US 20200185467A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2020/0185467 A1**

SUN et al. (43) **Pub. Date: Jun. 11, 2020**

(54) **ACTIVE MATRIX ORGANIC LIGHT-EMITTING DIODE DISPLAY PANEL**

(71) Applicant: **WUHAN CHINA STAR OPTOELECTRONICS SEMICONDUCTOR DISPLAY TECHNOLOGY CO., LTD.**, Wuhan, Hubei (CN)

(72) Inventors: **Liang SUN**, Wuhan, Hubei (CN); **Shoucheng Wang**, Wuhan, Hubei (CN); **Mian Zeng**, Wuhan, Hubei (CN); **Shijuan YI**, Wuhan, Hubei (CN)

(21) Appl. No.: **16/330,091**

(22) PCT Filed: **Dec. 29, 2018**

(86) PCT No.: **PCT/CN2018/125210**

§ 371 (c)(1),
(2) Date: **Mar. 3, 2019**

(30) **Foreign Application Priority Data**

Dec. 6, 2018 (CN) 201811485917.X

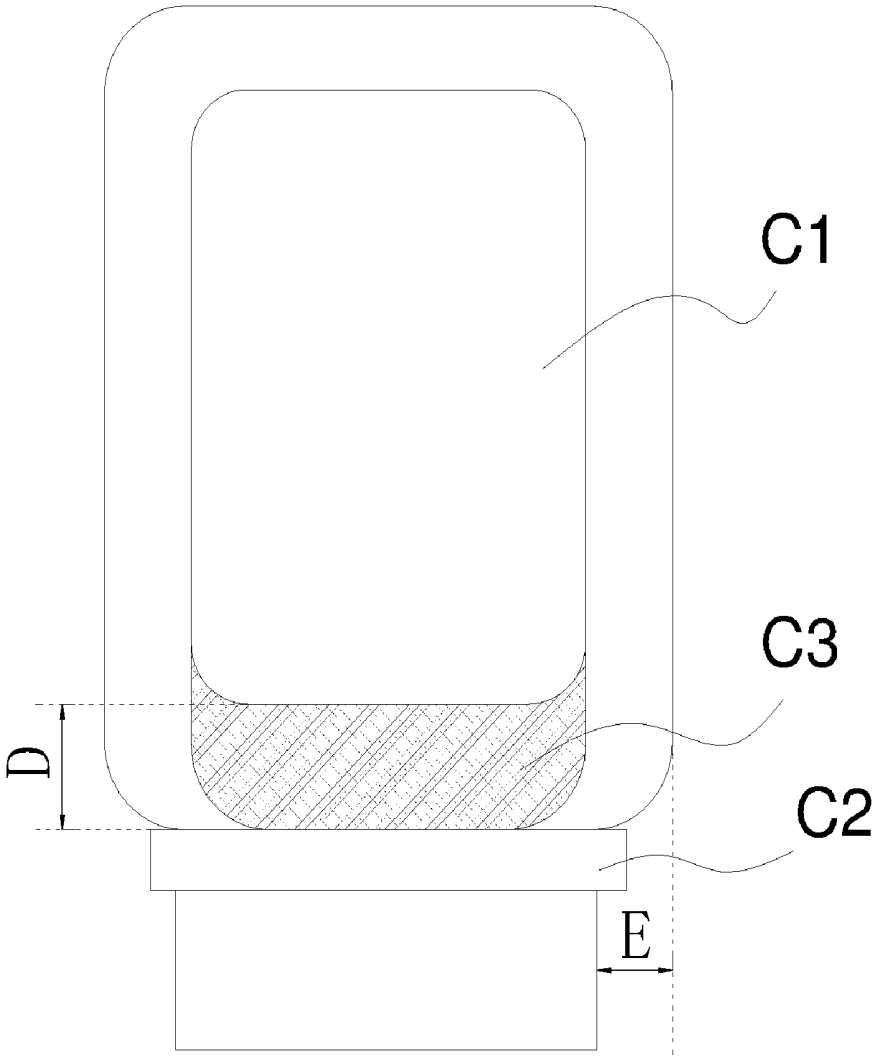
Publication Classification

(51) **Int. Cl.**
H01L 27/32 (2006.01)
H01L 51/52 (2006.01)

(52) **U.S. Cl.**
CPC ***H01L 27/3246*** (2013.01); *H01L 2227/323* (2013.01); ***H01L 51/5206*** (2013.01); ***H01L 27/3272*** (2013.01)

(57) **ABSTRACT**

An active matrix organic light-emitting diode (AMOLED) display panel is provided. The AMOLED display panel includes a display light-emitting region, a driving circuit region disposed below the display light-emitting region, and a fan-out region. An area of the driving circuit region is less than an area of the display light-emitting region, and the display light-emitting region completely covers the driving circuit region and at least a portion of the fan-out region. The AMOLED display panel saves a certain space for setting traces of the fan-out region by reducing an area of a lower edge region of the driving circuit region, so that a width of a lower side frame of the display panel is reduced.



