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(71) Applicant: **Samsung Display Co., Ltd.**
Yongin-City, Gyeonggi-Do, 446-711 (KR)

(72) Inventors:
- **Shin, Hyea-Weon**
  Gyeonggi-Do (KR)
- **Lee, Seung-Mook**
  Gyeonggi-Do (KR)
- **Park, Sang-Hun**
  Gyeonggi-Do (KR)
- **Kim, Jae-Bok**
  Gyeonggi-Do (KR)
- **Kim, Young-Il**
  Gyeonggi-Do (KR)
- **Ha, Jae-Kook**
  Gyeonggi-Do (KR)

(74) Representative: **Sampson, Eimear et al**
Venner Shipley LLP
200 Aldersgate
London EC1A 4HD (GB)

(54) Organic Light Emitting Structures, Methods of Forming Organic Light Emitting Structures, Organic Light Emitting Display Devices and Methods of Manufacturing Organic Light Emitting Display Devices

(57) An organic light emitting display device includes a hole transport layer (HTL) having a first region and a second region, an emitting layer (EML) disposed on the hole transport layer in the first region, a hydrophobic pattern disposed on the hole transport layer in the second region and an electron transport layer (ETL) disposed on the hydrophobic pattern and the emitting layer.

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Description

[0001] The present invention relates to organic light emitting structures and methods of forming organic light emitting structures, as well as to organic light emitting display devices comprising those organic light emitting structures and methods of manufacturing organic light emitting devices. More particularly, embodiments of the invention relate to organic light emitting structures including hydrophobic patterns and methods of forming organic light emitting structures including hydrophobic patterns as well as to organic light emitting display devices including organic light emitting structures comprising hydrophobic patterns and methods of manufacturing same.

[0002] An organic light emitting display (OLED) device may display desired information such as images, letters and/or characters using a light generated by the combination of holes provided from an anode and electrons provided from a cathode in an organic layer thereof. The OLED device may have several advantages such as wide viewing angle, high response time, exceptional thinness and overall compactedness, and low power consumption, so that the OLED device may be widely employed in various electrical and electronic apparatuses. Recently, the OLED device has been rapidly developed as one of the most promising class of display devices.

[0003] To form an organic emitting layer of the OLED device, a printing process using an inkjet, a spinner or a nozzle, a patterning process after the deposition of layers, and a transfer process using heat or laser have been utilized. The organic emitting layer, however, may not be formed uniformly within a pixel region of the OLED device and may not be endowed with a capability to visually display high contrast images when fabricated by the above-mentioned process techniques. Additionally, as the size of the OLED device increases, a mask used for, e.g., an exposure process may not be easily obtained and a large quantity of materials for forming the organic emitting layer may be required, thereby unnecessarily inflating the cost of manufacturing.

[0004] According to an aspect of the present invention there is provided an organic light emitting structure. The organic light emitting structure includes a hole transport layer (HTL) having a first region and a second region, an emitting layer (EML) disposed on the hole transport layer in the first region, a hydrophobic pattern disposed on the hole transport layer in the second region and an electron transport layer (ETL) disposed on the hydrophobic pattern and the emitting layer.

[0005] An organic light emitting structure according to the present invention may have improved luminescence characteristics. The hydrophobic pattern may ensure improved luminance characteristics.

[0006] In an embodiment, the first region substantially corresponds to a pixel region and the second region substantially corresponds to a non-pixel region.

[0007] In an embodiment, the emitting layer is substantially confined by the hydrophobic pattern.

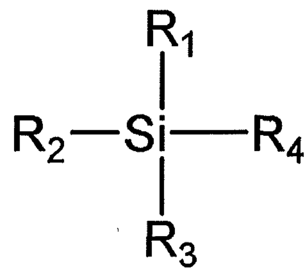
[0008] In an embodiment, a hole injection layer (HIL) may be further disposed beneath the hole transport layer.

[0009] In an embodiment, an electron injection layer (EIL) may be further disposed on the electron transport layer.

[0010] In an embodiment, the hydrophobic pattern includes at least one fluorine-based material, e.g., polymer, oligomer, dendrimer or monomer containing at least one carbon atom combined or hybridized with at least one fluorine atom, or may include at least one organosilane-based material containing at least one organic functional group combined with a silicon atom.

[0011] In an embodiment, the fluorine-based material has a repeating unit represented by a formula of -(CF2-CF2)n-.

[0012] In an embodiment, the organosilane-based material is represented by the following chemical formula.



[0013] In the above chemical formula, R_1 to R_4 may independently represent hydrogen, a C_1 to C_{20} alkyl group, a C_1 to C_{20} alkoxy group, halogen, an amino group or a hydroxyl group. At least one of R_1 to R_4 may represent a C_1 to C_{20} alkyl group or a C_1 to C_{20} alkoxy group.

[0014] In an embodiment, the C_1 to C_{20} alkyl group or the C_1 to C_{20} alkoxy group may have at least one fluorine atom substituent.

[0015] In an embodiment, the hydrophobic pattern has a thickness of about 100 nm to about 3 μm.

[0016] In an embodiment, the hole transport layer includes a first pattern located in the first region and a second pattern located in the second region.

[0017] In an embodiment, the first pattern includes a hole transport material, and the second pattern includes the hole transport material and a cross-linked or polymerized photosensitive material.

[0018] In an embodiment, the second pattern has an electrical conductivity substantially lower than that of the first pattern.

[0019] In an embodiment, the photosensitive material includes an acrylate-based material or a methacrylate-based material.

[0020] In an embodiment, the electron transport layer includes a third pattern and a fourth pattern. The third pattern and the fourth pattern may substantially overlap the first region and the second region, respectively.

[0021] In an embodiment, the third pattern includes an electron transport material. The fourth pattern may include an electron transport material and a cross-linked or polymerized photosensitive material.

[0022] In an embodiment, the fourth pattern has an electrical conductivity substantially lower than that of the third pattern.

[0023] According to the present invention, there is provided an organic light emitting display device comprising an organic light emitting structure according to the invention in its first aspect. The organic light emitting device may include a first substrate having a pixel region and a non-pixel region, a first electrode disposed on the first substrate, a pixel defining layer (PDL) disposed on the first substrate and partially exposing the first electrode in the pixel region, a hole transport layer disposed on the pixel defining layer and the exposed first electrode, a hydrophobic pattern disposed on the hole transport layer in the non-pixel region, an emitting layer disposed on the hole transport layer in the pixel region, an electron transport layer disposed on the hydrophobic pattern and the emitting layer, and a second electrode disposed on the electron transport layer.

[0024] In an embodiment, a switching device is further disposed on the first substrate. The switching device may be electrically connected to the first electrode.

[0025] In an embodiment, a hole injection layer may be further disposed on the pixel defining layer and the exposed first electrode, and beneath the hole transport layer.

[0026] In an embodiment, an electron injection layer may be further disposed between the electron transport layer and the second electrode.

[0027] In an embodiment, the pixel defining layer has a thickness of about 1000 Å to about 4000 Å.

[0028] In an embodiment, the hole transport layer includes a first pattern and a second pattern. The second pattern may have an electrical conductivity substantially lower than that of the first pattern.

[0029] In an embodiment, the first pattern is disposed on the exposed first electrode and a sidewall of the pixel defining layer. In this case, the second pattern may be disposed on a surface of the pixel defining layer.

[0030] In an embodiment, the first pattern is disposed on the exposed first electrode and a portion of a sidewall of the pixel defining layer. In this case, the second pattern may be disposed on a surface of the pixel defining layer and on a portion of the sidewall of the pixel defining layer not covered by the first pattern.

[0031] In an embodiment, the first pattern is disposed on the exposed first electrode and the second pattern may be disposed on a surface and a sidewall of the pixel defining layer.

[0032] In an embodiment, the first pattern is disposed on a portion of the exposed first electrode and the second pattern may be disposed on the pixel defining layer and on a portion of the exposed first electrode not covered by the first pattern.

[0033] In an embodiment, the electron transport layer includes a third pattern and a fourth pattern. The fourth pattern may have an electrical conductivity substantially lower than that of the third pattern.

[0034] In an embodiment, the third pattern is disposed on the emitting layer and the fourth pattern is disposed on the hydrophobic pattern.

[0035] In an embodiment, the third pattern is disposed on a portion of the emitting layer. In this case, the fourth pattern may be disposed on the hydrophobic pattern and on a portion of the emitting layer not covered by the third pattern.

[0036] According to a second aspect of the present invention, there is provided a method of forming an organic light emitting structure. In the method, a hole transport layer having a first region and a second region is provided. A hydrophobic pattern is formed on the hole transport layer in the second region. An emitting layer is formed on the hole transport layer in the first region. An electron transport layer is formed on the hydrophobic pattern and the emitting layer.

[0037] In an embodiment, in forming the hydrophobic pattern, a hydrophobic layer may be formed on a donor substrate. The donor substrate may be arranged over the hole transport layer so that the hydrophobic layer may face the hole transport layer. A laser beam may be irradiated selectively in the second region to transfer a portion of the hydrophobic layer onto the hole transport layer.

[0038] In an embodiment, in forming the hydrophobic pattern, a hydrophobic layer may be formed on a donor substrate. The donor substrate may be arranged on the hole transport layer so that the hydrophobic layer may face the hole transport layer. Pressure and heat may be applied onto the donor substrate to form the hydrophobic pattern on the hole transport layer in the second region.

[0039] In an embodiment, the hydrophobic pattern is formed by an inkjet printing process, a nozzle printing process, a stamping process, an offset imprinting process or a reverse offset imprinting process.

[0040] In an embodiment, the hydrophobic pattern is formed by a soluble process. In the soluble process, a hydrophobic composition may be provided on the hole transport layer in the second region. The hydrophobic composition may include a fluorine-based material or an organosilane-based material, and a solvent.

[0041] In an embodiment, the hydrophobic pattern is formed by an insoluble process. In the insoluble process, a fluorine-based material or an organosilane-based material may be vaporized or sublimated. The fluorine-based material or the organosilane-based material may be provided on the hole transport layer in the second region.

[0042] In an embodiment, in providing the hole transport layer, a preliminary hole transport layer including a photosensitive composition is provided. A portion of the preliminary hole transport layer in the second region is selectively exposed to light.

[0043] The photosensitive composition may include a hole transport material, a photosensitive monomer, a photopolymerization initiator and an organic solvent.

[0044] In an embodiment, the portion of the preliminary hole transport layer in the second region is transformed into a second pattern by a cross-linking reaction or a polymerization reaction. A portion of the preliminary hole transport layer in the first region may be transformed into a first pattern.

[0045] In an embodiment, the first pattern includes the hole transport material, and the second pattern includes the hole transport material and a polymer produced by cross-linking or polymerizing the photosensitive monomer.

[0046] In an embodiment, a baking process is further performed after selectively exposing the portion of the preliminary hole transport layer in the second region to light.

[0047] In an embodiment, the photosensitive monomer, the photopolymerization initiator and the organic solvent remaining in the first pattern are removed by providing a developing solution after selectively exposing the portion of the preliminary hole transport layer in the second region to light.

[0048] In an embodiment, in the formation of the electron transport layer, a preliminary electron transport layer is formed on the emitting layer and the hydrophobic pattern. The preliminary electron transport layer may include a photosensitive composition. A portion of the preliminary electron transport layer on the hydrophobic pattern may be selectively exposed to light.

The photosensitive composition may include an electron transport material, a photosensitive monomer, a photopolymerization initiator and an organic solvent.

[0049] In an embodiment, the portion of the preliminary electron transport layer on the hydrophobic pattern is transformed into a fourth pattern by a cross-linking reaction or a polymerization reaction. A portion of the preliminary electron transport layer on the emitting layer may be transformed into a third pattern.

[0050] In an embodiment, the third pattern includes the electron transport material, and the fourth pattern includes the electron transport material and a polymer produced by cross-linking or polymerizing the photosensitive monomer.

[0051] In an embodiment, a baking process is further performed after selectively exposing the portion of the preliminary electron transport layer on the hydrophobic pattern to the light.

[0052] In an embodiment, the photosensitive monomer, the photopolymerization initiator and the organic solvent remaining in the third pattern are removed by providing a developing solution after selectively exposing the portion of the preliminary electron transport layer on the hydrophobic pattern to light.

[0053] In an embodiment, a hole injection layer is further provided before providing the hole transport layer.

[0054] In an embodiment, an electron injection layer is further formed on the electron transport layer.

[0055] In an embodiment, the hydrophobic pattern has a thickness of about 1000 Å to about 3 μm.

[0056] According to an embodiment of the second aspect of the invention, there is provided a method of manufacturing an organic light emitting display device. In the method, a first electrode may be formed on a first substrate. The first substrate may have a pixel region and a non-pixel region. A pixel defining layer may be formed on the first substrate. The pixel defining layer may partially expose the first electrode. A hole transport layer may be formed on the pixel defining layer and the exposed first electrode. A hydrophobic pattern may be formed on the hole transport layer in the non-pixel region. An emitting layer may be formed on the hole transport layer in the pixel region. An electron transport layer may be formed on the hydrophobic pattern and the emitting layer. A second electrode may be formed on the electron transport layer.

[0057] In an embodiment, the hydrophobic pattern is formed using at least one fluorine-based material, e.g., polymer, oligomer, dendrimer or monomer containing at least one carbon atom combined or hybridized with at least one fluorine atom, or the hydrophobic pattern is formed using at least one organosilane-based material containing at least one organic functional group combined with a silicon atom.

[0058] In an embodiment, in the formation of the hydrophobic pattern, a hydrophobic layer is formed on a donor substrate. The donor substrate may be arranged over the hole transport layer so that the hydrophobic layer may face the hole transport layer. A laser beam may be irradiated selectively in the non-pixel region to transfer a portion of the hydrophobic layer onto the hole transport layer.

[0059] In an embodiment, in the formation of the hydrophobic pattern, a hydrophobic layer is formed on a donor substrate. The donor substrate may be arranged on the hole transport layer so that the hydrophobic layer may face the hole transport layer. Pressure and heat may be applied to the donor substrate to form the hydrophobic pattern on the hole transport layer in the non-pixel region.

[0060] In an embodiment, the hydrophobic pattern is formed by an inkjet printing process, a nozzle printing process, a stamping process, an offset imprinting process or a reverse offset imprinting process.

[0061] In an embodiment, the hydrophobic pattern is formed by a soluble process. In the soluble process, a hydrophobic composition may be provided on the hole transport layer in the non-pixel region. The hydrophobic composition may include a fluorine-based material or an organosilane-based material and a solvent.

[0062] In an embodiment, the hydrophobic pattern is formed by an insoluble process. In the insoluble process, a fluorine-based material or an organosilane-based material may be vaporized or sublimated. The fluorine-based material or the organosilane-based material may be provided on the hole transport layer in the non-pixel region.

[0063] In an embodiment, in the formation of the hole transport layer, a preliminary hole transport layer including a photosensitive composition is formed on the pixel defining layer and the exposed first electrode. A portion of the preliminary hole transport layer on the pixel defining layer may be selectively exposed to light.

