

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
7 August 2008 (07.08.2008)

PCT

(10) International Publication Number
WO 2008/094006 A1

(51) International Patent Classification:
G02F 1/13357 (2006.01)

(74) Agent: **LEE, Jong-Il**; Daeil Int'l Patent & Law Firm,
BYC Bldg., 904, 648-1, Yeoksam-dong, Gangnam-gu,
Seoul 135-080 (KR).

(21) International Application Number:
PCT/KR2008/000604

(22) International Filing Date: 31 January 2008 (31.01.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2007-0010774 1 February 2007 (01.02.2007) KR

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(71) Applicants (for all designated States except US):
ON-NURI ELECTRONICS INC., LTD. [KR/KR];
B-601, Hakye-Technotown, 250-3, Hakye-Dong,
Nowon-Gu, Seoul 139-230 (KR). **CHOI, Soo** [KR/KR];
1-1408, Samik APT, Dogok-Dong, Kangnam-Gu, Seoul
135-270 (KR).

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant and

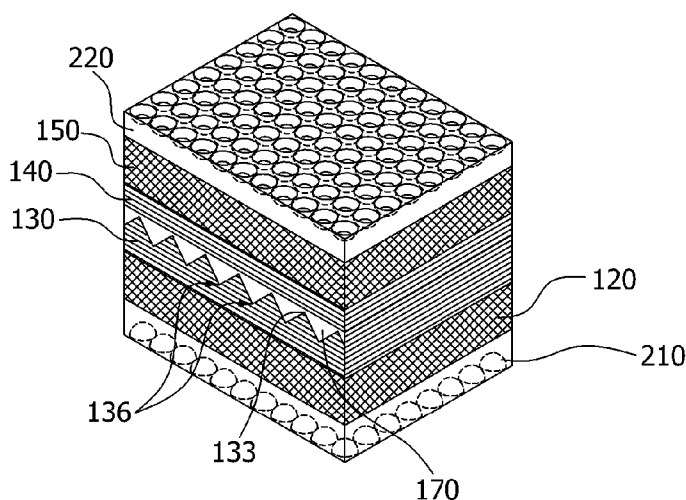
(72) Inventor: **SUNG, Gi Suk** [KR/KR]; 105-703, Jangan
Gunyoung APT, Bundang-Dong, Bundang-Gu, Seong-
nam-Si, Gyeonggi-do 463-030 (KR).

Published:

— with international search report

(54) Title: DIFFUSER-INTEGRATED PRISM SHEET FOR BACKLIGHT UNITS AND METHOD OF MANUFACTURING THE SAME

[Fig. 4]



(57) Abstract: Disclosed is a diffuser-integrated prism sheet, in which diffuser layers are provided on the upper and lower surfaces of the prism sheet and prism-shaped protrusions are formed in the prism sheet. The prism sheet for backlight units includes a lower diffuser layer having a light diffusion structure, a lower layer formed on the lower diffuser layer, a first intermediate layer formed on the lower layer and having prism-shaped protrusions formed parallel to each other, a second intermediate layer formed on the first intermediate layer, an upper layer formed on the second intermediate layer, and an upper diffuser layer formed on the upper layer and having a light diffusion structure, wherein an air layer is formed between the lower surface of the second intermediate layer and the valleys of the prism-shaped protrusions of the first intermediate layer. Also, a method of

manufacturing the diffuser-integrated prism sheet is provided.

WO 2008/094006 A1

Description

DIFFUSER-INTEGRATED PRISM SHEET FOR BACKLIGHT UNITS AND METHOD OF MANUFACTURING THE SAME

Technical Field

- [1] The present invention relates to a diffuser-integrated prism sheet for backlight units and a method of manufacturing the same. More particularly, the present invention relates to a prism sheet for backlight units, in which diffuser layers are provided on upper and lower surfaces of the prism sheet and prism-shaped protrusions are formed in the prism sheet, and to a method of manufacturing the same.

Background Art

- [2] FIG. 1 illustrates the construction of a conventional backlight unit.
- [3] As illustrated in FIG. 1, in the conventional backlight unit, a fluorescent lamp 1, which is a linear light source, and a lamp reflector plate 2 for reflecting the light of the fluorescent lamp 1 are disposed to one side of a light guide plate 3 for using the light from the fluorescent lamp 1 as a surface light source, and a reflector sheet 4 for preventing the leakage of light is disposed under the light guide plate 3. Further, a diffuser sheet 5 for uniformly diffusing light is placed on the light guide plate 3, and prism sheets 6, 7 respectively having a plurality of triangular linear prisms 8, 9 to collect scattered light are sequentially placed on the diffuser sheet 5. Two prism sheets 6, 7 are disposed so that linear prisms 8, 9 are perpendicular to each other, thus collecting light radiated in different directions. On the upper prism sheet 9, a protector sheet 10 for protecting the prisms from being scratched and preventing the entry of impurities between the prisms is disposed. The individual constituents are assembled, thereby completing a backlight unit.
- [4] However, because the conventional prism sheet has the prism-shaped protrusions on one surface thereof, defects caused by scratching of the prism-shaped protrusions and by the entry of small impurities into the valleys between the prism-shaped protrusions and shatter cracks caused by cutting of the prism-shaped protrusions, attributable to friction with the protective sheet, may be generated when the backlight unit is assembled. Hence, even if the backlight unit is carefully assembled, many assembly defects may occur, undesirably decreasing productivity, and furthermore, in the case where defects occur, the manufacturing process must be conducted again, resulting in high material cost loss.
- [5] Further, problems occur because the diffuser sheet, the prism sheet, and the protector

sheet must be sequentially and separately layered in the assembly process.

Disclosure of Invention

Technical Problem

- [6] Accordingly, the present invention has been made keeping in mind the above problems occurring in the related art, and provides a diffuser-integrated prism sheet, in which various optical sheets are integrately layered, and thus diffuser layers are formed on the outer surfaces of the prism sheet, and prism-shaped protrusions are formed in the prism sheet, in order to prevent the prism-shaped protrusions from being scratched, prevent the entry of impurities into the valleys between the prism-shaped protrusions in the course of assembling a backlight unit, and realize a short assembly time and a simple assembly process, resulting in decreased costs, and also provides a method of manufacturing the same.

Technical Solution

- [7] According to the present invention, a diffuser-integrated prism sheet for backlight units may comprise a lower diffuser layer having a light diffusion structure, a lower layer formed on the upper surface of the lower diffuser layer, a first intermediate layer formed on the upper surface of the lower layer and having a plurality of prism-shaped protrusions formed parallel to each other, a second intermediate layer formed on the upper surface of the first intermediate layer, an upper layer formed on the upper surface of the second intermediate layer, and an upper diffuser layer formed on the upper surface of the upper layer and having a light diffusion structure, wherein an air layer is formed between the lower surface of the second intermediate layer and the valleys of the prism-shaped protrusions of the first intermediate layer.

Brief Description of the Drawings

- [8] FIG. 1 is an exploded perspective view illustrating a conventional backlight unit;
- [9] FIG. 2 is a perspective view illustrating a diffuser-integrated prism sheet according to a first embodiment of the present invention;
- [10] FIG. 3 is a bottom perspective view illustrating the diffuser-integrated prism sheet of FIG. 2, in which the size and density of the protrusions of the lower diffuser layer are suppressed;
- [11] FIG. 4 is a perspective view illustrating a diffuser-integrated prism sheet according to a second embodiment of the present invention;
- [12] FIG. 5 is a perspective view illustrating a diffuser-integrated prism sheet according to a third embodiment of the present invention;

- [13] FIG. 6 is a perspective view illustrating a diffuser-integrated prism sheet according to a fourth embodiment of the present invention;
- [14] FIG. 7 is a perspective view illustrating a diffuser-integrated prism sheet according to a fifth embodiment of the present invention;
- [15] FIG. 8 is a perspective view illustrating a diffuser-integrated prism sheet according to a sixth embodiment of the present invention;
- [16] FIG. 9 is a perspective view illustrating a diffuser-integrated prism sheet according to a seventh embodiment of the present invention;
- [17] FIG. 10 is a perspective view illustrating a diffuser-integrated prism sheet according to an eighth embodiment of the present invention;
- [18] FIG. 11 is a perspective view illustrating a diffuser-integrated prism sheet according to a ninth embodiment of the present invention;
- [19] FIG. 12 is a perspective view illustrating a diffuser-integrated prism sheet according to a tenth embodiment of the present invention;
- [20] FIG. 13 is a perspective view illustrating a diffuser-integrated prism sheet according to an eleventh embodiment of the present invention;
- [21] FIG. 14 is a perspective view illustrating a diffuser-integrated prism sheet according to a twelfth embodiment of the present invention;
- [22] FIG. 15 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the first embodiment of the present invention;
- [23] FIG. 16 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the second embodiment of the present invention;
- [24] FIG. 17 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the fifth embodiment of the present invention;
- [25] FIG. 18 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the ninth embodiment of the present invention; and
- [26] FIG. 19 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the eleventh embodiment of the present invention.

