US 20030222576A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2003/0222576 A1

Lu

(43) Pub. Date: Dec. 4, 2003

(54) FULL COLOR ORGANIC LIGHT-EMITTING DISPLAY DEVICE

(75) Inventor: **Tien-Rong Lu**, Tainan (TW)

Correspondence Address:
BACON & THOMAS, PLLC
625 SLATERS LANE
FOURTH FLOOR
ALEXANDRIA, VA 22314

(73) Assignee: **RiTdisplay Corporation**, Hsin Chu Industrial Park (TW)

(21) Appl. No.: **10/445,950**

(22) Filed: **May 28, 2003**

(30) **Foreign Application Priority Data**

May 28, 2002 (TW) 91111360

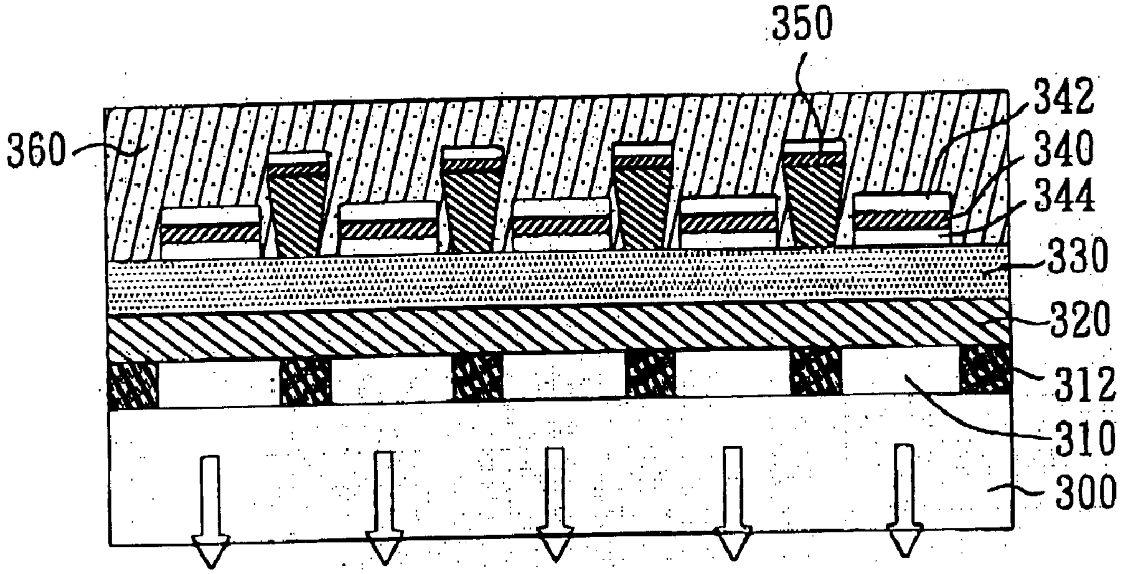
Publication Classification

(51) **Int. Cl.**^{7} **H05B 33/00**

(52) **U.S. Cl.** **313/504**

(57) **ABSTRACT**

This invention relates to an organic light-emitting display (OLED) device comprising a substrate, a first electrode layer mounted on one side of the substrate, a second electrode layer sandwiched between the substrate and the first electrode layer, at least one organic electroluminescent layer sandwiched between the first electrode layer and the second electrode layer, a color conversion layer of fluorescent powder sandwiched between the substrate and the second electrode layer, and at least one filter layer sandwiched between the color conversion layer of fluorescent powder and the substrate; wherein the color conversion layer of fluorescent powder converts in a shorter wavelength light emitted by excitation of the organic electroluminescent layer through an electric current into white combination light, and the white combination light is then converted into full color display information through the color filter. Also, the present invention relates to a process for fabricating the OLED device.



