(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
26 April 2007 (26.04.2007)

PCT

(10) International Publication Number
WO 2007/046649 A1

(51) International Patent Classification:
G02B 1/10 (2006.01)

(21) International Application Number:
PCT/KR2006/004269

(22) International Filing Date: 19 October 2006 (19.10.2006)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2005-0099003 20 October 2005 (20.10.2005) KR

(71) Applicant *(for all designated States except US)*: **LGS CORPORATION, LTD** [KR/KR]; 92-3 Dang Jung-dong Gunpo-city, Kyungki-do 435-030 (KR).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: **SHIM, Yong-Shig** [KR/KR]; D-611 Misung Apartment, Yeouido-dong, Youngdeungpo-gu, Seoul 150-795 (KR).

(74) Agent: **YANG, Young-Pil**; Hansem Patent & Law Firm, 2nd Floor, Namdo Building 823-24, Yeoksam-dong, Kangnam-gu, Seoul 135-080 (KR).

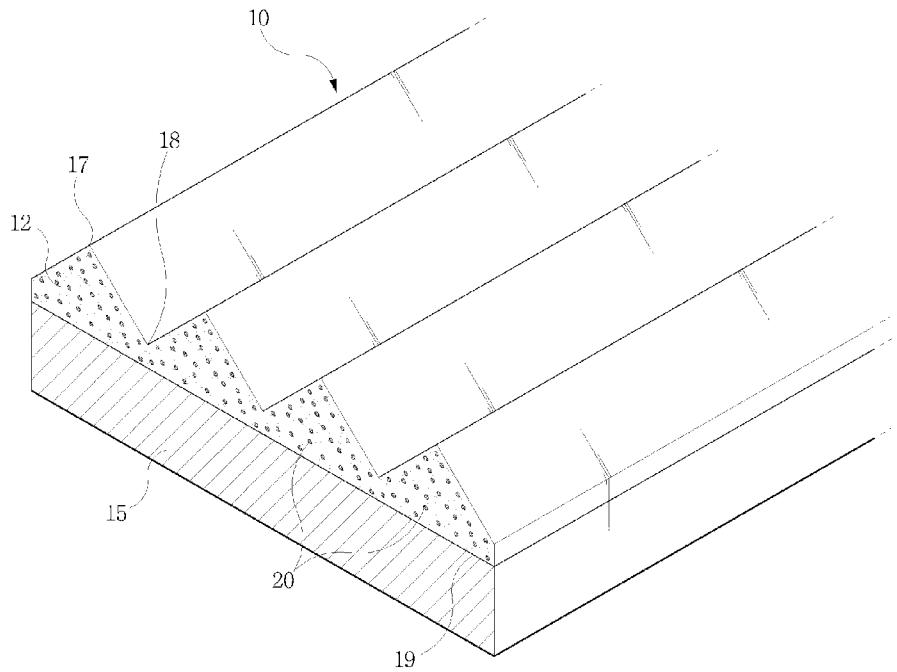
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, 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.

(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, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** MULTILAYER OPTICAL FILM WITH NANO PARTICLE



(57) **Abstract:** The present invention relates to a multilayered optical film including nano-particles used in a backlighting device. The optical film includes a transparent base film, a UV-hardened resin layer formed on the base film, and transparent nano-particles dispersed in the UV-hardened resin layer to reinforce the hardness of the UV-hardened resin layer. The hardness of the UV-hardened resin layer is improved and contractive deformation such as distortion and warping of a fine pattern of the UV-hardened resin layer due to a thermal expansion coefficient difference between the UV- hardened resin layer and the base film is removed.

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Description

MULTILAYER OPTICAL FILM WITH NANO PARTICLE

Technical Field

[1] The present invention relates to an optical film used in a backlighting device, and more particularly, to a multilayered optical film including nano-particles dispersed in a prism pattern forming layer having a fine pattern in order to remove contractive deformation caused by a thermal expansion coefficient difference at the interface between a base film layer and the prism pattern forming layer.

