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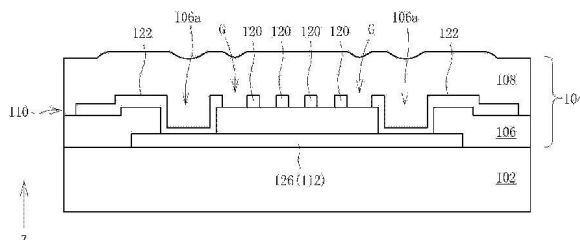
Claims 3 pages, Specification 9 pages, Drawings 11 pages

(54) Title of Utility Model

Touch Panel

(57) Abstract

The present utility model discloses a touch panel. The touch panel includes a transparent substrate and a touch sensing assembly. The touch sensing component is disposed on one side of the transparent substrate and includes a first insulating layer, a second insulating layer, and a first conductive pattern layer. The first insulating layer covers this side of the transparent substrate. The second insulating layer covers the first insulating layer, and the refractive index of the second insulating layer ranges from 1.3 to 1.55. The first conductive pattern layer includes a plurality of first electrodes, wherein each first electrode comprises multiple openings. Thereby, the light penetration rate of the touch panel is improved.



1. A touch panel, characterized in that it comprises:

A transparent substrate and

A touch sensing component, disposed on one side of the transparent substrate, and the touch sensing component comprises:

A first insulating layer, covering the side of the transparent substrate;

A second insulating layer, overlying the first insulating layer, with a refractive index between 1.3 and 1.55; and

A first conductive pattern layer disposed between the first insulating layer and the transparent substrate, between the first insulating layer and the second insulating layer, or on the second insulating layer. This layer comprises a plurality of first electrodes, each containing multiple openings.

2. The touch panel according to claim 1, characterized in that the first conductive pattern layer further comprises a plurality of second electrodes, and the first electrodes are electrically insulated from the second electrodes.

3. The touch panel according to claim 2, characterized in that the first conductive pattern layer is disposed between the first insulating layer and the transparent substrate.

4. The touch panel according to claim 2, characterized in that the first conductive pattern layer is disposed between the first insulating layer and the second insulating layer.

5. The touch panel according to claim 2, characterized in that the first conductive pattern layer is disposed on the second insulating layer, and the touch sensing component further comprises a protective layer, which is disposed on the first conductive pattern layer.

6. The touch panel according to claim 2, characterized in that each of the first electrodes is disposed corresponding to each of the second electrodes.

7. The touch panel according to claim 2, characterized in that the first electrodes are arranged in a matrix, and the first electrodes located in each column or each row are disposed to correspond to each of the second electrodes.

8. The touch panel according to claim 1, characterized in that the touch sensing component further comprises a second conductive pattern layer, wherein the first conductive pattern layer further includes a plurality of first connecting electrodes and a plurality of second electrodes. The second conductive pattern layer includes a plurality of second connecting electrodes, each of the first connecting electrodes is electrically connected to any two adjacent first electrodes arranged along a first direction, and each of the second connecting electrodes is electrically connected to any two adjacent second electrodes arranged along a second direction different from the first direction. Each of the second connecting electrodes is disposed between the transparent substrate and the first insulating layer. The first insulating layer has a plurality of contact holes corresponding to the overlapping parts of the second electrodes and the second connecting electrodes. Each of the second electrodes is electrically connected to the adjacent second connecting electrodes through the respective contact holes.

9. The touch panel according to claim 8, characterized in that the first connection electrode and the first electrode are arranged between the first insulating layer and the second insulating layer, a portion of the second electrode is arranged between the first insulating layer and the second insulating layer, another portion of the second electrode is formed on the second connection electrode through the contact hole from between the first insulating layer and the second insulating layer, and the second conductive pattern layer is arranged between the first insulating layer and the transparent substrate, with a portion of the second conductive pattern layer exposed through the contact hole.

10. The touch panel according to claim 1, characterized in that the refractive index of the first insulating layer is between 1.6 and 1.9.

11. The touch panel according to claim 10, characterized in that the first insulating layer comprises silicon oxynitride, aluminum oxide, magnesium oxide, yttrium oxide, or transparent polyimide.

12. The touch panel according to claim 1, characterized in that the first insulating layer comprises a mixture of transparent polymethyl methacrylate and titanium oxide, zirconium oxide, or tin oxide.

13. The touch panel according to claim 1, characterized in that the thickness of the first insulating layer is between 10 nanometers and 3 micrometers.

14. The touch panel according to claim 1, characterized in that the first insulating layer comprises a first film layer and a second film layer, which are sequentially stacked on the transparent substrate, and the refractive index of the first film layer is less than that of the second film layer.

15. The touch panel according to claim 14, characterized in that the refractive index of the second film layer is between 1.9 and 2.4.

16. The touch panel according to claim 14, characterized in that the thickness of the first film layer is between 10 nanometers and 3 micrometers.

17. The touch panel according to claim 14, characterized in that the first film layer comprises silicon dioxide, barium fluoride, magnesium fluoride, lithium fluoride, or strontium fluoride.

18. The touch panel according to claim 1, characterized in that the first electrode comprises a plurality of opaque conductive lines with a width of less than 10 micrometers, and at least two of the openings are surrounded by the opaque conductive lines, wherein, in a direction across both sides of the openings, the width of the openings is at least ten times the width of the opaque conductive lines.

19. The touch panel according to claim 1, characterized in that the thickness of the second insulating layer is not less than 50 nanometers and not greater than 170 nanometers.

20. The touch panel as described in claim 1, characterized in that it further includes a decorative layer and multiple signal wires, wherein the decorative layer is disposed between the signal wires and the transparent substrate.

21. A touch panel, characterized in that it comprises:

A transparent substrate and

A touch sensing component, disposed on one side of the transparent substrate, and the touch sensing component comprises:

A first insulating layer, covering the side of the transparent substrate, and the first insulating layer includes at least one film layer;

A second insulating layer, covering the first insulating layer, wherein the refractive index of the second insulating layer is lower than that of one film layer in the first insulating layer;

A first conductive pattern layer comprising a plurality of first connecting electrodes and a plurality of first electrodes, wherein each of the first connecting electrodes electrically connects any two adjacent and contiguous first electrodes arranged along a first direction, each of the first electrodes includes a plurality of openings, and the first conductive pattern layer is disposed between the first insulating layer and the second insulating layer; and

A second conductive pattern layer is disposed between the first insulating layer and the transparent substrate, comprising a plurality of second connecting electrodes and a plurality of second electrodes, wherein each of the second connecting electrodes electrically connects any two adjacent and contiguous second electrodes arranged along a second direction different from the first direction, and each of the second electrodes includes a plurality of openings.

22. The touch panel according to claim 21, wherein the refractive index of the second insulating layer is between 1.3 and 1.55.

23. The touch panel according to claim 21, wherein each first electrode includes a plurality of opaque conductive lines, each second electrode also includes a plurality of opaque conductive lines, and these opaque conductive lines surround the multiple openings.

24. The touch panel according to claim 21, wherein each first electrode includes a plurality of opaque conductive lines with a width less than 10 microns, and each second electrode includes a plurality of opaque conductive lines with a width less than 10 microns.

25. The touch panel according to claim 24, wherein at least two of the openings are surrounded by the opaque conductive lines, and in a direction across both sides of the opening, a width of the opening is at least ten times a width of the opaque conductive line.

26. The touch panel according to claim 21, characterized in that the thickness of the second insulating layer is not less than 50 nanometers and not more than 170 nanometers.

27. The touch panel according to claim 21, further comprising a decorative layer and a plurality of signal wires, the decorative layer disposed between the signal wires and the transparent substrate.

Touch Panel

Technical field

[0001] The present utility model relates to a touch panel, specifically to a touch panel with electrodes composed of fine conductive wires.

Background Art

[0002] In recent years, with the increasingly extensive application of consumer electronic products, the integration of touch panels and displays has led to the development of touch panel displays, such as mobile phones, GPS navigator systems, tablet PCs, personal digital assistants (PDAs), and laptop PCs.

[0003] In conventional touch panels, touch sensing components are used to detect the position of a touch object and are mounted on a transparent substrate, wherein the components include multiple first electrodes, multiple first connecting electrodes, multiple second electrodes, and multiple second connecting electrodes. The first connecting electrode is connected to the first electrodes arranged along a first direction to form a first electrode series, while the second connecting electrode is connected to the second electrodes arranged along a direction different from the first direction to form a second electrode series, which is interlaced with the first electrode series. As the display size increases, the transparent conductive material used in conventional touch panels will have greater impedance. Therefore, to reduce the impedance of the electrode series and enhance touch sensitivity, the first and second electrodes can be made from metal meshes. Additionally, in order to electrically isolate the staggered first and second electrode series from each other, the touch panel needs to further include a plurality of patterned insulating layers, which are respectively disposed between each first connecting electrode and each second connecting electrode. Since the patterned insulating layers are only disposed at the junction of each first connecting electrode and each second connecting electrode to form a ridge structure, each second connecting electrode spanning the patterned insulating layers will extend from the upper surface of each patterned insulating layer along its sidewalls to the upper surface of the transparent substrate.

