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Display panel and display device

Abstract

A display panel and a display device are provided, featuring a first substrate with a first base and a pixel electrode layer on one side. A light-modulating medium layer is on one side of the pixel electrode layer, facing away from the first base. The second substrate, on one side of the light-modulating medium layer away from the first substrate, includes a second base and a common electrode layer facing the light-modulating medium layer. The first substrate includes a first organic insulating layer between the first base and the pixel electrode layer, causing a surface of the pixel electrode layer facing away from the first base to be uneven. Alternatively, the second substrate includes a second organic insulating layer between the second base and the common electrode layer, making the common electrode surface uneven. This design enhances display effects at wide angles while ensuring high aperture ratio and light transmittance.

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Background/Summary

FIELD OF DISCLOSURE

(1) The present application relates to a field of display technology, specifically to a display panel and a display device.

DESCRIPTION OF RELATED ART

(2) With the development of display technology, flat-panel display devices such as liquid crystal displays (LCDs) are widely used in various consumer electronic products like mobile phones, televisions, personal digital assistants, digital cameras, laptops, and desktop computers, due to their high-quality imagery, power efficiency, thin body, and broad application range, becoming the mainstream in display devices.

(3) In related technology, a multi-domain design is commonly used to enhance the display effect of vertically aligned liquid crystal display panels at wide viewing angles. Theoretically, the more sub-pixel domains are designed, the better the display effect at wide viewing angles. However, an increase in the number of sub-pixel domains reduces the aperture ratio of sub-pixels, decreases light transmittance, and increases the power consumption of the display panel, which is a problem that urgently needs to be addressed.

SUMMARY OF INVENTION

(4) The present application provides a display panel and a display device that effectively solve the existing problem of being unable to improve the display effect at wide viewing angles while simultaneously maintaining a high aperture ratio, high light transmittance, and low power consumption in current display panels.

(5) In a first aspect, the present application provides a display panel. The display panel includes: a first substrate, including a first base and a pixel electrode layer disposed on one side of the first base; a light-modulating medium layer, disposed on one side of the pixel electrode layer that is away from the first base; and a second substrate, disposed on one side of the light-modulating medium layer that is away from the first substrate, the second substrate including a second base and a common electrode layer arranged on one side of the second base facing the light-modulating medium layer; wherein the first substrate includes a first organic insulating layer disposed between the first base and the pixel electrode layer, and the first organic insulating layer causes a surface of the pixel electrode layer that is away from the first base to be uneven; or, the second substrate includes a second organic insulating layer disposed between the second base and the common electrode layer, and the second organic insulating layer causes a surface of the common electrode layer that is away from the second base to be uneven.
(6) Optionally, the first substrate includes a color filter layer and a first organic insulating layer, the first organic insulating layer is disposed between the color filter layer and the pixel electrode layer, the color filter layer includes a plurality of color filter units, the pixel electrode layer includes a plurality of pixel electrodes, the pixel electrodes are disposed corresponding to the color filter units in a one-to-one correspondence, and each of the pixel electrodes includes a plurality of branches, wherein within each pixel electrode, at least part of one of the branches is at a first distance from a bottom surface of the color filter unit, and at least part of another branch is at a second distance from the bottom surface of the color filter unit, with the first distance being different from the second distance.
(7) Optionally, the first substrate further includes the first organic insulating layer, the first organic insulating layer includes a plurality of first parts and a plurality of second parts, each of the first parts possesses a first thickness, each of the second parts possesses a second thickness, and the first thickness is different from the second thickness; at least part of one branch, which is at the first distance from the bottom surface of the color filter unit, corresponds to the first part, and at least part of another branch, which is at the second distance from the bottom surface of the color filter unit, corresponds to the second part.
(8) Optionally, each of the pixel electrodes includes four branches, each of the branches includes a plurality of branch electrodes, and within each pixel electrode, orientations of the branch electrodes in any two branches are different; in each of the pixel electrodes, two of the four branches are at the first distance from the bottom surface of the color filter unit, and the other two branches are at the second distance from the bottom surface of the color filter unit.
(9) Optionally, the first substrate further includes a plurality of thin-film transistors, wherein in each of the pixel electrodes, the branch electrodes of all the branches are all electrically connected to one of the thin-film transistors.
(10) Optionally, the pixel electrodes are sequentially arranged in the first direction and the second direction, wherein within each pixel electrode, two branches that are at the first distance from the bottom surface of the color filter unit are adjacent to each other in either the first direction or the second direction, and two branches that are at the second distance from the bottom surface of the color filter unit are adjacent to each other in either the first direction or the second direction; or, two branches that are at the first distance from the bottom surface of the color filter unit are not adjacent to each other in the first direction and the second direction, and two branches that are at the second distance from the bottom surface of the color filter unit are not adjacent in the first direction and the second direction.
(11) Optionally, each of the pixel electrodes is divided into two first regions and two second regions, wherein in one of two adjacent pixel electrodes in the first direction, two branches at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively, while in the other of the two adjacent

pixel electrodes in the first direction, two branches at the first distance from the bottom surface of the color filter unit are located in the two second regions respectively, and the other two branches at the second distance from the bottom surface of the color filter unit are located in the two first regions respectively.

(12) Optionally, in one of two adjacent pixel electrodes in the second direction, two branches that are at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches that are at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively, while in the other of the two adjacent pixel electrodes in the second direction, two branches that are at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches that are at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively.

(13) Optionally, each of the pixel electrodes includes four branches, each of the branches includes a plurality of branch electrodes, and within each pixel electrode, orientations of the branch electrodes in any two branches are different, wherein in each of the four branches, each branch includes a first sub-branch and a second sub-branch, with the first sub-branch being at the first distance from the bottom surface of the color filter unit, and the second sub-branch being at the second distance from the bottom surface of the color filter unit; within each of the pixel electrodes, two of the second sub-branches are located on one side of the four first sub-branches, while the other two second sub-branches are located on an opposite side of the four first sub-branches, and these two second sub-branches are symmetrically arranged with respect to the other two second sub-branches.

(14) Optionally, the second substrate includes the second organic insulating layer, the second organic insulating layer includes a plurality of third parts and a plurality of fourth parts, each of the third parts possesses a third thickness, and each of the fourth parts possesses a fourth thickness, with the third thickness being different from the fourth thickness.

(15) In a second aspect, the present application provides a display device, which includes any display panel mentioned above.

