



US 20180122867A1

(19) **United States**(12) **Patent Application Publication**
CHOE et al.(10) **Pub. No.: US 2018/0122867 A1**(43) **Pub. Date: May 3, 2018**(54) **IN-CELL TOUCH ORGANIC
LIGHT-EMITTING DISPLAY DEVICE**(52) **U.S. CL.**
CPC .. **H01L 27/323** (2013.01); **G06F 2203/04112**
(2013.01); **H01L 51/5203** (2013.01); **G06F**
3/0412 (2013.01)(71) Applicant: **LG Display Co., Ltd.**, Seoul (KR)(72) Inventors: **Young-Jin CHOE**, Goyang-si (KR);
Nack-Bong CHOI, Goyang-si (KR);
Se-Jong YOO, Paju-si (KR);
Jong-Hyun HAN, Paju-si (KR)(21) Appl. No.: **15/798,134**(22) Filed: **Oct. 30, 2017**(30) **Foreign Application Priority Data**

Oct. 31, 2016 (KR) 10-2016-0143980

Publication Classification(51) **Int. Cl.**
H01L 27/32 (2006.01)
G06F 3/041 (2006.01)
H01L 51/52 (2006.01)(57) **ABSTRACT**

Disclosed is an organic light-emitting display device that has improved color viewing angle characteristics while including a mesh pattern. The organic light-emitting display device includes an organic light-emitting array including a plurality of pixel openings, and a touch electrode array bonded to the organic light-emitting array. The touch electrode array includes a plurality of first mesh electrodes arranged in a first direction and having a lattice structure, and a plurality of second mesh electrodes arranged in a second direction and having a lattice structure. Each of the first mesh electrodes and the second mesh electrodes includes a plurality of overlapping portions that overlap the pixel openings, and a plurality of non-overlapping portions positioned between the pixel openings. At least some of the overlapping portions include brightness-increasing portions, which are formed of a material different from that of the non-overlapping portions.