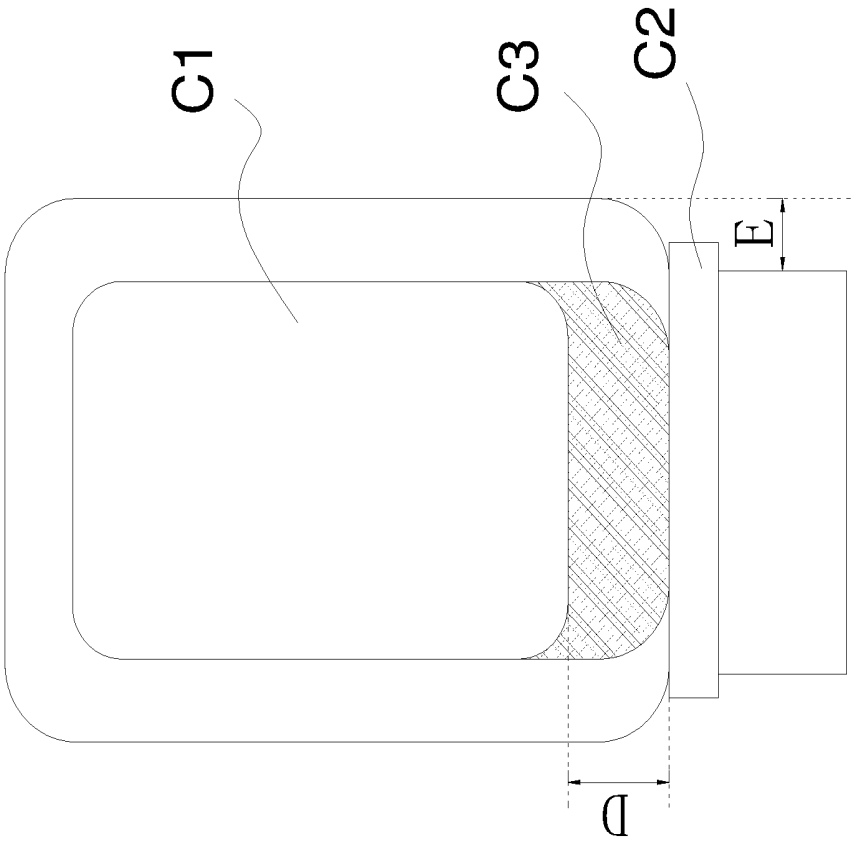


FIG. 1

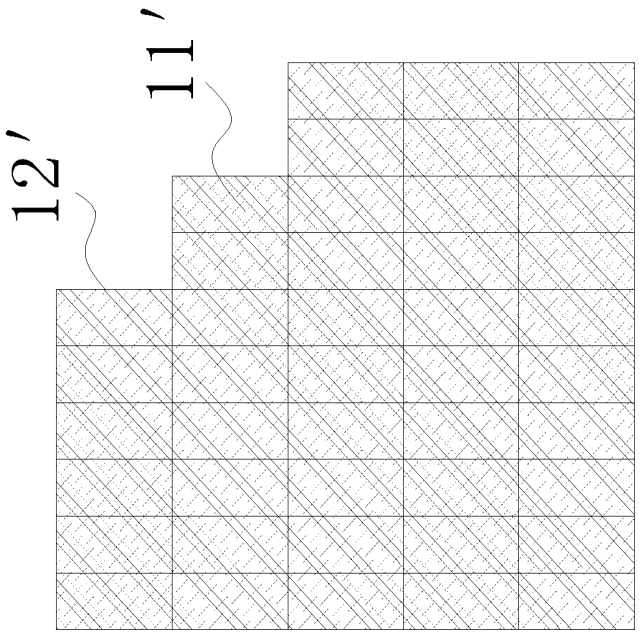


FIG. 2

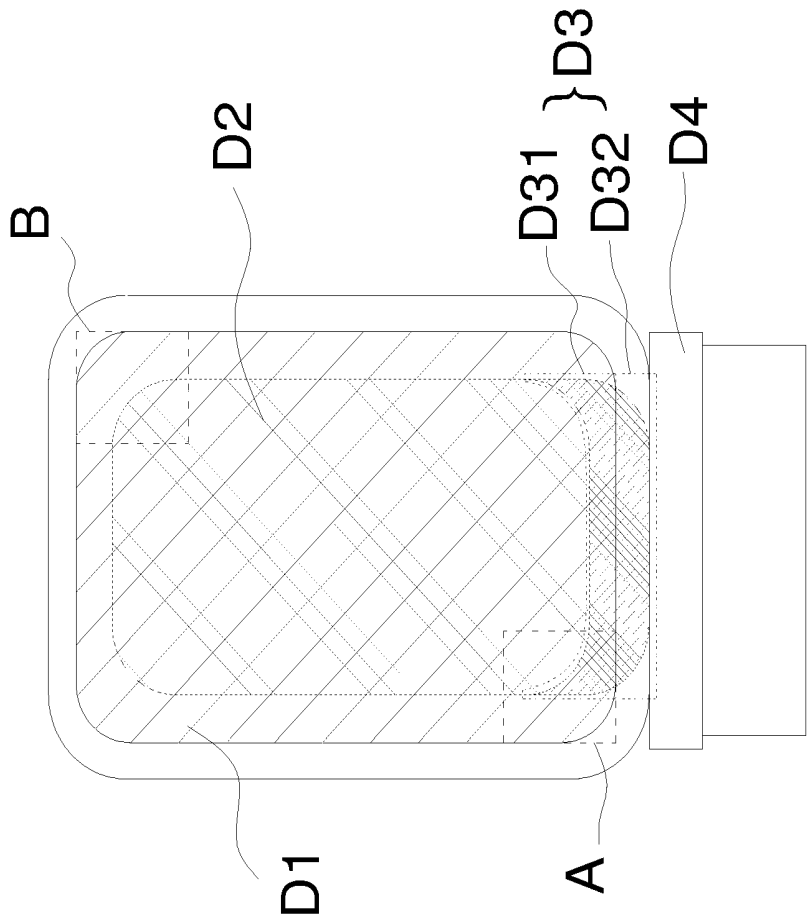


FIG. 3

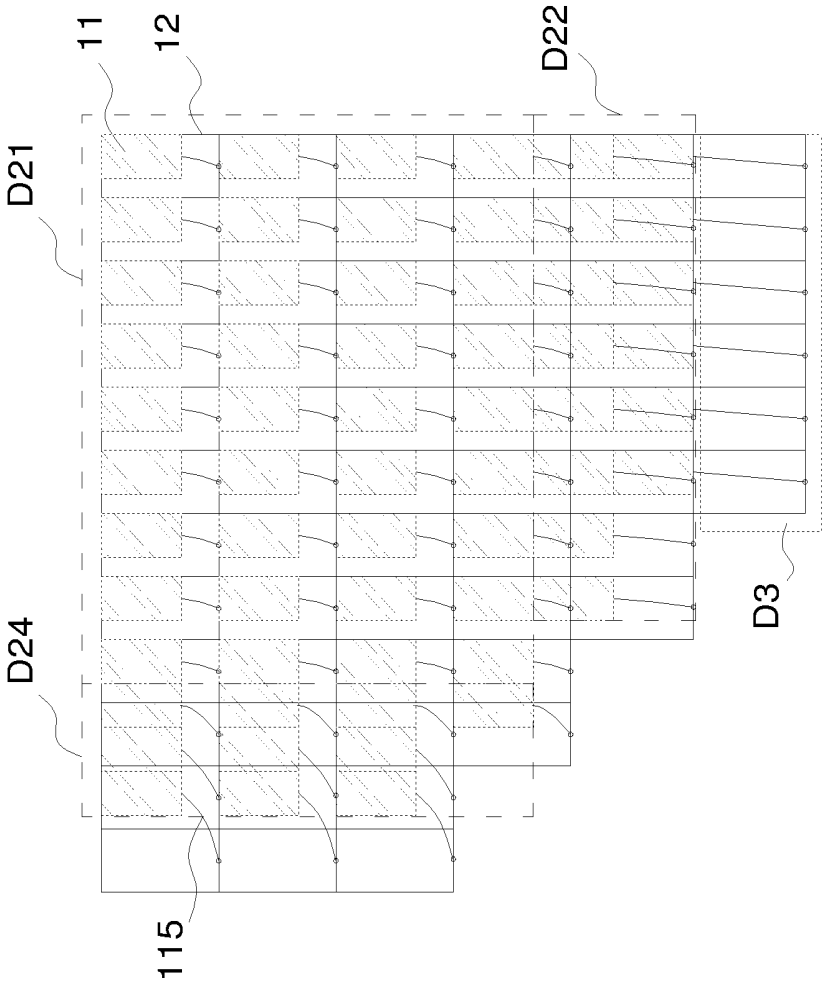


FIG. 4

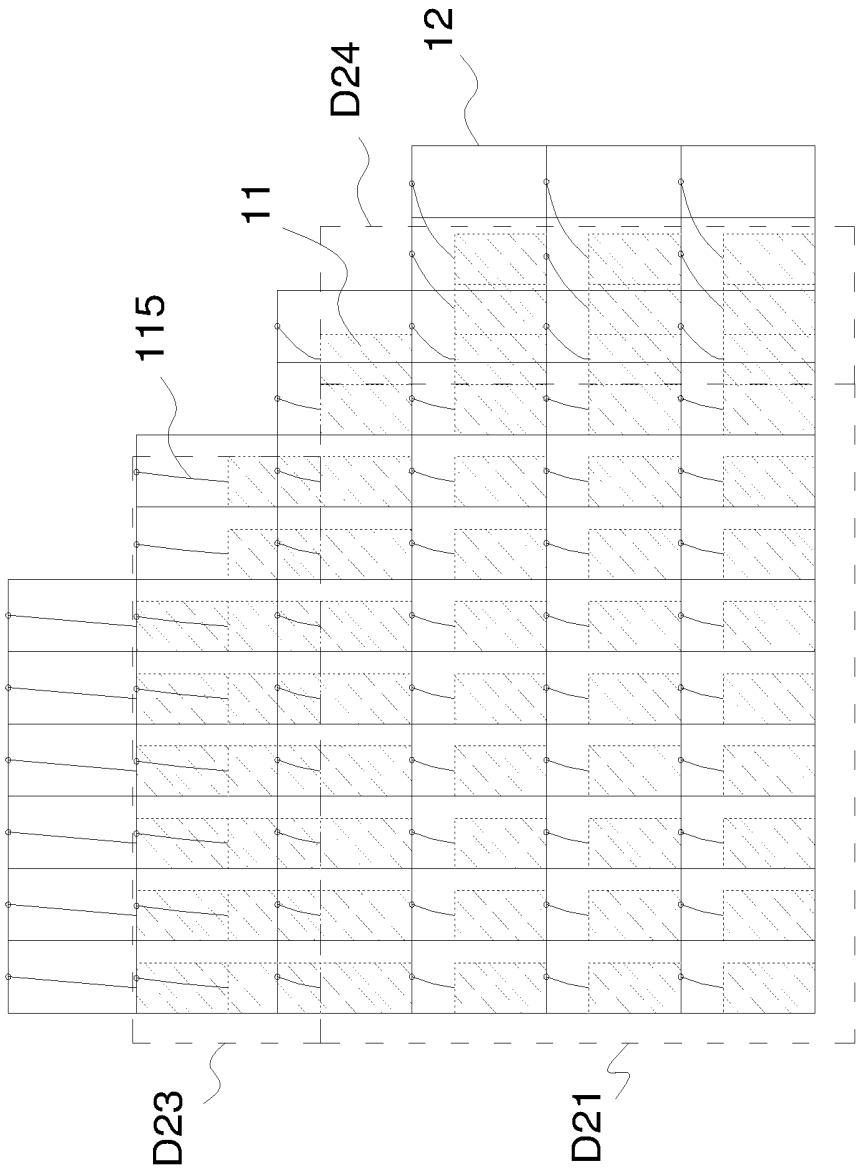


FIG. 5

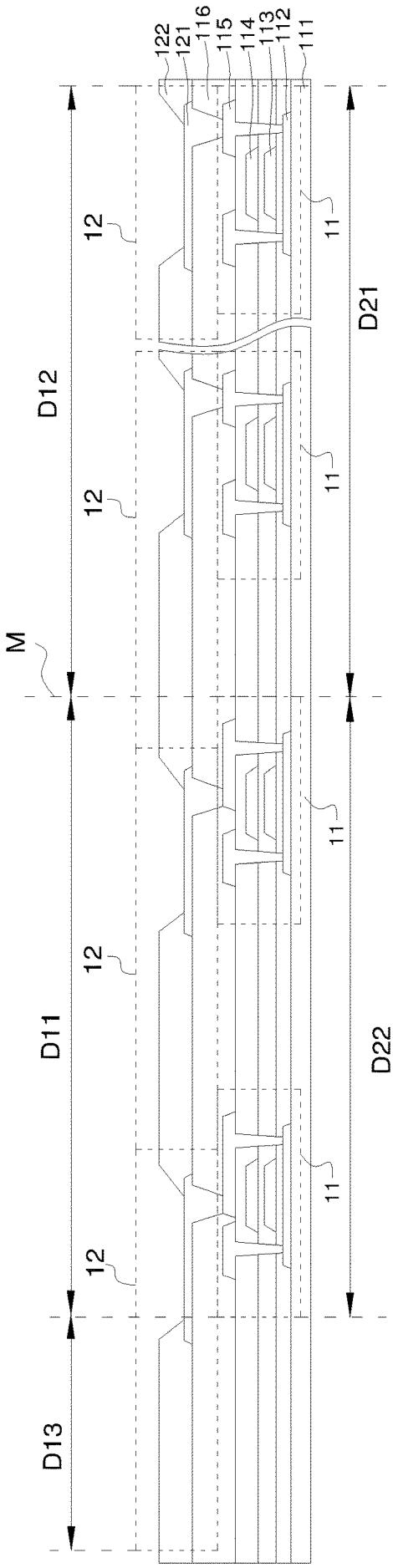


FIG. 6

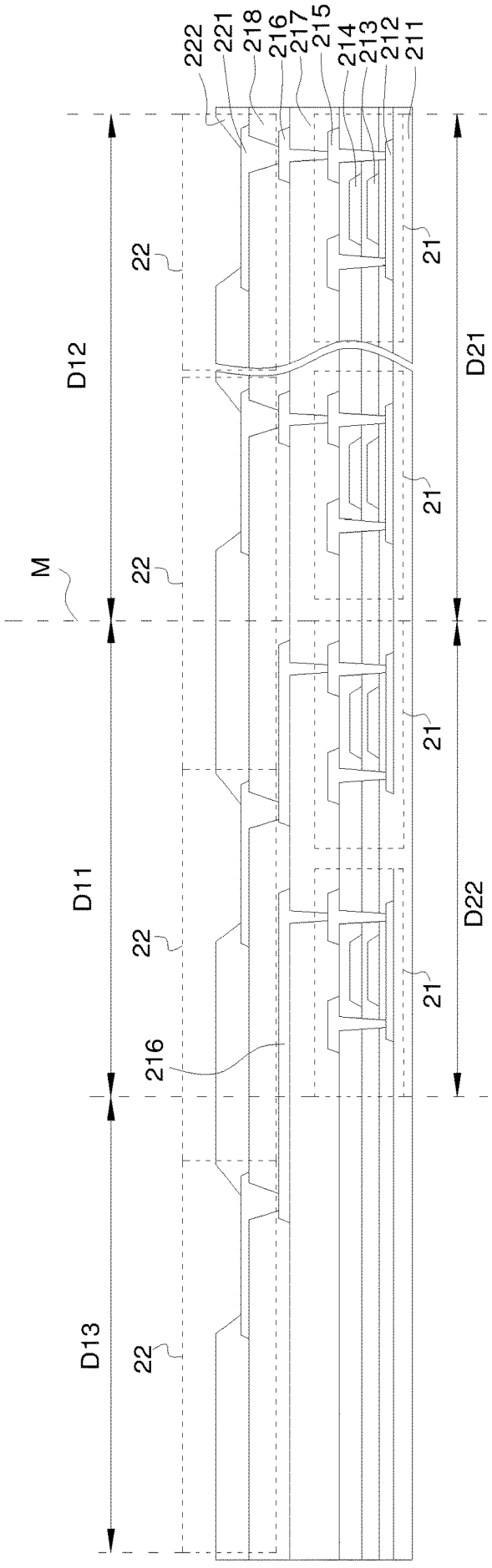

222
221
218
216
217
215
214
213
212
211
22
21
D12
D21
M
D11
D22
D13
216

FIG. 7

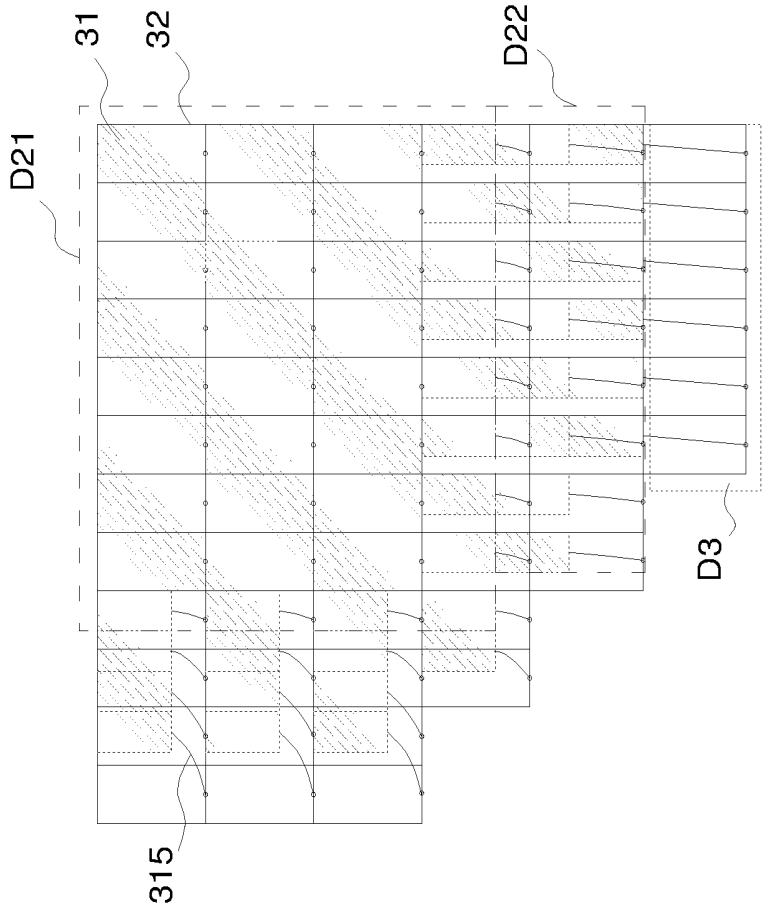


FIG. 8

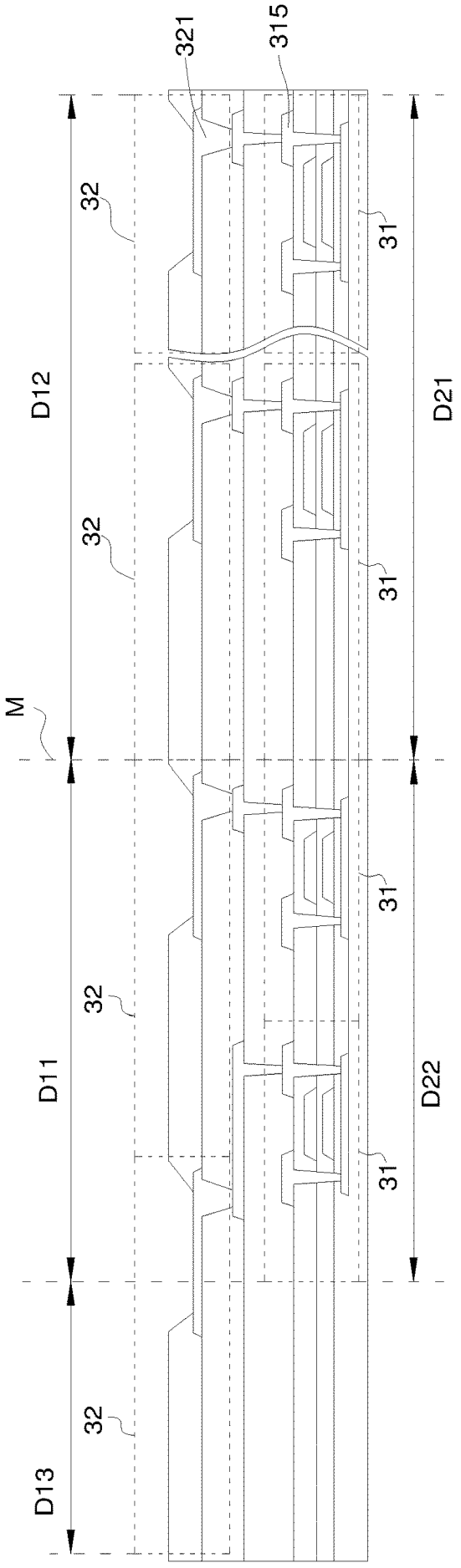


FIG. 9

ACTIVE MATRIX ORGANIC LIGHT-EMITTING DIODE DISPLAY PANEL

BACKGROUND OF INVENTION

Field of Invention

[0001] The present invention relates to a field of display technology, and more particularly, to an active matrix organic light-emitting diode (AMOLED) display panel.

Description of Prior Art

[0002] With the development of display industry technology, people are increasingly demanding high-quality display panels. For some high-end display panels, people will need to obtain narrow frame display panels.

[0003] With the development of flexible active matrix organic light-emitting diode (AMOLED) display panels, a new pad bending technology has been proposed for large lower frames of rigid panels. As shown in FIG. **1**, a chip on film (COF) is disposed on a bonding pad area (bonding area) or an ultra-thin chip on plastic (COP) is disposed on an IC (integrated circuit) bonding pad area, and both the bonding pad area and the IC bonding pad area are disposed below a display panel. A fanout trace connected to a data signal of a pixel circuit in an active area. The bonding pad area or the IC bonding pad area, the fanout trace, and some test circuit areas are bent below the panel, which can narrow the lower frames of original rigid display panels.

[0004] Referring to FIG. **1**, it is a schematic view of the existing flexible AMOLED display panel structure. In the existing display panels, in order to ensure a width called E value which is required for the panels having a curved edge, a distance called D value between the active area and a bending area (bending area C**2**) is still large due to a layout space of a fan-out region C**3** (a data line of the active area C**1** is fanned into a bending region, so that the E value and the D value are greater). In addition, a space is required for the bending area, so that the lower frame of the entire panel is still large.