[0004] Since the metal meshes are composed of opaque metals, the user can easily see the metal meshes from the appearance of the touch panel. To reduce the visibility of the metal mesh, the metal wires of the metal mesh tend to be designed with a thinner width. Thereby improving the transmittance of the electrodes, i.e., reducing the ratio of the area of the metal in the electrodes to the area of the opening region of the metal mesh. However, the width of the metal wires of the metal mesh is not only limited by process constraints; thinner metal wires are more susceptible to breaking due to bending at the transition from the upper surface of the patterned insulating layer to the upper surface of the side of the transparent substrate. This results in the touch panel failing to operate properly. Furthermore, in existing touch panels, electrodes are often protected by thick protective layers, which reduces the transmittance of the touch panel and affects display quality.

[0005] In view of this, enhancing the opening rate of the metal mesh and improving the transmittance of light through the touch panel are indeed industry goals.

Summary of Utility Model

[0006] The purpose of this present utility model is to provide a touch panel by utilizing the refractive index matching between the first insulating layer and the second insulating layer to produce destructive interference to the light passing through the electrode openings of the touch panel, thereby improving the transmittance of light through the touch panel. Furthermore, in some embodiments, the first insulating layer covers the transparent substrate in the area where at least the first conductive pattern layer is distributed, to reduce the chance of wire disconnection for the conductive pattern layers subsequently stacked on the first insulating layer.

[0007] the present utility model provides a touch panel. The touch panel includes a transparent substrate and a touch sensing component. The touch sensing component is disposed on one side of the transparent substrate, and includes a first insulating layer, a second insulating layer, and a first conductive pattern layer. The first insulating layer covers this side of the transparent substrate. The second insulating layer covers the first insulating layer, and the refractive index of the second insulating layer is 1.3 to 1.55. The first conductive pattern layer is disposed between the first insulating layer and the transparent substrate, or between the first insulating layer and the second insulating layer, and it includes a plurality of first electrodes, wherein each first electrode includes a plurality of openings.

[0008] According to one embodiment of the present utility model, the first conductive pattern layer also includes a plurality of second electrodes, and the first electrodes are electrically insulated from the second electrodes.

[0009] According to one embodiment of the present utility model, the first conductive pattern layer is disposed between the first insulating layer and the transparent substrate.

[0010] According to one embodiment of the present utility model, the first conductive pattern layer is disposed between the first insulating layer and the second insulating layer.

[0011] According to one embodiment of the present utility model, the first conductive pattern layer is disposed on the second insulating layer, and the touch sensing component further includes a protective layer disposed on the first conductive pattern layer.

[0012] According to one embodiment of the present utility model, each first electrode is disposed corresponding to each second electrode.

[0013] According to one embodiment of the present utility model, the first electrodes are arranged in a matrix configuration, and the first electrodes in each column or row are positioned to correspond to each second electrode.

[0014] According to one embodiment of the present utility model, the touch sensing module further includes a second conductive pattern layer. The first conductive pattern layer contains multiple first connection electrodes and multiple second electrodes, while the second conductive pattern layer comprises multiple second connection electrodes. Each first connection electrode is electrically connected to any two adjacent first electrodes arranged in a first direction, and each second connection electrode is electrically connected to any two adjacent second electrodes arranged in a second direction different from the first direction. Each second connection electrode is positioned between the transparent substrate and the first insulating layer. The first insulating layer has multiple contact holes that respectively correspond to the overlapping portions of the second electrodes and the second connection electrodes. Moreover, each second electrode is electrically connected to an adjacent second connection electrode through the respective contact hole.

[0015] According to one embodiment of the present utility model, a plurality of first connect electrodes and the first electrode are disposed between the first insulating layer and the second insulating layer. A portion of the second electrode is disposed between the first insulating layer and the second insulating layer, while another portion is formed on the second connect electrode through a contact hole from between the first and second insulating layers. Furthermore, the second conductive pattern layer is disposed between the first insulating layer and the transparent substrate, with a portion exposed through contact holes.

[0016] According to one embodiment of the present utility model, the refractive index of the first insulating layer is between 1.6 and 1.9.

[0017] According to one embodiment of the present utility model, the first insulating layer includes silicon oxynitride, aluminum oxide, magnesium oxide, yttrium oxide, or transparent polyimide.

[0018] According to one embodiment of the present utility model, the first insulating layer includes a mixture of transparent polymethyl methacrylate and titanium oxide, zirconium oxide, or tin oxide.

[0019] According to one embodiment of the present utility model, the thickness of the first insulating layer ranges from 10 nanometers to 3 micrometers.

[0020] According to one embodiment of the present utility model, the first insulating layer includes a first film layer and a second film layer, sequentially stacked on a transparent substrate, with the refractive index of the first film layer being less than that of the second film layer.

[0021] According to one embodiment of the present utility model, the refractive index of the second film layer ranges from 1.9 to 2.4.

[0022] According to one embodiment of the present utility model, the thickness of the first film layer is between 10 nanometers and 3 micrometers.

[0023] According to one embodiment of the present utility model, the first film layer includes silicon oxide, barium fluoride, magnesium fluoride, lithium fluoride, or strontium fluoride.

[0024] According to one embodiment of the present utility model, the first electrode includes multiple opaque conductive lines with a width of less than 10 micrometers, and at least two openings among the multiple openings are enclosed by opaque conductive lines, wherein in a direction across both sides of the openings, the width of the openings is at least ten times the width of the opaque conductive lines.

[0025] According to one embodiment of the present utility model, the thickness of the second insulating layer is not less than 50 nanometers and not more than 170 nanometers.

[0026] According to one embodiment of the present utility model, it also includes a decorative layer and multiple signal wires, with the decorative layer positioned between the signal wires and the transparent substrate.

[0027] The present utility model provides a touch panel. The touch panel includes a transparent substrate and a touch sensing component. The touch sensing component is disposed on one side of the transparent substrate and includes a first insulating layer, a second insulating layer, a first conductive pattern layer, and a second conductive pattern layer. The first insulating layer covers this side of the transparent substrate and includes at least one film layer. The second insulating layer covers the first insulating layer, with a refractive index lower than that of one of the film layers in the first insulating layer. The first conductive pattern layer comprises a plurality of first connection electrodes and a plurality of first electrodes, each first connection electrode electrically connecting any two adjacent first electrodes arranged along a first direction. Each first electrode includes multiple openings, and the first conductive pattern layer is positioned between the first insulating layer and the second insulating layer. The second conductive pattern layer is disposed between the first insulating layer and the transparent substrate and includes a plurality of second connection electrodes and a plurality of second electrodes. Each second connection electrode electrically connects any two adjacent second electrodes arranged along a second direction different from the first direction, with each second electrode having multiple openings.

[0028] According to one embodiment of the present utility model, the refractive index of the second insulating layer ranges from 1.3 to 1.55.

[0029] According to one embodiment of the present utility model, each first electrode includes a plurality of opaque conductive lines, each second electrode includes a plurality of opaque conductive lines, and the plurality of opaque conductive lines surround a plurality of openings.

[0030] According to one embodiment of the present utility model, each first electrode includes a plurality of opaque conductive lines having a width less than 10 micrometers, and each second electrode includes a plurality of opaque conductive lines having a width less than 10 micrometers.

[0031] According to one embodiment of the present utility model, at least two of the plurality of openings are surrounded by opaque conductive lines, wherein the width of the openings in the direction across the sides of the openings is at least ten times the width of the opaque conductive lines.

[0032] According to one embodiment of the present utility model, the thickness of the second insulating layer is not less than 50 nanometers and not more than 170 nanometers.

[0033] According to one embodiment of the present utility model, a decorative layer and a plurality of signal wires are further included, wherein the decorative layer is disposed between the signal wires and the transparent substrate.

[0034] In the touch panel of the present utility model, since the first insulating layer and the second insulating layer successively cover the transparent substrate, and the first insulating layer contains a material layer with a refractive index greater than that of the second insulating layer, the first and second insulating layers overlapping the opening can optically match each other in the projection direction perpendicular to the transparent substrate, causing destructive interference to the light passing through the transparent substrate, thereby improving the light transmittance through the touch panel. Additionally, the first insulating layer has a certain thickness, allowing it to provide a flattening effect, thereby enabling the touch sensing components to be formed on a flat surface to improve the manufacturing quality of the touch sensing components.

Brief Description of the Drawings

[0035] FIG. 1 shows a top view of the touch panel of the first embodiment of the present utility model.

[0036] FIG. 2A shows a perspective view of a portion of the touch panel of the first embodiment of the present utility model.

