US012133437B2

(12) **United States Patent**
Xu et al.

(10) **Patent No.: US 12,133,437 B2**
(45) **Date of Patent: Oct. 29, 2024**

(54) **DISPLAY PANEL AND DISPLAY DEVICE**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 394 days.

(21) Appl. No.: **17/694,068**

(22) Filed: **Mar. 14, 2022**

(65) **Prior Publication Data**

US 2022/0199710 A1 Jun. 23, 2022

Related U.S. Application Data

(63) Continuation of application No. PCT/CN2021/075340, filed on Feb. 4, 2021.

(30) **Foreign Application Priority Data**

Mar. 24, 2020 (CN) 202010214534.X

(51) **Int. Cl.**
H01L 33/00 (2010.01)
G06F 1/16 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H10K 59/353*** (2023.02); ***G06F 1/1637*** (2013.01); ***H10K 59/86*** (2023.02); *H04M 1/0266* (2013.01)

(58) **Field of Classification Search**
CPC H10K 59/353; H10K 59/86; H10K 59/121; H10K 59/131
(Continued)

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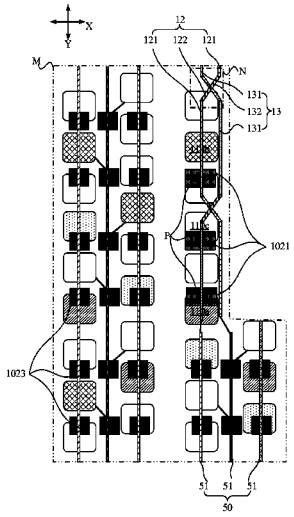
(74) *Attorney, Agent, or Firm* — Maier & Maier, PLLC

(57) **ABSTRACT**

A display panel and a display device. The display panel includes a first display area, a second display area and a transition display area between the first display area and the second display area. A light transmittance of the first display area is greater than a light transmittance of the second display area. The display panel includes a plurality of columns of first sub-pixels disposed in the transition display area arranged in a first direction, and each column of sub-pixels includes a plurality of first sub-pixels arranged in a second direction which intersects the first direction. A plurality of first pixel circuits corresponding to at least one column of first sub-pixels are distributed on a same column.

20 Claims, 8 Drawing Sheets



(51) **Int. Cl.**
H10K 59/35 (2023.01)
H10K 59/86 (2023.01)
H04M 1/02 (2006.01)

(58) **Field of Classification Search**
USPC 257/89
See application file for complete search history.

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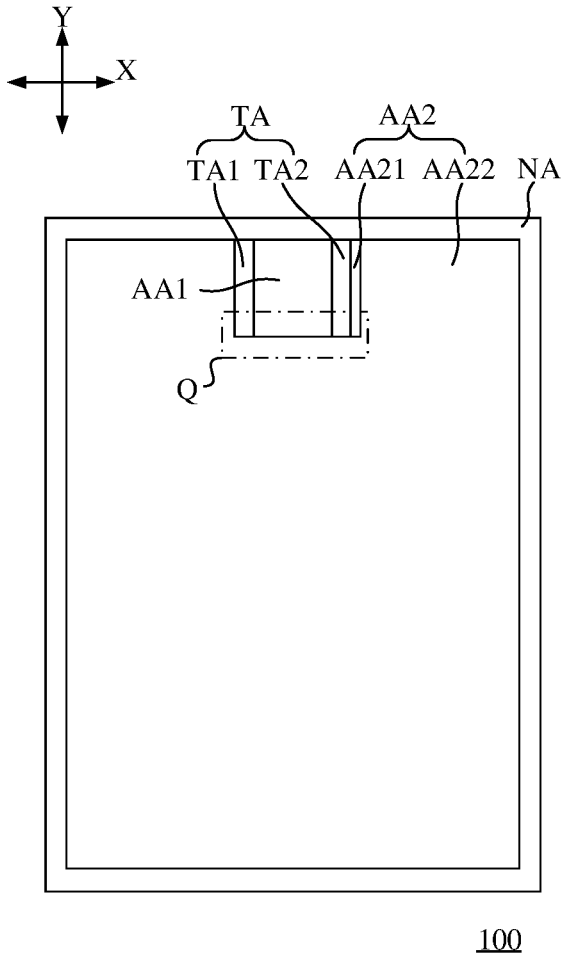
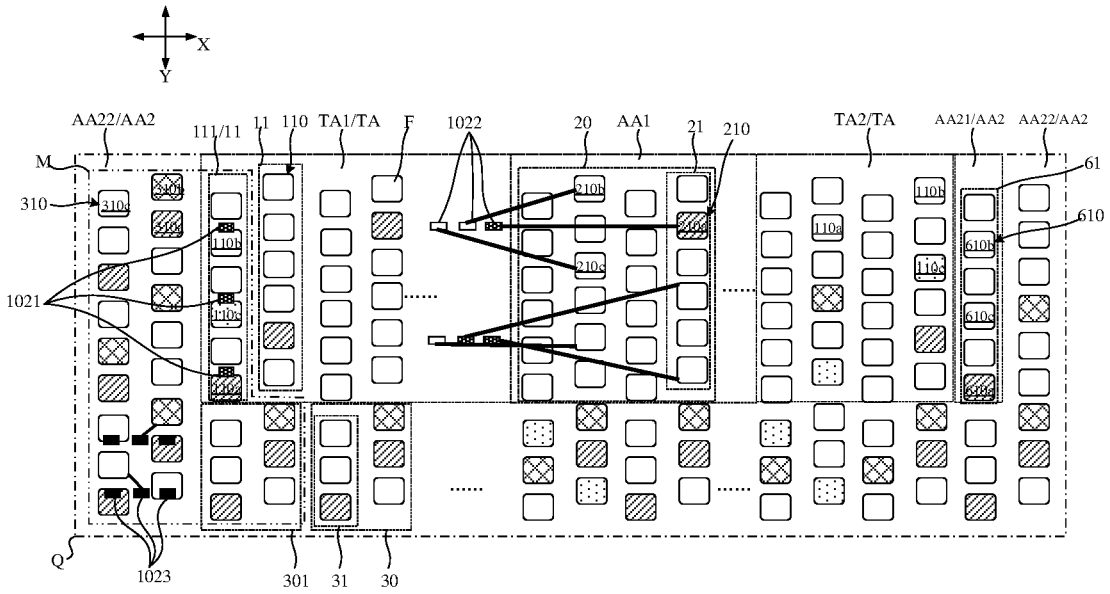


Fig. 1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Y
AA22/AA2
111/11
11
110
TA1/TA
F
1022
20
AA1
21
210
TA2/TA
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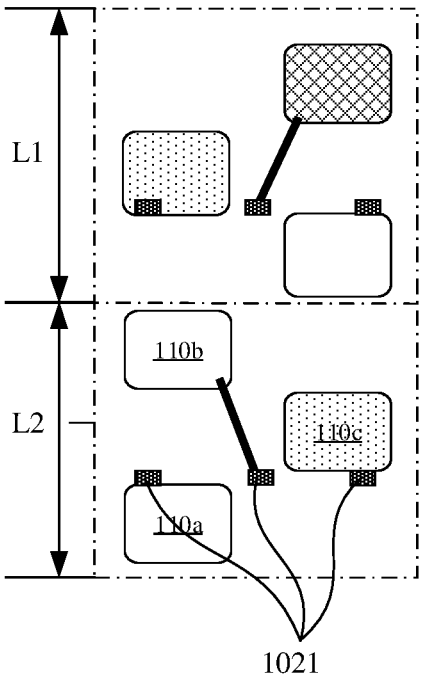
1021
61
610
Q
1023
301
31
30

