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(54) **Flat panel display and method of fabricating the same**

Flachbildschirm und Herstellungsverfahren dafür

Dispositif d'affichage plat et son procédé de fabrication

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- **PATENT ABSTRACTS OF JAPAN vol. 2003, no. 08, 6 August 2003 (2003-08-06) -& JP 2003 123987 A (TOYOTA CENTRAL RES & DEV LAB INC), 25 April 2003 (2003-04-25)**
- **JUNG B Y ET AL: "Control of resonant wavelength from organic light emitting materials by use of a Fabry-Perot microcavity structure" APPLIED OPTICS, OSA, OPTICAL SOCIETY OF AMERICA, WASHINGTON, DC, US, vol. 41, no. 16, 1 June 2002 (2002-06-01), pages 3312-3318, XP002345077 ISSN: 0003-6935**

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] This invention relates to a flat panel display that has a phase shift layer and a reflecting layer stacked on an opposite electrode to destructively interfere with reflected external light to realize black. The invention also relates to a method of fabricating the flat panel display.

Discussion of the Background

[0002] An organic light emitting display (OLED) has a contrast ratio depending on the intensity of external light. A black matrix material may be employed to improve the contrast ratio, but it is very difficult to realize perfect black by shielding the external light in an emission region.

[0003] One device used in the prior art to attempt to solve this problem is a circular polarizer 140 shown in FIG. 1. US Patent No. 5,596,246 discloses an OLED that employs the circular polarizer 140. The OLED includes a circular polarizer 140, a lower substrate 100, a transparent first electrode 110, an organic emission layer 120, and a reflecting second electrode 130.

[0004] The circular polarizer 140 is employed to reduce the amount of external light that is reflected off a display panel. The circular polarizer 140 includes a linear polarizer 145 and a quarter compensating plate 141. Two axes of the quarter compensating plate 141 form a 45° angle to an axis of the linear polarizer 145. External light passes through the linear polarizer 145 and becomes linearly polarized. The quarter compensating plate 141 rotates the polarized light 45° spirally. The rotation direction of the polarized light is reversed after it is reflected from a reflecting layer of the display. The polarized light is rotated another 45° when it passes back through the quarter compensating plate 141. At this point, the polarized light is perpendicular to the linear polarizer and is therefore blocked by the linear polarizer 145.

[0005] Only about 44% of light emitted from the organic emission layer 120 passes through the circular polarizer 140. A large amount of light emitted from the organic emission layer 120 is absorbed by the circular polarizer 140, which causes the luminous efficiency and the contrast ratio to be low. To compensate for the reduced luminance, a relatively high voltage must be applied to achieve the desired luminance, which increases the power consumption and decreases the life span of the display. Furthermore, the manufacturing costs of the OLED are increased because the manufacturing process is complicated and the polarizer is expensive.

[0006] Another device used in the prior art to attempt to solve this problem was developed by Luxell Technologies Inc. Instead of a polarizer, Luxell incorporated an absorbing layer and a dielectric layer between an inorganic phosphorescent layer and an opposite electrode in an inorganic device. The method achieves black by destructive interference of external light and was disclosed in the Journal of Military and Aerospace Electronics, Volume 9, No. 6, June, 1998. But the method does not realize black to a satisfactory degree because the thickness of a thin film should be adjusted in consideration of the refractive index and absorptivity thereof.

[0007] The following documents also disclose flat panel displays with resonant structures:

US 6 639 250 B1 (SHIMODA TATSUYA ET AL) 28 October 2003 (2003-10-28)

WO 03/096757 A (ZEOLUX CORPORATION) 20 November 2003 (2003-11-20)

PATENT ABSTRACTS OF JAPAN vol. 2003, no. 08, 6 August 2003 (2003-08-06) -& JP 2003 123987 A (TOYOTA CENTRAL RES & DEV LAB INC), 25 April 2003 (2003-04-25)

US 6 326 224 B1 (XU JI-HAI ET AL) 4 December 2001 (2001-12-04)

EP 1 154 676 A (SONY CORPORATION) 14 November 2001 (2001-11-14)

US 2004/195965 A1 (YAMAZAKI SHUNPEI ET AL) 7 October 2004 (2004-10-07)

JUNG B Y ET AL: "Control of resonant wavelength from organic light emitting materials by use of a Fabry-Perot microcavity structure" APPLIED OPTICS, OSA, OPTICAL SOCIETY OF AMERICA, WASHINGTON, DC, US, vol. 41, no. 16, 1 June 2002 (2002-06-01), pages 3312-3318, XP002345077 ISSN: 0003-6935

SUMMARY OF THE INVENTION

[0008] The present invention provides a flat panel display as disclosed in claim 1.The flat panel display has excellent luminous efficiency and contrast ratio, which lowers the required luminance and thus reduces power consumption and increases the life span of the display.

[0009] Additional features of the invention will be set forth in the description which follows.

[0010] Preferably the flat panel display further comprises at least one thin film transistor disposed between the substrate and the pixel electrode. Preferably the organic layer further includes at least one additional layer selected from the group of a hole injection layer, a hole transport layer, a hole blocking layer, an electron transport layer, and an electron injection layer. Preferably the opposite electrode is formed of a material selected from the group of Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg, and Li. Preferably the opposite electrode is 150Å (10 Å = 1 nm) to 250Å thick. Preferably the opposite electrode is 180Å thick. Preferably the phase shift layer is 500Å to 800Å thick.

