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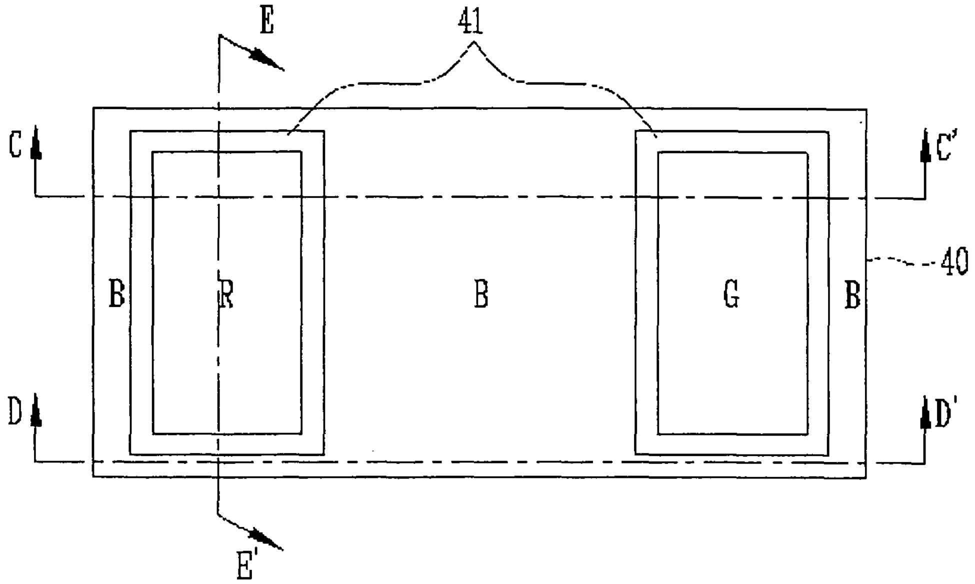
(54) **Organic light emitting display and method for fabricating the same**

(57) In an organic light emitting display and a method for fabricating the same, a layout of respective pixels is changed in order to improve life span so that one pixel region having low luminous efficiency is increased. The organic light emitting display includes at least one pixel comprising sub pixels having a plurality of colors. A first sub pixel emission layer is formed over an entire surface of a pixel region. At least two second sub pixel emission layers are formed at the first sub pixel emission layer so as to have a closed curve. The layout of respective pixels is changed so as to increase an area of one sub pixel region having low luminous efficiency in order to improve the life span and aperture ratio of the organic light emitting display. In addition, during formation of an emission layer, the number of masks is reduced. Accordingly, the possibility of misalignment is reduced, thereby maximizing resolution, improving yield, and reducing manufacturing cost.

FIG. 4



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Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] The present invention relates to an organic light emitting display and a method for fabricating the same. More particularly, the present invention relates to an organic light emitting display and a method for fabricating the same, wherein a layout of respective pixels is changed in order to improve life duration so that one pixel region having low luminous efficiency is increased.

2. Related Art

[0002] Recently, various flat panel displays capable of reducing weight and volume, which are disadvantages of cathode ray tubes (CRT), have been developed. Flat panel displays include liquid crystal displays (LCD), field emission displays (FED), plasma display panels (PDP), and organic light emitting displays (OLED).

[0003] In particular, since light emitting displays have a greater use temperature range, higher resistance to shock or vibration, a wider angle of visibility, and a higher-speed response in comparison with other flat panel displays, they have been proposed as the next generation of planar type display devices.

[0004] Such light emitting displays include an organic light emitting display using an organic light emitting diode and an inorganic light emitting display using an inorganic light emitting diode. The organic light emitting diode includes an anode electrode, a cathode electrode, and an organic emission layer disposed between the anode electrode and the cathode electrode for emitting light by means of a combination of electrons and holes. The inorganic light emitting diode includes an inorganic light emitting layer composed of a PN junction semiconductor.

[0005] In an organic light emitting display, red (R), green (G), and blue (B) materials are deposited at sub pixel regions formed in at least one pixel region on a substrate, and the respective sub pixel regions emit light using a thin film transistor formed on the substrate. The reason why red (R), green (G), and blue (B) sub pixel regions are respectively disposed at different locations is to embody a full color display, in which light from three primary colors are integrated by a human being's eyes, so that the panel displays colors based only on the three primary colors.

[0006] Prior displays have been burdened by several disadvantages. Specifically, since there are limits to the fabrication of a sub pixel region of a certain color, it is difficult to make displays having improved life span. In response to this problem, a laser thermal transfer method has been proposed, but this method is characterized by the disadvantages of the high cost of laser equipment, and the difficulty of improving the quality of a transfer layer.

[0007] In some prior displays, different sub pixels must be patterned using different masks for each color. However, in this case, there is a problem of misalignment, and the resolution of the display deteriorates as a result. In addition, manufacturing cost increases and a more precise patterning technique is required.

SUMMARY OF THE INVENTION

[0008] Accordingly, it is an object of the present invention to provide an organic light emitting display and a method for fabricating the same, wherein a layout of respective pixels is changed in order to improve life span so that one pixel region having low luminous efficiency is increased.

[0009] It is another object of the present invention to provide an organic light emitting display and a method for fabricating the same, wherein the number of masks for forming an emission layer is reduced.

[0010] The foregoing and/or other aspects of the present invention are achieved by providing an organic light emitting display comprising at least one pixel including sub pixels having a plurality of colors, the display comprising: a first sub pixel emission layer formed over an entire surface of a pixel region; and at least two second sub pixel emission layers formed at the first sub pixel emission layer so as to have a closed curve.

[0011] Preferably, the first sub pixel emission layer is formed so as to have a blue color. In addition, a forming area of the first sub pixel emission layer, except forming areas of the at least two second sub pixel emission layers, is greater than that of each of the at least two second sub pixel emission layers. More preferably, the organic light emitting display further comprises an electron blocking layer formed over the entire surface of the pixel region between the first sub pixel emission layer and the at least two second sub pixel emission layers.

[0012] According to another aspect of the present invention, an organic light emitting display comprises at least one pixel including sub pixels having a plurality of colors, and further comprises: at least two first sub pixel emission layers formed on a pixel region so as not to overlap each other; and a second sub pixel emission layer formed on the at least two first sub pixel emission layers and over an entire surface of the pixel region so as to include the at least two first sub pixel emission layers.

[0013] Preferably, the second sub pixel emission layer is formed so as to have a blue color. In addition, a forming area of the second sub pixel emission layer, except forming areas of the at least two first sub pixel emission layers, is greater than that of each of the at least two first sub pixel emission layers. More preferably, the organic light emitting display further comprises a hole blocking layer formed over the entire surface of the pixel region between the at least two first sub pixel emission layers and the second sub pixel emission layer.

[0014] According to a further aspect of the present invention, an organic light emitting display comprises at least one pixel including sub pixels having a plurality of colors, and further comprises: first electrode layers respectively included in the sub pixels and formed on one region of a substrate; a first sub pixel emission layer formed over an entire surface of a pixel region; a second sub pixel emission layer formed at one region of the first sub pixel emission layer so as to have a closed curve; a third sub pixel emission layer formed at another region of the first sub pixel emission layer so as to have a closed curve; and second electrode layers formed at the first, second, and third sub pixel emission layers, respectively.

[0015] Preferably, the first sub pixel emission layer is formed so as to have a blue color. In addition, a forming area of the first sub pixel emission layer, except forming areas of the second and third sub pixel emission layers, is greater than that of each of the second and third sub pixel emission layers.

[0016] More preferably, the organic light emitting display further comprises an electron blocking layer formed over the entire surface of the pixel region between the first and second sub pixel emission layers The organic light emitting display may further comprise an electron blocking layer formed over an entire surface of a pixel region between the first and third sub pixel emission layers. The electron blocking layer may be formed of $Ir(ppz)_3$.

[0017] Most preferably, the luminous efficiency of the first sub pixel emission layer is lower than that of each of the second and third sub pixel emission layers, a ratio of the area of the second sub pixel emission layer to the area of the first sub pixel emission layer ranges from 0.2 to 0.5. A ratio of the area of the third sub pixel emission layer to the area of the first sub pixel emission layer may range from 0.2 to 0.5. The second and third sub pixel emission layers may be formed so as to have red and green colors, respectively. The first, second and third sub pixel emission layers may be arranged in a stripe pattern. The first, second and third sub pixel emission layers may be arranged in a delta pattern.

[0018] According to an additional aspect of the present invention, an organic light emitting display comprises at least one pixel including sub pixels having a plurality of colors, the at least one pixel comprising: first electrode layers respectively included in the sub pixels and formed on one region of a substrate; a first sub pixel emission layer formed on one region of a pixel region on the first electrode; a second sub pixel emission layer formed on another region of the pixel region on the first electrode; a third sub pixel emission layer formed over an entire surface of the pixel region so as to include the first and second sub pixel emission layers on the first and second sub pixel emission layers; and second electrode layers formed at the first, second, and third sub pixel emission layers, respectively.