Mode for the Invention

- [27] Hereinafter, a detailed description will be given of the preferred embodiments of the present invention with reference to the appended drawings.
- [28] FIG. 2 is a perspective view illustrating a diffuser-integrated prism sheet according to a first embodiment of the present invention.
- [29] As illustrated in FIG. 2, the diffuser-integrated prism sheet according to the first embodiment of the present invention comprises a lower diffuser layer 110, a lower layer

- 120, a first intermediate layer 130, a second intermediate layer 140, an upper layer 150, an upper diffuser layer 160, and an air layer 170.
- [30] The lower diffuser layer 110 and the upper diffuser layer 160 have structures for uniformly diffusing light. Specifically, the lower diffuser layer 110 has a plurality of hemispherical protrusions for diffusing light on the lower surface thereof, and the upper diffuser layer 160 has a plurality of hemispherical protrusions for diffusing light on the upper surface thereof.
- [31] The height of the protrusions formed on the lower diffuser layer 110 and the upper diffuser layer 160 ranges from 1 μm to 150 μm .
- [32] As illustrated in FIG. 3, when the density of the protrusions formed on the lower diffuser layer 110 is suppressed while the height thereof is maintained to the range from 1 μm to 50 μm , spaces are defined between the protrusions, thereby realizing a non-slip function rather than a diffusion function.
- [33] The lower layer 120 and the upper layer 150 are formed of synthetic resin, such as PET (polyethyleneterephthalate)
- [34] The lower diffuser layer 110, the first intermediate layer 130, the second intermediate layer 140, and the upper diffuser layer 160 are formed of a UV light-curable acrylic resin or a heat-curable acrylic resin.
- [35] In the first intermediate layer 130, a plurality of prism-shaped protrusions, cross-sections of which have a triangular shape or a polygonal shape having five or more sides, similar to the triangular shape, is formed parallel to each other, in order to collect light in a direction perpendicular to the upper and lower surfaces of the diffuser-integrated prism sheet.
- [36] The ridges 133 of the prism-shaped protrusions of the first intermediate layer 130 are integrated with the lower surface of the second intermediate layer 140 through fusion. Further, an air layer 170 is formed between the lower surface of the second intermediate layer 140 and the valleys 136 of the prism-shaped protrusions.
- [37] The reason why the air layer 170 is formed is as follows. That is, because the refractive index of air is 1 and the refractive index of material other than air is greater than 1, in the case where the above space is filled with material other than air, the effect of collecting light in the direction perpendicular to the upper and lower surfaces of the diffuser-integrated prism sheet is decreased, as per Snell's law. Thus, the intention is to maximize the light collection effect.
- [38] Light emitted from the light guide plate is diffused, collected, and then diffused again, through the prism sheet, which is integrally layered with the diffuser sheet to

thus exhibit a diffusion function, thereby realizing desired luminance and viewing angle of a backlight unit. This case eliminates the problems with general prism sheets, in which scratches occur upon the use thereof and a process of assembling a plurality of optical sheets is complicated, ultimately improving the workability of assembly of sheets and productivity, resulting in decreased costs.

[39] FIG. 4 is a perspective view illustrating a diffuser-integrated prism sheet according to a second embodiment of the present invention.

[40] As illustrated in FIG. 4, the diffuser-integrated prism sheet according to the second embodiment of the present invention comprises a lower diffuser layer 210, a lower layer 120, a first intermediate layer 130, a second intermediate layer 140, an upper layer 150, an upper diffuser layer 220, and an air layer 170.

[41] The lower diffuser layer 210 and the upper diffuser layer 220 have structures for uniformly diffusing light. Specifically, the lower diffuser layer 210 has a plurality of hemispherical recesses for diffusing light in the lower surface thereof, and the upper diffuser layer 220 has a plurality of hemispherical recesses for diffusing light in the upper surface thereof.

[42] The depth of the recesses formed in the lower diffuser layer 210 and the upper diffuser layer 220 ranges from 1 μm to 150 μm .

[43] As in the lower diffuser layer 110 shown in FIG. 3, when the density of the recesses formed in the lower diffuser layer 210 is suppressed while the depth thereof is maintained to the range from 1 μm to 50 μm , spaces are defined between the recesses, thereby realizing a non-slip function rather than a diffusion function.

[44] The lower layer 120, the first intermediate layer 130, the second intermediate layer 140, the upper layer 150, and the air layer 170 are formed as in the diffuser-integrated prism sheet according to the first embodiment of the present invention, and a detailed description thereof is thus omitted.

[45] In addition, the diffuser-integrated prism sheet according to the present invention may be manufactured in a manner such that the lower diffuser layer 210 and the upper diffuser layer 160 are provided as illustrated in FIG. 5 (3rd embodiment), or such that the lower diffuser layer 110 and the upper diffuser layer 220 are provided as illustrated in FIG. 6 (4th embodiment).

[46] FIG. 7 is a perspective view illustrating a diffuser-integrated prism sheet according to a fifth embodiment of the present invention.

[47] As illustrated in FIG. 7, the diffuser-integrated prism sheet according to the fifth embodiment of the present invention comprises a lower diffuser layer 110, a lower layer

120, an intermediate layer 300, an upper layer 150, an upper diffuser layer 160, and an air layer 170.

- [48] A small amount of adhesive 320 is applied on the ridges 310 of the prism-shaped protrusions of the intermediate layer 300, and the ridges 310 of the prism-shaped protrusions are integrated with the lower surface of the upper layer 150 through adhesion using the adhesive. Useful adhesives include, for example, highly transparent polymers, such as silicone-urethane (SU) hybrid polymers, acrylic polymers, and polyester-based polymers. In the case where too much adhesive is used, the functionality of the prism is weakened, and stain defects may occur. Preferably, the adhesive is used in as small an amount as possible while still maintaining adhesion.
- [49] The lower diffuser layer 110, the lower layer 120, the upper layer 150, the upper diffuser layer 160, and the air layer 170 are formed as in the diffuser-integrated prism sheet according to the first embodiment of the present invention, and thus a detailed description thereof is omitted.
- [50] The diffuser-integrated prism sheet according to the fifth embodiment of the present invention may be modified in a manner such that the lower diffuser layer 110 and the upper diffuser layer 160 are replaced with the lower diffuser layer 210 and the upper diffuser layer 220, as illustrated in FIG. 8 (6th embodiment), such that the lower diffuser layer 210 and the upper diffuser layer 160 are provided as illustrated in FIG. 9 (7th embodiment), or such that the lower diffuser layer 110 and the upper diffuser layer 220 are provided as illustrated in FIG. 10 (8th embodiment).
- [51] FIG. 11 is a perspective view illustrating a diffuser-integrated prism sheet according to a ninth embodiment of the present invention.
- [52] As illustrated in FIG. 11, the diffuser-integrated prism sheet according to the ninth embodiment of the present invention comprises a PC lower layer 400, an upper layer 150, an upper diffuser layer 160, and an air layer 170.
- [53] The PC lower layer 400 is formed of PC (polycarbonate). The upper surface of the PC lower layer 400 includes a plurality of prism-shaped protrusions formed parallel to each other, cross-sections of which have a triangular shape or a polygonal shape having five or more sides, similar to the triangular shape, in order to collect light in a direction perpendicular to the upper and lower surfaces of the flat prism sheet. The lower surface thereof includes a plurality of hemispherical protrusions for diffusing light.
- [54] The height of the protrusions formed on the PC lower layer 400 ranges from 1 μm to 150 μm .