Preferably the transparent layer is an organic layer, an inorganic layer, or a stacked structure of an organic layer and an inorganic layer. Preferably the inorganic layer is formed of a material selected from the group of silicon nitride (SiNx), silicon oxide (SiO_2), silicon oxynitride (SiON), and a transparent conductive oxide (TCO). Preferably the partially reflecting layer is a semi-transparent metal layer. Preferably the semi-transparent metal layer is formed of a material selected from the group of Mg, Ag, MgAg, Cr, Pt, and Au. Preferably the partially reflecting layer is 80Å to 120Å thick.

[0011] The present invention also discloses a method of fabricating a flat panel display. The method includes the steps of claim 10.

Preferably the method further comprises the step of forming at least one thin film transistor between the substrate and the pixel electrode. Preferably the opposite electrode is formed of a material selected from the group of Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg, and Li. Preferably the opposite electrode is 150Å to 250Å thick. Preferably the opposite electrode is 180Å thick. Preferably the phase shift layer is 500Å to 800Å thick. Preferably the transparent layer is an organic layer, an inorganic layer, or a stacked structure of an organic layer and an inorganic layer. Preferably the inorganic layer is formed of a material selected from the group of silicon nitride (SiNx), silicon oxide (SiO_2), silicon oxynitride (SiON), and a transparent conductive oxide (TCO). Preferably the partially reflecting layer is a semi-transparent metal layer. Preferably the semi-transparent metal layer is formed of a material selected from the group of Mg, Ag, MgAg, Cr, Pt, and Au. Preferably the partially reflecting layer is about 80Å to about 120Å thick.

[0012] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and together with the description serve to explain the principles of the invention.

[0014] FIG. 1 shows a cross-sectional view of a conventional OLED having a circular polarizer.

[0015] FIG. 2 shows a cross-sectional view of an OLED according to an exemplary embodiment of the present invention.

[0016] FIG. 3 shows a graph illustrating the luminance of an OLED according to an exemplary embodiment of the present invention.

[0017] FIG. 4 shows a graph illustrating the luminous efficiency of an OLED according = to an exemplary embodiment of the present invention.

[0018] FIG. 5A, FIG. 5B, and FIG. 5C shows photographs of OLEDs which realize different degrees of black.

[0019] FIG. 6 shows a graph illustrating the reflectivity of an OLED according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0020] The invention is described more fully hereinafter with reference to the accompanying drawings, in which embodiments of the invention are shown. This invention may, however, be embodied in many different forms within the scope of the claims and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure is thorough, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the size and relative sizes of layers and regions may be exaggerated for clarity.

[0021] It will be understood that when an element such as a layer, film, region or substrate is referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present. In contrast, when an element is referred to as being "directly on" another element, there are no intervening elements present.

[0022] FIG. 2 shows a cross-sectional view of a flat panel display according to an exemplary embodiment of the present invention. The present invention may be applied to any type of flat panel display device. FIG 2. shows an exemplary embodiment in which the flat panel display is an OLED.

[0023] A pixel electrode 210 is disposed on a substrate 200, an organic layer 220 having at least an emission layer is disposed on the pixel electrode 210, and an opposite electrode 230, a phase shift layer 240 and a reflecting layer 242 are sequentially disposed on the organic layer 220. A plurality of thin film transistors (TFTs) may be disposed between the substrate 200 and the pixel electrode 210.

[0024] The pixel electrode 210 is a reflecting electrode with a transparent conductive oxide (TCO) such as indium tin oxide (ITO) or indium zinc oxide (IZO) formed on a reflecting layer made of A1 (Nd), an A1 alloy, Ag, or an Ag alloy. The opposite electrode 230 is a reflecting electrode layer. The opposite electrode 230 may be made of one of Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg, or Li. The opposite electrode 230 is 150Å to 250Å thick, and preferably is 180Å thick.

[0025] The phase shift layer 240 may be an organic layer, an inorganic layer, or a stacked structure of layers. The phase shift layer 240 is 400Å to 1300Å thick, and preferably is 500Å to 800Å thick. The phase shift layer 240 serves as a transparent layer that inverts the phase of light reflected from the opposite electrode 230 to create a phase shift. The phase shift creates an annihilation phenomenon that causes external reflected light to destroy itself.

[0026] The reflecting layer 242 may be a semi-transparent metal layer made of Mg, Ag, MgAg, Cr, Pt, or Au. The reflecting layer 242 may be 60Å to 130Å thick and preferably is 80Å to 120Å thick. The reflecting layer 242 should have a higher transmittance than the opposite electrode 230. The reflecting layer 242 has a transmittance of 40% to 60%, and the opposite electrode 230 has a transmittance of 10% to 40%.

[0027] A method of fabricating the OLED will now be explained below.

[0028] First, a pixel electrode 210 is disposed on a substrate 200. The pixel electrode 210 is a transparent electrode and may be made of a transparent conductive oxide (TCO) such as indium tin oxide (ITO) or indium zinc oxide (IZO). The pixel electrode 210 includes a reflecting layer (not shown) positioned below it. At least one thin film transistor (TFT) may be disposed between the transparent substrate 200 and the pixel electrode 210.

[0029] An organic layer 220 with at least an emission layer is formed on the pixel electrode 210. The organic layer 220 may also include one or more of a hole injection layer, a hole transport layer, a hole blocking layer, an electron transport layer, and an electron injection layer.

[0030] An opposite electrode 230 is formed on the organic layer 220. The opposite electrode 230 is a reflecting electrode layer and may be made of Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg, or Li. The opposite electrode 230 may be 150Å to 250Å thick and preferably is 180Å thick.