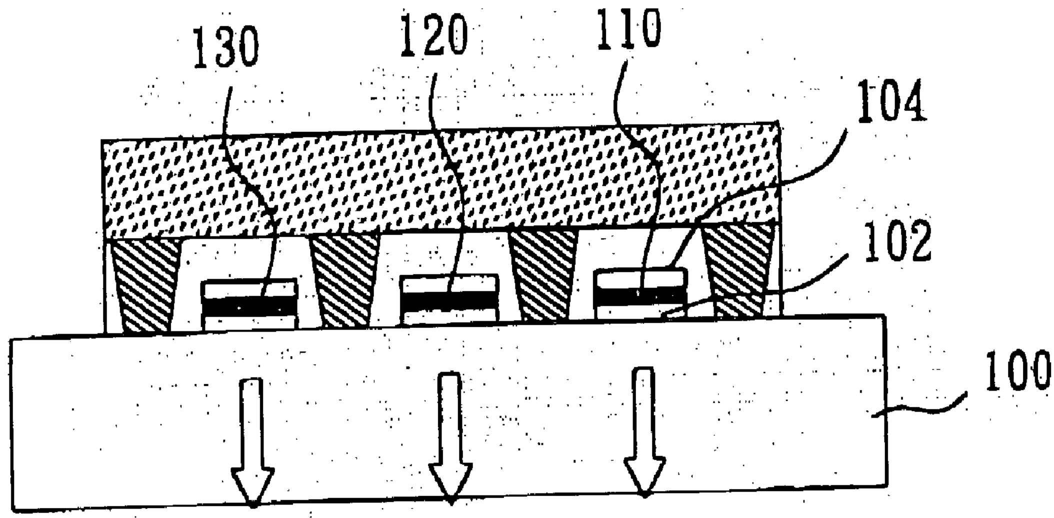


FIG. 1

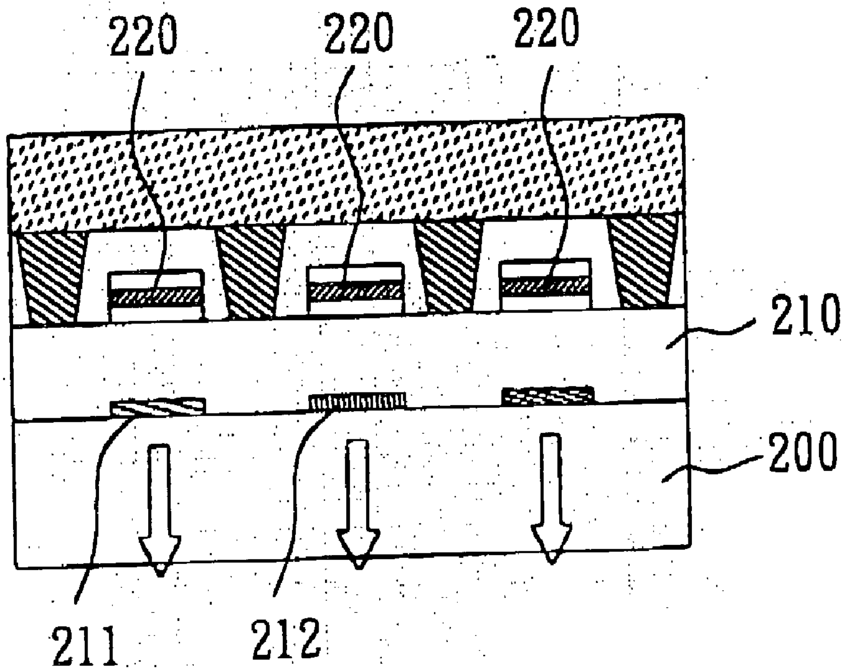


FIG. 2

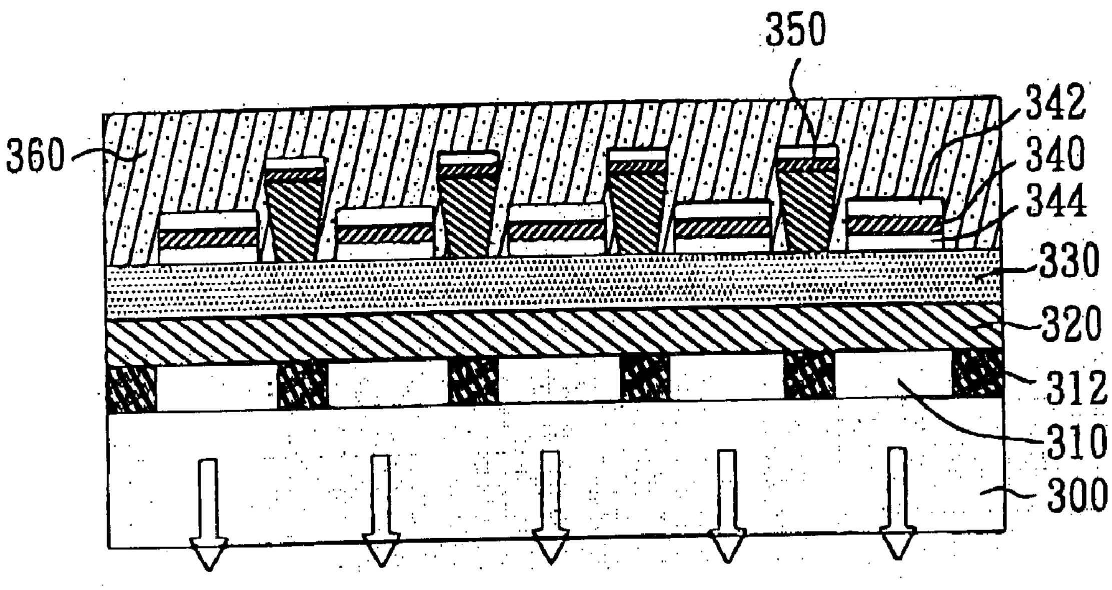


FIG. 3

FULL COLOR ORGANIC LIGHT-EMITTING DISPLAY DEVICE

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a flat-panel display device, and more particularly, to an organic light-emitting display (OLED) device suitable for full color display.