- [55] As in the lower diffuser layer 110 shown in FIG. 3, when the density of the protrusions formed on the PC lower layer 400 is suppressed while the height thereof is maintained to the range from 1 μm to 50 μm , spaces are defined between the protrusions, thereby realizing a non-slip function rather than a diffusion function.
- [56] Further, a small amount of adhesive 420 is applied on the ridges 410 of the prism-shaped protrusions of the PC lower layer 400, and the ridges of the prism-shaped protrusions are integrated with the lower surface of the upper layer 150 through adhesion using the adhesive. Useful adhesives include, for example, highly transparent polymers, such as silicone-urethane (SU) hybrid polymers, acrylic polymers, and polyester-based polymers. In the case where too much adhesive is used, the functionality of the prism is weakened, and stain defects may occur. Preferably, the adhesive is used in as small an amount as possible while still maintaining adhesion.
- [57] The upper layer 150, the upper diffuser layer 160, and the air layer 170 are formed as in the diffuser-integrated prism sheet according to the first embodiment of the present invention, and thus a detailed description thereof is omitted.
- [58] The diffuser-integrated prism sheet according to the ninth embodiment of the present invention may be modified in such a manner that the upper diffuser layer 160 is replaced with the upper diffuser layer 220, as illustrated in FIG. 12 (10th embodiment).
- [59] FIG. 13 is a perspective view illustrating a diffuser-integrated prism sheet according to an eleventh embodiment of the present invention.
- [60] As illustrated in FIG. 13, the diffuser-integrated prism sheet according to the eleventh embodiment of the present invention comprises a PC lower layer 500, an upper layer 150, an upper diffuser layer 160, and an air layer 170.
- [61] The PC lower layer 500 is formed of PC (polycarbonate). The upper surface of the PC lower layer 500 includes a plurality of prism-shaped protrusions formed parallel to each other, cross-sections of which have a triangular shape or a polygonal shape having five or more sides, similar to the triangular shape, in order to collect light in a direction perpendicular to the upper and lower surfaces of the flat prism sheet. The lower surface thereof includes a plurality of hemispherical recesses for diffusing light.
- [62] The depth of the recesses formed in the PC lower layer 500 ranges from 1 μm to 150 μm .
- [63] A small amount of adhesive 520 is applied on the ridges 510 of the prism-shaped protrusions of the PC lower layer 500, and the ridges of the prism-shaped protrusions are integrated with the lower surface of the upper layer 150 through adhesion using the adhesive. Useful adhesives include, for example, highly transparent polymers, such as

silicone-urethane (SU) hybrid polymers, acrylic polymers, and polyester-based polymers. In the case where too much adhesive is used, the functionality of the prism is weakened, and stain defects may occur. Preferably, the adhesive is used in as small an amount as possible while still maintaining adhesion.

- [64] The upper layer 150, the upper diffuser layer 160, and the air layer 170 are formed as in the diffuser-integrated prism sheet according to the first embodiment of the present invention, and a detailed description thereof is thus omitted.
- [65] The diffuser-integrated prism sheet according to the eleventh embodiment of the present invention may be modified in such a manner that the upper diffuser layer 160 is replaced with the upper diffuser layer 220, as illustrated in FIG. 14 (12th embodiment).
- [66] Turning to FIG. 15, there is a flowchart illustrating the process of manufacturing the diffuser-integrated prism sheet according to the first embodiment of the present invention.
- [67] The method of manufacturing the diffuser-integrated prism sheet according to the first embodiment comprises applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the lower surface of the lower layer 120 (S110); passing the lower layer 120 having the uncured acrylic resin applied on the lower surface thereof over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured acrylic resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical protrusions, thereby forming the lower diffuser layer 110 (S120); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the lower layer 120 (S130); passing the lower layer 120 having the uncured acrylic resin applied on the upper surface thereof over a roll having prism-shaped recesses and in contact therewith to thus form an uncured acrylic resin layer having prism-shaped protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the prism-shaped protrusions, thereby forming the first intermediate layer 130 (S140); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the upper layer 150 (S150); passing the upper layer 150 having the uncured acrylic resin applied on the upper surface thereof over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured acrylic resin layer having a plurality of

hemispherical protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical protrusions, thereby forming the upper diffuser layer 160 (S160); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the lower surface of the upper layer 150 to thus form an uncured acrylic resin layer, and then bringing the lower layer 120 into close contact with the upper layer 150 so that the ridges of the prism-shaped protrusions of the first intermediate layer 130 come into contact with the uncured acrylic resin layer of the upper layer 150, under pressure the magnitude of which is set so that the ridges of the prism-shaped protrusions of the first intermediate layer 130 are not brought into direct contact with one surface of the upper layer 150 but slightly overlap with the uncured acrylic resin layer of the upper layer 150, in a state in which the lower layer 120 is positioned on the upper layer 150 such that the uncured acrylic resin applied on the upper layer 150 does not flow down along the prism-shaped protrusions of the first intermediate layer 130 (S170); and radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer of the lower surface of the upper layer 150, thereby forming the second intermediate layer 140 (S180).

[68] FIG. 16 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the second embodiment of the present invention.

[69] The method of manufacturing the diffuser-integrated prism sheet according to the second embodiment comprises applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the lower surface of the lower layer 120 (S210); passing the lower layer 120 having the uncured acrylic resin applied on the lower surface thereof over a roll having a plurality of hemispherical protrusions and in contact therewith to thus form an uncured acrylic resin layer having a plurality of hemispherical recesses, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical recesses, thereby forming the lower diffuser layer 210 (S220); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the lower layer 120 (S230); passing the lower layer 120 having the uncured acrylic resin applied on the upper surface thereof over a roll having prism-shaped recesses and in contact therewith to thus form an uncured acrylic resin layer having prism-shaped protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the prism-shaped protrusions, thereby forming the first intermediate layer

130 (S240); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the upper layer 150 (S250); passing the upper layer 150 having the uncured acrylic resin applied on the upper surface thereof over a roll having a plurality of hemispherical protrusions and in contact therewith to thus form an uncured acrylic resin layer having a plurality of hemispherical recesses, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical recesses, thereby forming the upper diffuser layer 220 (S260); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the lower surface of the upper layer 150 to thus form an uncured acrylic resin layer, and then bringing the lower layer 120 into close contact with the upper layer 150 so that the ridges of the prism-shaped protrusions of the first intermediate layer 130 come into contact with the uncured acrylic resin layer of the upper layer 150, under pressure the magnitude of which is set so that the ridges of the prism-shaped protrusions of the first intermediate layer 130 are not brought into direct contact with one surface of the upper layer 150 but slightly overlap with the uncured acrylic resin layer of the upper layer 150, in a state in which the lower layer 120 is positioned on the upper layer 150 such that the uncured acrylic resin applied on the upper layer 150 does not flow down along the prism-shaped protrusions of the first intermediate layer 130 (S270); and radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer of the lower surface of the upper layer 150, thereby forming the second intermediate layer 140 (S280).

[70] FIG. 17 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the fifth embodiment of the present invention.

[71] The method of manufacturing the diffuser-integrated prism sheet according to the fifth embodiment comprises applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the lower surface of the lower layer 120 (S310); passing the lower layer 120 having the uncured acrylic resin applied on the lower surface thereof over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured acrylic resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical protrusions, thereby forming the lower diffuser layer 110 (S320); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the lower layer 120

(S330); passing the lower layer 120 having the uncured acrylic resin applied on the upper surface thereof over a roll having prism-shaped recesses and in contact therewith to thus form an uncured acrylic resin layer having prism-shaped protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the prism-shaped protrusions, thereby forming the intermediate layer 300 (S340); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the upper layer 150 (S350); passing the upper layer 150 having the uncured acrylic resin applied on the upper surface thereof over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured acrylic resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical protrusions, thereby forming the upper diffuser layer 160 (S360); applying an adhesive 320 on the ridges 310 of the prism-shaped protrusions of the intermediate layer 300, and then bringing the lower layer 120 into close contact with the upper layer 150 such that the ridges of the prism-shaped protrusions thereof come into contact with the upper layer 150 (S370); and drying the adhesive 320 applied on the intermediate layer 300.

[72] FIG. 18 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the ninth embodiment of the present invention.

