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(54) **LIGHT GUIDE PLATE WITH TRANSLUCENT INK FILM, AND BACKLIGHT MODULE AND LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME**

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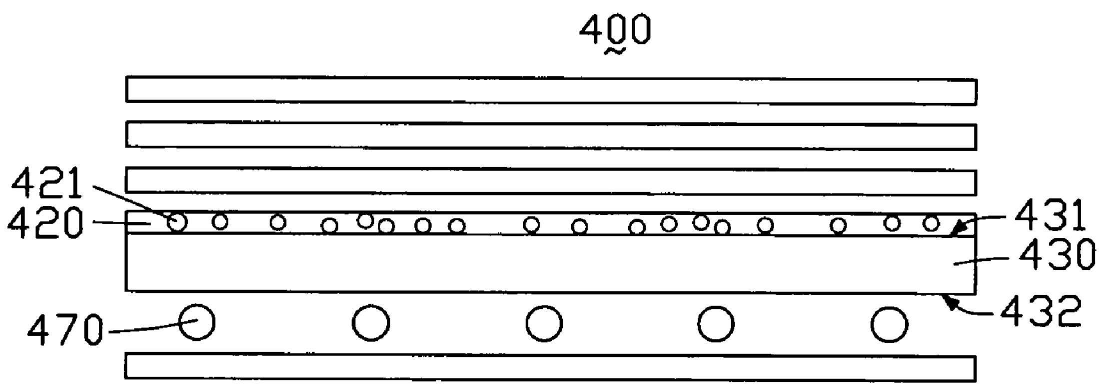
(57) **ABSTRACT**

A light guide plate (**200**) includes at least one surface through which light beams pass, at least one translucent ink film (**220**) disposed on the at least one surface through which light beams pass, and the at least one translucent ink film includes a plurality of pigment particles (**221**). The pigment particles of the translucent ink film can absorb red light and green light, and thereby compensate for a shift in chromaticity that would otherwise occur in a backlight module due to absorption of blue light in the optical sheets of the backlight module. Therefore degradation of the display quality of the LCD is reduced or even eliminated.



