US 20030174257A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2003/0174257 A1

Harada et al.

(43) Pub. Date: Sep. 18, 2003

(54) **TRANSPARENT HARD COAT FILM, TRANSPARENT CONDUCTIVE HARD COAT FILM, TOUCH PANEL USING THIS FILM, AND LIQUID CRYSTAL DISPLAY DEVICE USING THIS TOUCH PANEL**

(75) Inventors: **Masahiro Harada**, Tokyo (JP); **Masato Saitou**, Saitama-shi (JP); **Masuo Koyama**, Ageo-shi (JP); **Yoshihisa Kimura**, Saitama-shi (JP)

Correspondence Address:
LORUSSO & LOUD
3137 Mt. Vernon Avenue
Alexandria, VA 22305 (US)

(73) Assignee: **KIMOTO CO., LTD.**

(21) Appl. No.: **10/385,641**

(22) Filed: **Mar. 12, 2003**

(30) **Foreign Application Priority Data**

Mar. 15, 2002 (JP) 2002-071640

Publication Classification

(51) **Int. Cl.**^{7} **G02F 1/1335**

(52) **U.S. Cl.** **349/12**

(57) **ABSTRACT**

A transparent hard coat film having an excellent hard coat property and transmitted resolution, in which an interference fringe attributable to ununiform thickness of the transparent hard coat layer is not noticeable, is provided. The transparent hard coat film of the invention has a transparent hard coat layer formed at least on one surface of a transparent polymer film, wherein the transparent hard coat film has a b* value in L*a*b* color space system of 0.5 or less. As a result of the diligent study conducted by the inventors, it was found that the interference fringe attributable to ununiform thickness of the transparent hard coat layer could be made unnoticeable by making the b* value of the film in L*a*b* color space system small.