[0064] In an embodiment, a portion of the preliminary hole transport layer on a top surface of the pixel defining layer is transformed into a second pattern by a cross-linking reaction or a polymerization. In this case, a portion of the preliminary hole transport layer on a sidewall of the pixel defining layer and the exposed first electrode may be transformed into a first pattern.

[0065] In an embodiment, a portion of the preliminary hole transport layer on a surface and a portion of a sidewall of the pixel defining layer is transformed into a second pattern by a cross-linking reaction or a polymerization. In this case, a portion of the preliminary hole transport layer on the sidewall of the pixel defining layer not covered by the second pattern and on the exposed first electrode may be transformed into a first pattern.

[0066] In an embodiment, a portion of the preliminary hole transport layer on a surface and a sidewall of the pixel defining layer is transformed into a second pattern by a cross-linking reaction or a polymerization reaction. In this case, a portion of the preliminary hole transport layer on the exposed first electrode may be transformed into a first pattern.

[0067] In an embodiment, a portion of the preliminary hole transport layer on the pixel defining layer and a portion of the exposed first electrode is transformed into a second pattern by a cross-linking reaction or a polymerization reaction. In this case, a portion of the preliminary hole transport layer on the exposed first electrode not covered by the second pattern may be transformed into a first pattern.

[0068] In an embodiment, in the formation of the electron transport layer, a preliminary electron transport layer is formed on the emitting layer and the hydrophobic pattern. The preliminary electron transport layer may include a photosensitive composition. A portion of the preliminary electron transport layer in the non-pixel region may be selectively exposed to light.

[0069] In an embodiment, a portion of the preliminary electron transport layer on the hydrophobic pattern is transformed into a fourth pattern by a cross-linking reaction or a polymerization reaction. In this case, a portion of the preliminary electron transport layer on the emitting layer may be transformed into a third pattern.

[0070] In an embodiment, a portion of the preliminary electron transport layer on the hydrophobic pattern and a portion of the emitting layer is transformed into a fourth pattern by a cross-linking reaction or a polymerization reaction. In this case, a portion of the preliminary electron transport layer on the emitting layer not covered by the fourth pattern may be transformed into a third pattern.

[0071] In an embodiment, a hole injection layer is further formed on the pixel defining layer and the exposed first electrode before forming the hole transport layer.

[0072] In an embodiment, an electron injection layer is further formed on the electron transport layer after forming the electron transport layer.

[0073] According to an embodiment, an organic light emitting display device includes a hydrophobic pattern on a portion of a hole transport layer in a non-pixel region. A portion of the hole transport layer in a pixel region may have a hydrophilicity so that an organic emitting layer may be formed selectively in the pixel region. Accordingly, a light emitting material of the organic emitting layer may be prevented from being deposited on the non-pixel region and blurring or smearing the non-pixel region, so that the organic light emitting display device may have improved resolution and contrast. Additionally, an electrical conductivity of the hole transport layer in the non-pixel region may be reduced so that luminescence characteristics of the organic light emitting display device may be more enhanced.

[0074] 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:

FIG. 1 is a cross-sectional view illustrating an organic light emitting display device including an organic light emitting structure constructed according to an embodiment of the present invention;

FIGS. 2A to 2D are cross-sectional views illustrating organic light emitting display devices including organic light emitting structures constructed according to embodiments of the present invention;

FIG. 3 is a cross-sectional view illustrating an organic light emitting display device including an organic light emitting structure constructed according to embodiments of the present invention;

FIGS. 4 to 11 are cross-sectional views illustrating a method of manufacturing an organic light emitting display device including an organic light emitting structure according to an embodiment of the present invention;

FIGS. 12 to 17 are cross-sectional views illustrating a method of manufacturing an organic light emitting display device including an organic light emitting structure according to an embodiment of the present invention; and

FIGS. 18 to 20 are cross-sectional views illustrating a method of manufacturing an organic light emitting display device including an organic light emitting structure according to an embodiment of the present invention.

[0075] Various exemplary embodiments will be described more fully hereinafter with reference to the accompanying drawings, in which some exemplary embodiments are shown. The invention may, however, be embodied in many different forms and should not be construed as limited to the exemplary embodiments set forth herein. Rather, these exemplary embodiments are provided so that this description will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the sizes and relative sizes of layers and regions may be exaggerated for clarity.

[0076] It will be understood that when an element or layer is referred to as being "on," "connected to" or "coupled to" another element or layer, it can be directly on, connected or coupled to the other element or layer or intervening elements or layers may be present. In contrast, when an element is referred to as being "directly on," "directly connected to" or "directly coupled to" another element or layer, there are no intervening elements or layers present. Like numerals refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0077] It will be understood that, although the terms first, second, third etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the invention.

[0078] Spatially relative terms, such as "beneath," "below," "lower," "above," "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0079] The terminology used herein is for the purpose of describing particular exemplary embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a," "an" and "the" are intended to include a plurality of forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0080] Exemplary embodiments are described herein with reference to cross-sectional illustrations that are schematic illustrations of embodiments (and intermediate structures). As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, exemplary embodiments should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing. For example, an implanted region illustrated as a rectangle will, typically, have rounded or curved features and/or a gradient of implant concentration at its edges rather than a binary change from implanted to non-implanted region. Likewise, a buried region formed by implantation may result in some implantation in the region between the buried region and the surface through which the implantation takes place. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the actual shape of a region of a device and are not intended to limit the scope of the invention.

[0081] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0082] FIG. 1 is a cross-sectional view illustrating an organic light emitting display device including an organic light emitting structure constructed as an embodiment in accordance with the principles of the present invention.

[0083] Referring to FIG. 1, the organic light emitting display (OLED) device may include a first substrate 100, a switching device 140, a first electrode 160, an organic light emitting structure 240, a second electrode 250, etc.

[0084] The first substrate 100 may include a transparent substrate such as a glass substrate, a quartz substrate, a transparent plastic substrate, etc. For example, the transparent plastic substrate may include polyimide, acryl-based resin, polyethylene terephthalate (PET), polycarbonate, polyacrylate, polyether, etc. A planarization process may be performed on the first substrate 100 so that the first substrate 100 may have a substantially planar top surface. For example, the planarization process may include a chemical mechanical polishing (CMP) process or an etch-back process.

[0085] A buffer layer 105 may be disposed on the first substrate 100. The buffer layer 105 may block the diffusion of impurities generated from the first substrate 100 and may control heat transfer when a semiconductor pattern 110 is formed by a crystallization process. For example, the buffer layer 105 may include silicon oxide (SiOx), silicon nitride (SiNx), silicon oxynitride (SiOxNy), etc. The buffer layer 105 may have a single-layered structure or a multi-layered structure including these materials. The buffer layer is optional and the OLED device may not include the buffer layer 105.

[0086] The switching device 140 may be disposed on the buffer layer 105. The switching device 140 may include the semiconductor pattern 110, a gate electrode 125, a gate insulation layer 120, a source electrode 133 and a drain electrode 135, etc. The switching device 140 may include a thin film transistor (TFT) having an active region of polysilicon. Alternatively, the switching device 140 may include an oxide semiconductor device. In this case, the switching device 140 may include a gate electrode on the buffer layer 105, a gate insulation layer covering the gate electrode, a source electrode at one side of the gate insulation layer, a drain electrode at the other side of the gate insulation layer, an active layer having an oxide semiconductor material and being disposed on the source electrode, the drain electrode and the gate insulation layer, etc.

[0087] Referring now to FIG. 1, the semiconductor pattern 110 may include a source region 112 connected to the source electrode 133, a drain region 116 connected to the drain electrode 135 and a channel region 114 between the source region 112 and the drain region 116. The semiconductor pattern 110 may include polysilicon.

[0088] The gate insulation layer 120 may be disposed on the buffer layer 105 to cover the semiconductor pattern 110. The gate insulation layer 120 may insulate the gate electrode 125 from the semiconductor pattern 110. The gate insulation layer 120 may include a silicon-based compound, e.g., silicon oxide, silicon nitride, silicon oxynitride, etc. These may be used alone or in a mixture thereof. The gate insulation layer 120 may include a metal oxide. For example, the gate insulation layer 120 may include aluminium oxide (AlOx), zirconium oxide (ZrOx), hafnium oxide (HfOx), tantalum oxide (TaOx), etc. These may be used alone or in a mixture thereof. The gate insulation layer 120 may have a single-layered structure or a multi-layered structure including the above silicon-based compounds and/or the metal oxides.

[0089] The gate electrode 125 to which a gate signal is applied may be disposed on the gate insulation layer 120. The gate electrode 125 may include a metal such as chromium (Cr), aluminium (Al), tantalum (Ta), molybdenum (Mo), titanium (Ti), tungsten (W), copper (Cu), silver (Ag), neodymium (Nd), etc., or an alloy of these metals. These may be used alone or in a mixture thereof. A gate line (not illustrated) electrically connected to the gate electrode 125 and extending in a predetermined direction may be disposed on the gate insulation layer 120.

[0090] A first insulating interlayer 130 covering the gate electrode 125 may be disposed on the gate insulation layer 120. The first insulating interlayer 130 may include silicon oxide or a transparent insulating material such as an acryl-based resin, polyimide-based resin, siloxane-based resin, etc. The first insulating interlayer 130 may insulate the gate electrode 125 from the source and drain electrodes 133 and 135.

[0091] The source electrode 133 and the drain electrode 135 may be disposed on the first insulating interlayer 130. The source electrode 133 and the drain electrode 135 may be electrically connected to the source region 112 and the drain region 116, respectively, through openings formed in the first insulating interlayer 130 and the gate insulation layer 120. The source electrode 133 and the drain electrode 135 may be positioned symmetrically to each other with respect to the gate electrode 125. The source and drain electrodes 133 and 135 may include a metal such as chromium, aluminium, tantalum, molybdenum, titanium, tungsten, copper, silver, neodymium, etc., or an alloy of these metals.

[0092] A second insulating interlayer 150 covering the switching device 140 may be disposed on the first insulating interlayer 130. That is, the second insulating interlayer 150 may cover the source and drain electrodes 133 and 135. The second insulating interlayer 150 may protect the switching device140 and may insulate the switching device 140 from upper structures. The second insulating interlayer 150 may include a transparent insulating material having a self-planarizing property. For example, the second insulating interlayer 150 may include an acryl-based resin, polyimide-based resin, siloxane-based resin, benzocyclobutene (BCB), etc.

[0093] The first electrode 160 may be disposed on the second insulating interlayer 150 and may be electrically to the drain electrode 135 through an opening formed in the second insulating interlayer 150. For such electrical connection between the first electrode 160 and the drain electrode 135, the second insulating interlayer 150 may include an opening (not illustrated) or a hole (not illustrated) at least partially exposing the drain electrode 135. The first electrode 160 may fill up the opening or the hole and may extend on a top surface of the second insulating interlayer 150. The first electrode 160 may partially fill the opening or the hole and may extend on the top surface of the second insulating interlayer 150. In this case, the first electrode 160 may be formed uniformly on a sidewall of the opening or the hole.

[0094] The first electrode 160 may serve as a transparent electrode or a reflective electrode according to the type of OLED device, for example, a top-emission type or a back-emission type. When the first electrode 160 serves as the transparent electrode, the first electrode 160 may include a transparent conductive material, for example, indium tin oxide (ITO), zinc tin oxide (ZTO), indium zinc oxide (IZO), zinc oxide (ZnOx), tin oxide (SnOx), etc. When the first electrode 160 serves as the reflective electrode, the first electrode 160 may include a metal such as silver (Ag), aluminium (Al), platinum (Pt), gold (Au), chromium (Cr), tungsten (W), molybdenum (Mo), titanium (Ti), palladium (Pd), etc., or an alloy of these metals. The first electrode 160 may have a multi-stacked structure including a first layer and a second layer. The first layer may include, e.g., the above metal or the alloy and the second layer may include, e.g., the above transparent conductive material.

[0095] As illustrated in FIG. 1, a pixel defining layer (PDL) 165 may be disposed on the second insulating interlayer 150 and the first electrode 160. The PDL 165 may partially expose the first electrode 160 to define a first region I of the OLED device. The first region I may correspond to a pixel region of the OLED device. In some embodiments, the PDL 165 includes a photosensitive material, for example, polyimide-based resin or acryl-based resin. Alternatively, the PDL 165 may include a non-photosensitive material or an inorganic material.

[0096] The PDL 165 may have a thickness of about 1000 Å to about 4000 Å.

[0097] The organic light emitting structure 240 may be disposed on the first electrode 160 and the PDL 165. The organic light emitting structure 240 may include a hole transport layer (HTL) 210, a hydrophobic pattern 215, an organic light emitting layer (EML) 220 and an electron transport layer (ETL) 230 sequentially stacked on the first electrode 160 and the PDL 165.

[0098] The HTL 210 may be disposed on the PDL 165 and a portion of the first electrode 160 exposed by the PDL 165. The HTL 210 may include a hole transport material. Non-limiting examples of the hole transport material may include 4,4-bis[N-(1-naphtyl)-N-phenylamino]biphenyl (NPB), N,N-diphenyl-N,N-bis(3-methylphenyl)-1,1-biphenyl-4,4-diamine (TPD), N,N-di-1-naphtyl-N,N-diphenyl-1,1-biphenyl-4,4-diamine (NPD), N-phenylcarbazole, polyvinylcarbazole or a mixture of these materials.

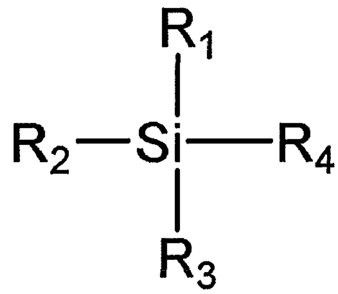
[0099] A hole injection layer (HIL) (not illustrated) may be located on the PDL 165 and the exposed first electrode 160, and beneath the HTL 210. The HIL may include, e.g., 4,4',4"-tris(N-carbazolyl)triphenylamine (TCTA), 4,4',4"-tris(N-(3-methylphenyl)-N-phenylamino)triphenylamine (m-MTDATA), 1,3,4-tris{4-[methylphenyl(phenyl)amino]phenyl}benzene (m-MTDAPB), 4,4',4"-tris(2-naphthylphenylamino)triphenylamine (2-TNATA), or a mixture of these materials.

[0100] The hydrophobic pattern 215 may be disposed on a portion of the HTL 210 in a second region II in which the PDL 165 and the portion of the HTL 210 may substantially overlap each other. The second region II may correspond to a non-pixel region of the OLED device. The second region II (non-pixel region) of the OLED device may have a hydrophobic surface by forming the hydrophobic pattern 215. The hydrophobic pattern 215 may have a thickness of about 1000 Å to about 3 μm.