(16) The present application provides a display panel and a display device. The display panel includes a first substrate, a second substrate, and a light-modulating medium layer. The first substrate includes a first base and a pixel electrode layer set on one side of the first base. The light-modulating medium layer is positioned on a side of the pixel electrode layer that faces away from the first base. The second substrate is set on a side of the light-modulating medium layer that faces away from the first substrate and includes a second base and a common electrode layer placed on a side of the second base facing the light-modulating medium layer. Additionally, the first substrate includes a first organic insulating layer placed between the first base and the pixel electrode layer. This first organic insulating layer causes a surface of the pixel electrode layer facing away from the first base to be uneven. Alternatively, the second substrate includes a second organic insulating layer placed between the second base and the common electrode layer. This second organic insulating layer causes a surface of the common electrode layer facing away from the second base to be uneven. The display panel and the display device provided by the present application can improve the display effects at wide viewing angles while maintaining a high aperture ratio, high light transmittance, and low power consumption.

Description

BRIEF DESCRIPTION OF DRAWINGS

(1) To more clearly illustrate the technical solutions in the embodiments of this application, the drawings used in the description of the embodiments will be briefly introduced below. It is evident that the drawings described below are only some embodiments of this application, and for those

skilled in the art, other drawings can be obtained from these drawings without creative efforts.
(2) FIG. **1** is a schematic cross-sectional view of a display panel according to some embodiments of the present application.
(3) FIG. **2** is a schematic plan view of a sub-pixel area in the display panel according to some embodiments of the present application.
(4) FIG. **3** is a schematic plan view showing a configuration of multiple branches of six pixel electrodes according to some embodiments of the present application.
(5) FIG. **4** is another schematic plan view showing a different configuration of the multiple branches of six pixel electrodes according to some embodiments of the present application.
(6) FIG. **5** is yet another schematic plan view showing an alternative configuration of the multiple branches of six pixel electrodes according to some embodiments of the present application.
(7) FIG. **6** is a schematic plan view of multiple branches of three pixel electrodes according to some embodiments of the present application.
(8) FIG. **7** is another plan schematic view of the multiple branches of three pixel electrodes according to some embodiments of the present application.
(9) FIG. **8** is a schematic cross-sectional view of another type of display panel according to some embodiments of the present application.
DESCRIPTION OF REFERENCE NUMERALS IN THE DRAWINGS
(10) first substrate **10**; pixel electrode layer **11**; pixel electrode **110**; trunk part **111**; branch **112**; first type branch **1121**; second type branch **1122**; branch electrode **113**; first sub-branch **114**; second sub-branch **115**; first organic insulating layer **12**; first part **121**; second part **122**; driving circuit layer **13**; thin-film transistor **131**; color filter layer **14**; color filter unit **141**; first color filter unit **142**; second color filter unit **143**; third color filter unit **144**; first base **15**; second substrate **20**; common electrode layer **21**; second base **22**; second organic insulating layer **23**; third part **231**; fourth part **232**; light-modulating medium layer **30**; backlight module **40**; first direction X; second direction Y; first distance d**1**; second distance d**2**; first thickness h**1**; second thickness h**2**; third thickness h**3**; fourth thickness h**4**; first region q**1**; second region q**2**.
DETAILED DESCRIPTION OF EMBODIMENTS
(11) In the following, the technical solutions in the present application are described clearly and completely in conjunction with the accompanying drawings and with reference to specific embodiments. It is apparent that the embodiments described here represent only a portion of the embodiments of this application, not all of them. Based on the embodiments in this application, all other embodiments obtained by those skilled in the art without making creative efforts fall within the scope of protection of this application. Furthermore, it should be understood that the specific embodiments described here are only for the purpose of illustration and explanation of this application and are not intended to limit the application. In this application, unless stated otherwise, orientation terms such as “upper” and “lower” typically refer to the upper and lower parts of the device in its actual use or working state, specifically the directions shown in the drawings; “inside” and “outside” refer to the contour of the device.
(12) The disclosure below provides many different embodiments or examples to implement various structures of this application. To simplify the disclosure, specific components and arrangements in particular examples are described in the text. These are merely examples, and their purpose is not to limit the scope of this application. Additionally, the application may repeat reference numbers and/or letters across different examples. Such repetition is intended for simplicity and clarity, and does not imply a relationship between the various discussed embodiments and/or setups. Moreover, the application provides examples of specific techniques and materials, but those skilled in the art can recognize the applicability of other techniques and/or the use of other materials. The detailed descriptions follow, noting that the order of description of the following examples does not imply a preferred order of the embodiments.
(13) In conventional technology, pixel electrodes corresponding to four-domain sub-pixels include

four branches, each branch containing multiple branch electrodes; whereas the pixel electrodes for eight-domain sub-pixels include eight branches, each branch also containing multiple branch electrodes. Clearly, eight-domain sub-pixels, through a design involving more branches, can better address the issue of poor viewing angles caused by differences in the optical path length of liquid crystals observed from different directions, thereby enhancing the display effects at wide viewing angles. However, the non-transparent area of eight-domain sub-pixels is larger, due to reasons including a greater number of thin-film transistors, which act as switching and/or driving components, and more complex layouts of opaque metal wiring.
(14) Therefore, the display panels in conventional technologies face the challenge of improving the display effects at wide viewing angles without being able to simultaneously maintain a high aperture ratio, high light transmittance, and low power consumption.
(15) To address the issue of improving the display effects at wide viewing angles while also considering a high aperture ratio, high light transmittance, and low power consumption, the present application provides a display panel and a display device.
First Embodiment
(16) FIG. **1** shows a schematic cross-sectional view of the display panel according to some embodiments. FIG. **2** is a schematic plan view of a sub-pixel area of a display panel according to some embodiments of this application. In conjunction with FIGS. **1** and **2**, a first aspect of this application provides a display panel, which can be a liquid crystal display panel or other types of display panels that operate on a similar principle to liquid crystal display panels.
(17) In some embodiments of the present application, the display panel includes a first substrate **10**, a second substrate **20**, and a light-modulating medium layer **30**. The first substrate **10** includes a first base **15** and a pixel electrode layer **11** located on one side of the first base **15**. The light-modulating medium layer **30** is situated on one side of the pixel electrode layer **11** that faces away from the first base **15**. The second substrate **20** is positioned on one side of the light-modulating medium layer **30** that faces away from the first substrate **10**. This second substrate **20** includes a second base **22** and a common electrode layer **21** set on one side of the second base **22** facing the light-modulating medium layer **30**. Additionally, the first substrate **10** also includes a first organic insulating layer **12** which is placed between the first base **15** and the pixel electrode layer **11**. The first organic insulating layer **12** creates an uneven surface on the side of the pixel electrode layer **11** that is away from the first base **15**.
(18) In the display panel provided by this application, when the first substrate **10** includes the first organic insulating layer **12**, the first organic insulating layer **12** can make a surface of the pixel electrode layer **11** on the side facing away from the first base **15** uneven. This unevenness allows for different distances between the pixel electrode layer **11** and the common electrode layer **21** in different areas. Consequently, when a certain voltage is applied to the pixel electrode layer **11** and another voltage to the common electrode layer **21**, a deflection angle of a light-modulating medium in the light-modulating medium layer **30** corresponding to one area can differ from a deflection angle of the light-modulating medium in the light-modulating medium layer **30** in another area. This variation in deflection angles enables the display panel to enhance the display effects at wide viewing angles while maintaining a high aperture ratio, high light transmittance, and low power consumption.
(19) In some embodiments of this application, the first substrate **10** includes a color filter layer **14**. The first organic insulating layer **12** is positioned between the color filter layer **14** and the pixel electrode layer **11**. The color filter layer **14** includes a plurality of color filter units **141**. The pixel electrode layer **11** includes a plurality of pixel electrodes **110**. Each pixel electrode **110** is correspondingly aligned with a color filter unit **141**. Optionally, the common electrode layer **21** has a flat surface, which allows the distance between different areas of each pixel electrode **110** and a corresponding bottom surface of the color filter unit **141** to reflect the distance between the respective areas of the pixel electrode **110** and the common electrode layer **21**. It should be noted