[0003] 2. Description of Related Art

[0004] There are two common technologies known in the prior full-color OLEDs, i.e., three primary color light emitting technology which uses an organic light-emitting material of three primary colors (i.e., red, green and blue) to separately serve as organic electroluminescent pixels, and color filtering technology which adopts only a white organic light-emitting material in combination with red, blue and green color filters to produce various colors.

[0005] The conventional three primary color light-emitting technology is shown **FIG. 1**, which is a schematic view of the conventional three primary color based technology. The three primary color based technology forms a plurality of anodes **102** over a transparent substrate **100**, and then a red organic electroluminescent layer **110**, a green organic electroluminescent layer **120** and a blue organic electroluminescent layer **130** are respectively formed on the anodes **102** by evaporation. A cathode **104** is subsequently formed on the organic electroluminescent layers **110**, **120** and **130** by evaporation, and appropriate treatments are made. The three primary color based technology employs the characteristic of active luminescence inherent in the OLED to produce different colors. Hence, no additional color-tuning filter element is necessary. However, the technology of manufacturing the separate pixels emitting light of three primary colors is complex and involves many difficulties. For manufacturing a large-sized and full-colored OLED panel with high resolutions, an excellent and complex evaporation processing is required, especially for the mass production.

[0006] In addition, a fine small-molecule red-light emitting organic material is indispensable. A reliable source of supply of such fine material is currently limited, however. Meanwhile, the luminescent efficiency of the light-emitting material of each of the three primary colors appears different. To ameliorate the uniformity of image display, a drive circuit to this end will be very complex. Also, in an attempt to harmonize the image display, difficulties in structural integration of films and driving of a circuit occur.

[0007] The conventional technology of color change medium (CCM) is shown in **FIG. 2**, which is a schematic view of the conventional technology of CCM. The CCM based technology forms a printed color CCM **210** including red CCM **211** and green CCM **212** over a transparent substrate **200**. Then blue organic electroluminescent layers **220** are formed over the color CCM **210**. As the currents is applied for driving the blue organic electroluminescent layer **220**, the light from the blue organic electroluminescent layer **220** will excite the red CCM **211** and green CCM **212** from the printed color CCM **210** and further converts into a full color display. However, the luminescent efficiency of the CCM technology is poor and an appropriate red CCM material is not available. Therefore, the scope of application of the CCM based technology is limited, and not suitable for mass production.

[0008] However, another new full color organic light-emitting device has been proposed. This new full color organic light-emitting device utilizes an organic electroluminescent layer emitting ultraviolet light first. The ultraviolet light then radiates and excites another organic electroluminescent layers for converting ultraviolet radiation into the light of red, green and blue colors located at predetermined positions for producing a full-color effect. However, since the degradation effect on the organic electroluminescent layer of red, green and blue caused by ultraviolet is very strong, the lifetime of this full color organic light-emitting device is short. Besides, it is found that the ultraviolet light is greatly absorbed by other elements of this full color organic light-emitting device. Hence, the efficiency of the light conversion is low, too. Moreover, since some of the ultraviolet light leaks out from the active area of the OLED panel, it is harmful to human eyes, especially for a long time watching.

[0009] Therefore, there is a need for the commercial market to provide a new full color technology to avoid the above-mentioned processing problems. Also, the features of close uniformity of luminescent efficiency and high resolution are achieved, and can be applicable to large-sized full color OELD devices.

SUMMARY OF THE INVENTION

[0010] Accordingly, it is a primary object of the present invention is to provide a full color OLED device to harmonize the luminescent efficiency of the pixels of the colors, reduce difference in luminescent efficiency between various colors, improve luminescent efficiency, enhance color resolution, and be applicable to large-sized displays.

[0011] A further object of the present invention is to provide a process for fabricating full color OLED devices to simplify the fabrication process without application of red organic electroluminescent layer, and enhance the purity of white light.

[0012] To attain the afore-mentioned objectives, an OLED device according to the present invention comprises a substrate; a first electrode layer (cathode) mounted on one side of said substrate; a second electrode layer (anode) sandwiched between said substrate and said first electrode layer (cathode); at least one organic electroluminescent layer sandwiched between said first electrode layer (cathode) and said second electrode layer (anode); a color conversion layer of fluorescent powder sandwiched between said substrate and said second electrode layer (anode); and at least one filter layer sandwiched between said color conversion layer of fluorescent powder and said substrate; wherein said color conversion layer of fluorescent powder converts the light emitted by excitation of said organic electroluminescent layer through an electric current into white combination light.

