Title: ANTI-GLARE FILM COMPRISING ANTI-GLARE AGENT WITH A SHAPE OVERLAPPED TWO ANTI-GLARE PARTICLES AND METHOD OF MANUFACTURING THE SAME

Abstract: An antiglare film is provided. The antiglare film comprises a transparent substrate and an antiglare layer laminated on the transparent substrate. The antiglare layer includes a light-transmitting coating layer and an antiglare agent contained in the light-transmitting coating layer. The antiglare agent consists of first antiglare particles and second antiglare particles overlapping each other. The antiglare film ensures high sharpness of transmitted images, has a high total light transmittance and exhibits good antiglare functions. Further provided is a method for producing the antiglare film.
Description

ANTI-GLARE FILM COMPRISING ANTI-GLARE AGENT WITH A SHAPE OVERLAPPED TWO ANTI-GLARE PARTICLES AND METHOD OF MANUFACTURING THE SAME

Technical Field

[1] The present invention relates to an antiglare film for use in a display and a method for producing the antiglare film. More specifically, the present invention relates to an antiglare film comprising a transparent substrate and an antiglare layer laminated on the transparent substrate wherein the antiglare layer includes a light-transmitting coating layer and an antiglare agent contained in the light-transmitting coating layer, the antiglare agent being in the form of single particles, each of which consists of a first antiglare particle and a second antiglare particle overlapping each other, thereby being capable of controlling both external anti-glareness and internal anti-glareness, and a method for producing the antiglare film.

Background Art

[2] Displays, typified by liquid crystal displays (LCDs), plasma display panels (PDPs), cathode ray tubes (CRTs) and electroluminescent displays (ELDs), have widely been used in recent years. When such a display is used in outdoor environments or bright light conditions, external light such as sunlight or light from a fluorescent lamp is incident on and reflected from the surface of the display, resulting in deteriorated performance of the device. Thus, there is a need for films capable of preventing external light from being reflected from display surfaces.

[3] Under these circumstances, a number of antireflective films and antiglare films are currently used in displays. The antiglare films are treated in such a manner as to have rough surfaces. General methods for the antiglare treatment of antiglare films can be broadly divided into two types: (1) surface roughening of an antiglare film by physical processing during curing to form a hard coat layer thereon, and (2) mixing of a hard coat agent with inorganic particles and organic particles as antiglare agents to form a hard coat layer (Japanese Unexamined Patent Publication Nos. 2003-347218 and 2003-408023).

[4] However, the films thus produced suffer from the problems that the choice of raw materials is limited and the antiglare properties are difficult to control.

Disclosure of Invention

Technical Problem
The present invention has been made in view of the problems of the prior art, and it is one object of the present invention to provide an antiglare film that uses an antiglare agent in which two kinds of antiglare particles having different refractive indexes and sizes overlap each other to achieve controllable antiglare properties.

Another object of the present invention is to provide a method for producing the antiglare film.

Still another object of the present invention is to provide a display comprising the antiglare film.

**Technical Solution**

According to one aspect of the present invention, there is provided an antiglare film comprising a transparent substrate and an antiglare layer laminated on the transparent substrate wherein the antiglare layer includes a light-transmitting coating layer and an antiglare agent contained in the light-transmitting coating layer, the antiglare agent consisting of first antiglare particles and second antiglare particles overlapping each other.

According to another aspect of the present invention, there is provided a method for producing an antiglare film, comprising the steps of:

(a) mixing a hard coat agent, an antiglare agent consisting of first antiglare particles and second antiglare particles overlapping each other, and a solvent to prepare a mixed solution;

(b) coating the mixed solution on a transparent substrate to form an antiglare layer in which a light-transmitting coating layer contains the antiglare agent; and

(c) drying and curing the antiglare layer.

According to yet another aspect of the present invention, there is provided a display comprising the antiglare film.

**Advantageous Effects**

The antiglare film of the present invention offers the following advantages. The antiglare agent in the form of single particles, each of which consists of first antiglare particles and second antiglare particles overlapping each other, is simple in structure in comparison with a conventional antiglare agent in the form of a mixture of two or more different materials. Further, the shape and content of the antiglare agent and the thickness of the coating layer can be suitably varied according to the intended antiglare properties of the antiglare film. Further, the internal haze of the antiglare film with respect to the total haze can be adjusted in a broad range by the use of the antiglare agent in the form of single particles, each of which consists of a first antiglare particle and a second antiglare particle overlapping each other.

Further, the antiglare film of the present invention exhibits excellent characteristics
in terms of transmittance and haze over conventional antiglare films. Particularly, the antiglare film of the present invention is prepared by dispersing the antiglare agent in a UV-curable hard coat agent, followed by coating, to ensure high scratch resistance, appearance uniformity and high-speed coatability. Therefore, roll-to-roll processing can suitably be applied to the production of the antiglare film according to the present invention.

The display of the present invention using the antiglare agent, in which two kinds of antiglare particles having different refractive indexes and sizes overlap each other, attains high anti-glareness without loss of high-definition image quality and has reduced surface reflectance, thus achieving maximized visibility.

