

DESCRIPTION

TITLE OF THE INVENTION:

DISPLAY PANEL

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BACKGROUND

Technical Field

[0001] The disclosure relates to a display panel.

10 Description of Related Art

[0002] Touchscreen technology has brought a new era to mobile phones and tablet computers, and is widely applied to notebook computers, desktop computer monitors, and all-in-one computers. To transform a display into a “touch panel,” it is necessary to combine two completely different functions: display and touch. In the past, a touch sensor
15 was added to the display by a “laminated” approach. Recently, technology has developed embedded displays that directly integrate the touch sensor into the display. However, touch signal lines disposed in the pixel array layer cause problems such as color shift, light leakage in a dark state, and contrast ratio degradation at a front viewing angle or a lateral viewing angle.

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SUMMARY

[0003] The disclosure provides a display panel, to which a color shift at a lateral viewing angle due to reflections from the signal lines does not occur. Light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle are also

avoided.

[0004] According to an embodiment of the disclosure, a display panel including a substrate, a pixel array layer, and a color resist layer is provided. The substrate has a surface. The pixel array layer is disposed on the surface and includes a plurality of signal
5 lines arranged along a first direction. The color resist layer is disposed on the pixel array layer and includes a plurality of pixel units. The plurality of pixel units are sequentially arranged along the first direction. Each of the plurality of pixel units includes a plurality of color resists. The plurality of color resists of each of the plurality of pixel units include a first color resist, a second color resist, and a third color resist sequentially arranged along
10 the first direction. The first color resist, the second color resist, and the third color resist are different in color. Each of the plurality of signal lines corresponds to a boundary between the first color resist and the second color resist, a boundary between the second color resist and the third color resist, or a boundary between the third color resist and the first color resist. An interval between adjacent two of the plurality of signal lines
15 corresponds to N of the plurality of color resists. N is a positive integer greater than 1, and N is not a multiple of 3.

[0005] According to another embodiment of the disclosure, a display panel including a substrate, a pixel array layer, and a color resist layer is provided. The substrate has a surface. The pixel array layer is disposed on the surface and includes a plurality of signal
20 line groups arranged along a first direction. Each of the plurality of signal line groups includes M signal lines arranged along the first direction. M is a positive integer greater than 1. The color resist layer is disposed on the pixel array layer and includes a plurality of pixel units. The plurality of pixel units are sequentially arranged along the first direction. Each of the plurality of pixel units includes a plurality of color resists. The plurality of

color resists of each of the plurality of pixel units include a first color resist, a second color resist, and a third color resist sequentially arranged along the first direction. The first color resist, the second color resist, and the third color resist are different in color. Each of the plurality of signal lines corresponds to a boundary between the first color resist and the second color resist, a boundary between the second color resist and the third color resist, or a boundary between the third color resist and the first color resist. An interval between adjacent two of the M signal lines in each of the plurality of signal line groups corresponds to one of the plurality of color resists. An interval between adjacent two of the plurality of signal line groups corresponds to N of the plurality of color resists. A sum of M and N is a positive integer greater than 3, and the sum of M and N is not a multiple of 3.

[0006] Based on the above, the display panel provided in the embodiment of the disclosure has a special signal line configuration. A signal line does not need to be disposed at each color resist boundary, thereby avoiding light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle. Color shift caused by reflection from the signal lines at a lateral viewing angle is also avoided.

[0007] To make the features and advantages of the disclosure more comprehensible, several embodiments accompanied with drawings are described in detail as follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. 1A is a schematic diagram of a display panel according to some embodiments of the disclosure.

[0009] FIG. 1B is a cross-sectional schematic diagram of a display panel according to an embodiment of the disclosure.

[0010] FIG. 1C is a schematic diagram of a display panel according to an embodiment of

the disclosure.

[0011] FIG. 2 is a schematic diagram of a display panel according to an embodiment of the disclosure.

[0012] FIG. 3 is a schematic diagram of a display panel according to a first embodiment
5 of the disclosure.

[0013] FIG. 4 is a schematic diagram of a display panel according to a second embodiment of the disclosure.

[0014] FIG. 5 is a schematic diagram of a display panel according to a third embodiment of the disclosure.

10 **[0015]** FIG. 6 is a schematic diagram of a display panel according to a fourth embodiment of the disclosure.

[0016] FIG. 7 is a schematic diagram of a display panel according to a fifth embodiment of the disclosure.

[0017] FIG. 8 is a schematic diagram of a display panel according to a sixth embodiment
15 of the disclosure.

