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(54) **DISPLAY DEVICE**

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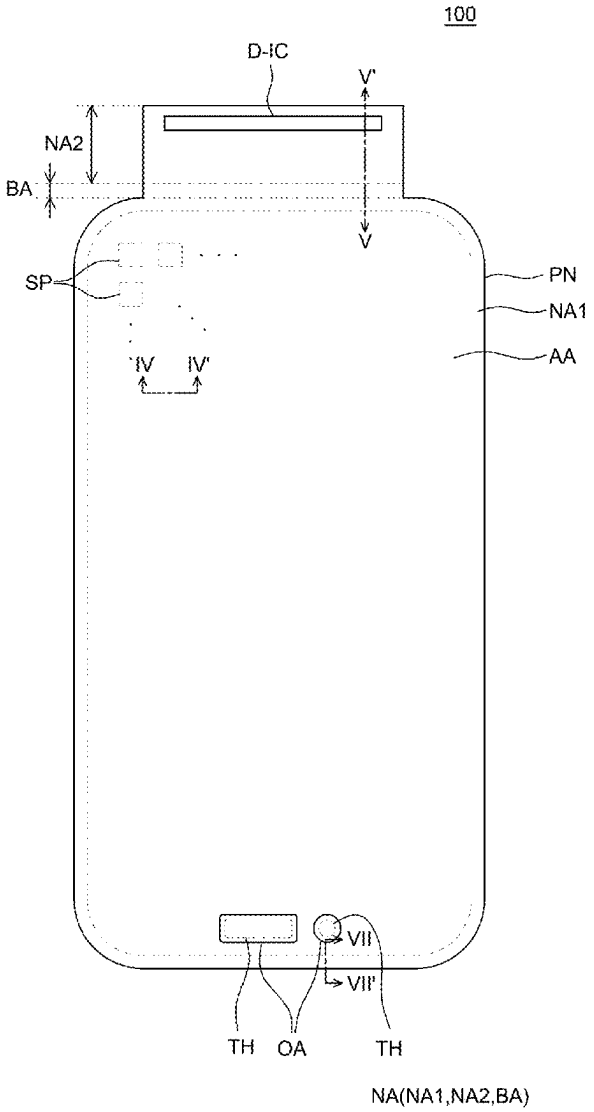
(57) **ABSTRACT**

A display device includes a display panel including a display area, an optical area disposed in the display area and including a through-hole, and a non-display area configured to surround the display area, a support member disposed below the display panel, a first bonding layer disposed between the display panel and the support member, a frame including a lower frame disposed below the support member, and a lateral frame disposed on side surfaces of the display panel, the support member, and the first bonding layer, and a molding member disposed between the display panel, the support member, and the frame, wherein the first bonding layer extends from one side of the display panel adjacent to the optical area and is disposed between the display panel and the molding member.