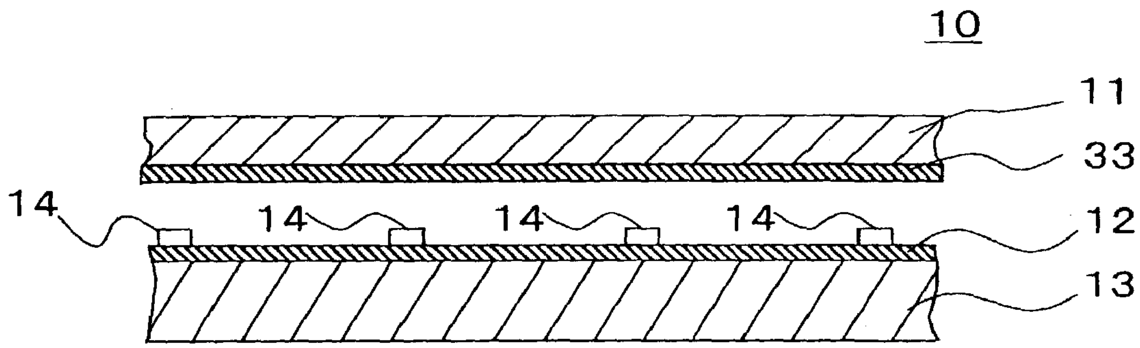


FIG. 1

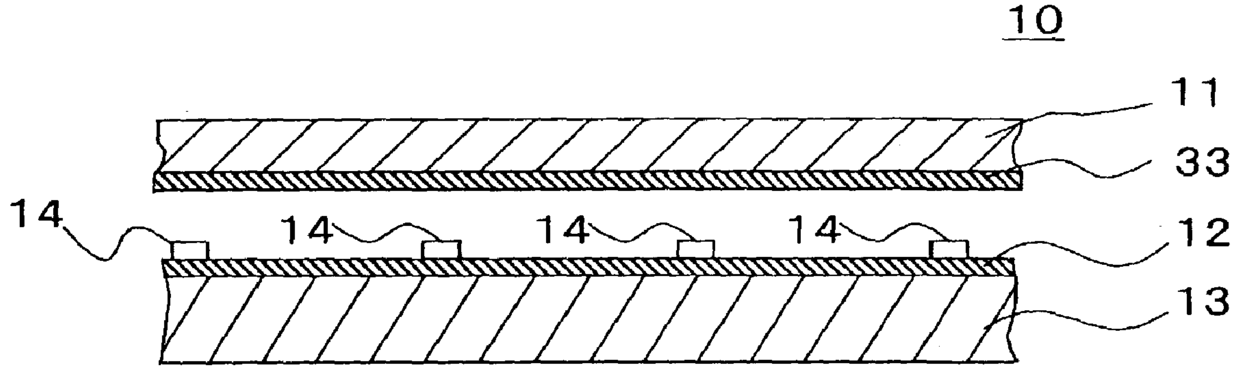


FIG. 2

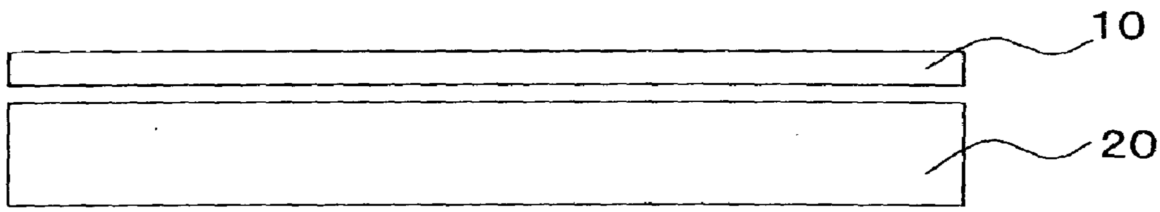


FIG. 3

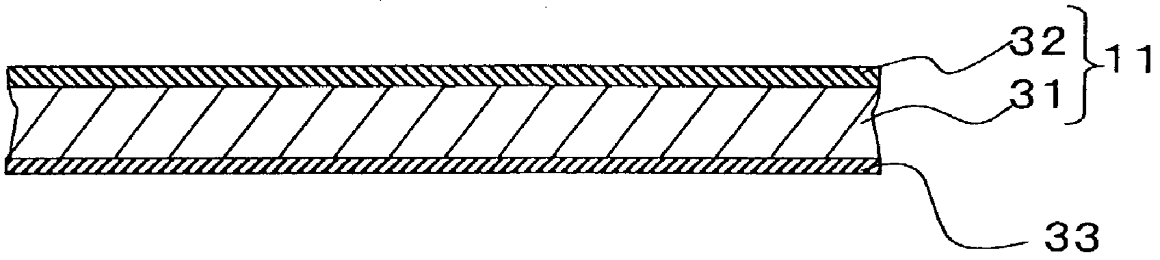
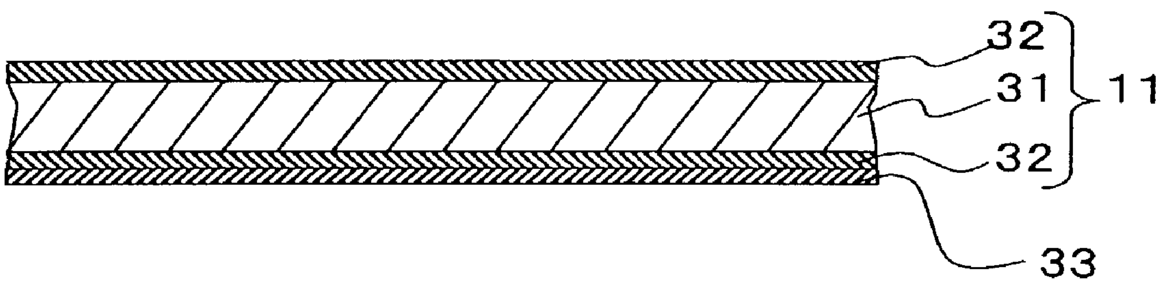


FIG. 4



TRANSPARENT HARD COAT FILM, TRANSPARENT CONDUCTIVE HARD COAT FILM, TOUCH PANEL USING THIS FILM, AND LIQUID CRYSTAL DISPLAY DEVICE USING THIS TOUCH PANEL

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a transparent conductive hard coat film suitably used for a transparent touch panel etc., and a transparent hard coat film suitable as a substrate film of the transparent conductive hard coat film.

RELATED ART

[0002] In recent years, a liquid crystal display device draws attention as an image display device, and application to portable electronic notes, information terminals etc. is expected as examples of its uses. As input devices of such portable electronic notes, information terminals etc., those with a transparent touch panel placed on the liquid crystal display device, in particular, resistance-film type touch panels are generally used in view of prices etc.

[0003] As the resistance-film type touch panels, those having a structure in which a transparent conductive film and a glass with a transparent conductive thin layer are separately disposed with an appropriate gap are generally used. When the transparent conductive film disposed on the upper side is pressed with a finger or a pen and brought into contact with the glass with a transparent conductive thin layer on the lower side, electric current is passed. Conventionally, as the transparent conductive film, those obtained by forming a transparent conductive thin layer made of indium tin oxide (referred to as "ITO", hereinafter) or the like on the lower surface (surface opposed to the glass with a transparent conductive thin layer) of a substrate film such as a plastic film are generally used.

[0004] As a substrate film of such a transparent conductive film, a transparent hard coat film having a structure in which a transparent hard coat layer is provided on the surface of a transparent polymer film is used to improve durability of the transparent conductive film is used.

[0005] Meanwhile, recently, in an office, which is an environment in which input devices such as portable electronic notes and information terminals are used, a three band fluorescent lamp with a particular wavelength having high emission intensity, with which objects can be clearly seen, is being increasingly used.

[0006] The transparent hard coat film currently incorporated in a touch panel etc. has a problem that an interference fringe attributable to ununiform thickness of the transparent hard coat layer is noticeable.

[0007] Such an interference fringe attributable to ununiform thickness of the transparent hard coat layer can be theoretically solved by completely eliminating unevenness the transparent hard coat layer. However, it is not easy to completely eliminate the unevenness with accuracy of the current film formation technique.

[0008] The interference fringe attributable to ununiform thickness of the transparent hard coat layer can also be theoretically eliminated by making the refraction index of the transparent polymer film and the refraction index of the transparent hard coat layer the same, but it is difficult to maintain hard coat property of the transparent hard coat layer when its refraction index is thus regulated.

[0009] Further, when a large amount of a matting agent is added to the transparent hard coat layer to make the surface uneven thereby, the interference fringe attributable to ununiform thickness of the transparent hard coat layer can be theoretically solved. However, if the surface of the transparent hard coat layer is made uneven, the resolution of images observed through the transparent hard coat film (referred to as "transmitted resolution" hereinafter) is deteriorated.

[0010] An object of the present invention is to provide a transparent hard coat film in which an interference fringe attributable to ununiform thickness of a transparent hard coat layer is not noticeable while its high hard coat property and transmitted resolution are maintained. Further, another object is to provide a transparent conductive hard coat film using this transparent hard coat film as a substrate film.

DISCLOSURE OF THE INVENTION

[0011] The inventors of the present invention conducted various studies to achieve the foregoing objects. As a result, they found that an interference fringe attributable to ununiform thickness of a transparent hard coat layer could be made less noticeable by lowering the b* value of a transparent hard coat film in the CIE 1976 L*a*b* color space system. By doing so, even when some ununiform thickness exists in the transparent hard coat layer, an interference fringe attributable to the ununiform thickness of the transparent hard coat layer can be made less noticeable without regulating the refraction index of the transparent hard coat layer or adding a large amount of a matting agent to the transparent hard coat layer.

[0012] Specifically, the transparent hard coat film of the present invention is a transparent hard coat film obtained by providing a transparent hard coat layer at least on one surface of a transparent polymer film, wherein the b* value of the transparent hard coat film in the CIE 1976 L*a*b* color space system is 0.5 or lower.

[0013] The CIE 1976 L*a*b* color space system refers to a method of color specification adopted in the Commission International de l'Echairage (CIE) in 1976, and the L* value, a* value, and b* value in the present invention are values obtained by measurement according to the method provided in JIS-Z8729:1994.

