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(54) **DISPLAY PANEL AND DISPLAY APPARATUS HAVING THE SAME**

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(57) **ABSTRACT**

A display panel and a display apparatus having the are provided. The display panel with a liquid crystal layer, includes first and second substrates which are disposed opposite to each other; a color filter polarizing layer which is formed on a surface of one of the first and second substrates between the first and second substrates, and includes a metal linear grid arranged at different pitches to emit a first polarized component of incident light with different colors; and a polarizing layer formed on an opposite surface to the surface of one of the first and second substrates. The provided display panel and display apparatus including the same, have decreased manufacturing costs and a simplified manufacturing process.

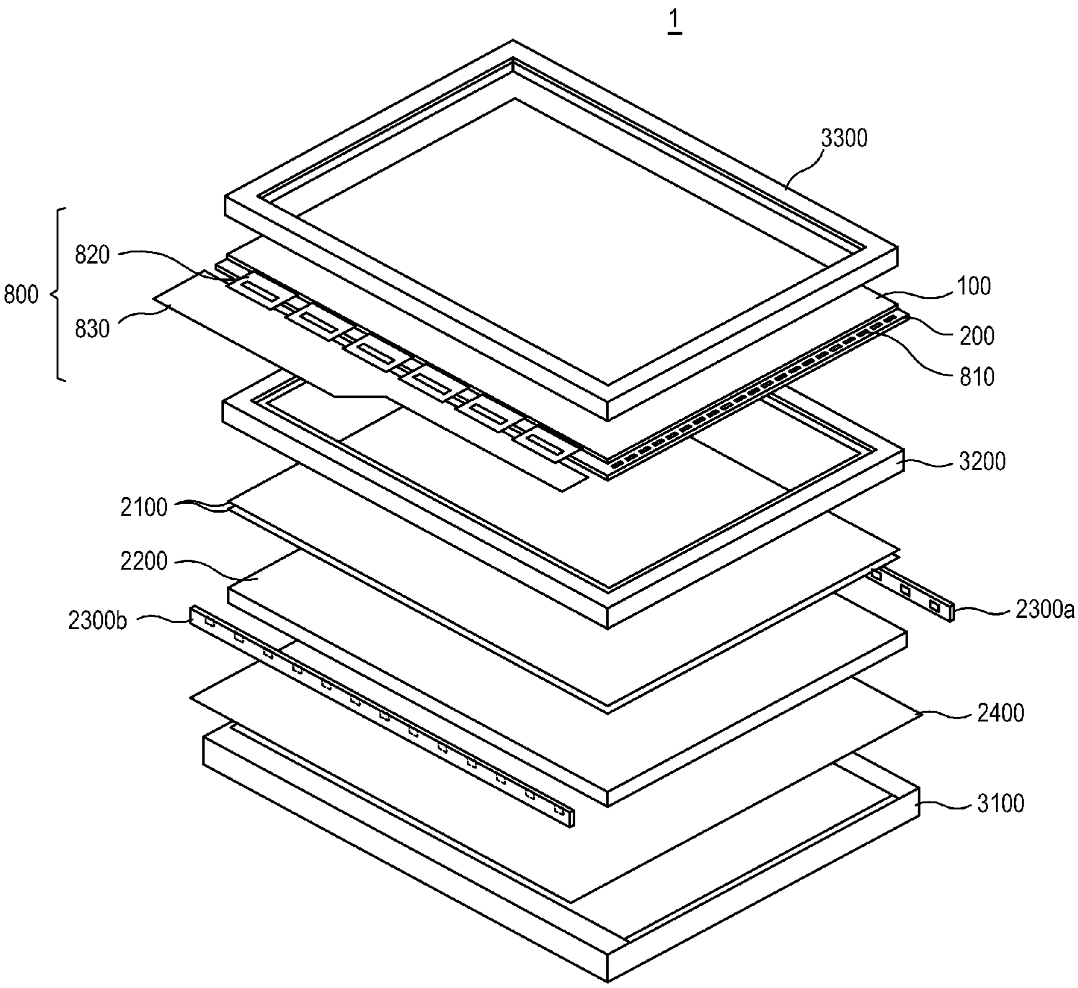


FIG. 1

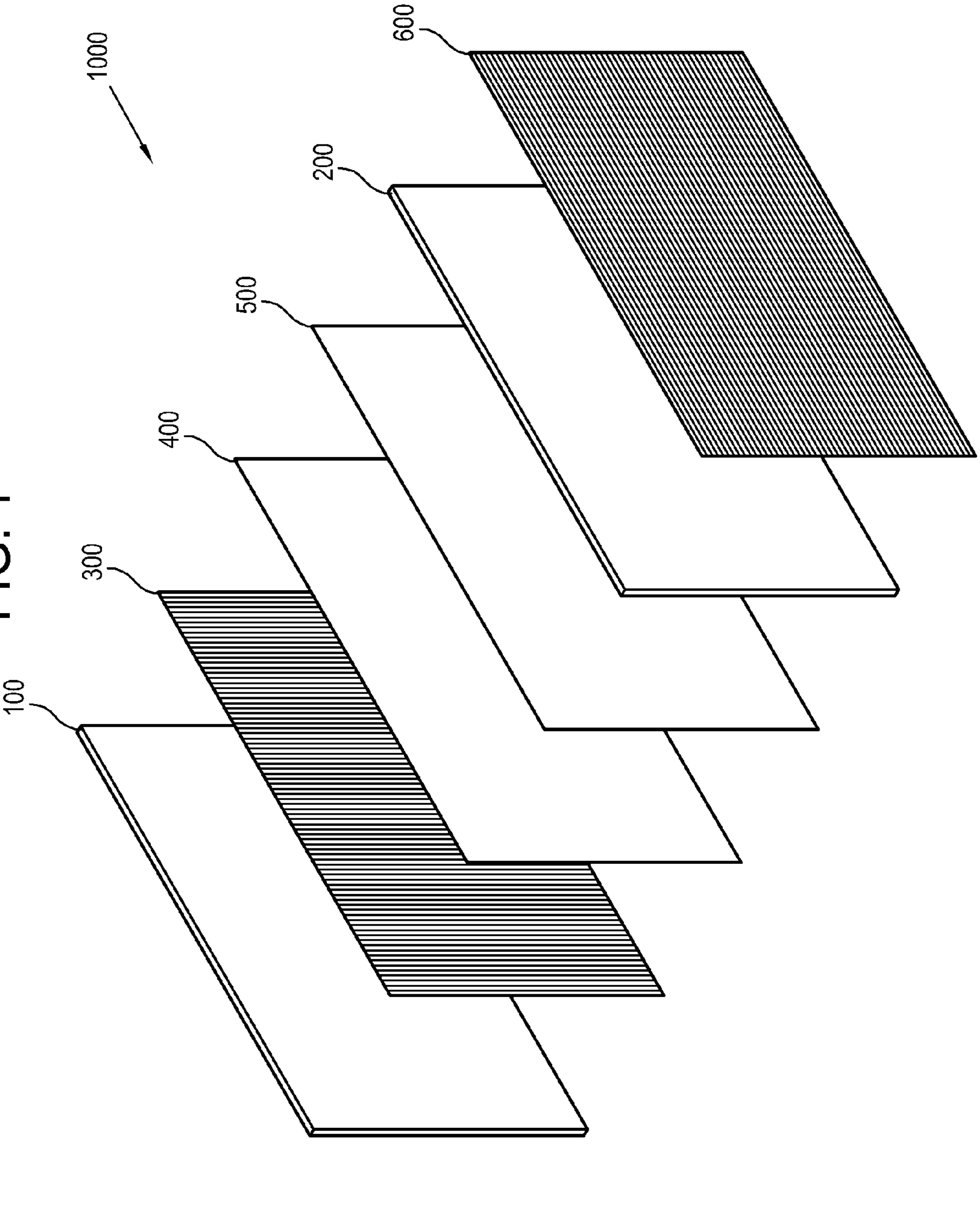
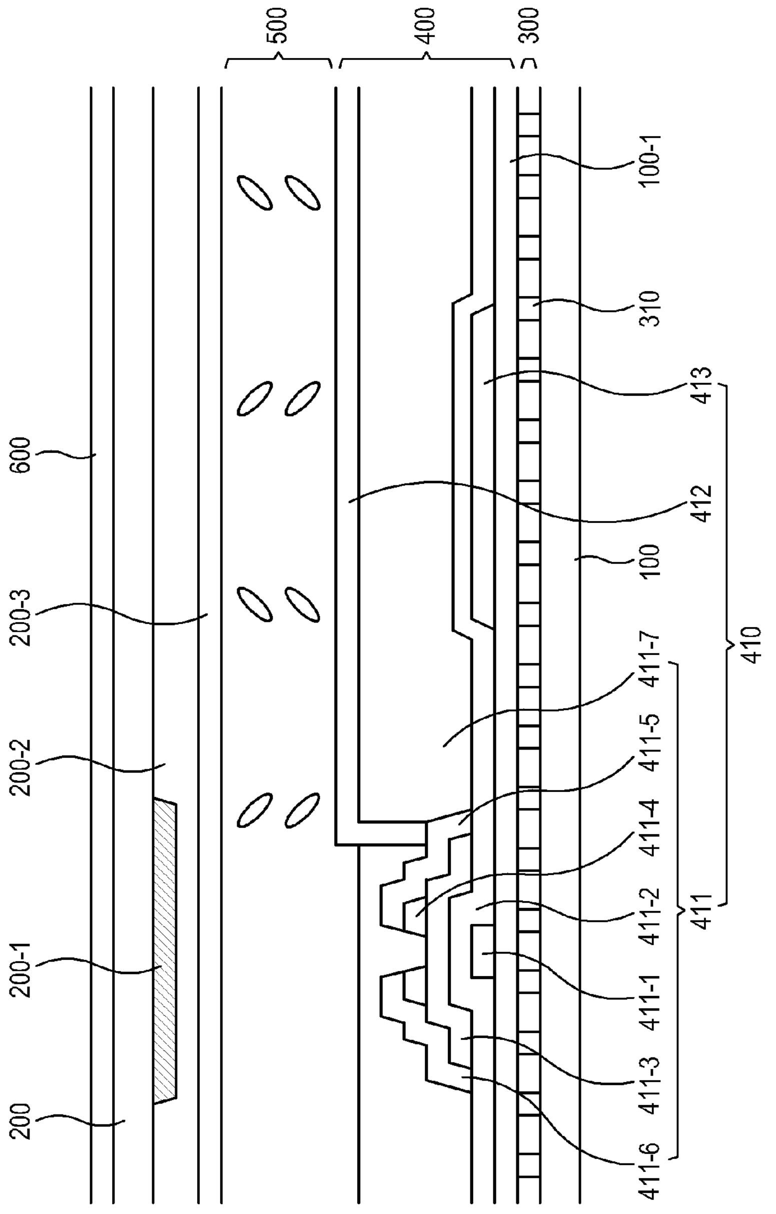


FIG. 2



500
400
300
600
200-3
200-2
200-1
200
100-1
310
413
412
100
410
411-7
411-5
411-4
411-2
411-1
411-3
411-6
411