[0031] A phase shift layer 240 is formed on the opposite electrode 230. The phase shift layer 240 serves to invert a phase of light reflected from the opposite electrode 230. The phase shift layer 240 is 400Å to 1300Å thick, and preferably is 500Å to 800Å thick. The annihilation phenomenon does not occur when the thickness of the phase shift layer 240 falls outside the range of 400Å to 1300Å thick.

[0032] The phase shift layer 240 may be formed of an organic layer, an inorganic layer, or a stacked structure of layers. Any type of transparent organic layer may be used to form an organic phase shift layer 240. SiNx, SiO_2, SiON, or transparent conductive oxide (TCO) may be used to form an inorganic phase shift layer 240.

[0033] A reflecting layer 242 is formed on the phase shift layer 240. The reflecting layer 242 may be a semi-transparent metal layer made of Mg, Ag, MgAg, Cr, Pt, or Au. The reflecting layer 242 may be 50Å to 120Å thick. The thickness of the reflecting layer 242 may be combined with the thickness of the phase shift layer 240 to create an optimal thickness to destructively interfere with and extinguish reflected external light. The reflecting layer 242 reflects external incident light to realize black by creating destructive interference with the phase-inverted light from the phase shift layer 240.

[0034] In an exemplary embodiment of the present invention, the phase shift layer 240 and the reflecting layer 242 are patterned only on an emission region of the OLED.

[0035] FIG. 3 shows a graph illustrating the luminance versus the voltage applied to a group of OLEDs. The graph in FIG. 3 shows the luminance of an OLED where the phase shift layer 240 is formed of an organic or inorganic material on an opposite electrode and the reflecting layer 242 is formed of MgAg on the phase shift layer. The graph in FIG. 3 shows luminance data for an OLED with a reflecting layer that is 50Å (MgAg50Å) and 100Å (MgAg100Å) thick. The graph in FIG. 3 also shows luminance data for an OLED on which a polarizer is employed (POLARIZER).

[0036] Referring to FIG. 3, it can be seen that an OLED that employs a phase shift layer 240 and a reflecting layer 242 is much higher in luminance than an OLED on which only a polarizer is employed. It can be also seen that an OLED that employs a reflecting layer 242 that is 50Å thick is similar in luminance to one where the reflecting layer 242 is 100Å thick.

[0037] FIG. 4 shows a graph illustrating luminous efficiency versus luminance for the same group of OLEDs shown in FIG. 3. It can be seen that an OLED that uses a phase shift layer 240 and a reflecting layer 242 (MgAg50Å and MgAg1001Å) is much higher in luminous efficiency than in an OLED on which a polarizer is employed (POLARIZER).

[0038] An example of an embodiment of the present invention will now be described below. The embodiment is given as an example to further understanding of the present invention, but the scope of the present invention is not limited to the embodiment described.

<Embodiment 1>

[0039] An OLED was formed as follows. A pixel electrode 210 was formed on a substrate 200. An organic emission layer 220 was formed on the pixel electrode 210. The organic emission layer 220 was made to different thicknesses according to its color. Red and green emission layers were 400Å thick, and a blue emission layer was 150Å thick. An electron transport layer about 250Å to about 300Å thick was formed as part of the emission layer. An opposite electrode 230, 180Å thick was formed on the organic layer 220. A phase shift layer 240, 500Å to 800Å thick was formed on the opposite electrode 230. A reflecting layer 242, 80Å to 120Å thick was formed on the phase shift layer 240. The luminous efficiency of Embodiment 1 is shown in Table 1.

<Comparative Example 1>

[0040] An OLED was formed in the same way as Embodiment 1 except that a reflecting layer 242 was excluded. The luminous efficiency of Comparative Example 1 is shown in Table 1.

<Comparative Example 2>

[0041] An OLED was formed in the same way as Embodiment 1 except that a polarizer was formed on the opposite electrode instead of a phase shift layer 240 and a reflecting layer 242. The luminous efficiency of Comparative Example 2 is shown in Table 1.

[Table 1]

	Red	Green	Blue
Embodiment 1	8cd/A	28cd/A	1.4cd/A
Comparison 1	11cd/A	56cd/A	1.8cd/A
Comparison 2	4.8cd/A	24cd/A	0.8cd/A

[0042] As shown in Table 1, the luminous efficiency of Embodiment 1 is 170% in red, 116% in green and 175% in blue, compared to Comparative Example 2.

[0043] FIG. 5A, FIG. 5B, and FIG. 5C show photographs illustrating OLEDs with different degrees of embodied blacks. FIG. 5A shows the embodied black when only a phase shift layer is stacked on an opposite electrode. FIG. 5B and FIG. 5C show the embodied black when a phase shift layer and a reflecting layer are stacked on an opposite electrode. The reflecting layer of FIG. 5B is 50Å thick, and the reflecting layer of FIG. 5C is 100Å thick. It can be seen that black, shown in the center of the photograph, is best realized when the reflecting layer is 100Å thick.

[0044] FIG. 6 shows a graph illustrating the reflectivity of various wavelengths of light of an OLED according to an exemplary embodiment of the present invention. In FIG. 6, "A" denotes the reflectivity of a pixel electrode alone, "B" denotes the reflectivity of aluminum (Al) alone, and "C" denotes the reflectivity of an opposite electrode with a phase shift layer 240 and a reflecting layer 242 stacked upon it.

[0045] As can be seen in FIG. 6, reflected external light is significantly reduced when the phase shift layer and the reflecting layer are stacked on the opposite electrode.