DESCRIPTION OF THE EMBODIMENTS

[0018] Referring to FIG. 1A, FIG. 1B, and FIG. 1C, a display panel 10 includes a first substrate 100, a pixel array layer PL, a second substrate 200, and a color resist layer 300.

20 The first substrate 100 has a first surface S1. The second substrate 200 has a second surface S2. The pixel array layer PL is disposed on the first surface S1 and includes a plurality of gate lines of a TFT array, a plurality of data lines of the TFT array, and a plurality of signal lines TS₁, TS₂... TS_m, TS_{m+1}.... It is particularly noted that the signal lines TS₁, TS₂... TS_m, TS_{m+1}... are not the gate lines and the data lines of the TFT array. In addition,

for the sake of understanding, the gate lines and the data lines of the TFT array are not shown.

[0019] The color resist layer 300 is disposed on the second surface S2 and is located above the pixel array layer PL. The display panel 10 may be implemented as an embedded touch panel, and the signal lines TS₁, TS₂... TS_m, TS_{m+1}... are touch signal lines and are respectively connected between a plurality of touch sensors SR and a controller DR. However, the disclosure is not limited thereto. In some embodiments, the display panel 10 is not a touch panel, and the signal lines TS₁, TS₂... TS_m, TS_{m+1}... may be heating lines used for heating.

[0020] The color resist layer 300 includes a plurality of pixel units PX. The pixel units PX are sequentially arranged along an X direction, and each pixel unit PX includes a first color resist CR1, a second color resist CR2, and a third color resist CR3 sequentially arranged along the X direction. The first color resist CR1, the second color resist CR2, and the third color resist CR3 are different in color. In this embodiment, the colors of the first color resist CR1, the second color resist CR2, and the third color resist CR3 are red, green, and blue respectively, but are not limited thereto. In some embodiments, the colors of the first color resist CR1, the second color resist CR2, and the third color resist CR3 are green, blue, and red respectively. In some embodiments, the colors of the first color resist CR1, the second color resist CR2, and the third color resist CR3 are blue, red, and green respectively.

[0021] As shown in FIG. 1B, each of the signal lines TS₁, TS₂... TS_m, TS_{m+1}... has a taper due to a limitation of a metal etching process. In this situation, when an environmental light (white light) EL enters the display panel 10, the environmental light EL is reflected by a side surface of each of the signal lines TS₁, TS₂... TS_m, TS_{m+1}... and then emitted out of

the display panel 10, and the emitted light is formed as light having a color of the color resist that the environmental light EL passes through.

[0022] In the embodiments of FIG. 1A, FIG. 1B, and FIG. 1C, each of the signal lines TS₁, TS₂... TS_m, TS_{m+1}... is exemplarily disposed under a black matrix BM at a boundary between the first color resist CR1 and the second color resist CR2. At a position under the black matrix BM where none of the signal lines TS₁, TS₂... TS_m, TS_{m+1}... is disposed, a spacer may be disposed, but is not limited thereto. Therefore, as shown in FIG. 1B, when a user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, a side surface of each of the signal lines TS₁, TS₂... TS_m, TS_{m+1}... facing the +X direction reflects the environmental light EL, and the user sees a reflected light GR having a color of the second color resist CR2, for example, a green reflected light GR. Similarly, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, a side surface of each of the signal lines TS₁, TS₂... TS_m, TS_{m+1}... facing the -X direction reflects the environmental light EL, and a reflected light RR having a color of the first color resist CR1 is seen, for example, a red reflected light RR. The above colored reflected lights may cause color shift in the display panel 10 at a lateral viewing angle.

[0023] To fully illustrate various embodiments of the disclosure, other embodiments of the disclosure are described below. It must be noted herein that the following embodiments differ from the above embodiments in a configuration manner of the signal lines, and descriptions of identical technical content are omitted. The omitted descriptions can be referred to the foregoing embodiments. In addition, the following embodiments also continue to use the reference numerals and some contents of the foregoing embodiments, and the same or similar elements are indicated by the same reference

numerals.