FIG. 3

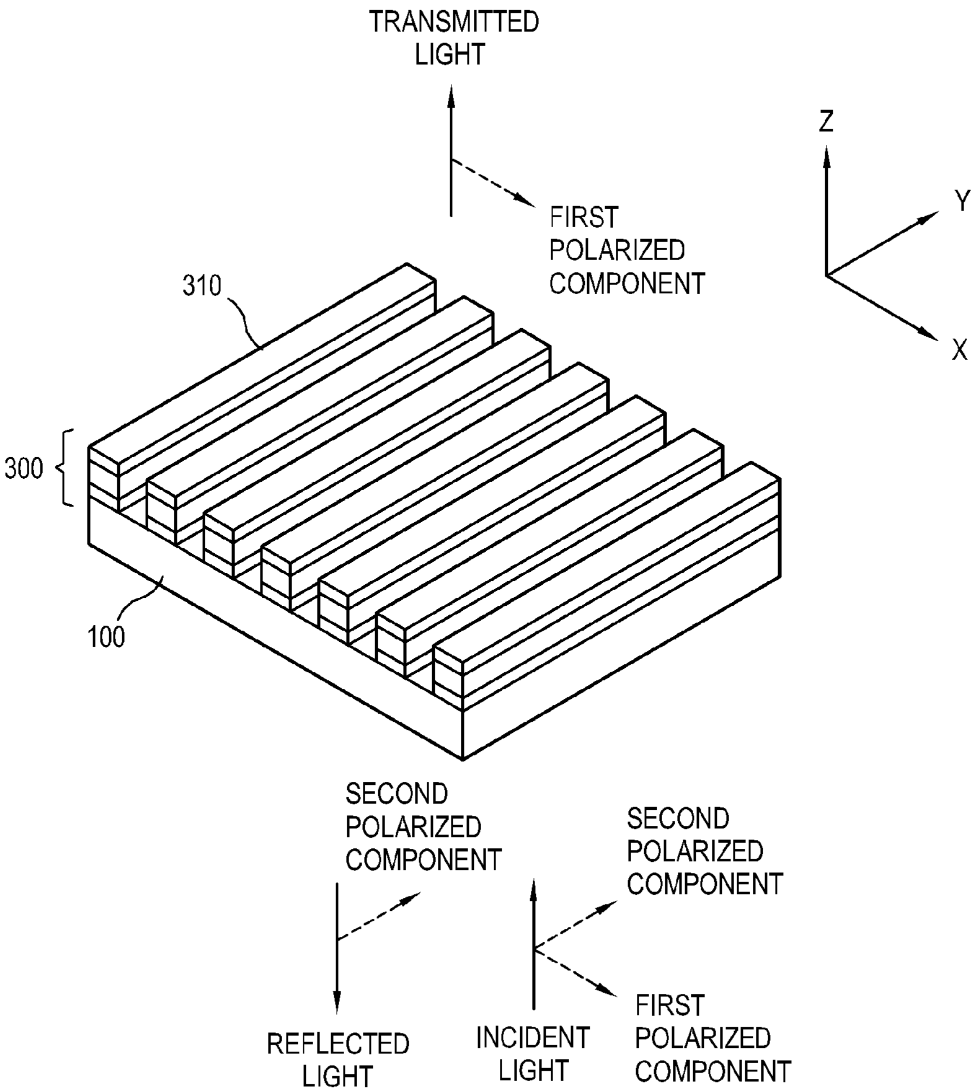

TRANSMITTED LIGHT
FIRST POLARIZED COMPONENT
Z
Y
X
310
300
100
SECOND POLARIZED COMPONENT
SECOND POLARIZED COMPONENT
REFLECTED LIGHT
INCIDENT LIGHT
FIRST POLARIZED COMPONENT