that a bottom surface of the color filter unit **141** is a side of the color filter unit **141** that is closer to the first base **15**.
(20) The following description is provided given that the common electrode layer **21** has a flat surface.
(21) In some embodiments of this application where the common electrode layer **21** has a flat surface, each pixel electrode **110** includes multiple branches **112**. Within each pixel electrode **110**, at least part of one branch **112** is at a first distance d**1** from the bottom surface of the corresponding color filter unit **141**, while at least part of another branch **112** is at a second distance d**2** from the same bottom surface of the corresponding color filter unit **141**. Importantly, this first distance d**1** is different from the second distance d**2**.
(22) In the display panel provided by this application, since within each pixel electrode **110**, at least part of one branch **112** is at the first distance d**1** from the bottom surface of the color filter unit **141**, and at least part of another branch **112** is at the second distance d**2** from the same bottom surface, and given that the first distance d**1** is different from the second distance d**2**, when a certain pixel voltage is applied to the pixel electrode **110** and a certain common voltage is applied to the common electrode layer **21**, a voltage difference between the part of the branch **112** at the first distance d**1** and the common electrode layer **21** can be different from a voltage difference between the part of the branch **112** at the second distance d**2** and the common electrode layer **21**. Consequently, the control capability of the part of the branch **112** at the first distance d**1** over the light-modulating medium in the light-modulating medium layer **30** can differ from the control capability of the part of the branch **112** at the second distance d**2** over the light-modulating medium in the light-modulating medium layer **30**. Thus, without changing the design of the pixel electrode **110** or increasing the number of domains, while maintaining a high aperture ratio, high light transmittance, and low power consumption, this approach effectively improves the poor viewing angle performance caused by differences in the optical path length of the light-modulating medium observed from various directions, thereby enhancing the display effects at wide viewing angles.
(23) It should be noted that in other embodiments of this application, at least part of other branches **112** can be at a distance from the bottom surface of the color filter unit **141** that is different from the first distance d**1** and the second distance d**2**, such as a third distance, a fourth distance, a fifth distance, etc. The overall inventive concept remains the same as the examples described above, and is not elaborated further in this application.
(24) Additionally, each pixel electrode **110** also includes a trunk part **111**. The trunk part **111** includes a first main trunk set along a first direction X and a second main trunk set along a second direction Y. The orientation of the branch electrodes **113** indicates the direction of extension from the end near the trunk part **111** to which they are connected towards the end far from the trunk part **111**.
(25) In some embodiments of this application, a difference between the first distance d**1** and the second distance d**2** is greater than or equal to 0.1 micrometers.
(26) The applicant has found that when the difference between the first distance d**1** and the second distance d**2** is too small, the effect of improving the poor viewing angle performance caused by differences in the optical path length of the light-modulating medium as observed from different directions is not significant. As a result, the display performance at wider viewing angles (for example, where the angle between the viewing direction and the normal to an emitting surface is greater than) 75° cannot be noticeably improved. Therefore, this application controls the difference between the first distance d**1** and the second distance d**2** to be more than 0.1 micrometers.
(27) In some embodiments of this application, the difference between the first distance d**1** and the second distance d**2** is less than or equal to 1 micrometer.
(28) The applicant has discovered that when the difference between d**1** and d**2** exceeds a certain threshold, the effect of addressing the poor viewing angle performance caused by differences in the optical path length of the light-modulating medium observed from various directions becomes less

pronounced, and it also increases the overall thickness of the display panel and the complexity of the manufacturing process. Therefore, this application keeps the difference between the first distance d**1** and the second distance d**2** controlled at less than 1 micrometer.

(29) In some embodiments of this application, the first substrate **10** includes a driving circuit layer **13** and a color filter layer **14**. Certainly, in other embodiments of this application, the driving circuit layer **13** and/or the color filter layer **14** can also be positioned on the second substrate **20**.

(30) In some embodiments of this application, the first organic insulating layer **12** is positioned on one side of the pixel electrode layer **11** that is away from the light-modulating medium layer **30**. The first organic insulating layer **12** includes multiple first parts **121** and multiple second parts **122**. The first part **121** has a first thickness h**1**, and the second part **122** has a second thickness h**2**, with the first thickness h**1** being different from the second thickness h**2**. A part of one branch **112** at the first distance d**1** from the bottom surface of the color filter unit **141** is disposed corresponding to the first part **121**. Meanwhile, a part of another branch **112** at the second distance d**2** from the bottom surface of the color filter unit **141** is disposed corresponding to the second part **122**.

(31) In the display panel provided by this application, the first organic insulating layer **12** is positioned on one side of the pixel electrode layer **11** that is away from the light-modulating medium layer **30**. A shape of the first organic insulating layer **12** can influence a surface condition of the pixel electrode **110**, thereby resulting each pixel electrode **110** having at least part of one branch **112** at a first distance d**1** from the bottom surface of the color filter unit **141**, and at least part of another branch **112** of the pixel electrode **110** at a second distance d**2** from the bottom surface of the color filter unit **141**.