[0037]	FIG. 2B shows a cross-sectional view of FIG. 1 along the cross-sectional line A-A'.			
[0038]	FIG. 3 shows a cross-sectional view of FIG. 1 along the cross-sectional line B-B'.			
[0039]	FIG. 4A and FIG. 4B show variations of the bottom view pattern of the openings in the present invention.			
[0040]	FIG. 5 shows a cross-sectional view of the touch panel of the second embodiment of this present utility model.			
[0041]	FIG. 6 shows a perspective view of the touch panel of the third embodiment of this present utility model.			
[0042]	FIG. 7 shows a top view of the touch panel of the fourth embodiment of this present utility model.			
[0043]	FIG. 8 shows a cross-sectional view of the touch panel of the fourth embodiment of this present utility model.			
[0044]	FIG. 9 shows a cross-sectional view of the touch panel of the fifth embodiment of this present utility model.			
[0045]	FIG. 10 shows a cross-sectional view of the touch panel of the sixth embodiment of this present utility model.			
[0046]	FIG. 11 shows a top view of the touch panel of the seventh embodiment of this present utility model.			
[0047]	Wherein, the reference numerals are described as follows:			
[0048]	100, 200, 250, 300, 400, 500, 600 touch panel			
[0049]	102 transparent substrate 104 touch sensing component			
[0050]	106	First insulating layer	106a	Contact hole
[0051]	108	Second insulating layer	110	First conductive pattern layer
[0052]	112	Second conductive pattern layer	114, 302, 602	First electrode
[0053]	116	Opening	118a	Opaque conductive line
[0054]	118b	Opaque conductive line	120	First connection electrode
[0055]	122, 304, 604	Second electrode	124	First electrode series
[0056]	126	Second connection electrode	128	Second electrode series
[0057]	202	First film layer	204	Second film layer
[0058]	306	Electrode pair	308	First signal wire
[0059]	310	Second signal wire	502	Protective layer
[0060]	312	Conductive pattern layer	G	Gap;
[0061]	X	Horizontal direction	Y	Vertical direction
[0062]	Z	Projection direction		

Detailed Embodiment

[0063] In order to enable those skilled in the technical field of the present utility model to further understand the present utility model, multiple embodiments of the present utility model are listed below, along with the attached drawings, to detail the composition of the present utility model.

[0064] Please refer to FIG. 1 to 3, FIG. 1 shows a bottom view of the touch panel of the first embodiment of the present utility model, and FIG. 2A shows a perspective view of a portion of the touch panel of the first embodiment of the present utility model. FIG. 2B shows a cross-sectional view of FIG. 1 along the sectional line A-A', and FIG. 3 shows a cross-sectional view of FIG. 1 along the sectional line B-B'. As shown in Figures 1 and 2A, the touch panel 100 includes a transparent substrate 102 and a touch sensing component 104. The touch sensing component 104 is disposed on one side of the transparent substrate 102 and is used to detect the position of the touch object. As shown in the figure, each layer of the touch sensing component 104 is disposed on the same side of the transparent substrate 102. The transparent substrate 102 can be a rigid substrate or a flexible substrate, and its material can be transparent glass or transparent plastic. An example of a flexible substrate material is polyethylene terephthalate (PET) film, but is not limited thereto. In this embodiment, the touch sensing component 104 includes a first insulating layer 106, a second insulating layer 108, a first conductive pattern layer 110, and a second conductive pattern layer 112. As shown in FIG. 2B and FIG. 3, the second conductive pattern layer 112 is disposed on this side of the transparent substrate 102, and the first insulating layer 106 covers this side of the transparent substrate 102 and the second conductive pattern layer 112, while exposing a portion of the second conductive pattern layer 112.

The first conductive pattern layer 110 is disposed on the first insulating layer 106, and the second insulating layer 108 covers the first insulating layer 106 and the first conductive pattern layer 110. The first insulating layer 106 may include at least one film layer. In this embodiment, the first insulating layer 106 is a single-layer structure, which is composed of only a single film layer, but is not limited thereto. The refractive index of the first insulating layer 106 may range from 1.6 to 1.9. The second insulating layer 108 is also a single-layer structure, with its refractive index potentially lower than that of the first insulating layer 106, ranging from 1.3 to 1.55. For example, the first insulating layer 106 may include silicon oxynitride, aluminum oxide, magnesium oxide, yttrium oxide, transparent polyimide, or transparent polymethylmethacrylate (PMMA) mixed with titanium oxide, zirconium oxide, or tin oxide. It can be formed by sol-gel and coating processes or by plasma-enhanced chemical vapor deposition (PECVD), but is not limited thereto. Moreover, the thickness of the first insulating layer 106 ranges from 10 nanometers to 3 micrometers. Additionally, the second insulating layer 108 may include silicon oxide, magnesium fluoride (MgF₂), calcium fluoride, francium fluoride, lithium fluoride, strontium fluoride, or transparent polymethyl methacrylate. It can be formed by sputtering, vapor deposition, or plasma-enhanced chemical vapor deposition processes, and the thickness of the second insulating layer 108 can be from 50 to 170 nanometers, but is not limited to this. The material of the first conductive pattern layer 110 and the second conductive pattern layer 112 mainly includes opaque high-conductivity materials with a width of less than 10 micrometers, such as metals. Since opaque materials in an extremely fine state are difficult to discern with the naked eye, when extremely fine opaque highly conductive materials are connected to surround the light-transmitting opening, and the area of opaque materials divided by the area of the light-transmitting region is less than 10%, the naked eye will almost be unable to perceive the presence of the conductive pattern layer, making the transparent substrate 102 configured with the touch sensing component 104 appear completely transparent.

[0065] Furthermore, when the first conductive pattern layer 110 and the second conductive pattern layer 112 are composed of highly reflective materials such as metal, in order to prevent light from reflecting on the first conductive pattern layer 110 and the second conductive pattern layer 112 and increase the visibility of the patterns of the first conductive pattern layer 110 and the second conductive pattern layer 112, in an embodiment not shown, the touch panel 100 further includes a light absorption layer to shield the first conductive pattern layer 110 and the second conductive pattern layer 112. In this embodiment, the transparent substrate 102 is, for example, a cover lens, and the side of the transparent substrate 102 not configured with the touch sensing component 104 is the touch operation side. In this case, the light absorption layer is disposed between the transparent substrate 102 and the first conductive pattern layer 110 and/or the second conductive pattern layer 112. Specifically, the pattern of the light absorption layer can be substantially the same as the pattern of the first conductive pattern layer 110 and the second conductive pattern layer 112, but the present utility model is not limited thereto. In other variant embodiments, the pattern of the light absorption layer may also be larger than the pattern of the first conductive pattern layer 110 and the second conductive pattern layer 112, to increase the shielding rate of the light absorption layer and enhance the visual effect of the user viewing the touch panel 100 at a side angle. For example, the material of the light absorption layer may be metal oxide, resin light-absorbing material, black paint of carbon black, or metal or its alloy with a scattering structure on the surface, so as to scatter or absorb ambient light, thereby reducing the visibility of the first conductive pattern layer 110 and the second conductive pattern layer 112. The metal oxide may include, for example, copper oxide, chromium oxide, titanium oxide, molybdenum oxide, or a stacked layer of at least two of the aforementioned.

[0066] In addition, the first conductive pattern layer 110 includes multiple first electrodes 114, wherein each first electrode 114 comprises multiple opaque conductive lines 118a with a width less than 10 micrometers and multiple openings 116, and at least two openings 116 are surrounded by opaque conductive lines 118a. In one direction across both sides of the openings 116, the overlapping width of the openings 116 in this direction is at least ten times the width of the opaque conductive lines 118a. As shown in FIG. 1, in this embodiment, the first electrode 114 is formed by opaque conductive lines 118a connected in a mesh-like manner. For example, the first electrode 114 may include multiple opaque conductive lines 118a with a width of 8 microns, and multiple openings 116 surrounded by opaque conductive lines 118a, wherein the overlapping width of opening 116 in the direction across the two sides of openings 116 is 160 microns. Preferably, the width of the opaque conductive line 118a is not greater than 6 microns. For example, the shape of openings 116 surrounded by opaque conductive lines 118a may be rectangular, but the present utility model is not limited thereto and can also be other geometric shapes, such as a rhombus, as shown in FIG. 4A, or a hexagon, as shown in FIG. 4B, but not limited thereto. Furthermore, the size and distribution density of the openings of the present utility model are not limited to the patterns shown in FIG. 1, FIG. 4A, and FIG. 4B. Moreover, in this embodiment, the first conductive pattern layer 110 further includes a plurality of first connecting electrodes 120 and a plurality of second electrodes 122. Each first connecting electrode 120 electrically connects two adjacent first electrodes 114 to form a first electrode series 124 extending along a first direction, such as a vertical direction Y. The area of the first connecting electrode 120 is smaller than that of the first electrode 114. The first electrode 114 and the second electrode 122 do not overlap each other. Specifically, each first connection electrode 120 includes one or more opaque conductive lines 118b connected to the opaque

conductive lines 118a of adjacent first electrodes 114. In this present utility model, the number of opaque conductive lines 118b of the disclosed first connection electrode 120 is multiple; however, the present utility model is not limited to this. The opaque conductive lines 118b of each first connection electrode 120 may be parallel to each other. In this embodiment, the line width of the opaque conductive lines 118b is slightly greater than the line width of the opaque conductive lines 118a. For example, the line width of the opaque conductive lines 118b is 1 micron greater than the line width of the opaque conductive lines 118a, but it is not limited to this. In some embodiments, the opaque conductive lines 118b and the opaque conductive lines 118a may have the same line width. In addition, the manufacturing process of the touch, the second electrode 122 may include multiple opaque conductive lines 118a, with the opaque conductive lines 118a encircling multiple openings 116. As shown in FIG. 1, the second electrode 122 is composed of opaque conductive lines 118a connected in a mesh pattern. In this embodiment, the opaque conductive lines 118a and the openings 116 of each second electrode 122 are the same as those of each first electrode 114, hence details are not repeated; however, the present utility model is not limited to this. A gap G is present between each first electrode 114 and each first connecting electrode 120 and the adjacent second electrode 122, ensuring that the first electrode 114 and the first connecting electrode 120 are electrically isolated from the second electrode 122.