[0101] In some embodiments, the hydrophobic pattern 215 located in the second region II includes a fluorine-based material. The fluorine-based material may include at least one of polymer, oligomer, dendrimer or monomer containing at least one carbon atom combined or hybridized with at least one fluorine atom. These may be used alone or in a mixture thereof. The carbon atom may be combined with one fluorine atom (CF), two fluorine atoms (CF_2) or three fluorine atoms (CF_3). In an embodiment, the hydrophobic pattern 215 includes a fluorine-based polymer having a repeating unit represented by $-(CF_2-CF_2)n-$. Here, n may be an integer in a range of about 2 to 10,000.

[0102] In some embodiments, the hydrophobic pattern 215 includes an organosilane-based material having at least one organic functional group combined with a silicon atom. The organic functional group may include alkyl, alkoxy, halogen, amino, hydroxyl, etc. For example, the organosilane-based material may be represented by a following chemical formula.

Chemical Formula



[0103] In the above chemical formula, R_1 to R_4 may independently represent hydrogen, a C1 to C20 alkyl group, a C1 to C20 alkoxy group, halogen, an amino group or a hydroxyl group. In some embodiments, at least one of R_1 to R_4 is a C1 to C20 alkyl group or a C1 to C20 alkoxy group. Additionally, the C1 to C20 alkyl group or the C1 to C20 alkoxy group may be substituted with at least one fluorine atom.

[0104] The hydrophobic pattern 215 may include the fluorine-based material or the organosilane-based material so that a difference in surface energy may be generated between the hydrophobic pattern 215 and the HTL 210. Accordingly, the EML 220 may be formed selectively in the first region I substantially corresponding to the pixel region.

[0105] The EML 220 may be disposed on a portion of the HTL 210 located in the first region I of the OLED device. The EML 220 may include at least one of light emitting materials for generating different colours of light, for example, a red colour of light, a green colour of light or a blue colour of light. The EML 220 may include a mixture or a combination of the light emitting materials for generating a white colour of light. The EML 220 may further include a host material having a relatively large band gap.

[0106] According to some embodiments, the EML 220 is disposed selectively in the first region I (pixel region) confined by the hydrophobic pattern 215. Thus, the light emitting materials may be prevented from being deposited or diffused onto the second region II (non-pixel region) and from blurring or smearing the non-pixel region, so that the EML 220 may be precisely formed in the pixel region with a high resolution. As a result, the OLED device may have an enhanced contrast.

[0107] Referring now to FIG. 1, the ETL 230 may be disposed on the hydrophobic pattern 215 and the EML 220. For example, the ETL 230 may include, but not limited to, tris(8-quinolinolate)aluminium (Alq_3), 2-(4-biphenylyl)-5-(4-tert-butylphenyl)-1,3,4-oxadiazole (PBD), 3-(4-tert-butylphenyl)-4-phenyl-5-(4- biphenylyl)-1,2,4-triazole (TAZ), 5,6,11,12-tetraphenylnaphthacene (rubrene), etc.

[0108] The second electrode 250 may be disposed on the ETL 230. The second electrode 250 may serve as a reflective electrode or a transparent electrode. When the second electrode 250 serves as the reflective electrode, the second electrode 250 may include a metal or a metal compound such as lithium (Li), calcium (Ca), lithium fluoride/calcium (LiF/Ca), lithium fluoride/aluminium (LiF/Al), aluminium (Al), magnesium (Mg), silver (Ag), chromium (Cr), tungsten (W), molybdenum (Mo), titanium, (Ti), etc., or an alloy of these metals. When the second electrode 250 serves as the transparent electrode, the second electrode 250 may include a transparent conductive material, e.g., indium tin oxide, zinc tin oxide, indium zinc oxide, zinc oxide, tin oxide, etc. The second electrode 250 may have a multi-stacked structure including a first layer and a second layer. The first layer may include, e.g., the above metal and/or the alloy, and the second layer may include, e.g., the above transparent conductive material.

[0109] An electron injection layer (EIL) may be further disposed between the ETL 230 and the second electrode 250. The EIL may include an alkaline metal, an alkaline earth metal, fluorides of these metals, oxides of these metals, etc. These may be used alone or in a mixture thereof.

[0110] A protection layer (not illustrated) and a second substrate (not illustrated) may be sequentially disposed on the second electrode 250. The protection layer may include a transparent insulating material and the second substrate may include a transparent insulating substrate.

[0111] FIGS. 2A to 2D are cross-sectional views illustrating organic light emitting display devices including organic light emitting structures constructed according to the present invention. The OLED devices of FIGS. 2A to 2D may have constructions substantially similar to that illustrated in FIG. 1.

[0112] As illustrated in FIGS. 2A to 2D, the OLED devices may include a switching device 140, a first insulating interlayer 130, a second insulating interlayer 150, a first electrode 160, a PDL 165, an organic light emitting structure, a second electrode 250, etc., on a first substrate 100. Elements including the first substrate 100, the switching device 140, the first insulating interlayer 130, the second insulating interlayer 150, the first electrode 160, the PDL 165 and the second electrode 250 may have structures substantially the same as or similar to those illustrated with reference to FIG. 1. Thus, detailed descriptions thereof are omitted.

[0113] Referring to FIG. 2A, the organic light emitting structure may include an HTL 212, a hydrophobic pattern 215, an EML 220 and an ETL 230. The hydrophobic pattern 215, the EML 220 and the ETL 230 may have structures substantially the same as or similar to those illustrated with reference to FIG. 1. Thus, detailed descriptions thereof are omitted.

[0114] The HTL 212 may be disposed on the PDL 165 and the first electrode 160. The HTL 212 may include a first pattern 212a substantially located in a first region I (a pixel region) and a second pattern 212b substantially located in a second region II (a non-pixel region). That is, the first pattern 212a of the HTL 212 may be located on a portion of the first electrode 160 exposed by the PDL 165 and on a sidewall of the PDL 165. The second pattern 212b of the HTL 212 may be located on a top surface of the PDL 165 in the second region II.

[0115] The first pattern 212a may include a hole transport material, e.g., NPB, TPD, α-NPD, N-phenylcarbazole, polyvinylcarbazole, etc. The second pattern 212b may include a cross-linked or polymerized photosensitive material in addition to the above hole transport material. The second pattern 212b may have a relatively low electrical conductivity by the cross-linked or polymerized photosensitive material.

[0116] Referring to FIG. 2B, an HTL 2121 may include a first pattern 212c containing the hole transport material and a second pattern 212d containing the hole transport material and the cross-linked or polymerized photosensitive material. The second pattern 212d may extend from the top surface of the PDL 165 to a portion of the sidewall of the PDL 165. In this case, the first pattern 212c may be located on the exposed first electrode 160 and on a remaining portion of the sidewall of the PDL 165 not covered by the second pattern 212d.

[0117] Referring to FIG. 2C, a second pattern 212f of the HTL 2122 may be located on the top surface and the sidewall of the PDL 165. In this case, a first pattern 212e may be located on the exposed first electrode 160.

[0118] Referring to FIG. 2D, a second pattern 212h of the HTL 2123 may extend from the top surface of the PDL 165 to a portion of the exposed first electrode 160. In this case, a first pattern 212g may be located on a remaining portion of the exposed first electrode 160 not covered by the second pattern 212h.

[0119] As illustrated in FIGS. 2A to 2D, regions on which the second patterns 212b, 212d, 212f and 212h having a reduced electrical conductivity are formed may be adjusted so that a region to which holes are transported may be confined properly. This may lead to a synergetic effect together with the hydrophobic pattern 215 limiting a region for the EML 220 so that the OLED device may have more enhanced resolution and contrast.

[0120] In an embodiment, an HIL (not illustrated) may be located beneath the HTL 210 and on the PDL 165 and the exposed first electrode 160, and the HTL 212 may be disposed on the HIL. The HIL may include, e.g., TCTA, m-MTDATA, m-MTDAPB, 2-TNATA or a mixture of these materials.

[0121] The hydrophobic pattern 215 and the EML 220 may be disposed on the HTL 212. The hydrophobic pattern 215 may be disposed in the non-pixel region and the EML 220 may be disposed in the pixel-region. The EML 220 may be confined by the hydrophobic pattern 215 to be located selectively in the pixel-region.

[0122] The ETL 230 and the second electrode 250 may be sequentially disposed on the EML 220. In an embodiment, an EIL may be further disposed between the ETL 230 and the second electrode 250. A protection layer (not illustrated) and a second substrate (not illustrated) may be disposed on the second electrode 250.

[0123] FIG. 3 is a cross-sectional view illustrating an organic light emitting display device including an organic light emitting structure constructed according to the present invention. The OLED device of FIG. 3 may have a construction substantially the same as or similar to that illustrated with reference to FIGS. 2A to 2D except for an organic light emitting structure.

[0124] Referring to FIG. 3, an ETL 235 of the organic light emitting structure may include a third pattern 235a located in a first region I and a fourth pattern 235b located in a second region II. The first region I and the second region II may substantially correspond to a pixel region and a non-pixel region, respectively. That is, the third pattern 235a and the fourth pattern 235b may be disposed on an EML 220 and a hydrophobic pattern 215, respectively. The organic light emitting structure of FIG. 3 may have a construction substantially the same as or similar to that illustrated with reference to FIGS. 2A to 2D except for a structure of the ETL 235.

[0125] The third pattern 235a of the ETL 235 may include an electron transport material such as Alq_3, PBD, TAZ, rubrene, etc. The fourth pattern 235b may include a cross-linked or polymerized photosensitive material in addition to the above electron transport material. The fourth pattern 235b may have a relatively low electrical conductivity by the cross-linked or polymerized photosensitive material.

[0126] The fourth pattern 235b may extend from the hydrophobic pattern 215 to a portion of the EML 220. In this case, the third pattern 235a may be located on a remaining portion of the EML 220 not covered by the fourth pattern 235b. That is, a region on which the fourth pattern 235b is formed may be adjusted so that a region to which electrons are transported may be confined properly.

[0127] FIGS. 4 to 11 are cross-sectional views illustrating a method of manufacturing an organic light emitting display device including an organic light emitting structure in accordance with the present invention.

[0128] Referring to FIG. 4, a semiconductor pattern 110 and a gate insulation layer 120 may be formed on a first substrate 100. The first substrate 100 may include a glass substrate, a quartz substrate, a transparent plastic substrate, etc.

[0129] A buffer layer 105 may be formed on the first substrate 100, and the semiconductor pattern 110 may be formed on the buffer layer 105. The buffer layer 105 may be formed using silicon nitride, silicon oxide, silicon oxynitride, etc. The buffer layer 105 may be obtained by a chemical vapor deposition (CVD) process, a plasma enhanced chemical vapor deposition (PECVD) process, a high density plasma-chemical vapor deposition (HDP-CVD) process, etc. The buffer layer 105 may have a single-layered structure or a multi-layered structure including silicon nitride, silicon oxide and/or silicon oxynitride.

[0130] A preliminary semiconductor pattern (not illustrated) may be formed on the buffer layer 105, and then the preliminary semiconductor pattern may be crystallized to obtain the semiconductor pattern 110. The preliminary semiconductor pattern may be formed using amorphous silicon. The preliminary semiconductor pattern may be obtained by a sputtering process, a CVD process, a low pressure chemical vapor deposition (LPCVD) process, a vacuum evaporation process, etc. In one exemplary embodiment, a heat treatment may be further performed about the semiconductor pattern 110 to remove hydrogen contained in the preliminary semiconductor pattern or the semiconductor pattern 110.

[0131] As described above, the preliminary semiconductor pattern may be transformed into the semiconductor pattern 100 including polysilicon by a crystallization process. In exemplary embodiments, the crystallization process may include a rapid thermal annealing (RTA) process, solid phase crystallization (SPC) process, a metal induced crystallization (MIC) process, a metal induced lateral crystallization (MILC) process, a super grain silicon (SGS) process, an eximer laser crystallization (ELA) process, a sequential lateral solidification (SLS) process, etc.

[0132] The crystallization of the preliminary semiconductor pattern may be facilitated by using a metal catalyst, e.g., nickel (Ni), palladium (Pd), iron (Fe), tin (Sn), platinum (Pt).

[0133] To control a threshold voltage of a switching device of the OLED device, N-type or P-type impurities may be implanted into the preliminary semiconductor pattern and/or the semiconductor pattern 110.

[0134] The gate insulation layer 120 covering the semiconductor pattern 110 may be formed on the buffer layer 105. For example, the gate insulation layer 120 may be formed using silicon oxide or a metal oxide. The gate insulation layer 120 may be obtained by a CVD process, a PECVD process, an ALD process, a sputtering process, a vacuum evaporation process, etc. The gate insulation layer 120 may have a single-layered structure or a multi-layered structure including silicon oxide and/or the metal oxide.

[0135] The gate electrode 125 may be formed on the gate insulation layer 120. A first conductive layer (not illustrated) may be formed on the gate insulation layer, and then the first conductive layer may be patterned by a photolithography process or an etching process using an additional etching mask to form the gate electrode

125. The first conductive layer may be formed using a metal such as chromium, aluminium, tantalum, molybdenum, titanium, tungsten, copper, silver, neodymium, etc., or an alloy of these metals. The first conductive layer may be obtained by a sputtering process, a CVD process, an ALD process, a vacuum evaporation process, a printing process, etc. As illustrated in FIG. 4, the gate electrode 125 may be formed to overlap a channel region 114 of the semiconductor pattern 110.

[0136] Impurities may be implanted into the semiconductor pattern 110 using the gate electrode 125 as an ion-implantation mask to form a source region 112 and a drain region 116 at the semiconductor pattern 110. A portion of the semiconductor pattern 110 between the source region 112 and the drain region 116 may be defined as the channel region 114. The channel region 114. may substantially overlap the gate electrode 125 formed over the channel region 114.

[0137] A first insulating interlayer 130 covering the gate electrode 125 may be formed on the gate insulation layer 120. The first insulating interlayer 130 may be formed using a silicon-based material such as silicon oxide, silicon nitride, silicon oxynitride, etc., or a transparent insulating material. The first insulating interlayer 130 may be obtained by a CVD process, a PECVD process, an HDP-CVD process, a spin coating process, etc. The first insulating interlayer 130 may have a single-layered structure or a multi-layered structure including the silicon-based material and/or the transparent insulating material.

[0138] Referring to FIG. 5, a source electrode 133 and a drain electrode 135 electrically connected to the source region 112 and the drain region 116, respectively, may be formed on the first insulating interlayer 130. The first insulating interlayer 130 and the gate insulation layer 120 may be partially removed to form holes or openings each of which may expose the source region 112 and the drain region 116 of the semiconductor pattern 110. A second conductive layer (not illustrated) filling the holes or the openings may be formed on the first insulating interlayer 130, the source region 112 and the drain region 116. The second conductive layer may be patterned using a photoresist pattern or a mask pattern to form the source electrode 133 and the drain electrode 135 electrically connected to the source region 112 and the drain region 116, respectively. The second conductive layer may be formed using chromium, aluminium, tantalum, molybdenum, titanium, tungsten, copper, silver, neodymium, etc., or an alloy of these metals. The second conductive layer may be obtained by a sputtering process, a CVD process, an ALD process, a vacuum evaporation process, a printing process, etc.