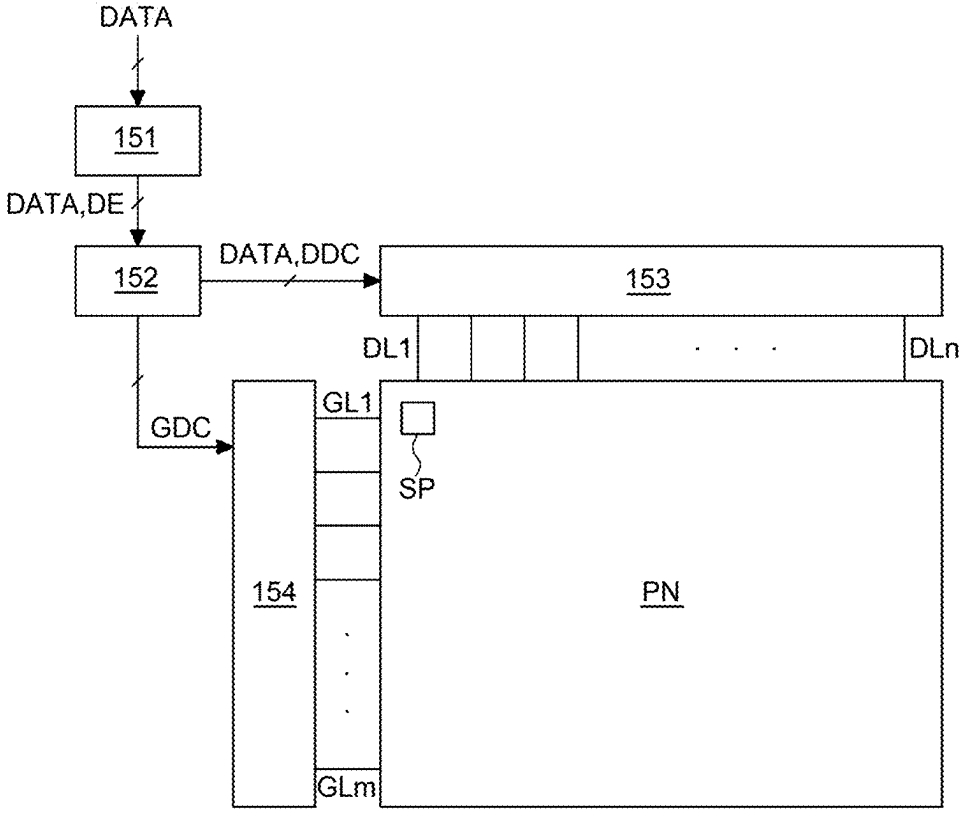


FIG. 1

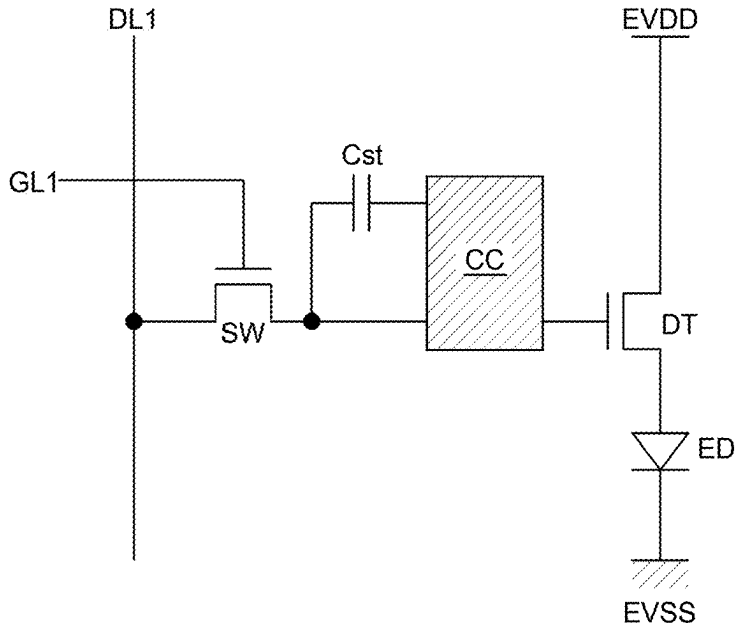


FIG. 2