Brief Description of Drawings

FIG. 1 is a schematic diagram illustrating an antiglare film according to one embodiment of the present invention in which an antiglare agent consists of two different kinds of antiglare particles, one of which has a higher refractive index and a larger diameter, and the other of which has a lower refractive index and a larger diameter;

FIG. 2 is a schematic diagram illustrating an antiglare film according to another embodiment of the present invention in which an antiglare agent consists of two different kinds of antiglare particles, one of which has a higher refractive index and a smaller diameter, and the other of which has a lower refractive index and a larger diameter;

FIG. 3 is a schematic diagram illustrating an antiglare film according to another embodiment of the present invention in which an antiglare agent consists of two kinds of antiglare particles having different refractive indexes but the same diameter;

FIG. 4 is a schematic diagram illustrating an antiglare agent contained in an antiglare film according to an embodiment of the present invention in which a first antiglare particle overlaps a second antiglare particle;

FIG. 5 is a cross-sectional diagram illustrating the principle of antiglare functions of an antiglare film according to an embodiment of the present invention;

FIG. 6 is a scanning electron microscopy (SEM) image showing an antiglare agent contained in an antiglare film according to one embodiment of the present invention; and

FIG. 7 is a scanning electron microscopy (SEM) image showing an antiglare agent contained in an antiglare film according to another embodiment of the present invention.

Mode for the Invention

Unless otherwise defined, the term "total solids content" as used herein refers to the weight percentage of a coating layer formed after a composition comprising a hard coat agent, an antiglare agent and a solvent is applied to a transparent substrate, dried
and cured, based on the total weight of the composition.

[25] Exemplary embodiments of the present invention will now be described in greater
detail with reference to the accompanying drawings.

[26] (A) Antiglare Film

[27] FIGS. 1 through 3 are schematic cross-sectional diagrams of antiglare films
according to embodiments of the present invention. Referring to FIGS. 1 through 3,
each of the antiglare films has a structure in which an antiglare layer 20 is laminated on
a transparent substrate 10.

[28] Any suitable material may be used for the production of the transparent substrate 10
so long as it is transparent. A polymeric material, i.e. a plastic film, is preferred in
terms of processability.

[29] Examples of materials suitable for the transparent substrate 10 include: celluloses,
such as acetyl cellulose, diacetyl cellulose, triacetyl cellulose, propionyl cellulose,
acetylpropionyl cellulose and nitrocellulose; polyesters, such as polyethylene
terephthalate, polybutylene terephthalate, polyethylene naphthalate, poly-
1,4-cyclohexanediyl terephthalate, polyethylene-
1,2-diphenoxycarbonyl-4,4’-diphenyl ether and cyclohexanediyl terephthalate;
and polyolefins, such as polyethylene, polypropylene and polymethylpentene. Other
examples of suitable materials include, but are not necessarily limited to, polymethyl
methacrylate, polyvinyl chloride, polyvinylidene chloride, polyvinyl alcohol,
polystyrene, polycarbonate, polyamide, polyether sulfone, polyether ketone,
poly sulfone, and polyimide. Of these, triacetyl cellulose (TAC), polyethylene
terephthalate (PET) or polycarbonate (PC) is a suitable material for the transparent
substrate of the optical film due to its high transparency. Triacetyl cellulose and
polyethylene terephthalate (PET) may be used in polarizing films for LCDs and optical
filters for PDPs.

[30] The antiglare layer 20 includes a light-transmitting coating layer 1 and an antiglare
agent 30 contained in the light-transmitting coating layer 1. The antiglare agent 30
consists of two different kinds of antiglare particles, i.e. a first antiglare particle 2 and a
second antiglare particle 3, which overlap each other.

[31] FIG. 4 is a schematic diagram illustrating an embodiment of the antiglare agent 30
contained in the antiglare film. In the antiglare agent 30 illustrated in FIG. 4, the first
antiglare particle 2 overlaps the second antiglare particle 3.

[32] The first and second antiglare particles 2 and 3 are formed by bonding a seed of a
first core to a seed of a second core and growing the first and second cores by poly-
merization, respectively. As a result, a portion of the first antiglare particle 2 overlaps a
portion of the second antiglare particle 3 at the center of the antiglare agent 30.

[33] The first core is selected from the group consisting of, but not necessarily limited to,
styrene particles (refractive index: 1.59), polyvinyl chloride particles (refractive index: 1.60), and high refractive index acrylic particles (refractive index: 1.59); and the second core is selected from the group consisting of, but not necessarily limited to, highly crosslinkable acrylic particles (refractive index: 1.51), highly crosslinkable methacrylic particles (refractive index: 1.51), acrylic-styrene copolymer particles (refractive index: 1.55), melamine particles (refractive index: 1.57), and polycarbonate particles (refractive index: 1.57).

Generally, the principle of imparting anti-glareness to a coating layer formed on a transparent substrate can be accomplished by forming irregularities on the surface of the coating layer or by utilizing internal scattering from a light-transmitting coating layer and light-transmitting polymer particles having different refractive indexes in the coating layer.

Particularly, two kinds of antiglare particles having different refractive indexes may be used as light-transmitting polymer particles to utilize both external anti-glareness and internal anti-glareness. Suitable antiglare particles having a relatively low refractive index are highly crosslinkable acrylic particles (refractive index: 1.51), highly crosslinkable methacrylic particles (refractive index: 1.51), acrylic-styrene copolymer particles (refractive index: 1.55), melamine particles (refractive index: 1.57), polycarbonate particles (refractive index: 1.57), etc., and suitable antiglare particles having a relatively high refractive index are styrene particles (refractive index: 1.59), polyvinyl chloride particles (refractive index: 1.60), high refractive index acrylic particles (refractive index: 1.59), etc.