[0046] It will be apparent to those skilled in the art that various modifications and variation can be made in the present invention without departing from the scope of the invention as defined in the appended claims. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims.

Claims

1. A flat panel display, comprising:

a reflecting pixel electrode (210) disposed above a substrate (200);
an organic layer (220) including an emission layer disposed on the pixel electrode (210);
an opposite electrode (230) disposed on the organic layer (220), the opposite electrode (230) comprising a visible light transmittance of 10% to 40%;
a transparent phase shift layer (240) directly disposed on the opposite electrode (230) for shifting the phase of light reflected from the opposite electrode (230), the phase shift layer (240) comprising a thickness between 40 nm and 130 nm; and
a partially reflecting layer (242) directly disposed on the phase shift layer (240), the partially reflecting layer (242) comprising a visible light transmittance of 40% to 60%.

2. The flat panel display of claim 1, further comprising at least one thin film transistor disposed between the substrate (200) and the pixel electrode (210).

3. The flat panel display of claim 1 or 2, wherein the organic layer (220) further includes at least one additional layer selected from the group of a hole injection layer, a hole transport layer, a hole blocking layer, an electron transport layer, and an electron injection layer.

4. The flat panel display of claim 1-3, wherein the opposite electrode (230) is formed of a material selected from the group of Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg, and Li and/or wherein the opposite electrode (230) is 15 nm to 25 nm thick.

5. The flat panel display of claim 1-4, wherein the opposite electrode (230) is 180 nm thick.

6. The flat panel display according to one of the preceding claims, wherein the phase shift layer (240) is 500 nm to 80 nm thick.

7. The flat panel display according to one of the preceding claims, wherein the transparent phase shift layer (240) is an organic layer, an inorganic layer, or a stacked structure of an organic layer and an inorganic layer.

8. The flat panel display of claim 7, wherein the inorganic layer is formed of a material selected from the group of silicon nitride (SiNx), silicon oxide (SiO_2), silicon oxynitride (SiON), and a transparent conductive oxide (TCO).

9. The flat panel display according to one of the preceding claims, wherein the partially reflecting layer (242) is a semitransparent metal layer and/or wherein the partially reflecting layer (242) is formed of a material selected from the group of Mg, Ag, MgAg, Cr, Pt, and Au and/or wherein the partially reflecting layer (242) is

8 nm 12 nm thick.

10. A method of fabricating a flat panel display, comprising:

forming a reflecting pixel electrode (210) above a substrate (200),
forming an organic layer (220) including an emission layer on the pixel electrode (210),
forming an opposite etectrode (230) on the organic layer (220), the opposite electrode (230) having a visible light transmittance of 10% to 40%,
forming a transparent phase shift layer (240) directly on the opposite electrode (230), the transparent phase shift layer (240) being adapted for shifting the phase of light reflected from the opposite electrode (230), and the phase shift layer (240) having a thickness between 40 nm and 130 nm, and
forming a partially reflecting layer (242) directly on the phase shift layer (240), the partially reflecting layer (242) having a visible light transmittance of 40% to 60%.

11. The method of claim 10,
further comprising forming at least one thin film transistor between the substrate (200) and the pixel electrode (210).

12. The method of claim 10 or 11,
wherein the opposite electrode (230) is formed of a material selected from the group of Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg, and Li and/or wherein the opposite electrode (230) is 15 nm to 25 nm thick.

13. The method of claim 12,
wherein the opposite electrode (230) is 17 nm to 19 nm, preferably 18 nm thick.

14. The method of claim according to one of the claims 10-13,
wherein the phase shift layer (240) is 50 nm to 80 nm thick.

15. The method according to one of the claims 10-14, wherein the transparent phase shift layer (240) is an organic layer, an inorganic layer, or a stacked structure of an organic layer and an inorganic layer.

16. The method of claim 15,
wherein the inorganic layer is formed of a material selected from the group of silicon nitride (SiNx), silicon oxide (SiO_2), silicon oxynitride (SiON), and a transparent conductive oxide (TCO).

17. The method The method according to at least one of the claims 10-16,
wherein the partially reflecting layer (242) is a semitransparent metal layer and/or wherein the partially reflecting layer (242) is 8 nm to 12 nm thick.

18. The method of claim 17,
wherein the semi-transparent metal layer is formed of a material selected from the group of Mg, Ag, MgAg, Cr, Pt, and Au.

Patentansprüche

1. Ein Flachbildschirm, umfassend:

eine oberhalb eines Substrats (200) angeordnete reflektierende Pixelelektrode (210);
eine auf der Pixelelektrode (210) angeordnete organische Schicht (220), die eine Emissionsschicht aufweist;
eine auf der organischen Schicht (220) angeordnete gegenüberliegende Elektrode (230), wobei die gegenüberliegende Elektrode (230) einen Transmissionsgrad für sichtbares Licht von 10% bis 40% umfasst;
eine direkt auf der gegenüberliegenden Elektrode (230) angeordnete transparente Phasenverschiebungsschicht (240) zur Verschiebung der Phase von der gegenüberliegenden Elektrode (230) reflektiertem Licht, wobei die Phasenverschiebungsschicht (240) eine Dicke zwischen 40 nm und 130 nm umfasst; und
eine direkt auf der Phasenverschiebungsschicht angeordnete teilreflektierende Schicht (242), wobei die teilreflektierende Schicht (242) einen Transmissionsgrad für sichtbares Licht von 40% bis 60% umfasst.

2. Der Flachbildschirm nach Anspruch 1,
ferner umfassend mindestens einen zwischen dem Substrat (200) und der Pixelelektrode (210) angeordneten Dünnfilmtransistor.