[0005] As shown in FIG. **2**, the flexible AMOLED display panel includes a driving unit **11'** and a display unit **12'**. The driving unit **11'** corresponds to the display unit **12'**, and the driving unit **11'** and the display unit **12'** have a same size. Also, the driving unit **11'** and the display unit **12'** are disposed in a same area and connected to each other through via holes.

[0006] Therefore, it is necessary to provide a narrow frame AMOLED display panel to solve the above technical problems.

SUMMARY OF INVENTION

[0007] One embodiment of the present invention provides a narrow frame AMOLED display panel to solve the technical problem that a large width of lower frame of existing AMOLED display panel.

[0008] In one embodiment of the present invention, an active-matrix organic light-emitting diode (AMOLED) display panel comprises a driving circuit region for driving a display light-emitting region to emit light; a fan-out region for setting a fanout trace; and a display light-emitting region disposed above the driving circuit region and the fan-out region; wherein an area of the driving circuit region is less than an area of the display light-emitting region, and the display light-emitting region completely covers the driving circuit region and at least a portion of the fan-out region; the driving circuit region comprises a plurality of driving units, the display light-emitting region comprises a plurality of display units, each of the driving units is electrically connected to one of the display units, and an area of each of the driving units is less than an area of each of the display units; the driving circuit region comprises an intermediate region and a lower edge region disposed below the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed in the lower edge region; the display light-emitting region comprises a first display light-emitting region corresponding to the lower edge region and a third display light-emitting region corresponding to the fan-out region, and at least a portion of the driving units is electrically connected to the display units disposed in the third display light-emitting region; and the fan-out region is disposed at one side of the lower edge region, and the fan-out region comprises a first portion covered by the display light-emitting region and a second portion disposed outside the display light-emitting region.