[0139] By performing the processes described above, the switching device 140 including the semiconductor pattern 110, the gate insulation layer 120, the gate electrode 125, the source electrode 133 and the drain electrode 135 may be obtained. The switching device 140 may be a TFT including the semiconductor pattern 110. Alternatively, an oxide semiconductor device may be employed as the switching device 140.

[0140] Referring to FIG. 6, a second insulating interlayer 150 covering the switching device 140 may be formed on the first insulating interlayer 130. The second insulating interlayer 150 may be formed using a transparent insulating material, e.g., an acryl-based resin, polyimide-based resin, siloxane-based resin, BCB, etc. The second insulating interlayer 150 may be obtained by a spin coating process, a slit coating process, etc. The second insulating interlayer 150 may be formed using a material having a self-planarizing property. A planarization process may be performed on the second insulating interlayer 150 so that the second insulating interlayer 150 may have a substantially level surface.

[0141] A first electrode 160 electrically connected to the drain electrode 135 may be formed on the second insulating interlayer 150. The second insulating interlayer 150 may be partially removed to form a contact hole (not illustrated) at least partially exposing the drain electrode 135. A third conductive layer (not illustrated) may be formed on the second insulating interlayer 150 and the exposed drain electrode 135, and then the third conductive layer may be patterned to form the first electrode 160. The third conductive layer may be formed using a metal such as chromium, aluminium, tantalum, molybdenum, titanium, tungsten, copper, silver, neodymium, etc., or an alloy of these metals. The third conductive layer may be obtained by a sputtering process, a CVD process, an ALD process, a vacuum evaporation process, a printing process, etc. The third conductive layer may be formed using a transparent conductive material, for example, indium tin oxide, zinc tin oxide, indium zinc oxide, zinc oxide, tin oxide, etc. The first electrode 160 may have a multi-stacked structure including a first layer and a second layer. The first layer may be formed using, e.g., the above metal or the alloy, and the second layer may be formed using, e.g., the above transparent conductive material.

[0142] Referring to FIG. 7, a PDL 165 and an HTL 210 may be formed on the second insulating interlayer 150 and the first electrode 160. A photosensitive material layer (not illustrated) including, e.g., an acryl-based resin, polyimide, BCB, etc., may be formed on the second insulating interlayer 150 and the first electrode 160. The photosensitive material layer may be selectively exposed to light using an exposure mask, and then an exposed portion of the photosensitive material layer may be removed by a developing process to form the PDL 165 partially exposing the first electrode 160. A non-photosensitive organic material layer or an inorganic material layer may be formed on the second insulating interlayer 150 and the first electrode 160, and then the non-photosensitive organic material layer or the inorganic material layer may be partially etched to form the PDL 165.

[0143] By forming the PDL 165, a first region I corresponding to a pixel region of the OLED device and a second region II corresponding to a non-pixel region of the OLED device may be defined. A portion of the first electrode 160 exposed by the PDL 165 may be located in the pixel region. The PDL 165 and a remaining portion of the first electrode 160 may be located in the non-pixel region.

[0144] The PDL 165 may have a thickness of about 1000 Å to about 4000 Å. When the PDL 165 has a thickness less than about 1000 Å, the first region I (pixel region) and the second region II (non-pixel region) may not be distinctly separated from each other, and thus a resolution of the OLED device may be decreased. Meanwhile, in case that the PDL 165 may have a thickness greater than about 4000 Å, an HTL 210 or an HIL may not be deposited continuously on the PDL 165 and the first electrode 160 with a uniform profile.

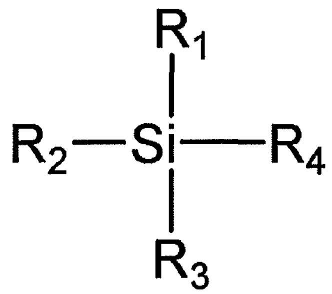
[0145] The HTL 210 may be formed on the PDL 165 and the exposed first electrode 160. The HTL 210 may cover both the pixel region and the non-pixel region. For example, the HTL 210 may be formed by using a hole transport material, e.g., NPB, TPD, α-NPD, N-phenylcarbazole, polyvinylcarbazole. The HTL 210 may be obtained by a vacuum evaporation process, a thermal evaporation process, a slit coating process, a spin coating process, a whole surface printing process, etc.

[0146] An HIL may be formed on the PDL 165 and the exposed first electrode 160 before forming the HTL 210, and the HTL 210 may be formed on the HIL. The HIL may be formed using, e.g., TCTA, m-MTDATA, m-MTDAPB, 2-TNATA, etc. The HIL may be obtained by a vacuum evaporation process, a thermal evaporation process, a slit coating process, a spin coating process, a whole surface printing process, etc.

[0147] Referring to FIG. 8, a hydrophobic pattern 215 may be formed on a portion of the HTL 210 located in the second region II. In some embodiments, the hydrophobic pattern 215 is formed using a fluorine-based material. The fluorine-based material may include polymer, oligomer, dendrimer or monomer containing at least one carbon atom combined or hybridized with at least one fluorine atom. These may be used alone or in a mixture thereof.

[0148] The carbon atom may be combined with one fluorine atom (CF), two fluorine atoms (CF_2) or three fluorine atoms (CF_3). The hydrophobic pattern 215 may be formed using a fluorine-based polymer having a repeating unit represented by -(CF_2-CF_2)n-. Here, n maybe an integer in a range of about 2 to 10,000.

[0149] In some embodiments, the hydrophobic pattern 215 is formed using an organosilane-based material having at least one organic functional group combined with a silicon atom. The organic functional group may include alkyl, alkoxy, halogen, amino, hydroxyl, etc. For example, the organosilane-based material may be represented by a following chemical formula.



[0150] In the above chemical formula, R_1 to R_4 may independently represent hydrogen, a C1 to C20 alkyl group, a C1 to C20 alkoxy group, halogen, an amino group or a hydroxyl group. At least one of R_1 to R_4 may be a C1 to C20 alkyl group or a C1 to C20 alkoxy group. Additionally, the C1 to C20 alkyl group or the C1 to C20 alkoxy group may have at least one fluorine atom substituent.

[0151] As described above, the hydrophobic pattern 215 may include the fluorine-based material or the organosilane-based material so that a difference of surface energy may be generated between the hydrophobic pattern 215 and the HTL 210. Accordingly, an EML 220 may be formed selectively in the first region I substantially corresponding to the pixel region.

[0152] In an embodiment, the hydrophobic pattern 215 is obtained by a laser induced thermal imaging (LITI) process.

[0153] FIG. 9 is a cross-sectional view illustrating a process of forming the hydrophobic pattern 215 on the HTL 210 according to an embodiment of the present invention.

[0154] Referring to FIG. 9, a hydrophobic layer 214 may be formed on a donor substrate 10 using the above fluorine-based material or the organosilane-based material.

[0155] The donor substrate 10 may be arranged or laminated on the first substrate 100 so that the hydrophobic layer 214 may substantially face the HTL 210. A laser beam may be irradiated selectively onto a portion of the hydrophobic layer 214 substantially overlapping the second region II using a mask 15 as indicated by arrows. By such laser irradiation, the hydrophobic layer 214 may be transferred selectively onto the portion of the HTL 210 located in the second region II to form the hydrophobic pattern 215 in the non-pixel region.

[0156] A light to heat conversion (LTHC) layer (not illustrated) may be formed between the donor substrate 10 and the hydrophobic layer 214. The LTHC layer may absorb a light, e.g., the laser beam to convert the light into a heat. The LTHC layer may be formed using metals such as aluminium or silver, oxides of these metals, sulfides of these metals, etc. Alternatively, the LTHC layer may be formed using carbon black, graphite or polymer containing a light-absorbent material.

[0157] In some embodiments, the hydrophobic pattern 215 is obtained without the above laser irradiation. For example, the hydrophobic layer 214 on the donor substrate 10 may be laminated on the HTL 210. Heat and pressure may be applied onto the donor substrate 10 to form the hydrophobic pattern 215 on the HTL 210. The HTL 210 may have a height difference between the first region I and the second region II so that the hydrophobic pattern 215 may be formed selectively on the portion of the HTL 210 located in the second region II.

[0158] In some embodiments, the hydrophobic pattern 215 is obtained by a printing process, e.g., an inkjet process or a nozzle printing process.

[0159] The inkjet or nozzle printing processes may be performed by soluble processes. For example, the fluorine-based material and/or the organosilane material may be mixed in a solvent to prepare a hydrophobic composition. The hydrophobic composition may be printed on the portion of the HTL 210 in the non-pixel region through nozzles of an inkjet printing or a nozzle printing apparatuses. The printed hydrophobic composition may be dried to form the hydrophobic pattern 215.

[0160] Alternatively, the inkjet or nozzle printing processes may be performed by insoluble processes. For example, the hydrophobic composition may be introduced into nozzles of the inkjet printing or nozzle printing apparatuses. A temperature of the nozzle may be increased by a first heating so that the solvent of the hydrophobic composition may be evaporated. The solvent-free hydrophobic composition may be vaporized or sublimated by a second heating. The vaporized or sublimated hydrophobic composition may be printed on the portion of the HTL 210 in the non-pixel region through the nozzle to form the hydrophobic pattern 215. The solvent-free hydrophobic composition may be directly printed on the HTL 210, and thus an additional drying process may not be needed. The temperature in the nozzle may be properly adjusted according to boiling points or sublimation points of the fluorine-based material and/or the organosilane material.

[0161] In some embodiments, the hydrophobic pattern 215 is formed selectively on the portion of the HTL 210 in the non-pixel region by a stamping process, an offset imprinting process or a reverse offset imprinting process.

[0162] The hydrophobic pattern 215 may have a thickness of about 1000 Å to about 3 μm. When the thickness of the hydrophobic pattern 215 is less than about 1000 Å, the EML 220 may not be easily formed only in the first region I. Meanwhile, the thickness of the hydrophobic pattern 215 of grater than about 3 μm may be disadvantageous in an economic aspect and in minimizing a size of the OLED device.

[0163] Referring to FIG. 10, the EML 220 may be formed on the portion of the HTL 210 in the first region I. The EML 220 may be formed using at least one of light emitting materials for generating different colours of light, for example, a red colour of light, a green colour of light or a blue colour of light. The EML 220 may be formed using a mixture or a combination of the light emitting materials for generating a white colour of light. The light emitting materials may serve as dopant materials of the EML 220. In this case, the EML 220 may further include host materials. Suitable dopant and host materials may be selected in accordance with a light-emitting mechanism of the EML 220, for example, a fluorescent mechanism or a phosphorescent mechanism.

[0164] The EML 220 may be obtained by a spin coating process, a roll coating process, a nozzle printing process, an inkjet printing process, a transfer process using a donor substrate, etc. In this case, the EML 220 may be confined by the hydrophobic pattern 215 located in the second region II. Thus, the EML 220 may be formed selectively on the portion of the HTL 210 in the first region I, which is relatively hydrophilic. A bottom of the EML 220 may make contact with a top surface of the HTL 210, and a sidewall of the EML 220 may make contact with the HTL 210 and a sidewall of the hydrophobic pattern 215.

[0165] Referring to FIG. 11, an ETL 230 may be formed on the hydrophobic pattern 215 and the EML 220, and a second electrode 250 may be formed on the ETL 230. The ETL 230 and the second electrode 250 may be formed uniformly along a profile of the EML 220 and the hydrophobic pattern 215. For example, the ETL 230 may be formed using Alq3, PBD, TAZ, rubrene, etc. The ETL 230 may be obtained by a vacuum evaporation process, a thermal evaporation process, a slit coating process, a spin coating process, etc.

[0166] The second electrode 250 may be formed by using a metal or a metal compound such as lithium (Li), calcium (Ca), lithium fluoride/calcium (LiF/Ca), lithium fluoride/aluminium (LiF/Al), aluminium (Al), magnesium (Mg), silver (Ag), chromium (Cr), tungsten (W), molybdenum (Mo), titanium, (Ti), etc., or an alloy of these metals. The second electrode 250 may be obtained by a sputtering process, a CVD process, an ALD process, a vacuum evaporation process, a printing process, etc. The second electrode 250 may have a multi-stacked structure including a first layer and a second layer. The first layer may include, e.g., the above metal or the alloy, and the second layer may include, e.g., the above transparent conductive material.

[0167] An EIL may be further formed on the ETL 230 before forming the second electrode 250. For example, the EIL may be formed using an alkaline metal, an alkaline earth metal, fluorides of these metals, oxides of these metals, chlorides of these metals, etc. The EIL may be obtained by a vacuum evaporation process, a thermal evaporation process, a slit coating process, a spin coating process, etc.

[0168] A protection layer (not illustrated) may be formed on the second electrode 250 and a second substrate (not illustrate) substantially facing the first substrate 100 may be formed on the protection layer. The protection layer may be formed using a transparent insulating material and the second substrate may be substantially the same as or similar to the first substrate 100.

[0169] FIGS. 12 to 17 are cross-sectional views illustrating a method of manufacturing an organic light emitting display device including an organic light emitting structure in accordance with an embodiment of the present invention.

[0170] Referring to FIG. 12, processes substantially the same as or similar to those illustrated with reference to FIGS. 4 to 6 may be performed. Accordingly, a first insulating interlayer 130, a switching device 140 and a second insulating interlayer 150 may be formed on a first substrate 100. A first electrode 160 electrically connected to a drain electrode 135 of the switching device 140 may be formed on the second insulating interlayer 150.

[0171] Referring to FIG. 13, a PDL 165 partially exposing the first electrode 160 may be formed on the second insulating interlayer 150 and the first electrode 160. A photosensitive material layer including, e.g., acryl-based resin, polyimide or BCB may be formed on the second insulating interlayer 150 and the first electrode 160. An exposure process and a developing process may be performed about the photosensitive material layer to form the PDL 165. Alternatively, a non-photosensitive organic material layer or an inorganic material layer may be formed on the second insulating interlayer 150 and the first electrode 160, and then the non-photosensitive organic material layer or the inorganic material layer may be etched to form the PDL 165.

[0172] By forming the PDL 165, a first region I substantially corresponding to a pixel region and a second region II substantially corresponding to a non-pixel region may be defined. That is, the second region II may be covered by the PDL 165 and the first electrode 160 may be partially exposed in the first region I.

