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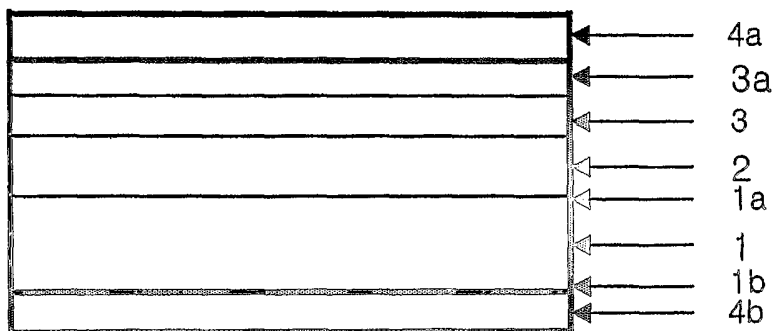
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(54) Title: PLASMA DISPLAY PANEL FILTER



(57) Abstract: A plasma display panel (PDP) filter comprising a transparent glass substrate having front and back faces, an adhesive sheet containing a near infrared (NIR) cutting pigment and a selective optical absorbent, and a conductive mesh layer, successively attached to the back face of the substrate; and, an anti-reflection (AR) film attached to the front face of the substrate is light-weight and has improved performance characteristics. A plasma display panel (PDP) filter comprising a transparent glass substrate having front and

back faces, an adhesive sheet containing a near infrared (NIR) cutting pigment and a selective optical absorbent, and a conductive mesh layer, successively attached to the back face of the substrate; and, an anti-reflection (AR) film attached to the front face of the substrate is light-weight and has improved performance characteristics.



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PLASMA DISPLAY PANEL FILTER

FIELD OF THE INVENTION

5 The present invention relates to an optical front filter for use on a plasma display panel(PDP), which is light-weight and has improved performance characteristics.

BACKGROUND ART

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 PDP is known to be more suitable for a high definition television(HDTV) having an enlarged, flat frame than a cathode ray tube(CRT) or a liquid crystal display(LCD), but has the problems of: releasing harmful electromagnetic interference(EMI)/infrared(IR) emissions; high photopic
15 reflection on the surface thereof; and lower color purity than CRT caused by orange light emitted from injected Ne gas. Accordingly, a filter has been applied in front of a plasma display panel to solve the above problems.

 PDPs can be divided into two types, industrial PDPs(class A) and personal PDPs(class B), according to the EMI shielding ability. An industrial
20 PDP filter is generally produced by alternately laminating a layer of a metal such as Ag and a layer of an oxide having a high refractive index on one side of a substrate to form EMI/IR shielding layers, and forming an anti-reflection(AR) layer on the other side or on both sides of the substrate.

 Japanese Patent Laid-open Publication No. 11-74683 discloses a
25 preparation method of a personal PDP filter which comprises placing a conductive mesh between two transparent glass substrate layers, attaching an AR film on the viewer side of the substrate and a near infra red (NIR) shield

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film on the surface of the substrate opposite to the viewer side, and applying an AR film on the NIR layer. Japanese Patent Laid-open Publication No. 13-134198 also provides a method for producing a personal PDP filter, which comprises successively attaching a conductive mesh and an AR film on one side
5 of a transparent acryl or glass substrate, and forming an NIR shielding layer on the other side of the substrate.

However, in these prior art methods, the use of two glass plates has a problem in that it is difficult to produce a thin and light-weight PDP filter, and the use of a light plastic resin sheet such as an acryl plate bring out the problem
10 of a low heat resistance.

In order to obtain a light-weight and thin PDP filter having good physical properties, there has been a recent attempt to apply a conductive mesh and optical films such as AR and NIR shielding film to one plate of a glass substrate with an adhesive film by a heat-pressing method. For example, Korean Patent
15 Laid-open Publication No. 2002-13743 discloses a method of producing a PDP filter comprising laminating a conductive mesh, adhesive layers such as a heat-bond film and a tackifier film, an NIR film, and an AR film, on a glass substrate, in a various layer-combination manner, and heat-pressing the resulting laminate in vacuum.

20 However, this method is still unsatisfactory in terms of reducing the weight and thickness of the PDP filter, and the filter thus obtained has a complicated layer structure.