3. Der Flachbildschirm nach Anspruch 1 oder 2,
wobei die organische Schicht (220) ferner mindestens eine aus der aus einer Lochinjektionsschicht, einer Lochtransportschicht, einer Lochsperrschicht, einer Elektronentransportschicht und einer Elektroneninjektionsschicht bestehenden Gruppe ausgewählte zusätzliche Schicht beinhaltet.

4. Der Flachbildschirm nach Anspruch 1-3,
wobei die gegenüberliegende Elektrode (230) aus einem aus der aus Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg und Li bestehenden Gruppe ausgewählten Material gebildet ist und/oder wobei die gegenüberliegende Elektrode (230) 15 nm bis 25 nm dick ist.

5. Der Flachbildschirm nach Anspruch 1-4, wobei die gegenüberliegende Elektrode (230) 18 nm dick ist.

6. Der Flachbildschirm gemäß einem der vorhergehenden Ansprüche, wobei die Phasenverschiebungsschicht (240) 50 nm bis 80 nm dick ist.

7. Der Flachbildschirm gemäß einem der vorhergehenden Ansprüche, wobei die transparente Phasenverschiebungsschicht (240) eine organische Schicht, eine anorganische Schicht oder eine gestapelte Struktur einer organischen Schicht und einer anorganischen Schicht ist.

8. Der Flachbildschirm nach Anspruch 7, wobei die anorganische Schicht aus einem aus der aus Siliziumnitrid (SiNx), Siliziumoxid (SiO_2), Siliziumoxynitrid (SiON) und einem transparenten leitfähigen Oxid (TCO) bestehenden Gruppe ausgewählten Material gebildet ist.

9. Der Flachbildschirm gemäß einem der vorhergehenden Ansprüche, wobei die teilreflektierende Schicht (242) eine halbtransparente Metallschicht ist und/oder wobei die teilreflektierende Schicht (242) aus einem aus der aus Mg, Ag, MgAg, Cr, Pt und Au bestehenden Gruppe ausgewählten Material gebildet ist und/oder wobei die teilreflektierende Schicht (242) 8 nm bis 12 nm dick ist.

10. Ein Verfahren zur Herstellung eines Flachbildschirms, umfassend:

Ausbilden einer reflektierenden Pixelelektrode (210) oberhalb eines Substrats (200),
Ausbilden einer eine Emissionsschicht beinhaltenden organischen Schicht (220) auf der Pixelelektrode (210),
Ausbilden einer gegenüberliegenden Elektrode (230) auf der organischen Schicht (220), wobei die gegenüberliegende Elektrode (230) einen Transmissionsgrad für sichtbares Licht von 10% bis 40% aufweist,
Ausbilden einer transparenten Phasenverschiebungsschicht (240) direkt auf der gegenüberliegenden Elektrode (230), wobei die transparente Phasenverschiebungsschicht (240) dazu ausgelegt ist, die Phase von der gegenüberliegenden Elektrode (230) reflektiertem Licht zu verschieben und die Phasenverschiebungsschicht (240) eine Dicke zwischen 40 nm und 130 nm aufweist, und
Ausbilden einer teilreflektierenden Schicht (242) direkt auf der Phasenverschiebungsschicht (240), wobei die teilreflektierende Schicht (242) einen Transmissionsgrad für sichtbares Licht von 40% bis 60% aufweist.

11. Das Verfahren nach Anspruch 10, ferner umfassend Ausbilden mindestens eines Dünnfilmtransistors zwischen dem Substrat (200) und der Pixelelektrode (210).

12. Das Verfahren nach Anspruch 10 oder 11, wobei die gegenüberliegende Elektrode (230) aus einem aus der aus Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg und Li bestehenden Gruppe ausgewählten Material gebildet ist und/oder wobei die gegenüberliegende Elektrode (230) 15 nm bis 25 nm dick ist.

13. Das Verfahren nach Anspruch 12, wobei die gegenüberliegende Elektrode (230) 17 nm bis 19 nm, vorzugsweise 18 nm dick ist.

14. Das Verfahren gemäß einem der Ansprüche 10-13, wobei die Phasenverschiebungsschicht (240) 50 nm bis 80 nm dick ist.

15. Das Verfahren gemäß einem der Ansprüche 10-14, wobei die transparente Phasenverschiebungsschicht (240) eine organische Schicht, eine anorganische Schicht oder eine gestapelte Struktur einer organischen Schicht und einer anorganischen Schicht ist.

16. Das Verfahren nach Anspruch 15, wobei die anorganische Schicht aus einem aus der aus Siliziumnitrid (SiNx), Siliziumoxid (SiO_2), Siliziumoxynitrid (SiON) und einem transparenten leitfähigen Oxid (TCO) bestehenden Gruppe ausgewählten Material gebildet ist.

17. Das Verfahren gemäß mindestens einem der Ansprüche 10-16, wobei die teilreflektierende Schicht (242) eine halbtransparente Metallschicht ist und/oder wobei die teilreflektierende Schicht (242) 8 nm bis 12 nm dick ist.

18. Das Verfahren nach Anspruch 17, wobei die halbtransparente Metallschicht aus einem aus der aus Mg, Ag, MgAg, Cr, Pt und Au bestehenden Gruppe ausgewählten Material gebildet ist.