In contrast, according to the present invention, the first and second antiglare particles 2 and 3 are formed by bonding a seed of a first core to a seed of a second core and growing the first and second cores by polymerization, respectively, rather than the two kinds of antiglare particles are simply mixed or bonded, so that a portion of the first antiglare particle 2 overlaps a portion of the second antiglare particle 3. That is, the internal and external antiglare functions of the antiglare film 30 can be simultaneously controlled by using the antiglare agent in the form of single particles.

The antiglare layer 20 preferably has a thickness of 2 to 20 μm and more preferably 2 to 7 μm. The thickness of the antiglare layer 20 may be adjusted depending on the desired antiglare properties of the antiglare film and the mechanical properties (e.g., hardness) of the coating layer. If the antiglare layer is too thin, the hardness of the coating layer is insufficient. If the antiglare layer is too thick, curling is likely to occur in the film to deteriorate the external antiglare properties of the film.

FIG. 5 is a cross-sectional diagram illustrating the principle of antiglare functions of an antiglare film according to an embodiment of the present invention. Referring to FIG. 5, an antiglare layer of the antiglare film includes an antiglare agent 30 consisting
of a first antiglare particle 2 and a second antiglare particle 3 overlapping each other and a light-transmitting coating layer 1. External light incident on the antiglare layer scatters on the surface of the second antiglare particle 3 exposed to the surface of the light-transmitting coating layer 1 to impart external antiglare effects to the antiglare film. In addition, the light transmits through the light-transmitting coating layer 1 and scatters at the interface between the light-transmitting coating layer 1 and the second antiglare particle 3 due to the refractive index difference to impart internal antiglare effects to the antiglare film.

The first antiglare particle 2 has a refractive index different from that of the second antiglare particle 3. The refractive index difference between the first antiglare particle 2 and the second antiglare particle 3 is from 0.04 to 0.1. The refractive indexes of the first antiglare particle 2 and the second antiglare particle 3 are preferably between 1.57 and 1.62 and between 1.49 and 1.55, respectively. The use of the second antiglare particle 3 having a relatively low refractive index contributes to an improvement in the external antiglare properties and transmittance of the antiglare film. The use of the first antiglare particle 2 having a relatively high refractive index contributes to an improvement in the internal antiglare properties and transmittance of the antiglare film.

The sizes of the first antiglare particle 2 and the second antiglare particle 3 may be varied depending on the desired internal and external antiglare properties of the antiglare film.

FIGS. 6 and 7 are scanning electron microscopy (SEM) images showing the overall diameters of antiglare agents contained in antiglare films according to embodiments of the present invention.

The "overall diameter" of each of the antiglare agents means the distance between two points where a line connecting the centers of first and second antiglare particles extends and meets the respective particles.

Referring to FIG. 6, the sum of the diameters of the respective particles (2.02 + 3.13 = 5.15 μm) is larger than the overall diameter (5.04 μm) of the antiglare agent, indicating that the first and second antiglare particles constituting the antiglare agent overlap each other.

A preferred overall diameter of the antiglare agent, in which the first antiglare particle overlaps the second antiglare particle, is from 3 to 7 μm. The overall diameter of the antiglare agent can be associated with the final thickness of the antiglare film. An overall diameter of the antiglare agent smaller than 3 μm results in a reduction in the thickness of the antiglare layer in order to control the external anti-glareness of the first antiglare particle. Too small a thickness of the antiglare layer leads to an insufficient hardness. Meanwhile, if the antiglare agent has an overall diameter larger than 7 μm, the antiglare layer is too thick, and as a result, curling is likely to occur in the film to
deteriorate the external antiglare properties of the film.

[45] The sizes of the respective antiglare particles constituting the antiglare agent may be varied depending on the required haze of the antiglare film, as illustrated in FIGS. 1 through 3. FIG. 1 illustrates a case in which the first antiglare particle has a higher refractive index and a larger diameter and the second antiglare particle has a lower refractive index and a smaller diameter, FIG. 2 illustrates a case in which the first antiglare particle has a higher refractive index and a smaller diameter and the second antiglare particle has a lower refractive index and a larger diameter, and FIG. 3 illustrates a case in which the first antiglare particle having a higher refractive index has the same diameter as the second antiglare particle having a lower refractive index.

[46] The haze of the antiglare film is determined by varying the difference in refractive index between the light-transmitting coating layer 1 and the antiglare agent 30 of the antiglare layer 20.

[47] (B) Production of Antiglare Film

[48] According to another embodiment of the present invention, there is provided a method for producing an antiglare film which comprises the steps of: (a) mixing a hard coat agent, an antiglare agent consisting of first antiglare particles and second antiglare particles overlapping each other, and a solvent to prepare a mixed solution; (b) coating the mixed solution on a transparent substrate to form an antiglare layer in which a light-transmitting coating layer contains the antiglare agent; and (c) drying and curing the antiglare layer.

[49] The hard coat agent used in step (a) forms the light-transmitting coating layer. The hard coat agent may contain a heat- and radiation-curable resin, a photopolymerization initiator, inorganic fine particles, a leveling agent, a surface modifier for the antiglare layer, and a silane coupling agent.