Background Art

[2] In general, a liquid crystal display (LCD) includes an LCD assembly that controls liquid crystal to realize a predetermined image and information, and a backlighting unit that provides light to view the image and information realized by the LCD assembly.

[3] The performance of an image display device such as LCD is greatly affected by the performance of the backlighting unit using an optical film.

[4] This is because the backlighting unit basically reflects or transmits light through the optical film to control the quantity of light. Accordingly, a variety of optical films having excellent optical performances have been proposed and effectively applied to image display devices.

[5] A conventional optical film is formed of a transparent polymer material. The conventional optical film has a fine pattern formed on one side thereof and has a smooth surface formed on the other side thereof. While there are various fine patterns formed on the optical film, a typical pattern used in the backlighting unit includes a linear arrangement of fine prisms arranged in parallel, in which a plurality of peaks and grooves are formed in the lengthwise direction of the optical film. The inclined faces of the fine prisms are at approximately 45 to the adjacent smooth face when the optical film is horizontally placed.

[6] The optical film having the fine pattern is generally manufactured using an UV hardening embossing method that coats UV-hardened pigments on a master, presses the surface of a base film with the master, and then irradiates UV rays to the base film to transfer a fine pattern to the base film. For mass production, a reel-to-reel method is employed. The reel-to-reel method coats a photo-polymer, one of UV-hardened pigments, on the surface of the base film, presses the surface of the base film with a master roll on which a pattern is formed and, simultaneously, dries the base film using a UV drier.

[7] FIG. 1 illustrates the structure of a conventional optical film 10 having a fine pattern layer. Referring to FIG. 1, the optical film 10 is made of a transparent polymer

material one side of which has a UV-hardened resin layer 12 having a fine pattern and the other side of which has a smooth surface. The UV-hardened resin layer 12 having a fine pattern includes a linear arrangement of fine prisms arranged in parallel and forms a plurality of peaks 17 and grooves 18 in the lengthwise direction of the optical film 10. The inclined faces of the fine prisms are at approximately 45 to the plane when the optical film 10 is horizontally placed.

[8] In the optical film 10 illustrated in FIG. 1, however, a relatively hard base layer 15 and the relatively soft UV-hardened resin layer 12 are bonded to each other at the interface 19.

[9] While a hard UV-hardened resin layer has higher durability, a soft UV-hardened resin is used in order to alleviate contraction due to UV polymerization or bending of the optical film caused by a thermal expansion coefficient difference between the UV-hardened resin layer and the base layer 15, which occurs when the hard UV-hardened resin layer is used. Accordingly, the soft UV-hardened resin layer is used in most cases, and thus the durability of the fine structure formed in the UV-hardened resin layer is decreased and a scratch may be formed on the fine structure.

[10] A flexible oligomer resin used as the UV-hardened resin layer 12 has a thermal expansion coefficient 1.33 to six times the thermal expansion coefficient of the base layer 15. Accordingly, when the hardened oligomer resin layer and the base layer of the optical film are bonded to each other and then cooled to the surrounding temperature, the hardened oligomer resin layer 12 and the base layer 15 contract according to their thermal expansion coefficients so that the optical film 10 unsymmetrically contracts due to a thermal expansion coefficient difference between the hardened oligomer resin layer 12 and the base layer 15.

[11] This unsymmetrical contraction causes the fine pattern of the hardened oligomer resin layer 12 to be deformed and deteriorates the optical performance of the optical film.

[12] To prevent the optical film from being bent due to thermal expansion, a soft UV-hardened resin having a low glass transient temperature Tg is used to minimize thermal contraction or thermal expansion. However, when the soft UV-hardened resin is used, the durability and mechanical strength of the fine structure formed in the soft UV-hardened resin layer are decreased so that the fine structure may be scratched or dented when used.