[0024] Referring to FIG. 1A and FIG. 2, in another embodiment of the disclosure, the signal lines $TS_1, TS_2 \dots TS_m, TS_{m+1} \dots$ of the display panel 10 are sequentially disposed along an X direction under a black matrix BM at boundaries of adjacent color resists CR1, CR2, and CR3. In this situation, when a user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, side surfaces of the signal lines $TS_1, TS_2 \dots TS_m, TS_{m+1} \dots$ facing the +X direction respectively generate reflected light having colors of the first color resist CR1, the second color resist CR2, the third color resist CR3, the first color resist CR1, the second color resist CR2, the third color resist CR3..., for example, red reflected light, green reflected light, blue reflected light, red reflected light, green reflected light, blue reflected light.... Therefore, the above colored lights are mixed into white reflected light. Similarly, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, white reflected light is also seen. It is particularly noted that, compared with the display panel shown in FIG. 1C, color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel in this embodiment.

[0025] Referring to FIG. 1A and FIG. 3, in a first embodiment of the disclosure, a display panel 10 includes a first substrate 100, a pixel array layer PL, and a color resist layer 300.

[0026] The pixel array layer PL is disposed on a surface of the first substrate 100 and includes a plurality of gate lines of a TFT array, a plurality of data lines of the TFT array, and a plurality of signal lines $TP_1, TP_2 \dots TP_m, TP_{m+1} \dots$. It is particularly noted that the signal lines $TP_1, TP_2 \dots TP_m, TP_{m+1} \dots$ are not the gate lines and the data lines of the TFT array.

[0027] In some embodiments, the display panel 10 may be implemented as an embedded

touch panel, and the signal lines TP₁, TP₂... TP_m, TP_{m+1}... are touch signal lines respectively connected between a plurality of touch sensors SR and a controller DR. However, the disclosure is not limited thereto. In some embodiments, the display panel 10 is not a touch panel, and the signal lines TP₁, TP₂... TP_m, TP_{m+1}... may be heating lines used for heating.

- 5 **[0028]** The color resist layer 300 is disposed on the pixel array layer PL and includes a plurality of pixel units PX. The pixel units PX are sequentially arranged along an X direction, and each pixel unit PX includes a first color resist CR1, a second color resist CR2, and a third color resist CR3 sequentially arranged along the X direction. The first color resist CR1, the second color resist CR2, and the third color resist CR3 are different in color.
- 10 In this embodiment, the colors of the first color resist CR1, the second color resist CR2, and the third color resist CR3 are red, green, and blue respectively, but are not limited thereto. In some embodiments, the colors of the first color resist CR1, the second color resist CR2, and the third color resist CR3 are green, blue, and red respectively. In some embodiments, the colors of the first color resist CR1, the second color resist CR2, and the third color resist
- 15 CR3 are blue, red, and green respectively.

[0029] It should be noted that FIG. 3 merely illustrates a schematic diagram of a partial region of the display panel 10. In fact, the structure shown in FIG. 3 is periodically arranged on the first substrate 100.

- [0030]** As shown in FIG. 3, the signal line TP₁ corresponds to a boundary between the
- 20 first color resist CR1 and the second color resist CR2. The signal line TP₂ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. The signal line TP₃ corresponds to a boundary between the second color resist CR2 and the third color resist CR3. An interval between adjacent two of the signal lines corresponds to two of the color resists. Specifically, an interval between the adjacent signal line TP₁ and signal line

TP₂ corresponds to a second color resist CR₂ and a third color resist CR₃. An interval between the adjacent signal line TP₂ and signal line TP₃ corresponds to a first color resist CR₁ and a second color resist CR₂. An interval between the adjacent signal line TP₃ and signal line TP₄ (not shown) corresponds to a third color resist CR₃ and a first color resist
5 CR₁.

[0031] When a user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, light reflected by the signal line TP₁ and passing through the second color resist CR₂, light reflected by the signal line TP₂ and passing through the first color resist CR₁, and light reflected by the signal line TP₃ and passing through the third
10 color resist CR₃ are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 3 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, white reflected light is seen.

[0032] Similarly, when a user observes the display panel 10 from a lateral viewing angle
15 from a -X direction toward a +X direction, light reflected by the signal line TP₁ and passing through the first color resist CR₁, light reflected by the signal line TP₂ and passing through the third color resist CR₃, and light reflected by the signal line TP₃ and passing through the second color resist CR₂ are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 3 is periodically arranged on the
20 first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, white reflected light is seen.

[0033] Color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel 10 of the first embodiment.

[0034] Compared to the embodiment shown in FIG. 2, in which the signal lines TS₁,

TS₂... TS_m, TS_{m+1}... are disposed under the black matrix BM at all boundaries of adjacent color resists CR₁, CR₂, and CR₃, the distribution density of the signal lines TP₁, TP₂... TP_m, TP_{m+1}... in the embodiment shown in FIG. 3 is reduced to one-half. Accordingly, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines can be avoided. In some embodiments, a center (front viewing angle) contrast ratio of the display panel in FIG. 3 is increased by 10% compared to that of the display panel in FIG. 2, and a lateral (lateral viewing angle) contrast ratio of the display panel in FIG. 3 is increased by 17% compared to that of the display panel in FIG. 2.