[73] The method of manufacturing the diffuser-integrated prism sheet according to the ninth embodiment comprises passing a PC lower layer 400 formed of PC between an upper roll having prism-shaped recesses and a lower roll having a plurality of hemispherical recesses to thus form the PC lower layer 400 having prism-shaped protrusions on the upper surface thereof and a plurality of hemispherical protrusions on the lower surface thereof, and then radiating UV light or applying heat to thus cure the PC lower layer 400 (S410); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the upper layer 150 (S420); passing the upper layer 150 having the uncured acrylic resin applied on the upper surface thereof over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured acrylic resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical protrusions, thereby forming the upper diffuser layer 160 (S430); applying an adhesive 420 on the ridges 410 of the prism-shaped protrusions of

the PC lower layer 400, and then bringing the PC lower layer 400 into close contact with the upper layer 150 so that the ridges of the prism-shaped protrusions of the PC lower layer 400 come into contact with the upper layer 150 (S430); and drying the adhesive 420 applied on the PC lower layer 400.

[74] FIG. 19 is a flowchart illustrating a process of manufacturing the diffuser-integrated prism sheet according to the eleventh embodiment of the present invention.

[75] The method of manufacturing the diffuser-integrated prism sheet according to the eleventh embodiment comprises passing a PC lower layer 500 formed of PC between an upper roll having prism-shaped recesses and a lower roll having a plurality of hemispherical protrusions to thus form the PC lower layer 500 having prism-shaped protrusions on the upper surface thereof and a plurality of hemispherical recesses in the lower surface thereof, and then radiating UV light or applying heat to thus cure the PC lower layer 500 (S510); applying a UV light-curable acrylic resin or a heat-curable acrylic resin in an uncured state to a predetermined thickness on the upper surface of the upper layer 150 (S520); passing the upper layer 150 having the uncured acrylic resin applied on the upper surface thereof over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured acrylic resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus completely cure the uncured acrylic resin layer having the plurality of hemispherical protrusions, thereby forming the upper diffuser layer 160 (S530); applying an adhesive 520 on the ridges 510 of the prism-shaped protrusions of the PC lower layer 500, and then bringing the PC lower layer 500 into close contact with the upper layer 150 so that the ridges of the prism-shaped protrusions of the PC lower layer 500 come into contact with the upper layer 150 (S530); and drying the adhesive 520 applied on the PC lower layer 500.

Industrial Applicability

[76] As described hereinbefore, the present invention provides a diffuser-integrated prism sheet for backlight units and a method of manufacturing the same. According to the present invention, because the prism sheet includes prism-shaped protrusions formed therein and diffuser layers integrated therewith, the defect rates attributable to scratching and the entry of impurities in the course of assembling a backlight unit can be drastically decreased. Further, the generation of shatter cracks by friction with other sheets can be decreased, thus improving workability, and accordingly, defect rates can be greatly decreased, resulting in improved productivity. Moreover, various optical sheets are integrally layered, thus realizing a short assembly time and a simple

assembly process, resulting in decreased costs.

- [77] Although the preferred embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible, without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

Claims

- [1] A diffuser-integrated prism sheet for backlight units, comprising:
a lower diffuser layer, having a light diffusion structure formed on a lower surface thereof;
a lower layer, formed on an upper surface of the lower diffuser layer;
a first intermediate layer, formed on an upper surface of the lower layer and having a plurality of prism-shaped protrusions formed parallel to each other;
a second intermediate layer, formed on an upper surface of the first intermediate layer;
an upper layer, formed on an upper surface of the second intermediate layer; and
an upper diffuser layer, formed on an upper surface of the upper layer and having a light diffusion structure formed on an upper surface of the upper diffuser layer, wherein an air layer is formed between a lower surface of the second intermediate layer and valleys of the prism-shaped protrusions of the first intermediate layer, and the first intermediate layer and the second intermediate layer are integrated with each other through fusion.
- [2] The prism sheet according to claim 1, wherein the upper layer and the lower layer are formed of polyethyleneterephthalate (PET), and the lower diffuser layer, the first intermediate layer, the second intermediate layer, and the upper diffuser layer are formed of a UV light-curable acrylic resin or a heat-curable acrylic resin.
- [3] A diffuser-integrated prism sheet for backlight units, comprising:
a lower diffuser layer, having a light diffusion structure formed on a lower surface thereof;
a lower layer, formed on an upper surface of the lower diffuser layer;
an intermediate layer, formed on an upper surface of the lower layer and having a plurality of prism-shaped protrusions formed parallel to each other;
an upper layer, formed on an upper surface of the intermediate layer; and
an upper diffuser layer, formed on an upper surface of the upper layer and having a light diffusion structure formed on an upper surface of the upper diffuser layer, wherein an air layer is formed between a lower surface of the upper layer and valleys of the prism-shaped protrusions of the intermediate layer, and ridges of the prism-shaped protrusions of the intermediate layer and the lower surface of the upper layer are integrated with each other using an adhesive.

- [4] The prism sheet according to claim 3, wherein the upper layer and the lower layer are formed of polyethyleneterephthalate (PET), and the intermediate layer is formed of a UV light-curable acrylic resin or a heat-curable acrylic resin.
- [5] A diffuser-integrated prism sheet for backlight units, comprising:
a lower layer, having a light diffusion structure formed on a lower surface thereof and a plurality of prism-shaped protrusions formed parallel to each other on an upper surface thereof;
an upper layer, formed on an upper surface of the lower layer; and
an upper diffuser layer, formed on an upper surface of the upper layer and having a light diffusion structure formed on an upper surface of the upper diffuser layer, and
wherein an air layer is formed between a lower surface of the upper layer and valleys of the prism-shaped protrusions of the lower layer, and ridges of the prism-shaped protrusions of the lower layer and the lower surface of the upper layer are integrated with each other using an adhesive.
- [6] The prism sheet according to claim 5, wherein the upper layer is formed of polyethyleneterephthalate (PET), and the lower layer is formed of polycarbonate (PC).
- [7] The prism sheet according to any one of claims 1 to 6, wherein the light diffusion structure formed on the lower surface of the lower diffuser layer comprises a plurality of hemispherical protrusions for diffusing light.
- [8] The prism sheet according to any one of claims 1 to 6, wherein the light diffusion structure formed on the upper surface of the upper diffuser layer comprises a plurality of hemispherical protrusions for diffusing light.
- [9] The prism sheet according to any one of claims 1 to 6, wherein the light diffusion structure formed on the lower surface of the lower diffuser layer comprises a plurality of hemispherical recesses for diffusing light.
- [10] The prism sheet according to any one of claims 1 to 6, wherein the light diffusion structure formed on the upper surface of the upper diffuser layer comprises a plurality of hemispherical recesses for diffusing light.
- [11] The prism sheet according to any one of claims 1 to 6, wherein a cross-section of each of the prism-shaped protrusions has a triangular shape, a pentagonal shape, or a heptagonal shape.
- [12] A method of manufacturing a diffuser-integrated prism sheet, comprising:
applying a first uncured resin to a predetermined thickness on a lower surface of

a first resin sheet;

passing the first resin sheet having the first uncured resin over a roll having a plurality of hemispherical recesses and in contact therewith to thus form a first uncured resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus cure the first uncured resin layer, thereby forming a lower diffuser layer;

applying a second uncured resin to a predetermined thickness on an upper surface of the first resin sheet;

passing the first resin sheet having the second uncured resin over a roll having prism-shaped recesses and in contact therewith to thus form a second uncured resin layer having prism-shaped protrusions, and then radiating UV light or applying heat to thus cure the second uncured resin layer, thereby forming a first intermediate layer;

applying a third uncured resin to a predetermined thickness on an upper surface of a second resin sheet;

passing the second resin sheet having the third uncured resin over a roll having a plurality of hemispherical recesses and in contact therewith to thus form a third uncured resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus cure the third uncured resin layer, thereby forming an upper diffuser layer;

applying a fourth uncured resin on a lower surface of the second resin sheet to thus form a fourth uncured resin layer, and then bringing the first resin sheet into close contact with the second resin sheet so that ridges of the prism-shaped protrusions of the first resin sheet come into contact with the fourth uncured resin layer of the second resin sheet and thus overlap therewith; and

radiating UV light or applying heat to thus cure the fourth uncured resin layer, thereby forming a second intermediate layer.