[50] A compound having two or more functional groups is suitable as the heat- and radiation-curable resin. Examples of such compounds include oligomers, monomers and polymers that have polymerizable unsaturated bonds (e.g., methacryloyl and methacyrloyloxy groups) or cationically polymerizable functional groups (e.g., epoxy groups) in the molecule thereof. These compounds may be used alone or may be mixed to prepare a composition. The composition should be in a liquid state before curing and preferably has ethylenic and acrylic groups in the molecule thereof so as to be crosslinked by curing.

[51] As the monomers, there may be exemplified 2-hydroxyethyl methacrylate, 2-hydroxypropyl methacrylate, tetrahydrofurfuryl acrylate, glycidyl methacrylate, acryloylmorpholine, 2-cyanoacrylate, N,N-dimethylacrylamide, N-vinylpyrrolidone, N-vinyl-ε-caprolactam, phenoxydiethylene glycol methacrylate, pentaerythritol tetramethacrylate, dipentaerythritol trimethacrylate, trimethylolpropane
trimethacrylate, trimethylolethane trimethacrylate, dipentaerythritol tetramethacrylate, erythritol dimethacrylate, pentaerythritol trimethacrylate, and 1,2,3-cyclohexane tetramethacrylate.

[52] As the oligomers, there may be exemplified: a polyester methacrylate obtained by the reaction of a polyester polyol with methacrylic acid; and a urethane methacrylate obtained by the reaction of a bisphenol type epoxy resin with methacrylate, an organic polyisocyanate with hydroxymethacrylate, or a polyol, an organic polyisocyanate and a hydroxymethacrylate compound.

[53] The compound having ethylenically unsaturated groups that can form a crosslinked product by curing preferably has functional groups selected from isocyanate, epoxy, aldehyde, carbonyl, hydrazine, carboxyl, methylol and active methylene groups. The crosslinking groups are not limited and may be reactive groups obtained from the decomposition of the functional groups. The compound having the crosslinking groups can undergo crosslinking by heat after coating.

[54] The photopolymerization initiator contained in the hard coat agent serves to cure the composition upon UV irradiation. Examples of the photopolymerization initiator include 1-hydroxy cyclohexyl phenyl ketone, 2,2-dimethoxy-2-phenylacetophenone, xanthone, fluorinated ketone, 4,4'-dimethoxybenzophenone, 4,4'-diaminobenzophenone, Michler's ketone, benzoin propyl ether, benzoin ethyl ether, benzyl dimethyl ketal, 1-(4-isopropylphenyl)-2-hydroxy-2-methylpropan-1-one, 2-hydroxy-2-methyl-1-phenylpropan-1-one, thioxanthone, diethylthioxanthone, 2-isopropylthioxanthone, 2-chlorothioxanthone, 2-methyl-1-[4-(methylthio)phenyl]-2-morpholino-propan-1-one, 2,4,6-trimethylbenzoyldiphenylphosphine oxide, and bis-(2,6-dimethoxybenzoyl)-2,4,4-trimethylpentylphosphine oxide. These photopolymerization initiators may be used alone or in combination of two or more thereof.

[55] The amount of the photopolymerization initiator added is preferably in the range of 0.5 to 10% by weight and more preferably 0.5 to 5% by weight. If the photopolymerization initiator is added in an amount of less than 0.5% by weight, the hardness of the coating layer after curing of the curable composition is not sufficient. Meanwhile, if the photopolymerization initiator is added in an amount exceeding 10% by weight, the photopolymerization initiator itself may react with radicals to inhibit the polymerization of the curable resin.

[56] The inorganic fine particles contained in the hard coat agent serve to control the refractive index of the antiglare layer and to make the film stronger after curing. The average size of the inorganic fine particles is preferably not larger than 0.5 μm and more preferably not larger than 15 nm.

[57] The inorganic fine particles may be selected from silicon dioxide, titanium dioxide,
aluminum oxide, tin oxide, calcium carbonate, barium sulfate, talc, kaolin and calcium sulfate particles. The inorganic fine particles are preferably added in an amount between 10 and 90% by weight and more preferably between 30 and 60% by weight, based on the total weight of the hard coat agent.

The hard coat agent may contain either a fluorine or silicon-based leveling agent or both in order to prevent non-uniform flow during high-speed coating and non-uniform drying after coating and to ensure good appearance free of imperfections (e.g., coating streaks and point defects) and coating uniformity. The hard coat agent may contain a surface modifier and a silane coupling agent for the purpose of enhancing the dispersibility and bonding between the heat- and radiation-curable resin and the antiglare particles.

The solvent used in step (a) may be a mixture of a primary solvent and a secondary solvent, which may be varied depending on the kind of the substrate to be coated.

A soluble and swellable solvent is used as the secondary solvent. Specific examples of such soluble and swellable solvents include: ketones, such as methyl ethyl ketone, cyclohexanone, acetone, diacetone alcohol and polyhydric alcohols; ethers, such as methyl cellosolve, ethyl cellosolve, butyl cellosolve and cellosolve acetate; esters, such as methyl acetate and ethyl acetate; halogenated hydrocarbons, such as chloroform, methylene chloride and tetrachloroethane; nitrogenous compounds, such as nitromethane, acetonitrile, N-methylpyrrolidone and N,N-dimethylformamide; and other solvents, such as dimethylsulfoxide. These solvents may be used alone or as a mixture thereof. The primary solvent may be any solvent other than the aforementioned secondary solvents, but is not necessarily limited thereto.

