xylene, ethylbenzene, and benzene. The ketone solvent may be, for example, at least one selected from the group consisting of cyclopentanone, acetone, methyl ethyl ketone, methyl isobutyl ketone, diethyl ketone, cyclohexanone, isophorone, and acetophenone. The solvent may be, for example, a solvent obtained by mixing the hydrocarbon solvent and the ketone solvent in a mass ratio of 90:10 to 10:90. The mass ratio of the hydrocarbon solvent to the ketone solvent may be, for example, 80:20 to 20:80, 70:30 to 30:70, or 40:60 to 60:40, and the like. In this case, for example, the hydrocarbon solvent may be toluene and the ketone solvent may be methyl ethyl ketone.

[0082] In the case where triacetylcellulose (TAC) is employed as the translucent base (A) to form an intermediate layer (permeable layer), a good solvent for TAC can be suitably used, for example. Examples of the solvent include ethyl acetate, methyl ethyl ketone, and cyclopentanone.

[0083] In the case of containing a thixotropy-imparting agent, the anti-glare hard coat layer-forming material (coating liquid) can favorably have thixotropy by selecting a solvent as appropriate. For example, in the case of using organoclay, toluene and xylene can be suitably used alone or in combination. For example, in the case of using oxidized polyolefin, methyl ethyl ketone, ethyl acetate, and propylene glycol monomethyl ether can be suitably used alone or in combination. For example, in the case of using denatured urea, butyl acetate and methyl isobutyl ketone can be suitably used alone or in combination.

[0084] Various leveling agents can be added to the anti-glare hard coat layer-forming material. For the purpose of preventing unevenness in coating (for the purpose of making a surface to be evenly coated), a fluorine-based leveling agent or a silicone-based leveling agent can be used as the leveling agent, for example. In the present invention, a leveling agent can be selected as appropriate according to the case where the surface of the anti-glare hard coat layer (B) is required to have anti-smudge properties, the case where an antireflection layer (low refractive index layer) and/or a layer containing interlayer fillers is formed on the anti-glare hard coat layer (B) as mentioned below. In the present invention, for example, the coating liquid can have thixotropy by causing the coating liquid to contain thixotropy-imparting agents. Therefore, the unevenness in coating is less prone to occur. In this case, for example, the present invention has

an advantage of widening the choice of the leveling agents.

[0085] The amount of the leveling agent to be added is, for example, 5 parts by weight or less, preferably in the range from 0.01 to 5 parts by weight, relative to 100 parts by weight of the resin.

5 [0086] A pigment, a filler, a dispersant, a plasticizer, a UV absorber, a surfactant, an antifouling agent, an antioxidant, or the like may be added to the anti-glare hard coat layer-forming material to the extent of not impairing functions of the coating liquid. One kind of the additives may be used alone or two or more kinds of the same may be used in combination.

10 [0087] Any of conventionally known photoinitiators described in JP 2008-88309 A can be used in the anti-glare hard coat layer-forming material, for example.

[0088] As a method for forming a coating film by coating the coating liquid on the translucent base (A), a coating method such as a fountain coating method, a die coating method, a spray coating method, a gravure coating method, a roller coating method, or a bar coating method can be used, for example.

15 [0089] Next, as described above, the coating film is dried and cured to form an anti-glare hard coat layer (B). The drying may be, for example, natural drying, air drying by blowing air, heat drying, or a combination thereof.

[0090] The drying temperature of the coating liquid for forming the anti-glare hard coat layer (B) may be, for example, in a range from 30 to 200°C. The aforementioned drying temperature
20 may be 40°C or more, 50°C or more, 60°C or more, 70°C or more, 80°C or more, 90°C or more, or 100°C or more, and may be 190°C or less, 180°C or less, 170°C or less, 160°C or less, 150°C or less, 140°C or less, 135°C or less, 130°C or less, 120°C or less, or 110°C or less, for example. The drying time is not particularly limited, and may be, for example, 30 seconds or more, 40 seconds or more, 50 seconds or more, or 60 seconds or more, and may be 150 seconds or less,
25 130 seconds or less, 110 seconds or less, or 90 seconds or less.