BRIEF DESCRIPTION OF THE DRAWINGS

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The present invention will become apparent from the following description

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thereof, when taken in conjunction with the accompanying drawings which respectively show:

FIG. 1: a schematic diagram of a PDP filter according to the present invention; and

5 FIG. 2: a schematic diagram of a PDP filter according to the prior art.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a PDP filter having a thin
10 thickness, light-weight and simple structure, and simultaneously, excellent performance characteristics.

In accordance with one aspect of the present invention, there is provided a PDP filter comprising:

a transparent glass substrate having front and back faces;
15 an adhesive layer containing a near infrared (NIR) cutting pigment and a selective optical absorbent, and a conductive mesh layer, successively attached to the back face of the substrate; and,
an anti-reflection(AR) film attached to the front face of the substrate.

In accordance with a further aspect of the present invention, there is
20 provided a method of preparing a PDP filter comprising:

placing an adhesive sheet containing an NIR cutting pigment and a selective optical absorbent, and a conductive mesh, successively, on the back face of a transparent glass substrate having front and back faces;
heat-pressing the resulting laminate of the conductive mesh, the adhesive sheet
25 and the substrate in a vacuum; and
attaching an AR film to the front face of the substrate.

DETAILED DESCRIPTION OF THE INVENTION

The present invention is characterized in that an NIR cutting/selective
5 optical absorbent function of a PDP filter is achieved by way of employing a
single adhesive layer in which an NIR cutting pigment and a selective optical
absorbent pigment are incorporated, instead of separately laminating together
adhesive film, an NIR cutting film and a selective optical absorbent film, thus
reducing the weight and thickness of the PDP filter while maintaining the
10 performance of the filter.

FIG. 1 shows a schematic diagram of one embodiment of a PDP filter of
the present invention. Specifically, the inventive PDP filter comprises a
transparent glass substrate(1) having front(1b) and back(1a) faces, an adhesive
layer(2) containing an NIR cutting pigment and a selective optical absorbent,
15 attached to the back face(1a) of the substrate, a conductive mesh layer(3) attached
to the adhesive layer(2), an anti-reflection(AR) film(4a) attached to the mesh
face(3a) of the mesh layer(3), and an AR film(4b) laminated on the front face(1b)
of the substrate.

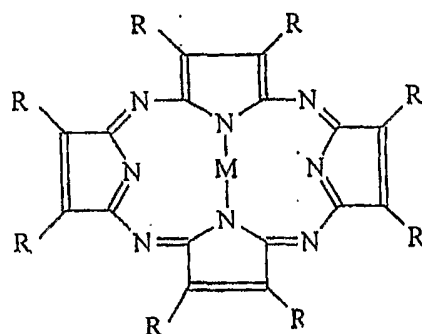
The adhesive layer(2) containing an NIR cutting pigment and a selective
20 optical absorbent, which is uniquely used in the present invention, may be
prepared by a conventional coating or extrusion method. For example, it can be
fabricated by applying a releasable layer on a transparent thermoplastic resin film
substrate, coating an adhesive resin composition containing the NIR cutting
pigment and the selective optical absorbent onto the releasable layer, drying the
25 coated adhesive layer and then removing the resulting adhesive film from the
substrate.

The transparent thermoplastic resin film substrate may be comprised of a thermoplastic resin, e.g., polyethyleneterephthalate(PET), polycarbonate(PC), polymethylmethacrylate(PMMA), triacetate cellulose(TAC), polyethersulfone(PES) or a mixture thereof, having a light transmittance of 80% or higher, preferably 90% or higher. The transparent resin film preferably has a thickness in the range of 25 to 250 μm .

The adhesive resin composition containing an NIR cutting pigment and a selective optical absorbent may be obtained by homogeneously mixing an adhesive resin and the pigment and the absorbent, e.g., in a kneader, at a high temperature of about 100°C.

Representative examples of the NIR cutting pigment include a mixture of a Ni complex-based dye and a diimmonium-based dye; a Cu or Zn ion-containing pigment; and other organic pigments. The NIR cutting pigment may be employed in an amount ranging from 1 to 20 % by weight based on the total solid component of the coating composition, in order to exhibit the desired effect of the present invention.