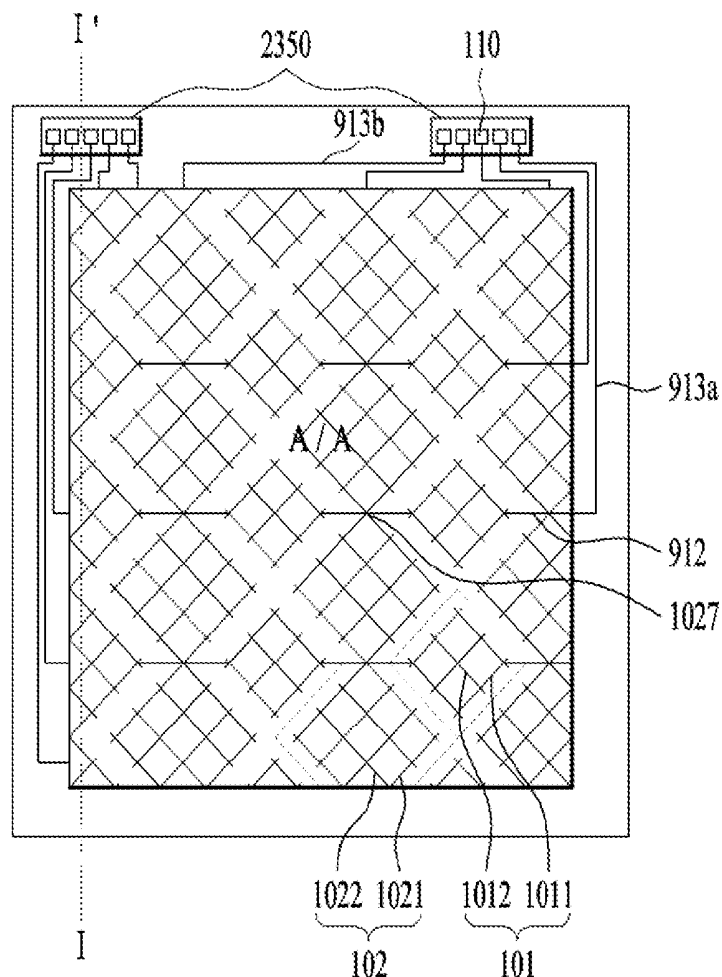


FIG. 1

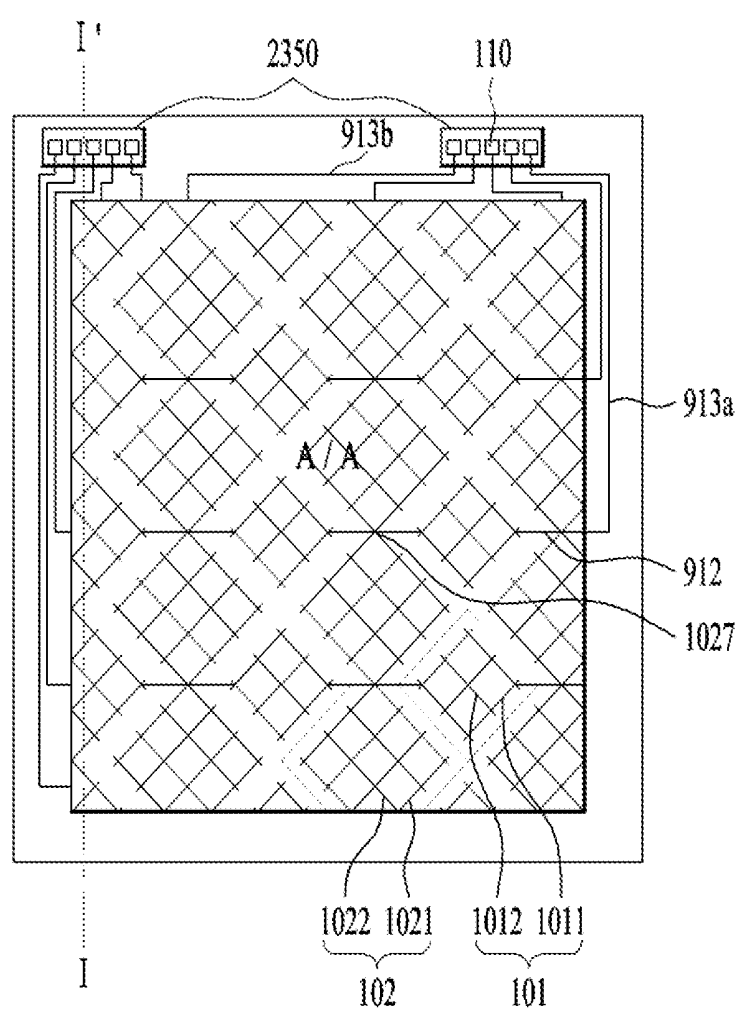


FIG. 2

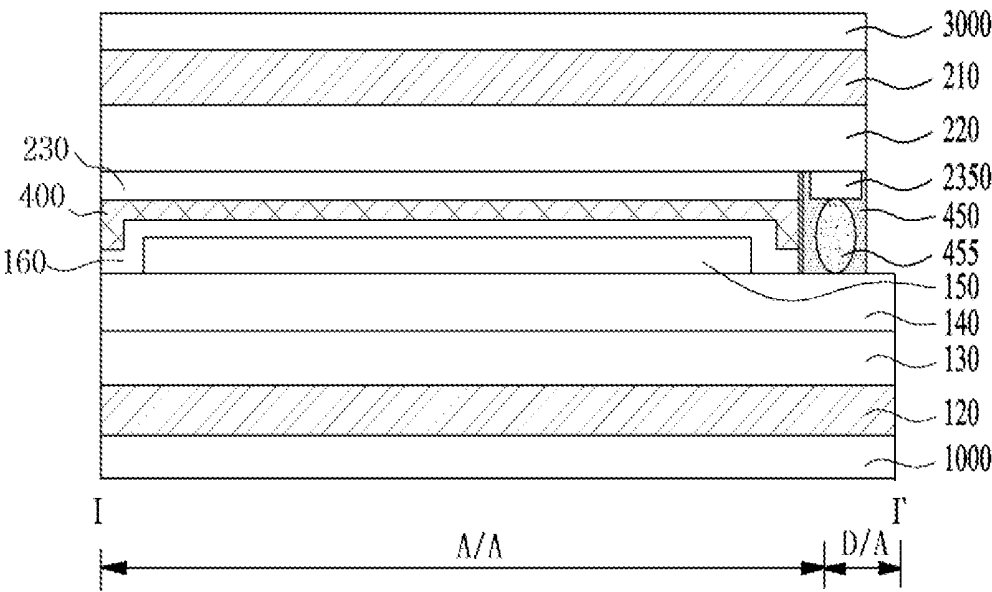


FIG. 3

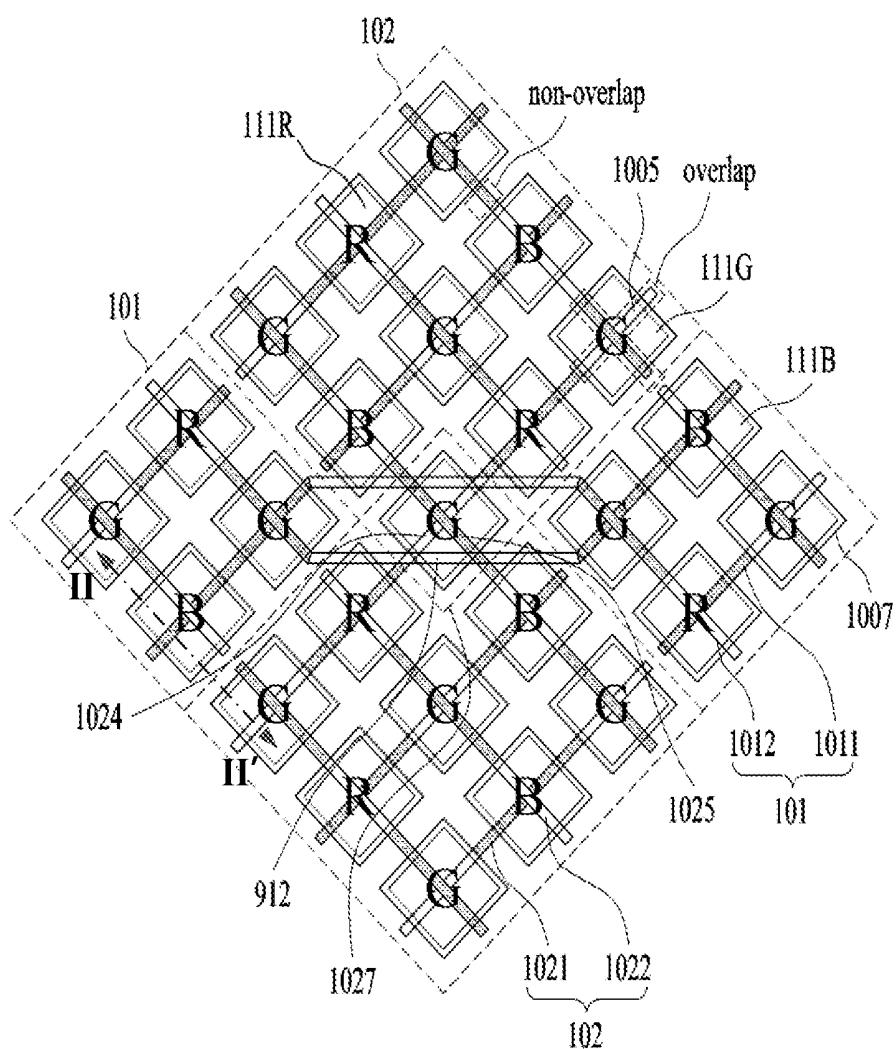


FIG. 4

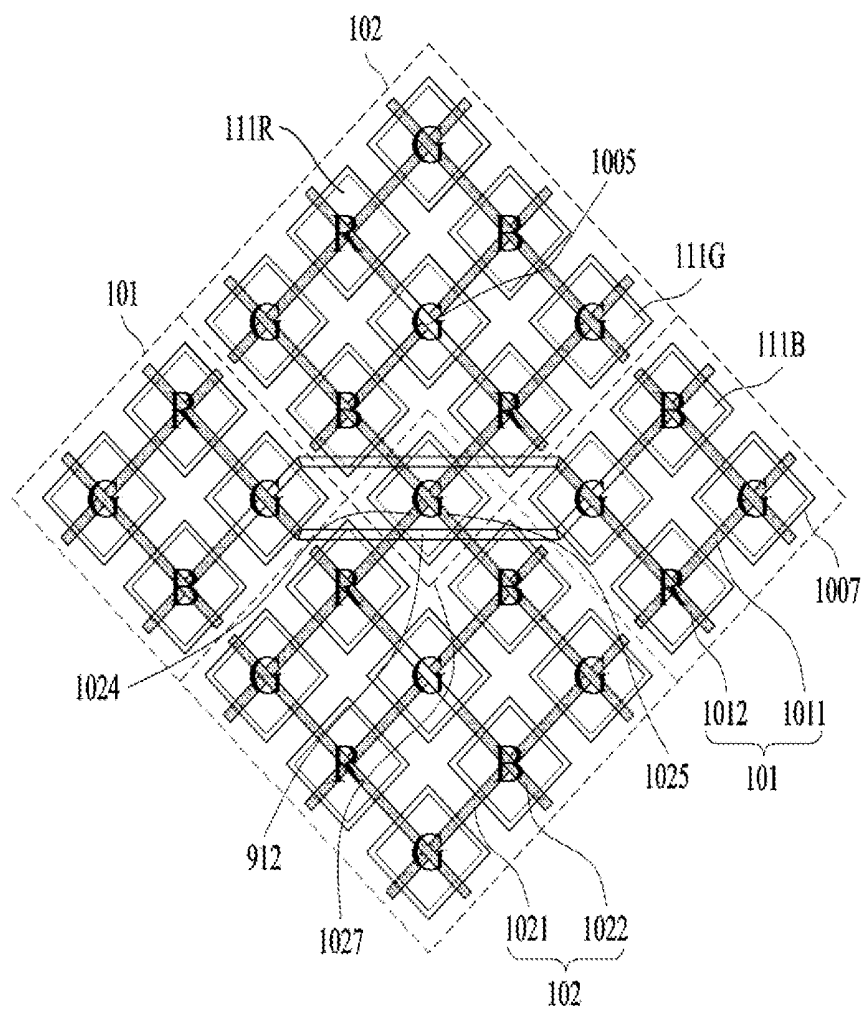


FIG. 5

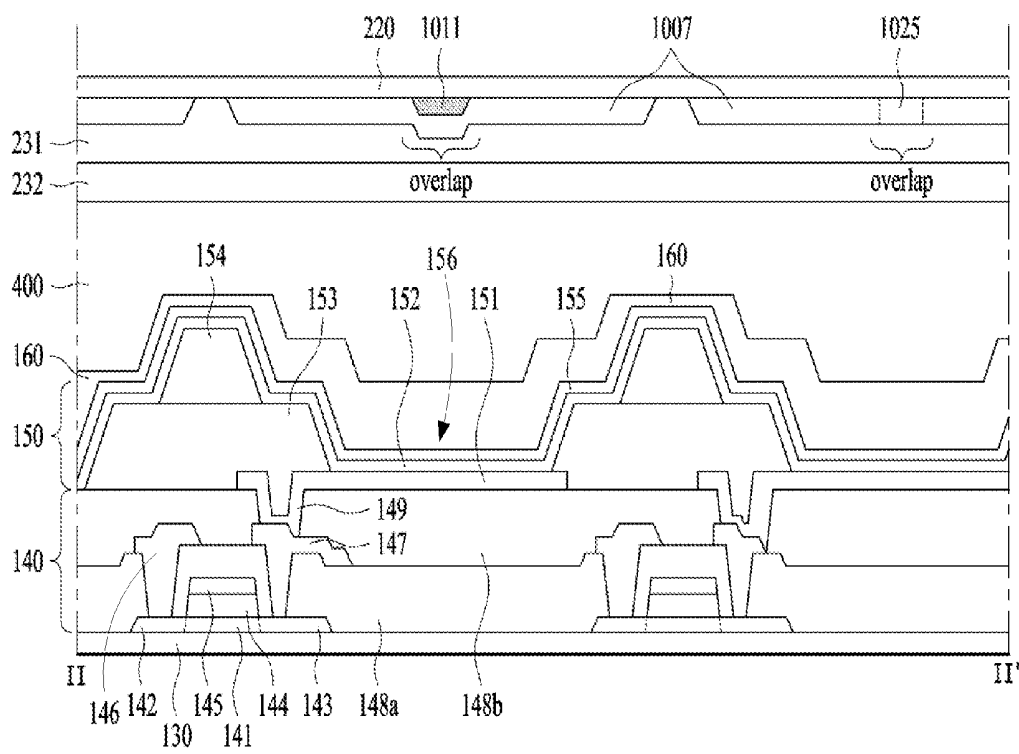


FIG. 6

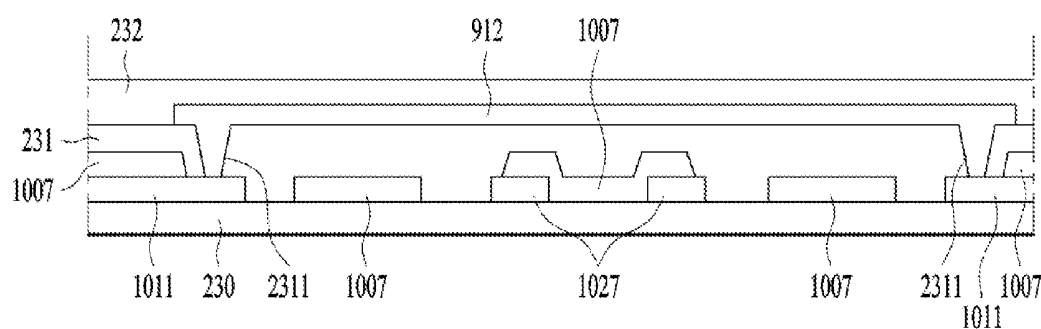
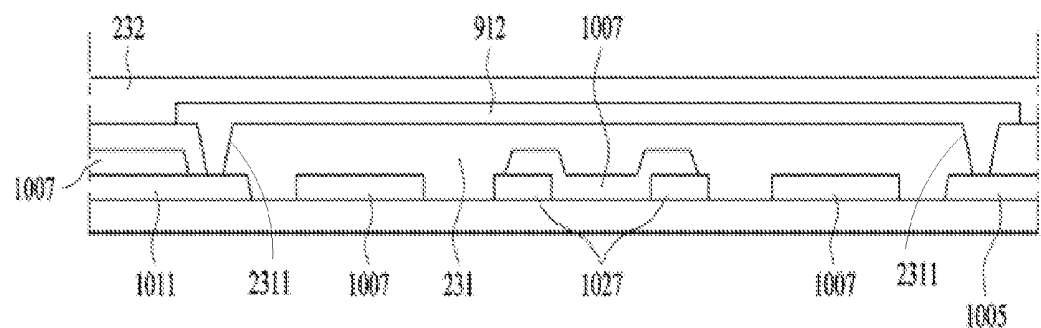


FIG. 7



IN-CELL TOUCH ORGANIC LIGHT-EMITTING DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of Republic of Korea Patent Application No. 10-2016-0143980, filed on Oct. 31, 2016, which is hereby incorporated by reference in its entirety.

BACKGROUND

Field of Technology

[0002] The present disclosure relates to an in-cell touch organic light-emitting display device, and more particularly to an organic light-emitting display device, which has improved viewing angle characteristics while including a metal mesh pattern.

Discussion of the Related Art

[0003] An image display device, which realizes various pieces of information on a screen, is a core technology of the information and communication age, and is being developed in the direction of becoming thinner, lighter, more portable, and having higher performance. As a flat panel display device that is capable of overcoming the problems of disadvantageous weight and volume of a cathode ray tube (CRT), for example, an organic light-emitting display device, which displays an image by controlling the intensity of luminescence of an organic emission layer, is attracting attention.

[0004] The organic light-emitting display device described above uses a self-illuminating organic light-emitting element, and therefore does not require a separate light source and enables realization of a super-thin-type display. In recent years, research on a touch-panel-integrated display device having an in-cell touch structure, which uses an organic light-emitting element and includes a touch electrode array inside a light-emitting cell, has been actively conducted.

[0005] A touch panel includes a first touch electrode, which is arranged in a first direction, and a second touch electrode, which is arranged in a second direction so as to intersect the first touch electrode. The first touch electrode and the second touch electrode are electrically isolated from each other. In this state, when an object charged with static electricity is brought into contact with the touch panel, the touch panel detects a touch input by sensing the change of mutual capacitance between the first touch electrode and the second touch electrode.

[0006] In manufacturing an organic light-emitting display device having a flexible touch structure, research is being actively conducted into the application of a metal mesh electrode, having superior flexibility and low resistance characteristics, to a touch electrode.