[0091] The way of curing the coating film is not particularly limited and is preferably ultraviolet curing. The amount of irradiation with the energy radiation source is preferably from 50 to 500 mJ/cm² in terms of accumulative exposure at the ultraviolet wavelength of 365 nm. With the amount of irradiation of at least 50 mJ/cm², the coating film is cured more sufficiently,
30 and the resultant anti-glare hard coat layer (B) has a more sufficient hardness. Moreover, with the amount of irradiation of 500 mJ/cm² or less, the resultant anti-glare hard coat layer (B) can be prevented from being colored.

[0092] As described above, a laminate of the translucent base (A) and the anti-glare hard coat layer (B) can be produced. This laminate may be used as it is as an anti-glare hard coat film of

the present invention, or may be used as an anti-glare hard coat film of the present invention, for example, by forming the other layer on the anti-glare hard coat layer (B). The method for forming the other layer is not particularly limited, and may be performed in the same manner as or according to a general method for forming a low refractive index layer, an antireflection layer, a high refractive index layer, a hard coat layer, a pressure-sensitive adhesive layer, or the like, for example.

[0093] [3. Optical member and image display device]

The optical member of the present invention is not particularly limited, and may be, for example, a polarizing plate. The polarizing plate is also not particularly limited, and may include, for example, an anti-glare hard coat film of the present invention and a polarizer, or may further include other components. Each of the components of the polarizing plate may be bonded by, for example, an adhesive or a pressure-sensitive adhesive.

[0094] The image display device of the present invention is not particularly limited, and any image display device may be used, and examples thereof include a liquid crystal display device and an organic EL display device.

[0095] The image display device of the present invention may be, for example, an image display device having the anti-glare hard coat film of the present invention on the viewing side surface, and the image display device may have a black matrix pattern.

[0096] Generally, the translucent base (A) side of the anti-glare hard coat film of the present invention can be bonded to an optical member used in LCD via a pressure-sensitive adhesive or an adhesive, for example. In order to perform the bonding, the translucent base (A) may be subjected to any of the above-mentioned surface treatments. As described above, according to the anti-glare hard coat film production method of the present invention, the surface profile of the anti-glare hard coat film can be freely controlled in a wide range. Therefore, the optical characteristics that can be obtained by laminating the anti-glare hard coat film on other optical member with an adhesive, a pressure-sensitive adhesive, or the like are in a wide range corresponding to the surface profile of the anti-glare hard coat film.

[0097] The optical member can be, for example, a polarizer or a polarizing plate, for example. The polarizing plate is generally configured to include a transparent protective film on one or both sides of the polarizer. When transparent protective films are provided on both sides of the polarizer, the front and back transparent protective films may be formed of the same material or different materials. Polarizing plates are generally placed on both sides of a liquid crystal cell and is placed so that the absorption axes of two polarizing plates are substantially orthogonal to each other.

[0098] The configuration of the polarizing plate on which the anti-glare hard coat film is laminated is not particularly limited and may be, for example, a configuration obtained by laminating a transparent protective film, the polarizer, and the transparent protective film in this order on the anti-glare hard coat film or a configuration obtained by laminating the polarizer and the transparent protective film in this order on the anti-glare hard coat film.

[0099] The configuration of the image display device according to the present invention is the same as that of the conventional image display device except that the anti-glare hard coat film is disposed in a specific direction. For example, in the case of a LCD, the image display device can be produced by incorporating a driving circuit through appropriately assembling components such as a liquid crystal cell, an optical member such as a polarizing plate, and if necessary, a lighting system (backlight or the like).

[0100] According to the anti-glare hard coat film of the present invention, for example, strong external light can be scattered and reflection can be suppressed, so that reflected glare can be suppressed even outdoors. Therefore, the image display device of the present invention can be suitably used for, for example, a public information display for outdoor use. However, the image display device of the present invention is not limited to this application, and can be used for any other application. Examples of the applications include office automation equipment such as a PC monitor, a notebook PC, and a copy machine, portable devices such as a mobile phone, a watch, a digital camera, a personal digital assistant (PDA), and a handheld game machine, home electric appliances such as a video camera, a television set, and a microwave oven, vehicle equipment such as a back monitor, a monitor for a car-navigation system, and a car audio device, display equipment such as an information monitor for stores, security equipment such as a surveillance monitor, and nursing and medical equipment such as a monitor for nursing care and a monitor for medical use.