Fig. 2


L1
L2
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110c
110a
1021

Fig. 3

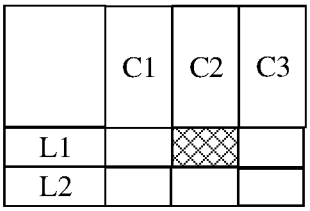
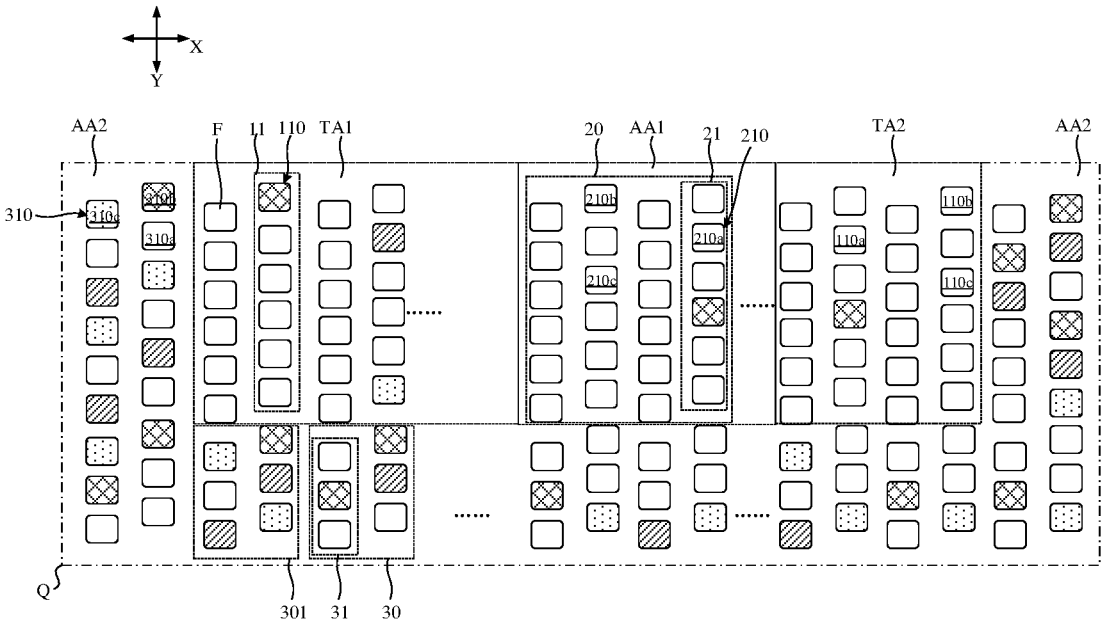

C1
C2
C3
L1
L2

Fig. 4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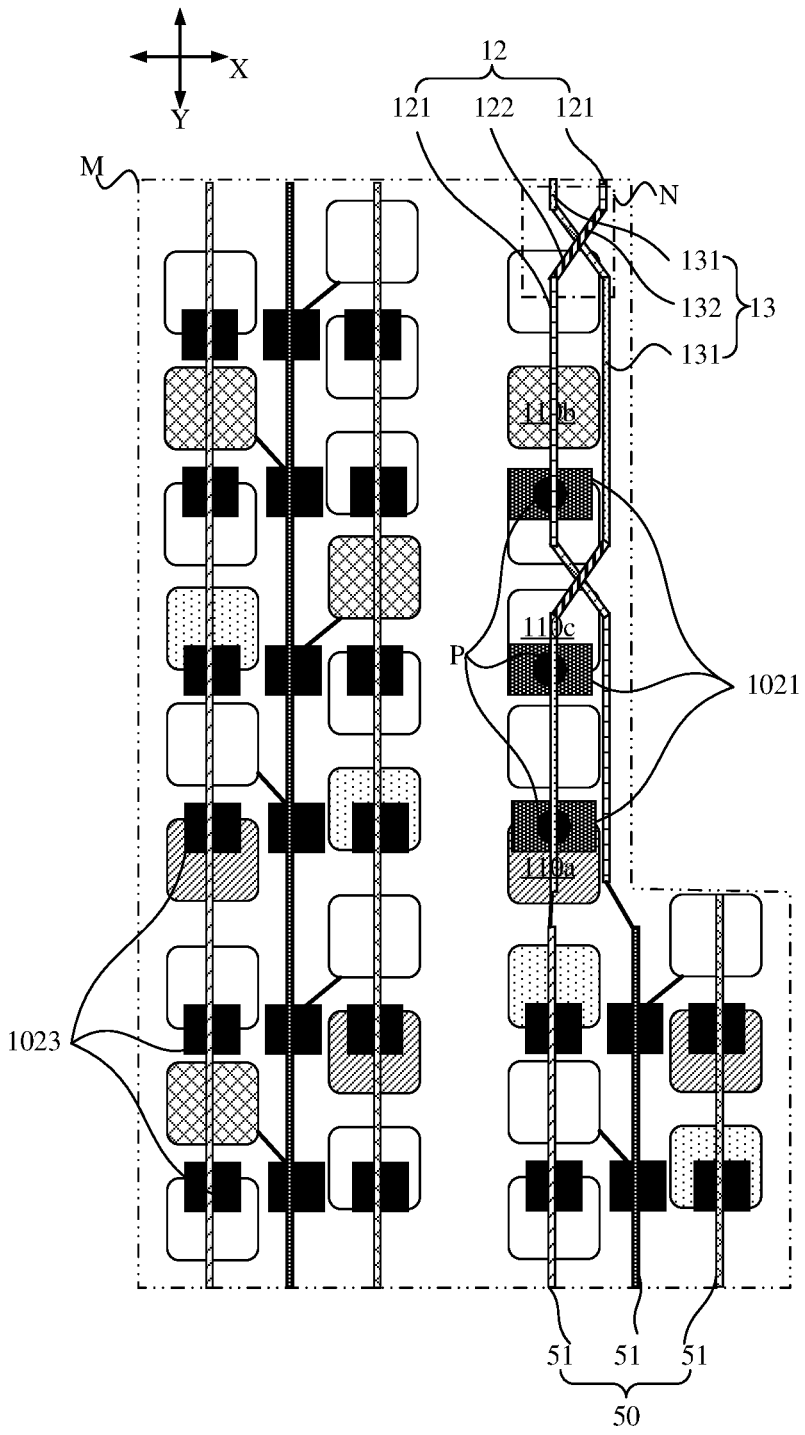
210c
210a
110b
110a
110c
Q
301
31
30

Fig. 5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121
122
121
M
N
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132
13
131
110b
110c
P
1021
110a
1023
51
51
51
50