Representative examples of the selective optical absorbent are derivative pigments disclosed in Korean Patent Laid-open Publication Nos. 2001-26838 and 2001-39727, in which a metal atom located in the center of tetraazaporphyrin is coordinated with one ligand selected from the group consisting of NH_3 , H_2O and halogen, the metal being selected from the group consisting of Zn, Pd, Mg, Mn, Co, Cu, Ru, Rh, Fe, Ni, V, Sn and Ti. Specifically, the selective optical absorbent may be a tetraazaporphyrin-based dye represented by the following formula



wherein,

M is selected from the group consisting of Zn, Pd, Mg, Mn, Co, Cu, Ru, Rh, Fe, Ni, V, Sn and Ti;

- 5 R is each independently selected from the group consisting of hydrogen; phenyl; C₁₋₈ alkyl; C₁₋₈ alkoxy; nitro; halogen; halide; cyano; C₁₋₈ alkylamino; C₁₋₈ aminoalkyl; and a substituted phenyl with C₁₋₈ alkyl, C₁₋₈ alkoxy, nitro, halogen, halide, cyano, C₁₋₈ alkylamino or C₁₋₈ aminoalkyl; or adjacent two Rs may form a fused ring.

- 10 The selective optical absorbent may be employed in an amount ranging from 0.01 to 5 % by weight based on the total solid component of the coating composition. When its content is less than 0.01 %, the selectively light-absorbing function becomes low and thus the color purity becomes poor, whereas when it exceeds 5%, the color balance and the transmittance of filter are
- 15 poor.

- In addition, other dyes such as an azo, cyanine, diphenylmethane, triphenylmethane, phthalocyanine, xanthene, diphenylene, indigoid or porphyrin dye may be employed for controlling the transmittance of the PDP filter at each wavelength, in an amount of 0.05 to 3 % by weight of the total solid component of
- 20 the composition.

Representative examples of the adhesive resin, which is used in the

adhesive composition as a base binder resin, include an ethylene vinyl acetate (EVA) copolymer, polyamide resin, polyurethane resin, polyester resin and polyolefin resin, polyacryl resin, and a mixture thereof. An EVA resin may be preferably used owing to good transparency, adhesiveness, stability and abrasion-resistance. The adhesive resin may be employed in an amount ranging from 10 to 80% by weight based on the adhesive coating composition.

Further, a crosslinking agent may be additionally used to enhance the physical properties, e.g., impact strength of the adhesive resin, in an amount ranging from 1 to 5 % by weight of the coating composition, and representative examples thereof include an isocyanate, melamine or epoxy compound.

The adhesive resin and the additional components may be dissolved in an organic solvent to be coated on the substrate. Representative examples of the solvent include toluene, xylene, acetone, methylethylketone(MEK), propylalcohol, isopropylalcohol, methylcellusolve, ethylcellusolve and dimethylformamide (DMF). A stabilization agent such as a radical reaction inhibitor may be added to the coating composition to prevent the degradation of the dye. Further, a UV cutting agent (e.g., Tinuvin) and other additives such as anti-deterioration agents or adhesive reinforcement agents may be employed in the adhesive coating composition.

The coating process of the adhesive resin composition may be carried out via a common coating technique, e.g., a comma, roll-, die- or spin-coating method.

The resulting adhesive layer(2) may be a sheet having a thickness ranging from 10 to 500 μm , preferably 50 to 250 μm , for attaining satisfactory adhesive strength and other desired properties.

In accordance with the present invention, the adhesive layer(2) is used to

attach a transparent substrate(1) to a conductive mesh layer(3). The conductive mesh may be made of a metallic fiber or metal-coated fiber, or a patterned metal, and it functions to enhance the safety of the filter. The conductive mesh has a width of 5 to 50 μm , a thickness of 1 to 100 μm , and a pitch of 50 to 500 μm .
5 Preferably, the conductive mesh has a thickness of 5 to 50 μm , and a pitch of 100 to 400 μm .