[0035] Referring to FIG. 1A and FIG. 4, FIG. 4 illustrates a schematic diagram of a display panel according to a second embodiment of the disclosure. It should be noted that FIG. 4 merely illustrates a schematic diagram of a partial region of the display panel of the second embodiment. In fact, the structure shown in FIG. 4 is periodically arranged on the first substrate 100.

[0036] The display panel of the second embodiment (FIG. 4) is generally the same in configuration as the display panel of the first embodiment (FIG. 3), and details are not repeated here. The display panel of the second embodiment is different from the display panel of the first embodiment in that the signal line TP₁ corresponds to a boundary between the first color resist CR₁ and the second color resist CR₂. The signal line TP₂ corresponds to a boundary between the second color resist CR₂ and the third color resist CR₃. The signal line TP₃ corresponds to a boundary between the third color resist CR₃ and the first color resist CR₁. An interval between adjacent two of the signal lines corresponds to four of the color resists. Specifically, an interval between the adjacent signal line TP₁ and signal line TP₂ corresponds to two second color resists CR₂, a third color resist CR₃, and a

first color resist CR1. An interval between the adjacent signal line TP₂ and signal line TP₃ corresponds to two third color resists CR3, a first color resist CR1, and a second color resist CR2. An interval between the adjacent signal line TP₃ and signal line TP₄ (not shown) corresponds to two first color resists CR1, a second color resist CR2, and a third color resist
5 CR3.

[0037] When a user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, light reflected by the signal line TP₁ and passing through the second color resist CR2, light reflected by the signal line TP₂ and passing through the third color resist CR3, and light reflected by the signal line TP₃ and passing through the first
10 color resist CR1 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 4 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, white reflected light is seen.

[0038] Similarly, when a user observes the display panel 10 from a lateral viewing angle
15 from a -X direction toward a +X direction, light reflected by the signal line TP₁ and passing through the first color resist CR1, light reflected by the signal line TP₂ and passing through the second color resist CR2, and light reflected by the signal line TP₃ and passing through the third color resist CR3 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 4 is periodically arranged on the
20 first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, white reflected light is seen.

[0039] Color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel 10 of the second embodiment.

[0040] Compared to the embodiment shown in FIG. 2, in which the signal lines TS₁,

TS₂... TS_m, TS_{m+1}... are disposed under the black matrix BM at all boundaries of adjacent color resists CR1, CR2, and CR3, the distribution density of the signal lines TP₁, TP₂... TP_m, TP_{m+1}... in the second embodiment shown in FIG. 4 is reduced to one-fourth. Accordingly, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines can be avoided.

[0041] Referring to FIG. 1A and FIG. 5, FIG. 5 illustrates a schematic diagram of a display panel according to a third embodiment of the disclosure. It should be noted that FIG. 5 merely illustrates a schematic diagram of a partial region of the display panel of the third embodiment. In fact, the structure shown in FIG. 5 is periodically arranged on the first substrate 100.

[0042] The display panel of the third embodiment (FIG. 5) is generally the same in configuration as the display panel of the first embodiment (FIG. 3), and details are not repeated here. The display panel of the third embodiment is different from the display panel of the first embodiment in that the signal line TP₁ corresponds to a boundary between the first color resist CR1 and the second color resist CR2. The signal line TP₂ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. The signal line TP₃ corresponds to a boundary between the second color resist CR2 and the third color resist CR3. An interval between adjacent two of the signal lines corresponds to five of the color resists. Specifically, an interval between the adjacent signal line TP₁ and signal line TP₂ corresponds to two second color resists CR2, two third color resists CR3, and a first color resist CR1. An interval between the adjacent signal line TP₂ and signal line TP₃ corresponds to two first color resists CR1, two second color resists CR2, and a third color resist CR3. An interval between the adjacent signal line TP₃ and signal line TP₄ (not

shown) corresponds to two third color resists CR3, two first color resists CR1, and a second color resist CR2.

[0043] When a user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, light reflected by the signal line TP₁ and passing through the second color resist CR2, light reflected by the signal line TP₂ and passing through the first color resist CR1, and light reflected by the signal line TP₃ and passing through the third color resist CR3 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 5 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, white reflected light is seen.