Fig. 6

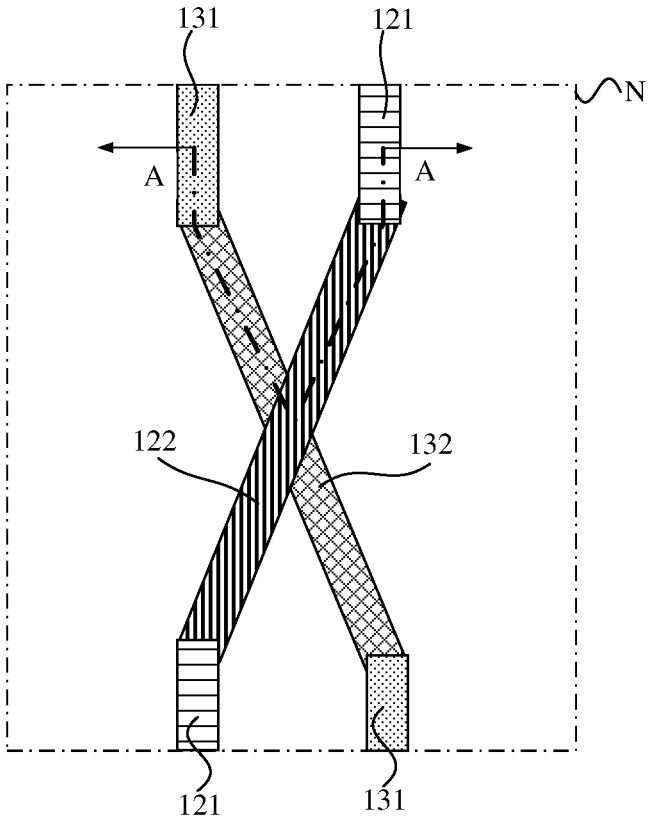


Fig. 7

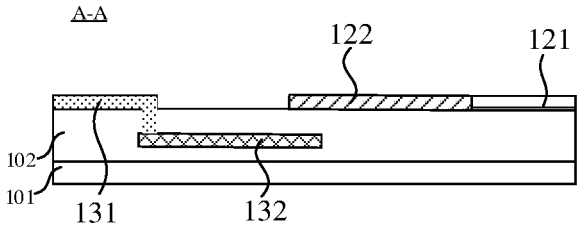


Fig. 8

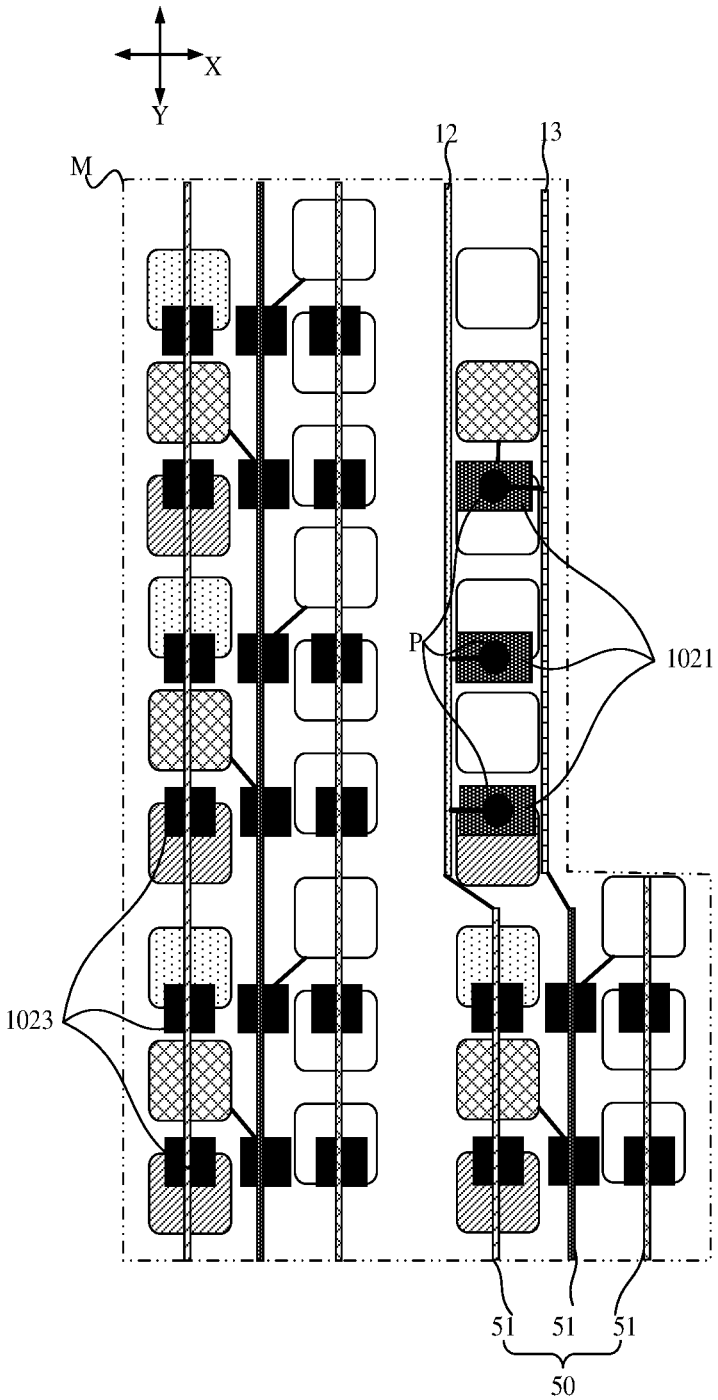
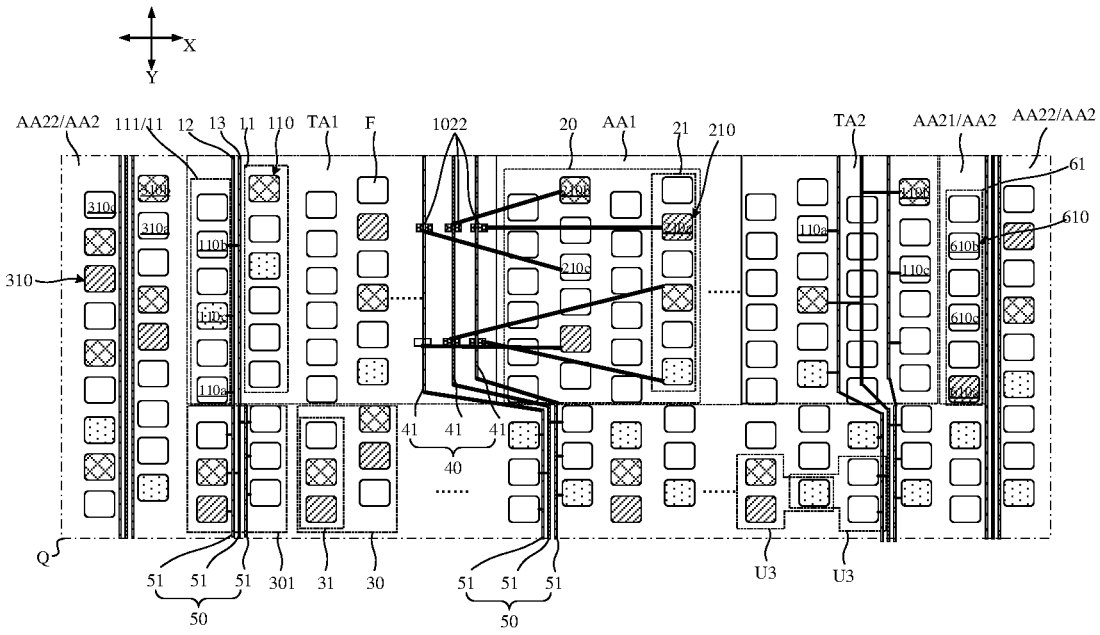


Fig. 9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610a
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U3
U3

Fig. 10

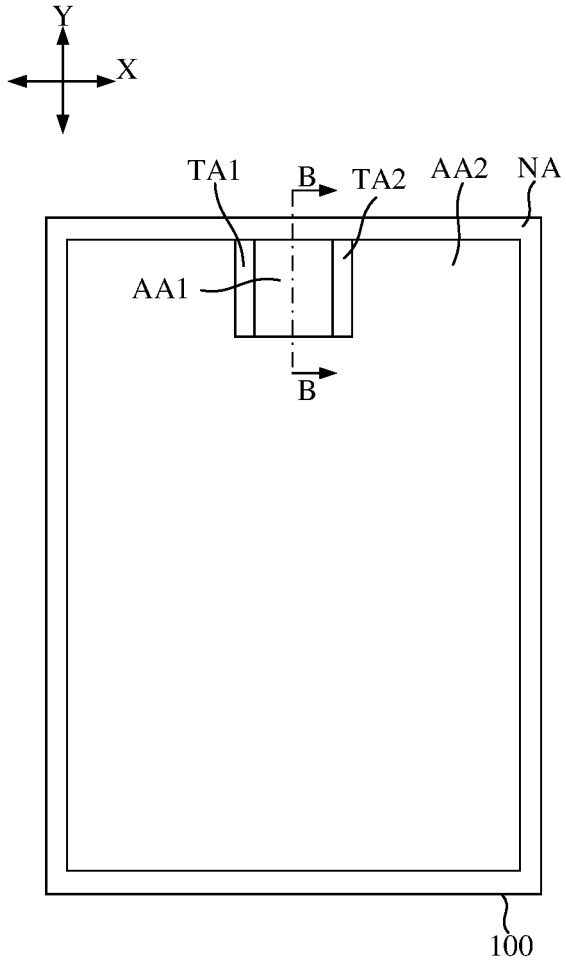

Fig. 11

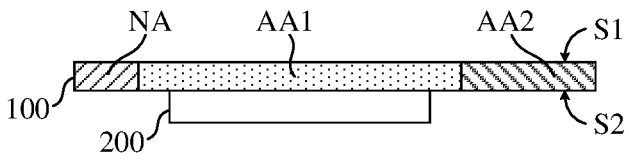

Fig. 12

DISPLAY PANEL AND DISPLAY DEVICE

CROSS REFERENCE TO RELATED APPLICATIONS

The application is a continuation of International Application No. PCT/CN2021/075340 filed on Feb. 4, 2021, which claims priority to Chinese patent application No. 202010214534.X, filed on Mar. 24, 2020 and titled with "Display Panel and Display Device", each of which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The application relates to the field of display, in particular to a display panel and a display device.

BACKGROUND

With rapid development of electronic devices, users have higher and higher requirements for a screen-to-body ratio, and thereby a full-screen display of an electronic device attracts more and more attention in the industry.

A traditional electronic device, such as a mobile phone, a tablet computer and the like, is required to integrate a front camera, an earphone and an infrared sensing element. Traditionally, a notch or a hole is formed in a display screen so that external light can arrive at photosensitive elements under the screen through the notch or the hole of the screen. However, such a display screen actually is not a full screen and cannot enable display in all areas of the entire screen, for example, an area corresponding to a front camera cannot display images.

SUMMARY

The embodiments provide a display panel and a display device, at least a part of an area of the display panel is light-transmittable and is available to display, which facilitates an under-screen integration of a photosensitive component. The embodiments provide a display panel, including a first display area, a second display area and a transition display area between the first display area and the second display area, wherein a light transmittance of the first display area is greater than a light transmittance of the second display area, wherein the display panel includes: a plurality columns of first sub-pixels disposed in the transition display area and arranged along a first direction, wherein each column of first sub-pixels includes a plurality of first sub-pixels arranged in a second direction which intersects the first direction, and a plurality of first pixel circuits corresponding to at least one column of first sub-pixels are distributed on a same column.

According to any one of foregoing implementations of the application, the display panel may include a device layer, and the device layer includes a first metal layer, a second metal layer and a third metal layer which are sequentially stacked and insulated from each other, wherein first line segments, first transition segments and second line segments are located in the third metal layer, and second transition segments are located in the first metal layer or the second metal layer.

The embodiments also provide a display device, including the display panel which is mentioned above.

According to the display panel of the embodiments of the application, a light transmittance of the first display area is greater than a light transmittance of the second display area, so that the display panel can be integrated with a photosensitive component on back of the first display area to realize an under-screen integration of a photosensitive component such as a camera, and meanwhile the first display area is available to display images to increase a display area of the display panel, thereby realizing a full-screen design of the display device.