Examples

[0101] Next, Examples of the present invention are described together with Comparative Examples. The present invention, however, is not limited by Examples and Comparative Examples.

[0102] In the following Examples and Comparative Examples, the number of parts of the substance is expressed in parts by mass (parts by weight), unless otherwise specified.

[0103] Example 1

An anti-glare hard coat film was produced in the following manner.

[0104] [1. Preparation of anti-glare hard coat layer-forming material]

As a resin contained in the anti-glare hard coat layer-forming material, 40 parts by

weight of a ultraviolet curable urethane acrylate resin (produced by SHIN-NAKAMURA CHEMICAL CO, LTD., trade name: "UA-53H-80MB", solid content: 80%) and 60 parts by weight of a polyfunctional acrylate containing pentaerythritol triacrylate as a main component (produced by OSAKA ORGANIC CHEMICAL INDUSTRY LTD, trade name: "Viscoat #300", solid content: 100%) were prepared. 5 parts by weight of acrylic styrene copolymer particle as the first particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX1055QXE", weight-average particle size: 5.0 μm , refractive index 1.515) and 1 part by weight of acrylic styrene copolymer particle as the second particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX103DXE", weight-average particle size: 3.0 μm , refractive index 1.525) in total of 6 parts by weight, 1.5 parts by weight of synthetic smectite (produced by Kunimine Industries, Co. Ltd., trade name: "SUMECTON SAN") which is an organic viscosity as a thixotropic imparting agent, 3 parts by weight of a photopolymerization initiator (produced by BASF Co., Ltd., trade name: "OMNIRAD907", and 1.0 part by weight of a leveling agent (produced by DIC Corporation, trade name: "GRANDIC PC4100", solid content: 10%) were mixed per 100 parts by weight of the resin solid content of the resin. This mixture was diluted with a mixed solvent of toluene/ethyl acetate (weight ratio 50/50) so as to achieve a solid content concentration of 30%, thereby preparing an anti-glare hard coat layer-forming material (coating liquid).

[0105] (Translucent base (A))

As the translucent base (A), a transparent plastic film base (acrylic film, produced by Toyo Kohan Co.Ltd., trade name: "HX-40UC", thickness: 40 μm , film thickness: 1330 mm, refractive index: 1.49) was prepared.

[0106] [2. Production method of anti-glare hard coat film]

On one side of the transparent plastic film base (translucent base (A)), the anti-glare hard coat layer (B)-forming material (coating liquid) was continuously coated 500 m using a die coater to form an undried coating film (coating liquid-coating). Then, the transparent plastic film base on which this undried coating film was formed was conveyed to the next step of drying (coating film-forming). In the drying (coating film-forming), the undried coating film was dried by heating at 100°C for 1 minute to form a coating film. Thereafter, the coating film was cured by being irradiated with ultraviolet having an accumulated light amount of 300 mJ/cm^2 using a high-pressure mercury lamp to form an anti-glare hard coat layer (B) having a thickness (maximum thickness) of 3.0 μm , thereby obtaining an anti-glare hard coat film of Example 1. The surface profile of the central part in the width direction of the obtained anti-glare hard coat film was measured using a contact type surface profile measuring instrument, and the surface

profile parameters R_y and θ_a were measured. As a result, R_y was $6.62\ \mu\text{m}$ and θ_a was 4.46° .

Note that R_y and θ_a were measured by the following measurement method. The same applies to the following Examples and Comparative Examples. Further, the thickness (maximum thickness) and the surface profile parameters are values obtained by cutting to measure the central part in the width direction of the film at the point of 500 m when subjected to continuous coating of 500 m or more. The same applies to the following Examples and Comparative Examples.