[0007] However, because the metal mesh electrode has higher reflectivity than a transparent conductive material, it has a high possibility of being visible and deteriorates the overall brightness of the organic light-emitting display device.

[0008] To solve this problem, a method of aligning a metal mesh electrode with a bank, which is a non-light-emitting region, has been devised. However, there is a high possi-

bility of occurrence of misalignment during a process of accurately aligning a mesh electrode with a display panel. If this misalignment occurs, as a viewing angle increases, the mesh electrode blocks a portion of a pixel opening, which causes asymmetry of a vertical viewing angle or a horizontal viewing angle.

SUMMARY

[0009] Accordingly, the present disclosure is directed to an organic light-emitting display device that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[0010] An object of the present disclosure is to provide an organic light-emitting display device, which has improved color viewing angle characteristics while including a mesh pattern.

[0011] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[0012] To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a touch display device includes a light-emitting array including a plurality of pixel openings arranged in a matrix form; and a touch electrode array attached to the light-emitting array, the touch electrode array including: a plurality of first mesh electrodes arranged in a first direction and having multiple lattice portions, at least one first mesh electrode of the plurality of first mesh electrodes including a first portion that overlaps a first pixel opening and a second portion that does not overlap the first pixel opening, the first portion of the at least one first mesh electrode that overlaps the first pixel opening more transparent than the second portion of the at least one first mesh electrode that does not overlap the first pixel opening; and a plurality of second mesh electrodes arranged in a second direction that intersects the first direction and having multiple lattice portions, at least one second mesh electrode of the plurality of second mesh electrodes including a first portion that overlaps a second pixel opening and a second portion that does not overlap the second pixel opening, the first portion of the at least one second mesh electrode that overlaps the second pixel opening more transparent than the second portion of the at least one second mesh electrode that does not overlap the second pixel opening.

[0013] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the disclosure and together with the description serve to explain the principle of the disclosure.

[0015] FIG. 1 is a plan view illustrating an organic light-emitting display device according to an embodiment of the present disclosure.

[0016] FIG. 2 is a schematic sectional view taken along line I-I' in FIG. 1 according to an embodiment of the present disclosure.

[0017] FIG. 3 is a schematic view illustrating the characteristics of first mesh electrodes and second mesh electrodes according to an embodiment.

[0018] FIG. 4 is a schematic view illustrating the characteristics of first mesh electrodes and second mesh electrodes according to an embodiment.

[0019] FIG. 5 is a sectional view taken along line II-II' in FIG. 3 according to an embodiment of the present disclosure.

[0020] FIG. 6 is a sectional view illustrating the cross-sectional structure according to an embodiment of bridges shown in FIG. 3 according to an embodiment of the present disclosure.

[0021] FIG. 7 is a sectional view illustrating the cross-sectional structure according to an embodiment of bridges shown in FIG. 4 according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

[0022] Hereinafter, exemplary embodiments of the present disclosure will be described with reference to the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. In addition, in the following description of the embodiments, a detailed description of known functions and configurations incorporated herein will be omitted when it may make the subject matter of the present invention rather unclear. Also, the terms of constituent elements used in the following description are defined taking into consideration ease in the preparation of the specification, and may differ from the terms used to describe elements of actual products.

[0023] In the description related to a positional relationship, for example, when an element is referred to as being “on”, “above”, “under” or “beside” another element, it can be directly on the other element, or intervening elements may also be present.

[0024] It will be understood that although the terms “first”, “second”, “third”, etc., may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. Thus, a first element discussed below could be termed a second element without departing from the teachings of example embodiments.

[0025] In the drawings, the size and thickness of each constituent element are illustrated merely for convenience of description, and the present invention is not necessarily limited to the illustrated size and thickness of each constituent element.

[0026] Hereinafter, various embodiments of the present invention will be described with reference to the accompanying drawings.

[0027] FIG. 1 is a plan view for explaining an organic light-emitting display device according to the present disclosure.

[0028] An organic light-emitting display device according to an embodiment of the present disclosure includes a plurality of first mesh electrodes **101**, which are arranged on

a substrate **1000** in a first direction, and a plurality of second mesh electrodes **102**, which are arranged in a second direction, which intersects the first direction. In this embodiment, the first direction is defined as the horizontal direction and the second direction is defined as the vertical direction; however, the embodiment is not limited thereto.

[0029] Each of the first mesh electrodes **101** and the second mesh electrodes **102** has a multiple-lattice structure. Each of the first mesh electrodes **101** includes a plurality of first line electrodes **1011**, which are formed lengthwise in a third direction, and a plurality of second line electrodes **1012**, which are formed lengthwise in a fourth direction and intersect the first line electrodes **1011** so as to form the lattice structure. That is, each second line electrode **1012** intersects at least one first line electrode **1011**.

[0030] Each of the second mesh electrodes **102** includes a plurality of third line electrodes **1021**, which are formed lengthwise in the third direction, and a plurality of fourth line electrodes **1022**, which are formed lengthwise in the fourth direction and intersect the third line electrodes **1021** so as to form the lattice structure.

[0031] The first mesh electrodes **101**, which are arranged adjacent to each other in the first direction, are connected to each other via bridges **912**. The second mesh electrodes **102**, which are arranged adjacent to each other in the second direction, are connected to each other via connecting mesh patterns **1027**. Here, the first mesh electrodes **101** connected via the bridges **912** may serve as driving electrodes that apply a driving signal for sensing a touch signal and the second mesh electrodes **102** connected via the connecting mesh patterns **1027** may serve as sensing electrodes that sense a touch signal, or vice versa; however, the embodiment is not limited thereto.

[0032] The concrete structures of the first and second mesh electrodes **101** and **102** and the connecting relationship therebetween will be described later.

[0033] The first mesh electrodes **101**, which are positioned at the outermost portion of a display area A/A, are connected to pad electrodes **110** of a touch pad portion **2350** via first routing lines **913a**, and the second mesh electrodes **102**, which are positioned at the outermost portion of the display area A/A, are connected to the pad electrodes **110** of the touch pad portion **2350** via second routing lines **913b**.

[0034] FIG. 2 is a schematic sectional view taken along line I-I' in FIG. 1 according to one embodiment.

[0035] The display device according to the embodiment of the present disclosure is constructed such that a first base **120**, a first buffer layer **130**, a thin-film transistor array **140** and an organic light-emitting array **150** are sequentially disposed on the substrate **1000** and such that a protective layer **160** is disposed so as to cover the organic light-emitting array **150**. A second base **210**, a second buffer layer **220** and a touch electrode array **230** are arranged inside a cover glass **3000**. The touch electrode array **230** is bonded to the protective layer **160**, which is disposed on the organic light-emitting array **150**, by means of an adhesive layer **400** so as to be opposite the organic light-emitting array **150**.

[0036] In each of the first buffer layer **130** and the second buffer layer **220**, an active area and a dead area are defined. The touch electrode array **230**, the organic light-emitting array **150**, and the thin-film transistors in the thin-film transistor array **140** excluding the pad portion are formed in

the active area. In addition, a touch pad portion **2350** and the pad portion of the thin-film transistor array **140** are defined in a portion of the dead area.