According to the display panel of the embodiments of the application, the display panel includes a plurality of columns of first sub-pixels disposed in the transition display area, wherein each column of first sub-pixels includes a plurality of first sub-pixels arranged in a second direction which intersects the first direction, and a plurality of first pixel circuits corresponding to at least one column of first sub-pixels are distributed on a same column By arranging a plurality of first pixel circuits corresponding to at least one column of first sub-pixels on a same column, an area occupied by the first pixel circuits corresponding to the column of first sub-pixels can be reduced, and a occupied space in the transition display area can be reduced, and more sub-pixels can be arranged in the transition display area and/or the first display area to improve a display effect of the display panel in a condition that the transition display area has a certain area.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a schematic top view of a display panel according to an embodiment of the application;

FIG. **2** shows a partial enlarged view of an example of an area Q shown in FIG. **1**;

FIG. **3** shows a schematic distribution diagram of first sub-pixels and first pixel circuits according to a comparative example with respect to FIG. **2**;

FIG. **4** shows a schematic diagram of electrical driving corresponding to the first sub-pixels and the first pixel circuits in the example of FIG. **3**;

FIG. **5** shows a partial enlarged schematic top view of the area Q shown in FIG. **1** according to a comparative example with respect to FIG. **2**;

FIG. **6** shows a partial enlarged schematic diagram of an example of an area M shown in FIG. **2**;

FIG. **7** shows a partial enlarged schematic diagram of an example of an area N in shown FIG. **6**;

FIG. **8** shows a cross-sectional view of the example shown in FIG. **7** along a direction of A-A;

FIG. **9** shows a partial enlarged schematic diagram of another example of the area M shown in FIG. **2**;

FIG. **10** shows a partial enlarged view of another example of the area Q shown in FIG. **1**;

FIG. **11** shows a schematic top view of a display device according to an embodiment of the present application; and

FIG. **12** shows a cross-sectional view of the example shown in FIG. **11** along a direction of B-B.

DETAILED DESCRIPTION

The features and exemplary embodiments of various aspects of the application will be described in detail below. In order to make the purpose, technical solutions and advantages of the application clearer, the application will be described in detail with reference to the accompanying drawings and specific embodiments. It should be understood that the specific embodiments described herein are only intended to explain the application, but not to limit the application. For those skilled in the art, the application can be implemented without some of these specific details. The

following description of the embodiments is only to provide a better understanding of the application by showing examples of the application.

In an electronic device such as a mobile phone and a tablet computer, it is required to integrate a photosensitive component such as a front camera, an infrared light sensor and a proximity light sensor at a side of the electronic device where a display panel is disposed. In some embodiments, a light-transmittable display area can be disposed on the electronic device and the photosensitive component is disposed on back of the light-transmittable display area so as to realize a full-screen display of the electronic device while ensuring a normal operation of the photosensitive component.

In order to increase a light transmittance of the light-transmittable display area, a transition display area is generally disposed between the light-transmittable display area and a main display area, and pixel circuits for the light-transmittable display area are disposed in the transition display area. In this way, not only pixel circuits for the transition display area but also pixel circuits for the light-transmittable display area are disposed in the transition display area, leading to an insufficient space in the transition display area.

In order to solve the above-mentioned problem, the embodiments of the application provide a display panel and a display device. The embodiments of the display panel and the display device will be described below with reference to the accompanying drawings.

According to the embodiments of the application, there is provided a display panel, which may be an organic light emitting diode (Organic Light Emitting Diode, OLED) display panel.

FIG. **1** shows a schematic top view of a display panel according to an embodiment of the application, and FIG. **2** shows a partial enlarged view of an example of an area Q shown in FIG. **1**.

As shown in FIG. **1**, the display panel **100** includes a first display area AA**1**, a second display area AA**2**, a transition display area TA, and a non-display area NA. The transition display area TA is located between the first display area AA**1** and the second display area AA**2**. The non-display area NA surrounds the first display area AA**1**, the second display area AA**2** and the transition display area TA. A light transmittance of the first display area AA**1** is greater than a light transmittance of the second display area AA**2**.

Here, the light transmittance of the first display area AA**1** may be greater than or equal to 15%. In order to ensure that the light transmittance of the first display area AA**1** is greater than 15% or even 40% or even a higher light transmittance, at least a part of functional film layers of the display panel **100** in the embodiments may has a light transmittance greater than 80% or even 90%.

According to the display panel **100** of the embodiments of the application, the light transmittance of the first display area AA**1** is greater than the light transmittance of the second display area AA**2**, so that the display panel **100** can be integrated with a photosensitive component on back of the first display area AA**1** to realize an under-screen integration of a photosensitive component such as a camera, and meanwhile the first display area AA**1** is available to display images to increase a display area of the display panel **100**, thereby realizing a full-screen design of the display device.

The display panel **100** according to the embodiments of the application includes a plurality of columns **11** of first sub-pixels. The plurality of columns **11** of first sub-pixels are arranged in the transition display area TA and along a first direction X. Each column **11** of first sub-pixels includes a plurality of first sub-pixels **110** arranged in a second direction Y which intersects the first direction X, and a plurality of first pixel circuits **1021** corresponding to at least one column **11** of first sub-pixels are distributed on a same column.

In the embodiments of the application, the first direction X and the second direction Y intersect with each other. Optionally, one of the first direction X and the second direction Y may be a row direction of the display panel **100**, and the other one is a column direction which is perpendicular to the row direction, wherein the "row" and the "column" are interchangeable.

As shown in FIG. **2**, in the first direction X, the transition display area TA located at a left side of the first display area AA**1** includes a plurality of columns **11** of first sub-pixels. Illustratively, a plurality of first pixel circuits **1021** corresponding to one column **11** of first sub-pixels in the transition display area TA which is adjacent to the second display area AA**2** are arranged on a same column That is, in the second direction Y, the plurality of first pixel circuits **1021** corresponding to the column **11** of first sub-pixels occupy a space of only one column.

By arranging a plurality of first pixel circuits **1021** corresponding to at least one column **11** of first sub-pixels on a same column, an area occupied by the first pixel circuits **1021** corresponding to the column **11** of first sub-pixels is reduced, and an occupied space in the transition display area TA can be reduced, and more sub-pixels can be arranged in the transition display area TA and/or the first display area AA**1** in a condition that the transition display area TA has a certain area, to improve a display effect of the display panel.

In order to better understand that such arrangement that the plurality of first pixel circuits **1021** corresponding to the column **11** of first sub-pixels are arranged on a same column can achieve an effect of space saving, please refer to FIG. **3** and FIG. **4**. FIG. **3** shows two columns **11** of first sub-pixels, and each column **11** of first sub-pixels includes a plurality of first sub-pixels **110**. The plurality of first sub-pixels **110** correspond to a plurality of first pixel circuits **1021** in one-to-one correspondence. The label "first row (L**1**)" shown in FIG. **3** indicates a area for a connection between a scan line extending in the first row and the first pixel circuits **1021**. The label "second row (L**2**)" shown in FIG. **3** indicates a area for a connation between a scan line extending in the second row and the first pixel circuits **1021**. It can be clearly shown in FIG. **3** that the first pixel circuits **1021** corresponding to the plurality of first sub-pixels **110** are arranged in a matrix along the first direction X and the second direction Y.

In order to achieve that the first sub-pixels **110** which are adjacent to each other can be shared, adjacent first sub-pixels **110** which are electrically connected to a same scan line are generally provided with different colors. When the display panel **100** includes a plurality of first pixel circuits **1021**, the first pixel circuits **1021** respectively corresponding to a first sub-pixel **110***a* of a first color, a first sub-pixel **110***b* of a second color and a first sub-pixel **110***c* of a third color are arranged sequentially along the first direction X, so that adjacent first sub-pixels **110** can be shared.

In FIG. **4**, a first row is taken as an example for description. When first sub-pixels **110** in the first row are driven by a scan line, a first sub-pixel **110***c* of the third color in a first column, a first sub-pixel **110***b* of the second color in a second column and a first sub-pixel **110***a* of the first color in a third column forms a pixel unit.

As shown in FIGS. **3** and **4**, the first pixel circuits **1021** corresponding to one column **11** of first sub-pixels occupy a space of two columns. By arranging a plurality of first pixel circuits **1021** corresponding to at least one column of first sub-pixels on a same column, an effect of saving space can be achieved.

In some embodiments, please continue to refer to FIG. **2**, the transition display area TA includes a first transition display sub-area TA**1** and a second transition display sub-area TA**2**. In the first direction X, the first display area AA**1** is between the first transition display sub-area TA**1** and the second transition display sub-area TA**2**.