[0044] Similarly, when a user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, light reflected by the signal line TP₁ and passing through the first color resist CR1, light reflected by the signal line TP₂ and passing through the third color resist CR3, and light reflected by the signal line TP₃ and passing through the second color resist CR2 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 5 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, white reflected light is seen.

[0045] Color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel 10 of the third embodiment.

[0046] Compared to the embodiment shown in FIG. 2, in which the signal lines TS₁, TS₂... TS_m, TS_{m+1}... are disposed under the black matrix BM at all boundaries of adjacent color resists CR1, CR2, and CR3, the distribution density of the signal lines TP₁, TP₂... TP_m, TP_{m+1}... in the third embodiment shown in FIG. 5 is reduced to one-fifth.

Accordingly, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines can be avoided.

[0047] Referring to FIG. 1A and FIG. 6, FIG. 6 illustrates a schematic diagram of a display panel according to a fourth embodiment of the disclosure. It should be noted that FIG. 6 merely illustrates a schematic diagram of a partial region of the display panel of the fourth embodiment. In fact, the structure shown in FIG. 6 is periodically arranged on the first substrate 100.

[0048] The display panel of the fourth embodiment (FIG. 6) is generally the same in configuration as the display panel of the first embodiment (FIG. 3), and details are not repeated here. The display panel of the fourth embodiment is different from the display panel of the first embodiment in that the signal line TP₁ corresponds to a boundary between the first color resist CR1 and the second color resist CR2. The signal line TP₂ corresponds to a boundary between the second color resist CR2 and the third color resist CR3. The signal line TP₃ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. An interval between adjacent two of the signal lines corresponds to seven of the color resists. Specifically, an interval between the adjacent signal line TP₁ and signal line TP₂ corresponds to three second color resists CR2, two third color resists CR3, and two first color resists CR1. An interval between the adjacent signal line TP₂ and signal line TP₃ corresponds to three third color resists CR3, two first color resists CR1, and two second color resists CR2. An interval between the adjacent signal line TP₃ and signal line TP₄ (not shown) corresponds to three first color resists CR1, two second color resists CR2, and two third color resists CR3.

[0049] When a user observes the display panel 10 from a lateral viewing angle from a +X

direction toward a -X direction, light reflected by the signal line TP₁ and passing through the second color resist CR₂, light reflected by the signal line TP₂ and passing through the third color resist CR₃, and light reflected by the signal line TP₃ and passing through the first color resist CR₁ are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 6 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, white reflected light is seen.

[0050] Similarly, when a user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, light reflected by the signal line TP₁ and passing through the first color resist CR₁, light reflected by the signal line TP₂ and passing through the second color resist CR₂, and light reflected by the signal line TP₃ and passing through the third color resist CR₃ are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 6 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, white reflected light is seen.

[0051] Color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel 10 of the fourth embodiment.

[0052] Compared to the embodiment shown in FIG. 2, in which the signal lines TS₁, TS₂... TS_m, TS_{m+1}... are disposed under the black matrix BM at all boundaries of adjacent color resists CR₁, CR₂, and CR₃, the distribution density of the signal lines TP₁, TP₂... TP_m, TP_{m+1}... in the fourth embodiment shown in FIG. 6 is reduced to one-seventh. Accordingly, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines can be avoided.

[0053] It should be noted that, as shown in the first embodiment to the fourth embodiment above, when an interval between adjacent two of the signal lines corresponds to N of the color resists, wherein N is a positive integer greater than 1 and N is not a multiple of 3, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines can be avoided, and color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel.

[0054] Referring to FIG. 1A and FIG. 7, in a fifth embodiment of the disclosure, a display panel 10 includes a first substrate 100, a pixel array layer PL, and a color resist layer 300.

[0055] The pixel array layer PL is disposed on a surface of the first substrate 100 and includes a plurality of gate lines of a TFT array, a plurality of data lines of the TFT array, and a plurality of signal lines TP₁, TP₂... TP_m, TP_{m+1}.... The signal lines TP₁, TP₂... TP_m, TP_{m+1}... can be grouped into a plurality of signal line groups TG₁, TG₂... TG_n, TG_{n+1}.... It is particularly noted that the signal lines TP₁, TP₂... TP_m, TP_{m+1}... are not the gate lines and the data lines of the TFT array.