The attachment of the transparent substrate(1) with the conductive mesh layer(3) using the adhesive layer(2) may be conducted by a roll lamination, or heat-pressing method, preferably in a vacuum. For instance, a hard plate is
10 placed on a mesh face(3a) of the laminate of the transparent substrate(1), the adhesive sheet(2) and the conductive mesh layer(3), in a vacuum press, and then the laminate is heat-pressed at a temperature in the range of 70 to 200 $^{\circ}\text{C}$, preferably 80 to 130 $^{\circ}\text{C}$, under a pressure in the range of 1 to 10 kgf/cm^2 , preferably 2 to 5 kg/cm^2 in a vacuum for about 30 minutes, and cooled to obtain
15 an assembly for the PDP filter. The vacuum may be 100 mmHg or less, preferably 10 mmHg or less.

The hard plate may be made of a metal, plastic or glass, and preferably have an average surface roughness (R_a) of 0.01 to 0.1 μm , and a thickness of 0.1 to 2 mm. When R_a is less than 0.01 μm , air present between the plate and the
20 assembly is not removed, thereby remaining traces on the mesh face of the assembly. Further, when R_a is greater than 0.1 μm , the roughness of the plate can be directly transferred to the mesh face of the assembly and therefore the picture of the PDP filter can be distorted.

Subsequently, an anti-reflection(AR) film(4b) is applied to the front
25 face(1b) of the substrate using a conventional method such as a roll lamination method, to fabricate the inventive PDP filter. Further, in order to reduce the

reflection of light at the surface of the PDP filter, another AR film(4a) may be applied to the mesh face(3a) of the assembly for the PDP filter.

The inventive PDP filter is thin, has a light weight and excellent performance characteristics, and can be fabricated with an enhanced productivity.

5

The present invention is further described and illustrated in Examples provided below, which are, however, not intended to limit the scope of the present invention.

10 Example 1

Step 1) Preparation of adhesive composition

300 g of EVA resin (E155L Grade, a product of Samsung Atofina Co. Ltd., VA contents 15%, melting point 90°C) was completely dissolved in 600
15 ml of a 1:1 (by volume) mixture of methyl ethyl ketone and toluene in a mixer, and thereto were added 1 g of octaphenyl tetraazaporphyrin as a selective optical absorbent and 15 g of IRG022(a dye marketed by Nippon Chemical pharmaceutical Co.) as an NIR cutting pigment. To the resulting solution, a solution of 120 mg of Acridine Orange (a product of Aldrich Chemical Co.)
20 dissolved in 50 ml of isopropyl alcohol was slowly added to obtain an adhesive composition.

Step 2) Preparation of adhesive sheet

On a high transparent PET(polyethylene terephthalate) film of 125 μm
25 thickness, a silicone resin was formed as a release layer through a gravure coating method. The adhesive composition obtained in Step 1 was coated on

the release layer by a comma coating method and dried at 100°C to obtain an NIR cutting/selective optical absorbent adhesive sheet having a thickness of 100 μm .

5 Step 3) Preparation of PDP filter

As shown in Figure 1, to the back face(1a) of a 600 x 1000 x 3 mm transparent glass plate(1), the adhesive sheet obtained in Step 2 (2) and a copper foil (3) having a mesh pattern (thickness: 125 μm , line width: 10 μm , line pitch: 300 μm , open area ratio: 93%) were applied in turn. On the mesh face (3a) of
10 the resulting laminate, an SUS plate having the thickness of 1 mm and R_a of 0.04 μm was placed and put in a vacuum presser. The laminate was heated at 120°C for 30 minutes in a vacuum of 10 mmHg or less under a pressure of 10 kgf/cm^2 to provide a glass plate/adhesive sheet/copper mesh assembly. After 30 minutes, the presser was brought to an ambient pressure and the assembly
15 was cooled for 30 minutes. Two AR films(4a, 4b) having a thickness of 125 μm were put on the mesh face(3a) and the front face(1b) of the assembly, respectively, using a roll laminator at a rate of 1.0m/min, to obtain a PDP filter.

Comparative Example 1

20

Step 1) Preparation of adhesive composition

300 g of poly(methyl methacrylate) (Paraloid B-82, $T_g=35^\circ\text{C}$, a product of Rohm&Has Co.) was completely dissolved in 600 ml of a 1:1 (by volume) mixture of methyl ethyl ketone and toluene in a mixer, and thereto were added 1
25 g of octaphenyl tetraazaporphyrin and 15 g of IRG022(a dye marketed by Nippon Chemical pharmaceutical Co.). To the resulting solution, a solution of

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120 mg of Acridine Orange (a product of Aldrich Chemical Co.) dissolved in 50 ml of isopropyl alcohol was slowly added to obtain an adhesive coating composition.