[0037] Here, the first and second bases **120** and **210** serve to prevent damage to the internal arrays during a laser irradiation or etching process. In some cases, the substrate **1000** and the cover glass **3000** are omitted, and the first and second bases **120** and **210** serve to protect the display device from external shocks. The first and second bases **120** and **210** may be formed of a polymer material such as, for example, polyimide or photoacryl.

[0038] Each of the first buffer layer **130** and the second buffer layer **220** is formed by sequentially stacking the same type of inorganic films, such as an oxide film (SiO_2) or a nitride film (SiN_x), one above another, or by alternately stacking different inorganic films one above another. The first and second buffer layers **130** and **220** function as barriers that prevent moisture or outside air from permeating the organic light-emitting array **150** in the subsequent process of bonding the upper substrate to the lower substrate.

[0039] The touch electrode array **230** and the touch pad portion **2350** are formed on the same surface of the second buffer layer **220**. The touch pad portion **2350** is connected to the pad portion (not illustrated) of the thin-film transistor array **140** by a seal **450** having a conductive ball **455**, in a vertical bonding process using the adhesive layer **400**. At this time, the adhesive layer **400** has a moisture permeation preventing function and is directly in contact with the protective layer **160**, which covers the organic light-emitting array **150**, thereby serving to prevent outside air from entering the organic light-emitting array **150** and to more reliably prevent the permeation of moisture, in addition to the function of the protective layer **160**.

[0040] Here, the thin-film transistor array **140** including the pad portion may be configured so as to protrude further than one side of the touch electrode array **230**. A driving Integrated Circuit (IC) (not illustrated) may be provided on the protruding portion of the thin-film transistor array **140** to transmit signals for driving the touch electrode array, the thin-film transistor array, and the organic light-emitting array. Although not illustrated, with regard to the driving IC and the thin-film transistor array, a driving pad and a dummy pad include a plurality of dummy electrodes and are connected to the driving IC via wires. In addition, after glass removal, the driving IC may be bonded to and connected to a flexible printed circuit board (FPCB) (not illustrated), thereby being controlled by a micro control unit (MCU) (not illustrated) and a timing controller (not illustrated) provided in the FPCB. The dummy pad is formed in the same layer as the metal that forms a gate line or a data line in the area that corresponds to the touch pad portion **2350** in the dead area around the active area.

[0041] The driving IC may be mounted on the flexible printed circuit board and the FPCB may be bonded with the display device using an anisotropic conductive film (ACF). Or, the driving IC may be mounted on the thin-film transistor array **140** using the ACF in a chip-on-film (COF) manner.

[0042] Although not illustrated, the dummy pad and the driving pad of the thin-film transistor array **140** are connected to the flexible printed circuit board. In addition, the flexible printed circuit board may further include a controller (not illustrated) for controlling the driving IC.

[0043] The dummy pad is formed in the same layer as the metal that forms a gate line or a data line in the area that corresponds to the touch pad portion in the dead area around the active area.

[0044] FIG. 3 is a schematic view illustrating the characteristics of the first mesh electrodes **101** and the second mesh electrodes **102** according to an embodiment.

[0045] The first mesh electrodes **101**, as described above, include the first and second line electrodes **1011** and **1012**, which are arranged in the third and fourth directions so as to intersect each other. The second mesh electrodes **102** include the third and fourth line electrodes **1021** and **1022**, which are arranged in the third and fourth directions so as to intersect each other.

[0046] The first and second mesh electrodes **101** and **102** may be positioned so as to include portions that overlap the pixel openings **111R**, **111G** and **111B**. Each of the pixel openings **111R**, **111G** and **111B** defines a light emitting portion of each of red, green, and blue organic light emitting elements. The first and second mesh electrodes **101** and **102** may be divided into overlapping portions, which are positioned so as to overlap the pixel openings **111R**, **111G** and **111B**, and non-overlapping portions, which are positioned so as not to overlap the pixel openings **111R**, **111G** and **111B**. Referring to FIG. 3, the overlapping portions are the portions that are indicated by cross-shaped dotted lines, and the non-overlapping portions are the remaining portions.

[0047] Although it is illustrated in FIG. 3 that each of the pixel openings **111R**, **111G** and **111B** is formed in a diamond shape, the embodiment is not limited thereto. The pixel openings **111R**, **111G** and **111B** may be formed in various other shapes, such as a rectangular shape, depending on the design.

[0048] As shown in FIG. 3, lattice portions, which are formed by the intersection between the first line electrodes **1011** and the second line electrodes **1012** or the intersection between the third line electrodes **1021** and the fourth line electrodes **1022**, may be positioned at the overlapping portions; however, the embodiment is not limited thereto. The lattice portions may be positioned at the non-overlapping portions, rather than the overlapping portions, and any one of the first to fourth line electrodes may be positioned so as to pass through the overlapping portions.

[0049] At this time, in the case in which the lattice portions are positioned at the centers of the pixel openings **111R**, **111G** and **111B**, the possibility of the lattice portions being visible to the outside is low even when the viewing angle increases. Therefore, in order to improve the viewing angle characteristics, it is desirable for the lattice portions to be positioned at the centers of the pixel openings **111R**, **111G** and **111B**.

[0050] All or at least some of the overlapping portions include brightness-increasing portions **1005**, which are formed of a material different from that of the non-overlapping portions. The brightness-increasing portions **1005** are formed of a material different from that of the first to fourth line electrodes **1011**, **1012**, **1021** and **1022** positioned in the portions other than the brightness-increasing portions **1005**, such as the non-overlapping portions.

[0051] For example, the first to fourth line electrodes **1011**, **1012**, **1021** and **1022**, excluding the brightness-increasing portions **1005**, may be formed of metal selected from among Cu, Ag, Al, Mo, Ti and Au, or an alloy thereof, and the brightness-increasing portions **1005** may be formed

of a transparent conductive material such as, for example, ITO, IZO, IGZO or ZnO. However, the embodiment is not limited thereto.

[0052] Although the illustration is omitted from FIG. 1 for convenience, segment electrodes 1007 may be further provided at regions corresponding to the overlapping portions. The segment electrodes 1007 are disposed at the positions corresponding to the pixel openings 111R, 111G and 111B and the overlapping portions. The segment electrodes 1007 may be formed of a transparent conductive material such as, for example, ITO, IZO, IGZO or ZnO; however, the embodiment is not limited thereto. The segment electrodes 1007 may be omitted depending on the design. Since the segment electrodes 1007 are formed of a transparent conductive material, they do not block the pixel openings 111, and compensate for the resistance components of the first and second mesh electrodes 101 and 102.

[0053] In the case in which the segment electrodes 1007 are positioned on the overlapping portions, the segment electrodes 1007 may be formed of the same material as the brightness-increasing portions 1005 and may be formed integrally therewith.