(32) In some embodiments of the present application, the first organic insulating layer **12** is made of an organic material, such as positive or negative photoresist.

(33) In some embodiments, the present application can utilize a half-tone mask process to form the first organic insulating layer **12** with multiple first parts **121** having a first thickness h**1** and multiple second parts **122** having a second thickness h**2**. This process enables the formation of a step at the junction between the first part **121** and the second part **122**. Utilizing the difference in thickness between the first part **121** and the second part **122**, at least part of one branch **112** of each pixel electrode **110** can be positioned at a first distance d**1** from the bottom surface of the color filter unit **141**, and at least part of another branch **112** can be at a second distance d**2** from the bottom surface of the color filter unit **141**.

(34) In some embodiments of this application, the first substrate **10** includes sequentially stacked layers including a first base **15**, a driving circuit layer **13**, a color filter layer **14**, a first organic insulating layer **12**, and a pixel electrode layer **11**. The color filter layer **14** includes a plurality of color filter units **141**, each corresponding to one pixel electrode **110** and one sub-pixel. Each color filter unit **141** has a light-transmitting area, and a surface of each color filter unit **141** that is away from the first base **15** is flat in this light-transmitting area. This flatness allows the shape and surface texture of the first organic insulating layer **12**, situated on the color filter unit **141** in the light-transmitting area, to directly influence the distance between the pixel electrode **110** and the bottom surface of the color filter unit **141**. Consequently, by forming the first parts **121** and the second parts **122**, it is possible to ensure that in each pixel electrode **110**, at least part of one branch **112** of is at a first distance d**1** from the bottom surface of the color filter unit **141**, while at least part of another branch **112** is at a second distance d**2** from the bottom surface of the color filter unit **141**.

(35) In some embodiments of this application, the color filter units **141** include a plurality of first color filter units **142**, a plurality of second color filter units **143**, and a plurality of third color filter units **144**. The color filter units **142**, the color filter units **143**, and the color filter units **144** differ in their light-transmitting colors. For example, the first color filter unit **142** is a red filter, the second color filter unit **143** is a green filter, and the third color filter unit **144** is a blue filter. In this setup, the first color filter unit **142** and the second color filter unit **143** have a same thickness, which is less than a thickness of the third color filter unit **144**.

(36) In some embodiments of this application, the first substrate **10** also includes a plurality of thin-film transistors (TFTs) **131**. In each pixel electrode **110**, all the branch electrodes **113** within all the branches **112** are electrically connected to a single thin-film transistor **131**.
(37) In the display panel provided by this application, the branch electrodes **113** in all the branches **112** of each pixel electrode **110** are electrically connected to one single thin-film transistor **131**. This means that all the branch electrodes **113** in all the branches **112** of each pixel electrode **110** are controlled by one single thin-film transistor **131**, ensuring that the branches **112** within each pixel electrode **110** are controlled by one pixel drive signal. This configuration simplifies the driving requirements and reduces the number of thin-film transistors required. Since the thin-film transistors **131** include numerous opaque metal structures, reducing the number of thin-film transistors **131** can effectively increase the aperture ratio and light transmittance of the display panel, and decrease the power consumption of the display.
(38) FIG. **3** is a schematic plan view showing the arrangement of multiple branches of six pixel electrodes according to some embodiments of this application; FIG. **4** is another schematic plan view depicting a different arrangement of the multiple branches of six pixel electrodes according to some embodiments of this application; and FIG. **5** is yet another schematic plan view illustrating an alternative distribution of the multiple branches of six pixel electrodes according to some embodiments of this application. Referring to FIGS. **3**, **4**, and **5**, in some embodiments of this application, each pixel electrode **110** includes four branches **112**, each branch **112** including a plurality of branch electrodes **113**. In each pixel electrode **110**, the orientations of the branch electrodes **113** in any two branches **112** are different; where in the four branches **112** of each pixel electrode **110**, two of the branches **112** are at the first distance d**1** from the bottom surface of the color filter unit **141**, and the other two branches **112** are at the second distance d**2** from the bottom surface of the color filter unit **141**.
(39) For clarity and explanation purposes, this application defines that within each pixel electrode **110**, the branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** are categorized as first type branches **1121**, and the branches **112** at the second distance d**2** from the bottom surface of the color filter unit **141** are categorized as second type branches **1122**.
(40) In the display panel provided by the present application, each pixel electrode **110** includes four branches **112**, meaning that the sub-pixels in the display are designed with four domains. Additionally, since each pixel electrode **110** includes both the first type branches **1121** and the second type branches **1122**, which are at different distances from the common electrode layer **21**, this application is able to achieve the superior wide-angle display performance typically only possible with eight-domain designs on the basis of a four-domain design. Of course, in other embodiments of this application, each pixel electrode **110** can also include six branches **112**, eight branches **112**, etc., which are not elaborated further in this application.
(41) Additionally, in the display panel provided by this application, since two of the four branches **112** within each pixel electrode **110** are at the first distance d**1** from the bottom surface of the color filter unit **141**, and the other two branches **112** are at the second distance d**2** from the bottom surface of the color filter unit **141**, this setup allows for the four branches **112** of the pixel electrode **110** to be evenly divided. This division groups two branches **112** together, each group sharing the same first distance d**1** relative to the common electrode layer **21**. The other two branches **112** are grouped together at the same second distance d**2** relative to the common electrode layer **21**. This configuration improves the wide-angle display performance while ensuring uniformity in the display. It also simplifies the fabrication process, which in turn reduces production and manufacturing costs.
(42) Referring to FIG. **3**, in some embodiments of the present application, the pixel electrodes **110** are arranged sequentially in the first direction X and the second direction Y. Within each pixel electrode **110**, two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** (that is, two first type branches **1121**) are adjacent in the second direction Y. Additionally,

the other two branches **112**, which are at the second distance d**2** from the bottom surface of the color filter unit **141** (that is, two second type branches **1122**), are also adjacent in the second direction Y.

(43) In the display panel provided by this application, since within each pixel electrode **110**, two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** are adjacent in the second direction Y, and the other two branches **112** at the second distance d**2** are also adjacent in the second direction Y, it is possible to continuously arrange the two first parts **121** of the first organic insulating layer **12**, as well as the two second parts **122** of the first organic insulating layer **12**. This continuity reduces the complexity of preparing the first organic insulating layer **12** and lowers the production and manufacturing costs associated with the halftone mask.