[0019] Preferably, the third sub pixel emission layer is formed so as to have a blue color. A forming area of the third sub pixel emission layer, except forming areas of the first and second sub pixel emission layers, is greater than that of each of the first and second sub pixel emission layers.

[0020] More preferably, the organic light emitting display further comprises a hole blocking layer formed over the entire surface of the pixel region between the first and third sub pixel emission layers. A hole blocking layer may be formed over the entire surface of the pixel region between the second and third sub pixel emission layers. Most preferably, the hole blocking layer is made of one material selected from the group consisting of BCP, BAlq, SAlq, TAZ, OXD7, Alq_3, and PBD.

[0021] In this embodiment, luminous efficiency of the third sub pixel emission layer is lower than that of each of the first and second sub pixel emission layers. A ratio of the area of the first sub pixel emission layer to the area of the third sub pixel emission layer may range from 0.2 to 0.5. A ratio of the area of the second sub pixel emission layer to the area of the third sub pixel emission layer may range from 0.2 to 0.5. Also, the first and second sub pixel emission layers may be formed so as to have red and green colors, respectively. The first, second and third sub pixel emission layers may be arranged in a stripe pattern. The first, second and third sub pixel emission layers may be arranged in a delta pattern. In addition, pixel definition films may be respectively formed along peripheral regions of the first and second sub pixel emission layers.

[0022] According to a further aspect of the present invention, in a method for fabricating an organic light emitting display comprising at least one pixel including sub pixels having a plurality of colors, a method of forming a region of the pixel comprises the steps of: forming first electrode layers of the sub pixels on one region of a substrate; forming a first sub pixel emission layer over an entire surface of the pixel region; forming a second sub pixel emission layer on one region of the first sub pixel emission layer so as to have a closed curve; forming a third sub pixel emission layer on another region of the first sub pixel emission layer so as to have a closed curve; and forming second electrode layers on the first and second sub pixel emission layers, respectively.

[0023] Preferably, the first sub pixel emission layer is formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method. More preferably, the first and second sub pixel emission layers are formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method. Most preferably, the method further comprises forming a hole blocking layer over the entire surface of the pixel region between the first and second sub pixel emission layers. The first and third sub pixel emission layers are formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method.

[0024] According to another aspect of the present invention, in a method for fabricating an organic light emitting display comprising at least one pixel including sub pixels having a plurality of colors, a method of forming a region of the pixel comprises the steps of: forming first electrode layers of the sub pixels on one region of a substrate; forming a first sub pixel emission layer at one region of the pixel region so as to be disposed on the first electrode layer; forming a second sub pixel emission layer at another region of the pixel region so as to be disposed on the first electrode layer; forming a third sub pixel emission layer over an entire surface of the pixel region, including the first and second sub pixel emission layers , so as to be disposed between the first and second sub pixel emission layers; and forming second electrode layers on the first, second and third sub pixel emission layers, respectively.

[0025] Preferably, the third sub pixel emission layer is formed by vacuum deposition, wet coating, ink jet or a thermal transfer method. The first and second sub pixel emission layers may be formed by vacuum deposition, wet coating, ink jet or a thermal transfer method. Most preferably, the method further comprises forming a hole blocking layer over the entire surface of the pixel region between the first and third sub pixel emission layers. The hole blocking layer may formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] A more complete appreciation of the invention, and many of the attendant advantages thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

[0027] FIG. 1 is a layout schematically showing a one pixel region;

[0028] FIG. 2 is a cross-sectional view of the one pixel region taken along line A-A' of FIG. 1;

[0029] FIG. 3 is a view showing an organic light emitting display according to an embodiment of the present invention;

[0030] FIG. 4 is a plan view of the one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a first embodiment of the present invention;

[0031] FIG. 5 is a cross-sectional view of the one pixel region taken along one side of line C-C' of FIG. 4 according to an embodiment of the invention;

[0032] FIG. 6 is a cross-sectional view of the one pixel region of FIG. 4 taken along one side of the line C-C' according to another embodiment of the invention;

[0033] FIG. 7 is a cross-sectional view of the one pixel region of FIG. 4 taken along one side of line D-D' according to an embodiment of the invention;

[0034] FIG. 8 is a cross-sectional view of the one pixel region of FIG. 4 taken along another side of the line D-D' according to another embodiment of the invention;

[0035] FIG. 9 is a cross-sectional view of the one pixel region of FIG. 4 taken along one side of line E-E' according to an embodiment of the invention;

[0036] FIG. 10 is a cross-sectional view of the one pixel region of FIG. 4 taken along another side of the line E-E' according to another embodiment of the invention;

[0037] FIG. 11 is a plan view of the one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a second embodiment of the present invention;

[0038] FIG. 12 is a plan view of the one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a third embodiment of the present invention; and

[0039] FIG. 13 is a plan view of the one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0040] Hereinafter, an organic light emitting display and a method for fabricating the same according to preferable embodiments of the present invention will be described with reference to the accompanying drawings. When one element is connected to another element, one element may be not only directly connected to another element but also indirectly connected to another element via a third element. Further, certain elements have been omitted for clarity. Also, like reference numerals refer to like elements throughout.

[0041] FIG. 1 is a layout schematically showing a one-pixel region.

[0042] With reference to FIG. 1, a pixel region 10 includes red (R), green (G) and blue (B) sub pixel regions. The red (R), green (G) and blue (B) sub pixel regions have the same area in a strip pattern. The red (R), green (G) and blue (B) sub pixel regions are divided by pixel definition films 12 formed between the red (R), green (G) and blue (B) sub pixel regions.

[0043] According to a sub pixel arrangement of another organic light emitting display, red (R), green (G) and blue (B) sub pixel regions are arranged at a pixel region in a delta pattern. As described above, when the red (R), green (G) and blue (B) sub pixel regions are formed in the stripe or delta pattern, the red (R), green (G) and blue (B) sub pixel regions may be formed so as to have different areas in such a way that the pixel regions are patterned and deposited by red (R), green (G) and blue (B) sub pixel regions. However, because there is a limit to fabrication of a sub pixel region of a specific color to meet a request for a current organic light emitting display, it is difficult to improve the life span of the organic light emitting display.

[0044] In order to solve the aforementioned problem, a laser thermal transfer method capable of providing a minute patterning and transferring an emission layer has been proposed. However, the laser thermal transfer method has problems in that laser equipment is expensive, and it is difficult to improve the quality of a transfer layer.

[0045] FIG. 2 is a cross-sectional view of the one-pixel region taken along line A-A' of FIG. 1.

[0046] Referring to FIG. 2, the organic light emitting display includes a transistor array TA, a first electrode layer 21, a hole transport layer 23, red (R), green (G) and blue (B) sub pixels, an electron transport layer 24, and a second electrode layer 25. The transistor array TA is formed on a substrate 20. The first electrode layer 21 is formed on the transistor array TA. The hole transport layer 23 is formed over an entire surface of a pixel region on the first electrode layer 21. The red (R), green (G) and blue (B) sub pixels are formed on the hole transport layer 23 so as not to be overlapped with each other by a pixel definition film 22. The electron transport layer 24 is formed over an entire surface of the substrate 20 on the red (R) green (G) and blue (B) sub pixels. The second electrode layer 25 is formed on the electron transport layer 24.

[0047] As mentioned above, the red (R), green (G) and blue (B) sub pixels are patterned and formed using a shadow mask or a fine metal mask (FMM).

[0048] However, when the organic light emitting display forms an emission layer, the red (R), green (G), and blue (B) sub pixels should be patterned using different masks for each colors. Since different masks for each colors of the sub pixels should be used, there is a substantial possibility that a misalignment will occur, and the resolution of the organic light emitting display will deteriorate due to the occurrence of the misalignment. Furthermore, because different masks for each colors of emission layer are used, manufacturing cost is increased and a more precise patterning technique is required.

[0049] FIG. 3 is a view showing an organic light emitting display according to an embodiment of the present invention.

[0050] With reference to FIG. 3, in the organic light emitting display of the embodiments of the present invention a power supply unit 30 generates and provides to substrate 35 voltages necessary to drive the substrate 35, namely, a drive power supply ELVdd, a ground power supply ELVss, and power necessary to drive a data driver 32 and a scan driver 31.

[0051] In the aforementioned organic light emitting display, the scan driver 31 controls a selection signal to drive an organic light emitting diode (not shown) included in each of pixel regions 34, and provides the controlled selection signal to scan lines S1 to Sn. The selection signal is transferred to a switch (not shown) in each pixel region 34 which allows the switch to be turned on/off.

[0052] The data driver 32 controls a data voltage or a data current indicating an image signal of each pixel region 34, and provides the controlled data voltage or current to respective data lines D1 to Dm.