In order to blur a boundary between the first display area AA**1** and the second display area AA**2**, a sub-pixel distribution density corresponding to the first transition display sub-area TA**1** and a sub-pixel distribution density corresponding to the second transition display sub-area TA**2** may be respectively greater than or equal to a sub-pixel distribution density corresponding to the first display area AA**1**, and the sub-pixel distribution density corresponding to the first transition display sub-area TA**1** and the sub-pixel distribution density corresponding to the second transition display sub-area TA**2** may be respectively smaller than a sub-pixel distribution density corresponding to the second display area AA**2**.

Optionally, the sub-pixel distribution density corresponding to the first transition display sub-area TA**1** may be greater than the sub-pixel distribution density corresponding to the first display area AA**1**, and the sub-pixel distribution density corresponding to the second transition display sub-area TA**2** may be equal to the sub-pixel distribution density corresponding to the first display area AA**1**.

In order to better understand the effect of such arrangement that the sub-pixel distribution density corresponding to the first transition display sub-area TA**1** is greater than the sub-pixel distribution density corresponding to the first display area AA**1**, please refer to FIG. **5**. In FIG. **5**, the sub-pixel distribution density corresponding to the first transition display sub-area TA**1** is equal to the sub-pixel distribution density corresponding to the first display area AA**1**, and the sub-pixel distribution density corresponding to the first transition display sub-area TA**1** is smaller than the sub-pixel distribution density corresponding to the second display area AA**2**, thus a dark stripe is easily formed at a boundary between the second display area AA**2** with a higher pixel density and the first transition display sub-area TA**1** with a lower pixel density, the "pixel density" refers to PPI (Pixels Per Inch).

In order to blur the dark stripe, some first sub-pixels **110** capable of emitting light can be formed at positions occupied by one column of virtual sub-pixels F of the first transition display sub-area TA**1** which is adjacent to the second display area AA**2** in FIG. **5**, to obtain the first transition display sub-area TA**1** as shown in FIG. **2**. In FIG. **2**, the column of first sub-pixels **110** capable of emitting light is disposed in the first transition display sub-area TA**1** which is adjacent to the second display area AA**2**, so the dark stripe between the first transition display sub-area TA**1** and the second display area AA**2** can be blurred.

The virtual sub-pixels F can be understood that, under a rule of an arrangement of the sub-pixels, the virtual sub-pixels F occupy positions of real sub-pixels, that is, the positions occupied by the virtual sub-pixels F are non-light-emitting areas.

Compared with FIG. **5**, it can be understood that one sub-column **111** of first sub-pixels of the first transition display sub-area TA**1** which is adjacent to the second display area AA**2** in FIG. **2** is provided additionally. A plurality of first pixel circuits **1021** corresponding to the additionally provided sub-column **111** of first sub-pixels can be distributed on a same column That is, the plurality of first pixel circuits **1021** corresponding to the sub-column **111** of first sub-pixels in the first transition display sub-area TA**1** which is adjacent to the second display area AA**2** are distributed on a same column In this way, the sub-column **111** of first sub-pixels and their corresponding first pixel circuits **1021** can be additionally provided without increasing an area of the first transition display sub-area TA**1**.

In some embodiments, as shown in FIG. **2**, the sub-column **111** of first sub-pixels includes a plurality of first sub-pixels **110**, and the sub-column **111** of first sub-pixels may include first sub-pixels **110** of three colors, which include a first sub-pixel **110***a* of a first color, a first sub-pixel **110***b* of a second color and a first sub-pixel **110***c* of a third color. Exemplarily, the first sub-pixel **110***a* of the first color can emit red light, the first sub-pixel **110***b* of the second color can emit green light, and the first sub-pixel **110***c* of the third color can emit blue light.

As shown in FIG. **6**, the first sub-pixel **110***a* of the first color and the first sub-pixel **110***c* of the third color are electrically connected to a second signal line **13** through respective first pixel circuits **1021**, and the first sub-pixel **110***b* of the second color is electrically connected to a first signal line **12** through a first pixel circuit **1021**. In this way, each first sub-pixel **110** in the sub-column **111** of first sub-pixels can be shared with adjacent sub-pixels in the first direction X, thereby improving a display effect of the display panel.

Optionally, both the first signal line **12** and the second signal line **13** are data lines.

In some embodiments, please continue to refer to FIG. **6**, the first signal line **12** and the second signal line **13** are interweaved and extend along the second direction Y. Specifically, the first signal line **12** includes a plurality of first line segments **121** and a plurality of first transition segments **122** which are alternately distributed in the second direction Y. The first line segment **121** extends along the second direction Y. In the second direction Y, two adjacent first line segments **121** are located in different columns and are electrically connected by a first transition segment **122**. The second signal line **13** includes a plurality of second line segments **131** and a plurality of second transition segments **132** which are alternately distributed in the second direction Y. The second line segment **131** extends along the second direction Y. In the second direction Y, two adjacent second line segments **131** are located in different columns and are electrically connected by a second transition segment **123**. The first signal line **12** and the second signal line **13** can be insulated at a position where they are interweaved, so as to avoid crosstalk between the first signal line **12** and the second signal line **13**. By arranging the first signal line **12** and the second signal line **13** to be interweaved with each other and extend along the second direction Y, the first signal line **12** and the second signal line **13** can be arranged more closely, and the occupied space in the transition display area TA can be further reduced.

In some embodiments, in order to avoid crosstalk between the first signal line **12** and the second signal line **13**, the first line segments **121** and the first transition segments **122** may be arranged in a same layer, and the second line segments **131** and the second transition segments **132** may be arranged in different layers. Optionally, the first line segment **121** and the second line segment **131** which are adjacent to each other in the first direction X are arranged in a same layer and

arranged in parallel, and a projection of the first transition segment **122** corresponding to the first line segment **121** in a direction orthogonal to the display panel **100** intersects a projection of the second transition segment **132** corresponding to the second line segment **131** in a direction orthogonal to the display panel. That is, the first signal line **12** and the second signal line **13** are interweaved at the first transition segment **122** and the second transition segment **132**, and the first transition segment **122** and the second transition segment **132** are located in different layers to avoid direct interweaving of the first transition segment **122** and the second transition segment **132**.

Optionally, the first signal line **12** may be electrically connected to the first pixel circuits **1021** through the first line segments **121** at signal access points P. The second signal line **13** may be electrically connected to the first pixel circuits **1021** through the second line segments **131** at signal access points P. By using the first line segments **121** and the second line segments **131** which are not interweaved to electrically connect to corresponding first pixel circuits **1021**, a possibility of interference between the first signal line **12** and the second signal line **13** can be reduced. As shown in FIG. **6**, the first line segments **121** of the first signal line **12** and the second line segments **131** of the second signal line **13** directly pass through various signal access points P in their respective extending directions, without requiring additional wirings to connect the first line segments **121** and the second line segments **131** to corresponding signal access points P.

In some embodiments, the first line segments **121** and the first transition segments **122** may be arranged in a same layer, and the second line segments **131** and the second transition segments **132** may be arranged in different layers. Further, the first line segments **121**, the first transition segments **122** and the second line segments **131** may be disposed in a same layer, and the second transition segments **132** are disposed in a different layer from the first line segments **121**, the first transition segments **122** and the second line segments **131**. As shown in FIGS. **7** and **8**, the display panel **100** may include a device layer **102**, and the device layer **102** may include a first metal layer, a second metal layer and a third metal layer sequentially stacked and insulated from each other. The first line segments **121**, the first transition segments **122** and the second line segments **131** may be disposed in the third metal layer, and the second transition segments **132** may be disposed in the first metal layer or the second metal layer. A second line segment **131** may be connected to a corresponding second transition segment **132** through a through-hole. In this way, during a manufacturing process, the first line segments **121**, the first transition segments **122**, and the second line segments **131** can be formed at the same time, which can simplify the manufacturing process.

Exemplarily, the device layer **102** may be provided on a substrate **101**. The substrate **101** may be made of light-transmittable materials such as glass and polyimide (PI). The pixel circuits used to drive sub-pixels of respective display areas to display and signal lines electrically connected to the pixel circuits may be provided in the device layer **102**.

In some embodiments, referring to FIG. **9**, the first signal line **12** and the second signal line **13** may extend along the second direction Y and be arranged in parallel. With this arrangement, a mutual interference between the first signal line **12** and the second signal line **13** can be better avoided. Optionally, the first signal line **12** and the second signal line **13** may be disposed in a same layer. Exemplarily, the first signal line **12** and the second signal line **13** may be disposed in the third metal layer of the device layer **102**. In this way, during a manufacturing process, the first signal line **12** and the second signal line **13** can be formed at the same time, which can reduce complexity of the manufacturing process.

In some embodiments, please refer to FIG. **6** or FIG. **7** and FIG. **10**, the display panel includes a plurality of second units **30** and a plurality of second line groups **50** in the second display area AA**2**. The second units **30** refers to a miniaturized unit which is arranged repeatively, the second line group **50** refers to a miniaturized line group which is arranged repeatively. FIG. **6**, FIG. **7** and FIG. **10** show schematic diagrams of electrical connections between various signal lines and various sub-pixels, which do not indicate a specific location of a signal line.