[0056] In some embodiments, the display panel 10 may be implemented as an embedded touch panel, and the signal lines TP₁, TP₂... TP_m, TP_{m+1}... are touch signal lines respectively connected between a plurality of touch sensors SR and a controller DR. However, the disclosure is not limited thereto. In some embodiments, the display panel 10 is not a touch panel, and the signal lines TP₁, TP₂... TP_m, TP_{m+1}... may be heating lines used for heating.

[0057] The color resist layer 300 is disposed on the pixel array layer PL and includes a plurality of pixel units PX. The pixel units PX are sequentially arranged along an X direction, and each pixel unit PX includes a first color resist CR1, a second color resist CR2, and a third color resist CR3 sequentially arranged along the X direction. The first color

resist CR1, the second color resist CR2, and the third color resist CR3 are different in color.

In this embodiment, the colors of the first color resist CR1, the second color resist CR2, and the third color resist CR3 are red, green, and blue respectively, but are not limited thereto.

In some embodiments, the colors of the first color resist CR1, the second color resist CR2,

5 and the third color resist CR3 are green, blue, and red respectively. In some embodiments,

the colors of the first color resist CR1, the second color resist CR2, and the third color resist CR3 are blue, red, and green respectively.

[0058] It should be noted that FIG. 7 merely illustrates a schematic diagram of a partial region of the display panel 10. In fact, the structure shown in FIG. 7 is periodically

10 arranged on the first substrate 100.

[0059] In this embodiment, each of the plurality of signal line groups $TG_1, TG_2 \dots TG_n, TG_{n+1} \dots$ includes two signal lines arranged along the X direction. As shown in FIG. 7, the

signal line group TG_1 includes the signal lines TP_1 and TP_2 . The signal line group TG_2 includes the signal lines TP_3 and TP_4 . The signal line group TG_3 includes the signal lines

15 TP_5 and TP_6 , and so on. Furthermore, an interval between the signal lines TP_1 and TP_{two}

of the signal line group TG_1 corresponds to a color resist (the second color resist CR2). An

interval between the signal lines TP_3 and TP_4 of the signal line group TG_2 corresponds to a

color resist (the third color resist CR3). An interval between the signal lines TP_5 and TP_6

of the signal line group TG_3 corresponds to a color resist (the first color resist CR1).

20 **[0060]** In addition, an interval between adjacent two of the signal line groups $TG_1, TG_2 \dots$

$TG_n, TG_{n+1} \dots$ corresponds to three of the color resists. Specifically, as shown in FIG. 7,

the interval between the two signal line groups TG_1 and TG_2 corresponds to three of the

color resists, and the interval between the two signal line groups TG_2 and TG_3 corresponds

to three of the color resists, and so on.

[0061] As shown in FIG. 7, the signal line TP₁ corresponds to a boundary between the first color resist CR1 and the second color resist CR2. The signal line TP₂ corresponds to a boundary between the second color resist CR2 and the third color resist CR3. The signal line TP₃ corresponds to a boundary between the second color resist CR2 and the third color resist CR3. The signal line TP₄ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. The signal line TP₅ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. The signal line TP₆ corresponds to a boundary between the first color resist CR1 and the second color resist CR2.

[0062] When a user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, light reflected by the signal line TP₁ and passing through the second color resist CR2, light reflected by the signal line TP₂ and passing through the third color resist CR3, light reflected by the signal line TP₃ and passing through the third color resist CR3, light reflected by the signal line TP₄ and passing through the first color resist CR1, light reflected by the signal line TP₅ and passing through the first color resist CR1, and light reflected by the signal line TP₆ and passing through the second color resist CR2 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 7 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, white reflected light is seen.

[0063] Similarly, when a user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, light reflected by the signal line TP₁ and passing through the first color resist CR1, light reflected by the signal line TP₂ and passing through the second color resist CR2, light reflected by the signal line TP₃ and passing through the second color resist CR2, light reflected by the signal line TP₄ and passing through the third

color resist CR3, light reflected by the signal line TP₅ and passing through the third color resist CR3, and light reflected by the signal line TP₆ and passing through the first color resist CR1 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 7 is periodically arranged on the first substrate 100.

5 Therefore, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, white reflected light is seen.

[0064] Color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel 10 of the fifth embodiment.

[0065] Compared to the embodiment shown in FIG. 2, in which the signal lines TS₁, TS₂... TS_m, TS_{m+1}... are disposed under the black matrix BM at all boundaries of adjacent color resists CR1, CR2, and CR3, the distribution density of the signal lines TP₁, TP₂... TP_m, TP_{m+1}... in the embodiment shown in FIG. 7 is reduced to one-half. Accordingly, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines

15 can be avoided.