5 Step 2) Formation of adhesive layer on a base film

The adhesive composition obtained in Step 1 was coated on a high transparent PET(polyethylene terephthalate) film of 125 μm thickness by a microgravure roll coating method and dried at 100°C to obtain a PET film(5) having an NIR cutting and selective optical absorbent layer(5a) in a thickness of
10 10 μm .

Step 3) Preparation of PDP filter

As shown in Figure 2, to the back face(1a) of a 600 x 1000 x 3 mm transparent glass plate(1), an EVA sheet having a thickness of 250 μm (2'), a
15 copper foil (3) having a mesh pattern (thickness: 125 μm , Line width: 10 μm , Line pitch: 300 μm , open area ratio: 93%), and the PET film (5) obtained in Step 2) were applied. At this time, the PET film (5) was placed such that the NIR cutting and selective optical absorbent layer (5a) thereof contacted with the mesh pattern. On the PET film (5) of the resulting laminate, an SUS plate
20 having a thickness of 1 mm and R_a of 0.04 μm was located, and the resultant was placed in a vacuum presser, heated at 120°C for 30 minutes in a vacuum of 10 mmHg or less under a pressure of 10 kgf/cm² to prepare an assembly for the PDP filter. After 30 minutes, the presser was brought to an ambient pressure and the assembly was cooled for 30 minutes. Two AR films(4a, 4b) having a
25 thickness of 125 μm were put on the PET film face(5) and the front face(1b) of the assembly, respectively, using a roll laminator at a rate of 1.0m/min, to

obtain a PDP filter.

Performance Test

- 5 A PDP filter prepared in Example or Comparative Example was installed in a PDP, and tested for the brightness, white light transmittance, NIR transmittance, and Ne light transmittance before and after installation, using a colorimeter (CS1000 of Minolta, Japan). The results are shown in Table 1.

10

Table 1

	Brightness (cd/cm ²)	White light Transmittance (%)	NIR Transmittance (%)	Ne light Transmittance (%)
Before installed	104	100	-	-
After installed with a filter prepared in Ex. 1	67.6	55	8.5	29
After installed with a filter prepared in Com. Ex. 1	57.2	53	8.0	28

As can be seen from the above results, the plasma display panel(PDP) filter prepared in accordance with the present invention, which comprises NIR cutting/selective optical absorbent pigments introduced in an adhesive resin layer
5 to be sandwiched between a transparent substrate and a conductive mesh layer, can impart an improved transmittance and less weight to a PDP, as compared with a filter comprising separately an NIR cutting/selective optical absorbent layer and an adhesive layer.

10 The inventive thin and light-weight optical filter comprising an NIR cutting/selective optical absorbent-containing adhesive layer sandwiched between a transparent substrate and a conductive mesh layer is beneficially used in a plasma display panel(PDP), to provide improved performance characteristics for the PDP.

15

While the subject invention has been described and illustrated with respect to the preferred embodiments only, various changes and modifications may be made therein without departing from the inventive concept of the present invention which should be limited only by the scope of the appended claims.

CLAIMS:

1. A plasma display panel(PDP) filter comprising:
a transparent glass substrate having front and back faces;
5 an adhesive layer containing a near infrared (NIR) cutting pigment and a selective optical absorbent, and a conductive mesh layer, successively attached to the back face of the substrate; and,
an anti-reflection(AR) film attached to the front face of the substrate.
- 10 2. The PDP filter of claim 1, wherein the adhesive layer has a thickness ranging from 10 to 500 μm .
3. The PDP filter of claim 1, wherein the NIR cutting pigment is a mixture of a Ni complex-based dye and a diimmonium-based dye, a Cu or Zn ion-containing
15 pigment, or an organic pigment.
4. The PDP filter of claim 1, wherein the NIR cutting pigment is employed in an amount ranging from 1 to 20 % by weight in the adhesive layer.
- 20 5. The PDP filter of claim 1, wherein the selective optical absorbent is a derivative pigment in which a metal atom located in the center of tetraazaporphyrin is coordinated with one ligand selected from the group consisting of NH_3 , H_2O and halogen, the metal being selected from the group consisting of Zn, Pd, Mg, Mn, Co, Cu, Ru, Rh, Fe, Ni, V, Sn and Ti.
- 25 6. The PDP filter of claim 1, wherein the selective optical absorbent is employed

in an amount ranging from 0.01 to 5 % by weight in the adhesive layer.