Disclosure of Invention

Technical Problem

[13] Accordingly, the present invention has been made to solve the above-mentioned problems occurring in the conventional art, and it is an object of the present invention

to provide an optical film including nano-particles dispersed in a UV-hardened resin layer having a fine pattern in order to remove deformation caused by a thermal expansion coefficient difference between the UV-hardened resin layer and a base film at the interface between the UV-hardened resin layer and the base film even when a hard UV-hardened resin is used as the UV-hardened resin layer.

Technical Solution

[14] To accomplish the above object, according to the present invention, there is provided an optical film comprising a transparent base film, a UV-hardened resin layer formed on the base film, and transparent nano-particles dispersed in the UV-hardened resin layer to reinforce the hardness of the UV-hardened resin layer.

[15] The nano-particles are made of a transparent material having hardness or strength greater than that of the UV-hardened resin layer and a thermal expansion coefficient smaller than that of the UV-hardened resin layer.

[16] The nano-particles are selected from an oxide including SiO_2 and TiO_2 and PMMA.

[17] Also, an optical film according to the present invention is better in term so performance, as the size of the nano-particles is smaller. The nano-particles are 40nm through 400nm in size or diameter.

[18] The base film is selected from the group consisting of acrylate, polycarbonate, polyester, poly vinyl chloride, and the UV-hardened resin layer is made of an acrylate-based UV-hardened resin.

Advantageous Effects

[19] According to the present invention, the hardness of the UV-hardened resin layer of the multilayered optical film obtained by hetero-junction of the UV-hardened resin layer having a fine pattern and a base film are increased to improve the durability of the UV-hardened resin layer. Furthermore, contractive deformation of the fine pattern formed in the UV-hardened resin layer, such as distortion and warping, can be removed.

Brief Description of the Drawings

[20] Further objects and advantages of the invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[21] FIG. 1 illustrates the structure of a conventional optical film having a fine pattern layer;

[22] FIG. 2 illustrates the structure of the conventional optical film having a fine pattern layer when the optical film is contracted; and

[23] FIG. 3 illustrates the structure of an optical film according to the present invention.

Best Mode for Carrying Out the Invention

[24] Hereinafter, a preferred embodiment of the invention will be explained in detail with reference to the appended drawings.

[25] FIG. 3 illustrates the structure of a multilayered optical film 10 including nano-particles according to the present invention. Referring to FIG. 3, the optical film 10 includes a transparent base film 15 and a UV-hardened resin layer 12, which have the interface 19 between them.

[26] The optical film 10 includes nano-particles 20 dispersed in the UV-hardened resin layer 12. The nano-particles 20 increase the elastic modulus and yield strength of the UV-hardened resin layer 12 to improve the hardness of the UV-hardened resin layer 12 and prevent the UV-hardened resin layer 12 from being deformed when thermally expanded. The nano-particles 20 have a thermal expansion coefficient smaller than that of the UV-hardened resin layer and are transparent. An oxide is useful as the nano-particles. However, the nano-particles are not limited to the oxide and any transparent material having hardness or strength greater than that of the UV-hardened resin and a thermal expansion coefficient smaller than that of the UV-hardened resin can be used as the nano-particles. It is preferable that the nano-particles 20 are selected from the group consisting of SiO_2, TiO_2 and PMMA.

[27] The base film 15 is approximately 20 through 30mm in height and the UV-hardened resin layer 12 is approximately 10 through 50mm in height. While the smaller the size (or diameter) of the nano-particles 20, the better, it is preferable that the size (or d iameter) of the nano-particles 20 dispersed in the UV-hardened resin layer 12 is approximately 40 through 400nm.

[28] Nano-particles having a size less than 40nm are too small and expensive because they are difficult to manufacture. On the other hand, nano-particles having a size greater than 400nm approximate the wavelength of visible ray input thereto so that light scattering occurs to affect optical efficiency.