[0067] Additionally, the second conductive pattern layer 112 includes a plurality of second connection electrodes 126, and each second connection electrode 126 electrically connects two adjacent second electrodes 122 to form a second electrode series 128 extending in a second direction different from the first direction, such as the horizontal direction X. The second connection electrodes 126 are interlaced with the first connection electrodes 120 and electrically insulated by the first insulating layer 106. For example, as shown in FIG. 2A and FIG. 2B, a portion of each second electrode 122 overlaps with a portion of an adjacent second connection electrode 126, and the first insulating layer 106 has a plurality of contact holes 106a, respectively corresponding to the overlapping parts of each second electrode 122 and second connection electrode 126, exposing a portion of the second connection electrode 126 to electrically connect each second electrode 122 with adjacent second connection electrodes 126 through the contact holes 106a. In other words, through the contact holes 106a, conductive pattern layers located at different layers can be electrically connected. In this embodiment, each second connection electrode 126 may include a plurality of opaque conductive lines 118b connected to the opaque conductive lines 118a of the adjacent second electrode 122, and the opaque conductive lines 118b of each second connection electrode 126 may be parallel to each other. In this embodiment, the opaque conductive lines 118b of each second connection electrode 126 are the same as those of each first connection electrode 120, and thus are not further elaborated, but the present utility model is not limited thereto. In other embodiments of the present utility model, at least one of the first connection electrode and the second connection electrode may also be composed of a strip-shaped electrode with a width greater than the opaque conductive lines, but the present utility model is not limited thereto. Moreover, the first conductive pattern layer and the second conductive pattern layer may include copper or its alloys, metal composite layers (e.g., molybdenum-aluminum-molybdenum composite layers), or metal oxides, but are not limited to these options. In other embodiments, the opaque conductive lines in the first connecting electrode or the second connecting electrode may also be connected in a mesh pattern, surrounding multiple openings.

[0068] Furthermore, in this embodiment, the thickness of the first conductive pattern layer 110 and the second conductive pattern layer 112 are less than the thickness of the first insulating layer 106. For example, the thickness of the first insulating layer 106 may be approximately 1 micron, while the thicknesses of the first conductive pattern layer 110 and the second conductive pattern layer 112 may be approximately 120 nanometers, but are not limited thereto. It is worth noting that since the first insulating layer 106 disposed between the first conductive pattern layer 110 and the transparent substrate 102 covers this side of the transparent substrate 102, the first conductive pattern layer 110, except for the portion in the contact hole 106a, does not need to extend from the upper surface of the first insulating layer 106 toward the transparent substrate 102. Additionally, the thickness of the second conductive pattern layer 112 may be approximately the same as that of the first conductive pattern layer 110, meaning the thickness of the second conductive pattern layer 112 is less than that of the first insulating layer 106. This ensures that the transition between the first connecting electrode 120 and the first electrode 114 does not have a height difference equivalent to the thickness of the first insulating layer 106, but only a height difference at most equivalent to the thickness of the second conductive pattern layer 112, thereby reducing the chance of wire disconnections. The difference in thickness between the first insulating layer 106 and the second conductive pattern layer 112 may cause the first conductive pattern layer 110 located outside the contact hole 106a to be substantially arranged at the same height; that is, the first insulating layer 106 has a flattening effect. In addition, since the first insulating layer 106 and the second insulating layer 108 cover this side of the transparent substrate 102, and the refractive index of the first insulating layer 106 is greater than the refractive index of the second insulating layer 108, the first insulating layer 106 and the second insulating layer 108 overlapping the opening 116 in a projection direction Z perpendicular to the transparent substrate 102 can be optically matched with each other to generate destructive interference to the light passing through the transparent substrate 102, thereby improving the light penetration rate of the touch panel 100. For example, the penetration rate of the opening 116 in this embodiment is approximately between 90% and 99%, but is not limited thereto.

[0069] In this embodiment, signal wires are omitted from the illustration. Through these signal wires, the first electrode series 124 and the second electrode series 128 can be electrically connected to the controller respectively. The signal wires connected to the first electrode series 124 can be composed of the first conductive pattern layer 110 or the second conductive pattern layer 112, while the signal wires connected to the second electrode series 128 can also be composed of the first conductive pattern layer 110 or the second conductive pattern layer 112. The signal wires can be composed of the same conductive pattern layer. Signal lines can be composed of an opaque conductive material with a width greater than that of the opaque conductive line 118a, and these signal lines may not encircle multiple openings, thereby enhancing the quality of signal transmission.

[0070] In other embodiments of the present utility model, the positions of the first conductive pattern layer and the second conductive pattern layer can also be interchanged. That is, the first conductive pattern layer can be disposed between the first insulating layer and the transparent substrate, and the second conductive pattern layer can be disposed between the first insulating layer and the second insulating layer. This allows the first conductive pattern layer to be arranged on a flat surface, thereby ensuring the quality of the touch panel.

[0071] The touch panel of the present utility model is not limited to the above-mentioned embodiments. Other embodiments or variations of the present utility model will be further disclosed below. To simplify the description and highlight the differences between various embodiments or variations, the same reference numerals are used to denote identical components, and repetitive parts will not be elaborated.

[0072] Please refer to FIG. 5, which shows a cross-sectional view of the touch panel according to the second embodiment of the present utility model. As shown in FIG. 5, compared with the above-mentioned first embodiment, in the touch panel 200 of the present embodiment, the first insulating layer 106 is a multi-layer structure. In other words, the first insulating layer 106 in this embodiment may include multiple film layers, and the refractive index of the second insulating layer 108 is lower than the refractive index of one of the film layers of the first insulating layer 106. For example, the first insulating layer 106 may include a first film layer 202 and a second film layer 204, which are sequentially stacked on this side of the transparent substrate 102, and the refractive index of the second insulating layer 108 is lower than the refractive index of either the first film layer 202 or the second film layer 204. Furthermore, the refractive index of the first film layer 202 may be lower than the refractive index of the second film layer 204. For example, the refractive index of the first film layer 202 may be between 1.3 and 1.55 and may include silicon dioxide or transparent polymethyl methacrylate, but is not limited thereto. Moreover, the thickness of the first film layer 202 may be between 10 nanometers and 3 micrometers. For example, the first film layer 202 may be transparent polymethyl methacrylate with a thickness of 1 micrometer, but is not limited thereto. The refractive index of the second film layer 204 may be between 1.9 and 2.4, and may include titanium oxide, zirconium oxide, or tin oxide, but is not limited thereto.

[0073] Please refer to FIG. 6, which shows a perspective view of the touch panel according to the third embodiment of the present utility model. As shown in FIG. 6, compared with the aforementioned first embodiment, the second electrode 122 of the touch panel 250 in this embodiment is located in the second conductive pattern layer 112. That is, the first conductive pattern layer 110 in this embodiment includes a plurality of first connection electrodes 120 and a plurality of first electrodes 114, and the second conductive pattern layer 112 includes a plurality of second connection electrodes 126 and a plurality of second electrodes 122. The first conductive pattern layer 110 is disposed between the first insulating layer 106 and the second insulating layer 108, and the second conductive pattern layer 112 is disposed between the first insulating layer 106 and the transparent substrate 102. Wherein, each first connecting electrode 120 is electrically connected to any two adjacent and optionally selected first electrodes 114 arranged along the first direction, for example, the vertical direction Y, to form a first electrode string 124 extending along the first direction. Each first electrode 114 may be composed of opaque conductive lines 118a connected in a mesh pattern and includes multiple openings 116. Moreover, each second connecting electrode 126 is electrically connected to any two adjacent and optionally selected second electrodes 122 arranged along the second direction, for example, the horizontal direction X. Each second electrode 122 may be composed of opaque conductive lines 118b connected in a mesh pattern and includes multiple openings 116. The first insulating layer 106 may include at least one film layer, and the refractive index of the second insulating layer 108 is lower than the refractive index of the film layer of the first insulating layer 106.