[0009] The AMOLED display panel according to one embodiment of the present invention, each of the driving units comprises a driving thin film transistor for driving the display unit to emit light, and the driving thin film transistor comprises a source/drain and a planar layer disposed on the source/drain; each of the display units comprises an anode disposed on the planar layer and a pixel defining layer disposed on the anode, and the pixel defining layer is provided with an opening; the source/drain is electrically connected to the anode; the lower edge region comprises a first edge, and the first edge is disposed at a side of the lower edge region close to the intermediate region; and in one of the driving units disposed in the lower edge region and in one of the display units which is electrically connected to the one of driving units disposed in the lower edge region and located near the first edge, the source/drain of each the driving units is closer to the first edge in relative to the anode of each the display units.

[0010] The AMOLED display panel according to one embodiment of the present invention, a distance between the source/drain of each the driving units and the anode in the lower region is larger from a side near the first edge to another side away from the first edge.

[0011] The AMOLED display panel according to one embodiment of the present invention, a length of the source/drain of each the driving units electrically connected to the anode of each the display units disposed in the lower edge region is longer from a side near the first edge to another side away from the first edge.

[0012] The AMOLED display panel according to one embodiment of the present invention, each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, and the planar layer disposed on the source/drain; and the source/drain of the driving thin film transistor is electrically connected to the anode corresponding to the display unit through a via hole.

[0013] The AMOLED display panel according to one embodiment of the present invention, each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active

layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, the planar layer disposed on the source/drain, and a source/drain trace disposed on the planar layer; the source/drain of the driving thin film transistor is electrically connected to the anode of the corresponding display unit through the source/drain trace; and a length of the source/drain trace of another one of the driving units electrically connected to the anode of another one of the display units disposed in the lower edge region and away from the first edge is longer than a length of the source/drain trace of the one of the driving units near the first edge.