[0107] <Measurement method of R_y and θ_a >

A glass sheet (thickness: 1.3 mm) produced by Matsunami Glass Ind., Ltd. was bonded to a surface of an anti-glare hard coat film on which no anti-glare hard coat layer had been formed, with a pressure-sensitive adhesive. Subsequently, the surface profile of the anti-glare hard coat layer (B) was measured under the condition where a cutoff value was 0.8 mm using a high-precision microfigure measuring instrument (trade name: SURFCORDER ET4000, produced by Kosaka Laboratory Ltd.), and the maximum height and the average tilt angle were calculated. Furthermore, the average values obtained by measuring the maximum height and the average tilt angle at any 10 points were defined as the maximum height R_y and the average tilt angle θ_a , respectively. The high-precision microfigure measuring instrument automatically calculated the maximum height R_y and the average tilt angle θ_a . The method for measuring and calculating the maximum height R_y and the average tilt angle θ_a was based on JIS B 0601 (1994 edition).

[0108] Example 2

An anti-glare hard coat film of Example 2 was produced by the same production method as in Example 1, except that the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of $7.0\ \mu\text{m}$. The surface profile parameters were as follows: $R_y = 1.45\ \mu\text{m}$ and $\theta_a = 1.15^\circ$.

[0109] Example 3

An anti-glare hard coat film of Example 3 was produced by the same production method as in Example 1, except that 8 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX1055QXE", weight-average particle size: $5.0\ \mu\text{m}$, refractive index 1.515) was used as the first particle, and the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of $5.0\ \mu\text{m}$. The surface profile parameters were as follows: $R_y = 2.97\ \mu\text{m}$ and $\theta_a = 3.12^\circ$.

[0110] Example 4

An anti-glare hard coat film of Example 4 was produced by the same production method as in Example 3, except that 6 parts by weight of acrylic styrene copolymer particle (produced by

Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX103DXE", weight-average particle size: 3.0 μm , refractive index 1.525) was used as the second particle. The surface profile parameters were as follows: $R_y = 3.03 \mu\text{m}$ and $\theta_a = 3.33^\circ$.

[0111] Example 5

5 An anti-glare hard coat film of Example 5 was produced by the same production method as in Example 4, except that 12 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX1055QXE", weight-average particle size: 5.0 μm , refractive index 1.515) was used as the first particle and 8 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: 10 "TECHPOLYMER SSX103DXE", weight-average particle size: 3.0 μm , refractive index 1.525) was used as the second particle. The surface profile parameters were as follows: $R_y = 3.23 \mu\text{m}$ and $\theta_a = 4.03^\circ$.

[0112] Example 6

An anti-glare hard coat film of Example 6 was produced by the same production method 15 as in Example 5, except that 8 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX1055QXE", weight-average particle size: 5.0 μm , refractive index 1.515) was used as the first particle and 1 part by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: 20 "TECHPOLYMER XX145AA", weight-average particle size: 1.5 μm , refractive index 1.495) was used as the second particle. The surface profile parameters were as follows: $R_y = 3.29 \mu\text{m}$ and $\theta_a = 3.61^\circ$.

[0113] Example 7

An anti-glare hard coat film of Example 7 was produced by the same production method as in Example 6, except that the anti-glare hard coat layer (B) was formed so as to have a 25 thickness (maximum thickness) of 9.0 μm . The surface profile parameters were as follows: $R_y = 1.57 \mu\text{m}$ and $\theta_a = 1.36^\circ$.

[0114] Example 8

An anti-glare hard coat film of Example 8 was produced by the same production method as in Example 1, except that 10 parts by weight of acrylic styrene copolymer particle (produced 30 by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER XX140AA", weight-average particle size: 3.5 μm , refractive index: 1.535) was used as the first particle, 2 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER XX145AA", weight-average particle size: 1.5 μm , refractive index 1.495) was used as the second particle, and the anti-glare hard coat layer (B) was formed so as to have a

thickness (maximum thickness) of 3.0 μm . The surface profile parameters were as follows:

$R_y = 3.81 \mu\text{m}$ and $\theta_a = 4.81^\circ$.

[0115] Example 9

An anti-glare hard coat film of Example 9 was produced by the same production method as in Example 8, except that the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 5.0 μm . The surface profile parameters were as follows:

$R_y = 1.59 \mu\text{m}$ and $\theta_a = 1.61^\circ$.