[0074] Please refer to FIG. 7 and 8, and FIG. 7 shows a bottom view of the touch panel in the fourth embodiment of the present utility model, and FIG. 8 shows a cross-sectional view of the touch panel in the fourth embodiment of the present utility model. As shown in Figures 7 and 8, compared to the first embodiment, the touch panel 300 in this embodiment comprises a touch sensing component 104 formed by a conductive pattern layer 312 disposed on the same surface. In this embodiment, the touch panel 300 may include a decorative layer 314, a touch sensing component 306, a first insulating layer 106, and a second insulating layer 108, all arranged on a transparent substrate 102. The transparent substrate 102 has a light-transmitting area 102a and a light-shielding area 102b, wherein the light-shielding area 102b is located on at least one side of the light-transmitting area 102a. The light-transmitting area 102a corresponds to display components such as liquid crystal display units or organic light-emitting diode display units, while the light-shielding area 102b corresponds to regions set for components that need to be concealed and are not used for display, such components include visible signal wires. In this embodiment, the touch panel 300 further includes multiple first signal wires 308 and multiple second signal wires 310. The first signal wires 308 and the second signal wires 310 may be formed by a conductive pattern layer 312. The position of the decorative layer 314 corresponds to the light-shielding area 102b and is located on at least one side of the light-transmitting area 102a. The first signal wires 308 and the second signal wires 310 are concealed and hidden by the decorative layer 314. In this embodiment, the decorative layer 314 is a frame-type pattern surrounding the light-transmitting area 102a and may be disposed between the transparent substrate 102 and the first signal wires 308 and the second signal wires 310. In this embodiment, the transparent substrate 102 may serve to cover and protect the lower components, and the side of the transparent substrate 102 not equipped with the touch sensing component 306 can be used as the user's operation interface. That is, in this embodiment, the transparent substrate 102 can be a cover plate, which can be a composite laminate of tempered glass, or a combination of polymethyl methacrylate (PMMA) and polycarbonate (PC), UV-curable resin (such as ORGA resin) or other hard light-transmitting materials such as providing protective features like scratch resistance and high mechanical strength. Thereby, making the touch panel 300 lighter and thinner. Additionally, the side of the transparent substrate 102 not equipped with the touch sensing component 306 may also be fitted with layers such as anti-glare film or anti-reflection film, where the thickness of these films is less than that of the transparent substrate 102, meaning this present utility model does not restrict the user from directly contacting the surface of the cover lens during operation. Furthermore, the side surface of the transparent substrate 102 not equipped with the touch sensing component 306 may have an arc-shaped structure, meaning the transparent substrate 102 is a 2.5D (pseudo three-dimensional) cover lens. In this embodiment, the conductive pattern layer 312 is disposed between the first insulating layer 106 and the transparent substrate 102. In addition, the conductive pattern layer 312 includes a plurality of first electrodes 302 and a plurality of second electrodes 304, and the first electrodes 302 and the second electrodes 304 are electrically insulated from each other and do not intersect. The first electrode 302 and the second electrode 304 each includes multiple opaque conductive lines 118a, and the opaque conductive lines 118a encircle multiple openings 116. Each first electrode 302 and second electrode 304 are arranged against each other to form multiple electrode pairs 306, and the electrode pairs 306 are arranged in a matrix. For example, the first electrode 302 and the second electrode 304 may be right-angled triangles, and the hypotenuse of the first electrode 302 is set opposite to the hypotenuse of the second electrode 304, forming approximately rectangular electrode pairs 306, but the present utility model is not limited to this. The first electrode 302 and the second electrode 304 of the present utility model may also have other shapes. Wherein, each first electrode 302 is electrically connected to its respective first signal wire 308 and then to an external controller through the first signal wire 308. Additionally, each second electrode 304 is electrically connected to its respective second signal wire 310 and then to an external controller through the second signal wire 310. The first signal wire 308 and the second signal wire 310 may be formed of an opaque conductive material having a width greater than that of the opaque conductive wire 118a. Furthermore, the first signal wire 308 and the second signal wire 310 may not surround multiple openings, thereby improving the quality of signal transmission. In other embodiments of the present utility model, the first insulating layer may also be the first insulating layer of the second embodiment.

[0075] Please refer to FIG. 9, which shows a cross-sectional view of the touch panel according to the fifth embodiment of the present utility model. As shown in FIG. 9, compared with the fourth embodiment, in the touch panel 400 of the present embodiment, the conductive pattern layer 312 is disposed between the first insulating layer 106 and the second insulating layer 108. In the present embodiment, the decorative layer 31 can be disposed between the transparent substrate 102 and the first insulating layer 106, and the first signal wire 308 and the second signal wire 310 are disposed on the decorative layer 314.

[0076] Please refer to FIG. 10, which shows a cross-sectional view of the touch panel according to the sixth embodiment of the present utility model. As shown in FIG. 10, compared with the fourth embodiment, in the touch panel 500 of the present embodiment, the conductive pattern layer 312 is disposed on the second insulating layer 108. In addition, the touch panel 500 of the present embodiment may further include a protective layer 502 disposed on the conductive pattern layer 312 to protect the conductive pattern layer 312.

[0077] Please refer to FIG. 11, which is a bottom view of the touch panel of the seventh embodiment of the present utility model. As shown in FIG. 11, compared with the fourth embodiment, in the touch panel 600 of this embodiment, the first electrodes 602 located in the same row or the same column are arranged corresponding to the same second electrode 604. Specifically, the first electrodes 602 of this embodiment are arranged in a matrix manner and are rectangular, but not limited thereto. Each second electrode 604 is positioned on one side of the first electrode 602 within the same row and arranged opposite the first electrode 602. Each second electrode 604 extends, that is, between any two adjacent first electrodes 602 in the same row, specifically between the adjacent first electrodes 602 arranged vertically in the Y direction, making each second electrode 604 have a mesh-like structure, but not limited to this. In other embodiments of the present utility model, each second electrode can be located on one side of the first electrodes in the same column and extend between any two adjacent first electrodes in the same column. Additionally, in this embodiment, the first signal wire 308 can be composed of an opaque conductive material with a width of less than 10 micrometers, thereby reducing the visibility of the first signal wire 308. In other embodiments of the present utility model, the first insulating layer may also be the first insulating layer of the second embodiment.

[0078] In summary, in the touch panel of the present utility model, since the first and second insulating layers successively cover the transparent substrate, and the first insulating layer contains a material layer with a refractive index greater than that of the second insulating layer, the first and second insulating layers overlapping the opening can optically match each other in the projection direction perpendicular to the transparent substrate, thereby causing destructive interference to the light passing through the transparent substrate, thus improving the transmittance of light through the touch panel. Additionally, the first insulating layer has a certain thickness, allowing it to provide a flattening effect, thereby enabling the touch sensing components to be formed on a flat surface to improve the manufacturing quality of the touch sensing components.

[0079] The above description is merely the preferred embodiment of the present utility model and is not intended to restrict the present utility model. For those skilled in the art, the present utility model can undergo various modifications and changes. Any modifications, equivalent replacements, improvements, etc., made within the spirit and principles of the present utility model shall be encompassed within the protective scope of the present utility model. Any modifications, equivalent replacements, improvements, etc., made within the spirit and principles of the present utility model shall be encompassed within the protective scope of the present utility model.