[0013] A process for fabricating OLED devices according to the present invention comprises the following steps: forming at least one filter layer over a substrate; forming a color conversion layer of fluorescent powder over said filter layer; forming a second electrode layer (anode) over said color conversion layer of fluorescent powder; forming at least one organic electroluminescent layer over said second electrode layer (anode); and forming a first electrode layer (cathode) over the organic electroluminescent layer; wherein said color conversion layer of fluorescent powder converts the light emitted by excitation of said organic electroluminescent layer through an electric current into white combination light.

[0014] Other objects, advantages, and novel features of the invention will become more apparent from the following detailed description when taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIG. 1 is a schematic view showing the conventional three primary color based technology of the full color OLEDs;

[0016] FIG. 2 is a schematic view showing the conventional technology of CCM of the full color OLEDs; and

[0017] FIG. 3 is schematic view of an OLED device according to a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] The material of the substrate of the OLED device according to the present invention is selected from transparent material, and preferably is soda-lime glass, borophosphosciliate glass, plastic or silicon wafer. The first electrode can be made of any conventional material. Preferably, the first electrode is made of $InSnO_3$, SnO_2, In_2O_3 with doped ZnO, CdSnO or Sb. The second electrode can be made of any conventional material. Preferably, the second electrode is made of MgAg, Al, diamond, quasi-diamond or Ca. The OLED device according to the present invention can be either a single-layered or multi-layered structure of an organic electroluminescent material. The multi-layered organic electroluminescent structure may selectively include a hole injection layer, a hole transport layer, a light-emission layer, an electron transport layer or an electron injection layer. A dark-color frame of a light-absorption matrix for shading light may be selectively provided between the filters or the filter and the substrate to lessen the luminescent interference caused by ambient lights and increase sharpness of display image at the edge of the pixels.

[0019] The color conversion layer of the present invention is a thin film composed of a fluorescent powder and a binding polymer to convert light emitted from the organic electroluminescent layer by excitation through an electric current into white combination light and produce colors by means of the filter. The color conversion layer is constructed by a fluorescent powder capable of absorbing ultraviolet or blue light in a short wavelength. The fluorescent powder is formed by wet coating process or dry deposition. The fluorescent powder is preferably selected to be endurable to highly intensive light and capable of combining with a blue organic light-emitting component to result in white light. Basically, the fluorescent powder is used based on the wavelength of light emitted from the organic electroluminescent layer. If the organic electroluminescent layer emits ultraviolet light, the fluorescent powder used for the color conversion layer is preferably a composition capable of converting the emitted ultraviolet light into red, green or blue. If the organic electroluminescent layer emits blue light, the fluorescent powder used for the color conversion layer is preferably a composition capable of converting the emitted blue light into red or green. Preferably, the binding polymer is transparent epoxy, polyimide, urea resin, silicone or transparent inorganic adhesive. The transparent inorganic adhesive preferably is SiO_2 or TiO_2. It is preferable for the transparent epoxy to be used in the wet coating processing while the transparent adhesive is preferably used in the dry deposition processing. The mixture ratio of the fluorescent powder and the binding polymer is adjustable in accordance with the luminescent efficiency of various colors to balance the luminescent efficiency. The distribution of the fluorescent powder in the color conversion layer can be controlled by arranging the structure of the color conversion layer as well as the temperature, viscosity, crystal structure and grain size used for forming the fluorescent powder. The OLED device can further comprise an overcoating layer sandwiched between the second electrode (anode) and the filter layer, wherein the second electrode layer (anode) and the substrate sandwich the overcoating layer to protect the color conversion layer. The material of the overcoating layer of the present invention is not specifically defined, and preferably is transparent epoxy, polyimide, urea resin, silicone or transparent inorganic adhesive. The transparent inorganic adhesive preferably is SiO_2 or TiO_2. It is preferable for the transparent epoxy to be used in the wet coating processing while the transparent adhesive is preferably used in the dry deposition processing.

[0020] The fluorescent powder used in the present invention is not specifically defined, and preferably is yttrium aluminum oxide (YAG) fluorescent powder with doped rare-earth element. Because part of the yttrium will be substituted by rare-earth element in the crystal lattice, $Y_{2.9}R_{0.1}Al_5O_{12}$ (R is rare-earth element) is formed. YAG is a transparent material of thermal stability, and capable of emitting light of different colors after doping different rare-earth elements; for example, Tb is doped into $Y_3Al_5O_{12}$ for emitting green light, and Ce for emitting yellow light.