[0116] Example 10

An anti-glare hard coat film of Example 10 was produced by the same production method as in Example 9, except that 2 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER XX42AA", weight-average particle size: 8.0 μm , refractive index: 1.515) was used as the first particle and 3 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX103DXE", weight-average particle size: 3.0 μm , refractive index: 1.525) was used as the second particle. The surface profile parameters were as follows: $R_y = 4.40 \mu\text{m}$ and $\theta_a = 2.28^\circ$.

[0117] Example 11

An anti-glare hard coat film of Example 11 was produced by the same production method as in Example 10, except that the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 9.0 μm . The surface profile parameters were as follows: $R_y = 1.70 \mu\text{m}$ and $\theta_a = 1.18^\circ$.

[0118] Comparative Example 1

An anti-glare hard coat film of Comparative Example 1 was produced by the same production method as in Example 1, except that the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 14.0 μm . The surface profile parameters were as follows: $R_y = 1.40 \mu\text{m}$ and $\theta_a = 0.88^\circ$.

[0119] Comparative Example 2

An anti-glare hard coat film of Comparative Example 2 was produced by the same production method as in Example 1, except that 8 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX1055QXE", weight-average particle size: 5.5 μm , refractive index 1.515) was used as the first particle, and the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 3.0 μm . The surface profile parameters were as follows: $R_y = 7.41 \mu\text{m}$ and $\theta_a = 5.90^\circ$.

[0120] Comparative Example 3

An anti-glare hard coat film of Comparative Example 3 was produced by the same production method as in Comparative Example 2, except that 6 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX103DXE", weight-average particle size: 3.0 μm , refractive index: 1.525) was used as the second particle. The surface profile parameters were as follows: $R_y = 7.68 \mu\text{m}$ and $\theta_a = 7.83^\circ$.

[0121] Comparative Example 4

An anti-glare hard coat film of Comparative Example 4 was produced by the same production method as in Comparative Example 3, except that 1.5 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER XX140AA", weight-average particle size: 3.5 μm , refractive index: 1.535) was used as the second particle. The surface profile parameters were as follows: $R_y = 2.32 \mu\text{m}$ and $\theta_a = 1.44^\circ$.

[0122] Comparative Example 5

An anti-glare hard coat film of Comparative Example 5 was produced by the same production method as in Comparative Example 4, except that 8.0 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX1055QXE", weight-average particle size: 5.5 μm , refractive index: 1.515) was used as the first particle, the second particle was not added, and the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 5.0 μm . The surface profile parameters were as follows: $R_y = 3.58 \mu\text{m}$ and $\theta_a = 3.59^\circ$.

[0123] Comparative Example 6

An anti-glare hard coat film of Comparative Example 6 was produced by the same production method as in Comparative Example 5, except that the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 9.0 μm . The surface profile parameters were as follows: $R_y = 1.74 \mu\text{m}$ and $\theta_a = 1.42^\circ$.

[0124] Comparative Example 7

An anti-glare hard coat film of Comparative Example 7 was produced by the same production method as in Comparative Example 5, except that 12.0 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX1055QXE", weight-average particle size: 5.5 μm , refractive index: 1.515) was used as the first particle. The surface profile parameters were as follows: $R_y = 3.74 \mu\text{m}$ and $\theta_a = 4.38^\circ$.

[0125] Comparative Example 8

An anti-glare hard coat film of Comparative Example 8 was produced by the same

production method as in Comparative Example 7, except that the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 9.0 μm . The surface profile parameters were as follows: $R_y = 1.96 \mu\text{m}$ and $\theta_a = 1.62^\circ$.

[0126] Comparative Example 9

5 An anti-glare hard coat film of Comparative Example 9 was produced by the same production method as in Example 1, except that the first particle was not added and 6 parts by weight of acrylic styrene copolymer particle (produced by Sekisui Kasei Co., Ltd., trade name: "TECHPOLYMER SSX103DXE", weight-average particle size: 3.0 μm , refractive index: 1.525) was used as the second particle. The surface profile parameters were as follows: $R_y = 2.94 \mu\text{m}$ and $\theta_a = 2.63^\circ$.