[0053] A pixel portion 33 includes a plurality of scan lines S1 to Sn, a plurality of data lines D1 to Dm, and a plurality of pixel regions 34. The plurality of scan lines S 1 to Sn extend from the scan driver 31 in a transverse direction. The plurality of data lines D1 to Dm extend from the data driver 32 in a longitudinal direction. Red (R), green (G) and blue (B) sub pixel regions are included in each pixel region 34. Each of the pixel regions 34 is formed at a region defined by the plurality of scan lines S 1 to Sn and the plurality of data lines D1 to Dm. Each pixel region 34 emits light of an organic light emitting diode according to a scan signal and a data signal so as to display an image.

[0054] FIG. 4 is a plan view of one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a first embodiment of the present invention.

[0055] Referring to FIG. 4, one pixel region 40 includes red (R), green (G) and blue (B) sub pixel regions. The red (R), green (G) and blue (B) sub pixel regions have areas different from each other. In particular, the blue (B) sub pixel region having relatively lower luminous efficiency is formed over an entire surface of the pixel region 40 in common. The red (R) and green (G) sub pixel regions are formed at a closed curve of the blue (B) sub pixel region so as not to overlap each other. In other words, the red (R), green (G) sub pixel regions are formed so are to superpose the blue (B) sub pixel region when considered in a direction perpendicular to the surface of the blue (B) sub pixel region. In detail, the red (R) and green (G) sub pixel regions are formed in a stripe pattern with the blue (B) sub pixel region disposed therebetween. Furthermore, the blue (B) sub pixel region is always disposed at a peripheral portion of the pixel region 40.

[0056] A forming area of the blue (B) sub pixel, except forming areas of the red (R) and green (G) sub pixels, is greater than that of each of the red (R) and green (G) pixels. In detail, a ratio of the area of the red (R) sub pixel to the area of the blue (B) sub pixel ranges from 0.2 to 0.5, and a ratio of the area of the green (G) sub pixel to the area of the blue (B) sub pixel ranges from 0.2 to 0.5.

[0057] Accordingly, the blue (B) sub pixel is formed over an entire surface of a pixel region in common so as to improve luminous efficiency of the blue (B) sub pixel having low luminous efficiency to a level similar to that of each of the red (R) and green (G) sub pixels, thereby improving the life span of the organic light emitting display according to embodiments of the present invention.

[0058] FIG. 5 is a cross-sectional view of the one pixel region taken along one side of line C-C' of FIG. 4 according to an embodiment of the invention.

[0059] Referring to FIG. 5, a transistor array TA and an organic light emitting diode are sequentially formed on a substrate 50. Although not described in detail in the drawings, in the construction of the transistor array TA, a buffer layer is formed on the substrate 50, a semiconductor layer includes an LDD layer formed between an active channel layer and an ohmic contact layer on one region of the buffer layer. A gate insulation film and a gate electrode are sequentially patterned and formed on the semiconductor layer. An interlayer insulation film is formed on the gate electrode so as to expose the ohmic contact layer among the semiconductor layer. A source electrode and a drain electrode are formed at one region of the interlayer insulation film to contact with the exposed ohmic contact layer.

[0060] Furthermore, a patterning film is formed on the interlayer insulation film. A via hole is formed by etching one region of the patterning film to expose the drain electrode. The drain electrode and a first electrode layer 51 are electrically connected to each other through the via hole. The first electrode layer 51 is formed at one region of the patterning film. A pixel definition film 52 is formed on the patterning film in which an opening portion, at least partially exposing the first electrode layer 51, is formed.

[0061] Moreover, a hole transport layer 53 is formed at the pixel definition film 52 and over an entire surface of the opening portion. In order to easily inject holes from the electrode layer 51, the hole transport layer 53 should have a small ionization potential and excellent interface adhesive force with the first electrode layer 51, but should be scarcely absorbed in a visibly ray region. The hole transport layer 53 is made up of a low molecular weight of aryl amine, a low molecular weight of hydrazones, a low molecular weight of stylbene, a low molecular weight of star bursts as NPB, TPD, s-TAD, MTADATTA, a high molecular weight of carbalzol, aryl amine system high molecule, high molecular weight of perylenes and pyrolles, or PVK. As described above, hole transport materials may easily transport holes and maintain electrons in only a light emitting region, thereby increasing the formation probability of an excitor.

[0062] A blue (B) emission layer having relatively lower luminous efficiency is ormed over an entire surface of the pixel region on the hole transport layer 53. An electron blocking layer 54 is formed on the blue (B) emission layer. The electron blocking layer 54 is formed of $Ir(ppz)_3$. A red (R) emission layer is formed on one region of the blue (B) emission layer so as to have a closed curve, and a green (G) emission layer is formed on another region of the blue (B) emission layer. In other words, the red (R), green (G) sub pixel regions are formed so are to superpose the blue (B) sub pixel region when considered in a direction perpendicular to the surface of the blue (B) sub pixel region.

[0063] An electron transport layer 55 is formed over an entire surface of the pixel region on the red (R) and green (G) emission layers. The electron transport layer 55 functions to easily transport electrons from the second electrode layer 56 to the emission layers. The electron transport layer 55 also functions to control the transportation of holes that have not combined with the emission layers in order to increase recombination in the emission layers. Materials having excellent electron affinity, and materials having excellent interface adhesive force with the second electron layer are widely used as the electron transport layer 55.

[0064] In addition to Alq3 having excellent electron affinity, PBD, spiro-PBD, oligothiophene, perfluorinated oligo-p-phenylen, or 2, 5-diarylsilole derivative is used as the electron transport layer 55.

[0065] A second electrode layer 56 is formed on the electron transport layer 55. When the second electrode layer 56 is a top-emitting layer, it is formed of a transparent ITO or IZO. In contrast to this, when the second electrode layer 56 is a rear-emitting layer, it is made of a metal film which is a reflection film.

[0066] In addition, although not shown in the drawings, a hole injection layer (not shown) may be further formed over an entire surface of the pixel region between the first electrode layer 51 and the hole transport layer 53. An electron injection layer (not shown) may be further formed over an entire surface of the pixel region between the second electrode layer 56 and the electron transport layer 55.

[0067] A method of fabricating an organic light emitting display as shown on one side of a line C-C' in FIG. 4 according to an embodiment of the invention will now be explained. A transistor array TA is formed on a substrate 50. Next, a first electrode layer 51 is formed on the transistor array TA. When the first electrode layer 51 is a top-emitting layer, it is formed of transparent ITO or IZO. In contrast to this, when the first electrode layer 51 is a rear-emitting layer, it is made of a metal film that is a reflection film.

[0068] Thereafter, a blue (B) emission layer having the lowest luminous efficiency is formed over an entire surface of the pixel portion on the first electrode layer 55. The blue (B) emission layer can be formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method.

[0069] The vacuum deposition is most used among methods for fabricating thin films, and a process thereof is performed by a simple principle. In the vacuum deposition, a metal, a chemical compound or an alloy is heated under vacuum conditions and is evaporated from a melting state. Evaporated particles are deposited on a surface of a substrate. The vacuum deposition is different from a sputtering method in that an evaporation process is a heat exchange process. A thin film made by the vacuum deposition is referred to as 'vacuum deposition thin film'. The vacuum deposition has advantages in that equipment is rather simple, and the vacuum deposition is easily applicable to various materials.

[0070] The wet coating coats a target using internal liquid materials, coating materials, and coating solvents. After the coating process, a process for removing solvents is necessarily required. Spray coating, spin coating and deposition coating are examples of wet coating. Accordingly, during a removal of the solvents, since deposition materials may be changed or solvents may remain in the deposition materials, the removal of the solvents should be carefully performed.

[0071] In the ink jet method, a head is filled with a solution having an electro-luminescence (EL) material, such as a high molecule organic EL material. In a state wherein the head filled with the solution is arranged away from a substrate by a predetermined distance, the solution from the head is injected into the substrate at high speed, thereby forming an emission layer. The ink jet method has advantages in that the emission layer may be selectively laminated at different regions, and consumption of forming materials of the emission layer may be minimized.

[0072] Moreover, the laser thermal transfer method irradiates a laser beam so as to transfer an emission layer by heat generated from light-heat conversion layer of a donor film. The laser thermal transfer method is profitable for the manufacture of a device having a large area. Since it does not need masks, minute patterning and uniformity of a thin film can be improved.

[0073] Next, an electron blocking layer 54 is formed over an entire surface of the pixel portion on the blue (B) emission layer. In the same way as the blue (B) emission layer, the electron blocking layer 54 is formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method.

[0074] Embodiments of the present invention are not limited to materials for respective emission layers. However, after the blue (B) emission layer is formed as a common layer, in order to form the red (R) and green (G) emission layers, in a case of a fluorescent light emitting diode using fluorescent emission materials as the emission layer, the emission layer is formed and then a hold transport layer is introduced. However, in the case of phosphorescent light emitting diode using emission materials as the emission layer, an electron blocking layer having a Highest Occupied Molecular Orbital (HOMO) greater than that of the emission layer is always needed.