[0054] The brightness-increasing portions 1005, which are formed of a transparent conductive material, have higher resistance characteristics than the non-overlapping portions, which are formed of metal. Therefore, in the case in which an excessively large number of the brightness-increasing portions 1005 are provided, the touch-sensing performance may be degraded. The positions and configuration of the brightness-increasing portions 1005 may be variously set depending on the design.

[0055] The brightness-increasing portions 1005 may be formed at the overlapping portions of the first line electrodes 1011 of the first mesh electrodes 101, or may be formed at the overlapping portions of the second line electrodes 1012. Alternatively, the brightness-increasing portions 1005 may be formed at both the overlapping portions of the first line electrodes 1011 and the overlapping portions of the second line electrodes 1012. However, in order to minimize deterioration in resistance-capacitance characteristics, it is desirable that the brightness-increasing portions 1005 be positioned at either the overlapping portions of the first line electrodes 1011 or the overlapping portions of the second line electrodes 1012. Similarly, the brightness-increasing portions 1005 may be formed at the overlapping portions of the third line electrodes 1021 of the second mesh electrodes 102, or may be formed at the overlapping portions of the fourth line electrodes 1022. Alternatively, the brightness-increasing portions 1005 may be formed at both the overlapping portions of the third line electrodes 1021 and the overlapping portions of the fourth line electrodes 1022. However, in order to minimize deterioration in resistance-capacitance characteristics, it is desirable that the brightness-increasing portions 1005 may be positioned at either the overlapping portions of the third line electrodes 1021 or the overlapping portions of the fourth line electrodes 1022.

[0056] At this time, one of two neighboring brightness-increasing portions 1005 may be positioned at the overlapping portion of the line electrode that is arranged in the third direction, out of the first to fourth line electrodes, and the other one may be positioned at the overlapping portion of the line electrode that is arranged in the fourth direction. That is, two neighboring brightness-increasing portions 1005 may be arranged in directions different from each other, thereby

minimizing deterioration in brightness of the pixel openings 111R, 111G and 111B and improving the viewing angle characteristics.

[0057] For example, in the first mesh electrode 101, when the brightness-increasing portion 1005, which is positioned on one pixel opening, is formed at the overlapping portion of the first line electrode 1011, which is arranged in the third direction, the brightness-increasing portion 1005, which is positioned on another neighboring pixel opening, may be formed at the overlapping portion of the second line electrode 1012, which is arranged in the fourth direction.

[0058] Further, in the second mesh electrode 102, when the brightness-increasing portion 1005, which is positioned on one pixel opening, is formed at the overlapping portion of the third line electrode 1021, which is arranged in the third direction, the brightness-increasing portion 1005, which is positioned on another neighboring pixel opening, may be formed at the overlapping portion of the fourth line electrode 1022, which is arranged in the fourth direction.

[0059] FIG. 4 is a schematic view illustrating the characteristics of the first mesh electrodes 101 and the second mesh electrodes 102 according to an embodiment.

[0060] The brightness-increasing portions 1005 may be formed at all portions of the first and second mesh electrodes 101 and 102 that overlap the pixel openings 111R, 111G and 111B. However, depending on the design, the brightness-increasing portions 1005 may be formed only at some of the overlapping portions.

[0061] Particularly, as shown in FIG. 4, the brightness-increasing portions 1005 may be spaced apart from each other, with the k (where k is a natural number) number of overlapping portions interposed therebetween. In other words, the overlapping portions including the brightness-increasing portions 1005 may be spaced apart from each other, with the k number of overlapping portions, which include no brightness-increasing portions, interposed therebetween.

[0062] FIG. 5 is a sectional view taken along line II-II' in FIG. 3 to illustrate the cross-sectional structure of the organic light-emitting display device according to an embodiment of the present disclosure. Although the illustration of the structure below the first buffer layer 130 and the structure above the second buffer layer 220 is omitted from the drawings for convenience, as shown in FIG. 2, the first base 120 and the substrate 1000 may be provided below the first buffer layer 130, and the second base 210 and the cover window 3000 may be provided above the second buffer layer 220.

[0063] The thin-film transistor array 140, which includes a thin-film transistor (TFT), is disposed on the first buffer layer 130. The thin-film transistor (TFT) includes an active layer 141, which includes a source region 142 and a drain region 143, a gate insulation film 144 and a gate electrode 145, which are disposed on the active layer 141, an inter-layer insulation film 148a, which covers the active layer 141 and the gate electrode 145 and has contact holes formed to expose the source and drain regions 142 and 143 therethrough, and a source electrode 146 and a drain electrode 147, which are formed so as to contact the source and drain regions 142 and 143 through the contact holes. A first passivation layer 148b is formed on the thin-film transistor (TFT). The first passivation layer 148b has a contact hole 149 formed to expose the drain electrode 147 therethrough.

[0064] A first electrode 151, which is connected to the contact hole 149, is disposed on the first passivation layer 148b. Further, a bank insulation film 153, which defines the pixel opening 111 by exposing a portion of the first electrode 151, is disposed on the first passivation layer 148b. A spacer 154 may be further disposed on the bank insulation film 153.

[0065] An organic layer 152, which includes an emission layer, is formed on the first electrode 151. Here, the organic layer 152 is divided into an electron injection layer (EIL), an electron transport layer (ETL), an emission layer (EML), a hole transport layer (HTL), and a hole injection layer (HIL). The emission layer emits light having a specific wavelength as excitons, which are generated by recombination of electrons from a cathode and holes from an anode, return to the ground state.

[0066] The organic layer 152 may be formed over the entire surface of the buffer layer 130 including the bank insulation film 153 as well as the first electrode 151. However, the embodiment is not limited thereto.

[0067] A second electrode 155 is formed on the organic layer 152. The second electrode 155 may be formed over the entire surface of the buffer layer 130 including the organic layer 152.

[0068] The organic light-emitting array 150 is protected from outside moisture by the protective layer 160. The protective layer 160 may be formed by alternately stacking inorganic films and organic films. However, the embodiment is not limited thereto.

[0069] The touch electrode array 230 is disposed on the second buffer layer 220. The touch electrode array 230 is bonded to the organic light-emitting array 150 by means of the adhesive layer 400 so as to be opposite the organic light-emitting array 150.

[0070] Described in more detail, the first to fourth line electrodes 1011, 1012, 1021 and 1022 are disposed on the surface of the second buffer layer 220 that is opposite the organic light-emitting array 150. At this time, the first to fourth line electrodes 1011, 1012, 1021 and 1022 include overlapping portions that overlap the pixel openings 156. FIG. 5 illustrates the overlapping portion of the first line electrode 1011 that overlaps the pixel opening 156. Some of the overlapping portions of the first to fourth line electrodes 1011, 1012, 1021 and 1022 are provided with the brightness-increasing portions 1005. Referring to FIG. 5, it can be seen that the brightness-increasing portion 1005 is also positioned at the overlapping portion of the third line electrode 1021 that overlaps the pixel opening 156.