[0066] Referring to FIG. 1A and FIG. 8, FIG. 8 illustrates a schematic diagram of a display panel according to a sixth embodiment of the disclosure. It should be noted that FIG. 8 merely illustrates a schematic diagram of a partial region of the display panel of the sixth embodiment. In fact, the structure shown in FIG. 8 is periodically arranged on the

20 first substrate 100.

[0067] The display panel of the sixth embodiment (FIG. 8) is generally the same in configuration as the display panel of the fifth embodiment (FIG. 7), and details are not repeated here. The display panel of the sixth embodiment is different from the display panel of the fifth embodiment in that each of the plurality of signal line groups TG₁, TG₂...

TG_n, TG_{n+1}... includes 3 signal lines arranged along the X direction. As shown in FIG. 8, the signal line group TG₁ includes the signal lines TP₁, TP₂, and TP₃. The signal line group TG₂ includes the signal lines TP₄, TP₅, and TP₆. The signal line group TG₃ includes the signal lines TP₇, TP₈, and TP₉, and so on. Furthermore, each interval between the signal lines TP₁, TP₂, and TP₃ in the signal line group TG₁ corresponds to a color resist. Each interval between the signal lines TP₄, TP₅, and TP₆ in the signal line group TG₂ corresponds to a color resist. Each interval between the signal lines TP₇, TP₈, and TP₉ in the signal line group TG₃ corresponds to a color resist.

[0068] In addition, an interval between adjacent two of the signal line groups TG₁, TG₂... TG_n, TG_{n+1}... corresponds to two of the color resists. Specifically, as shown in FIG. 8, the interval between the two signal line groups TG₁ and TG₂ corresponds to two of the color resists, and the interval between the two signal line groups TG₂ and TG₃ corresponds to two of the color resists.

[0069] As shown in FIG. 8, the signal line TP₁ corresponds to a boundary between the first color resist CR1 and the second color resist CR2. The signal line TP₂ corresponds to a boundary between the second color resist CR2 and the third color resist CR3. The signal line TP₃ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. The signal line TP₄ corresponds to a boundary between the second color resist CR2 and the third color resist CR3. The signal line TP₅ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. The signal line TP₆ corresponds to a boundary between the first color resist CR1 and the second color resist CR2. The signal line TP₇ corresponds to a boundary between the third color resist CR3 and the first color resist CR1. The signal line TP₈ corresponds to a boundary between the first color resist CR1 and the second color resist CR2. The signal line TP₉ corresponds to a boundary

between the second color resist CR2 and the third color resist CR3.

[0070] When a user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, light reflected by the signal line TP₁ and passing through the second color resist CR2, light reflected by the signal line TP₂ and passing through the third color resist CR3, light reflected by the signal line TP₃ and passing through the first color resist CR1, light reflected by the signal line TP₄ and passing through the third color resist CR3, light reflected by the signal line TP₅ and passing through the first color resist CR1, light reflected by the signal line TP₆ and passing through the second color resist CR2, light reflected by the signal line TP₇ and passing through the first color resist CR1, light reflected by the signal line TP₈ and passing through the second color resist CR2, and light reflected by the signal line TP₉ and passing through the third color resist CR3 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 8 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a +X direction toward a -X direction, white reflected light is seen.

[0071] Similarly, when a user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, light reflected by the signal line TP₁ and passing through the first color resist CR1, light reflected by the signal line TP₂ and passing through the second color resist CR2, light reflected by the signal line TP₃ and passing through the third color resist CR3, light reflected by the signal line TP₄ and passing through the second color resist CR2, light reflected by the signal line TP₅ and passing through the third color resist CR3, light reflected by the signal line TP₆ and passing through the first color resist CR1, light reflected by the signal line TP₇ and passing through the third color resist CR3, light reflected by the signal line TP₈ and passing through the first color resist CR1, and light

reflected by the signal line TP₉ and passing through the second color resist CR2 are seen at the same time. The above light is mixed into white light. As described above, the structure shown in FIG. 8 is periodically arranged on the first substrate 100. Therefore, when the user observes the display panel 10 from a lateral viewing angle from a -X direction toward a +X direction, white reflected light is seen.

[0072] Color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel 10 of the sixth embodiment.