The plurality of second units **30** are arranged along the first direction X in the second display area AA**2**, and each of the second units **30** includes at least two columns **31** of third sub-pixels arranged along the first direction X, and each column **31** of third sub-pixels includes a plurality of third sub-pixels **310** arranged along the second direction Y. The plurality of second line groups **50** are arranged along the first direction X in the second display area AA**2**, and each of the second line groups **50** includes at least two fourth signal lines **51** arranged along the first direction X, and the fourth signal line **51** extends along the second direction Y. The at least two fourth signal lines **51** in each of second line groups **50** are matched and electrically connected with a plurality of third sub-pixels **310** of a corresponding second unit **30** through third pixel circuits **1023**.

In the display panel **100** according to the embodiments of the application, the second line groups **50** are repeatedly arranged, so that adjacent second line groups **50** can share a fourth signal line **51** with each other to satisfy a sharing of a third sub-pixel **310**.

Exemplarily, each column **31** of third sub-pixels may include three third sub-pixels **310**, which are respectively a third sub-pixel **310***a* of a first-color, a third sub-pixel **310***b* of a second color and a third sub-pixel **310***c* of a third color. The third sub-pixel **310***a* of the first color can emit red light, the third sub-pixel **310***b* of the second color can emit green light, and the third sub-pixel **310***c* of the third color can emit blue light. Six third sub-pixels **310** in each second unit **30** can form two third pixel units U**3**, and third sub-pixels **310** in adjacent second units **30** may be shared to form a third pixel unit U**3**. In this way, the PPI of the second display area AA**2** can be increased, and the display effect of the display panel can thus be improved.

The second unit **30** includes a second sub-unit **301** which is adjacent to the sub-column **111** of first sub pixels in the second direction Y, and the first signal line **12** and the second signal line **13** are electrically connected with the two fourth signal lines **51** matched with the second sub-unit **301** in one-to-one correspondence.

As described above, with respect to FIG. **5**, in order to blur the dark stripe between the first transition display sub-area TA**1** and the second display area AA**2**, it can be understood that the sub-column **111** of first sub-pixels is provided additionally. By electrically connecting the first signal line **12** and the second signal line **13** with the two fourth signal lines **51** matched with the second sub-unit **301** in one-to-one correspondence, the first sub-pixels **110** in the sub-column **111** of first sub-pixels may have the same brightness as that of the third sub-pixels **310** in the second display area AA**2**, which further blurs the dark stripe between the first transition display sub-area TA**1** and the second display area AA**2**.

In some embodiments, in order to transmit a stable electrical signal to corresponding first sub-pixels **110** and third sub-pixels **310** through the electrically connected first signal line **12** and the fourth signal line **51**, the first sub-pixels **110** and the third sub-pixels **310** respectively connected with the first signal line **12** and the fourth signal line **51** (which are electrically connected with each other) may have the same color. Similarly, the first sub-pixels **110** and the third sub-pixels **310** respectively connected with the second signal line **13** and the fourth signal line **51** (which are electrically connected with each other) may have the same color. For example, the second signal line **13** is electrically connected to a first sub-pixel **110***a* of a first color and a first sub-pixel **110***c* of a third color, and the fourth signal line **51** which is electrically connected with the second signal line **13** can be electrically connected to a third sub-pixel **310***a* of the first color and a third sub-pixel **310***c* of the third color; the first signal line **12** is electrically connected to a first sub-pixel **110***b* of a second color, and the fourth signal line **51** that is electrically connected with the first signal line **12** can be electrically connected to a third sub-pixel **310***b* of the second color. Through the above arrangement, the first signal line **12** and the fourth signal line **51** which are electrically connected to each other can drive sub-pixels of the same display color, and the second signal line **13** and the fourth signal line **51** which are electrically connected to each other can drive sub-pixels of the same display color, thereby improving the display effect.

In some embodiments, please continue to refer to FIG. **10**, display panel includes a plurality of first units **20** in the first display area AA**1**, and the display panel includes a plurality of first line groups **40** in the transition display area TA. The first units **20** refers to a miniaturized unit which is arranged repeatively, the first line group **40** refers to a miniaturized line group which is arranged repeatively

The plurality of first units **20** are arranged along the first direction X in the first display area AA**1**, and each of the first unit **20** includes at least two columns **21** of second sub-pixels arranged along the first direction X, and each column **21** of second sub-pixels includes a plurality of second sub-pixels **210** arranged along the second direction Y. The plurality of first line groups **40** are arranged along the first direction X in the transition display area TA, and each of the first line groups **40** includes at least two third signal lines **41** arranged along the first direction X, and the third signal line extends along the second direction Y. The at least two third signal lines **41** in each of the first line groups **40** are matched and electrically connected with a plurality of second sub-pixels **210** of a corresponding one of the first units **20** through second pixel circuits **1022** in the transition display area TA.

The third signal lines **41** in the plurality of first line groups **40** are selectively electrically connected with the fourth signal lines **51** in the plurality of second line groups **50** other than the fourth signal lines **51** matched with the second sub-unit **301**.

In the display panel **100** according to the embodiments of the application, the first line groups **40** are repeatedly arranged, so that the third signal lines **41** in adjacent first line groups **40** can be shared with each other, to satisfy a sharing of the second sub-pixels **210**. Since the third signal lines **41** in the plurality of first line groups **40** are selectively electrically connected with the fourth signal line **51** in the plurality of second line groups **50** other than the fourth signal lines **51** matched with the second sub-unit **301**, the fourth signal lines **51** and the third signal lines **41** which are connected with each other can be formed synchronously, and on the other hand, the number of third signal lines **41** can be reduced, so that the light transmittance of the first display area AA**1** can be effectively increased, a photosensitive component **200** can be integrated on back of the display panel **100**, a under-screen integration of a photosensitive component **200** such as a camera can be realized.

Exemplarily, each column **21** of second sub-pixels may include three second sub-pixels **210**, which are respectively a second sub-pixel **210***a* of a first color, a second sub-pixel **210***b* of a second color and a second sub-pixel **210***c* of a third color. The second sub-pixel **210***a* of the first color can emit red light, the second sub-pixel **210***b* of the second color can emit green light, and the second sub-pixel **210***c* of the third color can emit blue light. Six second sub-pixels **210** in each first unit **20** can form two second pixel units, and the second sub-pixels **210** in adjacent first units **20** may be shared to form a second pixel unit. In this way, the PPI of the first display area AA**1** can be increased, and the display effect of the display panel can thus be improved.

In the embodiments of the application, in order to increase the light transmittance of the first display area AA**1**, the third signal lines **41** and the second pixel circuits **1022** corresponding to the second sub-pixels **210** in the first display area AA**1** are all disposed in the transition display area TA. Exemplarily, in the first direction X, all of the third signal lines **41** and the second pixel circuits **1022** corresponding to the second sub-pixels **210** which are close to the first transition display sub-area TA**1** can be disposed in the first transition display sub-area TA**1**. Exemplarily, in the first direction X, all of the third signal lines **41** and the second pixel circuits **1022** corresponding to the second sub-pixels **210** which are close to the second transition display sub-area TA**2** can be disposed in the second transition display sub-area TA**2**.

In order to simplify arrangement of the signal lines and the sub-pixels, accurate and stable connections between the third signal line **41** and the second sub-pixels **210** and accurate and stable connections between the fourth signal lines **51** and the third sub-pixels **310** are provided. In some embodiments, the number of the columns **31** of third sub-pixels in each second unit **30** is the same as the number of the columns **21** of second sub-pixels in each first unit **20**, and the number of the fourth signal lines **51** in each second line group **50** may be the same as the number of the third signal lines **41** in each first line group **40**. Optionally, each first line group **40** includes three third signal lines **41**, and each second line group **50** includes three fourth signal lines **51**.

In order to transmit a stable electrical signal to corresponding second sub-pixels **210** and third sub-pixels **310** through the electrically connected third signal lines **41** and the fourth signal lines **51**, in some embodiments, the second sub-pixels **210** and the third sub-pixels **310** respectively connected with the third signal line **41** and the fourth signal line **51** (which are electrically connected with each other) may have the same color. Through the arrangement, the third signal line **41** and the fourth signal line **51** which are electrically connected to each other can drive sub-pixels of the same display color, thereby improving the display effect.

In some embodiments, please continue to refer to FIG. **10**, the second display area AA**2** may include a first display sub-area AA**21** and a second display sub-area AA**22**. In the first direction X, the first display sub-area AA**21** is located between the second transition display sub-area TA**2** and the second display sub-area AA**22**, and a sub-pixel distribution density corresponding to the first display sub-area AA**21** is smaller than a sub-pixel distribution density corresponding to the second display sub-area AA**22**.