[13]

A method of manufacturing a diffuser-integrated prism sheet, comprising:

applying a first uncured resin to a predetermined thickness on a lower surface of a first resin sheet;

passing the first resin sheet having the first uncured resin over a roll having a plurality of hemispherical protrusions and in contact therewith to thus form a first uncured resin layer having a plurality of hemispherical recesses, and then radiating UV light or applying heat to thus cure the first uncured resin layer, thereby forming a lower diffuser layer;

applying a second uncured resin to a predetermined thickness on an upper surface of the first resin sheet;
passing the first resin sheet having the second uncured resin over a roll having prism-shaped recesses and in contact therewith to thus form a second uncured resin layer having prism-shaped protrusions, and then radiating UV light or applying heat to thus cure the second uncured resin layer, thereby forming a first intermediate layer;
applying a third uncured resin to a predetermined thickness on an upper surface of a second resin sheet;
passing the second resin sheet having the third uncured resin over a roll having a plurality of hemispherical protrusions and in contact therewith to thus form a third uncured resin layer having a plurality of hemispherical recesses, and then radiating UV light or applying heat to thus cure the third uncured resin layer, thereby forming an upper diffuser layer;
applying a fourth uncured resin on a lower surface of the second resin sheet to thus form a fourth uncured resin layer, and then bringing the first resin sheet into close contact with the second resin sheet so that ridges of the prism-shaped protrusions of the first resin sheet come into contact with the fourth uncured resin layer of the second resin sheet and thus overlap therewith; and
radiating UV light or applying heat to thus cure the fourth uncured resin layer, thereby forming a second intermediate layer.

[14] The method according to claim 12 or 13, wherein the first resin sheet and the second resin sheet are a polyethyleneterephthalate (PET) sheet, and the first uncured resin, the second uncured resin, the third uncured resin, and the fourth uncured resin are a UV light-curable acrylic resin or a heat-curable acrylic resin.

[15] A method of manufacturing a diffuser-integrated prism sheet, comprising:
applying a first uncured resin to a predetermined thickness on a lower surface of a first resin sheet;
passing the first resin sheet having the first uncured resin over a roll having a plurality of hemispherical recesses and in contact therewith to thus form a first uncured resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus cure the first uncured resin layer, thereby forming a lower diffuser layer;
applying a second uncured resin on an upper surface of the first resin sheet;
passing the first resin sheet having the second uncured resin over a roll having

prism-shaped recesses and in contact therewith to thus form a second uncured resin layer having prism-shaped protrusions, and then radiating UV light or applying heat to thus cure the second uncured resin layer;
applying a third uncured resin to a predetermined thickness on an upper surface of a second resin sheet;
passing the second resin sheet having the third uncured resin over a roll having a plurality of hemispherical recesses and in contact therewith to thus form a third uncured resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus cure the third uncured resin layer, thereby forming an upper diffuser layer;
applying an adhesive on ridges of the prism-shaped protrusions of the first resin sheet, and then bringing the first resin sheet into close contact with the second resin sheet so that the ridges of the prism-shaped protrusions of the first resin sheet come into contact with one surface of the second resin sheet; and
drying the adhesive.

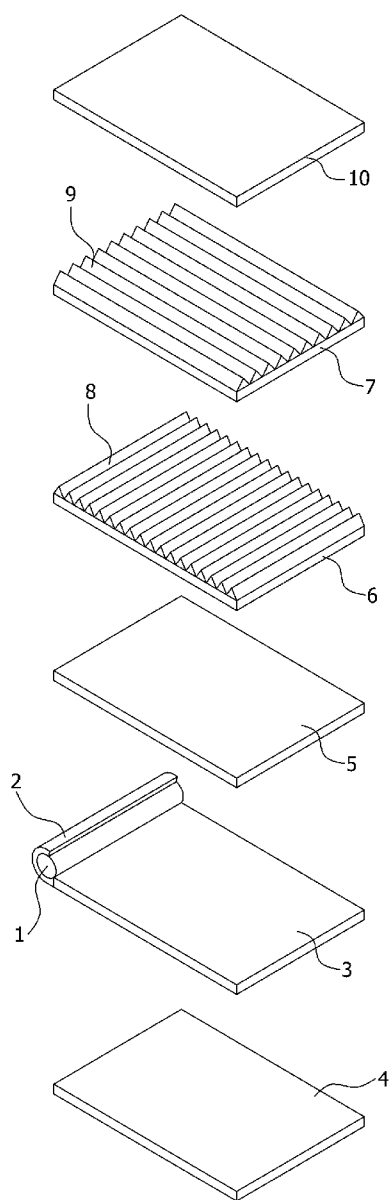
[16] The method according to claim 15, wherein the first resin sheet and the second resin sheet are a polyethyleneterephthalate (PET) sheet, and the first uncured resin, the second uncured resin, and the third uncured resin are a UV light-curable acrylic resin or a heat-curable acrylic resin.

[17] A method of manufacturing a diffuser-integrated prism sheet, comprising:
passing a first resin sheet between an upper roll having prism-shaped recesses and a lower roll having a plurality of hemispherical recesses to thus form the first resin sheet having prism-shaped protrusions on an upper surface thereof and a plurality of hemispherical protrusions on a lower surface thereof, and then cooling the first resin sheet to thus cure it;
applying an uncured resin to a predetermined thickness on an upper surface of a second resin sheet;
passing the second resin sheet having the uncured resin over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus cure the uncured resin layer, thereby forming an upper diffuser layer;
applying an adhesive on ridges of the prism-shaped protrusions of the first resin sheet, and then bringing the first resin sheet into close contact with the second resin sheet so that the ridges of the prism-shaped protrusions of the first resin

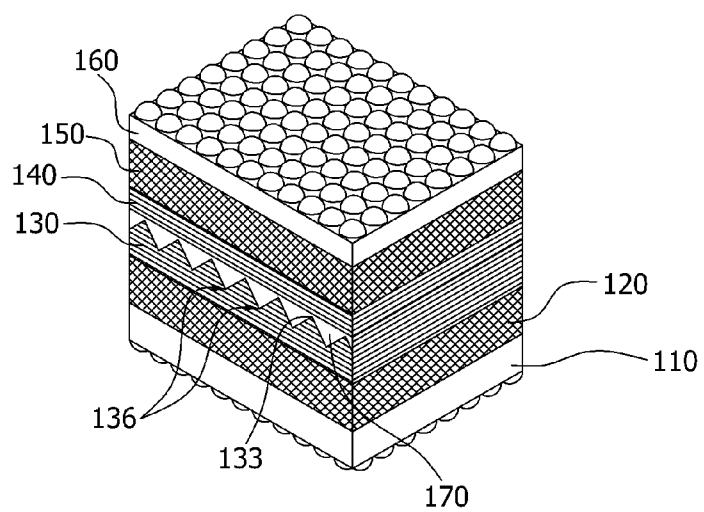
sheet come into contact with one surface of the second resin sheet; and drying the adhesive.

- [18] A method of manufacturing a diffuser-integrated prism sheet, comprising:
passing a first resin sheet between an upper roll having prism-shaped recesses and a lower roll having a plurality of hemispherical protrusions to thus form the first resin sheet having prism-shaped protrusions on an upper surface thereof and a plurality of hemispherical recesses in a lower surface thereof, and then cooling the first resin sheet to thus cure it;
applying an uncured resin to a predetermined thickness on an upper surface of a second resin sheet;
passing the second resin sheet having the uncured resin over a roll having a plurality of hemispherical recesses and in contact therewith to thus form an uncured resin layer having a plurality of hemispherical protrusions, and then radiating UV light or applying heat to thus cure the uncured resin layer, thereby forming an upper diffuser layer;
applying an adhesive on ridges of the prism-shaped protrusions of the first resin sheet, and then bringing the first resin sheet into close contact with the second resin sheet so that the ridges of the prism-shaped protrusions of the first resin sheet come into contact with one surface of the second resin sheet; and drying the adhesive.
- [19] The method according to claim 17 or 18, wherein the first resin sheet is a polycarbonate (PC) sheet, the second resin sheet is a polyethyleneterephthalate (PET) sheet, and the uncured resin is a UV light-curable acrylic resin or a heat-curable acrylic resin.
- [20] The method according to any one of claims 15 to 18, wherein the adhesive is any one selected from among highly transparent adhesives, including silicone-urethane hybrid polymers, acrylic polymers, and polyester-based polymers.
- [21] The method according to any one of claims 12, 13, 15 to 18, wherein a cross-section of each of the prism-shaped protrusions has a triangular shape, a pentagonal shape, or a heptagonal shape.