FIG. 4A

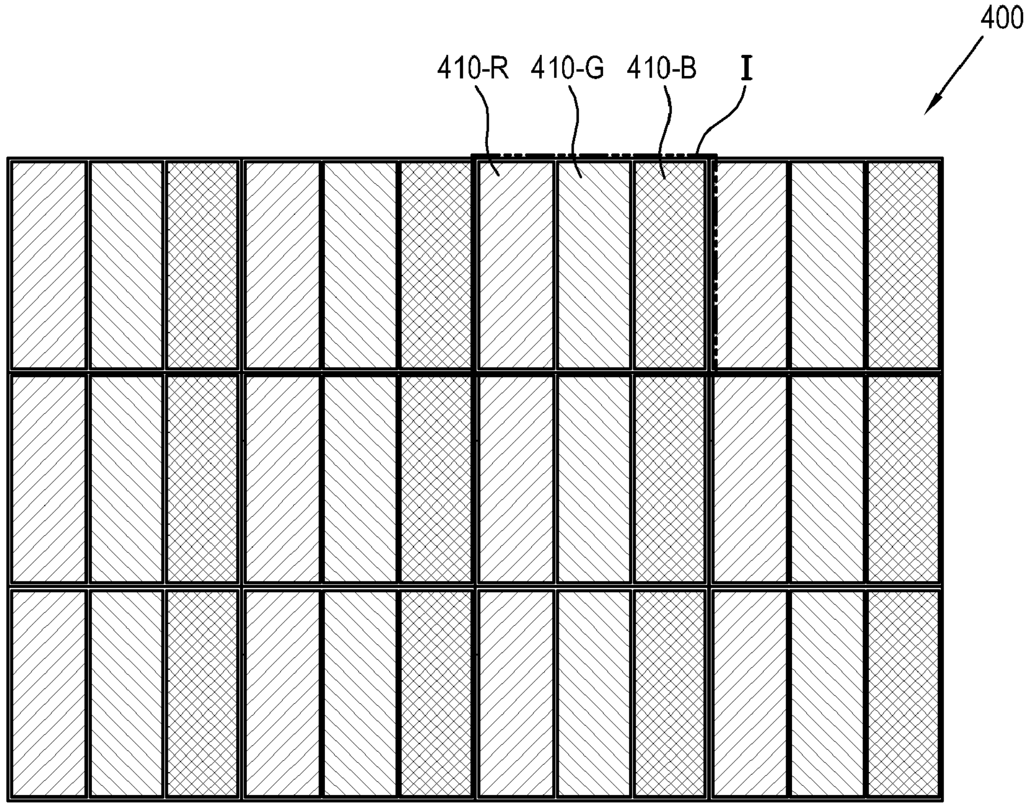


FIG. 4B

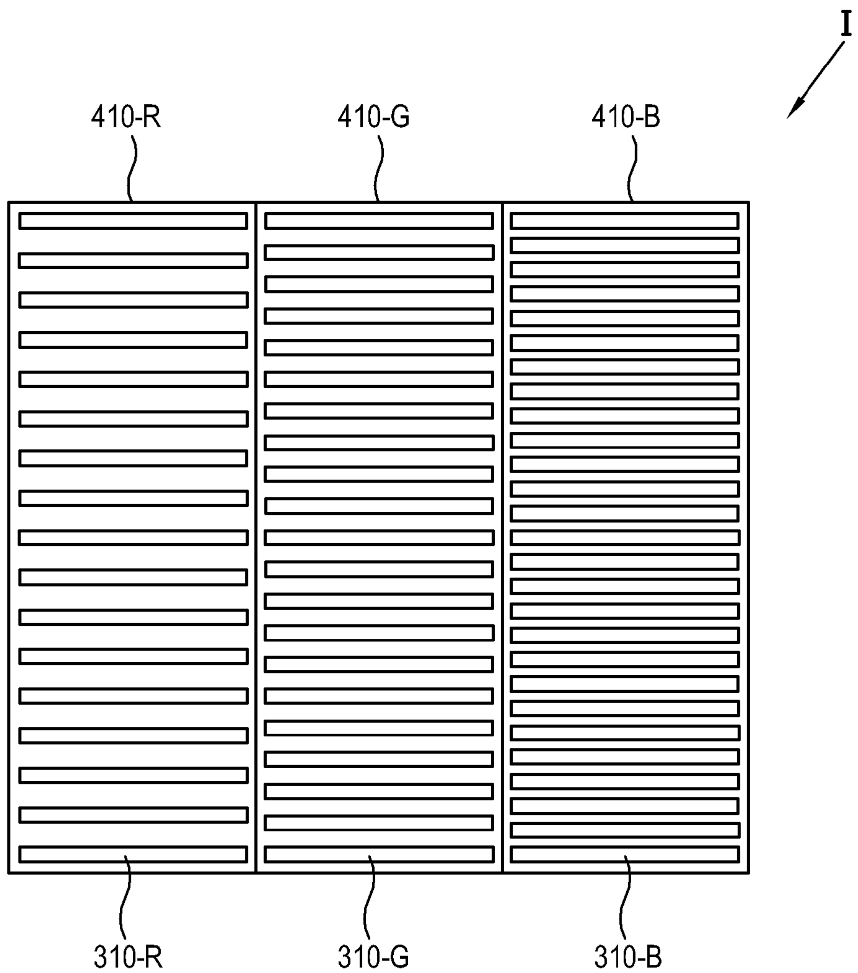


FIG. 5

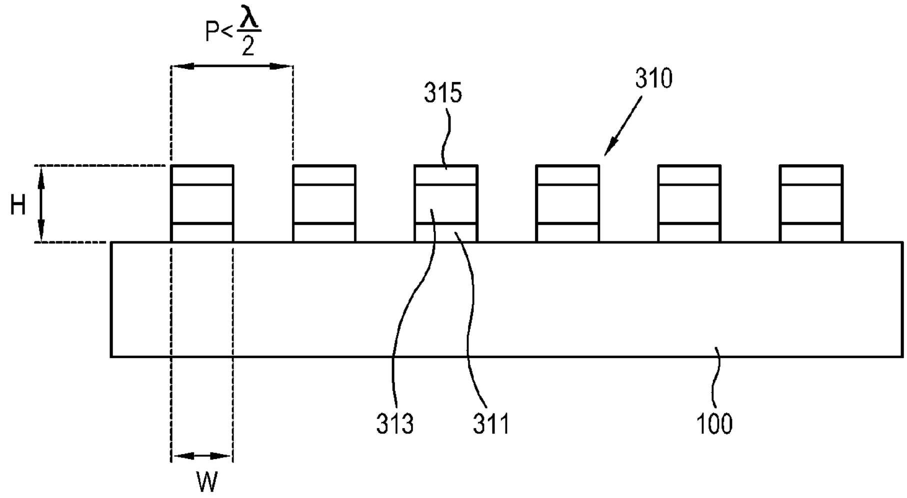


FIG. 6

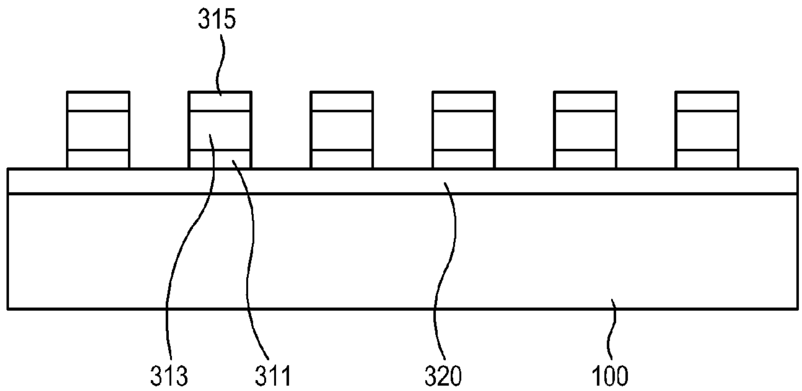


FIG. 7

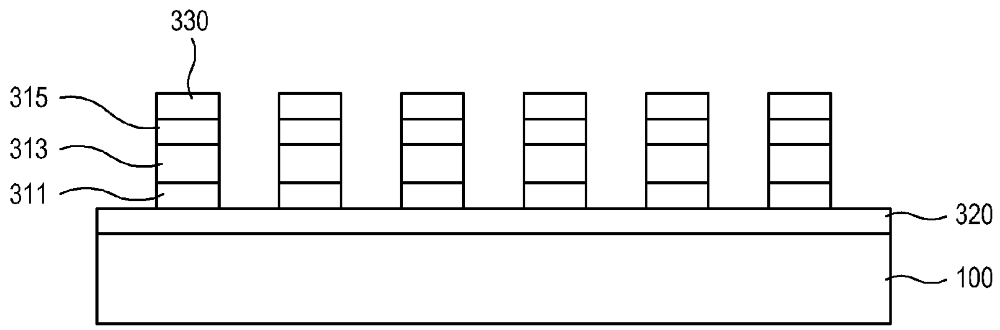


FIG. 8A

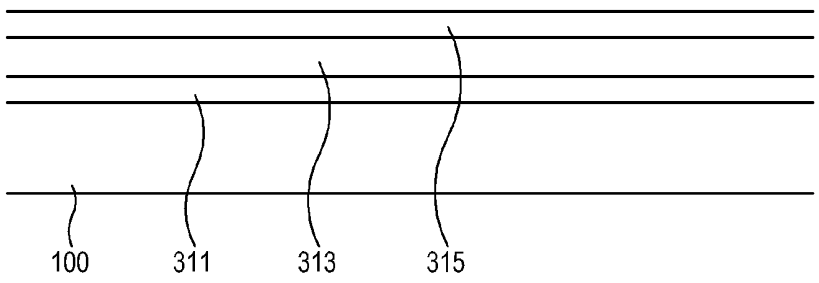


FIG. 8B

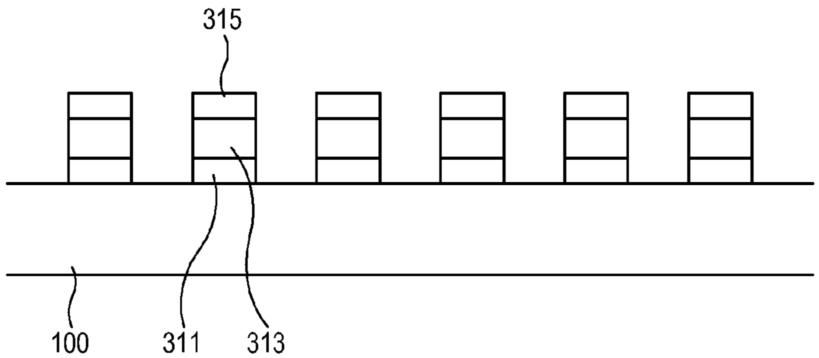


FIG. 8C

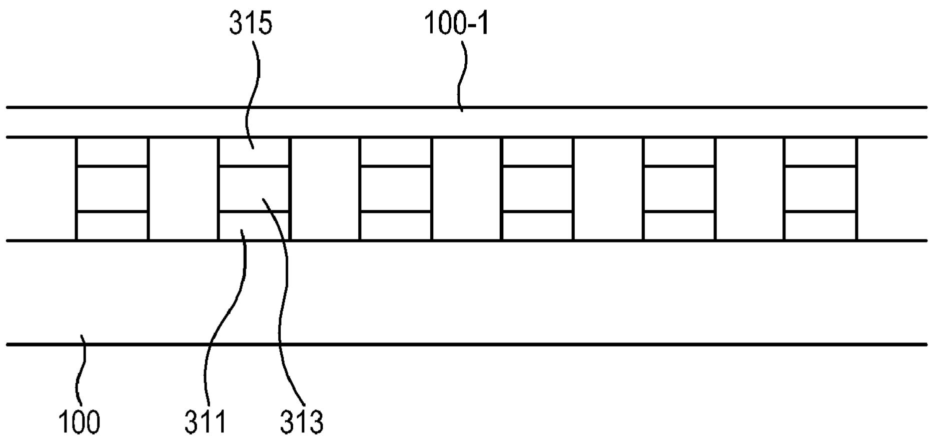


FIG. 8D

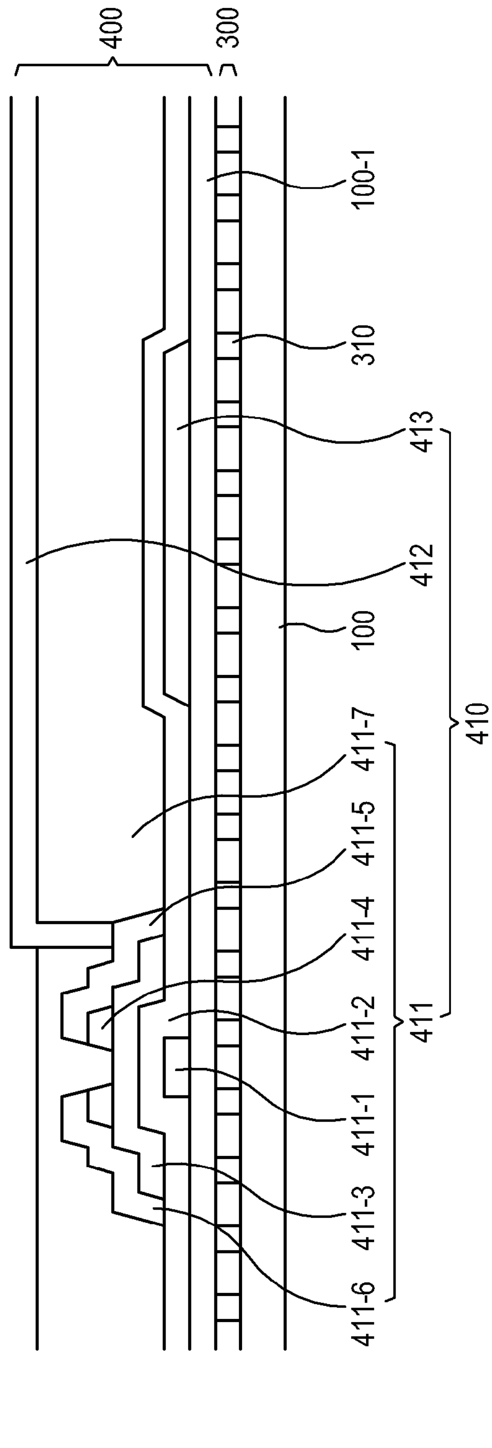
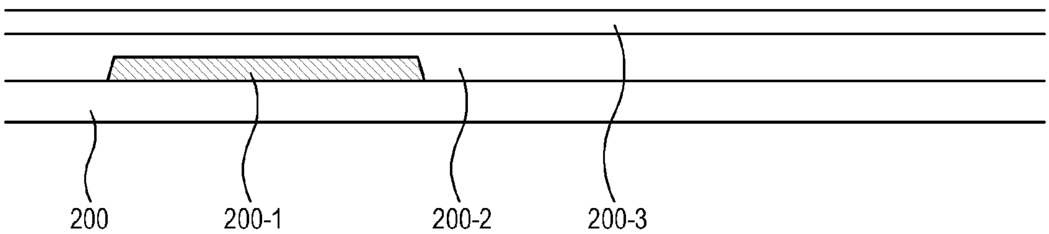

400
300
100-1
310
413
412
100
410
411-7
411-5
411-4
411-2
411
411-1
411-3
411-6

FIG. 8E



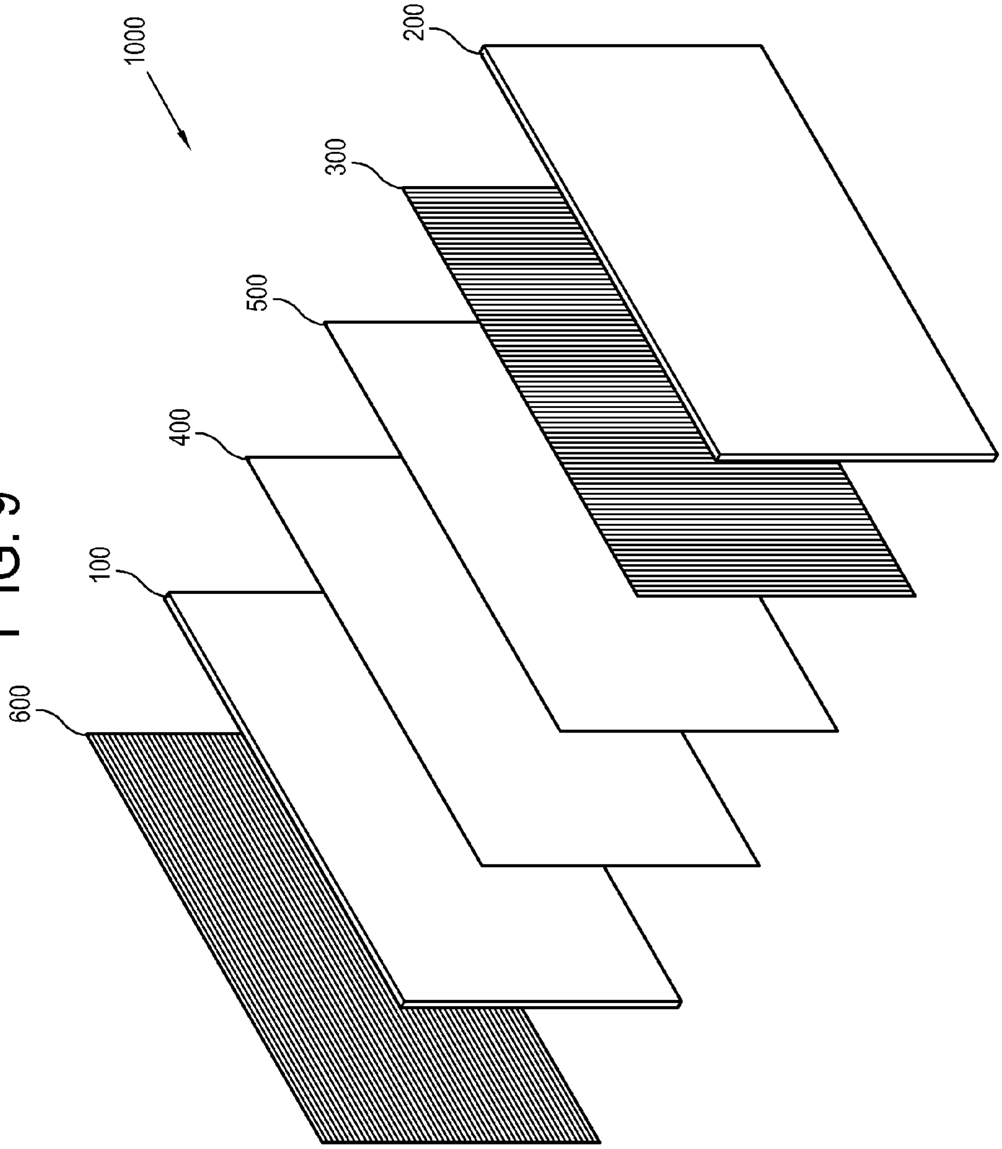
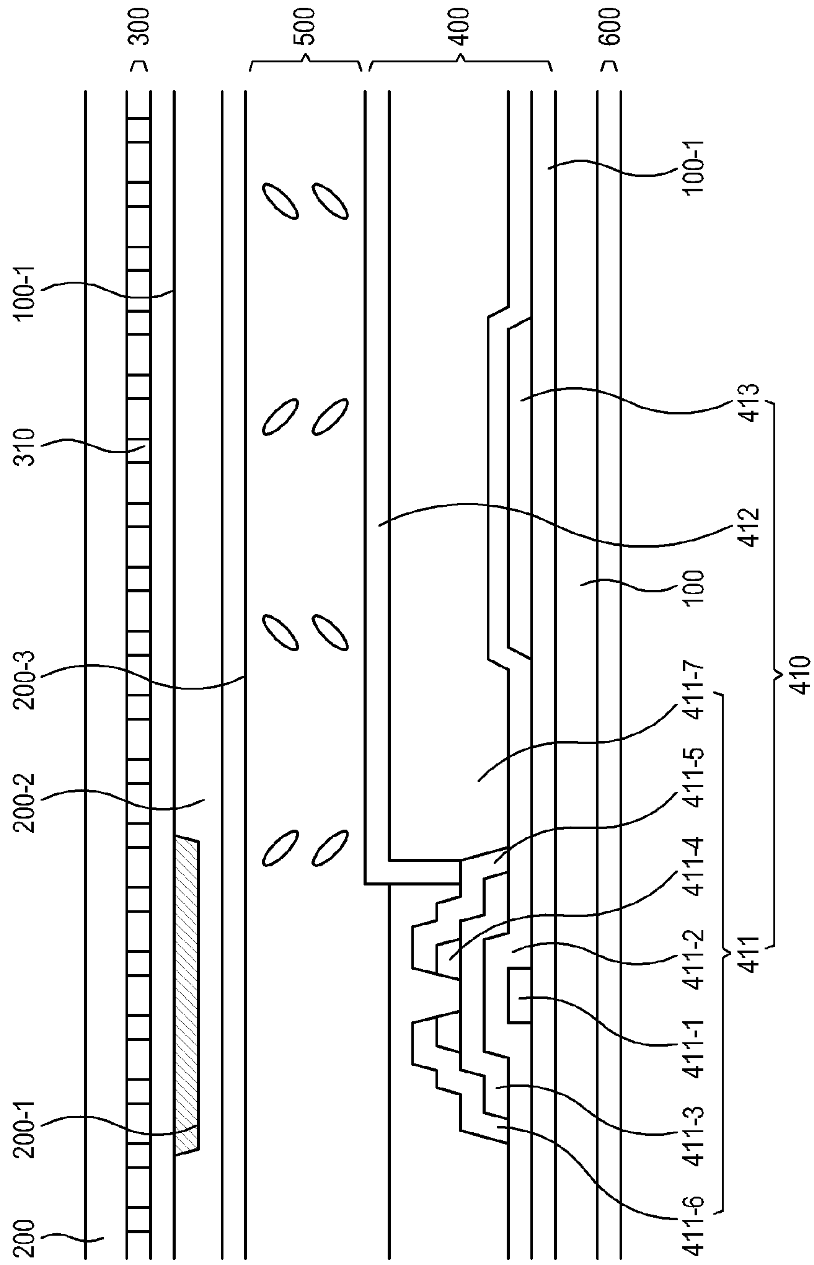