[0014] The AMOLED display panel according to one embodiment of the present invention, the driving circuit region further comprises two side edge regions disposed at both sides of the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed at each of the two side edge regions.

[0015] In another embodiment of the present invention, an active-matrix organic light-emitting diode (AMOLED) display panel comprises a driving circuit region for driving a display light-emitting region to emit light; a fan-out region for setting a fanout trace; and a display light-emitting region disposed above the driving circuit region and the fan-out region; wherein an area of the driving circuit region is less than an area of the display light-emitting region, and the display light-emitting region completely covers the driving circuit region and at least a portion of the fan-out region.

[0016] The AMOLED display panel according to one embodiment of the present invention, the driving circuit region comprises a plurality of driving units, the display light-emitting region comprises a plurality of display units, each of the driving units is electrically connected to one of the display units, and an area of each of the driving units is less than an area of each of the display units.

[0017] The driving circuit region comprises an intermediate region and a lower edge region disposed below the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed in the lower edge region, so that the area of lower edge of driving region is reduced.

[0018] The AMOLED display panel according to one embodiment of the present invention, each of driving units comprises a driving thin film transistor for driving the display unit emitting, and the driving thin film transistor comprises a source/drain and a planar layer disposed on the source/drain; each the display units comprises an anode disposed on the planar layer and a pixel defining layer disposed on the anode, and the pixel defining layer is provided with an opening; the source/drain is electrically connected to the anode; the display light-emitting region comprises a first display light-emitting region corresponding to the lower edge region and a third display light-emitting region corresponding to the fan-out region, and at least portion of the driving units is electrically connected to the display units disposed in the third display light-emitting region.

[0019] The AMOLED display panel according to one embodiment of the present invention, the lower edge region comprises a first edge, and the first edge is disposed at a side of the lower edge region close to the intermediate region; and in one of the driving units disposed in the lower edge region and in one of the display units which is electrically connected to the one of driving units disposed in the lower edge region and located near the first edge, the source/drain of each the driving units is closer to the first edge in relative to the anode of each the display units.

[0020] The AMOLED display panel according to one embodiment of the present invention, a distance between the source/drain of each the driving units and the anode in the lower edge region is larger from a side near the first edge to another side away from the first edge.

[0021] The AMOLED display panel according to one embodiment of the present invention, a length of each the source/drain of the driving units electrically connected to the anode of each the display units disposed in the lower edge region is longer from a side near the first edge to another side away from the first edge.

[0022] The AMOLED display panel according to one embodiment of the present invention, the fan-out region is disposed at one side of the lower edge region, and the fan-out region comprises a first portion covered by the display light-emitting region and a second portion disposed outside the display light-emitting region.

[0023] The AMOLED display panel according to one embodiment of the present invention, the driving circuit region further comprises an upper edge region disposed above the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed at the upper edge region, so that the area of upper edge of driving region is reduced.

[0024] The AMOLED display panel according to one embodiment of the present invention, the driving circuit region comprises two side edge regions disposed at both sides of the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed at the two side edge regions, so that the area of two side edge of driving regions is reduced.

[0025] The AMOLED display panel according to one embodiment of the present invention, the driving circuit region comprises a plurality of driving units, the display light-emitting region comprises a plurality of display units, each of the driving units is electrically connected to one of the display units; and the driving circuit region comprises an intermediate region and a lower edge region disposed below the intermediate region, and an area of each of the driving units disposed in the intermediate region is equal to an area of each of the display units disposed in the intermediate region, and an area of each of the driving units disposed in the lower edge region is less than an area of each of the display units disposed in the lower edge region.

[0026] The AMOLED display panel according to one embodiment of the present invention, each of driving units comprises a driving thin film transistor, and the driving thin film transistor comprises a source/drain and a planar layer disposed on the source/drain; each of the display units comprises an anode disposed on the planar layer and a pixel defining layer disposed on the anode, and the pixel defining layer is provided with an opening; the source/drain is electrically connected to the anode; the display light-emitting region comprises a first display light-emitting region corresponding to the lower edge region and a third display light-emitting region corresponding to the fan-out region,

and at least portion of the driving units is electrically connected to the display units disposed in the third display light-emitting region.

[0027] The AMOLED display panel according to one embodiment of the present invention, the lower edge region comprises a first edge, and the first edge is disposed at a side of the lower edge region close to the intermediate region; and in one of the driving units is disposed in the lower edge region and in one of the display units is electrically connected to the one of driving units disposed in the lower edge region and located near the first edge, the source/drain of each the driving units is closer to the first edge in relative to the anode of each the display units.

[0028] The AMOLED display panel according to one embodiment of the present invention, a distance between the source/drain of each the driving units and the anode in the lower edge region is larger from a side near the first edge to another side away from the first edge.

[0029] The AMOLED display panel according to one embodiment of the present invention, a length of the source/drain of each the driving units electrically connected to the anode of the display unit disposed in the lower edge region is longer from a side near the first edge to another side away from the first edge.

[0030] The AMOLED display panel according to one embodiment of the present invention, the fan-out region is disposed at one side of the lower edge region, and the fan-out region comprises a first portion covered by the display light-emitting region and a second portion disposed outside the display light-emitting region.

[0031] The AMOLED display panel according to one embodiment of the present invention, each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, the planar layer disposed on the source/drain, and the source/drain of the driving thin film transistor is electrically connected to the anode of the corresponding display unit through a via hole, and a trace of the fan-out region extends outwardly from a lower edge region of the drive circuit region.

[0032] The AMOLED display panel according to one embodiment of the present invention, each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, the planar layer disposed on the source/drain, and a source/drain trace is disposed on the planar layer; the source/drain of the driving thin film transistor is electrically connected to the anode of the corresponding to the display unit through the source/drain trace; and a length of the source/drain trace of another one of the driving units electrically connected to the anode of another one of the display units disposed in the lower edge region and away from the first edge is longer than a length of the source/drain trace of the one of the driving units near the first edge.

[0033] In the present invention, it should be noted that, when the pixels per inch (PPI) is less than 530, the area of the driving unit can be less than the area of the display unit electrically connected thereto in the current state of the art. Of course, with the development of level of technology, when the PPI is greater than or equal to 530, the above structure should be also achieved. Therefore, the PPI is not limited in the present invention.

[0034] As compared with the AMOLED display panel of the prior art, the AMOLED display panel of the present application reduces an occupied area of the lower edge region of the driving circuit region by keeping an area of the display light-emitting region, and the AMOLED display panel saves a certain space for setting a trace of the fan-out region, so that a width of a lower side frame of the display panel is reduced.

[0035] Furthermore, the occupied area of the upper edge region of the driving circuit region is reduced and thus an additional space is used for setting a source driving circuit or the VSS trace. Therefore, a width of an upper side frame of the display panel is reduced. Reducing area of two side edge regions of the driving circuit region and thus an additional space is used for setting a gate driving circuit or the VSS trace, and a width of frames of two sides of the display panel is reduced. Accordingly, a technical problem of the large width of the lower side frame of the existing AMOLED display panel is solved.

BRIEF DESCRIPTION OF DRAWINGS

[0036] In order to more clearly illustrate the embodiments of the present application or the technical solutions in the prior art, the drawings used in the embodiments will be briefly described below. The drawings in the following description are only partial embodiments of the present application, and those skilled in the art can obtain other drawings according to the drawings without any creative work.

[0037] FIG. **1** is a schematic structural view of an active matrix organic light-emitting diode (AMOLED) display panel of prior art.

[0038] FIG. **2** is a schematic structural view of a driving unit and a display unit of the prior art.

[0039] FIG. **3** is a schematic structural view of an AMOLED display panel according to a first embodiment of the present invention.

[0040] FIG. **4** is an enlarged view of A in FIG. **3**.

[0041] FIG. **5** is an enlarged view of B in FIG. **3**.