[0075] Thereafter, a red (R) emission layer is formed on the electron blocking layer 54 so as to have a closed curve in the blue (B) emission layer, and a green (G) emission layer is formed thereon so as to have a closed curve in another region of the blue (B) emission layer. In other words, the red (R), green (G) sub pixel regions are formed so are to superpose the blue (B) sub pixel region when considered in a direction perpendicular to the surface of the blue (B) sub pixel region. The blue (B) emission layer is formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method.

[0076] FIG. 6 is a cross-sectional view of the one pixel region of FIG. 4 taken along a side of the line C-C' according to another embodiment of the invention.

[0077] Referring to FIG. 6, a transistor array TA and a light emitting diode are sequentially formed on a substrate 60. A drain electrode of the transistor array TA and a first electrode layer 61 are electrically connected to each other. A pixel definition film 62 is formed on the first electrode layer 61. An opening portion is formed at the pixel definition film 62, and partially exposes the first electrode layer 61.

[0078] A hole transport layer 63 is formed on the pixel definition film 61 and the opening portion. In order to easily inject holes from the electrode layer 61, the hole transport layer 63 should have a small ionization potential and excellent interface adhesive force with the first electrode layer 61, but be scarcely absorbed in a visibly ray region. The hole transport layer 63 is formed of low molecular weight of aryl amine, low molecular weight of hydrazones, low molecular weight of stylbene, low molecular weight of star bursts as NPB, TPD, s-TAD, MTADATTA, high molecular weight of carbalzol, aryl amine system high molecule, high molecular weight of perylenes and pyrolles, or PVK. As described above, hole transport materials may easily transport holes and maintain electrons in only a light emitting region, thereby increasing the formation probability of an excitor.

[0079] A blue (B) emission layer and a green (G) emission are formed on the hole transport layer 63 so as not to overlap each other. The blue (B) emission layer having relative lower luminous efficiency is formed over an entire surface of the pixel portion so as to include the red (R) and green (G) emission layers. A hole blocking layer 64 is formed over an entire surface of the pixel region between red (R) and blue (B) emission layers, and between the green (G) and blue (B) emission layers. The hole blocking layer 64 is formed of BCP, BAlq, SAlq, TAZ, OXD7, Alq3, or PBD.

[0080] A blue (B) emission layer is formed over an entire surface of the pixel region on the hole blocking layer 64. An electron transport layer 65 is formed on the blue (B) emission layer. The electron transport layer 65 functions to easily transport electrons from the second electrode layer 66 to the emission layers. The electron transport layer 65 also functions to control the transportation of holes that have not combined with the emission layers in order to increase recombination in the emission layers. Excellent electron affined materials and materials having excellent interface adhesive force with the second electron layer are widely used as the electron transport layer 65.

[0081] In addition to Alq3 having excellent electron affinity, PBD, spiro-PBD, oligothiophene, perfluorinated oligo-p-phenylen, or 2, 5-diarylsilole derivative is used as the electron transport layer 65.

[0082] A second electrode layer 66 is formed on the electron transport layer 65. When the second electrode layer 66 is a top-emitting layer, it is formed of a transparent ITO or IZO. In contrast to this, when the second electrode layer 66 is a rear-emitting layer, it is made of a metal film that is a reflection film.

[0083] In addition, although not shown in the drawings, a hole injection layer (not shown) may be further formed over an entire surface of the pixel region between the first electrode layer 61 and the hole transport layer 63. An electron injection layer (not shown) may be further formed over an entire surface of the pixel region between the second electrode layer 66 and the electron transport layer 65.

[0084] A method for fabricating an organic light emitting display as shown along a side of a line C-C' in FIG. 4 according to this embodiment of the invention will be now explained. A transistor array TA is formed on a substrate 60. Next, a first electrode layer 61 is formed on the transistor array TA. When the first electrode layer 61 is a top-emitting layer, it is formed of transparent ITO or IZO. In contrast to this, when the first electrode layer 61 is a rear-emitting layer, it is made of a metal film that is a reflection film.

[0085] Thereafter, red (R) and green (G) emission layers are formed on a first electrode layer 61. The red (R) and green (G) emission layers are formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method so as not to overlap each other. Since such methods has been described previously, a description thereof is omitted.

[0086] Next, a hole blocking layer 64 is formed over an entire surface of the pixel region on the red (R) and (G) emission layers. Then, a blue (B) emission layer is formed over an entire surface of the pixel region on the hole blocking layer 64. The hole blocking layer 64 and the blue (B) emission layer are formed by vacuum deposition, wet coating, ink jet, or a thermal transfer method. Finally, a second electrode layer 66 is formed on the blue (B) emission layer.

[0087] Embodiments of the present invention are not limited to materials for respective emission layers. However, after the blue (B) emission layer is formed as a common layer, in order to form the red (R) and green (G) emission layers, in the case of a fluorescent light emitting diode using fluorescent emission materials as the emission layer, the emission layer is formed and then a hold transport layer is introduced. However, in the case of phosphorescent light emitting diode using emission materials as the emission layer, an electron blocking layer having an HOMO greater than that of the emission layer is always needed.

[0088] The blue (B) and green (G) emission layers are divided from each other by a pixel definition film 62 formed along boundaries of corresponding sub pixel regions.

[0089] In order to assist in an understanding of embodiments of the present invention, some elements have been omitted for clarity. In particular, detailed descriptions of the construction of a substrate, the functions of layers, and materials are omitted.

[0090] FIG. 7 is a cross-sectional view of the one pixel region of FIG. 4 taken along a side of line D-D' according to an embodiment of the invention.

[0091] As shown in FIG. 7, a transistor array TA is formed on a substrate 70, and a first electrode layer 71 is formed on the transistor array TA. A hole transport layer 72 is formed on the first electrode layer 71, and a blue (B) emission layer having the lowest luminous efficiency is formed over an entire surface of the hole transport layer 72.

[0092] The red (R) and green (G) emission layers are not shown in FIG. 7. A forming area of the blue (B) emission layer, except a forming area of the red (R) or (G) emission layer, is greater than that of the red (R) or (G) emission layer. A ratio of the area of the red (R) emission layer to the area of the blue (B) emission layer ranges from 0.2 to 0.5, and a ratio of the area of the green (G) emission layer to the area of the blue (B) emission layer ranges from 0.2 to 0.5.

[0093] An electron blocking layer 73 is formed on the blue (B) emission layer, and an electron transport layer 74 is formed on the electron blocking layer 73. Furthermore, a second electrode layer 75 is formed on the electron transport layer 74.

[0094] FIG. 8 is a cross-sectional view of the one pixel region of FIG. 4 taken along a side of the line D-D' according to another embodiment of the invention.

[0095] As shown in FIG. 8, a transistor array TA is formed on a substrate 80, and a first electrode layer 81 is formed on the transistor array TA. A hole transport layer 82 is formed on the first electrode layer 81, and a hole blocking layer 83 is formed on the hole transport layer 82. Furthermore, a blue (B) emission layer having the lowest luminous efficiency is formed over an entire surface of the hole blocking layer 83.

[0096] The red (R) and green (G) emission layers are shown in FIG. 8. A forming area of the blue (B) emission layer, except a forming area of the red (R) or (G) emission layer, is greater than that of the red (R) or (G) emission layer. A ratio of the area of the red (R) emission layer to the area of the blue (B) emission layer ranges from 0.2 to 0.5, and a ratio of the area of the green (G) emission layer to the area of the blue (B) emission layer ranges from 0.2 to 0.5.

[0097] An electron transport layer 84 is formed on the blue (B) emission layer, and a second electrode layer 85 is formed on the electron transport layer 84.

[0098] In order to assist in an understanding of embodiments of the present invention, irrelevant elements are omitted for clarity. In particular, detailed descriptions of the construction of a substrate, the functions of layers, and materials are omitted.

[0099] FIG. 9 is a cross-sectional view of the one pixel region of FIG. 4 taken along one side of line E-E' according to an embodiment of the invention.

[0100] As shown in FIG. 9, a transistor array TA is formed on a substrate 90, and a first electrode layer 91 is formed on the transistor array TA. A hole transport layer 92 is formed over an entire surface of a pixel region on the first electrode layer 91, and a blue (B) emission layer having the lowest luminous efficiency is formed over an entire surface of the hole transport layer 92.

[0101] Furthermore, an electron blocking layer 93 is formed on a blue (B) emission layer, and a red (R) emission layer is formed at one region on the electron blocking layer 93. An electron transport layer 95 is formed over an entire surface of the pixel region on the red (R) emission layer and the electron blocking layer 94. Additionally, a second electrode layer 96 is formed on the electron transport layer 95.

[0102] FIG. 10 is a cross-sectional view of the one pixel region of FIG. 4 taken along a side of line E-E' according to another embodiment of the invention.

[0103] As shown in FIG. 10, a transistor array TA is formed on a substrate 100, and a first electrode layer 101 is formed on the transistor array TA. A hole transport layer 103 is formed on the first electrode layer 101, and a red (R) emission layer is formed at one region of the hole transport layer 103. A hole blocking layer 104 is formed over an entire surface of the pixel region on a red (R) emission layer and the hole transport layer 103. Furthermore, a blue (B) emission layer having the lowest luminous efficiency is formed over an entire surface of the hole blocking layer 104.