[0071] Referring to FIG. 5, the segment electrodes 1007 may be further disposed on the first to fourth line electrodes 1011, 1012, 1021 and 1022. The segment electrodes 1007 may be formed of a transparent conductive material. As shown in FIG. 5, the segment electrodes 1007 may be formed of the same material as the brightness-increasing portions 1005, and may be formed integrally therewith. However, the embodiment is not limited thereto. In the case in which the segment electrodes 1007 and the brightness-increasing portions 1005 are formed integrally with each other, no stepped portions are formed between the segment electrodes 1007 and the brightness-increasing portions 1005. As such, by forming the segment electrodes 1007 and the brightness-increasing portions 1005 at the same time, the process of forming the brightness-increasing portions 1005 may be simplified.

[0072] The segment electrodes 1007 are disposed at positions corresponding to the pixel openings 156, and are disposed below the first to fourth line electrodes 1011, 1012, 1021 and 1022 so as to cover the overlapping portions. In the case in which the brightness-increasing portions 1005 are provided, the segment electrodes 1007 may be formed of the same material and in the same layer as the brightness-increasing portions 1005.

[0073] FIGS. 6 and 7 are sectional views illustrating the cross-sectional structures of the bridges 912 shown in FIGS. 3 and 4.

[0074] As described above, the connecting mesh patterns 1027 are positioned in the same plane as the first and second mesh electrodes 101 and 102 and connect neighboring second mesh electrodes 102 to each other. The connecting mesh patterns 1027 connect the neighboring second mesh electrodes 102 to each other via line electrodes 1024 and 1025 that are arranged in the third direction and the fourth direction. The connecting mesh patterns 1027 include overlapping portions that overlap the pixel openings 156, and the segment electrodes 1007 are formed at positions corresponding to the overlapping portions. Depending on the embodiment, within the region at which the connecting mesh patterns 1027 overlap the pixel openings, at least one of the line electrodes 1024 and 1025 may be further provided with the brightness-increasing portion, thereby further enhancing the brightness.

[0075] A second passivation layer 231 is formed so as to cover the first and second mesh electrodes 101 and 102 and the connecting mesh patterns 1027, and the bridge 912 is formed on the second passivation layer 231. The neighboring first mesh patterns 101 are connected to each other by the bridges 912.

[0076] Referring to FIG. 6, the second passivation layer 231 has contact holes 2311 formed to expose the line electrodes 1011 of the first mesh electrodes 101 there-through. The bridge 912 is connected to the line electrodes 1011 of two neighboring first mesh electrodes 101 through the contact holes 2311, thereby electrically connecting the two neighboring first mesh electrodes 101 to each other.

[0077] Meanwhile, the second passivation layer 231, as shown in FIG. 7, may be formed so as to expose the brightness-increasing portion 1005. Specifically, any one contact hole 2311 may expose the brightness-increasing portion 1005 that may be connected to one end portion of the bridge 912, and another contact hole 2311 may expose the line electrode 1011 that may be connected to an opposite end portion of the bridge 912. The bridge 912 may be connected at two opposite end portions thereof to the brightness-increasing portions 1005, or may be connected at two opposite end portions thereof to the line electrodes 1011, or may be connected at one end portion thereof to the brightness-increasing portion 1005 and may be connected at the opposite end portion thereof to the line electrode 1011, thereby electrically connecting the first mesh electrodes 101 to each other.

[0078] The bridge 912 has a structure that is covered with the first passivation layer 232.

[0079] The touch electrode array 230 shown in FIGS. 6 and 7 is bonded to the organic light-emitting array 150 so as to be opposite the same using the adhesive layer 400. Accordingly, in practice, the touch electrode array 230 is arranged in the state of being vertically inverted from the state shown in FIGS. 6 and 7.

[0080] In the above-described in-cell touch organic light-emitting display device according to the embodiments of the present invention, the first and second mesh electrodes **101** and **102** are arranged so as to overlap the pixel openings **111**.

[0081] In the related art, the mesh electrodes are positioned between the pixel openings. However, in this structure, if an error occurs during an aligning process, the mesh electrodes are positioned to overlap the sides of the pixel openings. Thus, the mesh electrodes block the sides of the pixel openings, thereby causing asymmetry of the viewing angle. On the other hand, according to the embodiments of the present invention, the first and second mesh electrodes **101** and **102** may be positioned so as to overlap the centers of the pixel openings **111**. As a result of the first and second mesh electrodes **101** and **102** being positioned at the centers of the pixel openings **111**, asymmetry of the viewing angle is prevented.

[0082] Even if the first and second mesh electrodes **101** and **102** are slightly misaligned sideways from the centers of the pixel openings **111**, the possibility of occurrence of asymmetry of the viewing angle is much lower than the case in which the mesh electrodes block the sides of the pixel openings **111**.

[0083] Accordingly, the organic light-emitting display device according to the embodiments of the present disclosure has a high process margin compared to the related art, in which the mesh electrodes are positioned between the pixel openings **111**. As a result, the in-cell touch organic light-emitting display device according to the embodiments of the present invention has an effect of reducing the degree of asymmetry of the viewing angle attributable to error in the process of aligning the first and second mesh electrodes **101** and **102**.

[0084] In addition, in order to minimize deterioration in brightness attributable to the first and second mesh electrodes **101** and **102** being positioned on the pixel openings **111**, the brightness-increasing portions **1005** are provided at the overlapping portions of the first and second mesh electrodes **101** and **102**. Since the brightness-increasing portions **1005** are formed of a transparent conductive material, they have an effect of minimizing deterioration in brightness attributable to the first and second mesh electrodes **101** and **102** overlapping the pixel openings **111**.

[0085] Specifically, it is possible to minimize deterioration in brightness and resistance by positioning the brightness-increasing portion **1005** at only one of two line electrodes positioned on the pixel opening **111**.

[0086] The following Table 1 shows the comparison results between the vertical color viewing angle and the horizontal color viewing angle of the organic light-emitting display device according to the embodiments of the present disclosure and those of the related art, in which mesh electrodes do not overlap pixel openings. Even though results different from the following results may be derived in accordance with a difference in processing, the possibility of occurrence of deviation of the viewing angle during processing and the degree of deviation of the viewing angle can be estimated by comparing the maximum deviations measured in the experiment.

TABLE 1

	Deviation of Horizontal Color Viewing Angle	Deviation of Vertical Color Viewing Angle
Prior Art	6° (Maximum Deviation Measured in Experiment)	7° (Maximum Deviation Measured in Experiment)
Present Invention	3° (Maximum Deviation Measured in Experiment)	4.5° (Maximum Deviation Measured in Experiment)

[0087] In the organic light-emitting display device, if the deviation of the viewing angle is 5° or more, the degree of asymmetry of the color viewing angle is considered large.

[0088] According to the above experimental results, in the organic light-emitting display device of the related art, the maximum deviation of the horizontal color viewing angle is 6° and the maximum deviation of the vertical color viewing angle is 7°. That is, the related art has a problem in that the degree of asymmetry of the color viewing angle is very large even when a processing error is small, and consequently deterioration in the image quality occurs.

[0089] On the other hand, in the organic light-emitting display device according to the embodiments of the present disclosure, the maximum deviation of the horizontal color viewing angle is only 3°, and the maximum deviation of the vertical color viewing angle is only 4.5°. That is, a processing error, if any, has less influence on deviation of the viewing angle.