(44) Referring to FIG. **4**, in some embodiments of this application, multiple pixel electrodes **110** are arranged sequentially in both the first direction X and the second direction Y. Within each pixel electrode **110**, two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** (namely two first type branches **1121**) are adjacent in the first direction X, and the other two branches **112** at the second distance d**2** (namely two second type branches **1122**) are also adjacent in the first direction X.

(45) In the display panel provided by this application, since within each pixel electrode **110**, two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** are adjacent in the first direction X, and the other two branches **112** at the second distance d**2** are also adjacent in the first direction X, it allows for the two first parts **121** of the first organic insulating layer **12** to be arranged continuously, and similarly allows for the two second parts **122** of the first organic insulating layer **12** to be arranged continuously. This continuity simplifies the preparation of the first organic insulating layer **12** and reduces the production and manufacturing costs related to the halftone mask.

(46) Referring to FIG. **5**, in some embodiments of this application, within each pixel electrode **110**, two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** (namely two first type branches **1121**) are not adjacent in both the first direction X and the second direction Y. Similarly, the other two branches **112** at the second distance d**2** (namely two second type branches **1122**) from the bottom surface of the color filter unit **141** are not adjacent in both the first direction X and the second direction Y.

(47) In the display panel provided by this application, since within each pixel electrode **110**, two branches **112** at the first distance d**1** and two branches **112** at the second distance d**2** are not adjacent in both the first direction X and the second direction Y, it allows for a better improvement of the viewing angle issues caused by differences in the optical path length of the liquid crystals observed from various directions.

(48) Continuing to refer to FIGS. **3**, **4**, and **5**, in some embodiments of the present application, the pixel electrodes **110** are sequentially arranged in the first direction X. Each pixel electrode **110** is divided into two first regions q**1** and two second regions q**2**. In one of two adjacent pixel electrodes **110** in the first direction X, the two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** (namely two first type branches **1121**) are located in the two first regions q**1**, and the other two branches **112** at the second distance d**2** from the bottom surface of the color filter unit **141** (namely two second type branches **1122**) are located in the two second regions q**2**. In the other of the two adjacent pixel electrodes **110** in the first direction X, the two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** (namely two first type branches **1121**) are located in the two second regions q**2**, and the two branches **112** at the second distance d**2** from the bottom surface of the color filter unit **141** (namely two second type branches **1122**) are located in the two first regions q**1**.

(49) In the display panel provided by the present application, the positions of the first region q**1** and the second region q**2** of each pixel electrode **110** are fixed. In two adjacent pixel electrodes **110** in the first direction X, the branches **112** in the first region q**1** of one pixel electrode **110** are at the first

distance d**1** from the bottom surface of the color filter unit **141**, while the branches **112** in the first region q**1** of the other pixel electrode **110** are at the second distance d**2** from the bottom surface of the color filter unit **141**. This setup allows for different distances between the branches **112** in the same region (either first region q**1** or second region q**2**) of two adjacent pixel electrodes **110** in the first direction X, thereby enhancing the symmetry of viewing angles for the user and further improving the display performance of the display panel.
(50) In some embodiments of this application, the sub-pixels corresponding to two adjacent pixel electrodes **110** in the first direction X have the same color, and the corresponding color filter units **141** also have the same color.
(51) In the display panel provided by the present application, since the colors of the sub-pixels corresponding to two adjacent pixel electrodes **110** in the first direction X are the same, the colors of the corresponding color filter units **141** are also the same. This application further differentiates the design of the branches **112** in two adjacent pixel electrodes **110** in the first direction X. This differentiation is aimed to ensure that the liquid crystal molecules on one side of the branches **112** in the same region of two adjacent pixel electrodes **110** exhibit different tilt angles, thereby further enhancing the display performance at wide viewing angles.
(52) Continuing to refer to FIGS. **3**, **4**, and **5**, in some embodiments of this application, in one of two adjacent pixel electrodes **110** in the second direction Y, two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** (namely two first type branches **1121**) are located in the two first regions q**1**, and two other branches **112** at the second distance d**2** from the bottom surface of the color filter unit **141** (namely two second type branches **1122**) are located in the two second regions q**2**. In the other of the two adjacent pixel electrodes **110** in the second direction Y, two branches **112** at the first distance d**1** from the bottom surface of the color filter unit **141** (namely two first type branches **1121**) are located in the two first regions q**1**, and two other branches **112** at the second distance d**2** from the bottom surface of the color filter unit **141** (namely two second type branches **1122**) are located in the two second regions q**2**.
(53) In the display panel provided by this application, the positions of the first region q**1** and the second region q**2** of each pixel electrode **110** are fixed. Due to the branches **112** in the first region q**1** of one of the pixel electrodes **110** in two adjacent ones in the second direction Y being at a first distance d**1** from the bottom surface of the color filter unit **141**, and the branches **112** in the first region q**1** of the other adjacent pixel electrode **110** also being at the first distance d**1** from the bottom surface of the color filter unit **141**, this arrangement ensures that the distance between the branches **112** in the same region (either the first region q**1** or the second region q**2**) and the bottom surface of the color filter unit **141** is the same in two adjacent pixel electrodes **110** in the second direction Y. This consistency allows for a more repetitive design of the branches **112** in the pixel electrodes **110** along the second direction Y, thereby reducing the complexity of the process and lowering production and manufacturing costs.
(54) In some embodiments of this application, the colors of the sub-pixels corresponding to two adjacent pixel electrodes **110** in the second direction Y are different, as are the colors of the corresponding color filter units **141**.
(55) In the display panel provided by this application, since the colors of the sub-pixels corresponding to two adjacent pixel electrodes **110** in the second direction Y are different, when the distance between the branches **112** in the same region (either the first region q**1** or the second region q**2**) and the bottom surface of the color filter unit **141** is the same in two adjacent pixel electrodes **110**, it allows for the liquid crystal molecules on one side of the branches **112** in the same region of adjacent pixel electrodes **110** to exhibit the same tilt angle when different colored sub-pixels within the same pixel unit illuminate simultaneously. This configuration enhances the display performance of the display panel.
(56) In some embodiments of this application, the display panel further includes a backlight module **40**. The backlight module **40** is positioned on one side of the first substrate **10** away from