The content of the solvent is preferably from about 20 to about 100 parts by weight and more preferably 50 to 100 parts by weight, based on 100 parts by weight of the curable resin. If the solvent is present in an amount of less than 10 parts by weight, there is a difficulty in uniformly applying the composition to the substrate due to the high viscosity of the composition. Meanwhile, if the solvent is present in an amount of exceeding 100 parts by weight, pinholes are left after coating and drying.

In step (b), the coating of the mixed solution on the substrate may be carried out by various wet processes, including roll coating, die coating, gravure coating, microgravure coating, wire bar coating, knife coating, slot die coating and spin coating.

In step (c), the drying is carried out at a temperature of 40 to 100°C to remove the solvent from the composition. After drying, the coating layer is cured by UV light from a UV curing system to form an antiglare layer. The UV curing system may use a UV lamp, such as a high-pressure mercury lamp, a metal halide lamp, a xenon lamp or a microwave electrodeless lamp. A wavelength range and an exposure dose required to cure the coating layer are generally from 200 to 400 nm and from 100 to 1,000 mJ/cm²,
respectively.

According to another embodiment of the present invention, there is provided a display comprising the antiglare film. The display may be a cathode ray tube (CRT), a plasma display panel (PDP), an electroluminescent display (ELD), or a liquid crystal display (LCD). The antiglare film is disposed on an outermost surface of the display to achieve low reflectance of the display. Taking advantage of the principle of optical interference, the antiglare film prevents deterioration of contrast and visibility arising from the reflection of external light and the receipt of reflected images.

Hereinafter, the present invention will be explained in more detail with reference to the following examples. However, these examples are given for the purpose of illustration and are not intended to limit the scope of the present invention.

**EXAMPLES**

**Examples 1 to 41**

First, a transparent hard coat agent (DIC, RC26-338), the antiglare agent (SX8707(C)-04, JSR) shown in Table 1 and solvents were mixed together to prepare a mixed solution.

Table 1

<table>
<thead>
<tr>
<th>Antiglare agent</th>
<th>Refractive index of first antiglare particle</th>
<th>Refractive index of second antiglare particle</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.6 μm</td>
<td>1.7 μm</td>
</tr>
</tbody>
</table>

Specifically, an antiglare film was produced by the following procedure. The hard coat agent was diluted with a primary solvent until the solid content reached 50 parts by weight. After the antiglare agent particles were added to the primary dilution, the mixture was diluted with a secondary solvent until the final mixed solution had a desired solids content.

A mixture of methyl isobutyl ketone and methyl ethyl ketone (MIBK/MEK) as ketone-based solvents was used as the primary solvent when a PET film was used as a transparent substrate, and a mixture of butyl acetate (BA) and isopropyl alcohol (IPA) was used as the primary solvent when a TAC film was used as a transparent substrate.

Methyl isobutyl ketone (MIBK), propylene glycol monomethyl ether acetate (PGMEA), propylene glycol monomethyl ether (PGME) or cyclohexanone (CCH) was
used as the secondary solvent.

Subsequently, the mixed solution was coated on the transparent substrate to form an antiglare layer in which the antiglare agent was contained in a light-transmitting coating layer. A wire bar coater was used to coat the mixed solution on the transparent substrate.

Thereafter, the antiglare layer was dried in a dryer, followed by UV curing. The drying temperature was adjusted between 40°C (initial temperature) and 100°C depending on the volatility of the solvents. The UV curing conditions were varied depending on the curability of the hard coat agent and the total exposure dose was adjusted to 500 mJ/cm².

The specific reaction conditions are shown in Tables 2 and 3. The haze and transmittance values of the films produced in Examples 1-41 were measured and the results are shown in Tables 2 and 3.