[0014] Further, the transparent conductive hard coat film of the present invention is a transparent conductive hard coat film obtained by providing a transparent conductive layer at least on one surface of the transparent hard coat film.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] **FIG. 1** is a cross sectional view of a touch panel **10** according to an embodiment of the present invention.

[0016] **FIG. 2** is a cross sectional view of a liquid crystal display device with the touch panel according to an embodiment of the present invention.

[0017] **FIG. 3** is a cross sectional view showing the structure of a transparent conductive hard coat film according to one embodiment of the present invention, which is provided with a transparent conductive layer **33** on a one-side-type transparent hard coat film **11**.

[0018] **FIG. 4** is a cross sectional view showing the structure of a transparent conductive hard coat film according to another embodiment of the present invention, which is provided with a transparent conductive layer **33** on a both-sides-type transparent hard coat film **11**.

PREFERRED EMBODIMENT OF THE INVENTION

[0019] Preferred embodiments of the transparent hard coat film and the transparent conductive hard coat film of the present invention will be explained in detail.

[0020] The transparent hard coat film **11** of the present invention has a transparent hard coat layer **32** on one surface or both surfaces of a transparent polymer film **31** as shown in **FIG. 3** and **FIG. 4**. The transparent hard coat film **11** may have a functional layer, which is not shown in **FIG. 3** and **FIG. 4**, in addition to the transparent hard coat layer **32**.

[0021] The transparent hard coat film **11** of the present invention has a b* value in the CIE 1976 L*a*b* color space system of 0.5 or lower, preferably 0 or lower. The CIE 1976 L*a*b* color space system is a method of color specification adopted in the Commission International de l'Echairage (CIE) in 1976, and the L* value, a* value, and b* value in the present invention are values obtained by measurement according to the method provided in JIS-Z8729. The method provided in JIS-Z8729 includes the method using a reflected light (reflection method) and the method using a transmitted light (transmittance method). Values in the embodiments are those measured by the transmittance method. Values measured by reflection method may be used but, in such a case, preferable values as the L* value, a* value, and b* value in the CIE 1976 L*a*b* color space system are not equal to those measured by the transmittance method. Accordingly, the preferable values for values measured by the reflection method should be found out beforehand by the experiments.

[0022] As well known in the art, in the CIE 1976 L*a*b* color space system, the L* value represents lightness, and the a* value and the b* value represent hue and chromaticness. Specifically, the a* value with a positive sign indicates a red hue, and the a* value with a negative sign indicates a green hue. The b* value with a positive sign indicates a yellow hue, and the b* value with a negative sign indicates a blue hue. Further, for both the a* value and the b* value, the larger the absolute value is, the higher chromaticness the color has, and the more vivid color is indicated. The smaller the absolute value is, the lower chromaticness the color has. When the a* value and the b* value are both 0, an achromatic color is indicated.

[0023] The transparent hard coat film of the present invention is constructed so that yellow chromaticness should be suppressed and a blue color should be preferably shown, and thereby the b* value thereof in the CIE 1976 L*a*b* color space system becomes 0.5 or lower, preferable 0 or lower. The color specification can be adjusted by, for example, adding a colorant. It was confirmed by the experiments conducted by the present inventors that, even if unevenness of the transparent hard coat layer **32** exists, an interference fringe caused thereby can be effectively suppressed by controlling the hue and chromaticness of the transparent hard coat film **11**. Such an interference fringe can be generated when display light of a color liquid crystal panel is transmitted through the transparent hard coat layer **32** and when illumination light from a three-band fluorescent lamp is reflected at the transparent hard coat layer **32**. The transparent hard coat film **11** of the present invention has an effect of suppressing interference fringe generated in both cases. Thus, an interference fringe can be suppressed while the hard coat property and transmitted resolution of the transparent hard coat film **11** are maintained. Although effect of suppressing interference fringes can be obtained by the structure of the this embodiment without using the conventional techniques such as control of the refraction index of the transparent hard coat layer and addition of a matting agent to the transparent hard coat layer, the structure of this embodiment may be combined with the other techniques such as control of the refraction index and addition of a matting agent.

[0024] Since the transparent hard coat film **11** of the present invention is used for the purpose such as a touch panel put on a liquid crystal display device etc., it is not desirable that its hue becomes extreme or that its lightness becomes low. Therefore, it is desirable that the L* value, which represents lightness, of the transparent hard coat film in the CIE 1976 L*a*b* color space system is 90.0 or higher, preferably 92.0 or higher. Further, it is desirable that the a* value, which represents green or red hue and its chromaticness, is −3.0 or higher, preferably −2.0 or higher, and 1.5 or lower, preferably 1.0 or lower. Further, it is desirable that the b* value, which represents yellow or blue hue and its chromaticness, is 0.5 or lower, preferably 0 or lower, and −4.0 or higher, preferably −3.0 or higher.

[0025] In this embodiment, as means for making the b* value of the transparent hard coat film **11** in the CIE 1976 L*a*b* color space system 0.5 or lower, preferably 0 or lower, addition of a colorant to the transparent polymer film **31** or the transparent hard coat layer **32** can be employed.

[0026] As the colorant, colored inorganic pigments, organic pigments, dyestuff and the like can be used. In a viewpoint of superior weather resistance, preferably used are colored inorganic pigments such as cadmium red, red iron oxide, molybdenum red, chrome vermilion, chromium oxide, viridian, titanium cobalt green, cobalt green, cobalt chrome green, Victoria green, ultramarine, ultramarine blue, Prussian blue, Berlin blue, Milori blue, cobalt blue, Cerulean blue, cobalt silica blue, cobalt zinc blue, manganese violet, mineral violet, and cobalt violet and organic pigments such as phthalocyanine pigments.

[0027] Meanwhile, any material which does not impair transparency can be used as the transparent polymer film **31**. Examples of such a material include polyethylene terephthalate, polybutylene terephthalate, polyethylene naphthalate, polycarbonates, polyethylenes, polypropylenes, polystyrenes, polyalylates, cycloolefins, triacetyl cellulose, acrylic, and polyvinyl chloride. Among them, a polyethylene terephthalate film subjected to orienting, in particular, biaxial orienting is preferred in view of superiority in mechanical strength and dimensional stability. It is also preferred to use the film having a surface subjected to corona discharge treatment or provided with an easy adhesion layer to improve adhesion to the transparent hard coat layer **32**. The thickness of such a transparent polymer film **31** is suitably selected depending on the applied material, but is generally 25-500 μm, preferably 50-200 μm.