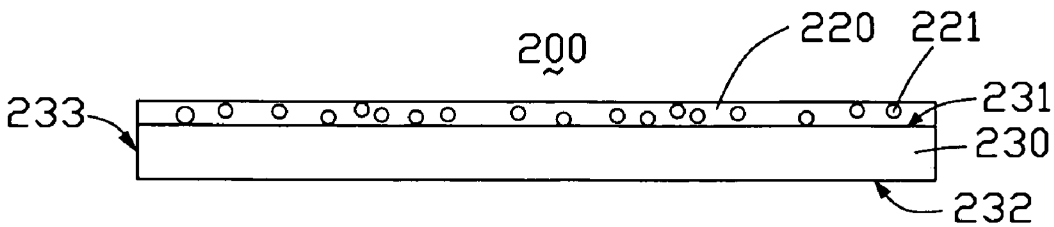


FIG. 1

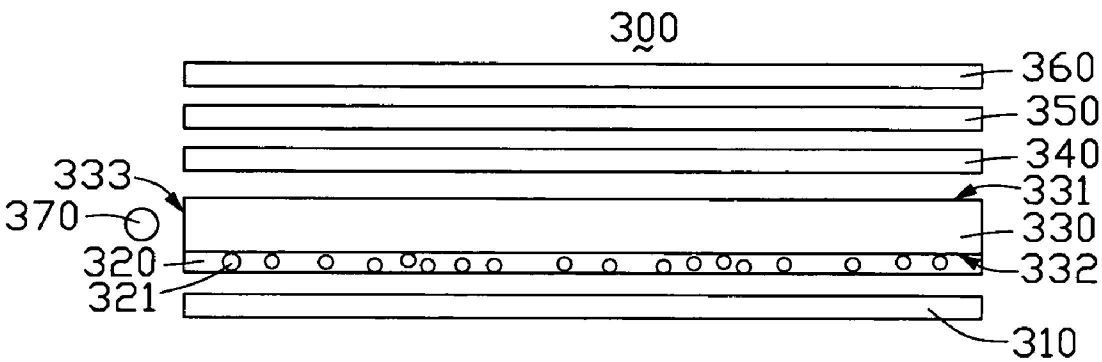


FIG. 2

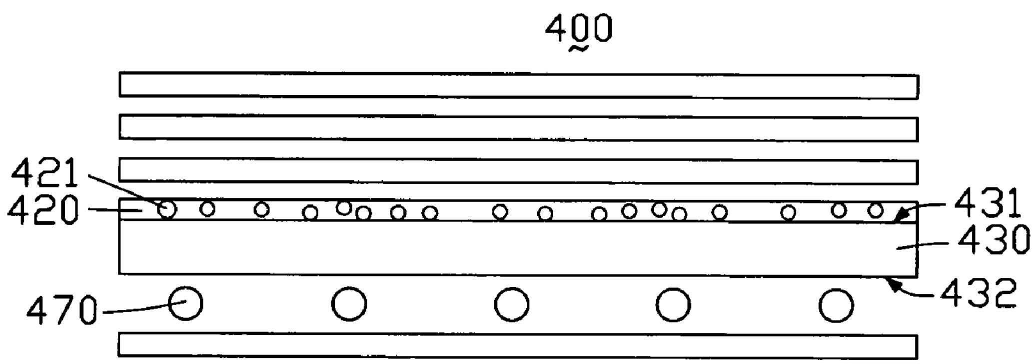


FIG. 3

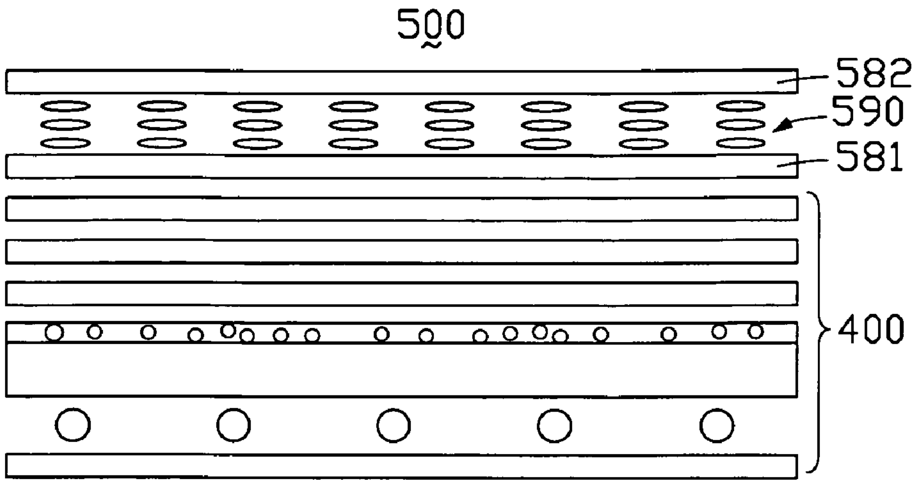


FIG. 4

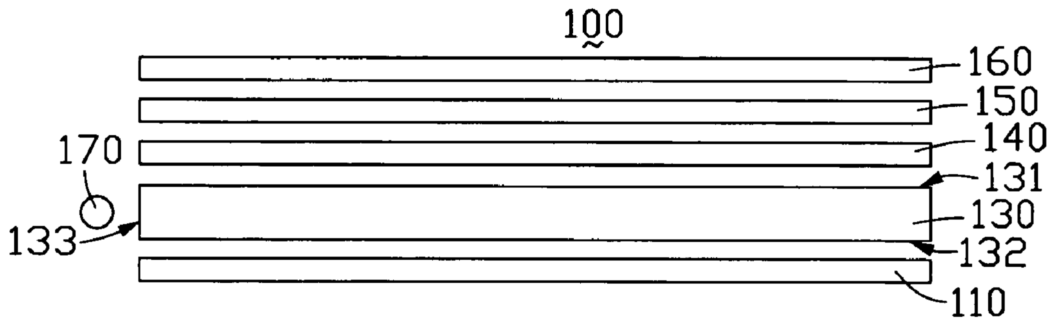


FIG. 5
(RELATED ART)

LIGHT GUIDE PLATE WITH TRANSLUCENT INK FILM, AND BACKLIGHT MODULE AND LIQUID CRYSTAL DISPLAY DEVICE USING THE SAME

FIELD OF THE INVENTION

[0001] The present invention relates to light guide plates, backlight modules that include a light guide plate, and liquid crystal display devices that include a backlight module.

GENERAL BACKGROUND

[0002] Conventionally, a liquid crystal display (LCD) device includes a backlight module, a liquid crystal panel, and a frame for accommodating the backlight module and the liquid crystal panel. The backlight module supplies light beams to the liquid crystal panel to display images.

[0003] **FIG. 5** is a schematic, exploded, side view of a conventional backlight module **100**. The backlight module **100** includes a first diffusion sheet **160**, a brightness enhancement sheet **150**, a second diffusion sheet **140**, a light guide plate **130**, and a reflection sheet **110** arranged in that order from top to bottom. The light guide plate **130** includes an emitting surface **131**, a bottom surface **132**, and an incident surface **133**. The backlight module **100** further includes a light source **170** disposed adjacent to the incident surface **133** of the light guide plate **130**. The first and second diffusion sheets **160**, **140** and the brightness enhancement sheet **150** are two kinds of optical sheets.