In order to better understand the effect of such arrangement that the sub-pixel distribution density corresponding to the first display sub-area AA**21** is smaller than the sub-pixel distribution density corresponding to the second display sub-area AA**22**, please refer to FIG. **5**. In FIG. **5**, the sub-pixel distribution density corresponding to the second transition display sub-area TA**2** is smaller than the sub-pixel distribution density corresponding to the second display area AA**2**, thus a bright stripe is easily formed at a boundary between the second display area AA**2** with a higher pixel density and the second transition display sub-area TA**2** with a lower pixel density, the "pixel density" refers to PPI (Pixels Per Inch).

In order to blur the bright stripe, a column of sub-pixels in the second display area AA**2** which is adjacent to the second transition display sub-area TA**2** in FIG. **5** can be reduced, to obtain the first display sub-area AA**21** as shown in FIG. **10**, thereby the bright stripe between the second transition display sub-area TA**2** and the second display area AA**2** can be blurred. For example, a column of sub-pixels in the second display area AA**2** which is adjacent to the second transition display sub-area TA**2** in FIG. **5** can be halved. A distance between two four sub-pixels **610** which are adjacent to each other in the second direction Y in the first display sub-area AA**21** may be twice a distance of two third sub-pixels **310** which are adjacent to each other in the second direction Y in the second display sub-area AA**22**.

Optionally, in order to better blur the bright stripe, the display panel may include only one column **61** of fourth sub-pixels in the first display sub-area AA**21**, and the column **61** of fourth sub-pixels includes a plurality of fourth sub-pixels **610** arranged along the second direction Y. The column **61** of fourth sub-pixels may include the fourth sub-pixels **610** of at least three colors. Every two adjacent fourth sub-pixels **610** have different colors. For example, the fourth sub-pixels **610** includes a fourth sub-pixel **610***a* of a first color, a fourth sub-pixel **610***b* of a second color and a fourth sub-pixel **610***c* of a third-color. The fourth sub-pixel **610***a* of the first color can emit red light, the fourth sub-pixel **610***b* of the second color can emit green light, and the fourth sub-pixel **610***c* of the third color can emit blue light.

As shown in the figure, the column **61** of fourth sub-pixels and the adjacent column **31** of third sub-pixels share fourth signal lines **51** in a second line group **50**, so that the fourth sub-pixels **610** and the third sub-pixels **610** have the same brightness, thereby better blurring the bright stripe.

In addition, in a particular implementation, the first sub-pixels **110**, the second sub-pixels **210**, the third sub-pixels **310** and the fourth sub-pixels **410** can be manufactured by using a same mask during manufacturing, while those positions where there is no need to set a sub-pixel can be occluded, and finally the pixel arrangement structure shown in FIG. **2** is formed. The occlusion can be performed in alterlaced rows and/or alterlaced columns.

In some embodiments, a circuit structure of the first pixel circuit **1021**, the second pixel circuit **1022** and the third pixel circuit **1023** may be any one of a 2T1C circuit, a 3T1C circuit, a 6T1C circuit, a 6T2C circuit, a 7T1C circuit, a 7T2C circuit, or a 9T1C circuit. In this document, the term "2T1C circuit" refers to a pixel circuit including two thin film transistors (T) and one capacitor (C) therein. The other terms "7T1C circuit", "7T2C circuit" and "9T1C circuit" and the like are interpreted in the same manner.

In some embodiments, each of the first sub-pixel **110**, the second sub-pixel **210**, the third sub-pixel **310** and the fourth sub-pixel **410** include a light-emitting structure, a first electrode, and a second electrode (not shown in the figures). The first electrode is disposed at a side of the light-emitting structure facing to the substrate **101**, and the second electrode is disposed at a side of the light-emitting structure facing away from the substrate **101**.

One of the first electrode and the second electrode acts as an anode, and the other one acts as a cathode. In the embodiments, the description is made by taking the first electrode being an anode and the second electrode being a cathode as an example.

The light-emitting structure may include an OLED light-emitting layer, and according to design requirements for the light-emitting structure, it may also include at least one of a hole injection layer, a hole transport layer, an electron injection layer, and an electron transport layer.

In some embodiments, a first electrode of the second sub-pixel **210** in the first display area AA**1** is a light-transmittable electrode. In some embodiments, the first electrode of the second sub-pixel **210** includes an indium tin oxide (Indium Tin Oxide, ITO) layer or an indium zinc oxide layer. In some embodiments, the first electrode of the second sub-pixel **210** is a reflective electrode, including a first light-transmittable conductive layer, a reflective layer on the first light-transmittable conductive layer and a second light-transmittable conductive layer on the reflective layer. The first light-transmittable conductive layer and the second light-transmittable conductive layer may be ITO, indium zinc oxide, etc., and the reflective layer may be a metal layer, for example, made of silver.

In some embodiments, a second electrode of the second sub-pixel **210** includes a magnesium-silver alloy layer. In some embodiments, the second electrodes of the second sub-pixels **210** may be interconnected as a common electrode.

In some embodiments, an orthographic projection of each light-emitting structure of the first display area AA**1** on the substrate **101** is composed of one first graphic unit or a splicing of two or more first graphic units. The first graphic unit includes at least one selected from a group including a circle, an oval, a dumbbell, a gourd, and a rectangle.

In some embodiments, an orthographic projection of each first electrode of the first display area AA**1** on the substrate **101** is composed of one second graphic unit or a splicing of two or more second graphic units. The second graphic unit includes at least one selected from a group including a circle, an oval, a dumbbell, a gourd, and a rectangle.

The above-mentioned shapes can cause a change in a periodic structure produced by diffraction, that is, a change in distribution of a diffraction field, so as to reduce a diffraction effect generated when external incident light passes through the first display area AA**1**, thereby ensuring that images captured by a camera disposed under the first display area AA**1** have a higher definition.

Exemplarily, the display panel **100** may further include an encapsulation layer, and a polarizer as well as a cover plate above the encapsulation layer, or a cover plate above the encapsulation layer without the polarizer. Alternatively, at least a cover plate is provided directly above the encapsulation layer of the first display area AA**1** without a polarizer, so as to prevent the polarizer from affecting light collection of a corresponding photosensitive element disposed under the first display area AA**1**. Of course, a polarizer can be additionally provided above the encapsulation layer of the first display area AA**1**.

The embodiments of the present application also provide a display device, which may include the display panel **100** of any one of the foregoing embodiments. The following will take a display device according to an embodiment as an

example for description. In the embodiment, the display device includes the display panel **100** according to the above-mentioned embodiments.

FIG. **11** shows a schematic top view of a display device according to an embodiment of the present application, and FIG. **12** shows a cross-sectional view of the example as shown in FIG. **11** along the B-B direction. In the display device of the embodiment, the display panel **100** may be the display panel **100** according to any one of the above embodiments. The display panel **100** includes a first display area AA**1**, a second display area AA**2**, and a transition display area TA between the first display area AA**1** and the second display area AA**2**, and a light transmittance of the first display area AA**1** is greater than a light transmittance of the second display area AA**2**.

The display panel **100** includes a first surface S**1** and a second surface S**2** which are opposite to each other, wherein the first surface S**1** is a display surface. The display device further includes a photosensitive component **200**, which is disposed on a side of the display panel **100** where the second surface S**2** is disposed, and a position of the photosensitive component **200** corresponds to the first display area AA**1**.

The photosensitive component **200** may be an image capture device for capturing external image information. In this embodiment, the photosensitive component **200** is a complementary metal oxide semiconductor (Complementary Metal Oxide Semiconductor, CMOS) image capture device. In some other embodiments, the photosensitive component **200** may be a charge-coupled device (Charge-coupled Device, CCD) image capture device or any other form of image capture device. It should be understood that the photosensitive component **200** may not be limited to an image capture device. For example, in some embodiments, the photosensitive component **200** may be an optical sensor such as an infrared sensor, a proximity sensor, an infrared lens, a flood light sensor, an ambient light sensor and a dot projector or the like. In addition, the display device may be further integrated with other components on a side of the display panel **100** where the second surface S**2** is disposed, such as a receiver, a speaker, and the like.

According to the display device of the embodiments of the application, a light transmittance of the first display area AA**1** is greater than a light transmittance of the second display area AA**2**, so that the display panel **100** can be integrated with a photosensitive component **200** on back of the first display area AA**1**, to realize, for example, under-screen integration of the photosensitive component **200** such as an image capture device, and meanwhile the first display area AA**1** is available to display images to increase a display area of the display panel **100**, thereby realizing a full-screen design of the display device.

According to the display device of the embodiments of the application, a plurality of columns **11** of first sub-pixels are arranged along a first direction X in the transition display area TA, and each column **11** of sub-pixels includes a plurality of first sub-pixels **110** arranged along a second direction Y which intersects the first direction X. A plurality of first pixel circuits **1021** corresponding to at least one column **11** of first sub-pixels are distributed on a same column By arranging a plurality of first pixel circuits **1021** corresponding to at least one column **11** of first sub-pixels on a same column, an area occupied by the first pixel circuits **1021** corresponding to the column **11** of first sub-pixels can be reduced, and an occupied space in the transitional display area TA can be reduced, and under a certain area of the transition display area TA, more sub-pixels can be provided in the transition display area TA and/or the first display area AA**1**, to improve a display effect of the display panel.