[0021] The color conversion layer can be prepared by either wet processing or dry processing. A wet processing technique is to weigh the required quantity of the fluorescent powder to be blended directly, and then appropriate solvent and epoxy are added to the fluorescent powder, whereafter the powder, solvent and epoxy are mixed together. Another wet processing technique is to mix the fluorescent powder with solvent at the atomic scale by the sol-gel process or co-precipitation method, and then, mix them with epoxy. Thereafter, the mixture is applied to the overcoating layer or light-emitting panel by spin coating or printing, and then, is baked to remove the solvent and water.

[0022] An overcoating layer is coated or deposited as necessary to form a white-light color conversion layer with protection. This is a technique for forming a single white-light color conversion layer microscopically blended at the atomic scale to overcome the deteriorations in luminescent uniformity and luminescent efficiency of the prior art.

[0023] The dry processing technique is to weigh the required quantity of the fluorescent powder to be blended directly or mixed with a solvent at the atomic scale by the sol-gel process or co-precipitation method, and then, the mixture is blended with transparent adhesive such as SiO_2 or TiO_2. It is necessary to consider the deposition rate for different color fluorescent powders in deposition. Further, an overcoating layer can be selectively formed to cover the color conversion structure.

[0024] It is preferable that the OLED according to the present invention be formed as a display panel having an array of a plurality of pixels emitting red, green and blue light to display an image, and also, the OLED according to the present invention can be a monochromatic display panel having an array of pixels emitting light, if so desired. The OLED panel fabricated according to the present invention can be applied to any environment or apparatus for displaying images, graphics, characters and text, and preferably, to the display panel of televisions, computers, printers, monitors, vehicles, to the displays of signal machines, communication apparatus, telephones, lamp equipment, headlights, interactive electronic books, micro-displays, fishing devices, personal digital assistants (PDA), game means, airplane equipment and head mounted displays.

[0025] Embodiment 1

[0026] OLED

[0027] **FIG. 3** is a schematic view of the OLED device according to a preferred embodiment of the present invention. The OLED device of the present invention is passive matrix type, comprising a substrate **300**, a cathode (a first electrode layer) **342**, an anode (a second electrode layer) **344**, a blue organic electroluminescent layer **340**, a color conversion layer of fluorescent powder **330**, an overcoating layer **320**, a plurality of filters **310**, a dark-color frame of a light-absorption matrix **312**, and a cathode passivation **360**. In the process of the OLED device of the present invention, the dark-color frame of the light-absorption matrix **312** and a plurality of filters **310** are first formed over the substrate **300**. Hence, each of the filters **310** corresponds to a pixel. The pixel as herein referred is constructed by the cathode (first electrode layer) **342**, the anode (second electrode layer) **344** and the organic electroluminescent layer **340**. Although the organic electroluminescent layer is of a single-layer structure as illustrated hereinto, it can also be of a multi-layer structure. The dark-color frame of light-absorption matrix **312** is a black light-shading shadow mask used to shade diffusion light at the edge of the pixels. The dark-color frame of the light-absorption matrix **312** surrounds the edge of the pixels to define the size of the pixels. The overcoating layer is formed over the black frame of the light-absorption matrix **312** and the filter **310** to protect the black light-absorption shadow mask and the filter. In the present preferred embodiment, an overcoating layer **320** is formed over the black light-absorption shadow mask **312** and the filter **310**. A color conversion layer of fluorescent powder **330** is formed over the overcoating layer **320**. The color conversion layer of fluorescent powder **330** is a thin film consisting of a fluorescent powder and a binding polymer to convert the light emitted by excitation of the organic electroluminescent layer through an electric current into white combination light. A transparent indium tin oxide (ITO) layer **344** in the form of stripes is provided over the color conversion layer of fluorescent powder **330**. The stripe-shaped ITO layers **344** can be separated by isolation bodies of a photoresist parallel to each other to isolate a cathode substance formed among the pixels. The organic electroluminescent layer **340** is formed over the ITO layer by evaporation or sputtering to emit in a certain wavelength range. In this preferred embodiment, the electroluminescent layer **340** emits light in a wavelength range of blue after excitation by an electric current.

[0028] The fabrication of the OLED device of the preferred embodiment is to prepare for a fluorescent powder for forming a layer of fluorescent powder over the substrate at the beginning. The fluorescent powder is prepared by co-precipitation with triethylamine oxalate. The process for preparation of the fluorescent powder is briefly described below.