[0090] As is apparent from the above description, in an organic light-emitting display device according to the embodiments of the present invention, since first and second mesh electrodes are positioned so as to overlap pixel openings, it is possible to reduce the degree of asymmetry of a viewing angle attributable to error in the process of aligning the first and second mesh electrodes.

[0091] In addition, in order to minimize deterioration in brightness attributable to the first and second mesh electrodes being positioned on the pixel openings, brightness-increasing portions are provided at overlapping portions of the first and second mesh electrodes. Since the brightness-increasing portions are formed of a transparent conductive material, they have an effect of minimizing deterioration in brightness attributable to the first and second mesh electrodes overlapping the pixel openings.

[0092] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention covers the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A touch display device comprising:
 - a light-emitting array including a plurality of pixel openings arranged in a matrix form; and
 - a touch electrode array attached to the light-emitting array, the touch electrode array including:
 - a plurality of first mesh electrodes arranged in a first direction and having multiple lattice portions, at least one first mesh electrode of the plurality of first mesh electrodes including a first portion that overlaps a first pixel opening and a second portion that does not overlap the first pixel opening, the first portion of the at least one first mesh electrode that overlaps the first pixel opening more transparent than the second portion

of the at least one first mesh electrode that does not overlap the first pixel opening; and
 a plurality of second mesh electrodes arranged in a second direction that intersects the first direction and having multiple lattice portions, at least one second mesh electrode of the plurality of second mesh electrodes including a first portion that overlaps a second pixel opening and a second portion that does not overlap the second pixel opening, the first portion of the at least one second mesh electrode that overlaps the second pixel opening more transparent than the second portion of the at least one second mesh electrode that does not overlap the second pixel opening.

2. The touch display device according to claim 1, wherein the lattice portions of the plurality of first mesh electrodes and the plurality of second mesh electrodes are positioned to overlap the plurality of pixel openings.

3. The touch display device according to claim 2, wherein the plurality of first mesh electrodes include a plurality of first line electrodes arranged in a third direction and a plurality of second line electrodes arranged in a fourth direction, the plurality of first line electrodes intersecting the plurality of second line electrodes forming a lattice structure, and wherein the first portion of the at least one first mesh electrode that overlaps the first pixel opening comprises a portion of at least one first line electrode or at least one second line electrode;

wherein the plurality of second mesh electrodes include a plurality of third line electrodes arranged in the third direction and a plurality of fourth line electrodes arranged in the fourth direction, the plurality of third line electrodes intersecting the plurality of fourth line electrodes forming a lattice structure, and wherein the first portion of the at least one second mesh electrode that overlaps the second pixel opening comprises a portion of at least one third line electrode or at least one fourth line electrode.

4. The touch display device according to claim 1, wherein the first mesh electrode and the second mesh electrode are formed of a transparent conductive material.

5. The touch display device according to claim 1, further comprising:

a plurality of bridges positioned in a different layer from the plurality of first mesh electrodes and the plurality of second mesh electrodes, the plurality of bridges configured to electrically connect together first mesh electrodes that are arranged adjacent to each other in the first direction through contact holes; and

a plurality of connecting mesh patterns positioned in a same layer as the plurality of first mesh electrodes and the plurality of second mesh electrodes, the plurality of connecting mesh patterns connecting together second mesh electrodes that are arranged adjacent to each other in the second direction.

6. The touch display device according to claim 5, wherein at least one of the plurality of connecting mesh patterns comprises a portion that overlaps a pixel opening, the

portion of the connection mesh pattern that overlaps a pixel opening more transparent than the first portion of the first mesh electrode that does not overlap the first pixel opening and the second portion of the second mesh electrode that does not overlap the second pixel opening.

7. The touch display device according to claim 3, further comprising:

a plurality of segment electrodes, each segment electrode positioned at a corresponding one of the plurality of pixel openings.

8. The touch display device according to claim 7, wherein the plurality of segment electrodes are formed of a transparent conductive material.

9. The touch organic display device according to claim 7, wherein the first portion of the first mesh electrode that overlaps the first pixel opening, the second portion of the second mesh electrode that overlaps the second pixel opening, and the plurality of segment electrodes are formed of a same transparent conductive material.

10. The touch display device according to claim 1, wherein the first portion of the first mesh electrode that overlaps the first pixel opening and the second portion of the second mesh electrode that overlaps the second pixel opening are spaced apart from each other, with a k (where k is a natural number) number of portions of other first mesh electrodes and other second mesh electrodes in between the first mesh electrode and the second mesh electrode, the other first mesh electrodes and the other second mesh electrodes less transparent than the first portion of the first mesh electrode that overlaps the first pixel opening and the second portion of the second mesh electrode that overlaps the second pixel opening.

11. The touch display device according to claim 3, wherein the first mesh electrode includes a first neighboring mesh electrode that is adjacent to the first mesh electrode and a second neighboring mesh electrode that is adjacent to the first mesh electrode, the first neighboring mesh electrode including a third portion comprising a line electrode arranged in the third direction that overlaps a third pixel opening, and the second neighboring mesh electrode including a fourth portion comprising a line electrode arranged in the fourth direction that overlaps a fourth pixel opening

wherein the third portion of the first neighboring mesh electrode is more transparent than other portions of the first neighboring mesh electrode that do not overlap the third pixel opening; and

wherein the fourth portion of the second neighboring mesh electrode is more transparent than other portions of the second neighboring mesh electrode that do not overlap the fourth pixel opening.

12. The touch display device according to claim 1, wherein the light-emitting array is an organic light-emitting array.

* * * * *

专利名称(译)	In-Cell Touch有机发光显示设备		
公开(公告)号	US20180122867A1	公开(公告)日	2018-05-03
申请号	US15/798134	申请日	2017-10-30
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	CHOE YOUNG JIN CHOI NACK BONG YOO SE JONG HAN JONG HYUN		
发明人	CHOE, YOUNG-JIN CHOI, NACK-BONG YOO, SE-JONG HAN, JONG-HYUN		
IPC分类号	H01L27/32 G06F3/041 H01L51/52		
CPC分类号	H01L27/323 G06F3/0412 H01L51/5203 G06F2203/04112 G06F3/0416 G06F3/044 G06F2203/04102 G06F3/0443 G06F3/0446		
优先权	1020160143980 2016-10-31 KR		
其他公开文献	US10236327		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种有机发光显示装置，其具有改进的彩色视角特性，同时包括网格图案。有机发光显示装置包括：有机发光阵列，包括多个像素开口；以及触摸电极阵列，结合到有机发光阵列。触摸电极阵列包括沿第一方向布置并具有格子结构的多个第一网格电极，以及沿第二方向布置并具有格子结构的多个第二网格电极。第一网状电极和第二网状电极中的每一个包括与像素开口重叠的多个重叠部分，以及位于像素开口之间的多个非重叠部分。至少一些重叠部分包括亮度增加部分，其由与非重叠部分的材料不同的材料形成。