[0104] An electron transport layer 105 is formed over the entire surface of the pixel region on the blue (B) emission layer, and a second electrode layer 106 is formed on the electron transport layer 105.

[0105] FIG. 11 is a plan view of the one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a second embodiment of the present invention.

[0106] Referring to FIG. 11, one pixel region 110 includes red (R), green (G), and blue (B) sub pixel regions. The red (R), green (G) and blue (B) sub pixel regions have different areas from each other. In particular, the blue (B) sub pixel region having relatively lower luminous efficiency is formed over an entire surface of the pixel region 110 in common. The red (R) and green (G) sub pixel regions are formed in a blue (B) closed curve so as not to overlap each other. In other words, the red (R), green (G) sub pixel regions are formed so are to superpose the blue (B) sub pixel region when considered in a direction perpendicular to the surface of the blue (B) sub pixel region. The red (R) sub pixel region is formed at an upper left portion of the pixel region 110, whereas the green (G) sub pixel region is formed at a lower right portion of the pixel region 110. The red (R), green (G) and blue (B) sub pixels are arranged in a delta pattern having a triangular shape. Each of the red (R), green (G) and blue (B) sub pixel regions has a square shape, and the blue (B) sub pixel region is formed at a peripheral portion of the pixel region 110.

[0107] The blue (B) sub pixel formed on the pixel region 110 may be formed at an upper portion or a lower portion of the red (R) and green (G) sub pixels. When the blue (B) sub pixel is formed at the upper portion thereof, the red (R) and green (G) sub pixel regions are divided from each other by a pixel definition film 111.

[0108] FIG. 12 is a plan view of one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a third embodiment of the present invention.

[0109] Referring to FIG. 12, one pixel region 120 includes red (R), green (G) and blue (B) sub pixel regions. The red (R), green (G) and blue (B) sub pixel regions have different areas from each other. In particular, the blue (B) sub pixel region having relatively lower luminous efficiency is formed over an entire surface of the pixel region 120 in common. The red (R) and green (G) sub pixel regions are formed in a blue (B) closed curve so as not to overlap each other. In other words, the red (R), green (G) sub pixel regions are formed so are to superpose the blue (B) sub pixel region when considered in a direction perpendicular to the surface of the blue (B) sub pixel region. The red (R) sub pixel region is formed at an upper left portion of the pixel region 120, whereas the green (G) sub pixel region is formed at an upper right portion of the pixel region 120. The red (R), green (G) and blue (B) sub pixels are arranged in a delta pattern having a triangular shape. Although the pixel region 120 of FIG. 12 has a construction similar to that of the pixel region 110 of FIG. 11, respective sub pixels are formed at different locations. Each of the red (R), green (G) and blue (B) sub pixel regions has a square shape, and the blue (B) sub pixel region is formed at a peripheral portion of the pixel region 120.

[0110] The blue (B) sub pixel formed on the pixel region 120 may be formed at an upper portion or a lower portion of the red (R) and green (G) sub pixels. When the blue (B) sub pixel is formed at the upper portion thereof, the red (R) and green (G) sub pixel regions are divided from each other by a pixel definition film 121.

[0111] FIG. 13 is a plan view of one pixel region shown in FIG. 3 as a layout of the organic light emitting display according to a fourth embodiment of the present invention.

[0112] Referring to FIG. 13, one pixel region 130 includes red (R), green (G) and blue (B) sub pixel regions. The red (R), green (G) and blue (B) sub pixel regions have different areas from each other. In particular, the blue (B) sub pixel region having relatively lower luminous efficiency is formed over an entire surface of the pixel region 130 in common. The red (R) and green (G) sub pixel regions are formed in a blue (B) closed curve so as not to overlap each other. In other words, the red (R), green (G) sub pixel regions are formed so are to superpose the blue (B) sub pixel region when considered in a direction perpendicular to the surface of the blue (B) sub pixel region. The red (R) sub pixel region and the green (G) sub pixel region are formed at left and right sides, respectively, of the pixel region 130. The red (R), green (G) and blue (B) sub pixels are arranged in a stripe pattern having a triangular shape. Each of the red (R), green (G) and blue (B) sub pixel regions has a square shape, and the blue (B) sub pixel region is formed at a peripheral portion of the pixel region 130.

[0113] The blue (B) sub pixel formed on the pixel region 130 may be formed at an upper portion or a lower portion of the red (R) and green (G) sub pixels. When the blue (B) sub pixel is formed at the upper portion thereof, the red (R) and green (G) sub pixel regions are divided from each other by a pixel definition film 131.

[0114] In FIG. 11 thru FIG. 13, a forming area of the blue (B) emission layer, except forming areas of the red (R) and green (G) emission layers, is greater than that of each of the red (R) and green (G) emission layers. In detail, a ratio of the area of the red (R) emission layer to the area of the blue (B) emission layer ranges from 0.2 to 0.5, and a ratio of the area of the green (G) emission layer to the area of the blue (B) emission layer ranges from 0.2 to 0.5.

[0115] Accordingly, the blue (B) sub pixel region is formed over an entire surface of the pixel region 121, thereby improving luminous efficiency of the blue (B) emission layer having a low luminous efficiency relative to a similar level of that of the red (R) or green (G) emission layer. This causes an improvement in life span of the organic light emitting display according to embodiments of the present invention.

[0116] Since some embodiments of the present invention use the blue (B) emission layer as a common layer, it is unnecessary to pattern the blue (B) emission layer region. Accordingly, the number of masks may be reduced. Furthermore, because blue emission materials are coated on an entire surface of a substrate, the degradation of emission materials occurs only to a small degree, so that embodiments of the present invention obtain a more stable organic light emitting display than conventional organic light emitting displays.

[0117] Although some embodiments of the present invention form a blue (B) emission layer as a common layer, other emission layers, for example those having low luminous efficiency, may be used as the common layer.

[0118] As mentioned above, in accordance with embodiments of the present invention, a layout of respective pixels is changed to increase an area of one sub pixel region having low luminous efficiency in order to improve life span and aperture ratio of the organic light emitting display. In addition, during formation of an emission layer, the number of masks is reduced. Accordingly, the possibility of occurrence of a misalignment is reduced, thereby maximizing resolution, improving yield, and reducing manufacturing cost.

[0119] Although some embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the the scope of which is defined in the claims and their equivalents.

Claims

1. An organic light emitting display comprising at least one pixel region which includes sub pixels being operable to emit light of one of a plurality of colors, said display further comprising:

    a first sub pixel emission layer formed over an entire surface of said at least one pixel region; and
    a second sub pixel emission layer formed so as to partially superpose said first sub pixel emission layer when considered in a direction perpendicular to the first sub pixel emission layer.

2. An organic light emitting display according to Claim 1, further comprising a third sub pixel emission layer formed so as to partially superpose said first sub pixel emission layer when considered in said direction perpendicular to the first sub pixel emission layer, wherein the second sub pixel emission layer and the third sub pixel emission layer are arranged so as to not to overlap each other.

3. An organic light emitting display according to claim 2, wherein said first sub pixel emission layer is operable to emit light in an emission direction, and wherein said second and third sub pixel emission layers each partially superpose said first sub pixel emission layer when considered in said emission direction of said first sub pixel emission layer.

4. An organic light emitting display according to claim 3, further comprising an electron blocking layer formed over the entire surface of the pixel region between said first sub pixel emission layer and said second and third sub pixel emission layers.

5. An organic light emitting display according to claim 4, wherein the electron blocking layer is formed of Ir $(ppz)_3$.

6. An organic light emitting display according to claim 2, wherein said first sub pixel emission layer is operable to emit light in an emission direction, and wherein said second and third sub pixel emission layers each partially superpose said first sub pixel emission layer when considered in a direction opposite to said emission direction.

7. An organic light emitting display according to claim 6, further comprising a hole blocking layer formed over the entire surface of the pixel region between said second and third sub pixel emission layers and said first sub pixel emission layer.

8. An organic light emitting display according to claim 7, wherein the hole blocking layer is formed of a material selected from the group consisting of BCP, BAlq, SAlq, TAZ, OXD7, Alq3, and PBD.

9. An organic light emitting display according to any one of claims 2 to 8, further comprising:

    a first electrode layer respectively included in said sub pixels and formed on one region of a substrate;
    a second electrode layer formed on the first, second and third sub pixel emission layers, respectively.

10. An organic light emitting display according to any one of claims 1 to 9, wherein the first sub pixel emission layer is operable to emit light having a blue color.

11. An organic light emitting display according to any one of claims 1 to 10, wherein said first sub pixel emission layer is formed so as to have an area that is greater than the areas of each of said second and

third sub pixel emission layers.

12. An organic light emitting display according to any one of claims 2 to 11, wherein a luminous efficiency of the first sub pixel emission layer is lower than a luminous efficiency of each of the second and third sub pixel emission layers.