EXAMPLE 1

Fluorescent Powder Production

[0029] YAG fluorescent powder is produced by co-precipitation with triethylamine oxalate. $R(NO_3)_3$ (wherein R is La, Ce, Pr, Sm, Tb, Ho, Tm or Yb), $Y(NO_3)_3$ and $Al(NO_3)_3$ are mixed under stoichiometric ratio, and sufficiently dissolved in 25 ml of deionized water. Thereafter, 15 ml of triethylamine and 10 ml of oxalic acid (1.2 moles) are added to the above-mentioned mixture and processed at a pH of approximately 10.22, thereby obtaining white precipitated gels in the solution. Subsequently, the liquid mixture is agitated for several minutes, and then purified with a filtering process by air-extraction. After filtering, the white precipitated gels are baked in an oven for about twelve hours, and then, the baked white precipitated gels are taken out. Thereafter, they are placed in a furnace. Initially, the furnace is maintained at a temperature of 300° C. for an hour, and then, the temperature is increased to 500° C. and is maintained for another one hour, and finally, the temperature is increased to 1000° C. and maintained for another 24 hours. After cooling, the fluorescent powder with doped rare-earth element is obtained. As a result, the fluorescent powder is characterized by having a short period of residual fluorescence for about 120 nano-seconds, and is therefore applicable to be described as a component requiring fast response time.

[0030] The composition of the fluorescent powder prepared by this example in accordance with different light-emitting sources is shown in Table 1.

TABLE 1

Wavelength of light-emitting source	Composition of fluorescent powder
470 nm (Blue light)	YAG : Ce^{3+}(Yellow)
420–473 nm (Blue light/Ultraviolet light)	YBO_3 : Ce^{3+},Tb^{3+}(Green)/ $SrGa_2S_4$: Eu^{2+}(Blue)/ Y_2O_2S:Eu^{3+}, Bi^{3+}(Red)
370 nm (Ultraviolet light	Ca_8 Mg $(SiO_4)_4$ Cl_2 : Eu^{2+}, Mn^{2+}(Green) 20–50% / Y_2O_3 : EU^{3+},Bi^{3+}(Red)40–80% / $Ca_5(PO_4)$ $_3$Cl:Eu^{2+}(Blue) or $BaMg_2Al_{16}O_{27}$:Eu^{2+}(Blue) 5–25%
460 nm (Blue light)	SrGa2O4 : Eu2+ (Green) / CaS : Eu (Red)

[0031] The white-light color conversion layer is prepared subsequent to completion of the preparation of the fluorescent powder layer. The process for preparation of the white-light color conversion layer is briefly described below.

EXAMPLE 2

Color Conversion Layer Production—Wet Process

[0032] The proportion of the fluorescent material is dosed in accordance with the principle of balancing the different luminescent efficiencies of the fluorescent material caused by three primary colors with reference to predetermined wavelength (e.g. blue light wavelength) of the emitted light in the spectrum. Then, the fluorescent materials are blended with epoxy resin at atomic scale through sol-gel process.

EXAMPLE 3

Color Conversion Layer Production—Dry Process

[0033] In the dry process, the quantities of the fluorescent material and transparent medium are weighed, and then, sufficiently blended to form a target. The target may be alternatively formed by the sol-gel process or co-precipitation method. A planed fluorescence color conversion layer is formed on the panel of organic light-emitting device by evaporation, sputtering or ion-beam deposition, wherein the proportion of the fluorescent material is dosed in accordance with the principle of balancing the difference in deposition rate of different fluorescent materials, to convert the light emitted at a shorter wavelength (e.g. blue light) in the spectrum into light of a longer wavelength in the spectrum (e.g. red light).