[0173] Referring to FIG. 14, a preliminary HTL 211 may be formed on the PDL 165 and the exposed first electrode 160. The preliminary HTL 211 may be formed by using a photosensitive composition including a hole transport material, a photosensitive monomer, a photopolymerization initiator, an organic solvent, etc. The preliminary HTL 211 may be obtained by a vacuum evaporation process, a thermal evaporation process, a slit coating process, a spin coating process, a printing process, etc. For example, the hole transport material may include TPD, α-NPD, N-phenylcarbazole, polyvinylcarbazole, etc. These may be used alone or in a mixture thereof. The photosensitive monomer may include a material cross-linked or polymerized by an exposure process. The photosensitive monomer may include an acrylate-based monomer or a methacrylate-based monomer. For example, the photosensitive monomer may include 1,4-butanediol acrylate, 1,3-butylene glycol diacrylate, 1,6-hexanediol diacrylate, diethylene glycol diacrylate, ethylene glycol diacrylate, triethylene glycol diacrylate, polyethylene glycol diacrylate, neopentyl glycol diacrylate, propylene glycol diacrylate, dipropylene glycol diacrylate, sorbitol triacrylate, bisphenol A diacrylate derivatives, pentaerythritol triacrylate, pentaerythritol tetraacrylate, pentaerythritol diacrylate, dipentaerythritol pentaacrylate, dipentaerythritol hexaacrylate, trimethyl propane ethoxy triacrylate or methacrylates of these materials. These may be used alone or in a mixture thereof.

[0174] The photopolymerization initiator may include an acetophenone-based compound, a benzophenone-based compound, a thioxanthone-based compound, a benzoin-based compound, a triazine-based compound, etc. These may be used alone or in a mixture thereof. Non-limiting examples of the acetophenone-based compound include 2,2'-diethoxy acetophenone, 2,2'-dibutoxy acetophenone, p-t-butyl trichloro acetophenone, 4-chloro acetophenone, etc. Non-limiting examples of the benzophenone-based compound may include 4,4'-dimethylamino benzophenone, 4,4'-dichloro benzophenone, 3,3'-dimethyl-2-methoxy benzophenone, hydroxy benzophenone, acrylated benzophenone, 4-phenyl benzophenone, etc. Non-limiting examples of the thioxanthone-based compound may include thioxanthone, 2-methyl thioxanthone, isopropyl thioxanthone, 2,4-diethyl thioxanthone, 2,4-diisopropyl thioxanthone, 2-chloro thioxanthone, etc. Non-limiting examples of the benzoin-based compound may include benzoin, benzoin methyl ether, benzoin ethyl ether, benzoin isopropyl ether, benzoin isobutyl ether, etc. Non limiting examples of the triazine compound may include 2,4,6-trichloro-s-triazine, 2-phenyl-4,6-bis(trichloromethyl)-s-triazine, 2-(3',4'-dimethoxystyryl)-4,6-bis(trichloromethyl)-s-triazine, 2-(4'-methoxynaphtyl)-4,6-bis(trichloromethyl)-s-triazine, 2-(p-methoxyphenyl)-4,6-bis(trichloromethyl)-s-triazine, etc. The organic solvent may include a suitable solvent in which the hole transport material, the photosensitive monomer and the photopolymerization initiator may be dissolved. The photosensitive composition may further include a surfactant to enhance a coatability thereof.

[0175] Referring to FIG. 15A, a selective exposure process may be performed about the preliminary HTL 211 so that a portion of the preliminary HTL 211 in the first region I may be transformed into a first pattern 212a and a portion of the preliminary HTL 211 in the second region II may be transformed into a second pattern 212b. Accordingly, an HTL 212 including the first and second patterns 212a and 212b may be obtained.

[0176] A mask 15 including a transparent region 12 and a blocking region 14 may be arranged over the preliminary HTL 211. The transparent region 12 of the mask 15 may substantially overlap the portion of the preliminary HTL 211 in the non-pixel region, and the blocking region 14 of the mask 15 may substantially overlap the portion of the preliminary HTL 211 in the pixel region. A light, e.g., a laser beam or an UV light may be irradiated through the mask 15 so that the portion of the preliminary HTL 211 in the non-pixel region may be selectively exposed to the light. Accordingly, a cross-linking reaction or a polymerization may be induced at the portion of the preliminary HTL 211 in the non-pixel region (the second region II). That is, the photosensitive monomer in the preliminary HTL 211 may be cross-linked or polymerized to form a photosensitive polymer so that the portion of the HTL 212 located in the non-pixel region may be transformed into the second pattern 212b.

[0177] The cross-linking reaction or the polymerization may not occur at the portion of the HTL 212 in the pixel region (the first region I), and thus the photosensitive polymer may not be produced in the first region I. The photosensitive monomer, the photopolymerization initiator and the organic solvent remaining in the portion of the preliminary HTL 211 in the first region I may be vaporized to form the first pattern 212a in the first region I. A baking process may be additionally performed to cure the photosensitive polymer in the second pattern 212b and to remove the photosensitive monomer, the photopolymerization initiator and the organic solvent remaining in the first pattern 212a. The photosensitive monomer, the photopolymerization initiator and the organic solvent remaining in the first pattern 212a may be removed using an additional developing solution.

[0178] Meanwhile, a width of the blocking region 14 of the mask 15 may be adjusted to vary a region in which the second pattern 212b is formed.

[0179] Referring to FIG. 15B, in another embodiment according to the present invention, the second pattern 212d may be formed on a top surface of the PDL 165 and on a portion of a sidewall of the PDL 165. In this case, the first pattern 212C may be formed on the exposed electrode 160 and on a portion of the sidewall of the PDL 165 not covered by the second pattern 212d.

[0180] Referring to FIG. 15C, in still another embodiment of the present invention, the second pattern 212f may be formed on the top surface and the sidewall of the PDL 165. In this case, the first pattern 212e may be formed on the exposed first electrode 160.

[0181] Referring to FIG. 15D, in a further embodiment according to the present invention, the second pattern 212h may be formed on the top surface and the sidewall of the PDL 165 and on a portion of the exposed first electrode 160. In this case, the first pattern 212g may be formed on a portion of the first electrode 160 not covered by the second pattern 212h.

[0182] The HTL 212 may include the first pattern 212a located in the pixel region I and the second pattern 212b located in the non-pixel region. The first pattern 212a may include the hole transport material, while the photosensitive monomer, the photopolymerization initiator and the organic solvent may be removed therefrom. Thus, the first pattern 212a may have a relatively high electrical conductivity. The second pattern 212b may further include the photosensitive polymer produced by cross-linking or polymerizing the photosensitive monomer. Thus, the second pattern 212b may have a relatively low electrical conductivity. That is, the electrical conductivity may be selectively allowed in the pixel region so that charges generated from the pixel region may be prevented from being diffused into the non-pixel region. Further, as illustrated in FIGS. 15B to 15D, the regions in which the second patterns 212d, 212f and 212h are formed may be adjusted to properly confine a region to which holes may be moved or transferred. Therefore, various characteristics of the OLED device, for example, luminescence property, colour purity, distribution of brightness, etc., may be improved.

[0183] In an embodiment, an HIL may be formed on the PDL 165 and the exposed first electrode 160 before forming the HTL 212, and then the HTL 212 may be formed on the HIL. The HIL may be formed using a hole injection material, e.g., TCTA, m-MTDATA, m-MTDAPB, 2-TNATA, etc. The HIL may be obtained by a vacuum evaporation process, a thermal evaporation process, a spin coating process, a slit coating process, a printing process, etc.

[0184] Hereinafter, subsequent processes in the case that the second pattern 212b is limited on the top surface of the PDL 165 as illustrated in FIG. 15A are described.

[0185] Referring to FIG. 16, a hydrophobic pattern 215 may be formed on the second pattern 212b of the HTL 212 located in the non-pixel region. The hydrophobic pattern 215 may be obtained by processes substantially the same as or similar to those illustrated with reference to FIGS. 8 and 9. The second pattern 212b may include the polymer having a relatively low electrical conductivity so that the hydrophobic pattern 215 may be easily formed selectively in the non-pixel region.

[0186] Referring to FIG. 17, processes substantially the same as or similar to those illustrated with reference to FIGS. 10 and 11 may be performed. Accordingly, an EML 220 may be formed on the HTL 212 in the pixel region. i.e., on the first pattern 212a, and then an ETL 230 and a second electrode 250 may be sequentially formed on the hydrophobic pattern 215 and the EML 220. The EML 220 may be formed selectively in the pixel region that may be relatively hydrophilic, because the hydrophobic pattern 215 may be formed in the non-pixel region.

[0187] In an embodiment, an EIL may be further formed between the ETL 230 and the second electrode 250. The EIL may be formed using an alkaline metal, an alkaline earth metal, fluorides of these metals, chlorides of these metals, oxides of these metals, etc. The EIL may be obtained by a vacuum evaporation process, a thermal evaporation process, a slit coating process, a spin coating process.

[0188] FIGS. 18 to 20 are cross-sectional views illustrating a method of manufacturing an organic light emitting display device including an organic light emitting structure according to the present invention.

[0189] Referring to FIG. 18, processes are substantially the same as or similar to those illustrated with reference to FIGS. 12 to 16. Accordingly, a switching device 140 may be formed on a first substrate 100, and then a second insulating interlayer 150, a first electrode 160, a PDL 165, an HTL 212 including a first pattern 212a and a second pattern 212b and a hydrophobic pattern 215 may be formed on the first substrate 100. The hydrophobic pattern 215 may be formed in a non-pixel region of the OLED device. An EML 220 may be formed on a portion of the HTL 212 located in a pixel region of the OLED device. In exemplary embodiments, the EML 220 may be confined by the hydrophobic pattern 215.

[0190] Regions in which the first and second patterns of the HTL 212 are formed may be adjusted as illustrated in FIGS. 15B to 15D. Hereinafter, subsequent processes in the case that the second pattern 212b is limited on the top surface of the PDL 165 as illustrated in FIG. 15A are described.

[0191] Referring to FIG. 19, a preliminary ETL 233 may be formed on the hydrophobic pattern 215 and the EML 220. The preliminary ETL 233 may be formed using a photosensitive composition that may include an electron transport material, a photosensitive monomer, a photopolymerization initiator, an organic solvent, etc. The preliminary ETL 233 may be obtained by a vacuum evaporation process, a thermal evaporation process, a slit coating process, a spin coating process, a printing process, etc.

[0192] In exemplary embodiments, the electron transport material may include, e.g., Alq_3, PBD, TAZ, rubrene, etc. The photosensitive monomer and the photopolymerization initiator may be substantially the same as those for the preliminary HTL 211 described with reference to FIG. 14.

[0193] Referring to FIG. 20, processes are substantially the same as or similar to those illustrated with reference to FIG. 15 may be performed about the preliminary ETL 233. Accordingly, a portion of the preliminary ETL 233 located in the pixel region may be transformed into a third pattern 235a and a portion of the preliminary ETL 233 located in the non-pixel region may be transformed into a fourth pattern 235b. That is, an ETL 235 including the third and fourth patterns 235a and 235b may be formed on the EML 220 and the hydrophobic pattern 215.

[0194] In some embodiments, the fourth pattern 235b is formed on the hydrophobic pattern 215 and on a portion of the EML 220. In this case, the third pattern 235a may be formed on a portion of the EML 220 not covered by the fourth pattern 235b.

[0195] The photosensitive monomer, the photopolymerization initiator and the organic solvent may be removed from the third pattern 235a so that the third pattern 235a may only include the electron transport material. Thus, the third pattern 235a of the ETL 235 may have a predetermined electrical conductivity. In contrast, the fourth pattern 235b of the ETL 235 may include polymer produced by a cross-linking reaction or a polymerization of the photosensitive monomer, thereby to have a relatively low electrical conductivity.

[0196] According to some embodiments, both the HTL 212 and the ETL 235 have relatively low electrical conductivity in the non-pixel region so that charges may be prevented from being diffused in a lateral direction. Additionally, a region in which the fourth pattern 235b is formed may be properly adjusted so that a region to which electrons may be moved or transported may be properly confined. Therefore, the OLED device may have more enhanced luminescence characteristics.

[0197] Processes substantially the same as or similar to those illustrated with reference to FIG. 17 may be performed to form a second electrode (not illustrated) on the ETL 235. In an embodiment, an EIL may be formed on the ETL 235 before forming the second electrode. A protection layer (not illustrated) and a second substrate (not illustrated) may be further formed on the second electrode.

[0198] Whilst the present invention has been described in connection with certain exemplary embodiments thereof, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

Claims

1. An organic light emitting structure comprising:

   a hole transport layer (HTL) having a first region and a second region;
   an emitting layer (EML) disposed on the hole transport layer in the first region;
   a hydrophobic pattern disposed on the hole transport layer in the second region;
   and
   an electron transport layer (ETL) disposed on the hydrophobic pattern and the emitting layer.

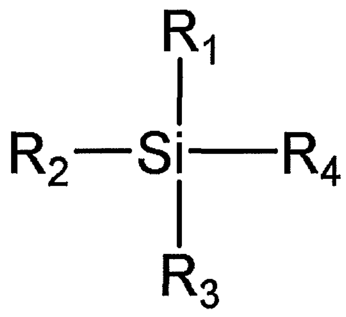
2. The organic light emitting structure of claim 1, wherein the first region corresponds to a pixel region and the second region corresponds to a non-pixel region.

3. The organic light emitting structure of claim 1 or claim 2, wherein the emitting layer is confined by the hydrophobic pattern.

4. The organic light emitting structure of any preceding claim, further comprising a hole injection layer (HIL) disposed beneath the hole transport layer and/or an electron injection layer (EIL) disposed on the electron transport layer.

5. The organic light emitting structure of any preceding claim, wherein the hydrophobic pattern includes at least one fluorine-based material selected from the group consisting of polymer, oligomer, dendrimer and monomer containing at least one carbon atom combined or hybridized with at least one fluorine atom, preferably wherein the fluorine-based material has a repeating unit represented by a formula of $-(CF_2-CF_2)_n-$; or the hydrophobic pattern includes at least one organosilane-based material containing at least one organic functional group combined with a silicon atom, preferably wherein the organosilane-based material is represented by a following chem-

ical formula:



wherein each of R_1 to R_4 independently represents hydrogen, a C_1 to C_{20} alkyl group, a C_1 to C_{20} alkoxy group, halogen, an amino group or a hydroxyl group, and
at least one of R_1 to R_4 represents a C_1 to C_{20} alkyl group or a C_1 to C_{20} alkoxy group, preferably wherein the C_1 to C_{20} alkyl group or the C_1 to C_{20} alkoxy group has at least one fluorine atom substituent.

6. The organic light emitting structure of any preceding claim, wherein the hydrophobic pattern has a thickness of 100 nm to 3 μm.

7. The organic light emitting structure of any preceding claim, wherein the hole transport layer includes:

a first pattern located in the first region; and
a second pattern located in the second region, preferably
wherein the first pattern includes a hole transport material, and the second pattern includes a hole transport material and a cross-linked or polymerized photosensitive material.

8. The organic light emitting structure of claim 7, wherein the second pattern has an electrical conductivity lower than that of the first pattern.

9. The organic light emitting structure of claim 7 or claim 8, wherein the photosensitive material includes an acrylate-based material or a methacrylate-based material.