13. An organic light emitting display according to any one of claims 1 to 14, wherein a ratio of the area of the second sub pixel emission layer to the area of the first sub pixel emission layer ranges from 0.2 to 0.5.

14. An organic light emitting display according to any one of claims 2 to 13, wherein a ratio of an area of the third sub pixel emission layer to an area of the first sub pixel emission layer ranges from 0.2 to 0.5.

15. An organic light emitting display according to any one of claims 2 to 14, wherein the second and third sub pixel emission layers are formed so as to emit light having a red color and a green color, respectively.

16. An organic light emitting display according to any one of claims 2 to 15, wherein the first, second and third sub pixel emission layers are arranged in a stripe pattern.

17. An organic light emitting display according to any one of claims 1 to 15, wherein the first, second and third sub pixel emission layers are arranged in a delta pattern.

18. An organic light emitting display according to any one of claims 2 to 17, further comprising pixel definition layers formed along peripheral regions of the second and third sub pixel emission layers, respectively.

19. In a method for fabricating an organic light emitting display which includes at least one pixel including sub pixels being operable to emit light of a plurality of colors, a method of forming a pixel region of said at least one pixel, comprising:

forming a first sub pixel emission layer over an entire surface of said pixel region;
forming a second sub pixel emission layer so as to partially superpose said first sub pixel emission layer when considered in a direction perpendicular to the first sub pixel emission layer;
forming a third sub pixel emission layer formed so as to partially superpose said first sub pixel emission layer when considered in said direction perpendicular to the first sub pixel emission layer, wherein the second sub pixel emission layer and the third sub pixel emission layer are arranged not to overlap each other.

20. A method according to claim 19, further comprising:

forming first electrode layers of the sub pixels on one region of a substrate;
forming the second sub pixel emission layer over on one region of the first sub pixel emission layer;
forming the third sub pixel emission layer over on another region of the first sub pixel emission layer; and
forming second electrode layers on the first and second sub pixel emission layers, respectively.

21. A method according to Claim 20, further comprising forming an electron blocking layer over the entire surface of the pixel region between the first sub pixel emission layer and the second sub pixel emission layer and/or between the first sub pixel emission layer and the third sub pixel emission layer.

22. A method according to claim 21, wherein the electron blocking layer is formed by one of vacuum deposition, wet coating, ink jet, and a thermal transfer method.

23. A method according to claim 19, further comprising:

forming first electrode layers of the sub pixels on one region of a substrate;
forming the second sub pixel emission layer on one region of the pixel region so as to be disposed on the first electrode layer;
forming the third sub pixel emission layer at another region of the pixel region so as to be disposed on the first electrode layer;
forming the first sub pixel emission layer over an entire surface of the pixel region including the first and second sub pixel emission layers so as to be disposed on the first and second sub pixel emission layers; and
forming second electrode layers on the first, second and third sub pixel emission layers, respectively.

24. A method according to claim 23, further comprising the step of forming a hole blocking layer over the entire surface of the pixel region between the first sub pixel emission layer and the second sub pixel emission layer and/or between the first sub pixel emission layer and the third sub pixel emission layer.

25. A method according to claim 24, wherein the hole blocking layer is formed by one of vacuum deposition, wet coating, ink jet, and a thermal transfer method.

26. A method according to any one of claims 19 to 25, wherein one or more of the first, second or third sub pixel emission layers are formed by one of vacuum deposition, wet coating, ink jet, and a thermal transfer method.

FIG. 1
(PRIOR ART)

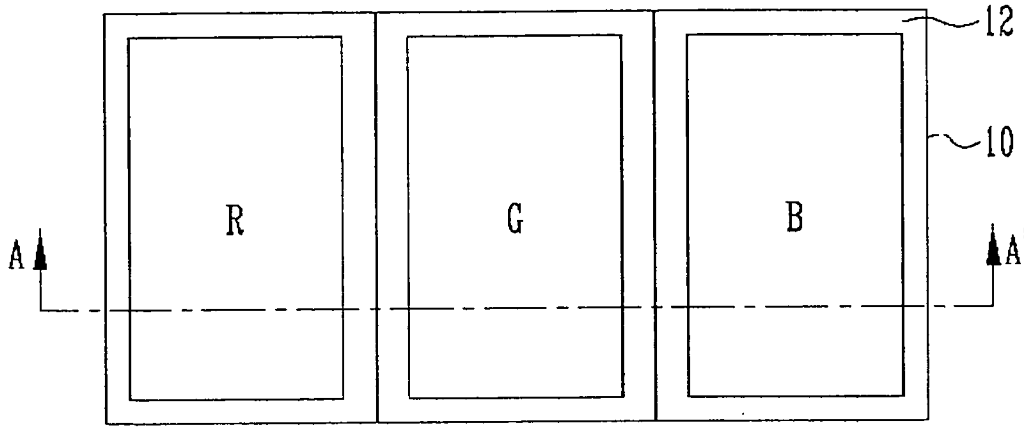


FIG. 2
(PRIOR ART)