[0028] The transparent hard coat layer **32** is not particularly limited so long as it has hard coat property represented by surface hardness etc., but it is preferably formed with an ionizing radiation curable resin to impart superior hard coat property to the transparent polymer film **31** surface having low heat resistance.

[0029] Here, as the ionizing radiation curable resins, those cured by irradiating an ionizing radiation curable paint containing one or more types of photopolymerizable prepolymers, photopolymerizable monomers or the like with ionizing radiation (ultraviolet ray or electron beams) can be used.

[0030] Here, as the photopolymerizable prepolymer, acrylic prepolymers, which have two or more acryloyl groups in one molecule and gain a three dimensional network structure by curing with crosslinking, are particularly preferably used. As the acrylic prepolymers, urethane acrylate, polyester acrylate, epoxy acrylate, melamine acrylate and the like can be used.

[0031] Examples of the photopolymerizable monomers include dipentaerythritol hexa(meth)acrylate, trimethylolpropane (meth)acrylate, pentaerythritol tri(meth)acrylate, ethylene glucol di(meth)acrylate, triethylene glycol divinyl ether, tetraethylene glycol (meth)acrylate, tripropylene glycol (meth)acrylate, 1,4-butane diol di(meth)acrylate, 1,6-hexane diol di(meth)acrylate, neopentyl glycol di(meth)acrylate, trimethylolpropane trioxyethyl (meth)acrylate, tris(2-hydroxyethyl)isocyanurate tri(meth)acrylate.

[0032] A photopolymerization initiator, ultraviolet ray sensitizer or the like can be suitably mixed in the ionizing radiation curable paint as required. Here, as the photopolymerization initiator can be used acetophenone, benzophenone, Michler's ketone, benzoin, benzyl methyl ketal, benzoin benzoate, hydroxy cyclohexylphenyl ketone, 2-methyl-1-(4-(methylthio)phenyl)-2-(4-morphonyl)-1-propane, α-acyloxime ester, thioxanthone and the like. As the ultraviolet ray sensitizer, n-butylamine, triethylamine, tri-n-butylphosphine and the like can be used.

[0033] In addition, thermoplastic resins, thermosetting resins, matting agents or the like can be added to the transparent hard coat layers **32** formed with such ionizing radiation curable resins so long as hard coat property and transmittance transparent resolution are not deteriorated.

[0034] Examples of the thermoplastic resins include cellulose derivatives such as acetyl cellulose, nitrocellulose, acetyl butyl cellulose, ethyl cellulose, and methyl cellulose, vinyl resins such as vinyl acetate and copolymers thereof, vinyl chloride and copolymers thereof, and vinylidene chloride and copolymers thereof, acetal resins such as polyvinyl formal and polyvinyl butyral, acrylic resins such as acrylic resins and copolymers thereof and methacrylic resins and copolymers thereof, polystyrene resins, polyamide resins, linear polyester resins, polycarbonate resins.

[0035] Examples of the thermosetting resins include thermosetting urethane resins composed of acrylic polyol and isocyanate prepolymer, phenol resins, urea melamine resins, epoxy resins, unsaturated polyester resins, and silicone resins.

[0036] Further, as the matting agents, there can be mentioned extender pigments such as calcium carbonate, magnesium carbonate, barium sulfate, silica, aluminium hydroxide, kaolin, clay, and talc, and synthetic resin particles such as acrylic resin particles, polystyrene resin particles, polyurethane resin particles, polyethylene resin particles, benzoguanamine resin particles, and epoxy resin particles.

[0037] Regarding the thickness of the transparent hard coat layer **32**, it is 2 μm or more, preferably 3 μm or more, and 15 μm or less, preferably 8 μm or less. With the thickness of 2 μm or more, sufficient hard coat property is easily obtained. With the thickness of 15 μm or less, the transparent hard coat film **11** provided with the transparent hard coat layer **32** only on one surface of the transparent polymer film **31** is kept from curling.

[0038] As the ionizing radiation irradiated on the ionizing radiation curable paint, ultraviolet ray emitted from an extra-high pressure mercury lamp, high pressure mercury lamp, low pressure mercury lamp, carbon arc, metal halide lamp or the like in a wavelength region of 100-400 nm, preferably 200-400 nm, or electron beams emitted from a scanning-type or curtain-type electron beam accelerator in a wavelength region of 100 nm or shorter can be used.

[0039] Next, the transparent conductive hard coat film will be explained. The transparent conductive hard coat film of the present invention is obtained by providing a transparent conductive thin layer **33** at least on one surface of the transparent hard coat film **11** of the present invention, as shown in **FIG. 3** and **FIG. 4**. Thus, the transparent hard coat film **11** of the present invention becomes a transparent conductive hard coat film having conductivity.

[0040] Here, for the transparent conductive thin layer **33** provided at least on one surface of the transparent hard coat film **11**, a generally known transparent conductive material can be used. For example, transparent conductive substances such as indium oxide, tin oxide, indium tin oxide, gold, silver, and palladium can be used. These can be formed into a thin layer on a transparent hard coat film **11** by the vacuum deposition method, sputtering method, ion plating method, solution coating method, or the like. Further, an organic conductive material can be also used for forming the transparent conductive thin layer **33**. In particular, transparent conductive materials containing any of indium oxide, tin oxide, and indium tin oxide as the main component, which are superior in transparency and conductivity and can be obtained at a relatively low cost, can be suitably used. Although such a transparent conductive thin layer **33** containing indium oxide, tin oxide, or indium tin oxide as the main component shows a light yellowish color, the yellowish color of the transparent conductive thin layer can be made less noticeable because the transparent hard coat film **11** of the present invention has the b* value in the CIE 1976 L*a*b* color space system of 0.5 or lower.