[0034] After completing the preparation for the white-light color conversion layer, a layer of color filters **310** is formed by printing in order of red, green and blue matrixes. An overcoating **320** is optionally coated onto the layer of color filters **310** by deposition. Thereafter, a white-light fluorescent powder is coated onto the filter layer **310** or the overcoating **320** by wet spin-coating. Then, the white-light fluorescent powder layer is baked to remove the solvent and water, and a white-light color conversion layer of fluorescent powder is completed after depositing. After the formation of the color conversion layer of fluorescent powder **330** over the filter layer **310**, an anode layer **344** (transparent electrode of ITO material) is formed over the color conversion layer of the fluorescent powder **330** by sputtering. The anode layer **344** is patterned by photolithography to form a plurality of transparent electrodes in form parallel stripes over the substrate. After sufficient rinsing of the substrate with patterned transparent electrodes, a photoresist layer **350** of a uniform thickness is formed over the substrate by spin-coating the composition of positive chemical amplification photoresist. Thereafter, the substrate coated with the positive chemical amplification photoresist composition is pre-baked in an oven. Then, the substrate is exposed in a development machine by means of stripe-patterned shadow masks. Further, the substrate is subjected to post-exposure baking treatment, and simultaneously, the surface of the photoresist layer is treated under the atmosphere full of tetramethyl ammonium hydroxide. After development, a plurality of transparent ITO electrodes in the form of parallel stripes which run perpendicular to the parallel stripe-shaped photoresist layer are formed over the substrate. The cross-section of the photoresist layer in form of parallel stripes shows a top of a reverse trapezoid with a thickness of 0.8 μm. The line width of the stripe-shape photoresist layer is 0.18 μm. Then, an organic electroluminescent layer **340** is formed over the anode layer **344** by evaporation. The formation of the organic electroluminescent layer **340** is made by using the stripe-shaped isolation body layer having a top of a reverse trapezoid as shadow masks, to form a layer of CuPc (copper phthalocyanine) with a thickness of 250 angstroms in the gaps between the parallel shadow masks by vacuum evaporation, and subsequently forming a layer of NPB(4,4'-bis[N-(1-naphthyl)-N-phenyl-amino]-biphenyl) with a thickness of 500 angstroms by evaporation, and then forming a layer of BA-1 (Bis (2-methyl-8-quinolinolato) aluminum(III)-μ-oxo-bis (2-methyl-8-quinolinolato) aluminum (III)) with a thickness of 500 angstroms by evaporation, and further forming a layer of LiF with a thickness of 15 angstroms. A cathode layer of aluminum **342** is formed over the organic electroluminescent layer **340** by evaporation. Similarly, the formation of the cathode layer **342** is made by vacuum evaporation to have a thickness of 1000 angstroms. Thus, an OLED component is formed. Finally, a passivation layer such as aromatic polyimide, parylene or teflon copolymer is deposited over the cathode layer **342**.

[0035] The device is turned on by providing an electric current through the cathode **342** and the anode **344**, and the organic electroluminescent layer **340** is driven to emit blue light. The blue light sheds light on the color conversion layer of fluorescent powder **330** and is converted into white combination light. The white combination light produces different color information by filtering through the color filter **310**.

[0036] Embodiment 2

[0037] Except for the use of the dry processing to form the white-light color conversion layer of the fluorescent powder and sputtering of the target material to form the white-light color conversion layer of fluorescent powder over the filter layer, the other processing steps are the same as those of Embodiment 1. After forming the white-light fluorescent powder, a white-light color conversion layer is formed over the filter layer by sputtering the composition, and simultaneously, the white-light color conversion structure is completed by depositing another passivation layer.

[0038] It is clear from the above description that the present invention is the first to disclose a technique for forming a single white light color conversion layer microscopically blended at the atomic level to overcome the deteriorations in luminescent uniformity and luminescent efficiency of the prior art. The present invention provides a component structure of high brightness and good uniformity for full color applications of the displays. Another advantage of the present invention is to dispense with the selective deposition of three primary colors so that the resolution of the upcoming display is no longer limited to the precision of the shadow mask. Also, the present invention increases yields of fabrication, and is very suitable for use in large-sized panels. Further, the present invention adopts the mature techniques of fluorescent material and color filtering for use in the field of OLED, and thus, can accelerate the commercial availability of the full color OLEDs.

[0039] In addition, the organic electroluminescent component of the present invention uses blue light to excite the fluorescent powder for emission without causing the specific orientation on spectrum. Hence, the present invention can provide uniform radiation of a wide bandwidth in the spectrum, and is particularly suitable for being a light source used for a scanner or display.

[0040] Although the present invention has been explained in relation to its preferred embodiment, it is to be understood that many other possible modifications and variations can be made without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. An organic light-emitting display device, comprising

a substrate;

a first electrode layer (cathode) mounted on one side of said substrate;

a second electrode layer (anode) sandwiched between said substrate and said first electrode layer (cathode);

at least one organic electroluminescent layer sandwiched between said first electrode layer (cathode) and said second electrode layer (anode);

a color conversion layer of fluorescent powder sandwiched between said substrate and said second electrode layer (anode); and

at least one filter layer sandwiched between said color conversion layer of fluorescent powder and said substrate;

wherein said color conversion layer of fluorescent powder converts the light emitted by excitation of said organic electroluminescent layer through an electric current into white combination light.

2. The organic light-emitting display device as claimed in claim 1, further comprising an overcoating layer sandwiched between said second electrode (anode) and said filter layer to protect said color conversion layer of fluorescent powder; wherein said second electrode (anode) and said substrate sandwich said overcoating layer.

3. The organic light-emitting display device as claimed in claim 1, further comprising a passivation layer formed over said first electrode layer (cathode) to protect said first electrode layer (cathode), and said passivation layer is aromatic polyimide, parylene or teflon copolymer.