Table 2

<table>
<thead>
<tr>
<th>Example No</th>
<th>Content of antiglare agent in total solids content (wt%)</th>
<th>Transparent substrate</th>
<th>Primary solvent</th>
<th>Secondary solvent</th>
<th>Thickness (µm)</th>
<th>Haze (%)</th>
<th>Transmittance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.5</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>MIBK</td>
<td>3.4</td>
<td>4.83</td>
<td>91.90</td>
</tr>
<tr>
<td>2</td>
<td>2.5</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>3.5</td>
<td>2.21</td>
<td>92.00</td>
</tr>
<tr>
<td>3</td>
<td>2.5</td>
<td>TAC</td>
<td>IPA</td>
<td>PGMEA</td>
<td>3.4</td>
<td>2.68</td>
<td>92.19</td>
</tr>
<tr>
<td>4</td>
<td>2.5</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>MIBK</td>
<td>5.6</td>
<td>9.38</td>
<td>90.98</td>
</tr>
<tr>
<td>5</td>
<td>2.5</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>5.6</td>
<td>10.01</td>
<td>91.89</td>
</tr>
<tr>
<td>6</td>
<td>2.5</td>
<td>TAC</td>
<td>IPA</td>
<td>PGMEA</td>
<td>5.6</td>
<td>9.79</td>
<td>92.03</td>
</tr>
<tr>
<td>7</td>
<td>2.5</td>
<td>TAC</td>
<td>IPA</td>
<td>PGMEA</td>
<td>3.4</td>
<td>21.73</td>
<td>91.1</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>TAC</td>
<td>MIBK/MEK</td>
<td>MIBK</td>
<td>3.4</td>
<td>23.8</td>
<td>91.32</td>
</tr>
<tr>
<td>9</td>
<td>5</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>PGMEA</td>
<td>5.6</td>
<td>19.64</td>
<td>91.10</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>5</td>
<td>13.56</td>
<td>91.45</td>
</tr>
<tr>
<td>11</td>
<td>5</td>
<td>TAC</td>
<td>IPA</td>
<td>PGMEA</td>
<td>4</td>
<td>15.09</td>
<td>91.42</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>PGMEA</td>
<td>8-9</td>
<td>19.64</td>
<td>91.05</td>
</tr>
<tr>
<td>13</td>
<td>5</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>9-10</td>
<td>14.57</td>
<td>91.54</td>
</tr>
<tr>
<td>14</td>
<td>5</td>
<td>TAC</td>
<td>IPA</td>
<td>PGMEA</td>
<td>8-9</td>
<td>28.06</td>
<td>91.24</td>
</tr>
<tr>
<td>15</td>
<td>5</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>PGMEA</td>
<td>9-10</td>
<td>21.78</td>
<td>91.23</td>
</tr>
<tr>
<td>16</td>
<td>5</td>
<td>TAC</td>
<td>BA</td>
<td>MIBK/PGMEA/PGMEA</td>
<td>8-9</td>
<td>34.81</td>
<td>92.18</td>
</tr>
<tr>
<td>17</td>
<td>5</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>MIBK/PGMEA/PGMEA</td>
<td>9-10</td>
<td>28.1</td>
<td>91.4</td>
</tr>
<tr>
<td>18</td>
<td>5</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>CCH</td>
<td>10</td>
<td>23.67</td>
<td>90.95</td>
</tr>
<tr>
<td>19</td>
<td>5</td>
<td>TAC</td>
<td>BA</td>
<td>CCH</td>
<td>10</td>
<td>24.3</td>
<td>91.75</td>
</tr>
<tr>
<td>20</td>
<td>5</td>
<td>TAC</td>
<td>IPA</td>
<td>CCH</td>
<td>10</td>
<td>21.74</td>
<td>91.92</td>
</tr>
<tr>
<td>21</td>
<td>8 33</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>CCH/PGMEA</td>
<td>7</td>
<td>27.99</td>
<td>93.56</td>
</tr>
<tr>
<td>22</td>
<td>8 33</td>
<td>PET</td>
<td>MIBK/MEK</td>
<td>CCH/PGMEA</td>
<td>8</td>
<td>33.79</td>
<td>93.05</td>
</tr>
<tr>
<td>23</td>
<td>8 33</td>
<td>TAC</td>
<td>BA</td>
<td>CCH/PGMEA</td>
<td>7-8</td>
<td>29.14</td>
<td>93.56</td>
</tr>
</tbody>
</table>

Table 3
First, a transparent hard coat agent (DIC, RC26-338), one of the four antiglare agents (SX8707(C)-04, JSR) shown in Table 4 and solvents were mixed together to prepare a mixed solution. Each of the antiglare agents consisted of two different kinds of antiglare particles, i.e. first antiglare particles and second antiglare particles, which had different sizes. The characteristics of the antiglare agents were compared and evaluated.

Table 4
Specifically, an antiglare film was produced by the following procedure. The hard coat agent was diluted with a primary solvent until the solid content reached 50 parts by weight. After the antiglare agent particles were added to the primary dilution, the mixture was diluted with a secondary solvent until the mixed solution had a desired solids content.

A TAC film was used as a transparent substrate and butyl acetate was used as the primary solvent. Propylene glycol monomethyl ether acetate (PGMEA) was used as the secondary solvent. Subsequently, the mixed solution was coated on the transparent substrate to form an antiglare layer in which the antiglare agent was contained in a light-transmitting coating layer. A wire bar coater was used to coat the mixed solution on the transparent substrate.

Thereafter, the antiglare layer was dried in a dryer, followed by UV curing. The drying temperature was adjusted between 40°C (initial temperature) and 100°C depending on the volatility of the solvents. The UV curing conditions were varied depending on the curability of the hard coat agent and the total exposure dose was adjusted to 500 mJ/cm².

The specific reaction conditions are shown in Table 5. The haze and transmittance
values of the films produced in Examples 42-53 were measured and the results are shown in Table 5.