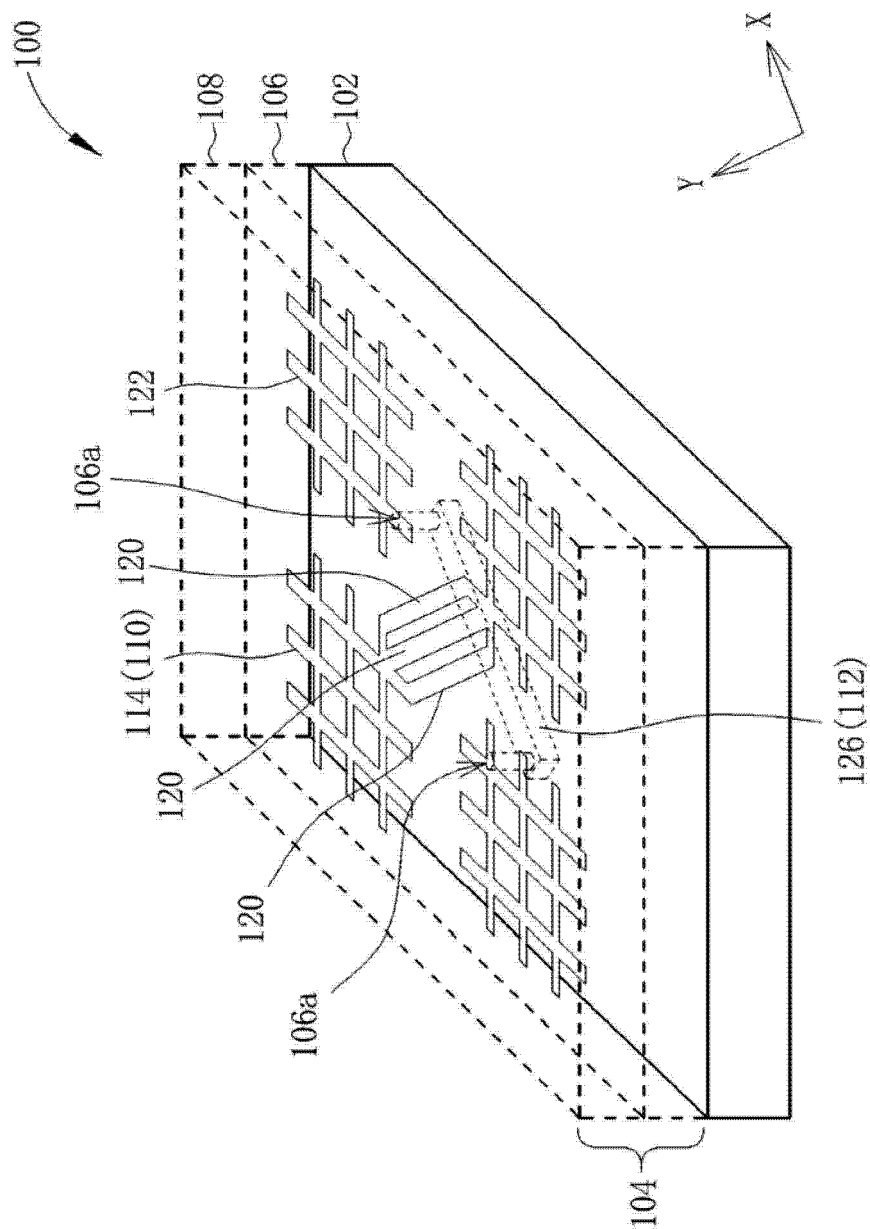
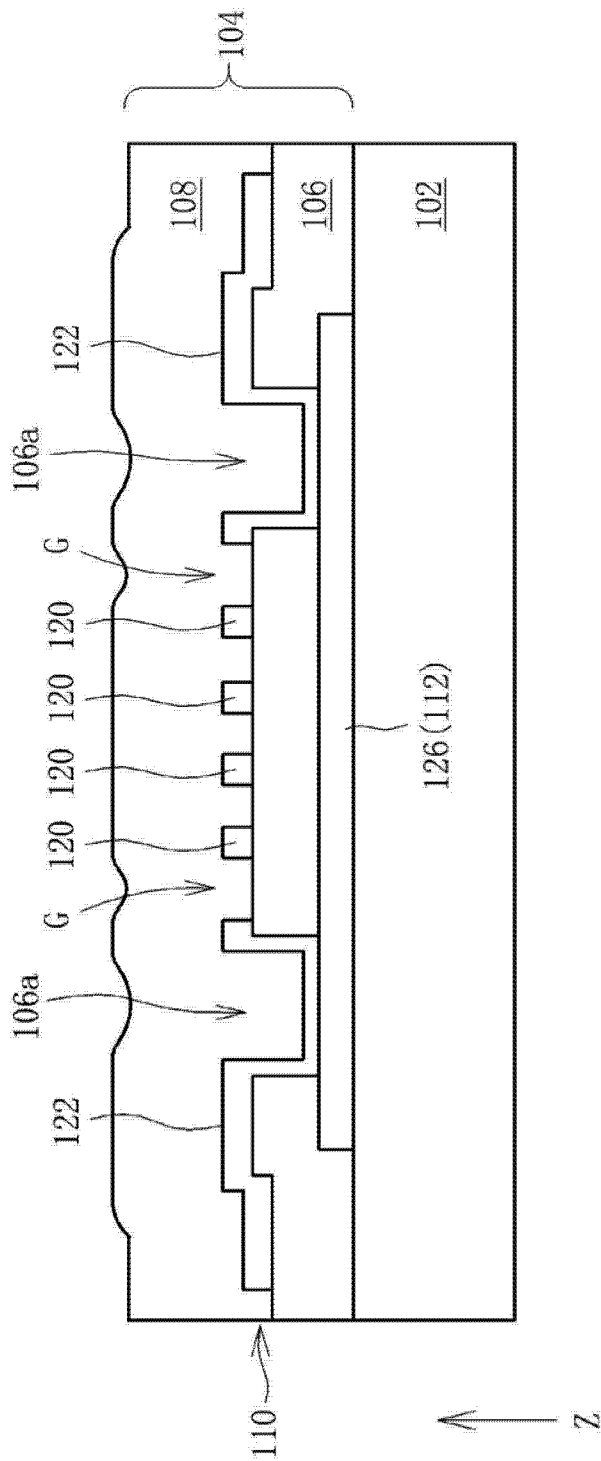
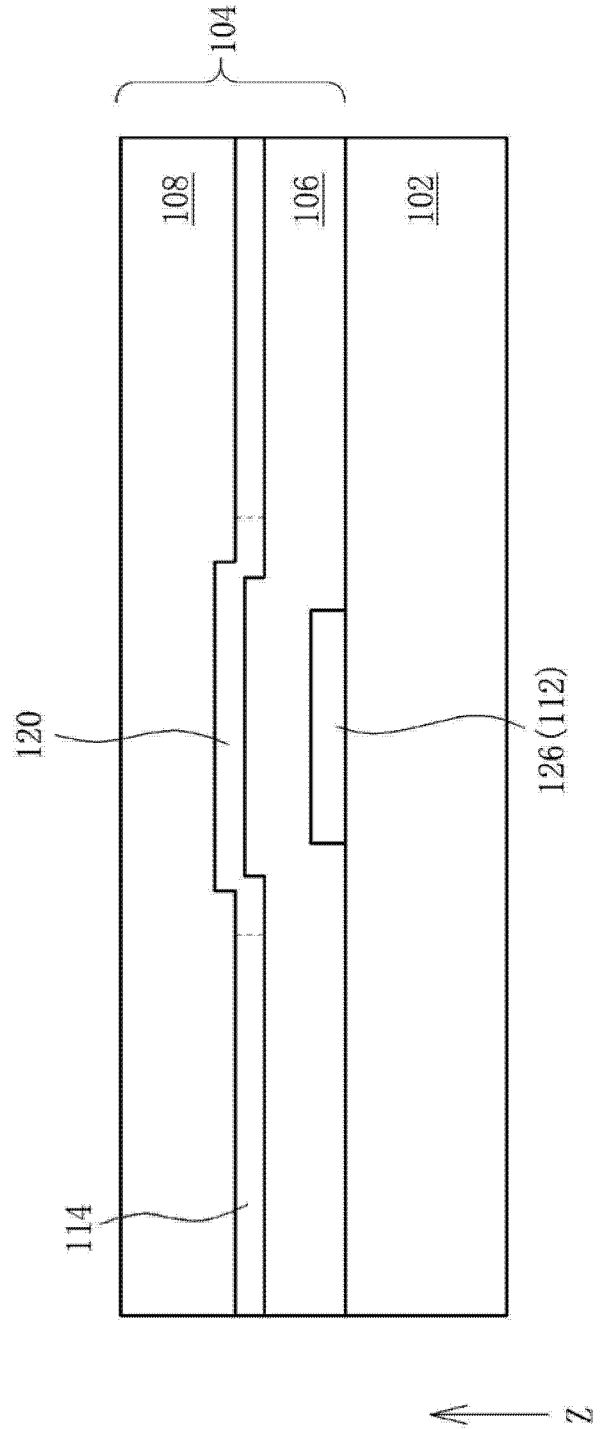