the second substrate **20**. The backlight module **40** includes a backlight source, which can be a direct-type backlight source. In other embodiments of this application, the backlight source can also be an edge-type backlight source.
(57) In a second aspect, the present application further provides a display device that includes a housing and any one of the aforementioned display panels. The housing has an accommodation space, and the display panel is disposed in the accommodation space.
Second Embodiment
(58) FIG. **6** shows a schematic plan view of multiple branches of three pixel electrodes according to some embodiments of the present application; FIG. **7** shows another schematic plan view of the multiple branches of three pixel electrodes according to some embodiments of this application. In conjunction with FIGS. **1**, **2**, **6**, and **7**, a first aspect of the second embodiment provided in this application provides a display panel. The display panel includes a first substrate **10**, a second substrate **20**, and a light-modulating medium layer **30**. The first substrate **10** includes a first base **15** and a pixel electrode layer **11** positioned on one side of the first base **15**. The light-modulating medium layer **30** is set on one side of the pixel electrode layer **11** that faces away from the first base **15**. The second substrate **20** is disposed on one side of the light-modulating medium layer **30** that faces away from the first substrate **10**, and includes a second base **22** and a common electrode layer **21** located on one side of the second base **22** facing the light-modulating medium layer **30**. Additionally, the first substrate **10** further includes a first organic insulating layer **12**. The first organic insulating layer **12** is positioned between the first base **15** and the pixel electrode layer **11**. The first organic insulating layer **12** causes a surface of the pixel electrode layer **11** facing away from the first base **15** to be uneven.
(59) It should be noted that the structure of the display panel provided in the second embodiment of this application is similar to the structure of the display panel provided in the first embodiment. For example, the common electrode layer **21** has a flat surface, and the first substrate **10** includes a color filter layer **14**. The first organic insulating layer **12** is positioned between the color filter layer **14** and the pixel electrode layer **11**. The color filter layer **14** includes a plurality of color filter units **141**, and the pixel electrode layer **11** includes a plurality of pixel electrodes **110**, the pixel electrodes **110** are arranged corresponding to the color filter units **141** in a one-to-one correspondence. Each pixel electrode **110** includes multiple branches **112**, and within each pixel electrode **110**, at least part of one branch **112** is at a first distance d**1** from the bottom surface of the color filter unit **141**, while at least part of another branch **112** is at a second distance d**2** from the bottom surface of the color filter unit **141**, with the first distance d**1** being different from the second distance d**2**. The second embodiment does not reiterate the parts that are the same.
(60) Referring to FIGS. **6** and **7**, in some embodiments of the present application, each pixel electrode **110** includes four branches **112**, each containing multiple branch electrodes **113**, and within each pixel electrode **110**, the orientations of the branch electrodes **113** in any two branches **112** are different. Each of the four branches **112** includes a first sub-branch **114** and a second sub-branch **115**, with the first sub-branch **114** being at the first distance d**1** from the bottom surface of the color filter unit **141**, and the second sub-branch **115** being at the second distance d**2** from the bottom surface of the color filter unit **141**. Within each pixel electrode **110**, two of the second sub-branches **115** are located on one side of the four first sub-branches **114**, while the other two second sub-branches **115** are located on the opposite side of the four sub-branches **114**, and the two second sub-branches **115** are symmetrically arranged in relation to the other two second sub-branches **115**.
(61) In the display panel provided by this application, since each branch **112** includes a first sub-branch **114** and a second sub-branch **115**, with the first sub-branch **114** at the first distance d**1** from the bottom surface of the color filter unit **141**, and the second sub-branch **115** at the second distance d**2** from the bottom surface of the color filter unit **141**, the precision of control over the corresponding liquid crystal molecules by each branch **112** is enhanced, thereby further improving the display performance at wide viewing angles.

(62) At the same time, by positioning two of the second sub-branches **115** on one side of the four first sub-branches **114**, and the other two second sub-branches **115** on the opposite side of the branches, and arranging these two second sub-branches **115** symmetrically with respect to the other two second sub-branches **115** within each pixel electrode **110**, the display panel provided in the second embodiment can use the pixel electrode **110** as the smallest repeating unit. This arrangement ensures that within the same region of each pixel electrode **110**, the branches **112** have the same distance to the common electrode, thereby simplifying the preparation of the first organic insulating layer **12** and reducing the production and manufacturing costs associated with the halftone mask.
(63) It should be noted that using the pixel electrode **110** as the smallest repeating unit ensures that, whether it is between two pixel electrodes **110** corresponding to two same-color sub-pixels adjacent in the first direction X or between two pixel electrodes **110** corresponding to two different-color sub-pixels adjacent in the second direction Y, the branches **112** within the same region of each pixel electrode **110** have the same distance to the common electrode.
(64) In some embodiments of the present application, within each pixel electrode **110**, a total area of the four first sub-branches **114** is denoted as a, and a total area of the four second branches **112** is denoted as b. The ratio of a to b is within the range of 1/2 to 1.
(65) In the display panel provided by this application, since the ratio of the total area of the four first sub-branches **114** to a total area of the four second branches **112** is above 1/2, it prevents the issue of increased manufacturing complexity due to the first sub-branches **114** being too small in area. Moreover, since the ratio of the total area of the four first sub-branches **114** to the total area of the four second branches **112** is below 1, it prevents the potentially adverse effect on the arrangement of liquid crystal molecules in edge regions of the pixel electrode **110** that could occur if the area of the four clustered first sub-branches **114** is too large, thereby ensuring the display quality of the panel.
(66) In the second aspect, the present application further provides a display device. The display device includes a housing and any one of the described display panels. The housing features an accommodation space in which the display panel is installed.
Third Embodiment
(67) FIG. **8** presents a schematic cross-sectional view of another type of display panel provided in some embodiments of this application. In conjunction with FIGS. **2-8**, a first aspect of the third embodiment provides a display panel that includes a first substrate **10**, a second substrate **20**, and a light-modulating medium layer **30**. The first substrate **10** includes a first base **15** and a pixel electrode layer **11** positioned on one side of the first base **15**. The light-modulating medium layer **30** is set on one side of the pixel electrode layer **11** that faces away from the first base **15**. The second substrate **20** is placed on one side of the light-modulating medium layer **30** that faces away from the first substrate **10**. This second substrate **20** includes a second base **22** and a common electrode layer **21** located on one side of the second base **22** facing the light-modulating medium layer **30**. Additionally, the second substrate **20** includes a second organic insulating layer **23**. The second organic insulating layer **23** is positioned between the second base **22** and the common electrode layer **21**. The second organic insulating layer **23** causes a surface of the common electrode layer **21** that faces away from the second base **22** to be uneven.
(68) It should be noted that the structure of the display panel provided in the third embodiment of this application is similar to the structures provided in the first and second embodiments, such as the pixel electrode layer **11** including multiple pixel electrodes **110**, each containing multiple branches **112**. The third embodiment does not reiterate the parts that are the same; its main difference lies in the fact that the first substrate **10** in the third embodiment does not need a first organic insulating layer **12** that includes multiple first parts **121** and multiple second parts **122**, and within the same pixel electrode **110**, the distance between each branch **112** and the bottom surface of the color filter unit **141** is the same.