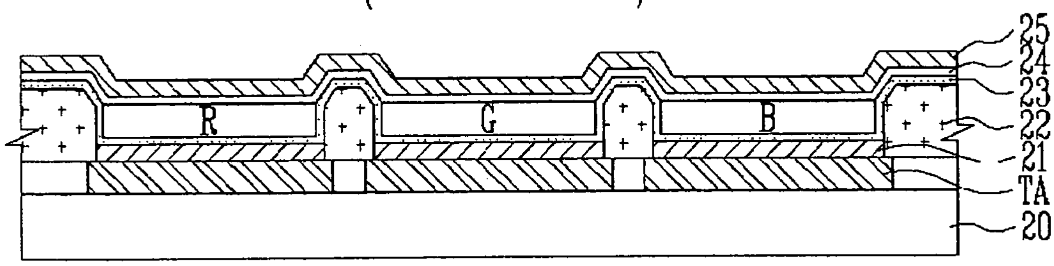


FIG. 3

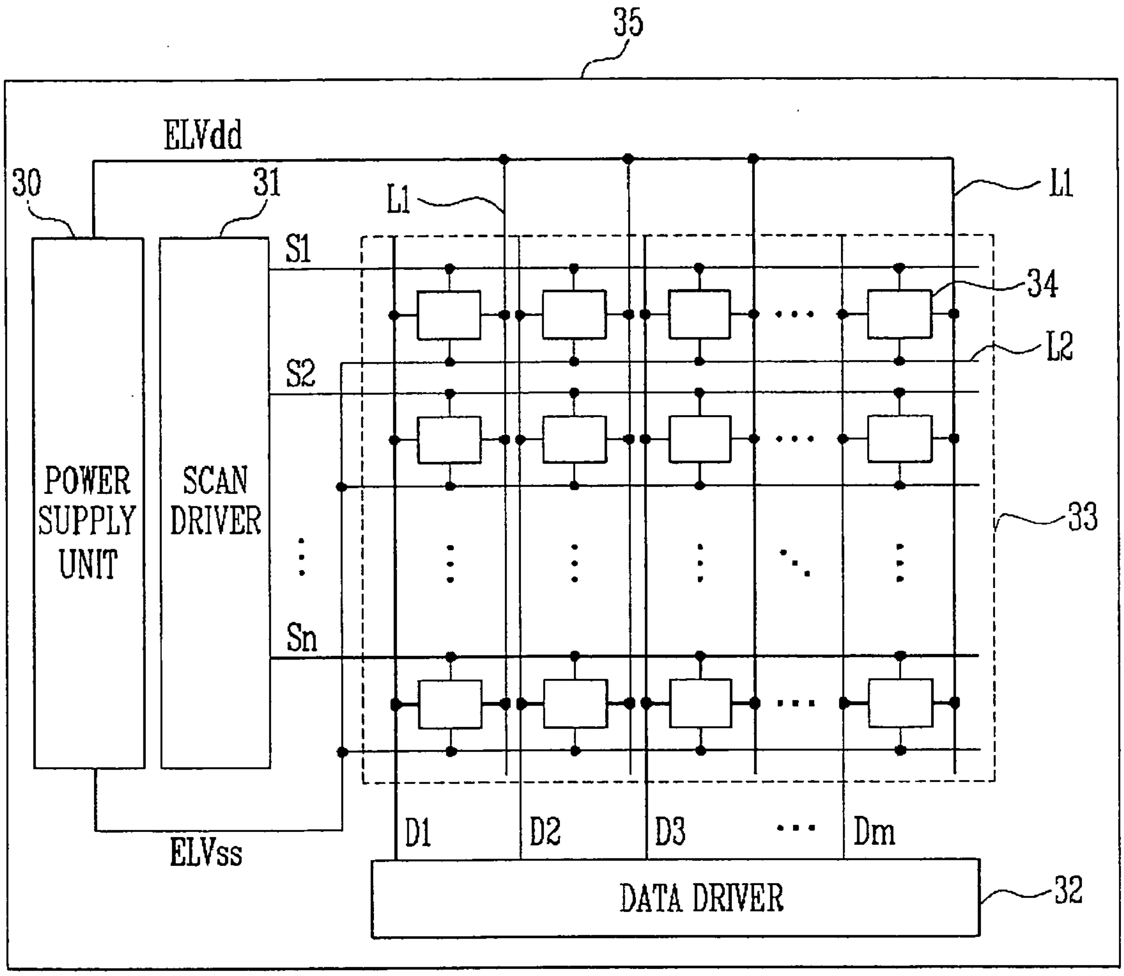

35
ELVdd
30
31
L1
L1
S1
34
L2
S2
POWER SUPPLY UNIT
SCAN DRIVER
33
Sn
D1
D2
D3
Dm
ELVss
DATA DRIVER
32

FIG. 4

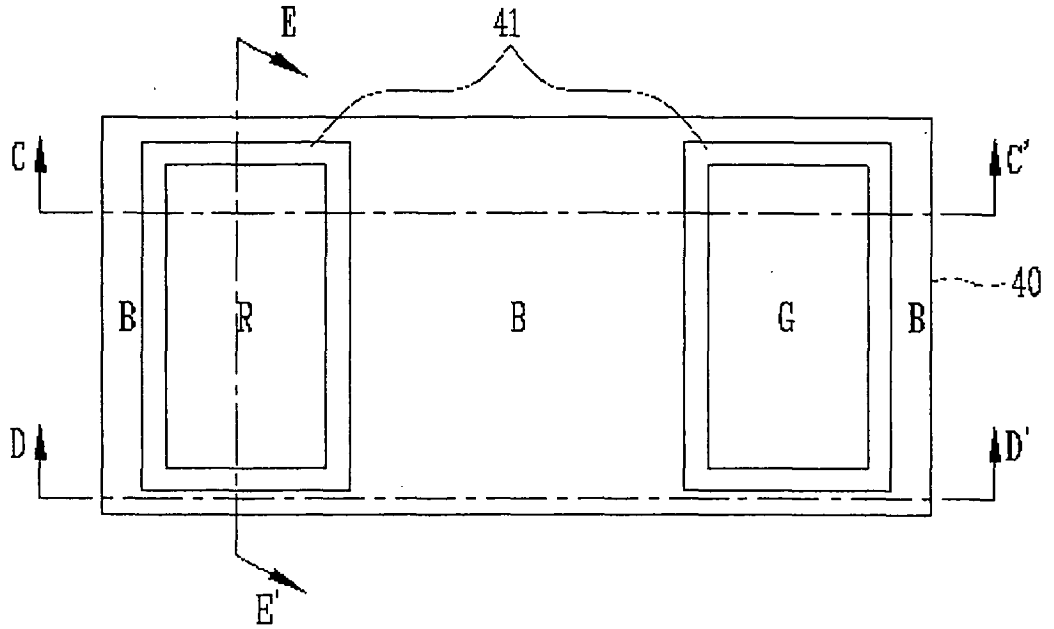


FIG. 5

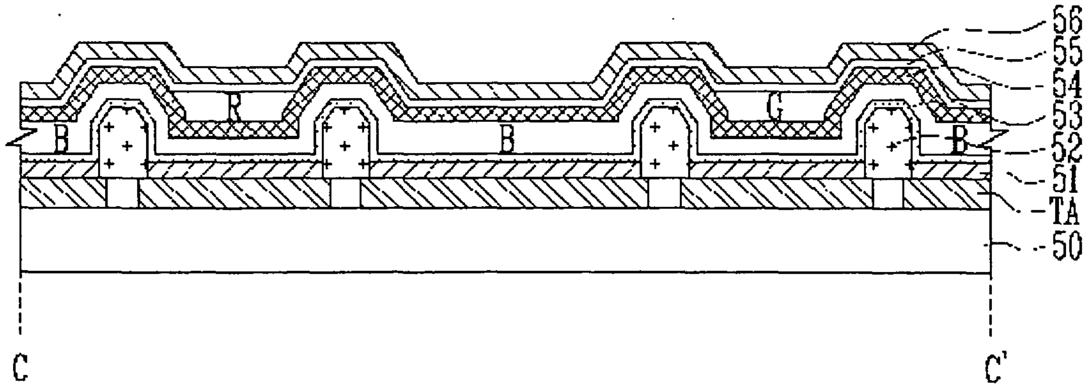


FIG. 6

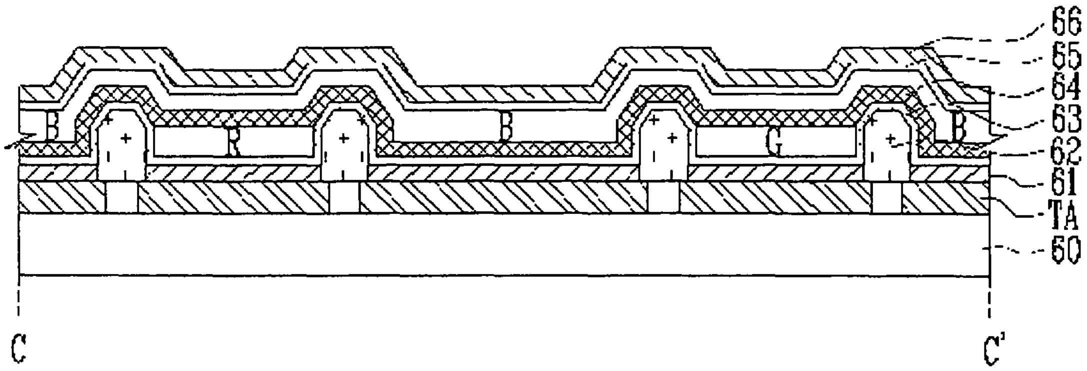


FIG. 7

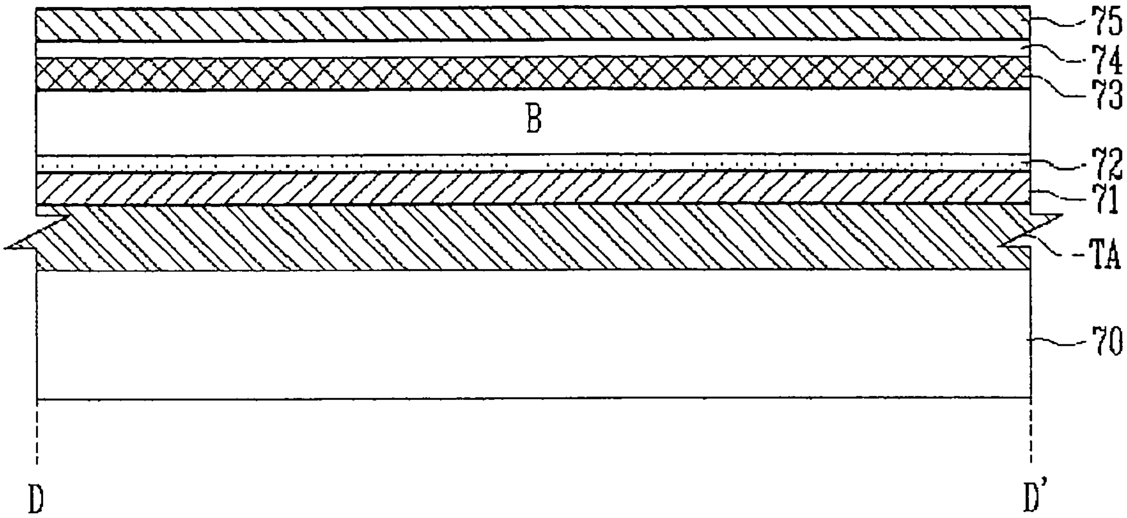


FIG. 8

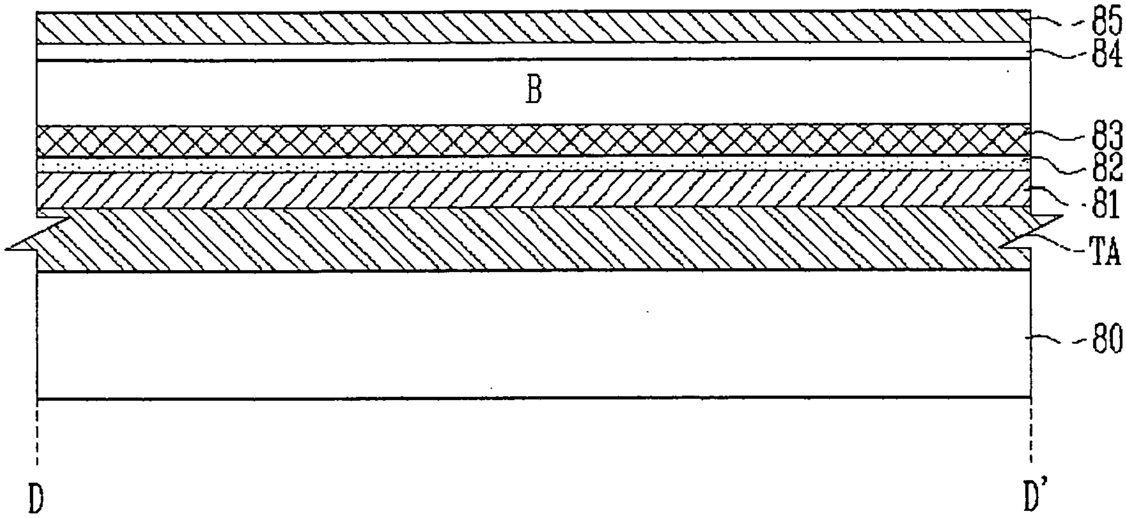


FIG. 9

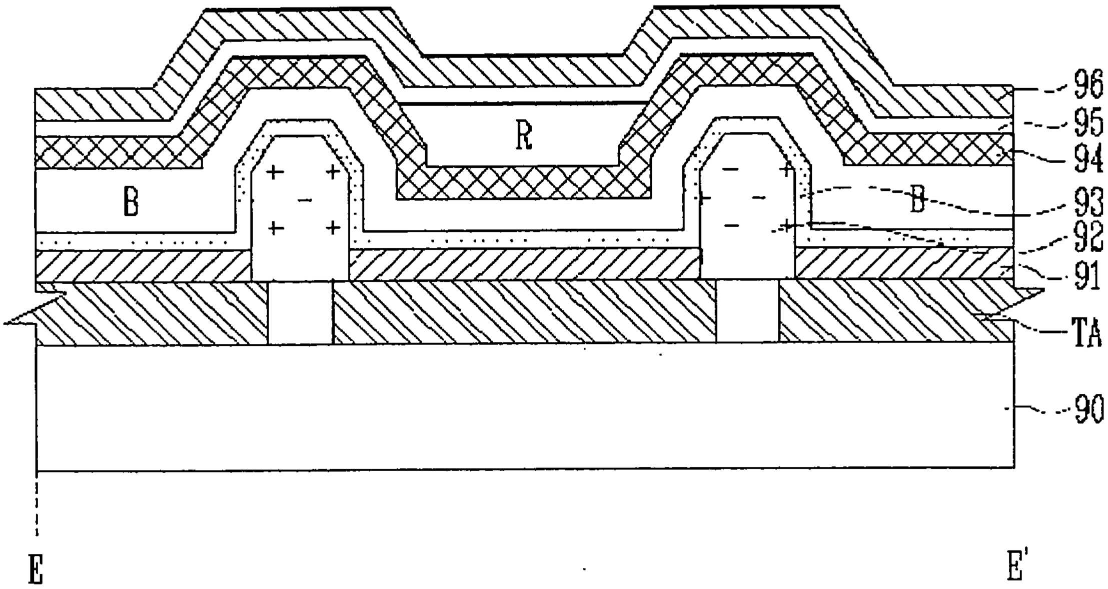


FIG. 10

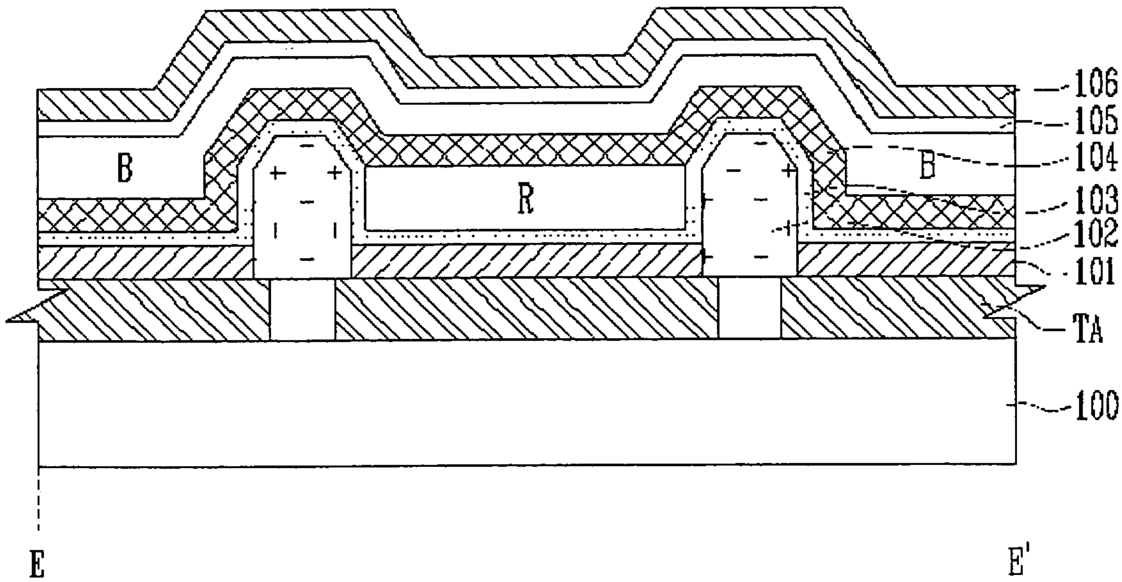


FIG. 11

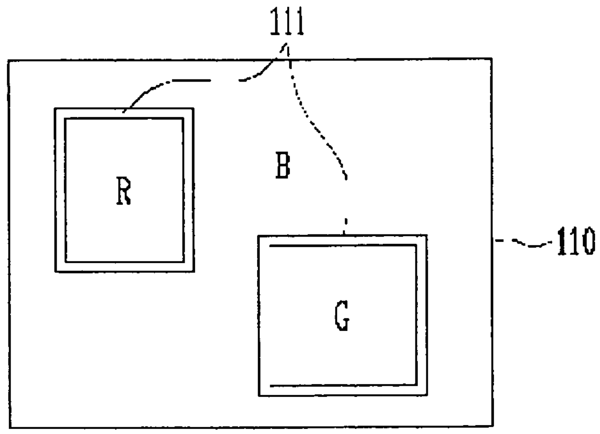


FIG. 12

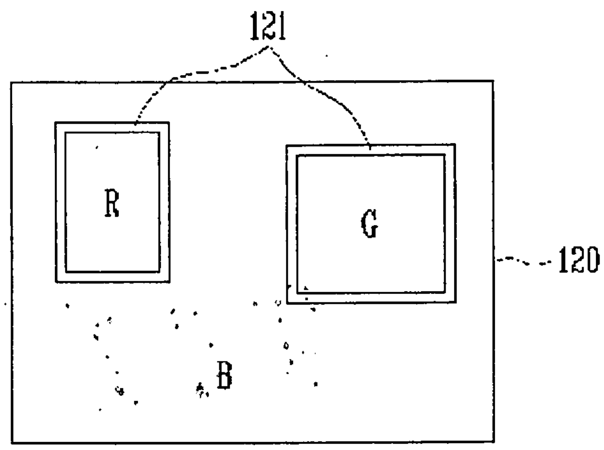
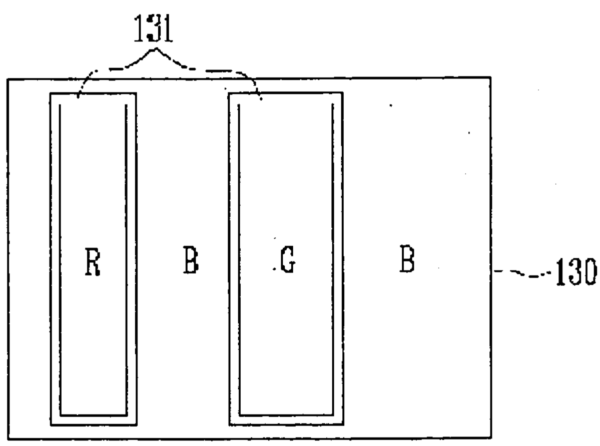