7. The PDP filter of claim 1, wherein the adhesive layer comprises an adhesive resin selected from the group consisting of an ethylene vinyl acetate (EVA) copolymer, polyamide resin, polyurethane resin, polyester resin and polyolefin resin, polyacryl resin, and a mixture thereof.

8. The PDP filter of claim 1, which further comprises an anti-reflection(AR) film attached to the conductive mesh layer.

10

9. A method for the preparation of a PDP filter comprising:
placing an adhesive sheet containing a near infrared (NIR) cutting pigment and a selective optical absorbent, and a conductive mesh, successively, on the back face of a transparent glass substrate having front and back faces;
15 heat-pressing the resulting laminate of the conductive mesh, the adhesive sheet and the substrate in vacuum, and
attaching an anti-reflection(AR) film to the front face of the substrate.

10. The method of claim 9, wherein the adhesive sheet is prepared by applying a releasable layer on a transparent thermoplastic resin film substrate, coating an adhesive resin composition containing an NIR cutting pigment and a selective optical absorbent on the releasable layer, drying the coated adhesive layer and removing the resulting adhesive film from the substrate.

25 11. The method of claim 9, wherein the heat-pressing step is carried out by placing a hard plate on the mesh face of the laminate, and heating and pressing the

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laminate to a temperature in the range of 70 to 200 °C under a pressure in the range of 1 to 10 kgf/cm² in a vacuum.

12. The method of claim 11, wherein the hard plate has an average surface
5 roughness (R_a) of 0.01 to 0.1 μm, and a thickness of 0.1 to 2 mm.

13. The method of claim 9, which further comprises attaching an anti-reflection(AR) film to the conductive mesh.

FIG. 1

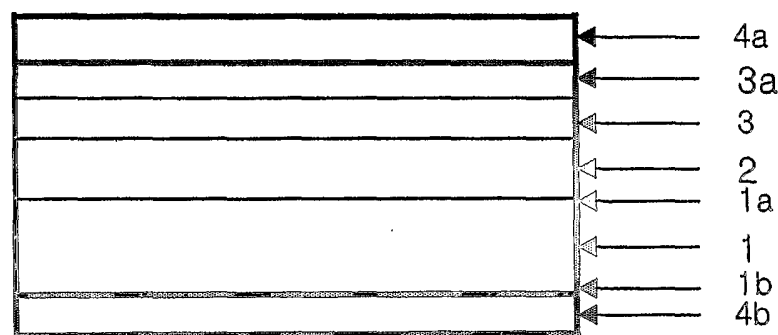
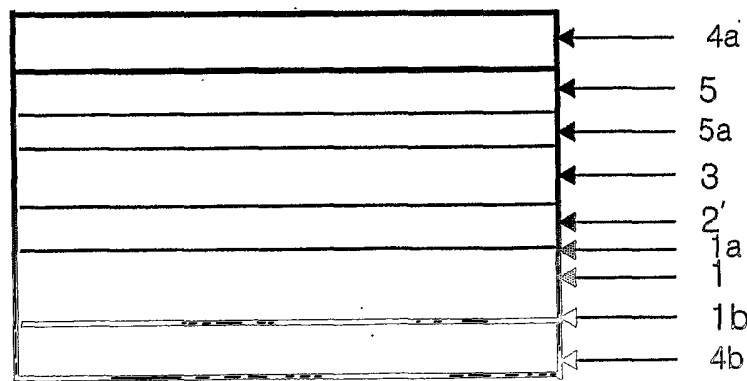


FIG. 2



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2004/000096

A. CLASSIFICATION OF SUBJECT MATTER**IPC7 H01J 17/49**

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)

IPC7 H01J, G02B, B32B, C08G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korea Patents and applications for inventions since 1975

Korea 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)

Korean Patents and Utility Model search system

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	US2002-0050321 A1 (Nisshinbo Industries Inc.) 2 May 2002, see the whole document	1-11, 13
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☐ 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

04 MAY 2004 (04.05.2004)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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