Revendications

1. Ecran plat, comprenant :

une électrode de pixel réfléchissante (210) disposée au-dessus d’un substrat (200) ;

une couche organique (220) comportant une couche d'émission disposée sur l'électrode de pixel (210) ;
une électrode opposée (230) disposée sur la couche organique (220), l'électrode opposée (230) comprenant un facteur de transmission de lumière visible de 10 % à 40 % ;
une couche de déphasage transparente (240) disposée directement sur l'électrode opposée (230) pour déphaser la lumière réfléchie de l'électrode opposée (230), la couche de déphasage (240) comprenant une épaisseur entre 40 nm et 130 nm ; et
une couche partiellement réfléchissante (242) disposée directement sur la couche de déphasage (240), la couche partiellement réfléchissante (242) comprenant un facteur de transmission de lumière de 40% à 60%.

2. Ecran plat de la revendication 1,
comprenant en outre au moins un transistor à couches minces disposé entre le substrat (200) et l'électrode de pixel (210) .

3. Ecran plat de la revendication 1 ou 2,
dans lequel la couche organique (220) comporte en outre au moins une couche supplémentaire choisie dans le groupe consistant en une couche d'injection de trous, une couche de transport de trous, une couche de blocage de trous, une couche de transport d'électrons et une couche d'injection d'électrons.

4. Ecran plat de la revendication 1-3,
dans lequel l'électrode opposée (230) est formée d'un matériau choisi dans le groupe constitué de Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg et Li, et/ou dans lequel l'électrode opposée (230) a une épaisseur de 15 nm à 25 nm.

5. Ecran plat de la revendication 1-4,
dans lequel l'électrode opposée (230) a une épaisseur de 18 nm.

6. Ecran plat selon l'une des revendications précédentes,
dans lequel la couche de déphasage (240) a une épaisseur de 50 nm à 80 nm.

7. Ecran plat selon l'une des revendications précédentes,
dans lequel la couche de déphasage transparente (240) est une couche organique, une couche inorganique, ou une structure empilée d'une couche organique et d'une couche inorganique.

8. Ecran plat de la revendication 7,
dans lequel la couche inorganique est formée d'un matériau choisi dans le groupe constitué de nitrure de silicium (SiNx), d'oxyde de silicium (SiO_2), d'oxynitrure de silicium (SiON) et d'un oxyde conducteur transparent (TCO).

9. Ecran plat selon l'une des revendications précédentes,
dans lequel la couche partiellement réfléchissante (242) est une couche en métal semi-transparente et/ou dans lequel la couche partiellement réfléchissante (242) est formée d'un matériau choisi dans le groupe constitué de Mg, Ag, MgAg, Cr, Pt et Au, et/ou dans lequel la couche partiellement réfléchissante (242) a une épaisseur de 8 nm à 12 nm.

10. Procédé de fabrication d'un écran plat, comprenant les étapes consistant à :

former une électrode de pixel réfléchissante (210) au-dessus d'un substrat (200),
former une couche organique (220) comportant une couche d'émission sur l'électrode de pixel (210),
former une électrode opposée (230) sur la couche organique (220), l'électrode opposée (230) ayant un facteur de transmission de lumière visible de 10% à 40%,
former une couche de déphasage transparente (240) directement sur l'électrode opposée (230), la couche de déphasage transparente (240) étant adaptée pour déphaser la lumière réfléchie de l'électrode opposée (230), et la couche de déphasage (240) ayant une épaisseur entre 40 nm et 130 nm, et
former une couche partiellement réfléchissante (242) directement sur la couche de déphasage (240), la couche partiellement réfléchissante (242) ayant un facteur de transmission de lumière de 40% à 60%.

11. Procédé de la revendication 10,
comprenant en outre le fait de former au moins un transistor à couches minces entre le substrat (200) et l'électrode de pixel (210).

12. Procédé de la revendication 10 ou 11,
dans lequel l'électrode opposée (230) est formée d'un matériau choisi dans le groupe constitué de Mg, MgAg, Ca, CaAg, Ag, AlCa, AlAg, LiMg et Li, et/ou dans lequel l'électrode opposée (230) a une épaisseur de 15 nm à 25 nm.

13. Procédé de la revendication 12,
dans lequel l'électrode opposée (230) a une épaisseur de 17 nm à 19 nm, de préférence une épaisseur de 18 nm.

14. Procédé selon l'une des revendications 10-13,
dans lequel la couche de déphasage (240) a une

épaisseur de 50 nm à 80 nm.

15. Procédé selon l'une des revendications 10-14, dans lequel la couche de déphasage transparente (240) est une couche organique, une couche inorganique ou une structure empilée d'une couche organique et d'une couche inorganique.

16. Procédé de la revendication 15, dans lequel la couche inorganique est formée d'un matériau choisi dans le groupe constitué de nitrure de silicium (SiNx), d'oxyde de silicium (SiO_2), d'oxynitrure de silicium (SiON) et d'un oxyde conducteur transparent (TCO) .

17. Procédé selon au moins l'une des revendications 10-16, dans lequel la couche partiellement réfléchissante (242) est une couche en métal semi-transparente et/ou dans lequel la couche partiellement réfléchissante (242) a une épaisseur de 8 nm à 12 nm.

18. Procédé de la revendication 17, dans lequel la couche en métal semi-transparente est formée d'un matériau choisi dans le groupe constitué de Mg, Ag, MgAg, Cr, Pt et Au.