[0004] Light beams emitted by the light source **170** transmit into the light guide plate **130** via the light incident surface **133**, and then pass through the emitting surface **131** of the light guide plate **130**, the second diffusion sheet **140**, the brightness enhancement sheet **150**, and the first diffusion sheet **160** to illuminate a display device employing the backlight module **100**. Thereby, the display device can display images.

[0005] However, any one or more of the optical sheets may partly absorb the light beams passing therethrough. Commonly, the optical sheets mainly absorb light beams with short wavelengths. Thus a portion of blue light beams is absorbed, and the chromaticity of emitting light beams is biased toward yellow. The shift in the chromaticity may degrade the display quality of the display device employing the backlight module **100**.

[0006] What is needed, therefore, is a backlight module and a display device using the same that overcome the above-described deficiencies.

SUMMARY

[0007] A light guide plate includes at least one surface through which light beams pass, at least one translucent ink film disposed on the at least one surface through which light beams pass, and the at least one translucent ink film includes a plurality of pigment particles.

[0008] A backlight module includes a light guide plate having an incident surface and at least one other surface through which light beams pass, and at least one translucent ink film disposed on at least one of the incident surface and the at least one other surface through which light beams pass, the at least one translucent ink film having a plurality of pigment particles. A light source is disposed adjacent to the incident surface of the light guide plate.

[0009] A liquid crystal display device includes a top and bottom substrate opposite to each other, a liquid crystal layer sandwiched between the substrates, and the backlight module as described above disposed adjacent to the bottom substrate.

[0010] Other advantages and novel features will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings. In the drawings, all the views are schematic.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] **FIG. 1** is a side view of a light guide plate according to a first embodiment of the present invention.

[0012] **FIG. 2** is an exploded, side view of a backlight module incorporating a light guide plate according to a second embodiment of the present invention.

[0013] **FIG. 3** is a schematic, side view of a backlight module incorporating a light guide plate similar to that of the first embodiment.

[0014] **FIG. 4** is a schematic, side view of a liquid crystal display device incorporating the backlight module of **FIG. 3**.

[0015] **FIG. 5** is an exploded, side view of a conventional backlight module.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] **FIG. 1** is a schematic, side view of a light guide plate according to a first embodiment of the present invention. The light guide plate **200** includes a substrate **230**, and a translucent ink film **220** formed on the substrate **230**. The substrate **230** includes an incident surface **233**, an emitting surface **231**, and a bottom surface **232**. The emitting surface **231** and the bottom surface **232** are opposite to each other. The incident surface **233** adjoins the emitting surface **231** and the bottom surface **232**. The translucent ink film **220** is formed on the emitting surface **231**.

[0017] A thickness of the translucent ink film **220** is in the range from 1 mm to 100 mm, and it can be printed or coated on the substrate **230**. The light guide plate **200** is typically made from polyethylene terephthalate (PET), polycarbonate (PC), or polymethyl methacrylate (PMMA). A base material of the translucent ink film **220** is translucent resin, which can for example be PMMA. The translucent ink film **220** includes a plurality of pigment particles **221** embedded in the base material. The pigment particles **221** are blue pigment particles or other tiny pigment particles which can absorb red light and green light, such as blue dye particles. The pigment particles **221** are spherical, and their size is in the range from 1 μm to 100 μm. The pigment particles **221** can compensate for a shift in chromaticity that would otherwise occur in an associated backlight module due to absorption of blue light in optical sheets of the backlight module.

[0018] In an alternative embodiment, a second translucent ink film **220** can be formed on the bottom surface **232** of the light guide plate **200**.

[0019] **FIG. 2** is a schematic, exploded, side view of a backlight module **300** incorporating a light guide plate according to a second embodiment of the present invention. The backlight module **300** includes a first diffusion sheet **360**, a brightness enhancement sheet **350**, a second diffusion sheet **340**, a light guide plate **330**, a translucent ink film **320**, and a reflection sheet **310** arranged in that order from top to bottom. The light guide plate **330** includes an emitting surface **331**, a bottom surface **332**, and an incident surface **333**. The emitting surface **331** and the bottom surface **332** are opposite to each other. The incident surface **333** adjoins the emitting surface **331** and the bottom surface **332**. The backlight module **300** further includes a light source **370** disposed adjacent to the incident surface **333** of the light guide plate **330**. The first and second diffusion sheets **360**, **340** and the brightness enhancement sheet **350** are two or three kinds of optical sheets.

[0020] The translucent ink film **320** is formed on the bottom surface **332**. A thickness of the translucent ink film **320** is in the range from 1 mm to 100 mm. The translucent ink film **320** includes a plurality of pigment particles **321**. The pigment particles **321** are blue pigment particles or other tiny pigment particles which can absorb red light and green light. The pigment particles **321** can compensate for a shift in chromaticity that would otherwise occur in the backlight module **300** due to absorption of blue light in the optical sheets **340**, **350**, **360** of the backlight module **300**.