[29] The nano-particles 20 dispersed in the UV-hardened resin layer 12 obstruct dislocation occurring when the UV-hardened resin layer 12 is expanded or contracted, and thus the hardness of the UV-hardened resin layer 12 is increased and the thermal expansion coefficient of the UV-hardened resin layer 12 is decreased, compared with original coefficient causing contraction.

[30] Accordingly, the thermal expansion coefficient of the UV-hardened resin layer 12 having the hardness improved by an increase in elastic modulus and yield strength caused by the nano-particles 20 dispersed therein becomes similar to the thermal expansion coefficient of the base film 15 so that the UV-hardened resin layer 12 and the base film 15 are combined with each other in harmony at the interface 19. As a result, the optical film 10 can be prevented from being distorted or deformed and the hardness, strength and scratch-resistance of the fine pattern of the UV-hardened resin

layer 12 can be improved.

[31] The UV-hardened resin layer 12 can use an oligomer resin composition hardened in flexible state. The oligomer resin composition includes acrylate, epoxy and urethane as a main ingredient, and a methacrylate or acrylate-based composition is preferable.

[32] The nano-particles 20 dispersed in the UV-hardened resin layer 12 are photopolymerized with the polymer forming the resin layer 12 and reduce contraction of the resin layer 12 when the resin layer 12 is thermally expanded and then contracted according to a temperature variation.

[33] The size of the nano-particles 20 dispersed in the UV-hardened resin layer 12 is much less than the wavelength of light transmitting the optical film, and thus the optical characteristics of the optical film are not varied while the light passes through the UV-hardened resin layer 12 and the base film 15 of the optical film 10 and the optical film 10 normally performs a light-condensing function.

[34] When the size order of the nano-particles 20 is increased, the optical film can function as a diffusion sheet. This is because when nano-particles having a size much larger than 400nm are dispersed in the UV-hardened resin layer 12, light scatters and diffuses when passing through the UV-hardened resin layer 12 since the wavelength of light, generally used, is greater than 400nm and less than 800nm.

[35] Accordingly, to use the optical film as a light-condensing sheet, the size of the nano-particles 20 dispersed in the UV-hardened resin layer 12 must be restricted to less than 400nm in consideration of the wavelength of light.

Industrial Applicability

[36] Accordingly, the transparent nano-particles 20 having a size in a restricted range are uniformly dispersed in the UV-hardened resin layer 12 to increase the elastic modulus and yield strength of the UV-hardened resin layer 12 to improve the hardness of the UV-hardened resin layer and approximate the thermal expansion coefficient of the UV-hardened resin layer to the thermal expansion coefficient of the base film 15. Therefore, it is possible to remarkably alleviate or remove distortion, warping and deformation occurring at the interface between the UV-hardened resin layer 12 and the base film 15 due to a thermal expansion coefficient difference between the UV-hardened resin layer and the base film when the UV-hardened resin layer and the base film are contracted.

[37] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

Claims

[1] An optical film comprising:
a transparent base film;
a UV-hardened resin layer formed on the base film; and
transparent nano-particles dispersed in the UV-hardened resin layer to reinforce the hardness of the UV-hardened resin layer.