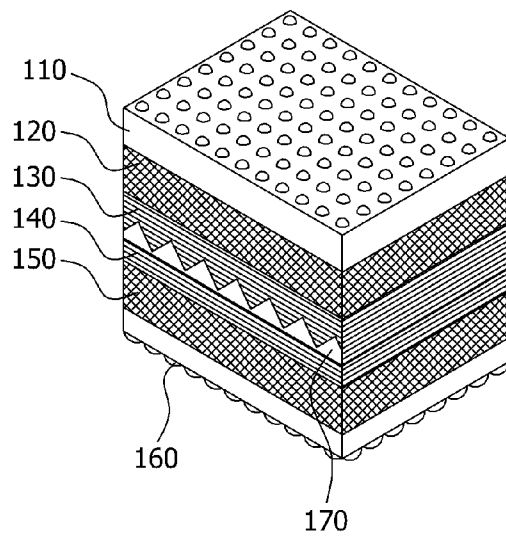
[Fig. 1]



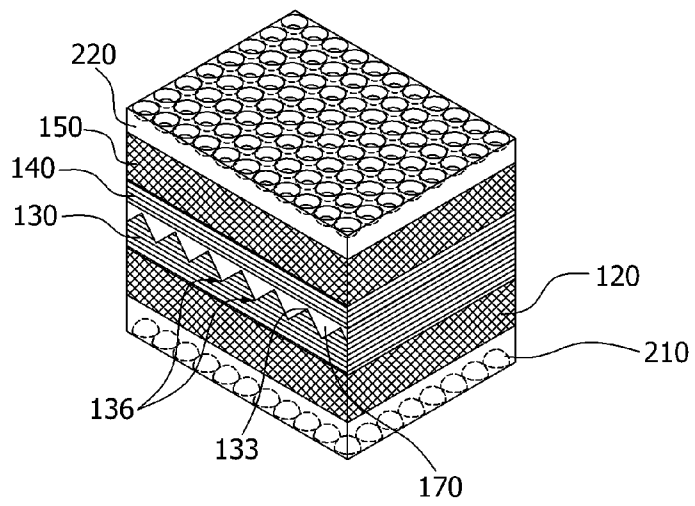
[Fig. 2]



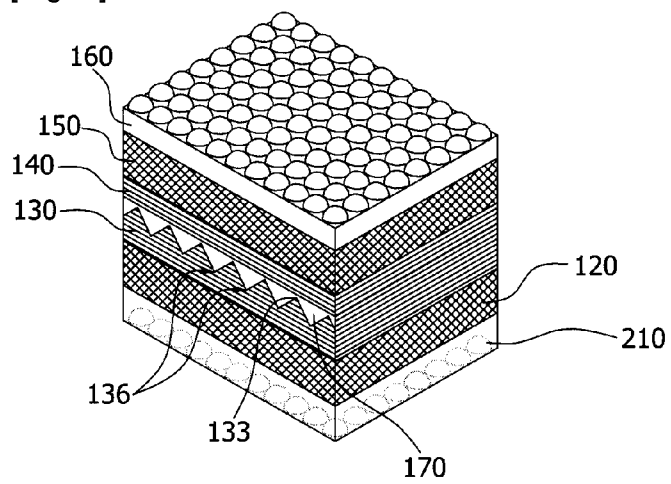
[Fig. 3]



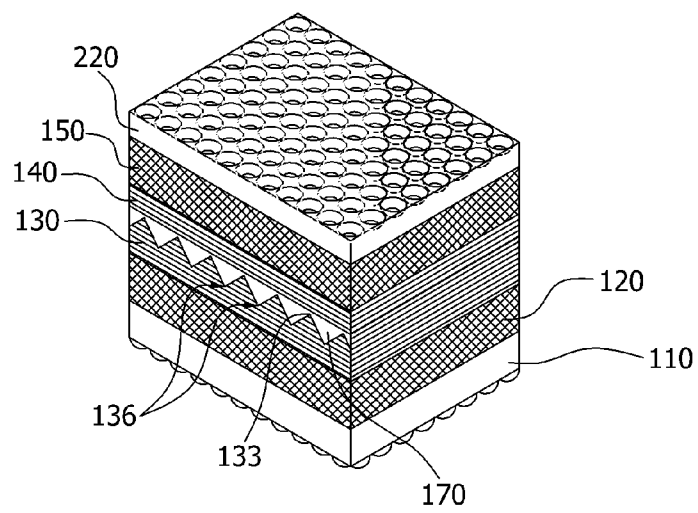
[Fig. 4]



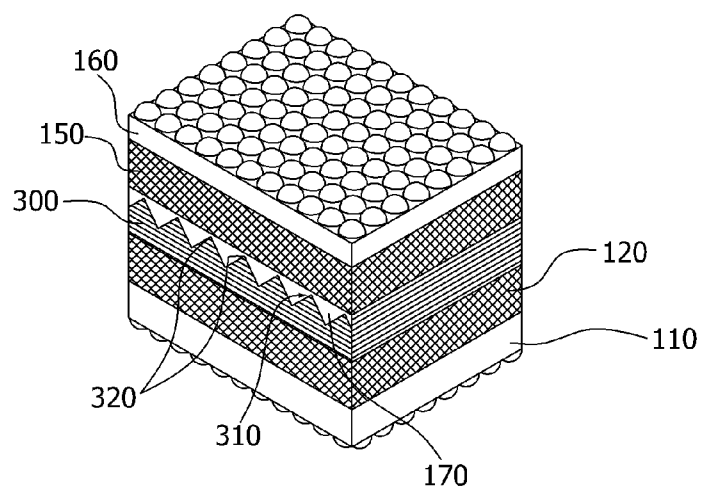
[Fig. 5]



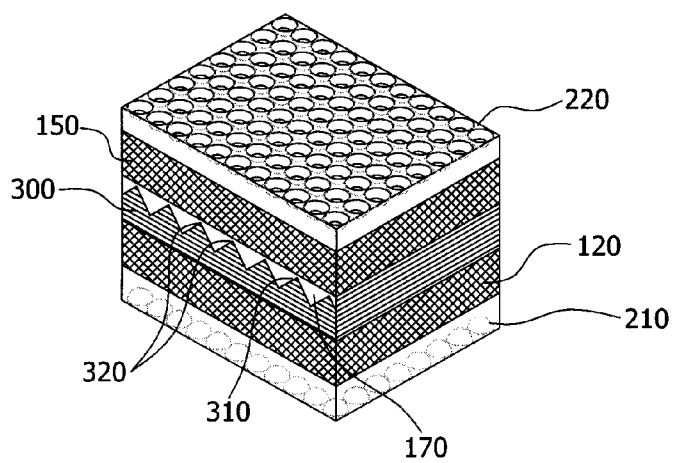
[Fig. 6]



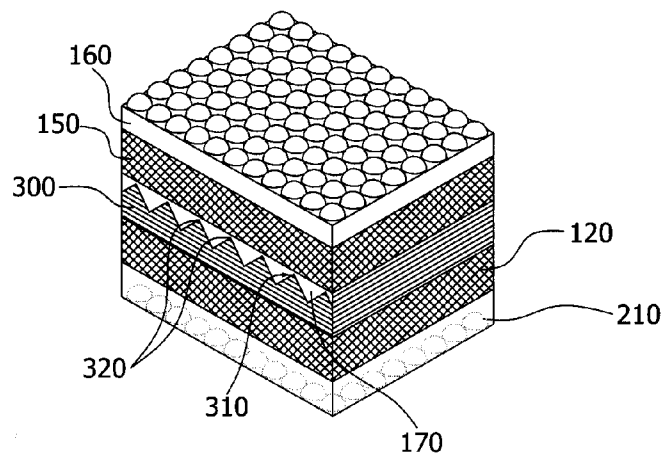
[Fig. 7]