[0041] Although it depends on the applied material, it is desirable that the thickness of the transparent conductive thin layer shows a surface resistivity of 1000 Ω or lower, preferably 500 Ω or lower, and is in the range of 10 nm or more, preferably 20 nm or more, and 80 nm or less, preferably 70 nm or less in consideration of economical efficiency. In such a thin layer, an interference fringe of visible light attributable to ununiform thickness of the transparent conductive thin layer **33** is hardly generated.

[0042] As shown in **FIG. 1, a** resistance-film type touch panel **10** can be constructed by forming a transparent conductive thin layer **33** on the transparent hard coat film **11** of the present invention and placing a glass substrate **13** on which a transparent conductive thin layer **12** is formed so that the transparent conductive thin layers should be opposed to each other with a certain gap. At the ends of the transparent hard coat film **11** and the glass substrate **13**, there are provided with electrodes, which are not shown in **FIG. 1**. When a user presses the transparent hard coat film **13** having the transparent conductive thin layer **33** with user's finger or a pen, the transparent conductive thin layer **33** comes into contact with the transparent conductive thin layer **12**. The touch panel **10** is constructed so as to detect this contact electrically through the electrodes at the end, and thus detect the position being pressed. The dotted spacers **14** may be provided on the transparent conductive thin layer **12** of the glass substrate **13** as required. Further, as shown in **FIG. 2, a** liquid crystal display device with a touch panel can be constructed by mounting the touch panel **10** shown in **FIG. 1** on a color liquid crystal panel **20**. In the touch panel **10** of this embodiment, an interference fringe attributable to ununiform thickness of the transparent hard coat layer **32** can be suppressed as described above. In addition, an interference fringe (the Newton ring) caused by change of the gap (distance) between the surface of the glass substrate **13** with a transparent conductive thin layer **13** and the opposed surface of the transparent conductive hard coat film **11** when the touch panel **10** is pressed can be suppressed. Further, since the transparent hard coat film **11** of the present invention has high hard coat property and high transmitted resolution, the touch panel **10** can be imparted with high durability, and display of the liquid crystal panel clear can be seen clearly.

[0043] As a material for a transparent conductive thin layer formed on a transparent hard coat film, generally used is indium tin oxide (ITO), whose thin film has a tendency to show a light yellow color. By this tendency of ITO, an interference fringe attributable to ununiform thickness of the transparent hard coat layer is emphasized. However, the emphasized interference fringe can be suppressed by the transparent conductive hard coat film of the present invention by the reasons considered as follows.

[0044] The ITO thin layer generally shows a light yellow color when observed both with transmitted light and reflected light. Showing a light yellow color means that the ITO thin layer absorbs blue, and transmits or reflects light with wavelengths of green and red. Therefore, when the transparent hard coat film **11** is completely transparent and the transparent hard coat layer **32** has ununiform thickness, light with wavelengths of green and red transmitted through or reflected at the ITO thin layer is interfered at the transparent hard coat layer, and an interference fringe is generated. The generated interference fringe is not strong if the intensity distribution of the transmitted green and red light is over a wide range of wavelengths. However, since the intensity distribution of the light emitted from the color liquid crystal panel or three band fluorescent lamps has a sharp peak at particular wavelengths of green and red, each light having these particular wavelengths interferes at the transparent hard coat layer **32** with light reflected by the ITO thin layer or transmitted through the ITO thin layer, and thus a strong interference fringe is observed. When the transparent hard coat film **11** of the present invention is used, however, since it is designed so that the b* value of the color in the CIE 1976 L*a*b* color space system should be 0.5 or lower, that is, yellow chromaticness should be low and a blue color should be shown, blue light is transmitted or reflected but light having at wavelengths of green and red is absorbed. Therefore, light with particular wavelengths of green and red transmitted through or reflected by the ITO film is absorbed by the transparent hard coat film **11** and thereby a phenomenon that each light with these wavelengths of green and red strongly interferes at the transparent hard coat layer **32** can be suppressed.

[0045] In other words, the transparent hard coat film **11** of the present invention is constructed so as to have a hue that is a color complementary to the hue of a film formed thereon (here, the transparent conductive film **32**). Consequently, since a gray tone is generated as a whole, a phenomenon that light with particular wavelengths has strong interference can be prevented.

[0046] The transparent hard coat film **11** itself has an effect to suppress an interference fringe attributable to ununiform thickness of the transparent hard coat layer **32**, even if the transparent conductive thin layer **33** is not formed thereon. Therefore, the transparent hard coat film **11** is not restricted to be used in the substrate film of the transparent conductive thin layer **33**.

[0047] As described above, according to the present invention, there can be provided a transparent hard coat film **11** in which an interference fringe attributable to ununiform thickness of the transparent hard coat layer **32** is made less noticeable by regulating the hue and chromaticness so that the b* value of the transparent hard coat film **11** in the CIE 1976 L*a*b* color space system should be 0.5 or lower even when the transparent hard coat layer **32** has some ununiform thickness. Consequently, the interference fringe can be suppressed without controlling the refraction index of the transparent hard coat layer **32** or adding a large amount of a matting agent to the transparent hard coat layer **32**.

[0048] Further, according to the present invention, the Newton ring generated when the transparent conductive hard coat films adhere to each other or the transparent conductive hard coat film adheres to the glass surface with a transparent conductive thin layer can be made less noticeable. Further, according to the present invention, there can be provided a transparent conductive thin layer in which a yellowish color is not noticeable.

EXAMPLES

[0049] Examples of the present invention will be explained hereinafter. In the following examples, "part" and "%" are used on a weight basis unless otherwise indicated.

Examples 1-7

[0050] As Examples 1-7, a one-side-type transparent hard coat film **11** having a transparent hard coat layer **32** on the one side of a transparent polymer film **31**, and a transparent conductive hard coat film having a transparent conductive thin layer **33** on the one-side-type transparent hard coat film **11** was produced respectively as shown in **FIG. 3**. The kind and quantity of pigments used for the transparent hard coat layer **32** were changed in Examples 1-7.