[0127] Comparative Example 10

An anti-glare hard coat film of Comparative Example 10 was produced by the same production method as in Comparative Example 9, except that the anti-glare hard coat layer (B) was formed so as to have a thickness (maximum thickness) of 9.0 μm . The surface profile parameters were as follows: $R_y = 0.92 \mu\text{m}$ and $\theta_a = 0.70^\circ$.

[0128] Comparative Example 11

An anti-glare hard coat film of Comparative Example 11 was produced by the same production method as in Example 3, except that 10 parts by weight of silica particle (produced by NISSAN CHEMICAL INDUSTRIES, LTD., trade name: "MIBK-ST", average particle size: 10 nm, solid content: 30%) was used as the second particle. The surface profile parameters were as follows: $R_y = 3.21 \mu\text{m}$ and $\theta_a = 2.67^\circ$.

[0129] With respect to the anti-glare hard coat films of Examples and Comparative Examples produced as described above, the external haze value was measured by the above-described measurement method, and the evaluation of the horizontal stripes and/or vertical stripes at the point of 500 m and the determination of the anti-glare properties were performed by the following method.

[0130] [Evaluation method of horizontal stripes and/or vertical stripes at point of 500 m]

With respect to a film roll (anti-glare hard coat film) after coating 500 m, a sheet of 1330 mm in the width direction and 1000 mm in the film traveling direction from any point after 500 m was cut out from the roll. Next, a black PET film with a pressure-sensitive adhesive was bonded to the cut-out sheet (anti-glare hard coat film) on the side facing away from the anti-glare hard coat layer (B). Thereafter, an LED light source was imaged on the anti-glare hard coat layer (B) in a dark room, the border between a LED light-reflected area and a non-reflected area was visually determined, and whether there is unevenness in outward appearance with white blurred

site and tight black site was evaluated according to the following criteria.

- Contrast of black-and-white shading is clear: poor
- There is slight shading, but acceptable: good

5 [0131] [Determination method of anti-glare properties]

With respect to a film roll (anti-glare hard coat film) after coating 500 m, a sheet of 1330 mm in the width direction and 1000 mm in the film traveling direction from any point after 500 m was cut out from the roll. Next, a black PET film with a pressure-sensitive adhesive was bonded to the cut-out sheet (anti-glare hard coat film) on the side facing away from the anti-glare
10 hard coat layer (B). Thereafter, an LED light source was imaged on the anti-glare hard coat layer (B) in a dark room, and the degree of blurring of the reflected LED light was visually determined and evaluated according to the following criteria.

- Fluorescent light is moderately blurred (achieve a balance with tight black site): good.
- 15 • White blur is too intense or reflected glare of light source is too much: poor

[0132] With respect to the anti-glare hard coat films of Examples and Comparative Examples, the weight-average particle size d1 of the first particles, the weight-average particle size d2 of the second particles, the content ratio (number of parts) of the first particles and the second particles, the external haze value, R_y , θ_a , the evaluation results of horizontal stripes and/or
20 vertical stripes at the point of 500 m, and the determination results of the anti-glare properties are summarized in Tables 1 and 2 below. In Tables 1 and 2, "number of parts" represents the number of parts by weight (parts by mass) of the first particles or the second particles relative to 100 parts by weight (parts by mass) of the resin forming the resin layer in the anti-glare hard coat layer (B). That is, this "number of parts" is equal to the content ratio (% by mass) of the first
25 particles or the second particles relative to the total mass of the resin forming the resin layer. In addition, in Tables 1 and 2, "total number of parts by weight" represents the total number of parts by weight (parts by mass) of the first particles and the second particles relative to 100 parts by weight (parts by mass) of the resin forming the resin layer in the anti-glare hard coat layer (B). That is, this "total number of parts by weight" is equal to the content ratio (% by mass) of the
30 total of the first particles and the second particles relative to the total mass of the resin forming the resin layer.