10. The organic light emitting structure of any preceding claim, wherein the electron transport layer includes a third pattern and a fourth pattern, the third pattern and the fourth pattern overlapping the first region and the second region, respectively, preferably
wherein the third pattern includes an electron transport material, and the fourth pattern includes an electron transport material and a cross-linked or polymerized photosensitive material.

11. The organic light emitting structure of claim 10, wherein the fourth pattern has an electrical conductivity lower than that of the third pattern.

12. An organic light emitting display device comprising:

a first substrate having a pixel region and a non-pixel region;
a first electrode disposed on the first substrate;
a pixel defining layer (PDL) disposed on the first substrate, the pixel defining layer partially exposing the first electrode in the pixel region;
an organic light emitting structure according to any of claims 1 to 11 disposed on the on the pixel defining layer and the exposed first electrode; and
a second electrode disposed on the electron transport layer of the organic light emitting structure.

13. The device of claim 12, further comprising a switching device disposed on the first substrate, the switching device being electrically connected to the first electrode.

14. The device of claim 12 or claim 13, wherein the pixel defining layer has a thickness of 100 nm to 400 nm.

15. The device of any of claims 12 to 14, wherein

(i) the first pattern is disposed on the exposed first electrode and a sidewall of the pixel defining layer, and the second pattern is disposed on a surface of the pixel defining layer;
(ii) the first pattern is disposed on the exposed first electrode and a portion of a sidewall of the pixel defining layer, and the second pattern is disposed on a surface of the pixel defining layer and on a portion of the sidewall of the pixel defining layer not covered by the first pattern;
(iii) the first pattern is disposed on the exposed first electrode, and the second pattern is disposed on a surface and a sidewall of the pixel defining layer; or
(iv) the first pattern is disposed on a portion of the exposed first electrode, and the second pattern is disposed on the pixel defining layer and on a portion of the exposed first electrode not covered by the first pattern.

16. A method of forming an organic light emitting structure, comprising:

providing a hole transport layer having a first region and a second region;
forming a hydrophobic pattern on the hole transport layer in the second region;
forming an emitting layer on the hole transport

layer in the first region; and
forming an electron transport layer on the hydrophobic pattern and the emitting layer.

17. The method of claim 16, wherein the hydrophobic pattern is formed by using at least one fluorine-based material selected from the group of polymer, oligomer, dendrimer and monomer containing at least one carbon atom combined or hybridized with at least one fluorine atom, or by using at least one organosilane-based material containing at least one organic functional group combined with a silicon atom.

18. The method of claim 16 or claim 17, wherein the step of forming the hydrophobic pattern includes:

forming a hydrophobic layer on a donor substrate;
arranging the donor substrate over the hole transport layer so that the hydrophobic layer faces the hole transport layer; and either
irradiating a laser beam selectively in the second region to transfer a portion of the hydrophobic layer onto the hole transport layer or applying a pressure and a heat to the donor substrate to form the hydrophobic pattern on the hole transport layer in the second region.

19. The method of any of claims 16 to 18, wherein the step of forming the hydrophobic pattern includes an inkjet printing process, a nozzle printing process, a stamping process, an offset imprinting process or a reverse offset imprinting process.

20. The method of any of claims 16 to 19, wherein the step of forming the hydrophobic pattern includes a soluble process that includes providing a hydrophobic composition on the hole transport layer in the second region, the hydrophobic composition including a fluorine-based material or an organosilane-based material and a solvent.

21. The method of any of claims 16 to 19, wherein the step of forming the hydrophobic pattern includes an insoluble process that includes:

vaporizing or sublimating a fluorine-based material or an organosilane-based material; and
providing the fluorine-based material or the organosilane-based material on the hole transport layer in the second region.

22. The method of any of claims 16 to 21, wherein the step of providing the hole transport layer includes:

providing a preliminary hole transport layer including a photosensitive composition; and
selectively exposing a portion of the preliminary hole transport layer in the second region to light, preferably
wherein the photosensitive composition includes a hole transport material, a photosensitive monomer, a photopolymerization initiator and an organic solvent.

23. The method of claim 22, wherein the portion of the preliminary hole transport layer in the second region is transformed into a second pattern by a cross-linking reaction or a polymerization, and
wherein a portion of the preliminary hole transport layer in the first region is transformed into a first pattern; preferably
wherein the first pattern includes the hole transport material, and the second pattern includes the hole transport material and a polymer produced by cross-linking or polymerizing the photosensitive monomer.

24. The method of any of claims 16 to 23, wherein the step of forming the electron transport layer includes:

forming a preliminary electron transport layer on the emitting layer and the hydrophobic pattern, the preliminary electron transport layer including a photosensitive composition; and
selectively exposing a portion of the preliminary electron transport layer on the hydrophobic pattern to light, preferably wherein the photosensitive composition includes an electron transport material, a photosensitive monomer, a photopolymerization initiator and an organic solvent.

25. The method of claim 24, wherein the portion of the preliminary electron transport layer on the hydrophobic pattern is transformed into a fourth pattern by a cross-linking reaction or a polymerization, and
wherein a portion of the preliminary electron transport layer on the emitting layer is transformed into a third pattern, preferably wherein the third pattern includes the electron transport material, and the fourth pattern includes the electron transport material and a polymer produced by cross-linking or polymerizing the photosensitive monomer.

26. The method of any of claims 22 to 25, further comprising performing a baking process:

(i) after selectively exposing the portion of the preliminary hole transport layer in the second region to light; and/or
(ii) after selectively exposing the portion of the preliminary electron transport layer on the hydrophobic pattern to light.

27. The method of claim 23 or claim 25, further comprising removing the photosensitive monomer, the photopolymerization initiator and the organic solvent remaining in the first pattern and/or in the third pattern by providing a developing solution after selectively exposing the portion of the preliminary hole transport layer in the second region or the preliminary electron transport layer on the hydrophobic pattern to light.

28. The method of any of claims 16 to 27, further comprising providing a hole injection layer before providing the hole transport layer and/or forming an electron injection layer on the electron transport layer.

29. A method of manufacturing an organic light emitting display device, comprising:

forming a first electrode on a first substrate having a pixel region and a non-pixel region;
forming a pixel defining layer on the first substrate, the pixel defining layer partially exposing the first electrode;
forming an organic light emitting structure according to the method of any of claims 16 to 28 on the pixel defining layer and the exposed first electrode; and
forming a second electrode on the electron transport layer.

FIG. 1

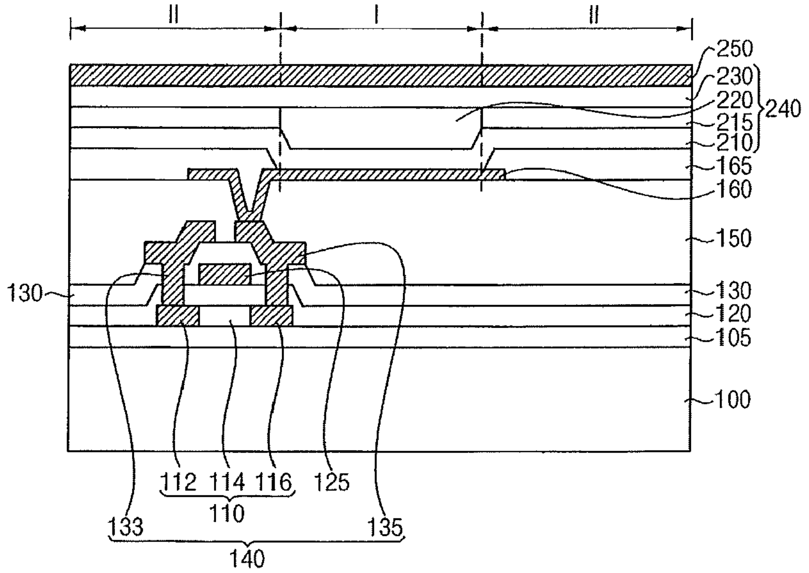

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FIG. 2A

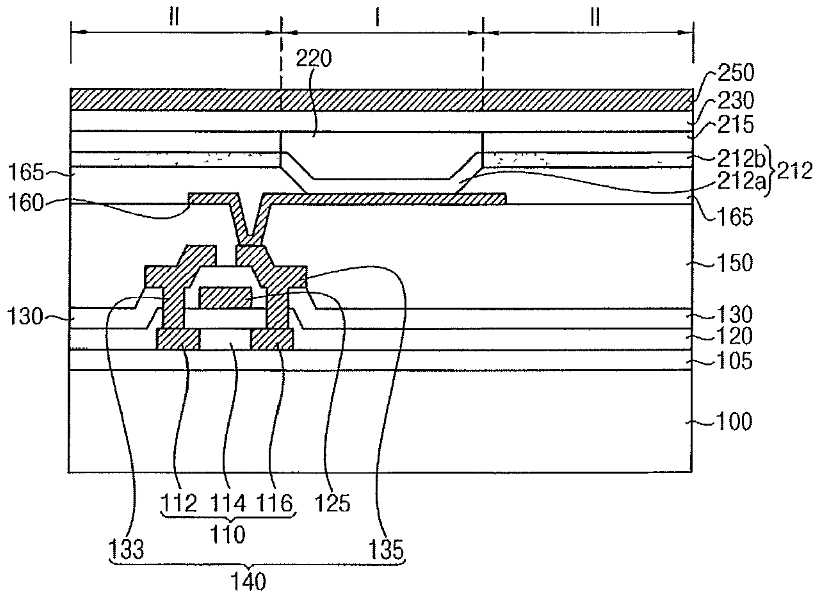
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FIG. 2B

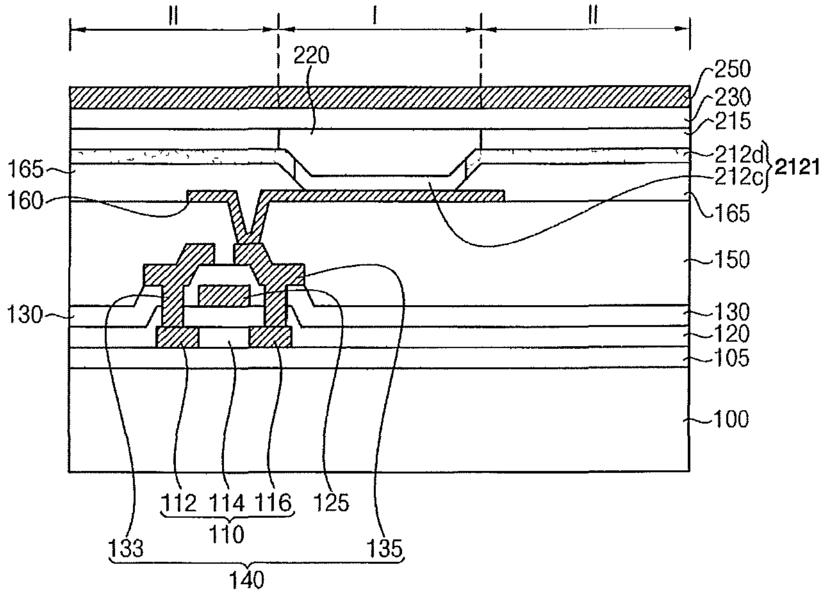
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FIG. 2C

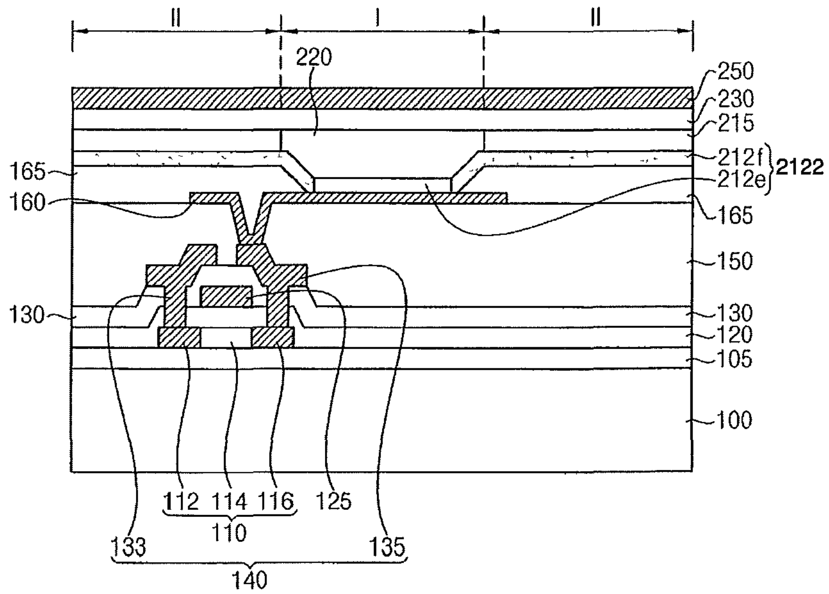
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FIG. 2D

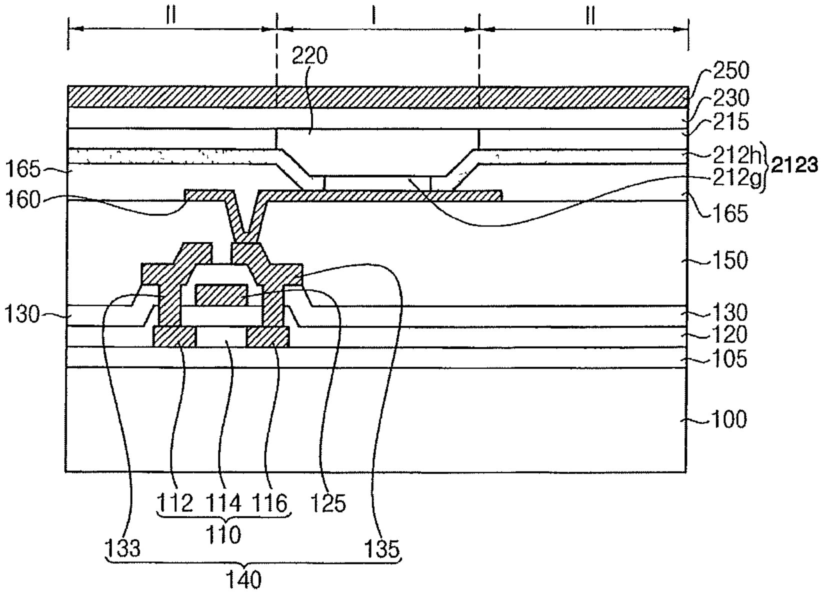
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FIG. 3