[0051] At first, as a transparent polymer film **31**, polyethylene terephthalate films (COSMOSHINE A4300: Toyobo

Co., Ltd.) having a thickness shown in Table 1 were prepared. Next, coating solutions (a) for transparent hard coat layer **32** having the following composition, each of which contains pigments shown in Table 1 as the colored inorganic pigment in an amount shown in Table 1, was prepared for Examples 1-7. Each of coating solutions (a) was applied to one surface of the transparent polymer film **31**, dried, and was irradiated with ultraviolet ray from a high pressure mercury lamp for 1-2 seconds to form a transparent hard coat layer **32** having a thickness of about 5 μm. Thus, transparent hard coat films **11** of Examples 1-7 having the transparent hard coat layer **32** on one side of the transparent polymer film **31** were produced.

[0052] Subsequently, a transparent conductive thin layer **33** made of indium tin oxide (ITO) having a surface resistivity of about 400 Ω was provided by the sputtering method on one surface, which is opposite of the surface provided with the transparent hard coat layer **32** thereon, of the transparent polymer film **31** of the transparent hard coat film **11** in each Examples 1-7. Thus, transparent conductive hard coat films, as shown in **FIG. 3**, were produced.

[0053] <Coating solution (a) for transparent hard coat layer>

[0054] Ionizing irradiation curable resin

[0055] (DIABEAM UR6530: Mitsubishi Rayon Co., Ltd.) 60 Parts

[0056] Colored inorganic pigment

[0057] (product's name and content are shown in Table 1)

[0058] Photopolymerization initiator

[0059] (IRGACURE 651: Ciba Specialty Chemicals K.K.) 1.8

Parts	
Methyl ethyl ketone	80 Parts
Toluene	60 Parts

Examples 8 and 9

[0060] As Examples 8 and 9, a both-sides-type transparent hard coat film **11** having transparent hard coat layer **32** on the both side of a transparent polymer film **31**, and a transparent conductive hard coat film having a transparent conductive thin layer **33** on a both-side-type transparent hard coat film **11** were produced as shown in **FIG. 4**. The kind and content of a pigment used for the transparent hard coat layer **32** are changed in Examples 8 and 9.

[0061] At first, as a transparent polymer film **31**, polyethylene terephthalate films (COSMOSHINE A4300: Toyobo Co., Ltd.) having a thickness shown in Table 1 were prepared. Next, coating solution (b) for transparent hard coat layer **32** having the following composition, which contains a pigment shown in Table 1 as the colored inorganic pigment in an amount shown in Table 1, was prepared for Examples 8 and 9. Each of the coating solutions (b) was applied to both surfaces of the transparent polymer film **31**, dried, and was irradiated with ultraviolet ray from a high pressure mercury lamp for 1-2 seconds to form a transparent hard coat layer **32** having a thickness of about 5 μm. Thus, transparent hard coat films **11** of Examples 8 and 9 having the transparent hard coat layer **32** on both sides of the transparent polymer film **31** were produced.

[0062] Subsequently, a transparent conductive thin layer **33** made of indium tin oxide (ITO) having a surface resistivity of about 400 Ω was provided by the sputtering method on the surface of one of the transparent hard coat layers **32** of the transparent hard coat film **11** in each Examples 8 and 9. Thus, transparent conductive hard coat films, as shown in **FIG. 4**, were produced.

[0063] <Coating solution (b) for transparent hard coat layer>

[0064] Ionizing irradiation curable resin

[0065] (DIABEAM UR6530: Mitsubishi Rayon Co., Ltd.) 58 Parts

[0066] Colored inorganic pigment

[0067] (product's name and content are shown in Table 1)

[0068] Photopolymerization initiator

[0069] (IRGACURE 651: Ciba Specialty Chemicals K.K.) 1.8

Parts	
Thermoplastic acetal resin (S-LEC BL-S: Sekisui Chemical Co., Ltd.)	2 Parts
Porous silica particles (Sylysia 446, mean particle diameter 4.5 μm, Fuji Silysia Chemical Ltd.)	1 Part
Fine powder silica particles (Aerosil 30, mean particle diameter 50 nm, Nippon Aerosil Co., Ltd.)	1 Part
Methyl ethyl ketone	80 Parts
Toluene	60 Parts

Comparative Examples 1-6

[0070] As Comparative Examples 1-6, transparent hard coat films and transparent conductive hard coat films were produced in the same manner as those in Examples 1-7 except that a colored inorganic pigment of coating solutions (a) was changed as shown in Table 1. In Comparative Examples 1 and 6, coating solutions that contained no colored inorganic pigment were used.

Comparative Examples 7 and 8

[0071] As Comparative Example 7, a transparent hard coat film and a transparent conductive hard coat film were produced in the same manner as those in Examples 8 and 9 except that was a colored inorganic pigment was removed from coating solution (b) used in Examples 8, 9.

[0072] As Comparative Example 8, a transparent hard coat film and a transparent conductive hard coat film were produced in the same manner as those in Examples 8 and 9 except that a colored inorganic pigment of coating solutions (b) used in Examples 8 and 9 was changed as shown in Table 1.

TABLE 1

	thickness of polyethylene terephthalate films (μm)	Colored inorganic pigment Product's name: Manufacturer	Parts
(One-Side-Type)			
Example 1	188 μm	UltramarineNo2000: Daiichi Kasei	0.4
Example 2	188 μm	FPGS-3RBlue: Dainichiseika	0.04
Example 3	125 μm	FINALVIOLET D6060: BASF Ltd.	0.008
Example 4	125 μm	FINALVIOLET D6060: BASF Ltd.	0.012
Example 5	188 μm	UltramarinePR-75: Daiichi Kasei	0.04
Example 6	188 μm	UltramarineNo2000: Daiichi Kasei	0.8
Example 7	188 μm	Heliogen Blue D6700T: BASF Ltd.	0.04
Com. Ex. 1	188 μm	NOT USED	NOT USED
Com. Ex. 2	188 μm	UltramarineZ3-254: Dainichiseika	0.04
Com. Ex. 3	188 μm	UTCO-051Blue: Dainichiseika	0.04
Com. Ex. 4	188 μm	UltramarineNo2000: Daiichi Kasei	0.2
Com. Ex. 5	188 μm	Mirori Blue 671: Dainichiseika	0.04
Com. Ex. 6	125 μm	NOT USED	NOT USED
(Both-Side-Type)			
Example 8	188 μm	UltramarineNo2000: Daiichi Kasei	0.75
Example 9	188 μm	UltramarineNo2000: Daiichi Kasei	1.1
Com. Ex. 7	188 μm	NOT USED	NOT USED
Com. Ex. 8	188 μm	UltramarineNo2000: Daiichi Kasei	0.35