FIG. 13



patsnap

专利名称(译)	有机发光显示器及其制造方法		
公开(公告)号	[EP1758170A2]	公开(公告)日	2007-02-28
申请号	EP2006254465	申请日	2006-08-25
[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SDI CO.，LTD.		
发明人	KIM, BYUNG HEE CO SAMSUNG SDI CO., LTD., LEGAL &		
IPC分类号	H01L27/32 H01L51/56		
CPC分类号	H01L27/3218 H01L27/3216 H01L51/56		
优先权	1020050079063 2005-08-26 KR		
其他公开文献	EP1758170B1 EP1758170A3		
外部链接	[Espacenet]		

摘要(译)

在有机发光显示器及其制造方法中，改变各个像素的布局以改善寿命，从而增加具有低发光效率的一个像素区域。有机发光显示器包括至少一个像素，该像素包括具有多种颜色的子像素。在像素区域的整个表面上形成第一子像素发射层。在第一子像素发射层处形成至少两个第二子像素发射层，以具有闭合曲线。改变各个像素的布局以增加具有低发光效率的一个子像素区域的面积，以便改善有机发光显示器的寿命和孔径比。另外，在形成发光层期间，掩模的数量减少。因此，减少了未对准的可能性，从而使分辨率最大化，提高了产量并降低了制造成本。

FIG. 4