[0021] In an alternative embodiment, a second translucent ink film **320** can be formed on the emitting surface **331** of the light guide plate **330**.

[0022] **FIG. 3** is a schematic, exploded, side view of a backlight module **400** incorporating a light guide plate that is similar to the light guide plate of **FIG. 1**. The backlight module **400** is similar to the backlight module **300** of **FIG. 2**. However, the backlight module **400** includes the light guide plate **430**, a translucent ink film **420**, and a plurality of light sources **470**. The light guide plate **430** has an emitting surface **431** and an opposite incident surface **432**. The translucent ink film **420** is formed on the emitting surface **431**, and includes a plurality of pigment particles **421**. The light sources **470** are disposed adjacent to the incident surface **432** of the light guide plate **430**.

[0023] **FIG. 4** is a schematic, exploded, side view of a liquid crystal display device incorporating the backlight module of **FIG. 3**. The liquid crystal display device **500** includes a top substrate **582**, a bottom substrate **581**, a liquid crystal layer **590** sandwiched between the substrates **581**, **582**, and the backlight module **400**. The backlight module **400** is disposed adjacent to the bottom substrate **581**.

[0024] The pigment particles **421** of the translucent ink film **420** can absorb red light and green light, and thereby compensate for a shift in chromaticity that would otherwise occur in the backlight module **400** due to absorption of blue light in the optical sheets of the backlight module **400**. Therefore degradation of the display quality of the LCD **500** is reduced or even eliminated.

[0025] It is to be understood, however, that even though numerous characteristics and advantages of the present embodiments have been set out in the foregoing description, together with details of the structures and functions of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. A light guide plate, comprising:

at least one surface through which light beams pass; and

at least one translucent ink film disposed on the at least one surface through which light beams pass;

wherein the at least one translucent ink film comprises a plurality of pigment particles.

2. The light guide plate as claimed in claim 1, wherein pigment particles are blue pigment particles.

3. The light guide plate as claimed in claim 1, wherein a thickness of the at least one translucent ink film is in the range from 1 mm to 100 mm.

4. The light guide plate as claimed in claim 1, further comprising an emitting surface, a bottom surface opposite to the emitting surface, and an incident surface between the emitting surface and a bottom surface, wherein the at least one surface through which light beams pass is selected from the group consisting of the emitting surface and the bottom surface.

5. The light guide plate as claimed in claim 4, wherein the at least one translucent ink film is disposed on the emitting surface.

6. The light guide plate as claimed in claim 4, wherein the at least one translucent ink film is disposed on the bottom surface.

7. The light guide plate as claimed in claim 1, further comprising an emitting surface and an incident surface opposite to the emitting surface, wherein the at least one surface through which light beams pass is selected from the group consisting of the emitting surface and the incident surface.

8. The light guide plate as claimed in claim 7, wherein the at least one translucent ink film is disposed on the incident surface.

9. The light guide plate as claimed in claim 2, wherein the blue pigment particles are blue dye particles.

10. The light guide plate as claimed in claim 1, wherein the pigment particles are spherical, and sizes of the pigment particles are in the range from 1 μm to 100 μm.

11. A backlight module, comprising:

a light guide plate, comprising an incident surface and at least one other surface through which light beams pass, and at least one translucent ink film disposed on at least one of the incident surface and the at least one other surface through which light beams pass, the at least one translucent ink film comprising a plurality of pigment particles; and

a light source disposed adjacent to the incident surface of the light guide plate.

12. The backlight module as claimed in claim 11, wherein the pigment particles are blue pigment particles.

13. The backlight module as claimed in claim 11, wherein a thickness of the translucent ink film is in the range from 1 mm to 100 mm.

14. The backlight module as claimed in claim 11, wherein the light guide plate further comprises an emitting surface and a bottom surface opposite to the emitting surface, wherein the incident surface is between the emitting surface and the bottom surface, and the at least one other surface through which light beams pass is selected from the group consisting of the emitting surface and the bottom surface.

15. A liquid crystal display device, comprising:

a top substrate and a bottom substrate opposite to each other;

a liquid crystal layer sandwiched between the substrates; and

a backlight module disposed adjacent to the bottom substrate, the backlight module comprising:

a light guide plate comprising an incident surface and at least one other surface through which light beams pass, and at least one translucent ink film disposed on at least one of the incident surface and the at least one other surface through which light beams pass, the at least one translucent ink film comprising a plurality of pigment particles; and

a light source disposed adjacent to the incident surface of the light guide plate.

16. The liquid crystal display device as claimed in claim 15, wherein the pigment particles are blue pigment particles.

17. The liquid crystal display device as claimed in claim 15 wherein a thickness of the at least one translucent ink film is in the range from 1 mm to 100 mm.

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