Explanatory notes in Table 1
Com. Ex.: Comparative Examaple
Daiichi Kasei: Daiichi Kasei CO., LTD
Dainichiseika: Dainichiseika Color & Chemicals Mfg. Co., LTD

Evaluation

[0073] The L* values, a* values, and b* values in the CIE 1976 L*a*b* color space system of the transparent hard coat films **11** (on which no transparent conductive thin layer **33** was provided) thus obtained in Examples 1-9 and Comparative Examples 1-8 were measured by transmittance method using an SM Color Computer SM-4 (Suga Test Instruments Co., Ltd.). The results are shown in Table 2. Further, illumination light from a three band fluorescent lamp was irradiated onto the transparent hard coat films **11** (on which the transparent conductive thin layer **33** was not provided) and "interference fringes", which occurred in reflected light, attributable to ununiform thickness of the transparent hard coat layers **32** were visually observed in a position where the reflected image of the three band fluorescent lamp could be observed. The evaluation results are shown in Table 2. In the table "o" indicates that interference fringe was unnoticeable, and "x" indicates that interference fringe was noticeable.

[0074] Further, two identical films for each of the transparent conductive hard coat films (on which the transparent conductive thin layer **33** was provided) obtained in Examples 1-9 and Comparative Examples 1-8 were prepared. These films were laminated so that respective surfaces on which the transparent conductive thin layer **33** was provided were opposed to each other, and allowed to adhere to each other. In this situation, "the Newton rings" generated due to interference by reflected light in the respective film surfaces were visually observed. The evaluation results are shown in Table 2. In the table, "o" indicates that the Newton ring was unnoticeable, and "x" indicates that the Newton ring was noticeable.

TABLE 2

	L* value, a* value, and b* value in CIE 1976 L*a*b* color space system			Occurrence of interference	Occurrence of Newton
	L* value	a* value	B* value	fringe	ring
one-side-type					
Example 1	95.09	−0.51	0.43	○	○
Example 2	95.28	−0.83	0.41	○	○
Example 3	96.26	−0.04	−0.08	○	○
Example 4	96.33	−0.07	−0.15	○	○
Example 5	94.13	−3.06	−0.19	○	○
Example 6	94.45	−0.86	−0.26	○	○
Example 7	94.45	−1.27	−0.88	○	○
Com. Ex. 1	95.49	−1.46	1.33	X	X
Com. Ex. 2	95.89	−0.18	1.01	X	X
Com. Ex. 3	95.90	−0.20	1.00	X	X
Com. Ex. 4	95.53	−0.33	0.79	X	X
Com. Ex. 5	95.66	−0.55	0.67	X	X
Com. Ex. 6	96.59	−0.10	0.51	X	X
both-side-type					
Example 8	93.29	−0.82	0.49	○	○
Example 9	92.69	−1.12	−0.05	○	○
Com. Ex. 7	94.42	−0.03	1.90	X	X
Com. Ex. 8	93.86	−0.42	1.21	X	X

Explanatory notes in Table 2
Com. Ex.: Comparative Examaple

[0075] As will be understood from the results in Table 2, since the b* values of the transparent hard coat films **11** (no transparent conductive thin layer **33**) obtained in Examples 1-9 were 0.5 or lower in the CIE 1976 L*a*b* color space system as a transparent hard coat film **11**, the interference fringes attributable to ununiform thickness of the transparent hard coat layer **32** were hardly noticeable. Further, since the refraction index of the transparent hard coat layers **32** was not controlled to make interference fringes attributable to ununiform thickness less noticeable in the transparent hard coat layers **32** in the transparent hard coat films **11** obtained in Examples 1-9, their hard coat property was not deteriorated and their durability was sufficient. Further, since a large amount of a matting agent was not added to the transparent hard coat layers **32** in the transparent hard coat films **11** obtained in Examples 1-9 to make the interference fringes attributable to ununiform thickness less noticeable, their transmitted resolution was not deteriorated.

[0076] Further, when the transparent conductive hard coat films obtained in Examples 1-9 were laminated so that surfaces of the transparent conductive thin layer **33** should adhere to each other, the Newton rings were hardly noticeable, because the transparent conductive hard coat films used transparent hard coat films **11** of which b* value was 0.5 or lower in the CIE 1976 L*a*b* color space system as a substrate film. Further, since the transparent conductive hard coat films used transparent hard coat films **11** of which b* value was 0.5 or lower in the CIE 1976 L*a*b* color space system as a substrate film, the yellowish color of the transparent conductive thin layers **33** was not very noticeable.

[0077] On the other hand, since the b* values of the transparent conductive hard coat films obtained in Comparative Examples 1-8 exceeded 0.5 in the CIE 1976 L*a*b* color space system as a transparent hard coat film, interference fringes attributable to ununiform thickness of the transparent hard coat layers easily became to be noticeable.

[0078] Further, when the transparent conductive hard coat films obtained in Comparative Examples 1-8 are laminated so that surfaces of the transparent conductive thin layer should adhere to each other, the Newton rings easily became to be noticeable, because the transparent conductive hard coat films used transparent hard coat films of which b* values exceeded 0.5 in the CIE 1976 L*a*b* color space system as a substrate film. Further, the transparent conductive hard coat films obtained in Comparative Examples 1-8 used transparent hard coat films of which b* values exceeded 0.5 in the CIE 1976 L*a*b* color space system as a substrate film, the yellowish color of the transparent conductive thin layers was noticeable.

1. A transparent hard coat film comprising a transparent polymer film and a transparent hard coat layer provided at least on one surface of said transparent polymer film,

wherein a b* value in CIE 1976 L*a*b* color space system is 0.5 or lower.