[0073] Compared to the embodiment shown in FIG. 2, in which the signal lines TS₁, TS₂... TS_m, TS_{m+1}... are disposed under the black matrix BM at all boundaries of adjacent color resists CR1, CR2, and CR3, the distribution density of the signal lines TP₁, TP₂... TP_m, TP_{m+1}... in the embodiment shown in FIG. 7 is reduced to three-fourths. Accordingly, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines can be avoided.

[0074] It should be noted that, as shown in the fifth embodiment to the sixth embodiment above, when each signal line group includes M signal lines, and an interval between adjacent signal line groups corresponds to N of the color resists, wherein M is a positive integer greater than 1, a sum of M and N is a positive integer greater than 3, and the sum of M and N is not a multiple of 3, problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle caused by overly high distribution density of signal lines can be avoided, and color shift at a lateral viewing angle due to reflection from the signal lines does not occur to the display panel.

[0075] In summary, the display panel provided in the embodiments of the disclosure has a special signal line configuration. A signal line does not need to be disposed at each color

resist boundary, thereby avoiding problems of light leakage in a dark state and contrast ratio degradation at a front viewing angle or a lateral viewing angle, and also avoiding color shift at a lateral viewing angle due to reflection from the signal lines.

CLAIMS

Claim 1:

A display panel, comprising:

5 a substrate, having a surface;

a pixel array layer, disposed on the surface and comprising a plurality of signal lines arranged along a first direction; and

a color resist layer, disposed on the pixel array layer and comprising a plurality of pixel units, wherein the plurality of pixel units are sequentially arranged along the first direction,

10 and each of the plurality of pixel units comprises a plurality of color resists, the plurality of color resists of each of the plurality of pixel units comprising a first color resist, a second color resist, and a third color resist sequentially arranged along the first direction, wherein the first color resist, the second color resist, and the third color resist are different in color,

wherein each of the plurality of signal lines corresponds to a boundary between the
15 first color resist and the second color resist, a boundary between the second color resist and the third color resist, or a boundary between the third color resist and the first color resist, and

wherein an interval between adjacent two of the plurality of signal lines corresponds to N of the plurality of color resists, N is a positive integer greater than 1, and N is not a
20 multiple of 3.

Claim 2:

The display panel according to claim 1, wherein $N=2$.

Claim 3:

The display panel according to claim 1, wherein $N=4$.

5 Claim 4:

The display panel according to claim 1, wherein $N=5$.

Claim 5:

The display panel according to claim 1, wherein $N=7$.

10

Claim 6:

The display panel according to claim 1, wherein the plurality of signal lines are a plurality of touch signal lines.

15 Claim 7:

The display panel according to claim 1, wherein the plurality of signal lines are a plurality of heating lines.

Claim 8:

20 The display panel according to claim 1, wherein when the display panel is observed from a lateral viewing angle along the first direction, the display panel provides a white light.

Claim 9:

A display panel, comprising:

a substrate, having a surface;

a pixel array layer, disposed on the surface and comprising a plurality of signal line groups arranged along a first direction, wherein each of the plurality of signal line groups comprises M signal lines arranged along the first direction, and M is a positive integer greater than 1; and

a color resist layer, disposed on the pixel array layer and comprising a plurality of pixel units, wherein the plurality of pixel units are sequentially arranged along the first direction, and each of the plurality of pixel units comprises a plurality of color resists, the plurality of color resists of each of the plurality of pixel units comprising a first color resist, a second color resist, and a third color resist sequentially arranged along the first direction, wherein the first color resist, the second color resist, and the third color resist are different in color,

wherein each of the plurality of signal lines corresponds to a boundary between the first color resist and the second color resist, a boundary between the second color resist and the third color resist, or a boundary between the third color resist and the first color resist,

an interval between adjacent two of the M signal lines in each of the plurality of signal line groups corresponds to one of the plurality of color resists,

an interval between adjacent two of the plurality of signal line groups corresponds to N of the plurality of color resists, and

a sum of M and N is a positive integer greater than 3, and the sum of M and N is not a multiple of 3.

Claim 10:

The display panel according to claim 9, wherein the sum of M and N is 5.

Claim 11:

5 The display panel according to claim 9, wherein M=2 and N=3.

Claim 12:

The display panel according to claim 9, wherein M=3 and N=2.

10 Claim 13:

The display panel according to claim 9, wherein the M signal lines are a plurality of touch signal lines.

Claim 14:

15 The display panel according to claim 9, wherein the M signal lines are a plurality of heating lines.

Claim 15:

20 The display panel according to claim 9, wherein when the display panel is observed from a lateral viewing angle along the first direction, the display panel provides a white light.