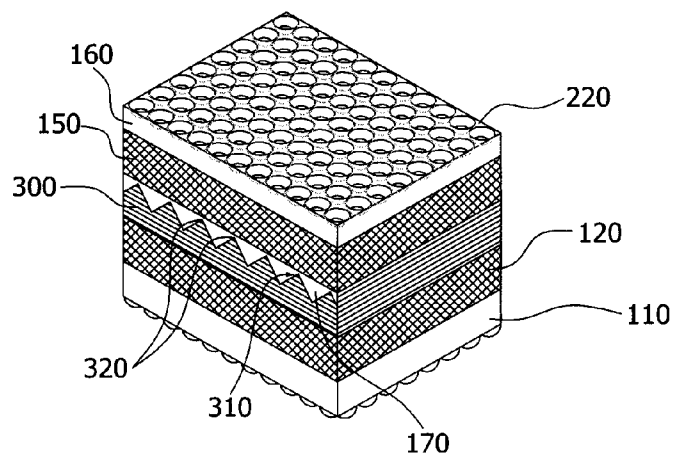
[Fig. 8]



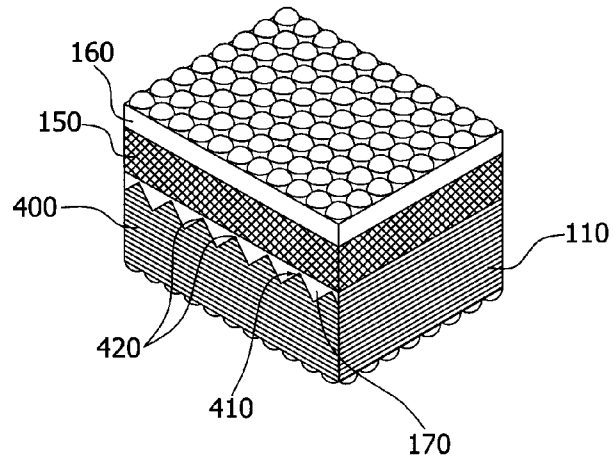
[Fig. 9]



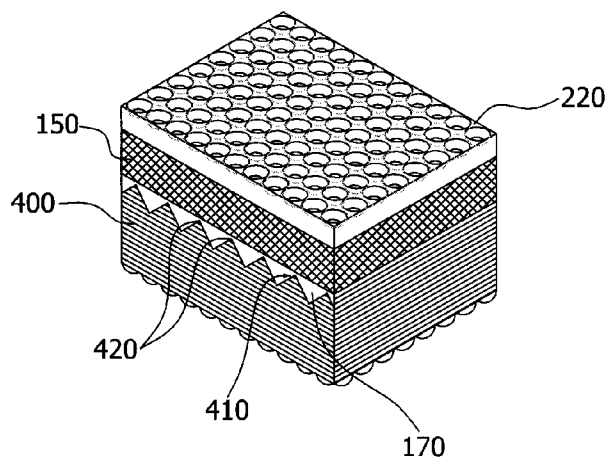
[Fig. 10]



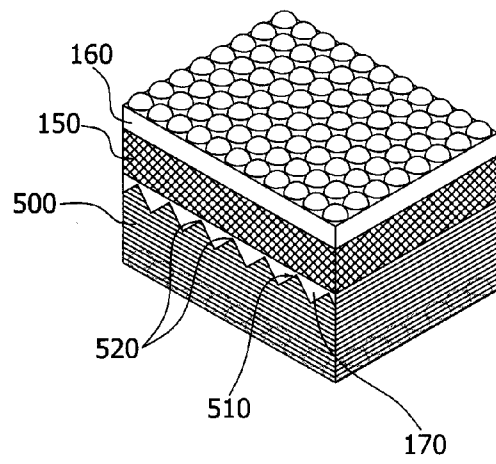
[Fig. 11]



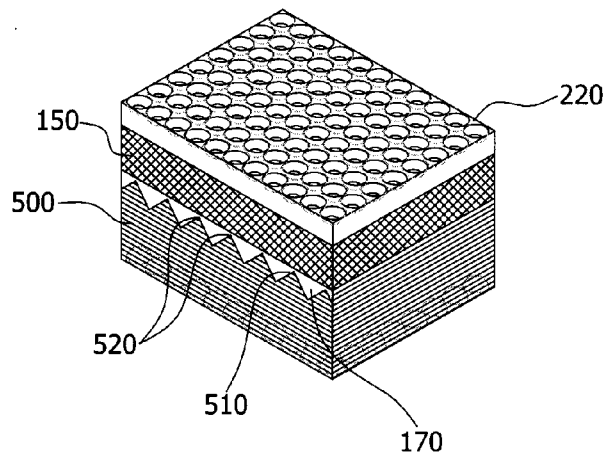
[Fig. 12]



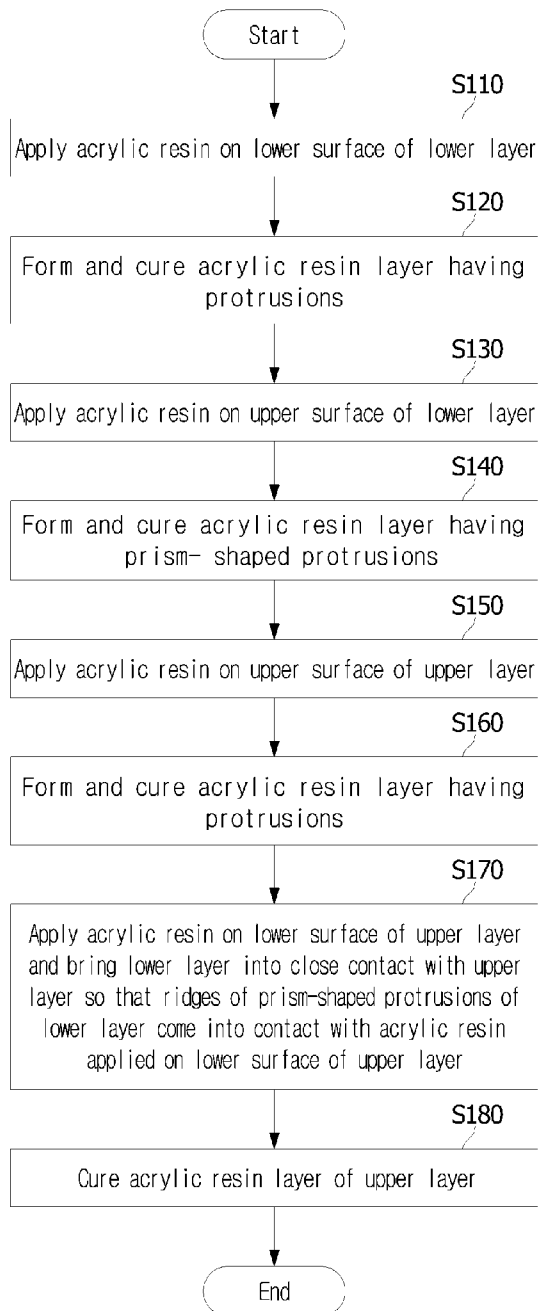
[Fig. 13]



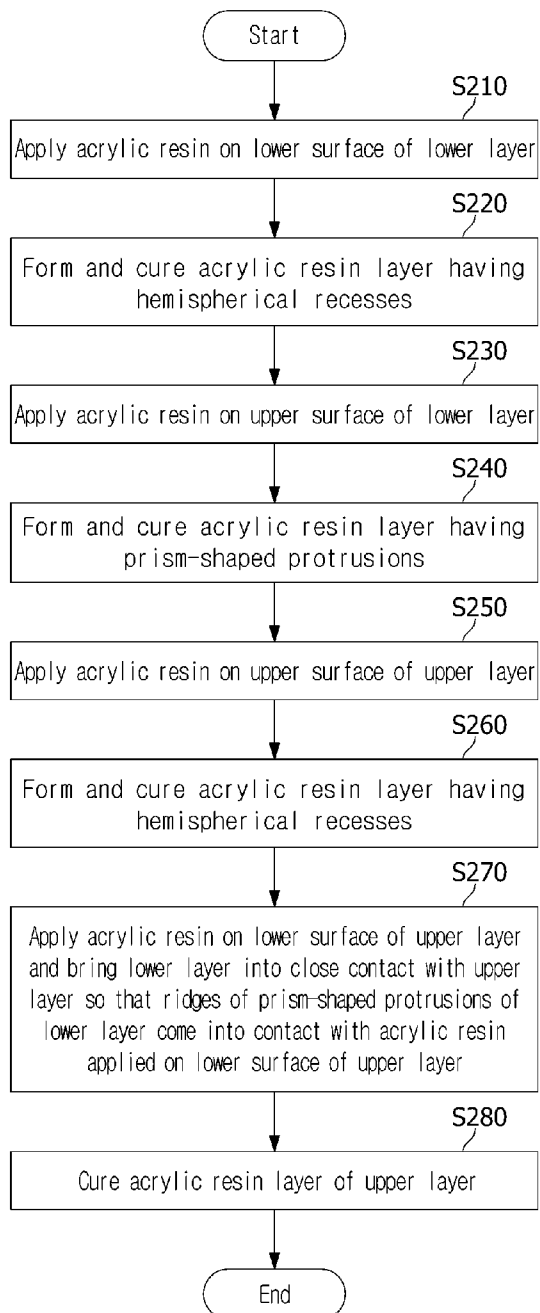
[Fig. 14]