FIG. 9

FIG. 10


300
500
400
600
100-1
310
200-3
200-2
200-1
200
413
412
100
410
411-7
411-5
411-4
411-2
411-1
411-3
411-6
411
100-1

F IG. 11

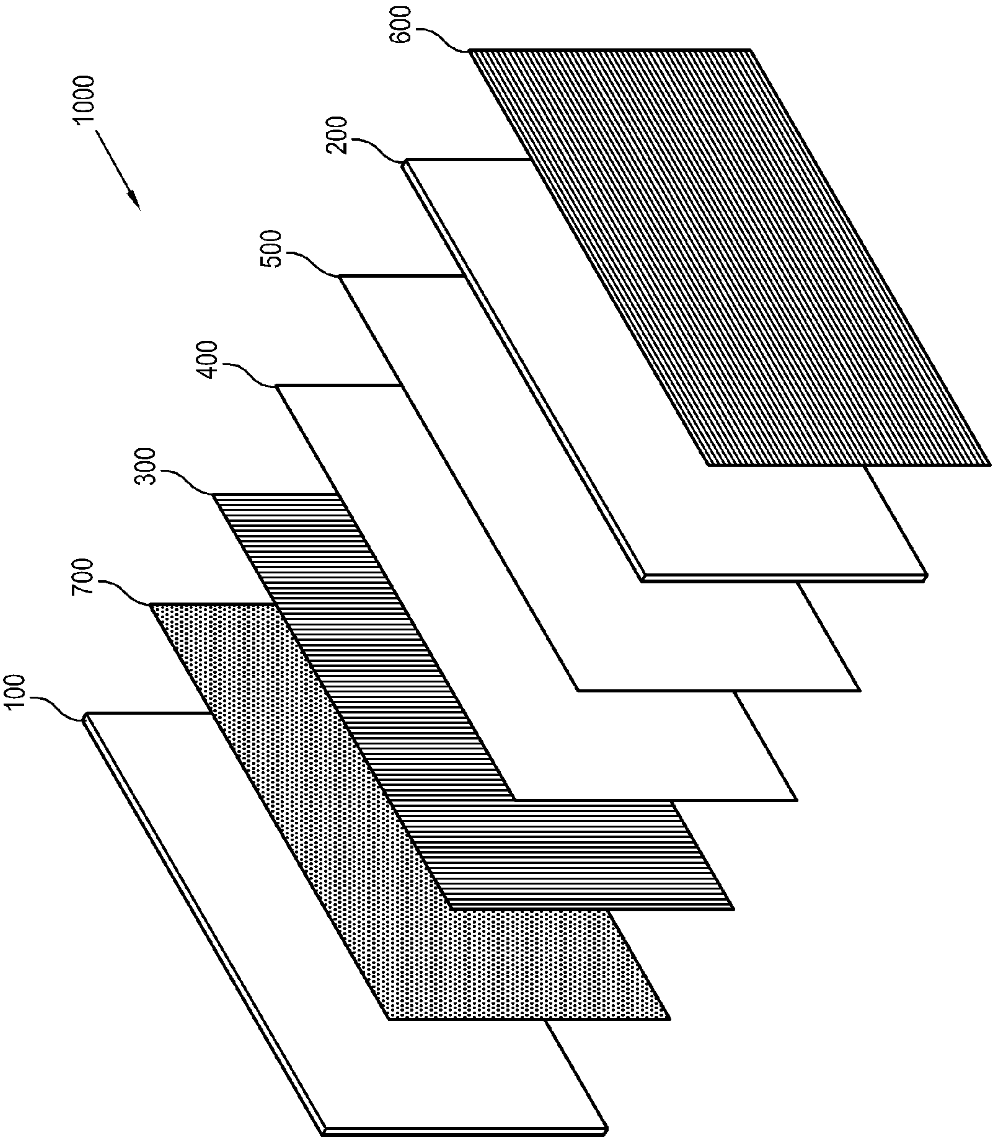
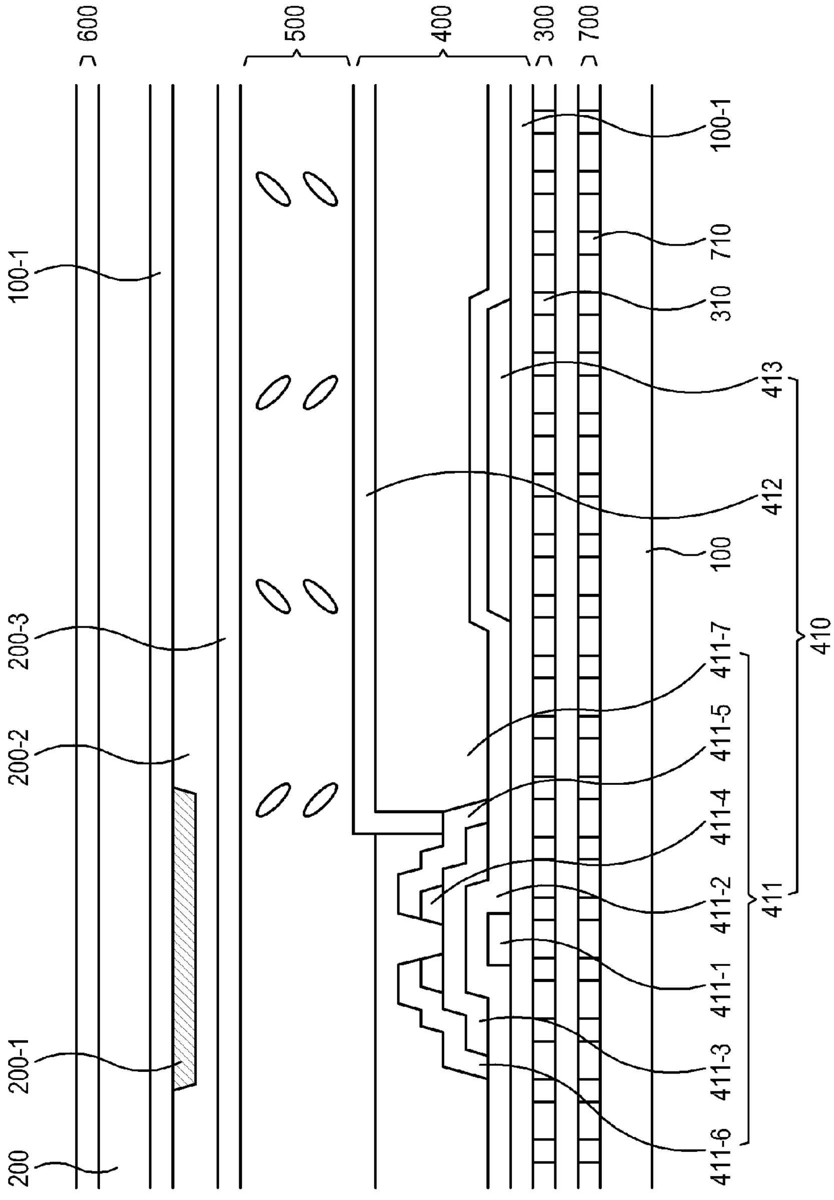


FIG. 12


600
500
400
300
700
200
200-1
200-2
200-3
100-1
100
100-1
710
310
413
412
410
411-7
411-5
411-4
411-2
411-1
411-3
411-6
411