(69) In some embodiments of this application, the second organic insulating layer **23** is positioned on one side of the common electrode layer **21** that faces away from the light-modulating medium layer **30**. The second organic insulating layer **23** includes a plurality of third parts **231** and a plurality of fourth parts **232**. The third part **231** has a third thickness h**3**, and the fourth part **232** has a fourth thickness h**4**, with the third thickness h**3** being different from the fourth thickness h**4**. Wherein, at least part of one branch **112** at a first distance from the common electrode layer **21** is arranged to correspond to the third part **231**, and at least part of another branch **112** at a second distance from the common electrode layer **21** is arranged to correspond to the fourth part **232**.
(70) In the display panel provided by this application, the second organic insulating layer **23** is positioned on one side of the common electrode layer **21** that is away from the light-modulating medium layer **30**. The shape of the second organic insulating layer **23** can influence the surface state of the common electrode layer **21**, consequently resulting in at least part of one branch **112** of each pixel electrode **110** being at the first distance from the common electrode layer **21**, and at least part of another branch **112** being at the second distance from the common electrode layer **21**.
(71) In some embodiments of this application, the second organic insulating layer **23** is made of an organic material, such as positive or negative photoresist.
(72) In some embodiments of this application, the second organic insulating layer **23** can be structured using a halftone mask process to form multiple third parts **231** with a third thickness h**3** and multiple fourth parts **232** with a fourth thickness h**4**. This can create a step at the junction between the third part **231** and the fourth part **232**. Utilizing the difference in thickness between the third part **231** and the fourth part **232**, the arrangement ensures that within each pixel electrode **110**, at least part of one branch **112** is at the first distance from the common electrode layer **21**, while at least part of another branch **112** is at the second distance from the common electrode layer **21**.
(73) In some embodiments of this application, the first substrate **10** includes a color filter layer **14**, the second substrate **20** includes a second base **22**, as well as a second organic insulating layer **23** positioned on a surface of the second base **22**, and a common electrode layer **21** located on a surface of the second organic insulating layer **23** away from the second base **22**.
(74) In the display panel provided by this application, since the color filter layer **14** is positioned on the first substrate **10**, it simplifies the structure of the second substrate **20**, reducing the number of layers in the second substrate **20**. This allows the second organic insulating layer **23** to be directly placed on the surface of the second base **22**, thereby improving the precision of thickness control for the third part **231** and fourth part **232** within the second organic insulating layer **23**, further enhancing the display performance at wide viewing angles.
(75) In summary, the present application provides a display panel and a display device. The display panel includes a first substrate, a second substrate, and a light-modulating medium layer, where the first substrate includes a first base and a pixel electrode layer positioned on one side of the first base; the light-modulating medium layer is set on one side of the pixel electrode layer away from the first base; the second substrate is positioned on one side of the light-modulating medium layer away from the first substrate, and includes a second base and a common electrode layer facing towards the light-modulating medium layer; the first substrate also includes a first organic insulating layer, positioned between the first base and the pixel electrode layer, which causes a surface of the pixel electrode layer facing away from the first base to be uneven; alternatively, the second substrate includes a second organic insulating layer, positioned between the second base and the common electrode layer, which causes a surface of the common electrode layer facing away from the second base to be uneven. The display panel and the display device provided by this application can enhance the display effects at wide viewing angles while maintaining a high aperture ratio, high light transmittance, and low power consumption.
(76) The detailed introduction provided above describes a display panel and a display device according to specific embodiments of this application. Specific examples have been used to explain the principles and implementations of this application. The description of these embodiments is

intended to aid in understanding the methods and core ideas of this application. Furthermore, for those skilled in the art, changes in specific implementations and application scopes are anticipated based on the ideas of this application. Therefore, the contents of this document should not be construed as limiting the scope of this application.

Claims

1. A display panel, comprising: a first substrate, comprising a first base and a pixel electrode layer disposed on one side of the first base; a light-modulating medium layer, disposed on one side of the pixel electrode layer that is away from the first base; and a second substrate, disposed on one side of the light-modulating medium layer that is away from the first substrate, the second substrate comprising a second base and a common electrode layer arranged on one side of the second base facing the light-modulating medium layer; wherein the first substrate comprises a color filter layer and a first organic insulating layer, the first organic insulating layer is disposed between the first base and the pixel electrode layer and arranged between the color filter layer and the pixel electrode layer, and the first organic insulating layer causes a surface of the pixel electrode layer that is away from the first base to be uneven; wherein the color filter layer comprises a plurality of color filter units, the pixel electrode layer comprises a plurality of pixel electrodes, the pixel electrodes are disposed corresponding to the color filter units in a one-to-one correspondence, and each of the pixel electrodes comprises a plurality of branches, wherein within each pixel electrode, at least part of one of the branches is at a first distance from a bottom surface of the color filter unit, and at least part of another branch is at a second distance from the bottom surface of the color filter unit, with the first distance being different from the second distance; wherein the first organic insulating layer comprises a plurality of first parts and a plurality of second parts, each of the first parts possesses a first thickness, each of the second parts possesses a second thickness, and the first thickness is different from the second thickness; at least part of one branch, which is at the first distance from the bottom surface of the color filter unit, corresponds to the first part, and at least part of another branch, which is at the second distance from the bottom surface of the color filter unit, corresponds to the second part; wherein the color filter units comprise a plurality of first color filter units, a plurality of second color filter units, and a plurality of third color filter units; the first color filter units, the second color filter units, and the third color filter units have different light-transmitting colors; the first color filter units are red color filter units, the second color filter units are green color filter units, and the third color filter units are blue color filter units; the first color filter units and the second color filter units possess a same first thickness, and the third color filter units possess a second thickness greater than the first thickness; wherein a thickness difference between the first thickness and the second thickness contributes to the first parts and the second parts correspond to the third color filter units being higher than the other first parts and the other second parts.
2. The display panel according to claim 1, wherein each of the pixel electrodes comprises four branches, each of the branches comprises a plurality of branch electrodes, and within each pixel electrode, orientations of the branch electrodes in any two branches are different; in each of the pixel electrodes, two of the four branches are at the first distance from the bottom surface of the color filter unit, and the other two branches are at the second distance from the bottom surface of the color filter unit.
3. The display panel according to claim 2, wherein the pixel electrodes are sequentially arranged in the first direction and the second direction, wherein within each pixel electrode, two branches that are at the first distance from the bottom surface of the color filter unit are not adjacent to each other in the first direction and the second direction, and two branches that are at the second distance from the bottom surface of the color filter unit are not adjacent in the first direction and the second direction.