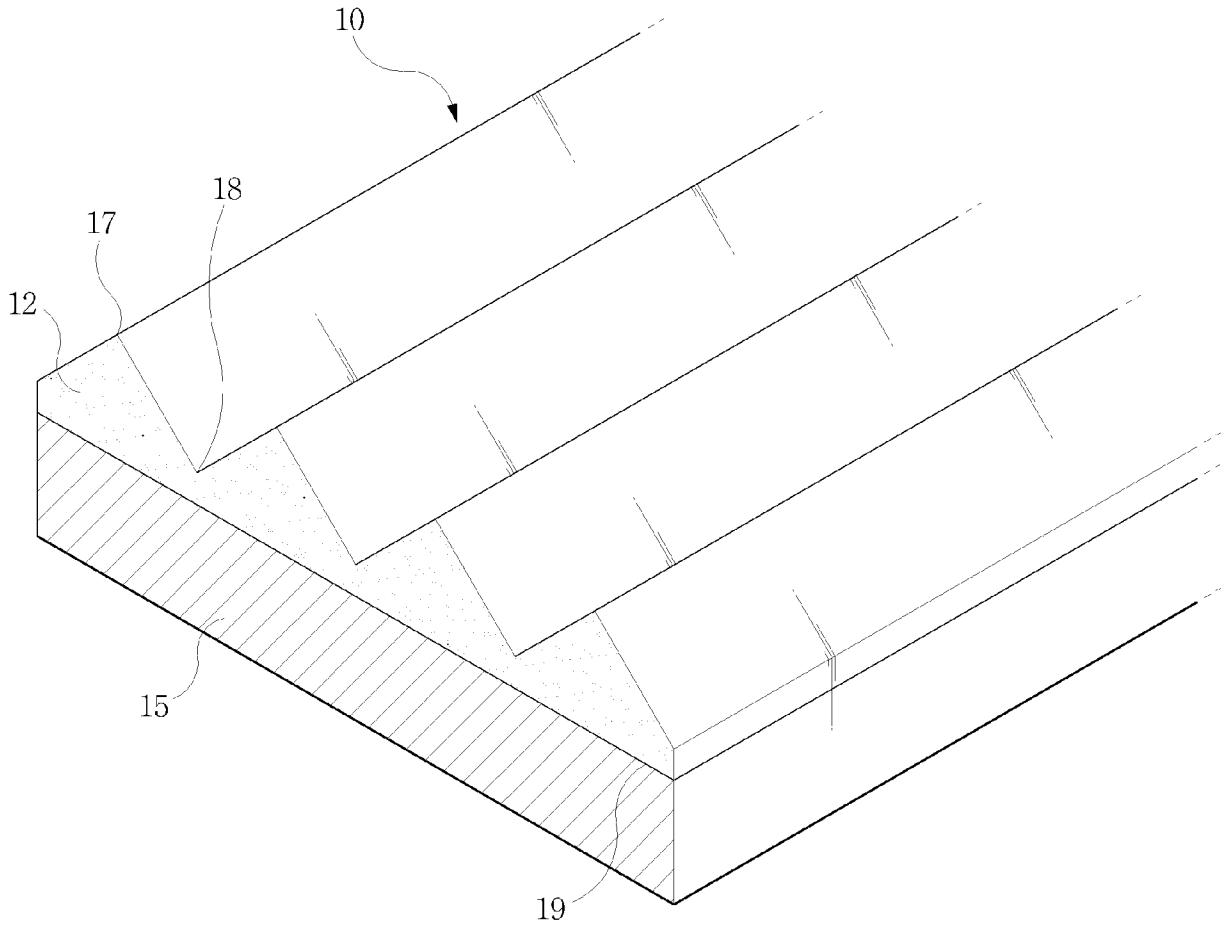
[2] The optical film according to claim 1, wherein the nano-particles are made of a transparent material having hardness or strength greater than that of the UV-hardened resin layer and a thermal expansion coefficient smaller than that of the UV-hardened resin layer.

[3] The optical film according to claim 1, wherein the nano-particles are selected from an oxide including SiO_2 and TiO_2 and PMMA.