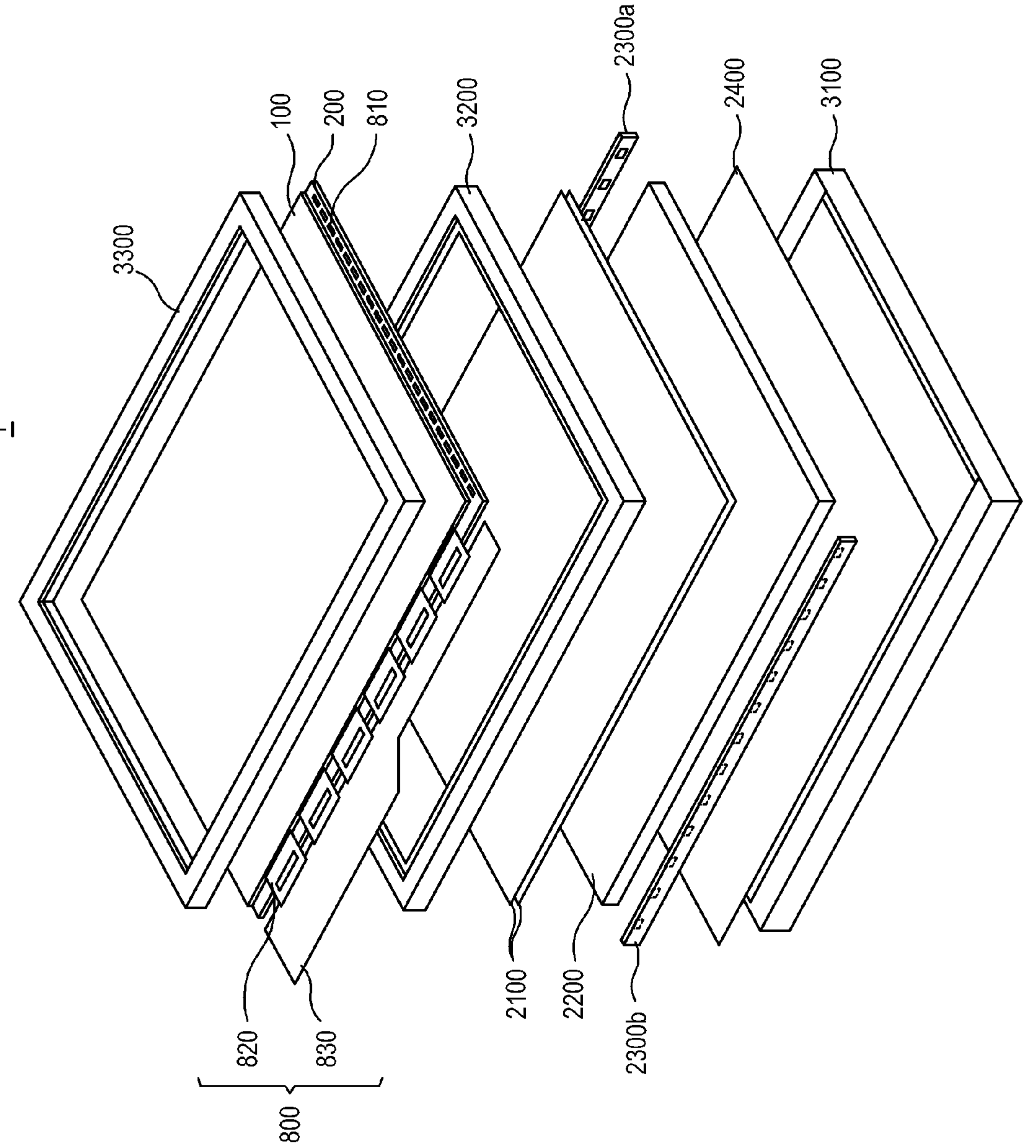

1
3300
100
200
810
3200
2300a
2400
3100
820
830
800
2100
2200
2300b

FIG. 13

FIG. 14

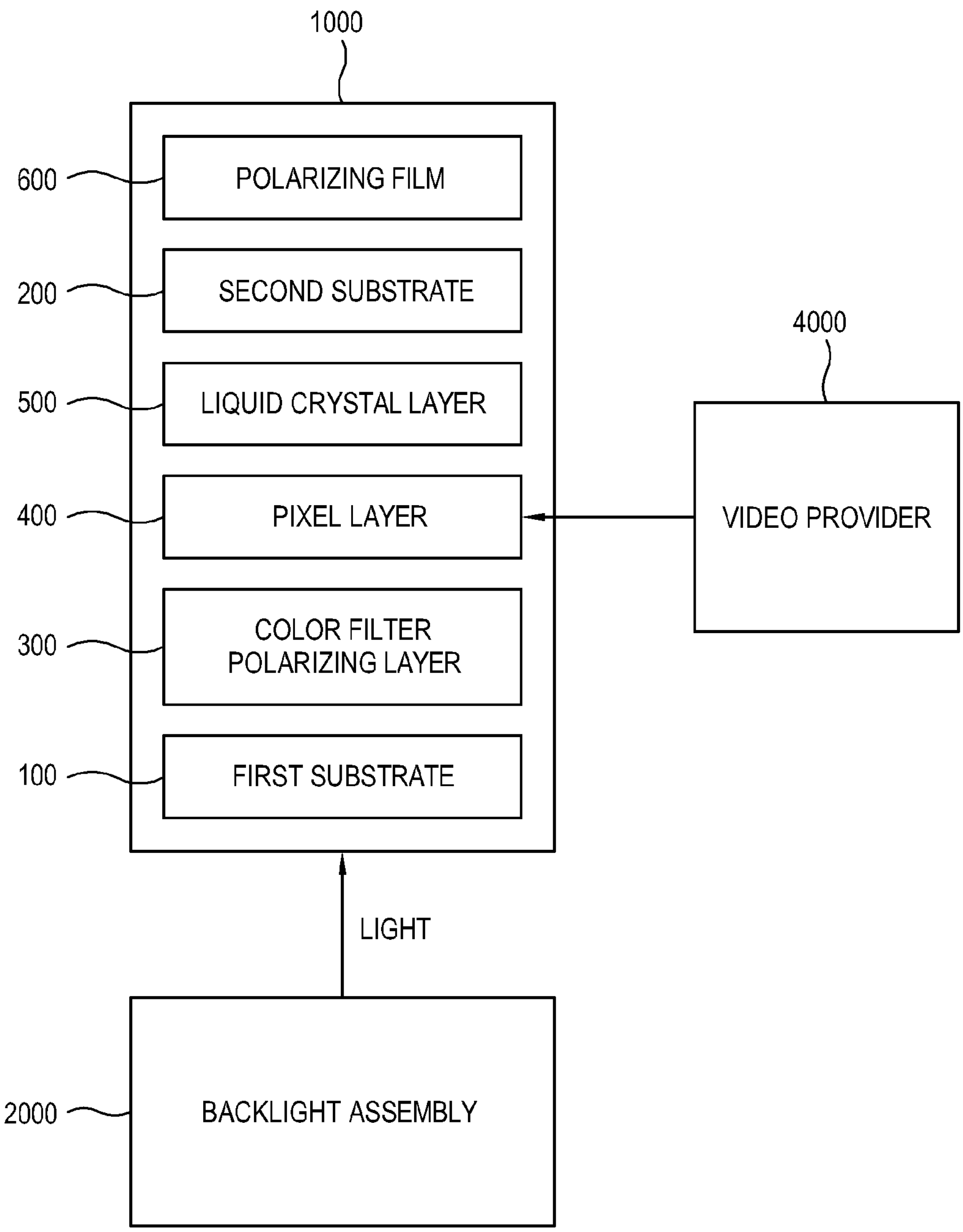
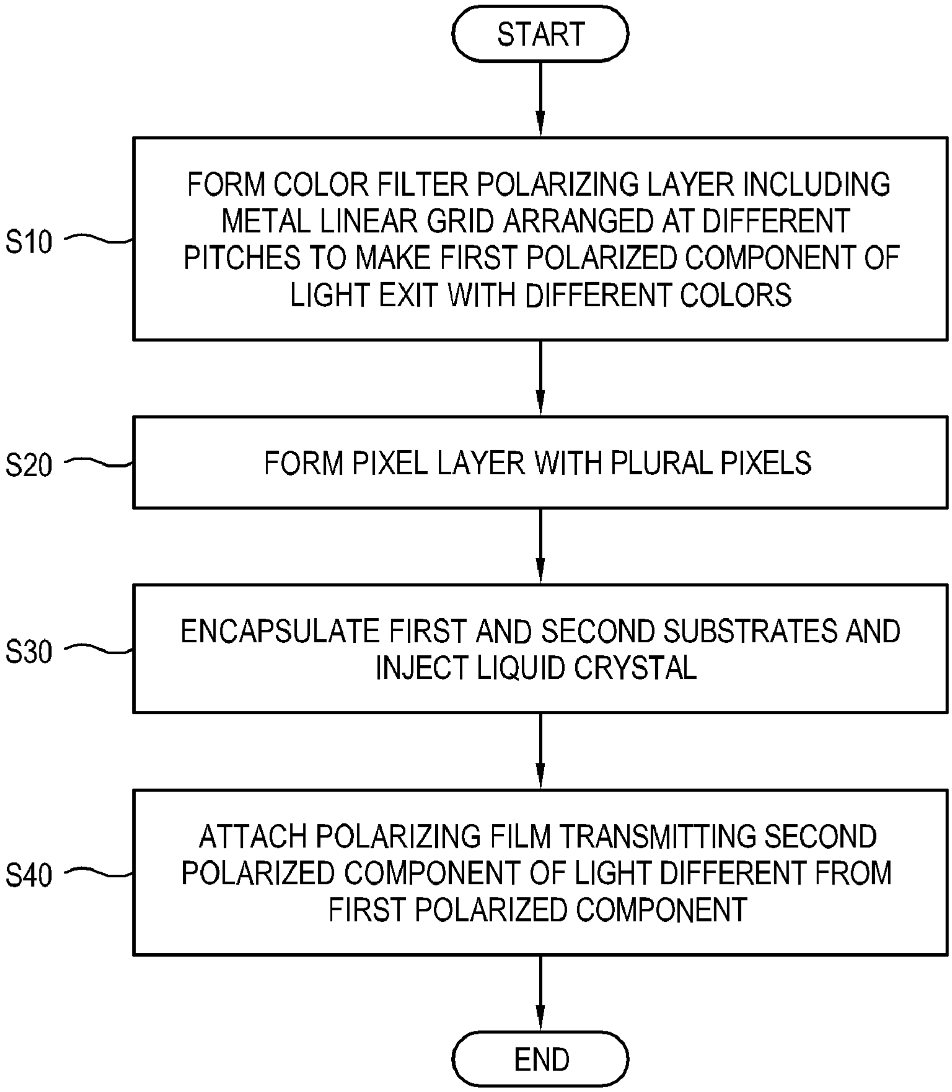

1000
600
POLARIZING FILM
200
SECOND SUBSTRATE
500
LIQUID CRYSTAL LAYER
400
PIXEL LAYER
300
COLOR FILTER
POLARIZING LAYER
100
FIRST SUBSTRATE
4000
VIDEO PROVIDER
LIGHT
2000
BACKLIGHT ASSEMBLY

FIG. 15


START
FORM COLOR FILTER POLARIZING LAYER INCLUDING METAL LINEAR GRID ARRANGED AT DIFFERENT PITCHES TO MAKE FIRST POLARIZED COMPONENT OF LIGHT EXIT WITH DIFFERENT COLORS
S10
FORM PIXEL LAYER WITH PLURAL PIXELS
S20
ENCAPSULATE FIRST AND SECOND SUBSTRATES AND INJECT LIQUID CRYSTAL
S30
ATTACH POLARIZING FILM TRANSMITTING SECOND POLARIZED COMPONENT OF LIGHT DIFFERENT FROM FIRST POLARIZED COMPONENT
S40
END

DISPLAY PANEL AND DISPLAY APPARATUS HAVING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Patent Application No. 61/442,394, filed on Feb. 14, 2011 in the United States Patent and Trademark Office and Korean Patent Application No. 10-2011-0037632, filed on Apr. 22, 2011 in the Korean Intellectual Property Office, the disclosures of which are incorporated herein by reference.

BACKGROUND

[0002] 1. Field

[0003] Apparatuses and methods consistent with the exemplary embodiments relate to a display panel and a display apparatus including the same, and more particularly, to a display panel including a color filter polarizing layer and a polarizing layer and a display apparatus including the same.

[0004] 2. Description of the Related Art

[0005] A liquid crystal display (LCD) panel includes first and second substrates having a liquid crystal layer formed therebetween, and a polarizing film for polarizing light incident on the first and second substrates. Also, the LCD panel includes a color filter layer in order to represent color with light. As the incident light passes through the polarizing film and the color filter layer, the optical efficiency of the light becomes lowered. Meanwhile, the LCD panel may further include a dual brightness enhance film (DBEF) at a light-incident side so as to compensate for light loss due to polarization.

[0006] The polarizing film and the DBEF increase manufacturing costs of the LCD panel or the display apparatus and make a manufacturing process complicated.

SUMMARY

[0007] One or more exemplary embodiments provide a display panel and a display apparatus including the same, in which manufacturing costs are decreased and a manufacturing process is simplified.

[0008] According to another aspect of an exemplary embodiment, there is provided a display panel having improved optical efficiency and a display apparatus including the same.

[0009] The foregoing and/or other aspects may be achieved by providing a display panel with a liquid crystal layer, including first and second substrates which are disposed opposite to each other; a color filter polarizing layer which is formed on a surface of one of the first and second substrates between the first and second substrates, and includes a metal linear grid arranged at different pitches to emit a first polarized component of incident light with different colors; and a polarizing layer formed on an opposite surface to the surface of one of the first and second substrates.

[0010] The polarizing layer may further include a polarizing film transmitting a second polarized component different from the first polarized component.