FIG. 1

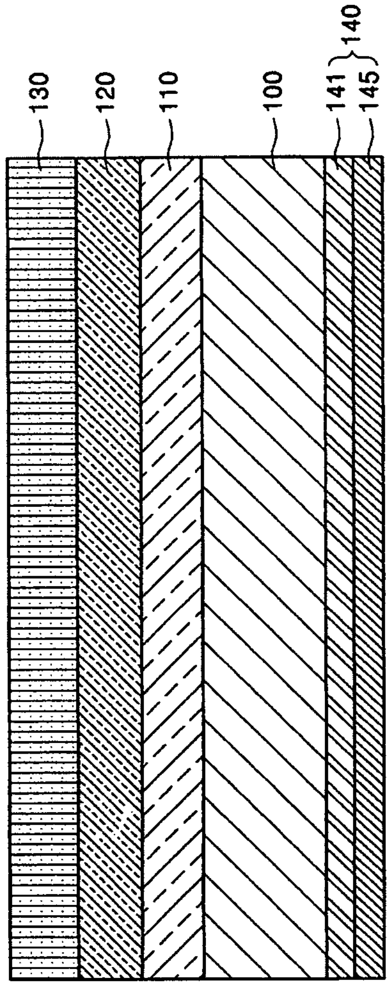


FIG. 2

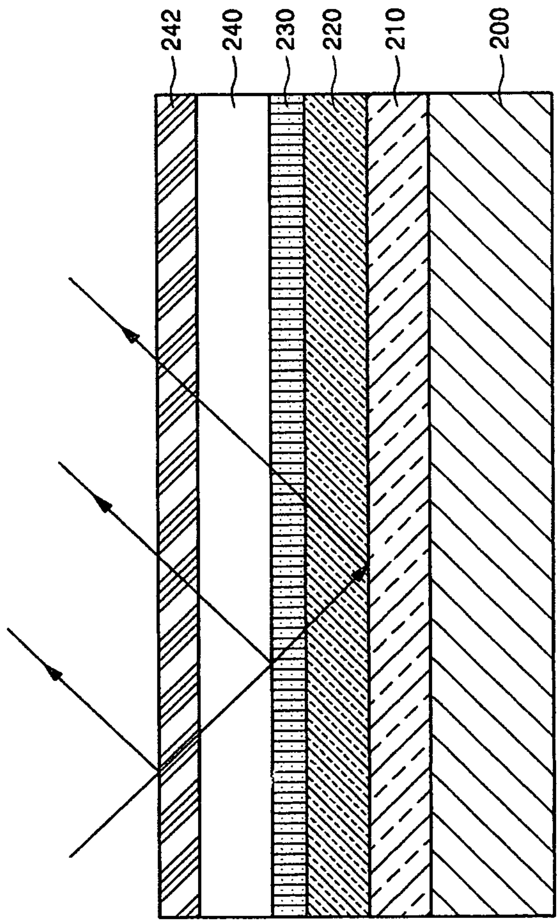


FIG. 3

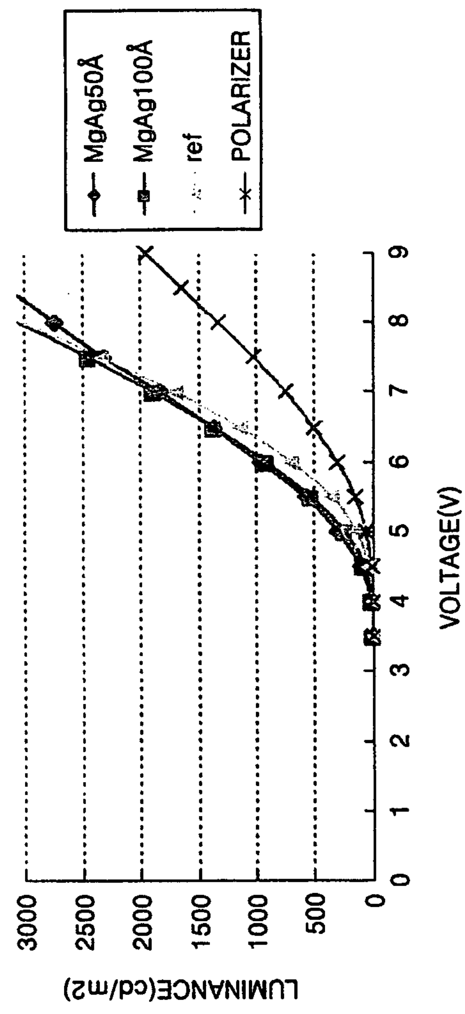

LUMINANCE(cd/m2)
3000
2500
2000
1500
1000
500
0
0
1
2
3
4
5
6
7
8
9
VOLTAGE(V)
MgAg50Å
MgAg100Å
ref
POLARIZER

FIG. 4

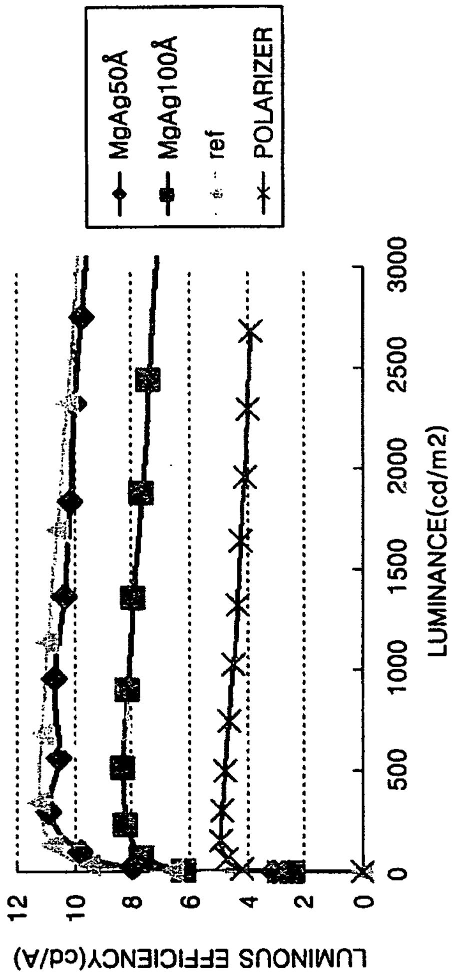

MgAg50Å
MgAg100Å
ref
POLARIZER
LUMINOUS EFFICIENCY(cd/A)
0
2
4
6
8
10
12
LUMINANCE(cd/m2)
0
500
1000
1500
2000
2500
3000