[0133] [Table 1]

	Particle design				Total number of parts by weight	External haze value	Ry [μm]	θ_a [$^\circ$]	Longitudinal stripes and/or vertical stripes at 500 m-coating point	Anti-glare properties determination
	d1 size [μm]	Number of parts	d2 size [μm]	Number of parts						
Requirements of present invention	$3.0 < d1 \leq 8.5$	–	$1.0 \leq d2 \leq 3.0$	–	2 to 25		1.0 to 7.0	1.0 to 7.5		
Ex. 1	5.5	5	3	1	6	21.5	6.62	4.46	Not observed	Good
Ex. 2	5.5	5	3	1	6	6.9	1.45	1.15	Not observed	Good
Ex. 3	5.5	8	3	1	9	28.7	2.97	3.12	Not observed	Good
Ex. 4	5.5	8	3	6	14	32.4	3.03	3.33	Not observed	Good
Ex. 5	5.5	12	3	8	20	40.6	3.23	4.03	Not observed	Good
Ex. 6	5.5	8	1.5	1	9	28.2	3.29	3.61	Not observed	Good
Ex. 7	5.5	8	1.5	1	9	8	1.57	1.36	Not observed	Good
Ex. 8	3.5	10	1.5	2	12	32.1	3.81	4.81	Not observed	Good
Ex. 9	3.5	10	1.5	2	12	18.9	1.59	1.61	Not observed	Good
Ex. 10	8	2	3	3	5	13.7	4.40	2.28	Not observed	Good
Ex. 11	8	2	3	3	5	7.7	1.70	1.18	Not observed	Good

[0134] [Table 2]

	Particle design				Total number of parts by weight	External haze value	Ry [μm]	θ_a [$^\circ$]	Longitudinal stripes and/or vertical stripes at 500 m-coating point	Anti-glare properties determination
	d1 size [μm]	Number of parts	d2 size [μm]	Number of parts						
Requirements of present invention	$3.0 < d1 \leq 8.5$	–	$1.0 \leq d2 \leq 3.0$	–	2 to 25		1.0 to 7.0	1.0 to 7.5		
Comp. Ex. 1	5.5	5	3	1	6	5.2	1.40	0.88	Not observed	Poor (lack of anti-glare properties)
Comp. Ex. 2	5.5	8	3	1	9	31.4	7.41	5.90	Not observed	Poor (too white)
Comp. Ex. 3	5.5	8	3	6	14	44.1	7.68	7.83	Not observed	Poor (too white)
Comp. Ex. 4	3.5	1.5	–	–	1.5	6.7	2.32	1.44	Observed	Good
Comp. Ex. 5	5.5	8	–	–	8	30.7	3.58	3.59	Observed	Good
Comp. Ex. 6	5.5	8	–	–	8	9.4	1.74	1.42	Observed	Good
Comp. Ex. 7	5.5	12	–	–	12	39.6	3.74	4.38	Observed	Good

Comp. Ex. 8	5.5		12	–		–	12	10.6	1.96	1.62	Observed	Good
Comp. Ex. 9	–		–	3	6	6	6	14.9	2.94	2.63	Observed	Good
Comp. Ex. 10	–		–	3		6	6	4.4	0.92	0.70	Not observed	Poor (lack of anti-glare properties)
Comp. Ex. 11	5.5		8	0.01	10	18	26	3.21	2.67	Observed	Good	

[0135] As summarized in Tables 1 and 2, the anti-glare hard coat films of Examples satisfying all of the requirements of the present invention had good anti-glare properties and had no horizontal stripes and/or vertical stripes. That is, the anti-glare hard coat films of Examples was suppressed from reflected glare and suppressed or prevented from horizontal stripes and/or vertical stripes. On the other hand, the anti-glare hard coat films of Comparative Examples not satisfying some of the requirements of the present invention had no good anti-glare properties or had horizontal stripes and/or vertical stripes. In other words, the anti-glare hard coat films of Comparative Examples failed to achieve both suppression of reflected glare and suppression of horizontal stripes and/or vertical stripes.