Table 5

<table>
<thead>
<tr>
<th>Example No</th>
<th>Kind of antiglare agent</th>
<th>Content of antiglare agent in total solids content (wt%)</th>
<th>Transparent substrate</th>
<th>Primary solvent</th>
<th>Secondary solvent</th>
<th>Thickness (μm)</th>
<th>Total haze (%)</th>
<th>Internal haze (%)</th>
<th>Externa haze (%)</th>
<th>Transmittance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>42</td>
<td>1 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>7</td>
<td>30 93</td>
<td>5.59</td>
<td>18.1</td>
<td>91.94</td>
<td></td>
</tr>
<tr>
<td>43</td>
<td>1 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>8.9</td>
<td>29 45</td>
<td>7.15</td>
<td>24.3</td>
<td>91.84</td>
<td></td>
</tr>
<tr>
<td>44</td>
<td>1 10.0</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>7</td>
<td>41 11</td>
<td>9.12</td>
<td>22.2</td>
<td>91.74</td>
<td></td>
</tr>
<tr>
<td>45</td>
<td>2 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>7</td>
<td>33 91</td>
<td>5.01</td>
<td>14.8</td>
<td>91.87</td>
<td></td>
</tr>
<tr>
<td>46</td>
<td>2 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>8</td>
<td>28 31</td>
<td>5.99</td>
<td>21.2</td>
<td>91.59</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>2 10.0</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>7</td>
<td>39 43</td>
<td>7.71</td>
<td>19.6</td>
<td>91.31</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>3 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>3.4</td>
<td>30 75</td>
<td>14.16</td>
<td>46.0</td>
<td>91.03</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>3 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>6.7</td>
<td>36 54</td>
<td>21.43</td>
<td>58.6</td>
<td>92.38</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>3 10.0</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>7</td>
<td>44 98</td>
<td>33.09</td>
<td>73.6</td>
<td>93.73</td>
<td></td>
</tr>
<tr>
<td>51</td>
<td>4 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>4</td>
<td>30 26</td>
<td>9.61</td>
<td>31.8</td>
<td>91.41</td>
<td></td>
</tr>
<tr>
<td>52</td>
<td>4 833</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>7</td>
<td>29 68</td>
<td>11.96</td>
<td>40.3</td>
<td>91.54</td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>4 10.0</td>
<td>TAC</td>
<td>BA</td>
<td>PGMEA</td>
<td>7</td>
<td>40 66</td>
<td>14.01</td>
<td>34.5</td>
<td>91.67</td>
<td></td>
</tr>
</tbody>
</table>

Comparative Examples 1 to 3

To evaluate the functions of the antiglare agents, hard coating films containing no antiglare agent were produced by the following procedure.

First, a transparent hard coat agent (DIC, RC26-338), a primary solvent and a secondary solvent were mixed together to prepare a mixed solution.

A mixture of methyl isobutyl ketone and methyl ethyl ketone (MIBK/MEK) as ketone-based solvents was used as the primary solvent when a PET film was used as a transparent substrate, and a mixture of butyl acetate (BA) and isopropyl alcohol (IPA) was used as the primary solvent when a TAC film was used as a transparent substrate.

Propylene glycol monomethyl ether acetate (PGMEA) or methyl isobutyl ketone (MIBK) was used as the secondary solvent.

Subsequently, the mixed solution was coated on the transparent substrate, dried and cured. A roll-to-roll coater was used to coat the mixed solution on the transparent substrate. The drying temperature was adjusted between 40°C (initial temperature) and 100°C depending on the volatility of the solvents. The UV curing conditions were varied depending on the curability of the hard coat agent and the total exposure dose was adjusted to 500 mJ/cm².

The specific reaction conditions are shown in Table 6. The haze and transmittance values of the films produced in Comparative Examples 1-3 were measured, and the results are shown in Table 6.

Table 6
Table 6

<table>
<thead>
<tr>
<th>Comparati ve Example No.</th>
<th>Content of antiglare agent in total solids content (wt%)</th>
<th>Transparent substrate</th>
<th>Primary solvent</th>
<th>Secondary solvent</th>
<th>Thickness (µm)</th>
<th>Haze (%)</th>
<th>Transmittance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>PET</td>
<td>MIBK/MMEK</td>
<td>MIBK</td>
<td>5-6</td>
<td>0.67</td>
<td>91.95</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>TAC</td>
<td>EA</td>
<td>PGMEA</td>
<td>5-6</td>
<td>0.89</td>
<td>92.14</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>TAC</td>
<td>IPA</td>
<td>PGMEA</td>
<td>5-6</td>
<td>0.98</td>
<td>92.38</td>
</tr>
</tbody>
</table>

Analysis - Haze and Transmittance Measurements

The haze and transmittance values of the films produced in Examples 1-53 and Comparative Examples 1-3 were measured using a haze meter (Nippon Denshoku Kogyo Co.).

The internal haze and the external haze of each of the films were measured using a pressure-sensitive adhesive. The total haze of the film was defined as the sum of the internal haze and the external haze.

Internal haze + External haze = Total haze

Specifically, an optical double-sided pressure-sensitive adhesive (PSA) film was adhered to the antiglare (AG) layer of the film under pressure. The pressure-sensitive surface of the PSA film was attached to the glass surface. The haze of the resulting structure was measured using the haze meter. The results are shown in Tables 2, 3, 5 and 6.

The results in Tables 2, 3, 5 and 6 show that the antiglare films of Examples 1-53 had a total light transmittance of 88% or above and a total haze value of 4 to 53%. In addition, the internal haze values of the films accounted for 74% or below of the respective total haze values. Particularly, the total light transmittance values of the antiglare films of Examples 1-53 were comparable to or higher than those of the antiglare films of Comparative Examples 1-3 containing no antiglare agent. Further, the internal and external haze values of the films of Examples 1-53 could be freely controlled by varying the sizes of the first and second antiglare particles of the antiglare agents and the amounts of the antiglare agents added.

While the present invention has been described in detail with reference to its preferred embodiments, the embodiments are merely illustrative. It will be understood by those skilled in the art that various modifications and equivalents can be made to the embodiments without departing from the spirit and scope of the invention. Therefore, the true scope of the present invention should be defined by the technical spirit of the appended claims.
Claims

[1] An antiglare film comprising a transparent substrate and an antiglare layer laminated on the transparent substrate wherein the antiglare layer includes a light-transmitting coating layer and an antiglare agent contained in the light-transmitting coating layer, the antiglare agent consisting of first antiglare particles and second antiglare particles overlapping each other.