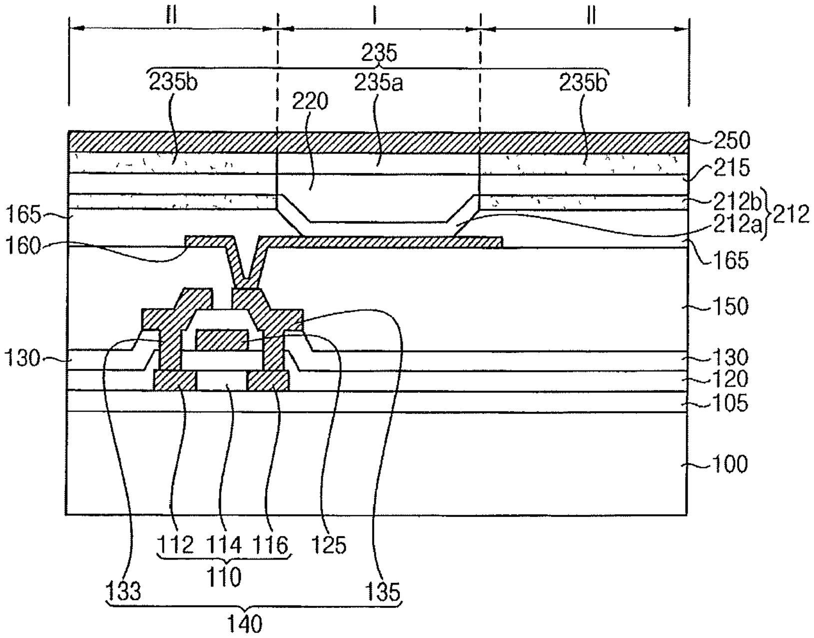
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FIG. 4

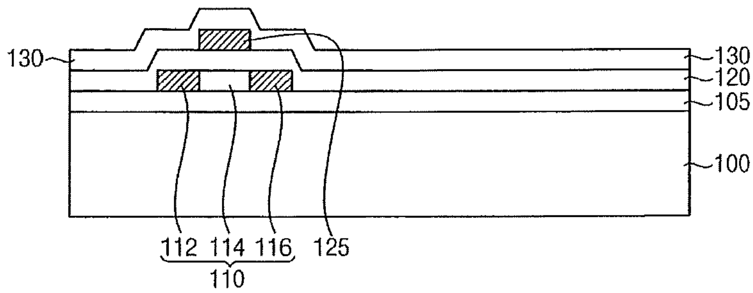
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FIG. 5

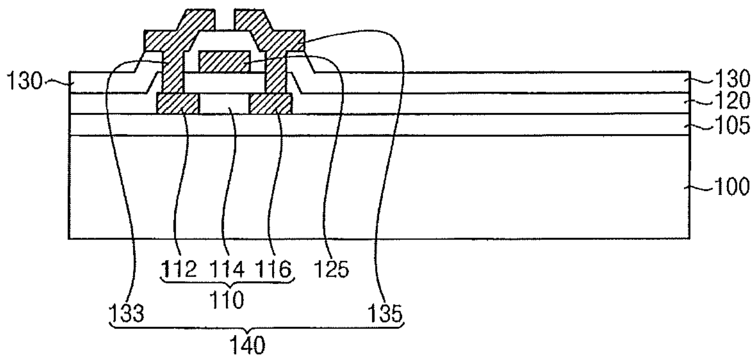
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FIG. 6

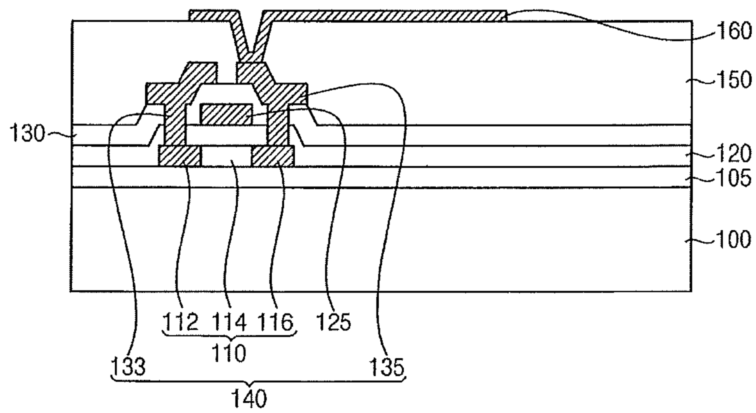
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FIG. 7

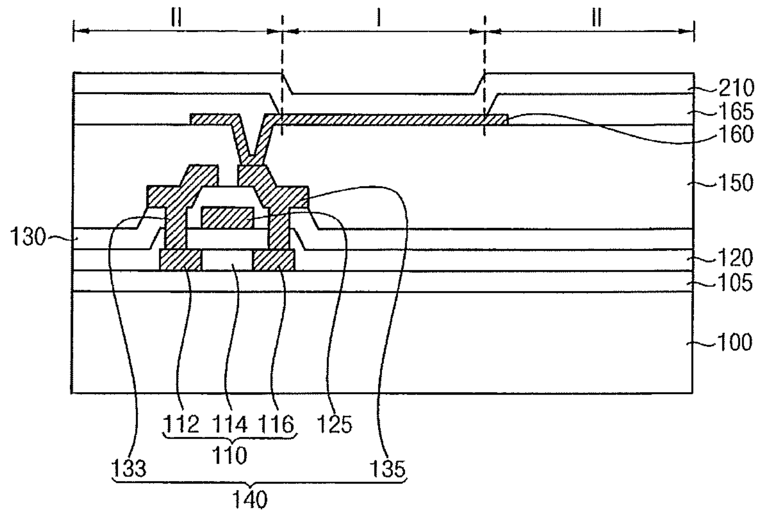
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FIG. 8

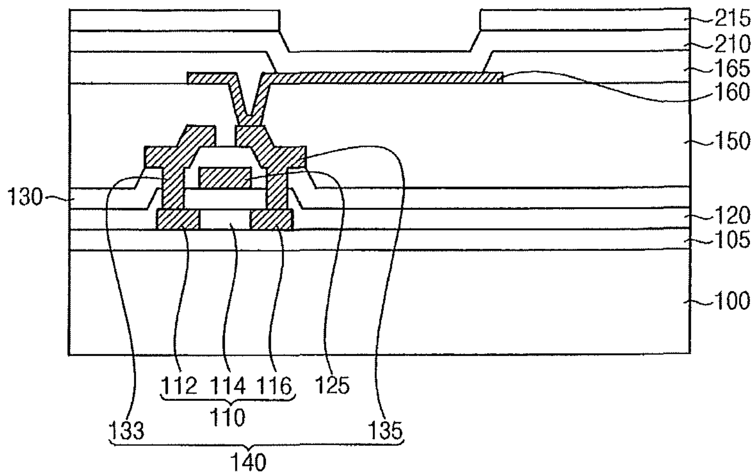
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FIG. 9

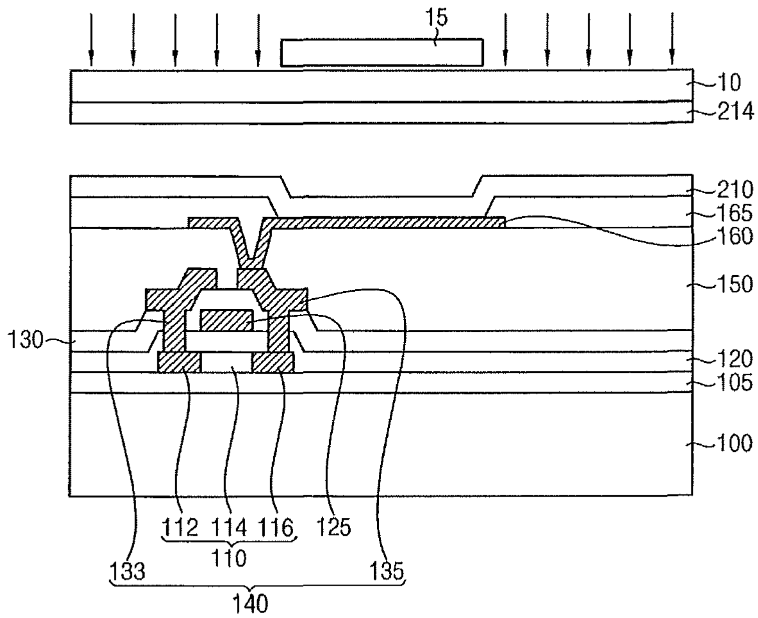
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FIG. 10

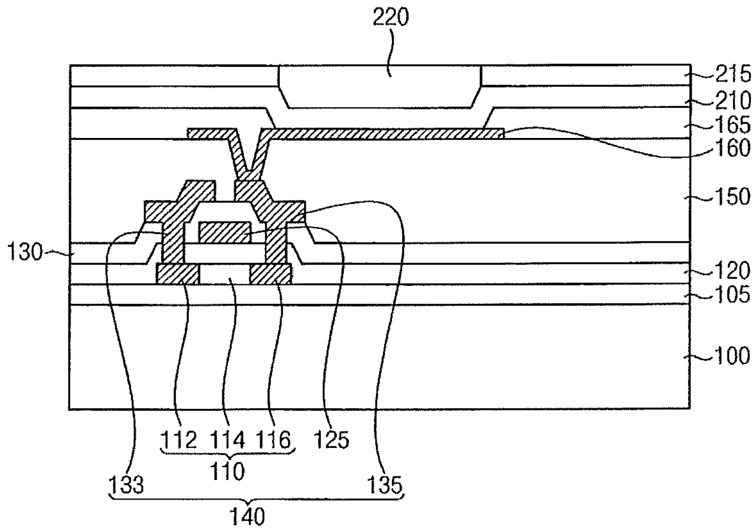

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FIG. 11

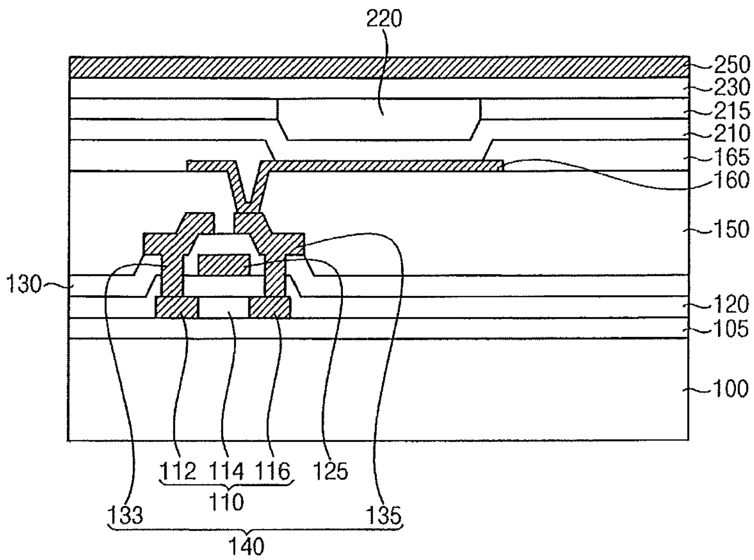

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FIG. 12

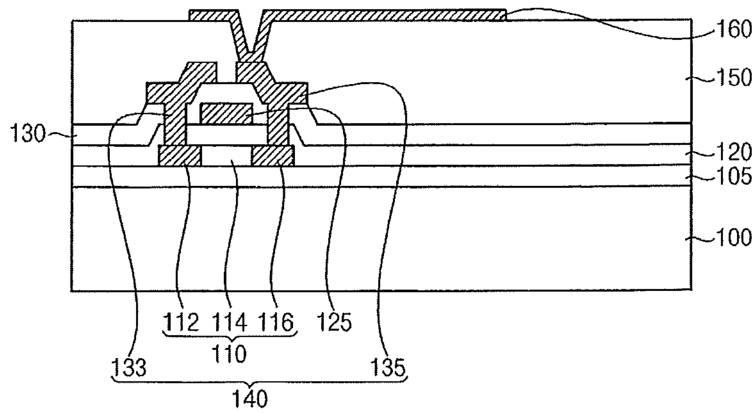
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FIG. 13

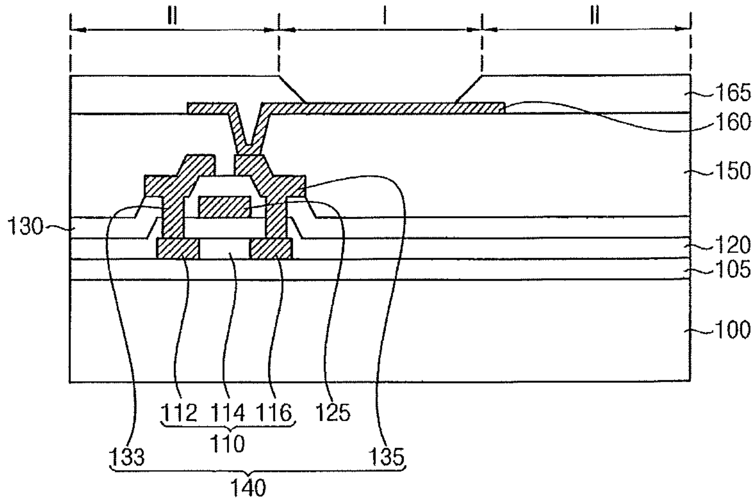
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FIG. 14