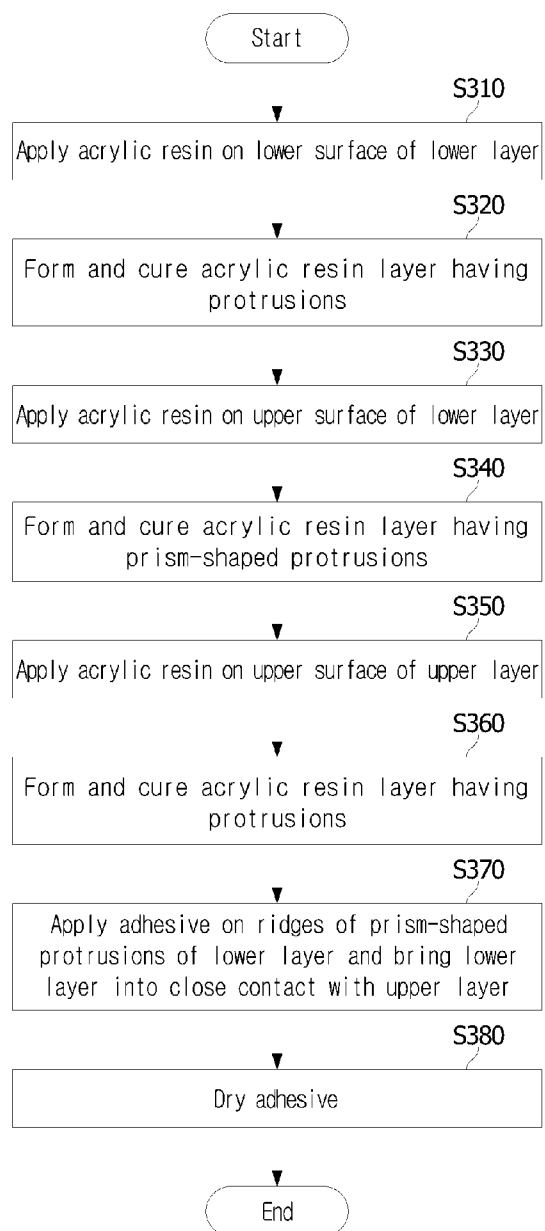
[Fig. 15]



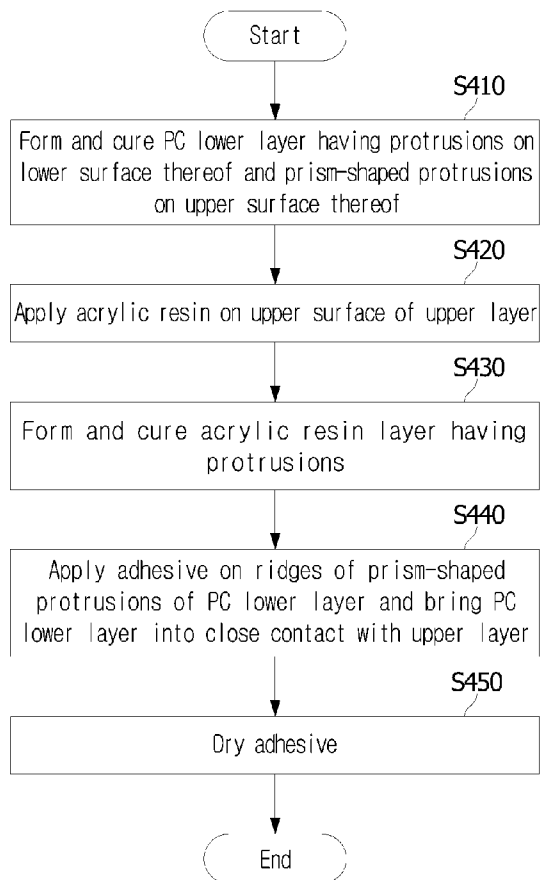
[Fig. 16]



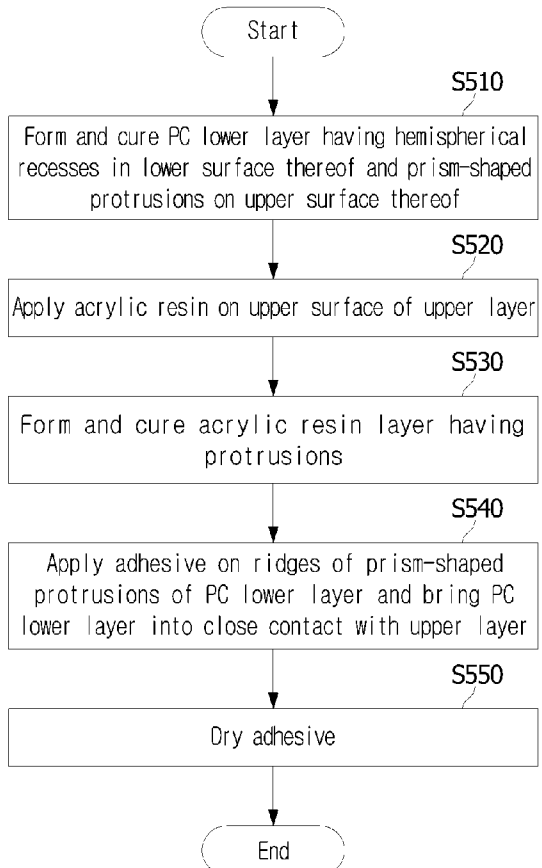
[Fig. 17]



[Fig. 18]



[Fig. 19]



A. CLASSIFICATION OF SUBJECT MATTER**G02F 1/13357(2006.01)i**

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 8 : G02F 1/13357, F21V 8/00

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)

eKIPASS (KIPO internal) & keywords : "back light", "diffuser", "prism", "air"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|---|-----------------------|
| A | US 2006/0087865 A1 (HA JU-HWA et al.) 27 April 2006 abstract; paragraphs 47-77; claims 1-14; figures 5-12. | 1-21 |
| A | JP 10-048430 A (GOYO PAPER WORKING CO., LTD.) 20 February 1998 abstract; paragraphs 5-30; claims 1-4; figures 1-2. | 1-21 |
| A | US 2003/0058390 A1 (FUJII GEN) 27 March 2003 abstract; paragraphs 7-85; claims 1-12; figures 7-11. | 1-21 |
| A | JP 2004-341294 A (KEIWA INC) 02 December 2004 abstract; paragraphs 40-69; claims 1-7; figures 1-3. | 1-21 |



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" 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

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

14 MAY 2008 (14.05.2008)

Date of mailing of the international search report

14 MAY 2008 (14.05.2008)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-
gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

YOU, Joo Ho

Telephone No. 82-42-481-5690



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/000604

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|--|--|
| US2006/0087865A1 | 27.04.2006 | JP18128060A KR2006037178A | 18.05.2006 03.05.2006 |
| JP10-048430A | 20.02.1998 | KR19980018165A | 05.06.1998 |
| US2003/058390A1 | 27.03.2003 | CN1186678C CN1410810A JP2003098325A KR20030027732A TW561281A | 26.01.2005 16.04.2003 03.04.2003 07.04.2003 11.11.2003 |
| JP 2004-341294 A | 02.12.2004 | | NONE |