[0042] FIG. **6** is a schematic cross-sectional view of the AMOLED display panel showing an intermediate region, a driving unit disposed in the lower edge region, and a corresponding display unit according to the first embodiment of the present invention.

[0043] FIG. **7** is a schematic cross-sectional view of the AMOLED display panel showing an intermediate region, a driving unit disposed in the lower edge region, and a corresponding display unit according to a second embodiment of the present invention.

[0044] FIG. **8** is a schematic structural view of AMOLED display panel showing an arrangement of a driving unit and a display unit according to a third embodiment of the present invention.

[0045] FIG. **9** is a schematic cross-sectional view of the AMOLED display panel showing an intermediate region, a driving unit disposed in the lower edge region, and a corresponding display unit according to a third embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0046] Please refer to the drawings in the drawings, in which the same reference numerals represent the same components. The following description is based on the specific embodiments of the present invention as illustrated, and should not be construed as limiting the specific embodiments that are not described herein.

[0047] Referring to FIG. **3**, FIG. **3** is a schematic structural view of an AMOLED display panel according to a first embodiment of the present invention.

[0048] According to a first embodiment of the present invention, the AMOLED display panel comprises a driving circuit region D**2** for driving a display light-emitting region D**1** to emit light, a fan-out region D**3** for setting a fanout trace, the display light-emitting region D**1** disposed above the driving circuit region D**2** and the fan-out region D**3**, and a bending region D**4** for bending.

[0049] An area of the driving circuit region D**2** is less than an area of the display light-emitting region D**1**, and the display light-emitting region D**1** completely covers the driving circuit region D**2** and at least a portion of the fan-out region D**3**.

[0050] According to the first embodiment of the present invention, an area of a lower edge region of the driving circuit region D**2** is reduced by keeping an area of the display light-emitting region D**1**, and a certain space is saved for setting a trace of the fan-out region D**3**, so that a width of a lower side frame of the display panel is reduced.

[0051] Specifically, referring to FIG. **4**, the driving circuit region D**2** comprises a plurality of driving units **1**, the display light-emitting region D**1** comprises a plurality of display units **12**, each of the driving units **11** is electrically connected to one of the display units **12**, and an area of each of the driving units **11** is less than an area of each of the display units **12**, and an area of the circuit region D**2** is maximally compressed.

[0052] The driving circuit region D**2** comprises an intermediate region D**21** and a lower edge region D**22** disposed below the intermediate region D**21**, and a distance between each two of the driving units **11** disposed in the intermediate region D**21** is greater than a distance between each two of the driving units **11** disposed in the lower edge region D**22**, so that the area of the lower edge region D**22** is reduced.

[0053] In the first embodiment of the present invention, the area of the display light-emitting area D**1** is a sum of areas of orthographic projections of the plurality of display units **12** on the substrate **111**. The area of single display unit **12** is a sum of areas of orthographic projections of an opening of a pixel defining layer and a partial pixel defining layer disposed at one side of the opening on the substrate **111** (as shown in FIG. **6**). The area of the driving circuit region D**2** is a sum of the areas of the orthographic projections of the plurality of driving units **11** on the substrate **111**. The area of single driving unit **11** is an area occupied by the layout of a sub-pixel circuit, such as a sum of areas of the orthographic projections of 7T1C and 6T1C on the substrate. That is, the area of the single driving unit **11** is a sum of the areas of the orthographic projections of the 7T1C and 6T1C on the substrate. However, there is merely one driving thin film transistor shown in the embodiment of the present invention, and the area of the single driving unit comprises the driving thin film transistor and at least one switched thin film transistor that are well known to those skilled persons in the art and will not be described again. Each of the driving units **11** comprises a driving thin film transistor used for driving the display unit **12** to emit light and at least one switching thin film transistor (not shown) functioning as a switch.

[0054] The size of the driving unit **11** and the display unit **12** are designed differently, and the display unit **12** is designed according to the original panel size and resolution in the prior art, and the area of the driving unit **11** is reduced. That is, the area of the driving unit **11** is less than the area of the display unit **12**.

[0055] In addition, the arrangement distance of the driving unit **11** of the lower edge region D**22** is reduced, so that an occupied area of the lower edge region D**22** is reduced. Therefore, a certain space is saved for setting a trace of the fan-out region D**3**, and a width of a lower side frame of the display panel is reduced.

[0056] Each of the driving units **11** comprises the driving thin film transistor. The driving thin film transistor comprises a source/drain **115** and a planar layer **116** disposed on the source/drain **115**. Each of the display units **12** comprises an anode **121** disposed on the planar layer **116** and a pixel defining layer **122** disposed on the anode **121**, and the pixel defining layer **122** is provided with an opening. The source/drain **115** is electrically connected to the anode **121**.

[0057] The display light-emitting region D**1** comprises a first display light-emitting region D**11** corresponding to the lower edge region D**22**, a second display light-emitting region D**12** corresponding to the intermediate region D**21**, and a third display light-emitting region D**13** corresponding to the fan-out region D**3**. At least one of the driving units **11** disposed in the lower edge region D**22** is electrically connected to at least one the display unit **12** disposed in the third display light-emitting region D**13**.

[0058] The lower edge region D**22** includes a first edge M, and the first edge M is disposed at a side of the lower edge region D**22** close to the intermediate region D**21**.

[0059] One of the driving units **11** is disposed in the lower edge region D**22** and one of the display units **12** is electrically connected to the one of driving units **11** disposed in the lower edge region and located near the first edge M. The source/drain **115** of each of the driving units **11** is closer to the first edge M in relative to the anode **121** of each of the display units. Therefore, there is no driving unit below the third display light-emitting region D**13**, so that it is used for setting a trace of the fan-out region D**3**.

[0060] The above arrangement can reduce the area of the lower edge region D**22**, so that the width of the lower side frame of the display panel is reduced.

[0061] In addition, a distance between the source/drain **115** of each of the driving units **11** and each of the anodes **121** in the lower edge region is larger from a side near the first edge M to another side away from the first edge M. Therefore, it can maximize an area of the third display light-emitting region D**13**, so that fan-out traces can be disposed below the third display light-emitting region D**13** and a number of the fan-out traces be maximized.

[0062] The fan-out region D**3** is disposed at one side of the lower edge region D**22**, and the fan-out region D**3** comprises a first portion D**31** covered by the display light-emitting region D**1** and a second portion D**32** disposed outside the display light-emitting region D**1**. That is, the third display light-emitting region D**13** is correspondingly disposed above the first portion D**31** of the fan-out region D**3**.

[0063] Furthermore, referring to FIG. **5**, the driving circuit region D**2** further comprises an upper edge region D**23** disposed above the intermediate region D**21**, and a distance between each two of the driving units **11** disposed in the intermediate region D**21** is greater than a distance between each two of the driving units **11** disposed at the upper edge region D**23**. Therefore, an occupied area of the upper edge area D**23** is reduced.

[0064] The arrangement distance of the driving units **11** disposed in the upper edge region D**23** is reduced. That is, in the vertical space, the driving units **11** disposed in the upper edge region D**22** and the display units **12** which correspond to the driving units **11** are dislocated, and the driving units **11** disposed in the upper edge region D**23** are close to the intermediate region D**21**, so that the occupied area of the upper edge area D**23** is reduced. Therefore, an additional space is used for arranging a source driving circuit or a VSS trace, and the width of the upper side frame of the display panel is reduced.

[0065] Furthermore, referring to FIG. **4** and FIG. **5**, the driving circuit region D**2** comprises two side edge regions D**24** disposed at both sides of the intermediate region D**21**, and a distance between each two of the driving units **11** disposed in the intermediate region D**21** is greater than a distance between each two of the driving units **11** disposed at each of the two side edge regions D**24**. Therefore, an occupied area of the two side edge regions D**24** is reduced.