2. The transparent hard coat film according to claim 1, wherein said b* value is −4.0 or higher, an L* value is 90.0 or higher, and an a* value is −3.0 or higher and 1.5 or lower in CIE 1976 L*a*b* color space system.

3. A transparent conductive hard coat film comprising said transparent hard coat film according to claim 1 and a transparent conductive thin layer provided at least on one surface of said transparent hard coat film.

4. A transparent hard coat film for being mounted a transparent conductive thin layer thereon, comprising a transparent polymer film and a transparent hard coat layer provided at least on one surface of said transparent polymer film,

wherein a b* value of said transparent hard coat film is 0.5 or lower in the CIE 1976 L*a*b* color space system.

5. A transparent hard coat film for being mounted a transparent conductive thin layer thereon, comprising a transparent polymer film and a transparent hard coat layer provided at least on one surface of said transparent polymer film,

wherein a hue of said transparent hard coat film is a color complementary to a hue of said transparent conductive thin layer formed thereon.

6. The transparent hard coat film according to claim 5, wherein at least one of the transparent polymer film and the transparent hard coat layer contains a colorant having a hue of said complementary color.

7. The transparent hard coat film according to claim 5, wherein a b* value is −4.0 or higher and 0.5 or lower, an L* value is 90.0 or higher, and an a* value is −3.0 or higher and 1.5 or lower in the CIE 1976 L*a*b* color space system.

8. A touch panel comprising a transparent hard coat film and a transparent substrate disposed as opposed each other with a gap, and transparent conductive thin layers formed on the respective opposed surfaces of said transparent hard coat film and said transparent substrate,

wherein said transparent hard coat film comprises a transparent polymer film and a transparent hard coat layer provided at least on one surface of the transparent polymer film, and

a b* value of said transparent hard coat film is 0.5 or lower in the CIE 1976 L*a*b* color space system.

9. The touch panel according to claim 8, wherein said transparent hard coat film has a b* value of −4.0 or higher, an L* value of 90.0 or higher, and an a* value of −3.0 or higher and 1.5 or lower in the CIE 1976 L*a*b* color space system.

10. A liquid crystal display device comprising a color liquid crystal panel and a touch panel disposed thereon,

wherein said touch panel comprises a transparent hard coat film and a transparent substrate disposed as opposed to each other with a gap, and transparent conductive thin layers formed on the respective opposed surfaces of said transparent hard coat film and said transparent substrate,

said transparent hard coat film comprises a transparent polymer film and a transparent hard coat layer provided at least on one surface of said transparent polymer film, and

a b* value of said transparent hard coat film is 0.5 or lower in the CIE 1976 L*a*b* color space system.

11. The liquid crystal display device according to claim 10, wherein said transparent hard coat film has a b* value of −4.0 or higher, an L* value of 90.0 or higher, and an a* value of −3.0 or higher and 1.5 or lower in the CIE 1976 L*a*b* color space system.

12. A touch panel comprising a transparent hard coat film and a transparent substrate disposed as opposed to each other with a gap, and transparent conductive thin layers formed on the respective opposed surfaces of said transparent hard coat film and said transparent substrate,

wherein said transparent hard coat film comprises a transparent polymer film and a transparent hard coat layer provided at least on one surface of the transparent polymer film, and

a hue of said transparent hard coat film is a color complementary to a hue of said transparent conductive thin layer formed thereon.

13. The touch panel according to claim 12, wherein said transparent hard coat film has a b* value of −4.0 or higher and 0.5 or lower, an L* value is 90.0 or higher, and an a* value is −3.0 or higher and 1.5 or lower in the CIE 1976 L*a*b* color space system.

14. A liquid crystal display device comprising a color liquid crystal panel and a touch panel disposed thereon,

wherein said touch panel comprises a transparent hard coat film and a transparent substrate disposed as opposed to each other with a gap, and transparent conductive thin layers formed on the respective opposed surfaces of said transparent hard coat film and said transparent substrate,

said transparent hard coat film comprises a transparent polymer film and a transparent hard coat layer provided at least on one surface of said transparent polymer film, and a hue of said transparent hard coat film is a color complementary to a hue of said transparent conductive thin layer formed thereon.

15. The liquid crystal display device according to claim 14, wherein said transparent hard coat film has a b* value of −4.0 or higher and 0.5 or lower, an L* value of 90.0 or higher, and an a* value of −3.0 or higher and 1.5 or lower in the CIE 1976 L*a*b* color space system.

* * * * *

专利名称(译)	透明硬涂膜，透明导电硬涂膜，使用该膜的触摸面板，以及使用该触摸面板的液晶显示装置		
公开(公告)号	US20030174257A1	公开(公告)日	2003-09-18
申请号	US10/385641	申请日	2003-03-12
[标]申请(专利权)人(译)	木本股份有限公司		
申请(专利权)人(译)	KIMOTO CO. , LTD.		
当前申请(专利权)人(译)	KIMOTO CO. , LTD.		
[标]发明人	HARADA MASAHIRO SAITOU MASATO KOYAMA MASUO KIMURA YOSHIHISA		
发明人	HARADA, MASAHIRO SAITOU, MASATO KOYAMA, MASUO KIMURA, YOSHIHISA		
IPC分类号	G02F1/1343 B32B27/00 G02B1/10 G02B1/14 G06F3/033 G06F3/041 G06F3/048 H01B5/14 H01B17/56 G02F1/1335		
CPC分类号	G06F3/0488 G06F3/0412		
优先权	2002071640 2002-03-15 JP		
其他公开文献	US7554615		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种透明硬涂膜，其具有优异的硬涂性和透射分辨率，其中由透明硬涂层的厚度不均匀引起的干涉条纹不明显。本发明的透明硬涂膜具有至少在透明聚合物膜的一个表面上形成的透明硬涂层，其中透明硬涂膜在L * a * b *颜色空间系统中的b *值为0.5或更小。作为本发明人进行的勤奋研究的结果，发现通过使膜的b *值为L * a * b *颜色，可以使由透明硬涂层的不均匀厚度引起的干涉条纹变得不明显。太空系统小。