FIG. 2A



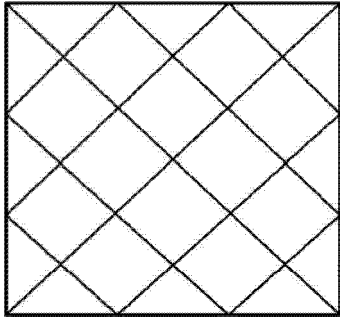


FIG. 4A

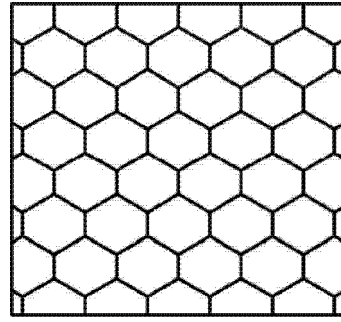


FIG. 4B

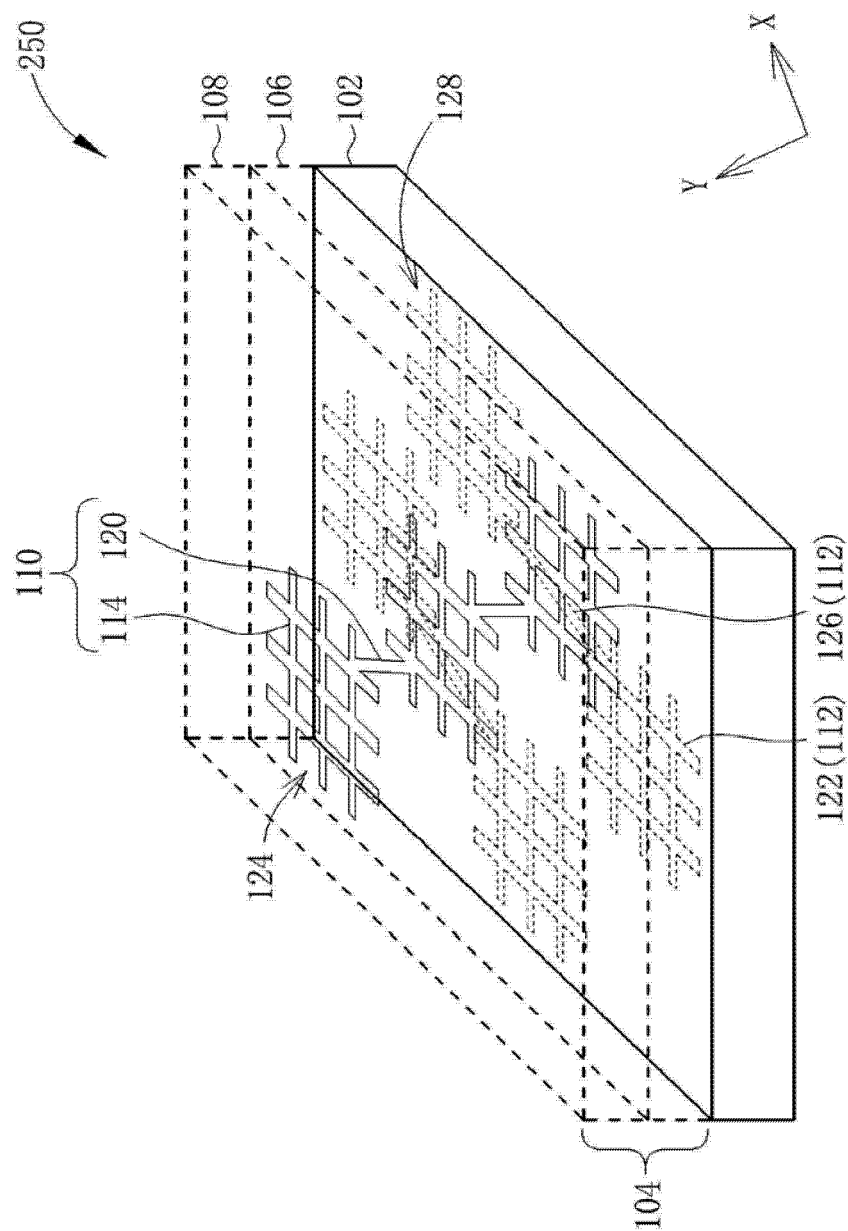


FIG. 6

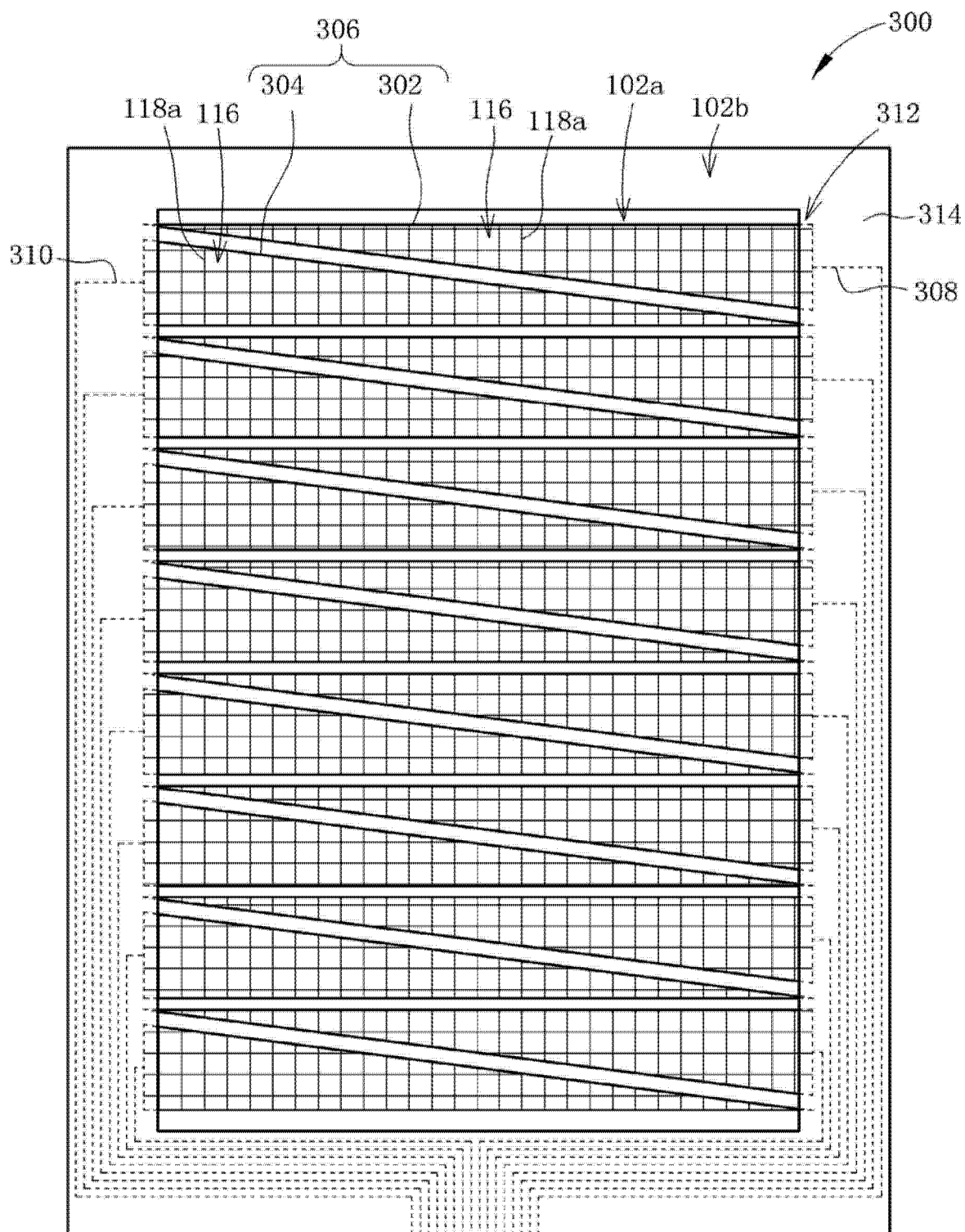


FIG. 7

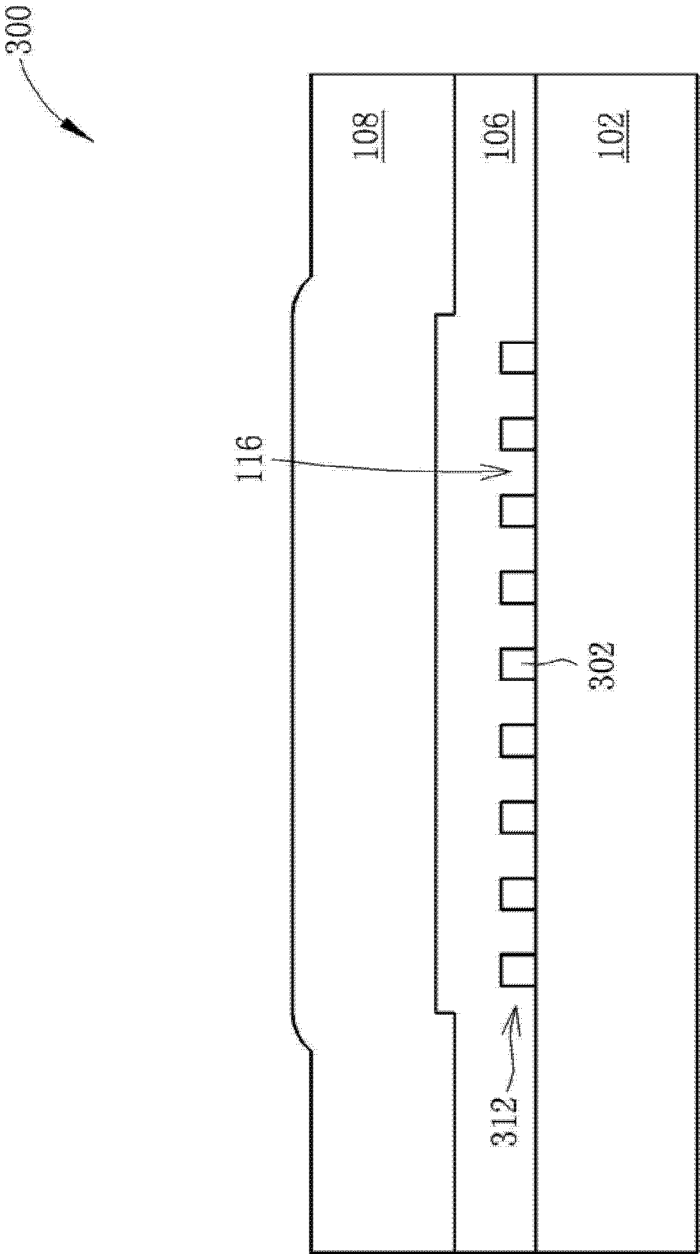


FIG. 8

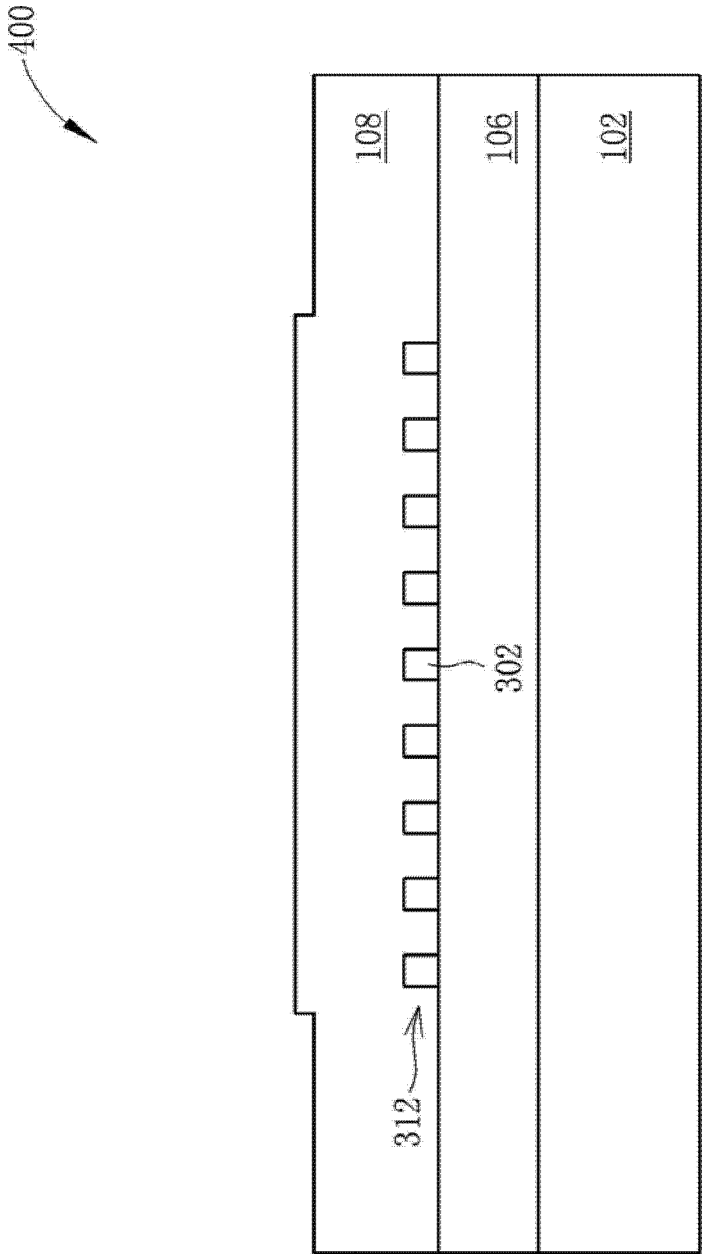


FIG. 9

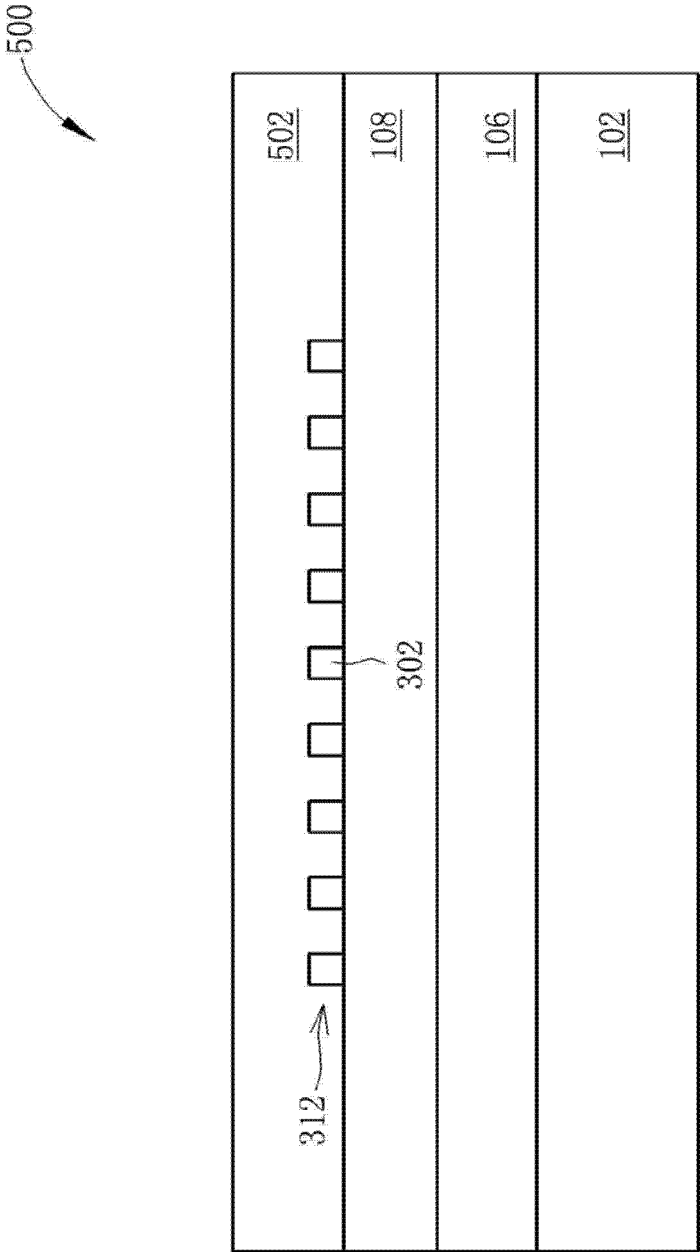


FIG. 10

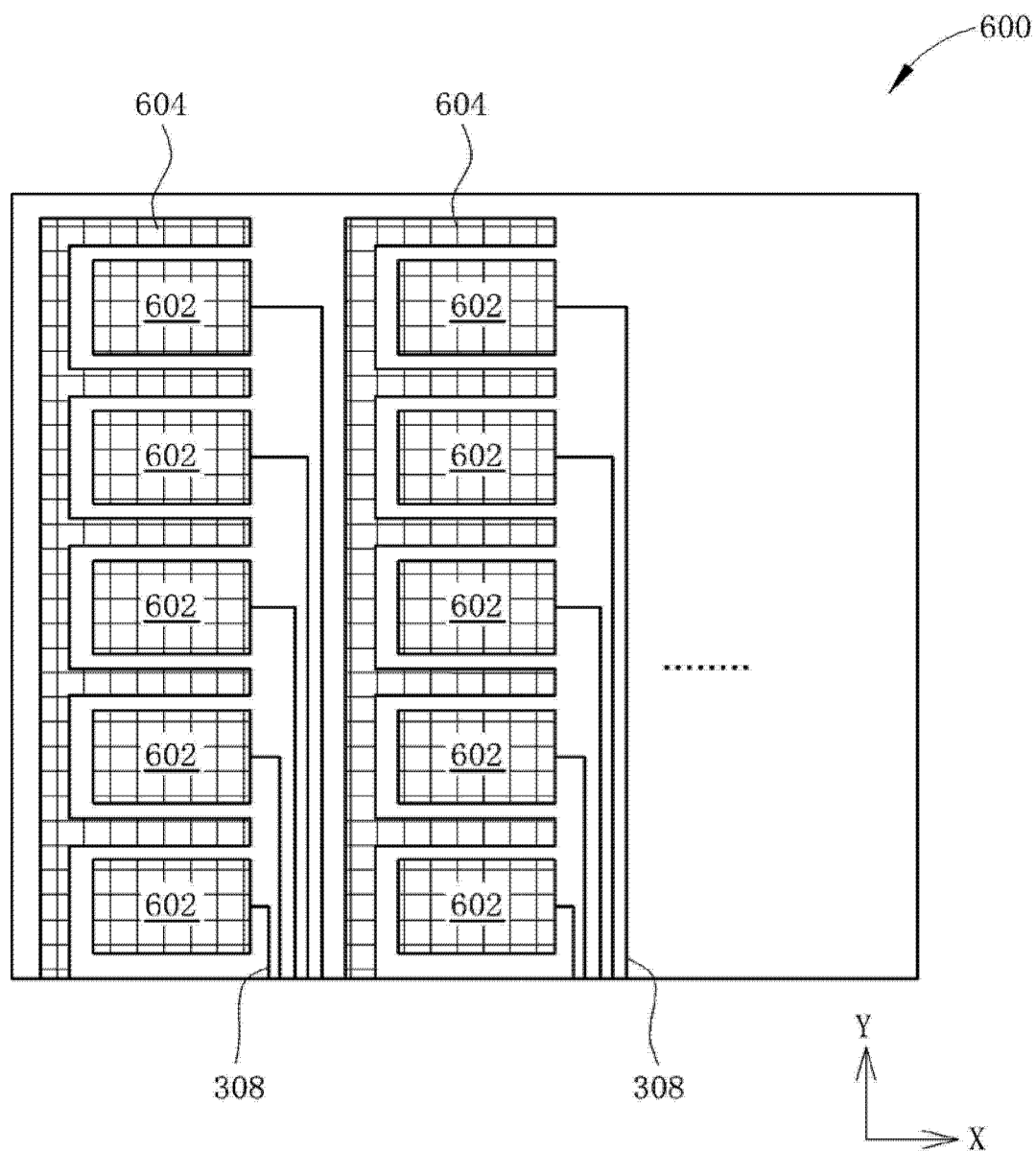


FIG. 11



TRANSLATION CERTIFICATION

Date: July 15, 2025

Translator's Declaration

I, Tony Zhou, hereby declare:

That I possess advanced knowledge of the Simplified Chinese and English languages. The attached Simplified Chinese into English translation has been translated by me and to the best of my knowledge and belief, it is a true and accurate translation of: CN203759670U Chen.

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true. I further declare that these statements were made with the knowledge that willfully false statements and the like are punishable by fine or imprisonment or both, under Section 1001 of Title 18 of the United States Code.

In signing this declaration, I understand that the translation and this declaration may be filed as evidence in a contested case. I acknowledge that I may be subject to cross-examination within the United States.

Tony Zhou

Signature

QUESTEL CONFIDENTIAL

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TRANSLATION CERTIFICATION

Date: 2025/07/15

To whom it may concern:

This is to certify that the attached translation is an accurate representation of the documents received by this office. The translation was completed from:

- Chinese (PRC)

To:

- English (USA)

The documents are designated as:

- 'CN203759670U Chen.pdf'

Tania Duvernay, Project Manager in this company, attests to the following:

"To the best of my knowledge, the aforementioned documents are a true, full and accurate translation of the specified documents."



Signature of **Tania Duvernay**, Project Manager

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