4. The display panel according to claim 3, wherein each of the pixel electrodes is divided into two first regions and two second regions, wherein in one of two adjacent pixel electrodes in the first direction, two branches at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively, while in the other of the two adjacent pixel electrodes in the first direction, two branches at the first distance from the bottom surface of the color filter unit are located in the two second regions respectively, and the other two branches at the second distance from the bottom surface of the color filter unit are located in the two first regions respectively.
5. The display panel according to claim 4, wherein in one of two adjacent pixel electrodes in the second direction, two branches that are at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches that are at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively, while in the other of the two adjacent pixel electrodes in the second direction, two branches that are at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches that are at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively.
6. The display panel according to claim 1, wherein each of the pixel electrodes comprises four branches, each of the branches comprises a plurality of branch electrodes, and within each pixel electrode, orientations of the branch electrodes in any two branches are different, wherein in each of the four branches, each branch comprises a first sub-branch and a second sub-branch, with the first sub-branch being at the first distance from the bottom surface of the color filter unit, and the second sub-branch being at the second distance from the bottom surface of the color filter unit; within each of the pixel electrodes, two of the second sub-branches are located on one side of the four first sub-branches, while the other two second sub-branches are located on an opposite side of the four first sub-branches, and these two second sub-branches are symmetrically arranged with respect to the other two second sub-branches.
7. The display panel according to claim 1, wherein the second substrate comprises the second organic insulating layer, the second organic insulating layer comprises a plurality of third parts and a plurality of fourth parts, each of the third parts possesses a third thickness, and each of the fourth parts possesses a fourth thickness, with the third thickness being different from the fourth thickness.
8. A display device, comprising a display panel, wherein the display panel comprises: a first substrate, comprising a first base and a pixel electrode layer disposed on one side of the first base; a light-modulating medium layer, disposed on one side of the pixel electrode layer that is away from the first base; and a second substrate, disposed on one side of the light-modulating medium layer that is away from the first substrate, the second substrate comprising a second base and a common electrode layer arranged on one side of the second base facing the light-modulating medium layer; wherein the first substrate comprises a color filter layer and a first organic insulating layer, the first organic insulating layer is disposed between the first base and the pixel electrode layer and arranged between the color filter layer and the pixel electrode layer, and the first organic insulating layer causes a surface of the pixel electrode layer that is away from the first base to be uneven; wherein the color filter layer comprises a plurality of color filter units, the pixel electrode layer comprises a plurality of pixel electrodes, the pixel electrodes are disposed corresponding to the color filter units in a one-to-one correspondence, and each of the pixel electrodes comprises a plurality of branches, wherein within each pixel electrode, at least part of one of the branches is at a first distance from a bottom surface of the color filter unit, and at least part of another branch is at a second distance from the bottom surface of the color filter unit, with the first distance being different from the second distance; wherein the first organic insulating layer comprises a plurality of first parts and a plurality of second parts, each of the first parts possesses a first thickness, each

of the second parts possesses a second thickness, and the first thickness is different from the second thickness; at least part of one branch, which is at the first distance from the bottom surface of the color filter unit, corresponds to the first part, and at least part of another branch, which is at the second distance from the bottom surface of the color filter unit, corresponds to the second part; wherein the color filter units comprise a plurality of first color filter units, a plurality of second color filter units, and a plurality of third color filter units; the first color filter units, the second color filter units, and the third color filter units have different light-transmitting colors; the first color filter units are red color filter units, the second color filter units are green color filter units, and the third color filter units are blue color filter units; the first color filter units and the second color filter units have a same first thickness, and the third color filter units have a second thickness greater than the first thickness; wherein a thickness difference between the first thickness and the second thickness contributes to the first parts and the second parts correspond to the third color filter units being higher than the other first parts and the other second parts.
9. The display device according to claim 8, wherein each of the pixel electrodes comprises four branches, each of the branches comprises a plurality of branch electrodes, and within each pixel electrode, orientations of the branch electrodes in any two branches are different; in each of the pixel electrodes, two of the four branches are at the first distance from the bottom surface of the color filter unit, and the other two branches are at the second distance from the bottom surface of the color filter unit.
10. The display device according to claim 9, wherein the pixel electrodes are sequentially arranged in the first direction and the second direction, wherein within each pixel electrode, two branches that are at the first distance from the bottom surface of the color filter unit are not adjacent to each other in the first direction and the second direction, and two branches that are at the second distance from the bottom surface of the color filter unit are not adjacent in the first direction and the second direction.
11. The display device according to claim 10, wherein each of the pixel electrodes is divided into two first regions and two second regions, wherein in one of two adjacent pixel electrodes in the first direction, two branches at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively, while in the other of the two adjacent pixel electrodes in the first direction, two branches at the first distance from the bottom surface of the color filter unit are located in the two second regions respectively, and the other two branches at the second distance from the bottom surface of the color filter unit are located in the two first regions respectively.
12. The display device according to claim 11, wherein in one of two adjacent pixel electrodes in the second direction, two branches that are at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches that are at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively, while in the other of the two adjacent pixel electrodes in the second direction, two branches that are at the first distance from the bottom surface of the color filter unit are located in the two first regions respectively, and the other two branches that are at the second distance from the bottom surface of the color filter unit are located in the two second regions respectively.
13. The display device according to claim 8, wherein each of the pixel electrodes comprises four branches, each of the branches comprises a plurality of branch electrodes, and within each pixel electrode, orientations of the branch electrodes in any two branches are different, wherein in each of the four branches, each branch comprises a first sub-branch and a second sub-branch, with the first sub-branch being at the first distance from the bottom surface of the color filter unit, and the second sub-branch being at the second distance from the bottom surface of the color filter unit; within each of the pixel electrodes, two of the second sub-branches are located on one side of the four first sub-branches, while the other two second sub-branches are located on an opposite side of

the four first sub-branches, and these two second sub-branches are symmetrically arranged with respect to the other two second sub-branches.

14. The display device according to claim 8, wherein the second substrate comprises the second organic insulating layer, the second organic insulating layer comprises a plurality of third parts and a plurality of fourth parts, each of the third parts possesses a third thickness, and each of the fourth parts possesses a fourth thickness, with the third thickness being different from the fourth thickness.