[0066] The arrangement distance of the driving units **11** disposed at two side edge regions of the driving circuit region D**2**. That is, in the vertical space, the driving units **11** disposed at two side edge regions D**24** and the display units **12** which correspond to the driving units **11** are dislocated, and the driving units **11** disposed at two side edge regions D**24** are close to the intermediate region D**21**, so that the occupied areas of the two side edge regions D**24** are reduced. Therefore, an additional space is used for arranging the gate driving circuit or the VSS trace, and a width of two side frame of the display panel is reduced.

[0067] In addition, in one embodiment of the present invention, the distance between each two of the driving units disposed in the intermediate region D**21** is not necessarily equal. For example, the distance between each two of the driving units disposed in the intermediate region D**21** can also be gradually reduced from a center to a peripheral edge. Therefore, an occupied area of the drive circuit region D**2** is further reduced.

[0068] Referring to FIG. **6**, in the first embodiment of the present invention, each of the driving thin film transistors comprises the substrate **111**, an active layer **112** disposed on the substrate **111**, a first gate **113** disposed on the active layer **112**, a second gate **114** disposed on the first gate **113**, the source/drain **115** disposed on the second gate **114**, and the planar layer **116** disposed on the source/drain **115**. A first insulating layer is disposed between the active layer **112** and the first gate **113**. A second insulating layer is disposed between the first gate **113** and the second gate **114**. An interlayer dielectric layer is disposed between the second gate **114** and the source/drain **115**.

[0069] Each of the display units **12** comprises the anode **121** disposed on the planar layer **116**, the pixel defining layer **122** disposed on the anode **121**, and an organic light-emitting layer (not shown).

[0070] The trace of the fan-out region D**3** and the first gate **113**, the second gate **114** or the source/drain **115** are disposed on the same layer. The trace of the fan-out region D**3** extends outward from the lower edge region of the driving circuit region D**2**.

[0071] In the first embodiment of the present invention, the driving units **11** disposed in the peripheral edge region of the driving circuit region D**2** and the display units **12** which are electrically connected to the driving units **11** are dislocated. That is, the source/drain **115** of each of the driving units **11** is dislocated in relative to the anode **121** near one side the first edge M, which results each of the driving units **11** not to be completely below the corresponding each of the display units **12**. When a space between the source/drain **115** is enough, a length of the source/drain **115** can be appropriately extended below the anode **121**. The driving units **11** disposed in the peripheral edge regions (upper, lower, and both side edge regions) of the driving circuit region D**2** are electrically connected to the display units **12** through via holes.

[0072] A length of the source/drain **115** of each of the driving units **11** electrically connected to the anode **121** of each of the display units **12** disposed in the lower edge region D**21** is longer from a side near the first edge M to another side away from the first edge M.

[0073] Referring to FIG. **7**, in a second embodiment of the present invention, the display light-emitting region D**1** comprises the first display light-emitting region D**11** corresponding to the lower edge region D**22**, the second display light-emitting region D**12** corresponding to the intermediate region D**21**, and the third display light-emitting region D**13** corresponding to the fan-out region D**3**. Each of the driving units **21** comprises the driving thin film transistor. The difference between the second embodiment and the first embodiment of the present invention is that the thin film transistor further comprises a substrate **211**, an active layer **212** disposed on the substrate **211**, a first gate **213** disposed on the active layer **212**, a second gate **214** disposed on the first gate **213**, the source/drain **215** disposed on the second gate **214**, and a planar layer **217** disposed on the source/drain **215**. A source/drain trace **216** is disposed on the planar layer **217**. A first insulating layer is disposed between the active layer **212** and the first gate **213**. A second insulating layer is disposed between the first gate **213** and the second gate **214**. An interlayer dielectric layer is disposed between the second gate **214** and the source/drain **215**. Another planar layer **218** is disposed between the source/drain **215** and the source/drain trace **216**.

[0074] Each of the display units **22** comprises an anode **221** disposed on the planar layer **218**, a pixel defining layer **222** disposed on the anode **221**, and an organic light-emitting layer (not shown).

[0075] The source/drain **215** of the driving thin film transistor is electrically connected to the anode **221** which corresponds to the display unit **22** through the source/drain trace **216**.

[0076] In the second embodiment of the present invention, the driving units **21** disposed in the peripheral edge region of the driving circuit region and the display units **22** which correspond to the driving units **21** are dislocated. That is, the source/drain **215** of each of the driving units **21** is dislocated in relative to the anode **221** near one side the first edge M, which results each of the driving units **21** not to be completely below the corresponding each of the display units **22**. When a space between the source/drain **215** is not enough, the driving units **21** disposed in the peripheral edge regions

(upper, lower, and both side edge regions) of the driving circuit region are electrically connected to the display units **22** through the source/drain traces **216**.

[0077] A length of the source/drain **216** of each of the driving unit **21** electrically connected to the anode **221** of each of the display units **22** disposed in the lower edge region D**21** is longer from a side near the first edge M to another side away from the first edge M.

[0078] The driving circuit region comprises the intermediate region D**21** and the lower edge region D**22** disposed below the intermediate region D**21**. In the intermediate region D**21**, an area of each of driving units **31** is equal to an area of each of display units **32**. In the lower edge region D**22**, the area of each of the driving units **31** is less than an area of each of the display units **32**.

[0079] The display light-emitting region D**1** comprises the first display light-emitting region D**11** corresponding to the lower edge region D**22**, the second display light-emitting region D**12** corresponding to the intermediate region D**21**, and the third display light-emitting region D**13** corresponding to the fan-out region D**3**. At least part of the driving unit **31** disposed in the lower edge region D**22** is electrically connected to the display unit **32** disposed in the third display light-emitting region D**13**.

[0080] The lower edge region D**22** includes the first edge M. The first edge M is disposed at a side of the lower edge region D**22** close to the intermediate region D**21**.

[0081] Each of the driving units **31** is disposed in the lower edge region D**22** and each of the display units **32** disposed in the lower edge region D**22** is electrically connected to the each of the driving units **31**. A source/drain **315** of each of the driving units **31** is dislocated in relative to the anode **321** near one side the first edge M. A space below the third display light-emitting region D**13** is used for setting a trace of the fan-out region D**3**. Therefore, an occupied area of the lower edge region D**22** is reduced so as to set the trace of the fan-out region D**3**.

[0082] The fan-out region is disposed at one side of the lower edge region D**22**, and the fan-out region D**3** comprises a first portion covered by the display light-emitting region and a second portion disposed outside the display light-emitting region.

[0083] As compared with the AMOLED display panel of the prior art, the AMOLED display panel of the present application reduces the occupied area of the lower edge region of the driving circuit region by keeping an area of the display light-emitting region, and the AMOLED display panel saves a certain space for setting a trace of the fan-out region, so that a width of a lower side frame of the display panel is reduced.

[0084] Furthermore, the occupied area of the upper edge region of the driving circuit region is reduced and thus an additional space is used for setting the source driving circuit or the VSS trace. Therefore, a width of an upper side frame of the display panel is reduced. Reducing area of two side edge regions of the driving circuit region and thus an additional space is used for setting a gate driving circuit or the VSS trace, and a width of frames of two sides of the display panel is reduced. Accordingly, a technical problem of the large width of the lower side frame of the existing AMOLED display panel is solved.

[0085] In the above, the present application has been described in the above preferred embodiments, but the preferred embodiments are not intended to limit the scope of the invention, and a person skilled in the art may make various modifications without departing from the spirit and scope of the application. The scope of the present application is determined by claims.

What is claimed is:

1. An active-matrix organic light-emitting diode (AMOLED) display panel, comprising:

a driving circuit region for driving a display light-emitting region to emit light;

a fan-out region for setting a fanout trace; and

a display light-emitting region disposed above the driving circuit region and the fan-out region;

wherein an area of the driving circuit region is less than an area of the display light-emitting region, and the display light-emitting region completely covers the driving circuit region and at least a portion of the fan-out region;

the driving circuit region comprises a plurality of driving units, the display light-emitting region comprises a plurality of display units, each of the driving units is electrically connected to one of the display units, and an area of each of the driving units is less than an area of each of the display units;

the driving circuit region comprises an intermediate region and a lower edge region disposed below the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed in the lower edge region;

the display light-emitting region comprises a first display light-emitting region corresponding to the lower edge region and a third display light-emitting region corresponding to the fan-out region, and at least a portion of the driving units is electrically connected to the display units disposed in the third display light-emitting region; and

the fan-out region is disposed at one side of the lower edge region, and the fan-out region comprises a first portion covered by the display light-emitting region and a second portion disposed outside the display light-emitting region.