[2] The antiglare film of claim 1, wherein the first and second antiglare particles are formed by bonding a seed of a first core to a seed of a second core and growing the first and second cores by polymerization, respectively, and the first antiglare particles partially overlap the second antiglare particles at the center of the antiglare agent.

[3] The antiglare film of claim 2, wherein the first core is selected from the group consisting of styrene particles, polyvinyl chloride particles, and high refractive index acrylic particles; and the second core is selected from the group consisting of highly crosslinkable acrylic particles, highly crosslinkable methacrylic particles, acrylic-styrene copolymer particles, melamine particles, and poly-carbonate particles.

[4] The antiglare film of claim 1, wherein the antiglare agent has an overall diameter of 3 to 7 μm.

[5] The antiglare film of claim 1, wherein the first and second antiglare particles have different refractive indexes.

[6] The antiglare film of claim 5, wherein the refractive index difference between the first and second antiglare particles is from 0.04 to 0.1.

[7] The antiglare film of claim 5, wherein the first antiglare particles have a refractive index of 1.57 to 1.62 and the second antiglare particles have a refractive index of 1.49 to 1.55.

[8] The antiglare film of claim 1, wherein the antiglare agent is present in an amount of 2.5 to 30% by weight, based on the total solids content.

[9] The antiglare film of claim 1, wherein the antiglare layer has a thickness of 2 to 20 μm.

[10] The antiglare film of claim 1, wherein the transparent substrate is made of a material selected from the group consisting of acetyl cellulose, diacetyl cellulose, triacetyl cellulose (TAC), propionyl cellulose, acetylpropionyl cellulose, nitro-cellulose, polyethylene terephthalate (PET), polybutylene terephthalate, polyethylene naphthalate, poly-1,4-cyclohexanedicarboxylate, cyclohexanedicarboxylate, polyethylene-1,2-diphenoxycarbonyl-4,4'-dicarboxylate, cyclohexanedicarboxylate, polyethylene, polypropylene, polymethylpentene, polymethyl
methacrylate, polyvinyl chloride, polyvinylidene chloride, polyvinyl alcohol, 
polystyrene, polycarbonate (PC), polyamide, polyether sulfone, polyether ketone, 
polysulfone, and polyimide.

[11] A method for producing an antiglare film, comprising the steps of:
(a) mixing a hard coat agent, an antiglare agent consisting of first antiglare 
particles and second antiglare particles overlapping each other, and a solvent to 
prepare a mixed solution;
(b) coating the mixed solution on a transparent substrate to form an antiglare 
layer in which a light-transmitting coating layer contains the antiglare agent; and 
(c) drying and curing the antiglare layer.

[12] The method of claim 11, wherein step (b) is carried out by a coating process 
selected from the group consisting of roll coating, die coating, gravure coating, 
micro-gravure coating, wire bar coating, knife coating, slot die coating and spin 
coating.

[13] The method of claim 11, wherein in step (c), the drying is carried out at a tem- 
perature of 40 to 100°C.

[14] A display comprising the antiglare film of any one of claims 1 to 10.

[15] The display of claim 14, wherein the display is a cathode ray tube (CRT), a 
plasma display panel (PDP), an electroluminescent display (ELD), or a liquid 
crystal display (LCD).
**INTERNATIONAL SEARCH REPORT**

**PCT/ISA/210 (second sheet) (July 2008)**

**A. CLASSIFICATION OF SUBJECT MATTER**

*G02B 5/02(2006.01)*

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility models since 1975
Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS (KIPO internal)
"keywords anti-glare film, overlap, particle"

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>KR 10-2008-0085742 A (DAI NIPPON PRINTING co., LTD.) 24.09.2008 See abstract ; claims 3-10 ; figure 1</td>
<td>1-15</td>
</tr>
<tr>
<td>A</td>
<td>KR 10-2006-0051122 A (TOMIOEGAWA PAPER CO., LTD.) 19.05.2006 See abstract ; claims 1-2 ; pages 2-4</td>
<td>1-15</td>
</tr>
<tr>
<td>A</td>
<td>KR 10-2008-0111173 A (TOYO BOSEKI KABUSHIKI KAISHA) 22.12.2008 See abstract ; claims 1-3 ; pages 4-6</td>
<td>1-15</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents
  * A document defining the general state of the art which is not considered to be of particular relevance
  * E document earlier application or patent but published on or after the international filing date
  * L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
  * O document referring to an oral disclosure, use, exhibition or other means
  * P document published prior to the international filing date but later than the priority date claimed

**Date of the actual completion of the international search** 25 JANUARY 2010 (25 01 2010)

**Date of mailing of the international search report** 25 JANUARY 2010 (25.01.2010)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seogu, Daejeon 302-701, Republic of Korea
Facsimile No 82-42-472-7140

Authorized officer

JEONG, So Yeon
Telephone No 82-42-481-5656
<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>us 2008-0260997 A1</td>
<td>23.10.2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>us 2006-0057344 A1</td>
<td>16.03.2006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 04-029356 B2</td>
<td>09.01.2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2007-3 13865 A</td>
<td>06.12.2007</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TW 2008 10924 A</td>
<td>01.03.2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>wo 2007-138785 A1</td>
<td>06.12.2007</td>
</tr>
</tbody>
</table>