[0011] The display panel may further include a pixel layer formed on the surface of one of the first and second substrates and including a pixel including a plurality of sub pixels, and at least three sub pixels each corresponding to the different arranged pitches of the metal linear grid.

[0012] The metal linear grid may include a red metal linear grid, a green metal linear grid and a blue metal linear grid, and every pitch of the red metal linear grid may be formed so that every pitch is shorter than ½ of a red light wavelength, the green metal linear grid is formed so that every pitch is shorter than ½ of a green light wavelength, and the blue metal linear grid is formed so that every pitch is shorter than ½ of a blue light wavelength.

[0013] The metal linear grid may include a first metal layer, an insulating layer, and a second metal layer stacked in sequence.

[0014] A height of the metal linear grid may be larger than a width thereof.

[0015] The color filter polarizing layer may further include a dielectric layer stacked beneath the metal linear grid.

[0016] According to another aspect of an exemplary embodiment, there is provided a display apparatus including a display apparatus having a liquid crystal layer, including a display panel which includes first and second substrates which are disposed opposite to each other, a color filter polarizing layer which is formed on a surface of one of the first and second substrates between the first and second substrates, and includes a metal linear grid arranged with different pitches to emit a first polarized component of incident light with different colors, and a polarizing layer formed on a surface opposite to the surface of one of the first and second substrates; and a backlight assembly which emits light to the display panel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The above and/or other aspects will become apparent and more readily appreciated from the following description of the exemplary embodiments, taken in conjunction with the accompanying drawings, in which:

[0018] FIG. **1** shows a layer structure of a display panel according to an exemplary embodiment;

[0019] FIG. **2** is a cross-section view of a display panel of FIG. **1**;

[0020] FIG. **3** is a view showing a color filter polarizing layer of FIG. **1**;

[0021] FIGS. **4**A and **4**B are views showing a metal linear grid of a sub pixel;

[0022] FIG. **5** is a cross-section view of a color filter polarizing layer of FIG. **3**;

[0023] FIG. **6** is a cross-section view of another color filter polarizing layer according to an exemplary embodiment;

[0024] FIG. **7** is a cross-section view of still another color filter polarizing layer according to an exemplary embodiment;

[0025] FIGS. **8**A to **8**E are views for explaining a manufacturing method for a display panel according to an exemplary embodiment;

[0026] FIG. **9** is a view showing a layer structure of a display panel according to another exemplary embodiment;

[0027] FIG. **10** is a cross-section view of the display panel of FIG. **9**;

[0028] FIG. **11** is a view showing a layer structure of a display panel according to still another exemplary embodiment;

[0029] FIG. **12** is a cross-section of the display panel of FIG. **11**;

[0030] FIG. **13** is a schematic view of a display apparatus according to an exemplary embodiment;

[0031] FIG. **14** is a control block diagram of a display apparatus according to an exemplary embodiment; and

[0032] FIG. **15** is a view for explaining a manufacturing method of the display apparatus of FIG. **13**.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

[0033] Below, exemplary embodiments will be described in detail with reference to accompanying drawings so as to be easily realized by a person having ordinary knowledge in the art. The exemplary embodiments may be embodied in various forms without being limited to the exemplary embodiments set forth herein. Descriptions of well-known parts are omitted for clarity, and like reference numerals refer to like elements throughout.

[0034] FIG. **1** shows a layer structure of a display panel according to an exemplary embodiment, and FIG. **2** is a cross-section view showing a display panel of FIG. **1**.

[0035] As shown therein, a display panel **1000** in this exemplary embodiment includes first and second substrates **100** and **200** opposite to each other, and a color filter polarizing layer **300**, a pixel layer **400** and a liquid crystal layer **500** arranged in sequence between the first and second substrates **100** and **200**, and a polarizing film **600** arranged on an outside surface of the second substrate **200**. The display panel **1000** including the liquid crystal layer **500** may be used in a television, home appliances such as a monitor, a cellular phone, a portable multimedia player (PMP), a Netbook, a notebook computer, a mobile terminal such as an E-book terminal or the like, a display apparatus for exhibition and advertisement, etc.

[0036] The color filter polarizing layer **300** and the pixel layer **400** are formed in sequence on the first substrate **100**, and a polarizing film **600** is formed on the second substrate **200**. As shown in FIG. **2**, the second substrate **200** is formed with a black matrix **200-1** in a region corresponding to the TFT **411** of the first substrate **100**, and a common electrode **200-3** generating a voltage corresponding to the pixel electrode **412**. The liquid crystal layer **500**, of which alignment is adjusted by applying a voltage, is inserted between the first and second substrates **100** and **200**. The array of the liquid crystal layer **500** is controlled in accordance with a twisted nematic (TN) mode, a vertical alignment (VA) mode, a patterned vertical alignment (PVA) mode, an in-plane switching (IPS) mode or the like operating mode of the display panel **1000**. To improve an optical viewing angle of the display panel **1000**, sub pixels are divided or patterned, the refractive index of the liquid crystal is uniformly adjusted, or the like technology may be used.

[0037] The color filter polarizing layer **300** is formed on the first substrate **100**, and the pixel layer **400** for controlling the liquid crystal array and displaying an image is formed on the color filter polarizing layer **300**. The color filter polarizing layer **300** includes the metal linear grid **310** arranged with different pitches so that first polarized component of the incident light can be emitted as light of different color. The polarizing film **600** transmits light of a second polarized component different from the first polarized component. On the metal linear grid **310**, a planarization layer **100-1** is formed for protecting and leveling the metal linear grid **310**. The metal linear grid **310** included in the color filter polarizing layer **300** will be described below in detail.

[0038] The pixel layer **400** formed on the planarization layer **100-1** includes a plurality of pixels (not shown) for changing the liquid crystal array filled in the liquid crystal layer **500** on the basis of a control signal received from the exterior, and each pixel includes a plurality of sub pixels **410**. In this exemplary embodiment, the sub pixels **410** represent the smallest unit pixels in which video signal values corresponding to red, green and blue are input, and a unit, which includes a plurality of sub pixels **410** and expresses one video signal, is regarded as the pixel. The sub pixel **410** includes a thin film transistor (TFT) **411** as a switching device, and a pixel electrode **412**. The sub pixel **410** has a two-dimensional spatial concept as well as a physical concept including the TFT **411** and the pixel electrode **412**.

[0039] On the planarization layer **100-1** of the first substrate **100**, the gate electrode **411-1** is formed. The gate electrode **411-1** may be a single or multiple layers containing metal. On the same layer as the gate electrode **411-1**, there are further formed a gate line (not shown) connected to the gate electrode **411-1** and arranged in a transverse direction of the display panel **1000**, and a gate pad (not shown) connected to a gate driver (not shown) and transmitting a driving signal to the gate line. Also, on the same layer as the gate electrode **411-1**, a sustain electrode **413** is formed for building electric charges up.

[0040] On the first substrate **100**, a gate insulating layer **411-2** containing silicon nitride (SiN_x) or the like covers the gate electrode **411-1** and the sustain electrode **413**.

[0041] On the gate insulating layer **411-2** of the gate electrode **411-1**, a semiconductor layer **411-3** containing amorphous silicon or the like semiconductor is formed. On the semiconductor layer **411-3**, an ohmic contact layer **411-4** containing n+ hydrogenated amorphous silicon or the like material highly doped with silicide or n-type impurities is formed. Further, the ohmic contact layer **411-4** is removed in a channel portion between a source electrode **411-5** and a drain electrode **411-6** to be described later.

[0042] On the ohmic contact layer **411-4** and the gate insulating layer **411-2**, data wiring lines **411-5** and **411-6** are formed. The data wiring lines **411-5** and **411-6** may also be a single or multiple layer containing metal. The data wiring lines **411-5** and **411-6** includes a data line (not shown) formed in a vertical direction and intersecting a gate line (not shown) to form the sub pixel **410**, a source electrode **411-5** branched from the data line and extended to an upper portion of the ohmic contact layer **411-4**, and a drain electrode **411-6** separated from the source electrode **411-5** and formed on an upper portion of the ohmic contact layer **411-4** opposite to the source electrode **411-5**.

[0043] On the data wiring lines **411-5** and **411-6** and the semiconductor layer **411-3** that is not covered with the data wiring lines **411-5** and **411-6**, a passivation layer **411-7** is formed. At this time, silicon nitride or the like inorganic insulting film may be further formed between the passivation layer **411-7** and the TFT **411**, thereby securing the reliability of the TFT **411**.

[0044] Typically, the pixel electrode **412** formed on the passivation layer **411-7** contains indium tin oxide (ITO) or indium zinc oxide (IZO), or the like transparent conductive material. The pixel electrode **412** is electrically connected to the source electrode **411-5**.

[0045] On the planarization layer **100-1** of the second substrate **200**, the black matrix **200-1** is formed in a region corresponding to the TFT **411** of the first substrate **100**. Generally, the black matrix **200-1** serves to divide the sub pixels **410** and prevent the TFT **411** from being exposed to external light. The black matrix **200-1** contains a photosensitive organic material with black dye. As the black dye, carbon black, titanium oxide or the like is used.

[0046] On the black matrix **200-1**, an overcoat layer **200-2** is formed for leveling and protecting the black matrix **200-1**. As the overcoat layer **200-2**, an acrylic epoxy material is typically used.

[0047] On the overcoat layer **200-2**, a common electrode **200-3** is formed. The common electrode **200-3** is made of a transparent conductive material such as indium tin oxide (ITO), indium zinc oxide (IZO), etc. The common electrode **200-3**, together with the pixel electrode **412** of the first substrate **100**, directly apply a voltage to the liquid crystal layer **500**.

[0048] FIG. **3** is a view showing a color filter polarizing layer of FIG. **1**. FIGS. **4**A and **4**B are views for explaining a metal linear grid of a sub pixel, and FIG. **5** is a cross-section view of a color filter polarizing layer of FIG. **3**.

[0049] As shown therein, the metal linear grid **310** is shaped like a bar arranged in certain direction on the first substrate **100**. The metal linear grid **310** is periodically arranged with a certain height (H) and width (W). The cycle, i.e., the pitch of the metal linear grid **310** is controlled differently according to desired colors of light.

[0050] If a pitch of a diffraction grid is adjusted to be equal to or shorter than ½ of the wavelength of the light, a diffraction wave is not formed but only transmitted light and reflected light exist. As shown therein, when the incident light passes through the metal linear grid **310** shaped like a slit, the first polarized component of the incident light, which is perpendicular to the metal linear grid **310**, is transmitted through the first substrate **100**, but a second polarized component, which is perpendicular to the metal linear grid **310**, becomes reflected light which is reflected once again. That is, the incident light passing through the color filter polarizing layer **300** is polarized with respect to a certain direction. Meanwhile, air may be formed in between the metal linear grids **310**.

[0051] FIG. **4**A is a view showing a pixel I and sub pixels **410**-R, **410**-G and **410**-B constituting the pixel I. In this exemplary embodiment, the pixel I includes a red sub pixel **410**-R formed in a region where red light is emitted, a green sub pixel **410**-G formed in a region where green light is emitted, and a blue sub pixel **410**-B formed in a region where blue light is emitted. The color filter polarizing layer **300** corresponding to such a pixel layer **400** is formed with the metal linear grid **310** having different pitches according to the sub pixels **410**-R, **410**-G and **410**-B.

[0052] FIG. **4**B is a view showing the metal linear grid **310** corresponding to the sub pixels **410**-R, **410**-G and **410**-B. The metal linear grid **310** includes a red metal linear grid **310**-R formed in a region corresponding to the red sub pixel **410**-R, a green metal linear grid **310**-G formed in a region corresponding to the green sub pixel **410**-G, and a blue metal linear grid **310**-B formed in a region corresponding to the blue sub pixel **410**-B.