FIG. 5A

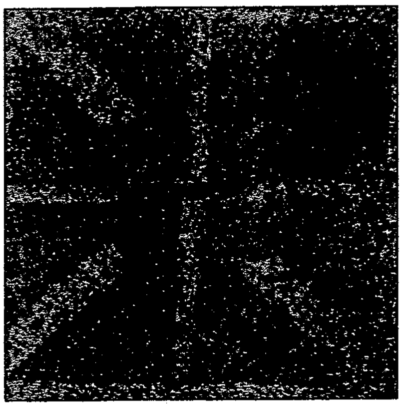


FIG. 5B

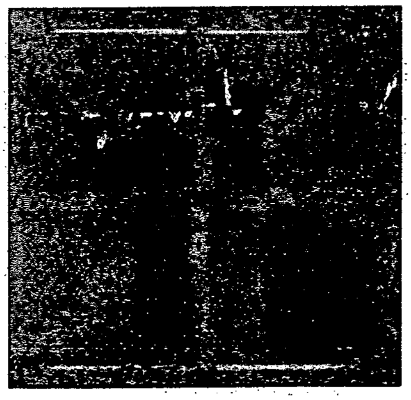


FIG. 5C

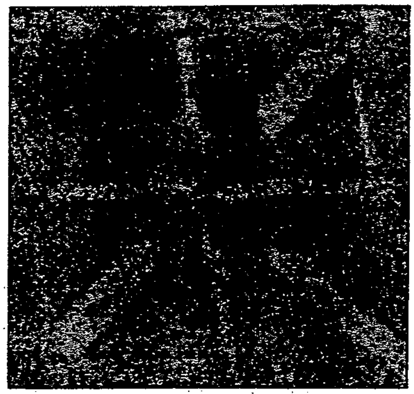
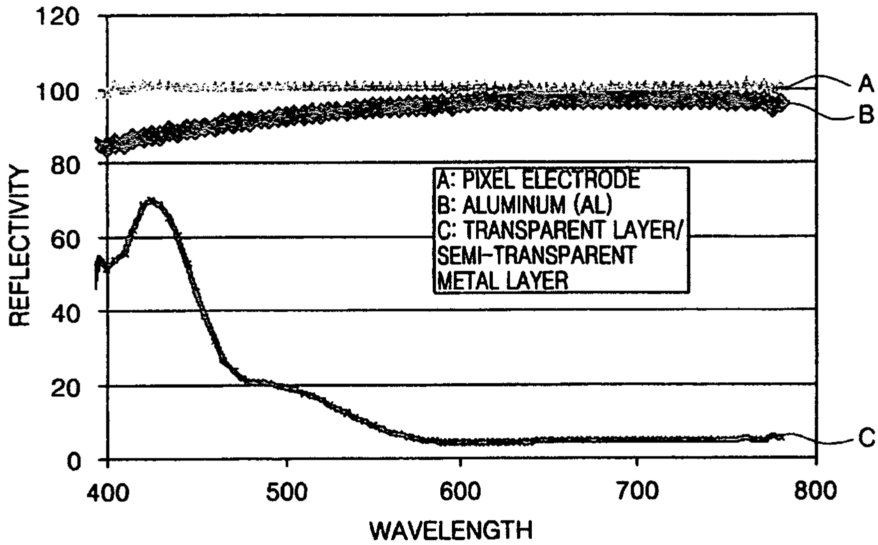


FIG. 6


120
100
80
60
40
20
0
REFLECTIVITY
400
500
600
700
800
WAVELENGTH
A
B
C
A: PIXEL ELECTRODE
B: ALUMINUM (AL)
C: TRANSPARENT LAYER/
SEMI-TRANSPARENT
METAL LAYER

REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	平板显示器及其制造方法		
公开(公告)号	EP1662574B1	公开(公告)日	2010-09-15
申请号	EP2005111347	申请日	2005-11-28
[标]申请(专利权)人(译)	三星斯笛爱股份有限公司		
申请(专利权)人(译)	三星SDI CO.，LTD.		
当前申请(专利权)人(译)	三星移动显示器有限公司.		
发明人	LEE, KWAN-HEE, SAMSUNG SDI CO., LTD. IM, JA-HYUN, SAMSUNG SDI CO., LTD.		
IPC分类号	H01L27/32 H01L51/52		
CPC分类号	H01L51/5265 H01L27/32 H01L51/5281		
代理机构(译)	hengelhaupt，Jürgen		
优先权	1020040098877 2004-11-29 KR		
其他公开文献	EP1662574A2 EP1662574A3		
外部链接	Espacenet		

摘要(译)

平板显示器包括像素电极，有机发光层，相对电极，相移层和设置在基板上的反射层。相移层和反射层堆叠在相对电极上，以破坏性地干扰反射的外部光，以实现黑色并实现优异的发光效率。

FIG. 1