4. The organic light-emitting display device as claimed in claim 1, further comprising at least one dark-color frame of light-absorption matrix mounted at the edge of the pixels of said color conversion layer of fluorescent powder to avoid leakage of light.

5. The organic light-emitting display device as claimed in claim 1, wherein said second electrode layer (anode) is transparent.

6. The organic light-emitting display device as claimed in claim 1, wherein said second electrode layer (anode) is made of indium tin oxide (ITO).

7. The organic light-emitting display device as claimed in claim 2, wherein said overcoating layer is made of transparent epoxy, polyimide, urea resin, silicone, transparent inorganic adhesive SiO_2 or transparent inorganic adhesive TiO_2.

8. The organic light-emitting display device as claimed in claim 1, wherein said organic electroluminescent layer is made of polymeric organic electroluminescent material or small-molecule organic electroluminescent material to produce blue or ultraviolet light to excite said color conversion layer of fluorescent powder to emit white light.

9. The organic light-emitting display device as claimed in claim 1, wherein said color conversion layer of fluorescent powder is a composition of red, blue and green fluorescent powders.

10. The organic light-emitting display device as claimed in claim 1, wherein said first electrodes layer (cathode) is in a form of plural stripes and said second electrode layer (anode) is in a form of plural stripes, and said first electrode layer (cathode) intersects said second electrode layer (anode).

11. A process for fabricating organic light-emitting display devices, comprising the following steps:

forming at least one filter layer over a substrate;

forming a color conversion layer of fluorescent powder over said filter layer;

forming a second electrode layer (anode) over said color conversion layer of fluorescent powder;

forming at least one organic electroluminescent layer over said second electrode layer (anode); and

forming a first electrode layer (cathode) over the organic electroluininescent layer;

wherein said color conversion layer of fluorescent powder converts the light emitted by excitation of said organic electroluminescent layer through an electric current into white combination light.

12. The process as claimed in claim 11, further comprising forming a transparent overcoating layer over said filter layer after forming said filter layer, and forming a color conversion layer of fluorescent powder over said overcoating layer.

13. The process as claimed in claim 11, further comprising forming a dark-color frame of a light-absorption matrix over said substrate before forming said color conversion layer of fluorescent powder, wherein said dark-color frame of said light-absorption matrix is mounted at the edge of the pixels of said filter layer to avoid leakage of light.

14. The process as claimed in claim 12, further comprising forming a dark-color frame of a light-absorption matrix over said substrate before forming said overcoating layer, wherein said dark-color frame of said light-absorption matrix is mounted at the edge of the pixels of said filter layer to avoid leakage of light.

15. The process as claimed in claim 11, wherein said color conversion layer of fluorescent powder is formed by spin coating or printing.

16. The process as claimed in claim 11, wherein said second electrode layer (anode) is made of indium tin oxide (ITO).

17. The process as claimed in claim 12, wherein said overcoating layer is made of transparent epoxy, polyimide, urea resin, silicone or transparent inorganic adhesive such as SiO_2 or TiO_2.

18. The process as claimed in claim 11, wherein said organic electroluminescent layer is made of polymer or small molecule material.

19. The process as claimed in claim 11, wherein said color conversion layer of fluorescent powder is a composition of red, blue and green fluorescent powders.

20. The process as claimed in claim 11, wherein said first electrodes layer (cathode) is in a form of plural stripes and said second electrode layer (anode) is in a form of plural stripes, and said first electrode layer (cathode) intersects said second electrode layer (anode).

* * * * *

专利名称(译)	全彩有机发光显示装置		
公开(公告)号	US20030222576A1	公开(公告)日	2003-12-04
申请号	US10/445950	申请日	2003-05-28
[标]申请(专利权)人(译)	铼宝科技股份有限公司		
申请(专利权)人(译)	铼宝科技股份有限公司		
当前申请(专利权)人(译)	铼宝科技股份有限公司		
[标]发明人	LU TIEN RONG		
发明人	LU, TIEN-RONG		
IPC分类号	H01L27/32 H05B33/00		
CPC分类号	H01L27/322		
优先权	091111360 2002-05-28 TW		
外部链接	Espacenet USPTO		

摘要(译)

本发明涉及一种有机发光显示（OLED）器件，包括基板，安装在基板一侧的第一电极层，夹在基板和第一电极层之间的第二电极层，至少一个有机电致发光层夹在第一电极层和第二电极层之间，荧光粉末的颜色转换层夹在基板和第二电极层之间，并且至少一个滤光层夹在荧光粉末的颜色转换层和基板之间;其中荧光粉末的颜色转换层在较短波长下通过电流激发有机电致发光层发出的光转换成白色组合光，然后通过滤色器将白色组合光转换成全色显示信息。此外，本发明涉及制造OLED器件的方法。