[0053] The red metal linear grid **310**-R is arranged such that every pitch is shorter than ½ of a red light wavelength, the green metal linear grid **310**-G is arranged such that every pitch is shorter than ½ of a green light wavelength, and the blue metal linear grid **310**-B is arranged such that every pitch is shorter than ½ of a blue light wavelength. Thus, each pitch of the metal linear grids **310**-R, **310**-G and **310**-B is adjusted in accordance with the sub pixels **410**-R, **410**-G and **410**-B, so that the wavelength of the incident light can be controlled to thereby allow the sub pixels **410** to emit light of different colors, respectively.

[0054] The pitch of the red metal linear grid **310**-R is shorter than ½ of the red light wavelength, i.e., about 330~390 nm, and the incident light is separated into a red light spectrum having a first polarized component while passing through the red metal linear grid **310**-R. The pitch of the green metal linear grid **310**-G is shorter than ½ of the green light wavelength, i.e., about 250~290 nm, and the incident light is separated into a green light spectrum having the first polarized component. The pitch of the blue metal linear grid **310**-B may be set up to be shorter than ½ of the blue light wavelength, i.e., about 220~240 nm. The light passing through the blue metal linear grid **310**-B is separated into a blue light spectrum having the first polarized component. In other words, the pitches of the metal linear grid **310** are decreased in order of the red metal linear grid **310**-R, the green metal linear grid **310**-G and the blue metal linear grid **310**-B. The pitch of the metal linear grid **310** may be adjusted in accordance with light wavelengths of color desired to be emitted from the display panel **1000**, and light of yellow, cyan and magenta may be emitted instead of the foregoing light of red, green and blue.

[0055] As shown in FIG. **5**, the metal linear grid **310** in this exemplary embodiment includes a first metal layer **311**, an insulating layer **313** and a second metal layer **315** stacked in sequence. The first metal layer **311** and the second metal layer **315** may be made of metal such as Al, Ag, etc. and may have a height of less than about 100 nm. In this exemplary embodiment, each of the first metal layer **311** and the second metal layer **315** may be formed to have a height of about 40 nm. The insulating layer **313** stacked between the first metal layer **311** and the second metal layer **315** may include a dielectric material such as ZnSe and TiO_2, and may be formed to have a height of less than about 150 nm. The height of the metal linear grid **310** is larger than the width thereof, and a ratio of height to width may be 2~4, for example, 3. In the metal linear grid **310**, the width, the height, the pitch, the ratio of height to width, and a ratio of pitch to width may be varied depending on the material forming the metal linear grid **310**. That is, simulation about optical transmittance is conducted by taking the kind of metal, the height of dielectric material, etc. into account, and an optimal condition may be selected. Also, the width, the height, the pitch, the ratio of height to width, and a ratio of pitch to width of the metal linear grid **310** may be varied depending on color of emitted light, i.e., each sub pixel **410**.

[0056] The principle that colored light is emitted from the metal layer **311**, **315** of the metal linear grid **310** is based on Plasmon that free electrons in metal are collectively oscillated. Nano-sized metal shows Plasmon resonance on a surface of the metal due to the oscillation of the free electrons. The surface Plasmon resonance is collective charge density oscillation of the electrons on the surface of a metal thin film, and a surface Plasmon wave caused by the surface Plasmon resonance is a surface electromagnetic wave propagating along a boundary surface between the metal and the dielectric material adjacent to the metal. As a kind of surface electromagnetic wave propagating along the boundary surface between metal and the dielectric material, the surface Plasmon wave corresponds to a wave generated when light incident to the metal surface and having a certain wavelength is not totally reflected and causes a surface wave. If the metal linear grid **310** including the first metal layer **311**, the insulating layer **313** and the second metal layer **315** is arranged in the form of slits in a certain cycle, the color of emitted light is varied depending on the cycle.

[0057] According to this exemplary embodiment, the metal linear grid **310** is configured to make white light filter into individual colors throughout a visible light region. This is to achieve a nano oscillator for quantum-Plasmon-quantum conversion within a certain oscillation wavelength, which enhances a pass bandwidth and makes compactness possible as compared with other color filtering methods. Also, the filtered light has already been naturally polarized, so that it can be directly applied to an LCD panel or the like without any separate polarizing layer.

[0058] Accordingly, the display panel **100** can generate polarized colored light through one color filter polarizing layer **300** instead of the existing polarizing film and color filter. Also, light that is not transmitted through the first substrate **100** is not absorbed but is instead reflected from the first metal layer **311** of the metal linear grid **310**, making it likely to be reflected again toward the display panel **1000**. That is, the total optical efficiency is improved so that the conventional dual brightness enhance film (DBEF) can be omitted.

[0059] If light enters through the bottom of the first substrate **100** and exits through the second substrate **200**, the light of only the first polarized component enters the liquid crystal layer **500**, and the light of the second polarized component is reflected from the first substrate **100**. Typically, a backlight assembly (not shown) emitting light under the display panel **1000** includes a reflective plate that reflects light reflected from the first substrate **100** toward the display panel **1000** again. Metal contained in the metal linear grid **310** may have high reflectivity so that more much light can be recycled by the reflective plate and enter the first substrate **100**, i.e., more much light of the second polarized component can enter the reflective plate. For example, the metal linear grid **310** may include metal having high reflectivity, such as Al, Ag, Cu, etc. Thus, if the highly-reflective metal causes the reflectivity of the metal linear grid **310**, it is possible to omit the dual brightness enhance film (DBEF) used in the conventional display panel. Accordingly, there is an effect on reducing production costs of the display panel **1000**, and it is possible to make the display apparatus including the display panel **1000** thin and lightweight.

[0060] FIG. **6** is a cross-section view of another color filter polarizing layer according to an exemplary embodiment.

[0061] As shown therein, the color filter polarizing layer **300** may further include a dielectric layer **320** formed under the metal linear grid **310**. The dielectric layer **320** may be made of a material similar to the first substrate **100**, and may contain MgF_2. The dielectric layer **320** may be provided in the form of a film coupled to the first substrate **100**. Here, the dielectric layer **320** may replace the first substrate **100** or may be omitted.

[0062] FIG. **7** is a cross-section view of still another color filter polarizing layer according to an exemplary embodiment.

[0063] As shown therein, the display panel **1000** may further include a light absorbing layer **330** formed on the metal linear grid **310** included in the first substrate **100** and absorbing light. If external light enters the display panel **1000** and is reflected again, there are problems that a contrast ratio of the display panel **1000** may be lowered and picture quality may be deteriorated due to the reflection of light. To prevent these problems, the first substrate **100** according to this exemplary embodiment includes the light absorbing layer **330** on the metal linear grid **310** in order to absorb undesired external light.

[0064] The light absorbing layer **330** may contain metal having low reflectivity, and or may include or be configured with carbon, chrome oxide, etc. for absorbing the light.

[0065] Alternatively, the light absorbing layer **330** may be formed not on the first substrate **100** but beneath the second substrate **200**. That is, the external light is intercepted by the light absorbing layer and thus prevented from entering the display panel **1000**.

[0066] FIGS. **8**A to **8**E are views for explaining a manufacturing method for a display panel according to an exemplary embodiment.

[0067] As shown in FIG. **8**A, the first metal layer **311**, the insulating layer **313** and the second metal layer **315** are stacked in sequence by a sputtering method or the like in order to form a color filter polarizing layer **300** on the first substrate **100**.

[0068] Then, as shown in FIG. **8**B, a general patterning process is performed. In other words, photoresist is deposited, exposed to light through a mask, and developed and etched to thereby form the metal linear grid **310**. That is, the first metal layer **311**, the insulating layer **313** and the second metal layer **315** are not respectively formed but stacked in sequence and once patterned to form the metal linear grid **310**. The process of forming the metal linear grid **310** may be achieved by any publicly-known or not-known patterning technique.

[0069] After forming the metal linear grid **310**, as shown in FIG. **8**C, the planarization layer **100-1** is formed for protecting and leveling the surface of the metal linear grid **310**. The planarization layer **100-1** may contain silicon nitride SiN_x.

[0070] Then, as shown in FIG. **8**D, the TFT **411** and the pixel electrode **412** electrically connected to the TFT **411** are formed on the planarization layer **100-1**. The pixel electrode **412** may be formed by depositing metal by the sputtering method and patterning it.

[0071] FIG. **8**E is views for explaining a manufacturing method for the second substrate **200**. As shown, the black matrix **200-1** is formed on the second substrate **200** in a region corresponding to the TFT **411**, and the overcoat layer **200-2** is formed for leveling the black matrix **200-1**. Further, the common electrode **200-3** containing a transparent conductive material is formed by a sputtering method.

[0072] Thereafter, if FIGS. **8**D and **8**E are coupled and then the polarizing film **600** is attached to an outside surface of the second substrate **200**, the display panel **1000** is completed as shown in FIG. **2**.

[0073] FIG. **9** is a view showing a layer structure of a display panel according to another exemplary embodiment, and FIG. **10** is a cross-section view of the display panel of FIG. **9**.

[0074] As shown therein, the display panel **1000** according to this exemplary embodiment includes a polarizing film **600** formed on the outer surface of the firs substrate **100**, and a color filter polarizing layer **300** formed on the second substrate **200**. In other words, the color filter polarizing layer **300** may be arranged on not the pixel layer **400** but on the substrate formed with the black matrix **200-1**. If light enters through the bottom of the first substrate **100**, the light of second polarized component passed through the polarizing film **600** passes through the liquid crystal layer **500**, and then emits as the light of the first polarized component with different colors while passing through the color filter polarizing layer **300**. Each of the color filter polarizing layer **300** and the polarizing film **600** may be selectively formed on the same or different substrates as the pixel electrode **400**. Of course, light may enter though the second substrate **200** and exit through the first substrate **100**.

[0075] In this exemplary embodiment, because the metal linear grid **310** is formed on the second substrate **200** through which the light exits, the metal linear grid **310** may contain metal having low reflectivity so as to suppress reflection of external light and absorb the light. The metal linear grid **310** may undergo additional processes for decreasing the reflectivity of the metal, or may include or be configured with carbon, chrome oxide, etc. for absorbing the light.

[0076] In the meantime, the metal linear grid **310** according to another exemplary embodiment may include metal having high strength in consideration of external impacts. For example, the second metal linear grid **610** may contain MoW or the like alloy, or may contain conductive polymer capable of performing substantially the same function as the metal layer.

[0077] FIG. **11** is a view showing a layer structure of a display panel according to still another exemplary embodiment, and FIG. **12** is a cross-section of the display panel of FIG. **11**.

[0078] As shown therein, the display panel **1000** in this exemplary embodiment further includes an additional polarizing layer **700** beneath the color filter polarizing layer **300** to transmit the first polarized component. The additional polarizing layer **700** may include an additional metal linear grid **710** that contains substantially the same metal as metal contained in the metal linear grid **310** and is arranged in the same direction as the metal linear grid **310**. The additional metal linear grid **710** is arranged in the same direction as the metal linear grid **310**, and thus transmits the first polarized component. The light of the first polarized component passed through the additional polarizing layer **700** is emitted with red, blue and green colors while passing through the color filter polarizing layer **300**.

[0079] The metal layer contained in the additional metal linear grid **710** may contain highly-reflective metal, e.g., at least one of Al, Ag and Cu. Further, a light absorbing layer may be further provided on the metal layer and absorb external light.

[0080] The display panel **1000** may further include a printed circuit board mounted with a gate driving integrated chip (IC) and a data chip film package although they are not shown. Also, a compensation film (not shown) may be further provided outside the first substrate **100** and the second substrate **200**.

[0081] FIG. **13** is a schematic view of a display apparatus according to an exemplary embodiment, and FIG. **14** is a control block diagram of a display apparatus according to an exemplary embodiment.