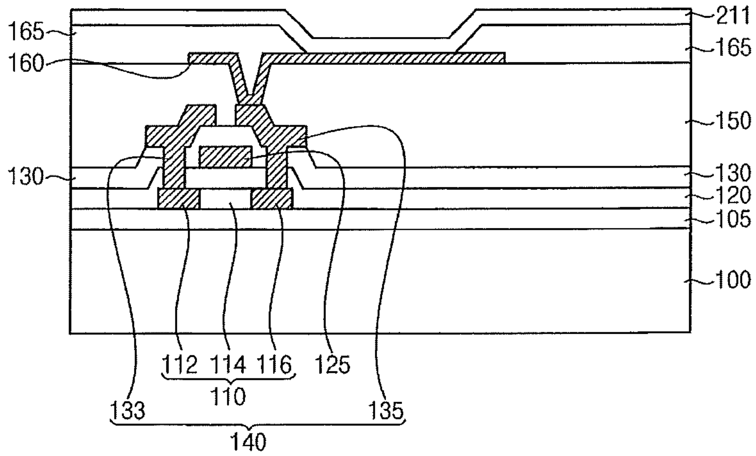

FIG. 15A

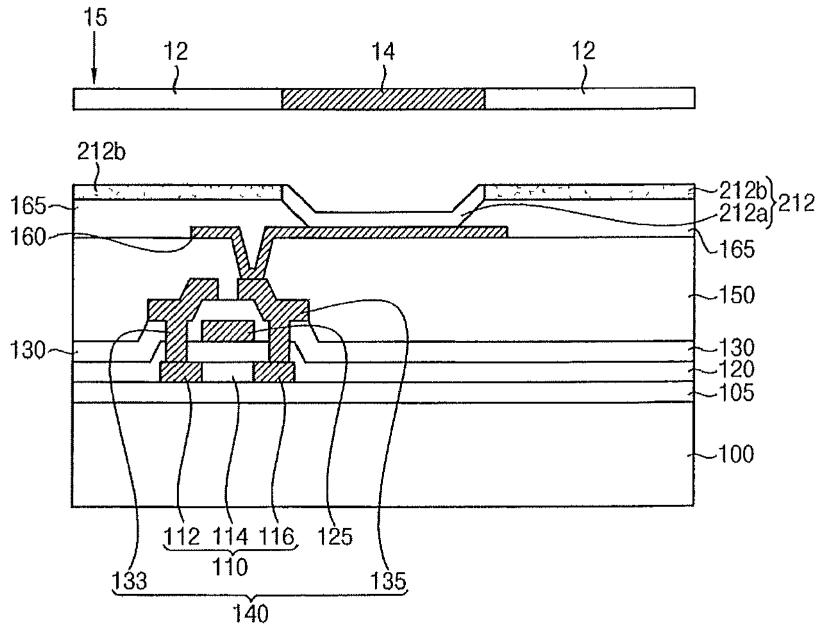

FIG. 15B

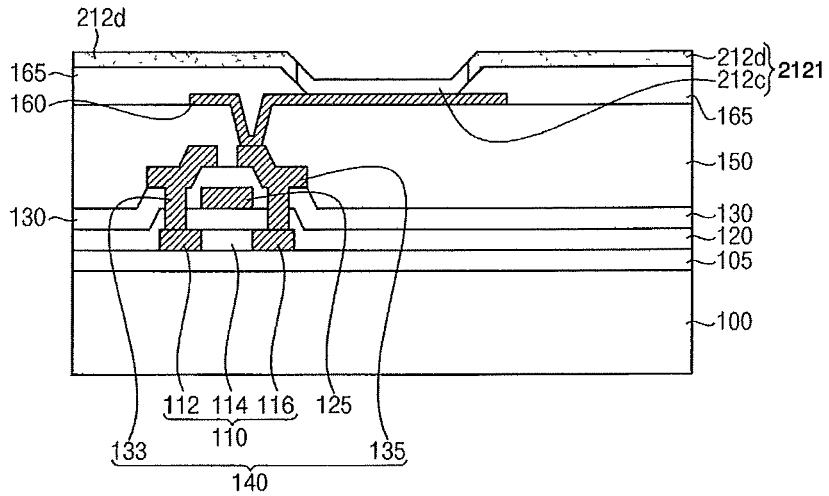

FIG. 15C

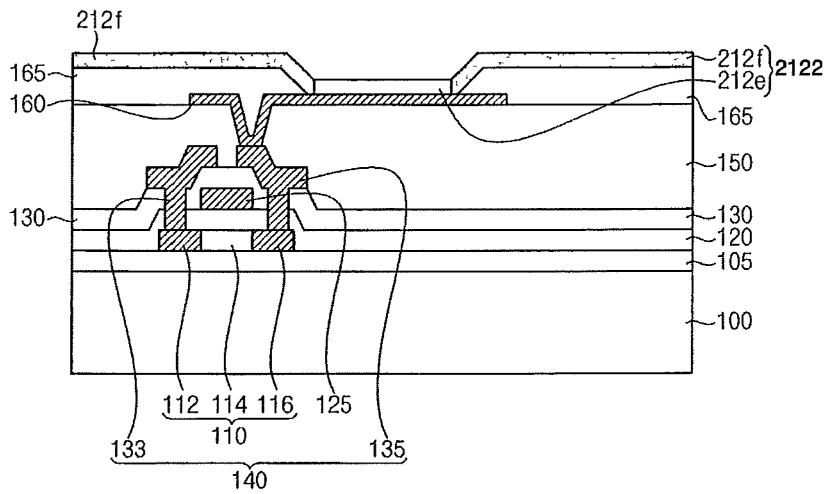

FIG. 15D

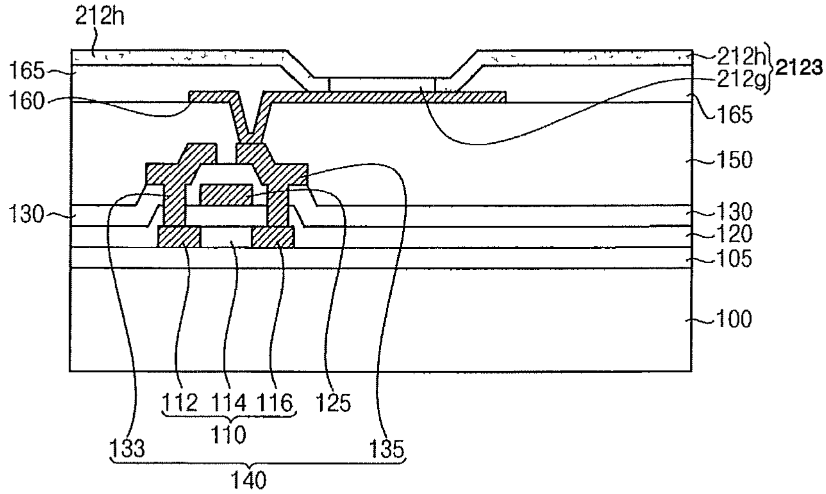

FIG. 16

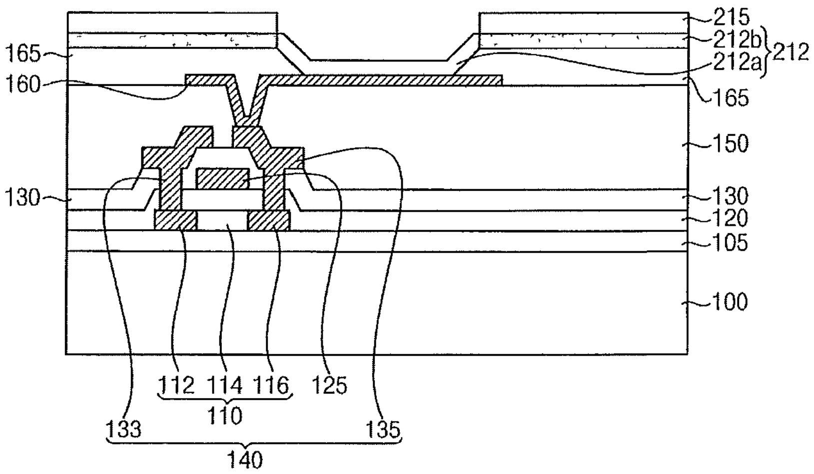

FIG. 17

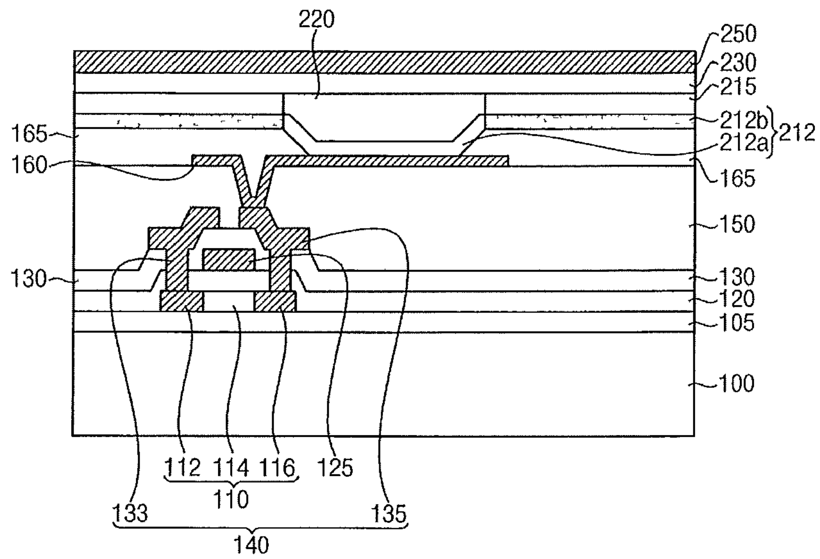
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FIG. 18

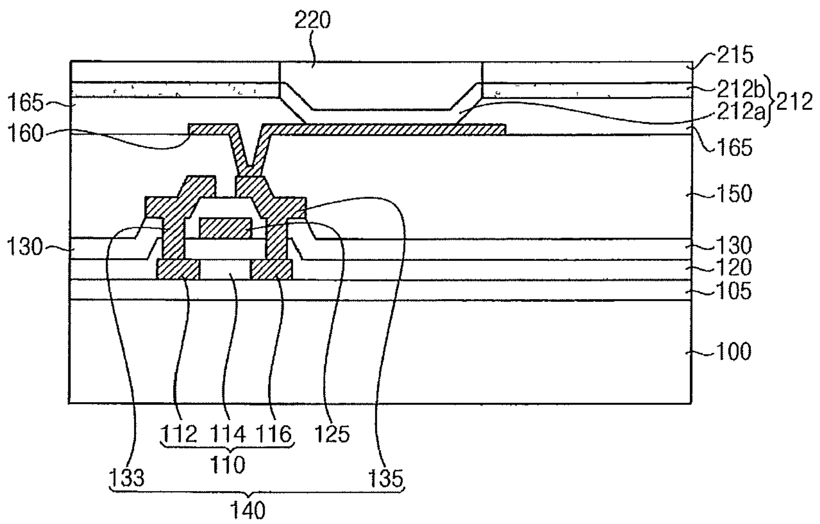
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FIG. 19

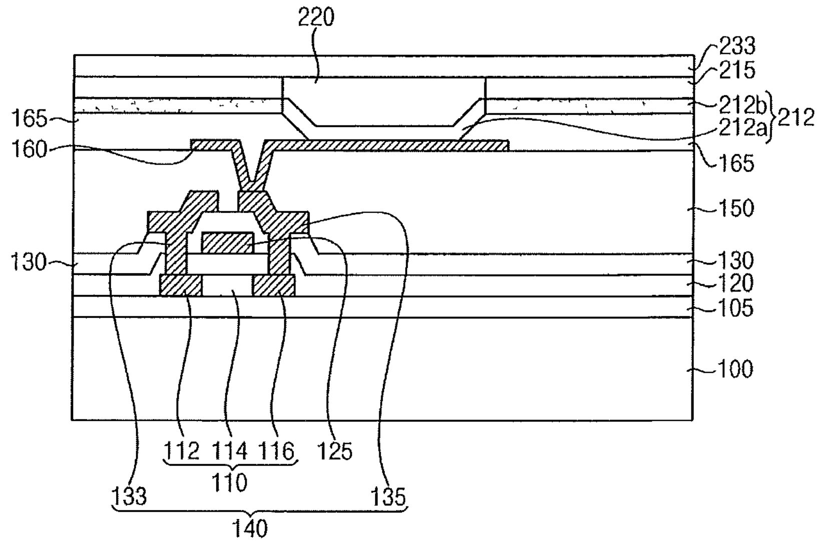
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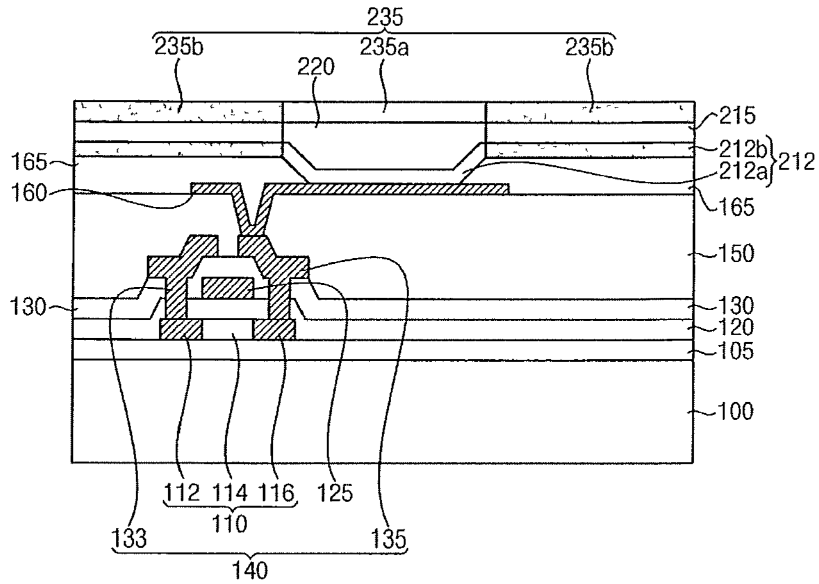
FIG. 20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EUROPEAN SEARCH REPORT

Application Number
EP 12 16 8689

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 202 817 A1 (LG DISPLAY CO LTD [KR]) 30 June 2010 (2010-06-30)	1-4,7,8, 12-16, 18-20, 22,23, 28,29	INV. H01L51/00 H01L51/56
Y	* page 6, paragraph 58 - page 7, paragraph 82; claims 1, 15; figures 4A-4G * -----	9-11, 24-27	
X	US 2011/127507 A1 (CHOI EUN-SUN [KR] ET AL) 2 June 2011 (2011-06-02)	1-6, 12-21, 28,29	
Y	* page 2, paragraph 34 - page 3, paragraph 61; claim 1; figures 1A-1G * -----	9-11, 24-27	
Y	CHENGMEI ZHONG , CHUNHUI DUAN , FEI HUANG *, HONGBIN WU , AND YONG CAO *: "Materials and Devices toward Fully Solution Processable Organic Light-Emitting Diodes", CHEMISTRY OF MATERIALS, vol. 23, no. 3, 21 October 2010 (2010-10-21), pages 326-340, XP002683467, * page 327, paragraph 2.1 - page 328 * -----	9-11, 24-27	TECHNICAL FIELDS SEARCHED (IPC) H01L
A	US 2006/087228 A1 (KOBAYASHI YOSHIHIRO [JP]) 27 April 2006 (2006-04-27) * the whole document * -----	1-29	
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	17 September 2012	Parashkov, Radoslav

CATEGORY OF CITED DOCUMENTS

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17-09-2012

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

专利名称(译)	有机发光结构，形成有机发光结构的方法，有机发光显示装置和制造有机发光显示装置的方法		
公开(公告)号	EP2535956A1	公开(公告)日	2012-12-19
申请号	EP2012168689	申请日	2012-05-21
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
[标]发明人	SHIN HYEA WEON LEE SEUNG MOOK PARK SANG HUN KIM JAE BOK KIM YOUNG II HA JAE KOOK		
发明人	SHIN, HYEA-WEON LEE, SEUNG-MOOK PARK, SANG-HUN KIM, JAE-BOK KIM, YOUNG-II HA, JAE-KOOK		
IPC分类号	H01L51/00 H01L51/56		
CPC分类号	H01L27/3246 H01L51/0014 H01L51/0015 H01L51/0016 H01L51/0017 H01L51/0018 H01L51/0019 H01L51/003 H01L51/5056 H01L51/56		
审查员(译)	PARASHKOV，拉多斯拉夫		
优先权	1020110058265 2011-06-16 KR 1020110091690 2011-09-09 KR		
其他公开文献	EP2535956B1		
外部链接	Espacenet		

摘要(译)

有机发光显示装置包括具有第一区域和第二区域的空穴传输层（HTL），设置在第一区域中的空穴传输层上的发光层（EML），设置在空穴传输层上的疏水图案第二区域和设置在疏水图案和发光层上的电子传输层（ETL）。