The above-mentioned embodiments of the application do not describe all the details in detail, nor do they limit the scope of the application. Obviously, based on the above description, those skilled in the art can make various modifications and changes. This specification specifically describes these embodiments in order to better explain principles and practical applications of the application, so that those skilled in the art can make good use of the application and make modification and utilization on the basis of the application. The scope of the application is limited only by the appended claims.

What is claimed is:

1. A display panel, comprising:

a first display area;

a second display area; and

a transition display area between the first display area and the second display area, wherein a light transmittance of the first display area is greater than a light transmittance of the second display area, the transition display area comprises a first transition display sub-area and a second transition display sub-area, and in the first direction, the first display area is located between the first transition display sub-area and the second transition display sub-area, a plurality of columns of first sub-pixels is disposed in the transition display area and arranged along a first direction, each column of first sub-pixels comprises a plurality of first sub-pixels arranged in a second direction which intersects the first direction, and a plurality of first pixel circuits corresponding to at least one column of first sub-pixels is distributed on a same column.

2. The display panel according to claim **1**, wherein a sub-pixel distribution density corresponding to the first transition display sub-area and a sub-pixel distribution density corresponding to the second transition display sub-area are respectively greater than or equal to a sub-pixel distribution density corresponding to the first display area, and the sub-pixel distribution density corresponding to the first transition display sub-area and the sub-pixel distribution density corresponding to the second transition display sub-area are respectively smaller than a sub-pixel distribution density corresponding to the second display area.

3. The display panel according to claim **2**, wherein the sub-pixel distribution density corresponding to the first transition display sub-area is greater than the sub-pixel distribution density corresponding to the first display area, and the sub-pixel distribution density corresponding to the second transition display sub-area is equal to the sub-pixel distribution density corresponding to the first display area.

4. The display panel according to claim **1**, wherein the columns of first sub-pixels comprise a sub-column of first sub-pixels adjacent to the second display area, and a plurality of first pixel circuits corresponding to the sub-column of first sub-pixels is distributed on a same column.

5. The display panel according to claim **4**, wherein the first sub-pixels in the sub-column of first sub-pixels comprise a first sub-pixel of a first color, a first sub-pixel of a second color and a first sub-pixel of a third color, the first sub-pixel of the first color and the first sub-pixel of the third color are electrically connected to a first signal line through respective first pixel circuits, and the first sub-pixel of the second color is electrically connected to a second signal line through a first pixel circuit.

6. The display panel according to claim **5**, wherein the first signal line and the second signal line are interweaved

with each other and extend along the second direction, the first signal line comprises a plurality of first line segments and a plurality of first transition segments which are distributed alternately in the second direction, and two of the first line segments which are adjacent to each other in the second direction are disposed in different columns and electrically connected through one of the first transition sections, and the second signal line comprises a plurality of second line segments and a plurality of second transition segments which are distributed alternately in the second direction, and two of the second line segments which are adjacent to each other in the second direction are disposed in different columns and electrically connected through one of the second transition sections.

7. The display panel according to claim **6**, wherein the first line segments and the first transition segments are disposed in a same layer, and the second line segments and the second transition segments are disposed in different layers.

8. The display panel according to claim **6**, wherein the first line segment and the second line segment which are adjacent to each other in the first direction are disposed in a same layer and arranged in parallel, and the first transition segment corresponding to the first line segment and the second transition segment corresponding to the second line segment are disposed in different layers, and a projection of the first transition segment in a direction orthogonal to the display panel intersects a projection of the second transition segment in a direction orthogonal to the display panel.

9. The display panel according to claim **6**, wherein the first signal line is electrically connected to a corresponding first pixel circuit through the first line segment, and the second signal line is electrically connected to a corresponding first pixel circuit through the second line segment.

10. The display panel according to claim **6**, wherein the display panel comprises a device layer, and the device layer comprises a first metal layer, a second metal layer and a third metal layer which are sequentially stacked and insulated from each other; wherein the first line segments, the first transition segments and the second line segments are disposed in the third metal layer, and the second transition segments are disposed in the first metal layer or the second metal layer.

11. The display panel according to claim **5**, wherein the first signal line and the second signal line extend along the second direction and are arranged in parallel, and the first signal line and the second signal line are disposed in a same layer.

12. The display panel according to claim **5**, further comprising:

a plurality of second units arranged along the first direction in the second display area, wherein each of the second units comprises at least two columns of third sub-pixels arranged along the first direction and, each column of third sub-pixels comprises a plurality of third sub-pixels arranged along the second direction;

a plurality of second line groups arranged along the first direction in the second display area, wherein each of the second line groups comprises at least two fourth signal lines arranged along the first direction, and the fourth signal line extends along the second direction, wherein the at least two fourth signal lines in each of the second line groups are matched and electrically connected with a plurality of third sub-pixels of a corresponding one of the second units through third pixel circuits; and

the second units comprise a second sub-unit which is adjacent to the sub-column of first sub-pixels in the second direction, wherein the first signal line and the second signal line are electrically connected with two fourth signal lines matched with the second sub-unit in a one-to-one correspondence.

13. The display panel according to claim **12**, further comprising:

a plurality of first units arranged along the first direction in the first display area, wherein each of the first units comprises at least two columns of second sub-pixels arranged along the first direction and, each column of second sub-pixels comprises a plurality of second sub-pixels arranged along the second direction;

a plurality of first line groups arranged along the first direction in the transition display area, wherein each of the first line groups comprises at least two third signal lines arranged along the first direction, and the third signal line extends along the second direction, wherein the at least two third signal lines in each of the first line groups are matched and electrically connected with a plurality of second sub-pixels of a corresponding one of the first units through second pixel circuits in the transition display area; and

the third signal lines in the plurality of first line groups are selectively electrically connected with the fourth signal lines in the plurality of second line groups other than the fourth signal lines matched with the second sub-unit-.

14. The display panel according to claim **13**, wherein the number of the third signal lines in each of the first line groups is equal to the number of the fourth signal lines in each of the second line groups.

15. The display panel according to claim **12**, wherein the second display area comprises a first display sub-area and a second display sub-area, in the first direction, the first display sub-area is between the second transition display sub-area and the second display sub-area, and a sub-pixel distribution density corresponding to the first display sub-area is smaller than a sub-pixel distribution density corresponding to the second display sub-area.

16. A display panel comprising:

a first display area;

a second display area; and

a transition display area between the first display area and the second display area, wherein a light transmittance of the first display area is greater than a light transmittance of the second display area, the transition display area comprises a first transition display sub-area and a second transition display sub-area, in the first direction, the first display area is located between the first transition display sub-area and the second transition display sub-area, and a sub-pixel distribution density corresponding to the first transition display sub-area and a sub-pixel distribution density corresponding to the second transition display sub-area are respectively greater than or equal to a sub-pixel distribution density corresponding to the first display area.

17. The display panel according to claim **16**, further comprising:

a plurality of first sub-pixels disposed in the transition display area, wherein the plurality of first sub-pixels comprises a first sub-pixel of a first color, a first sub-pixel of a second color and a first sub-pixel of a third color, the first sub-pixel of the first color and the first sub-pixel of the third color are electrically connected to a first signal line through respective first pixel

circuits, and the first sub-pixel of the second color is electrically connected to a second signal line through a first pixel circuit.

18. The display panel according to claim **17**, wherein the first signal line and the second signal line extend along the second direction and are arranged in parallel, and the first signal line and the second signal line are disposed in a same layer.

19. The display panel according to claim **17**, further comprising:

a plurality of second units arranged along the first direction in the second display area, wherein each of the second units comprises at least two columns of third sub-pixels arranged along the first direction and each column of third sub-pixels comprises a plurality of third sub-pixels arranged along the second direction;

a plurality of second line groups arranged along the first direction in the second display area, wherein each of the second line groups comprises at least two fourth signal lines arranged along the first direction, and the fourth signal line extends along the second direction, and the at least two fourth signal lines in each of the second line groups are matched and electrically connected with a plurality of third sub-pixels of a corresponding one of the second units through third pixel circuits.

20. The display panel according to claim **19**, further comprising:

a plurality of first units in the first display area, wherein each of the first units comprises a plurality of second sub-pixels; and

a plurality of first line groups arranged along the first direction in the transition display area, wherein each of the first line groups comprises at least two third signal lines arranged along the first direction, and the third signal line extends along the second direction, the at least two third signal lines in each of the first line groups are matched and electrically connected with a plurality of second sub-pixels of a corresponding one of the first units through second pixel circuits, and the number of the third signal lines in each of the first line groups is equal to the number of the fourth signal lines in each of the second line groups.

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