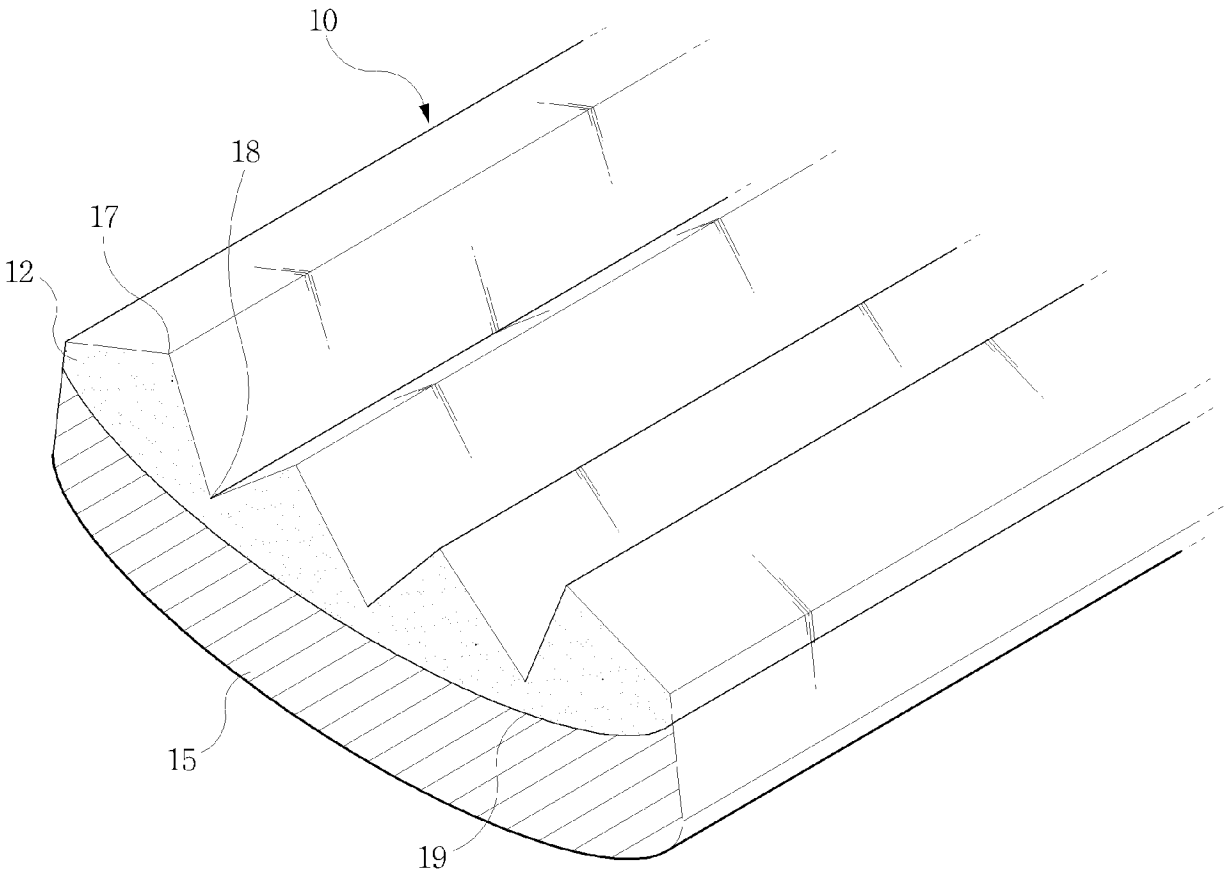
[4] The optical film according to claim 1, wherein the nano-particles are 40nm through 400nm in size or diameter

[5] The optical film according to claim 1, wherein the base film is selected from the group consisting of acrylate, polycarbonate, polyester, poly vinyl chloride, and the UV-hardened resin layer is made of an acrylate-based UV-hardened resin.