[0082] As shown therein, the display apparatus **1** includes the display panel **1000**, the backlight assembly **2000**, accommodating containers **3100**, **3200**, **3300** accommodating the display panel **1000** and the backlight assembly **2000**, and a video provider **4000**.

[0083] The display panel **1000** includes the first substrate **100**, the second substrate **200** opposite to the first substrate **100**, the liquid crystal layer (not shown) interposed between the first substrate **100** and the second substrate **200**, and a panel driver **800** for driving the pixel layer **400** to display a video signal. The panel driver **800** may include a gate driving IC **810**, a data chip film package **820**, and a printed circuit board **830**.

[0084] The first substrate **100** and the second substrate **200** may be formed with the pixel layer **400**, the color filter polarizing layer **300**, the polarizing film **600**, the black matrix **200-1**, the common electrode **200-3**, etc. The color filter polarizing layer **300** polarizes the incident light entering the first substrate **100**, and the polarizing film **600** polarizes light exiting through the display panel **1000**.

[0085] The display panel **1000** receives external light and controls intensity of light passing through the liquid crystal layer interposed between the first substrate **100** and the second substrate **200**, thereby displaying an image.

[0086] The gate driving IC **810** is integrated and formed on the first substrate **100**, and connected to each gate line (not shown) formed on the first substrate **100**. Further, the data chip film package **820** may be connected to each data line (not shown) formed on the first substrate **100**. Here, the data chip film package **820** may include a tape automated bonding (TAB) tape where a semiconductor chip is adhered to a wiring pattern formed on a base film by TAB technology. As an example of the chip film package, a tape carrier package (TCP), a chip on film (COF), etc. may be used.

[0087] Meanwhile, the printed circuit board **830** may be mounted with driving components for inputting a gate driving signal to a gate driving IC **931** and for inputting a data driving signal to a data chip film package **820**.

[0088] The backlight assembly **2000** may include a light guide plate **2200** for guiding light, first and second light sources **2300***a* and **2300***b* for emitting light, a reflective sheet **2400** placed beneath the light guide plate **2200**, and one or more optical sheets **2100**.

[0089] The light guide plate **2200** serves to guide the light to be supplied to the display panel **1000**. The light guide plate **2200** may be made of transparent plastic panel such as acryl, and guide light emitted from the first and second light sources **2300***a* and **2300***b* to travel toward the display panel **1000** formed on the light guide plate **2000**. On the rear of the light guide plate **2200**, there may be various patterns for changing a traveling direction of the light entering the inside of the light guide plate **2200** toward the display panel **1000**.

[0090] As shown in the drawing, the first light source **2300***a* and the second light source **2300***b* may include a light emitting diode (LED) as a point light source. The light source is not limited to the LED, and may include a line light source such as a cold cathode fluorescent lamp (CCFL) or a hot fluorescent lamp (HCFL). The first light source **2300***a* and the second light source **2300***b* are electrically connected with an inverter (not shown) supplying power, and receive the power.

[0091] The reflective sheet **2400** is provided under the light guide plate **2200** and reflects the light emitted under the light guide plate **2200** upward. Specifically, the light, which is not reflected by a fine dot pattern formed on the back of the light guide plate **2200**, is reflected again toward the light guide plate **2200**, thereby decreasing loss in the light entering the display panel **1000** and enhancing uniformity of light transmitting through the exit surface of the light guide plate **2200**.

[0092] One or more optical sheets **2100** are provided on the top of the light guide plate **2200** and serve to diffuse and condense the light transmitted from the light guide plate **2200**. The optical sheets **2100** may further include a diffusion sheet, a prism sheet, a protection sheet, etc. The diffusion sheet may be placed between the light guide plate **2200** and the prism sheet, and diffuses incident light from the light guide plate **2200** to thereby prevent the light from being partially concentrated. The prism sheet may include triangular prisms regularly arranged on the top thereof, and serve to condense the light diffused by the diffusion sheet in a direction perpendicular to the display panel **1000**. The protection sheet may be formed on the prism sheet, to protect the surface of the prism sheet, and diffuse the light and thus uniformly distribute the light.

[0093] The accommodating container may include a lower accommodating container **3100**, a middle accommodating container **3200** and an upper accommodating container **3300**. The lower accommodating container **3100** may accommodate the reflective sheet **2400**, the first and second light sources **2300***a* and **2300***b*, the light guide plate **2200**, and one or more optical sheets **2100**. The lower accommodating container **3100** may be made of metal having a strength capable of withstanding an external shock and ground ability.

[0094] The video provider **4000** connects with the display panel **1000** and provides a video signal. Although not shown in FIG. **13**, the video provider **4000** may be arranged on the reflective sheet **2400** and the lower accommodating container **3100**, or may be placed on the rear of the lower accommodating container **3100**.

[0095] FIG. **15** is a view for explaining a manufacturing method of the display apparatus of FIG. **13**.

[0096] First, at operation S**10**, the color filter polarizing layer **300** including the metal linear grid **310** arranged at different pitches to make the first polarized component of the light exit the display apparatus with different colors are formed on the first substrate **100**. At this time, the metal linear grid **310** may include the red metal linear grid arranged such that every pitch is shorter than ½ of a red light wavelength, the green metal linear grid arranged such that every pitch is shorter than ½ of a green light wavelength, and the blue metal linear grid arranged such that every pitch is shorter than ½ of a blue light wavelength. Of course, the metal linear grid may be arranged or formed with pitches different from the above in accordance with the colors of the light. The metal linear grid **310** may be formed by stacking the first metal layer **311**, the insulating layer **313** and the second metal layer **315** in sequence and applying the sputtering process thereto.

[0097] Beneath the metal linear grid **310** may be provided the dielectric layer **320**, and on the metal linear grid **310** may be provided the light absorbing layer **330** for suppressing reflection of light.

[0098] Characteristics of metal forming the metal linear grid **310**, i.e., reflectivity or strength of the metal may be varied depending on whether the metal linear grid **310** is formed on the substrate for incident light or on the substrate for exiting light.

[0099] On the color filter polarizing layer **300**, the pixel layer **400** including the plurality of sub pixels **410** is formed at operation S**20**. Alternatively, the pixel layer **400** may be formed on the substrate different from the color filter polarizing layer **300**, i.e., the second substrate **200**.

[0100] On the second substrate **200** having no pixel layer **400**, the black matrix **200-1**, the overcoat layer **200-2** and the common electrode **200-3** are formed.

[0101] Then, at operation S**30**, the first substrate **100** and the second substrate **200** are encapsulated, and the liquid crystal is injected between the first substrate **100** and the second substrate **200**.

[0102] At operation S**40**, the polarizing film **600** is attached to the outer surface of the second substrate **200** having no color filter polarizing layer **300**, thereby transmitting the second polarized component of light different from the first polarized component. With this process, the display panel **1000** is completed.

[0103] Next, the video provider **4000** capable of supplying video data to the sub pixels **410** and the panel driver **800** for driving the pixel layer **400** are connected to the substrate, and assembled to the backlight assembly **2000** including the light sources **2300***a* and **2300***b*, thereby completing the display apparatus **1** as shown in FIG. **13**.

[0104] As described above, according to an exemplary embodiment, there are provided a display panel and a display apparatus comprising the same, in which manufacturing costs are decreased and a manufacturing process is simplified.

[0105] According to another exemplary embodiment, there are provided a display panel having improved optical efficiency and a display apparatus comprising the same.

[0106] Although a few exemplary embodiments have been shown and described, it will be appreciated by those skilled in the art that changes may be made in these exemplary embodiments without departing from the principles and spirit of the inventive concept, the scope of which is defined in the appended claims and their equivalents.

1. A display panel with a liquid crystal layer, comprising:

first and second substrates which are disposed opposite to each other;

a color filter polarizing layer which is formed on a surface of one of the first and second substrates between the first and second substrates, and comprises a metal linear grid arranged at different pitches to emit a first polarized component of incident light with different colors; and

a polarizing layer formed on an outer surface of the other one of the first and second substrates.

2. The display panel according to claim **1**, wherein the polarizing layer comprises a polarizing film transmitting a second polarized component different from the first polarized component.

3. The display panel according to claim **1**, further comprising a pixel layer formed on the surface of one of the first and second substrates and including a pixel comprising a plurality of sub pixels,

wherein at least three sub pixels are arranged with corresponding three different pitches of the metal linear grid.

4. The display panel according to claim **1**, wherein the metal linear grid comprises a red metal linear grid, a green metal linear grid and a blue metal linear grid, and the red metal linear grid is arranged such that every pitch is shorter than ½ of a red light wavelength, the green metal linear grid is arranged such that every pitch is shorter than ½ of a green light wavelength, and the blue metal linear grid is arranged such that every pitch is shorter than ½ of a blue light wavelength.

5. The display panel according to claim **1**, wherein the metal linear grid comprises a first metal layer, an insulating layer, and a second metal layer stacked in sequence.

6. The display panel according to claim **1**, wherein a height of the metal linear grid is larger than a width thereof.

7. The display panel according to claim **1**, wherein the color filter polarizing layer further comprises a dielectric layer formed between the metal linear grid and one of the first and second substrates.

8. A display apparatus with a liquid crystal layer, comprising:

a display panel which comprises first and second substrates which are disposed opposite to each other, a color filter polarizing layer which is formed on a surface of one of the first and second substrates between the first and second substrates, and comprises a metal linear grid arranged at different pitches to emit a first polarized component of incident light with different colors, and a polarizing layer formed on an outer surface of the other one of the first and second substrates; and

a backlight assembly which emits light to the display panel.

9. The display apparatus according to claim **8**, wherein the display panel further comprises a polarizing film transmitting a second polarized component different from the first polarized component.

10. The display apparatus according to claim **8**, further comprises a pixel layer formed on the surface of one of the first and second substrates and including a pixel comprising a plurality of sub pixels, and at least three sub pixels arranged with corresponding different pitches of the metal linear grid.

11. The display apparatus according to claim **8**, wherein the metal linear grid comprises a red metal linear grid, a green metal linear grid and a blue metal linear grid, and the red metal linear grid is arranged such that every pitch is shorter than ½ of a red light wavelength, the green metal linear grid is arranged such that every pitch is shorter than ½ of a green light wavelength, and the blue metal linear grid is arranged such that every pitch is shorter than ½ of a blue light wavelength.

12. The display apparatus according to claim **8**, wherein the metal linear grid comprises a first metal layer, an insulating layer, and a second metal layer stacked in sequence.

13. The display apparatus according to claim **8**, wherein a height of the metal linear grid is larger than a width thereof.

14. The display apparatus according to claim **8**, wherein the color filter polarizing layer further comprises a dielectric layer formed between the metal linear grid and one of the first and second substrates.

15. A method of manufacturing a display apparatus comprising:

forming a color filter polarizing layer including a metal linear grid on a surface of a first substrate located between the first substrate and a second substrate;

forming a pixel layer including a plurality of sub pixels on the color filter polarizing layer;

encapsulating the first and second substrates and injecting a liquid crystal in a space formed between the first and second substrates; and

forming a polarizing film on a surface of the second substrate opposite to a surface between the first and second substrates.

* * * * *

patsnap

专利名称(译)	显示面板和具有该显示面板的显示设备		
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[标]申请(专利权)人(译)	三星电子株式会社		
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摘要(译)

提供一种显示面板和具有该显示面板的显示装置。具有液晶层的显示面板包括彼此相对设置的第一和第二基板;滤色器偏振层，形成在第一和第二基板之间的第一和第二基板之一的表面上，并包括以不同间距布置的金属线性栅格，以发射具有不同颜色的入射光的第一偏振分量;和在与第一和第二基板之一的表面相对的表面上形成的偏振层。所提供的显示面板和包括该显示面板的显示装置具有降低的制造成本和简化的制造工艺。