2. The AMOLED display panel according to claim **1**, wherein each of the driving units comprises a driving thin film transistor for driving the display units to emit light, and the driving thin film transistor comprises a source/drain and a planar layer disposed on the source/drain;

each of the display units comprises an anode disposed on the planar layer and a pixel defining layer disposed on the anode, and the pixel defining layer is provided with an opening;

the source/drain is electrically connected to the anode;

the lower edge region comprises a first edge, and the first edge is disposed at a side of the lower edge region close to the intermediate region; and

in one of the driving units disposed in the lower edge region and in one of the display units which is electrically connected to each of the driving units disposed in the lower edge region and located near the first edge, the source/drain of each of the driving units is closer to the first edge in relative to the anode of the one of the display units.

3. The AMOLED display panel according to claim **2**, wherein a distance between the source/drain of each of the

driving units and the anode in the lower region is larger from a side near the first edge to another side away from the first edge.

4. The AMOLED display panel according to claim **2**, wherein a length of the source/drain of each of the driving units electrically connected to the anode of the display unit disposed in the lower edge region is longer from a side near the first edge to another side away from the first edge.

5. The AMOLED display panel according to claim **4**, wherein each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, and the planar layer disposed on the source/drain; and

the source/drain of the driving thin film transistor is electrically connected to the anode corresponding to the display unit through a via hole.

6. The AMOLED display panel according to claim **2**, wherein each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, the planar layer disposed on the source/drain, and a source/drain trace disposed on the planar layer;

the source/drain of the driving thin film transistor is electrically connected to the anode of the corresponding display unit through the source/drain trace; and

a length of the source/drain trace of another one of the driving units electrically connected to the anode of another one of the display units disposed in the lower edge region and away from the first edge is longer than a length of the source/drain trace of the one of the driving units near the first edge.

7. The AMOLED display panel according to claim **1**, wherein the driving circuit region further comprises two side edge regions disposed at both sides of the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two the driving units disposed at each of the two side edge regions.

8. An active-matrix organic light-emitting diode (AMOLED) display panel, comprising:

a driving circuit region for driving a display light-emitting region to emit light;

a fan-out region for setting a fanout trace; and

a display light-emitting region disposed above the driving circuit region and the fan-out region;

wherein an area of the driving circuit region is less than an area of the display light-emitting region, and the display light-emitting region completely covers the driving circuit region and at least a portion of the fan-out region.

9. The AMOLED display panel according to claim **8**, wherein the driving circuit region comprises a plurality of driving units, the display light-emitting region comprises a plurality of display units, each of the driving units is electrically connected to one of the display units, and an area of each of the driving units is less than an area of each of the display units.

10. The AMOLED display panel according to claim **8**, wherein the driving circuit region comprises a plurality of driving units, the display light-emitting region comprises a plurality of display units, each of the driving units is electrically connected to one of the display units; and

the driving circuit region comprises an intermediate region and a lower edge region disposed below the intermediate region, and an area of each of the driving units disposed in the intermediate region is equal to an area of each of the display units disposed in the intermediate region, and an area of each of the driving units disposed in the lower edge region is less than an area of each of the display units disposed in the lower edge region.

11. The AMOLED display panel according to claim **9**, wherein the driving circuit region comprises an intermediate region and a lower edge region disposed below the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed in the lower edge region.

12. The AMOLED display panel according to claim **11**, wherein the display light-emitting region comprises a first display light-emitting region corresponding to the lower edge region and a third display light-emitting region corresponding to the fan-out region, and at least a portion of the driving units is electrically connected to the display units disposed in the third display light-emitting region.

13. The AMOLED display panel according to claim **12**, wherein each of the driving units comprises a driving thin film transistor for driving the display units emitting, and the driving thin film transistor comprises a source/drain and a planar layer disposed on the source/drain;

each of the display units comprises an anode disposed on the planar layer and a pixel defining layer disposed on the anode, and the pixel defining layer is provided with an opening;

the source/drain is electrically connected to the anode;

the lower edge region comprises a first edge, and the first edge is disposed at a side of the lower edge region close to the intermediate region; and

one of the driving units is disposed in the lower edge region and one of the display units is electrically connected to the one of driving units disposed in the lower edge region and located near the first edge, the source/drain of each of the driving units is closer to the first edge in relative to the anode of each of the display units.

14. The AMOLED display panel according to claim **13**, wherein a distance between the source/drain of each of the driving units and the anode in the lower edge region is larger from a side near the first edge to another side away from the first edge.

15. The AMOLED display panel according to claim **13**, wherein a length of the source/drain of each of the driving units electrically connected to the anode of each of the display units disposed in the lower edge region is longer from a side near the first edge to another side away from the first edge.

16. The AMOLED display panel according to claim **15**, wherein each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, and the planar layer disposed on the source/drain; and

the source/drain of the driving thin film transistor is electrically connected to the anode of the corresponding display unit through a via hole.

17. The AMOLED display panel according to claim **13**, wherein each of the driving thin film transistors comprises a substrate, an active layer disposed on the substrate, a first gate disposed on the active layer, a second gate disposed on the first gate, the source/drain disposed on the second gate, the planar layer disposed on the source/drain, and a source/drain trace is disposed on the planar layer,

the source/drain of the driving thin film transistor is electrically connected to the anode of the corresponding to the display unit through the source/drain trace; and

a length of the source/drain trace of another one of the driving units electrically connected to the anode of another one of the display units disposed in the lower edge region and away from the first edge is longer than a length of the source/drain trace of the one of the driving units near the first edge.

18. The AMOLED display panel according to claim **11**, wherein the fan-out region is disposed at one side of the lower edge region, and the fan-out region comprises a first portion covered by the display light-emitting region and a second portion disposed outside the display light-emitting region.

19. The AMOLED display panel according to claim **11**, wherein the driving circuit region further comprises two side edge regions disposed at both sides of the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed at the two side edge regions.

20. The AMOLED display panel according to claim **11**, wherein the driving circuit region further comprises an upper edge region disposed above the intermediate region, and a distance between each two of the driving units disposed in the intermediate region is greater than a distance between each two of the driving units disposed at the upper edge region.

* * * * *

专利名称(译)	有源矩阵有机发光二极管显示屏		
公开(公告)号	US20200185467A1	公开(公告)日	2020-06-11
申请号	US16/330091	申请日	2018-12-29
[标]发明人	SUN LIANG WANG SHOUCHENG ZENG MIAN YI SHIJUAN		
发明人	SUN, LIANG WANG, SHOUCHENG ZENG, MIAN YI, SHIJUAN		
IPC分类号	H01L27/32 H01L51/52		
CPC分类号	H01L51/5206 H01L27/3246 H01L2227/323 H01L2251/5338 H01L27/3262 H01L27/326 G09G2380/02 H01L51/0097		
优先权	201811485917.X 2018-12-06 CN		
外部链接	Espacenet USPTO		

摘要(译)

提供了一种有源矩阵有机发光二极管（AMOLED）显示面板。 AMOLED显示面板包括显示发光区域，布置在显示发光区域下方的驱动电路区域以及扇出区域。 驱动电路区域的面积小于显示发光区域的面积，并且显示发光区域完全覆盖驱动电路区域和扇出区域的至少一部分。 通过减小驱动电路区域的下边缘区域的面积，AMOLED显示面板节省了用于设置扇出区域的迹线的一定空间，从而减小了显示面板的下侧框架的宽度。