Industrial Applicability

[0136] As described above, the present invention can provide an anti-glare hard coat film suppressed from reflected glare and suppressed or prevented from horizontal stripes and/or vertical stripes, a method for producing an anti-glare hard coat film, an optical member, and an image display device. According to the anti-glare film of the present invention, for example, strong external light can be scattered and reflection can be suppressed, so that reflected glare can be suppressed even outdoors. Therefore, the present invention can be suitably used for an image display device such as a public information display for outdoor use, for example. The present invention, however, is not limited to this application, and can be used for a wide range of applications.

[0137] This application claims priority from Japanese Patent Application No. 2020-018382 filed on February 5, 2020. The entire subject matter of the Japanese Patent Applications is incorporated herein by reference.

Reference Signs List

[0138]

10: anti-glare film

11: translucent base (A)

12: anti-glare layer (B)

12a: resin layer

12b1: first particle

12b2: second particle

Ry: maximum height of protruding part of asperities on outermost surface

θ_a : average tilt angle of asperities on outermost surface

1. An anti-glare hard coat film, comprising:
a translucent base (A); and
5 an anti-glare hard coat layer (B), wherein
the anti-glare hard coat layer (B) is laminated on the translucent base (A),
the anti-glare hard coat layer (B) is formed of a resin layer and contains first particles
and second particles inside the resin layer,
a total mass of the first particles and the second particles is 2 to 25% by mass relative to
10 a total mass of a resin forming the resin layer,
asperities are formed on an outermost surface of the anti-glare hard coat film on a side
of the anti-glare hard coat layer (B),
a weight-average particle size of the first particles satisfies the following mathematical
equation (1),
15 a weight-average particle size of the second particles satisfies the following
mathematical equation (2), and
the asperities on the outermost surface satisfy the following mathematical equations (3)
and (4):

$$\begin{array}{ll} 20 & 3.0 < d1 \leq 8.5 [\mu\text{m}] \quad (1) \\ & 1.0 \leq d2 \leq 3.0 [\mu\text{m}] \quad (2) \\ & R_y: 1.0 \leq R_y \leq 7.0 [\mu\text{m}] \quad (3) \\ & \theta_a: 1.0 \leq \theta_a \leq 7.5 [^\circ] \quad (4) \end{array}$$

25 where in the mathematical equation (1), d1 is the weight-average particle size [μm] of
the first particles,
in the mathematical equation (2), d2 is the weight-average particle size [μm] of the
second particles,
in the mathematical equation (3), R_y is a maximum height [μm] of a protruding part of
30 the asperities, and
in the mathematical equation (4), θ_a is an average tilt angle [$^\circ$] of the asperities.

2. The anti-glare hard coat film according to claim 1, wherein
the total mass of the second particles is 1% by mass or more relative to the total mass of
35 the resin forming the resin layer.

3. The anti-glare hard coat film according to claim 1 or 2, wherein
an external haze value due to the asperities is 5% or more in the anti-glare hard coat
film.
5
4. The anti-glare hard coat film according to any one of claims 1 to 3, wherein
the total mass of the first particles is 2/3 or more of the total mass of the second
particles.
- 10 5. A method for producing the anti-glare hard coat film according to any one of claims 1 to
4, comprising the step of:
forming the anti-glare hard coat layer (B) on the translucent base (A) so as to satisfy the
mathematical equations (1) to (4), wherein
the anti-glare hard coat layer (B)-forming comprises the steps of:
15 coating a coating liquid on the translucent base (A); and
forming a coating film by drying the coated coating liquid, and
the coating liquid contains the resin, the first particles, the second particles, and a solvent.
6. The method according to claim 5, wherein
20 in the coating liquid-coating, the coating liquid is continuously coated 500 m or more
with a width of 1000 mm or more.
7. The method according to claim 5 or 6, wherein
the anti-glare hard coat layer (B)-forming further comprises the step of:
25 curing the coating film.
8. An optical member comprising the anti-glare hard coat film according to any one of
claims 1 to 4.
- 30 9. The optical member according to claim 8, which is a polarizing plate.
10. An image display device comprising the anti-glare hard coat film according to any one
of claims 1 to 4 or the optical member according to claim 8 or 9.

11. The image display device according to claim 10, which is a public information display.