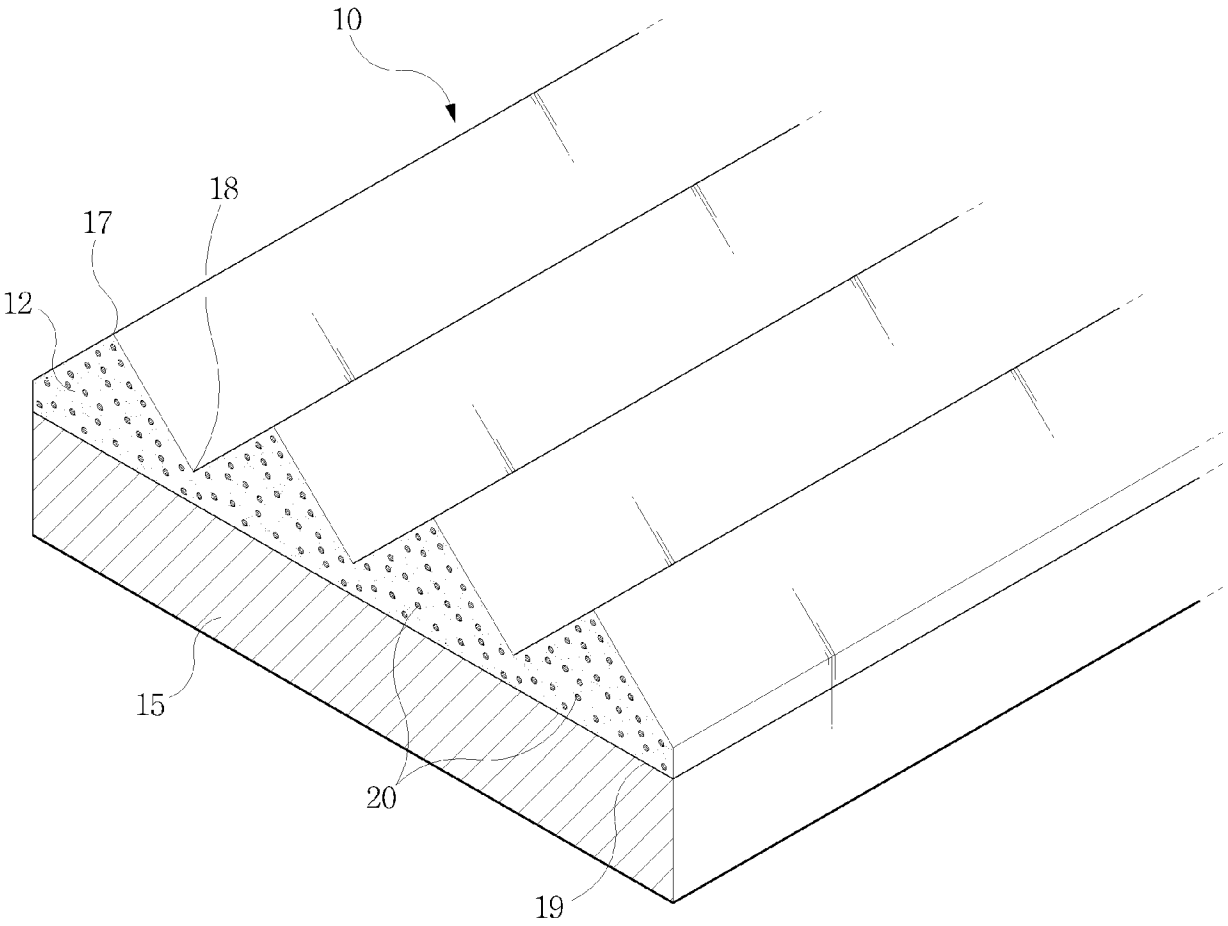
[Fig. 1]



[Fig. 2]



[Fig. 3]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/004269

A. CLASSIFICATION OF SUBJECT MATTER

G02B 1/10(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)
G02B 1/10 IPC8

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
KR, JP as above IPC

Electronic data base consulted during the intertnational search (name of data base and, where practicable, search terms used)
KIPONET, "nano", "optical", "film", "particle"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP2003285007A (DAINIPPON PRINTING CO LTD) 7 OCT 2003 see the wole documents	1-5
A	JP06155652A (NITTO DENKO CORP) 3 JUN 1994 see the whole documents	1-5
A	US6842288B1(Liu et al) 11 JAN 2005 see the whole documents	1-5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
29 JANUARY 2007 (29.01.2007)	**29 JANUARY 2007 (29.01.2007)**

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Authorized officer
CHUNG, Sang Tae
Telephone No. 82-42-481-5497

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR2006/004269

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