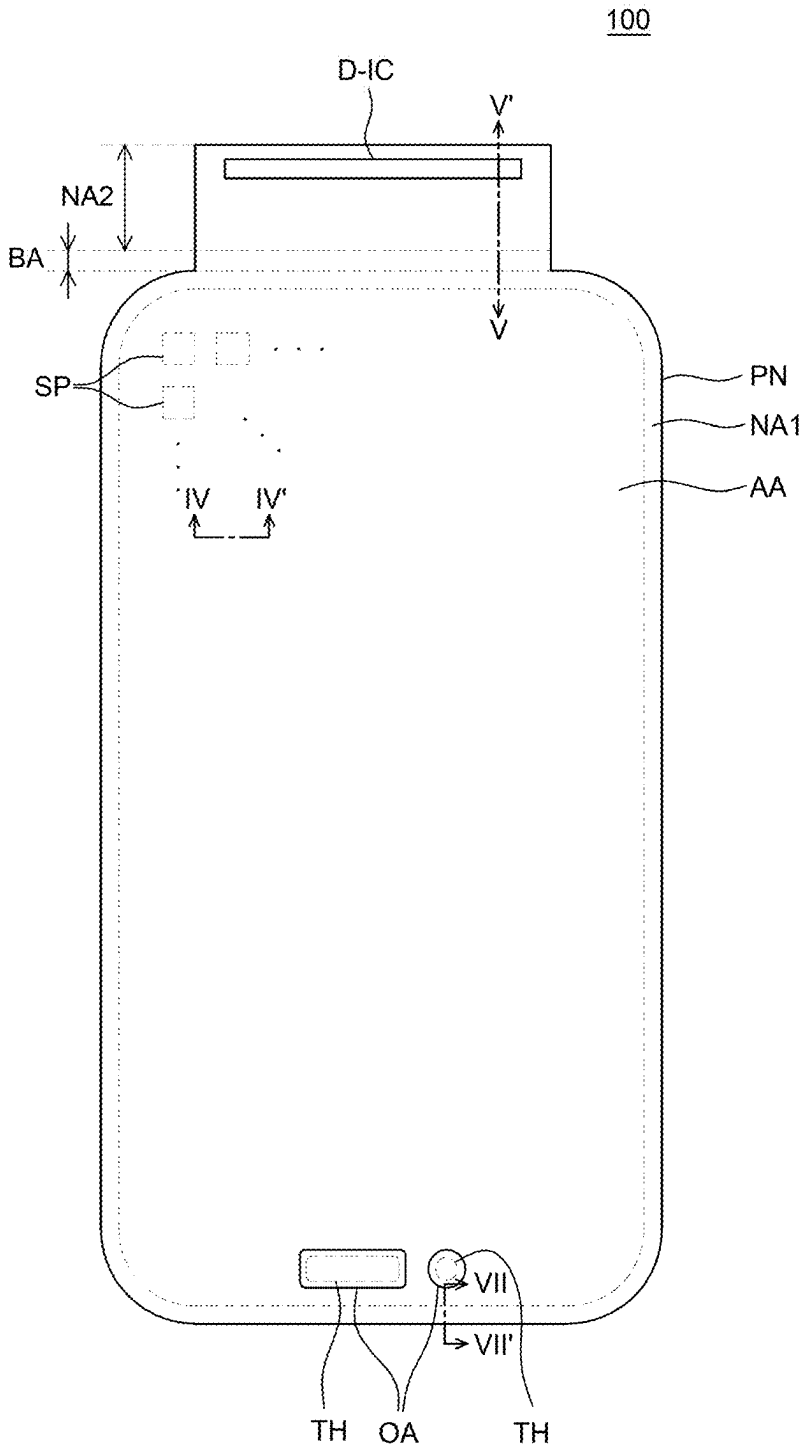


FIG. 3

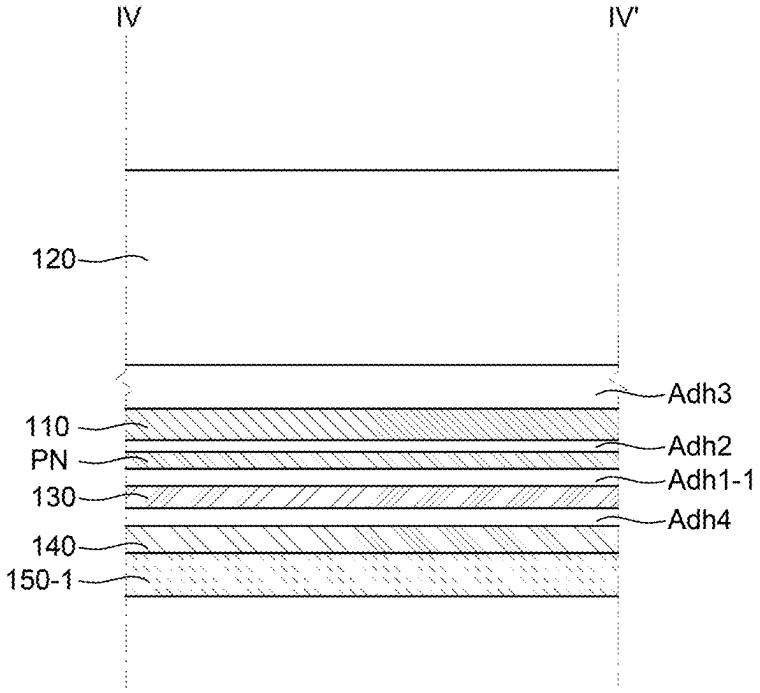


FIG. 4

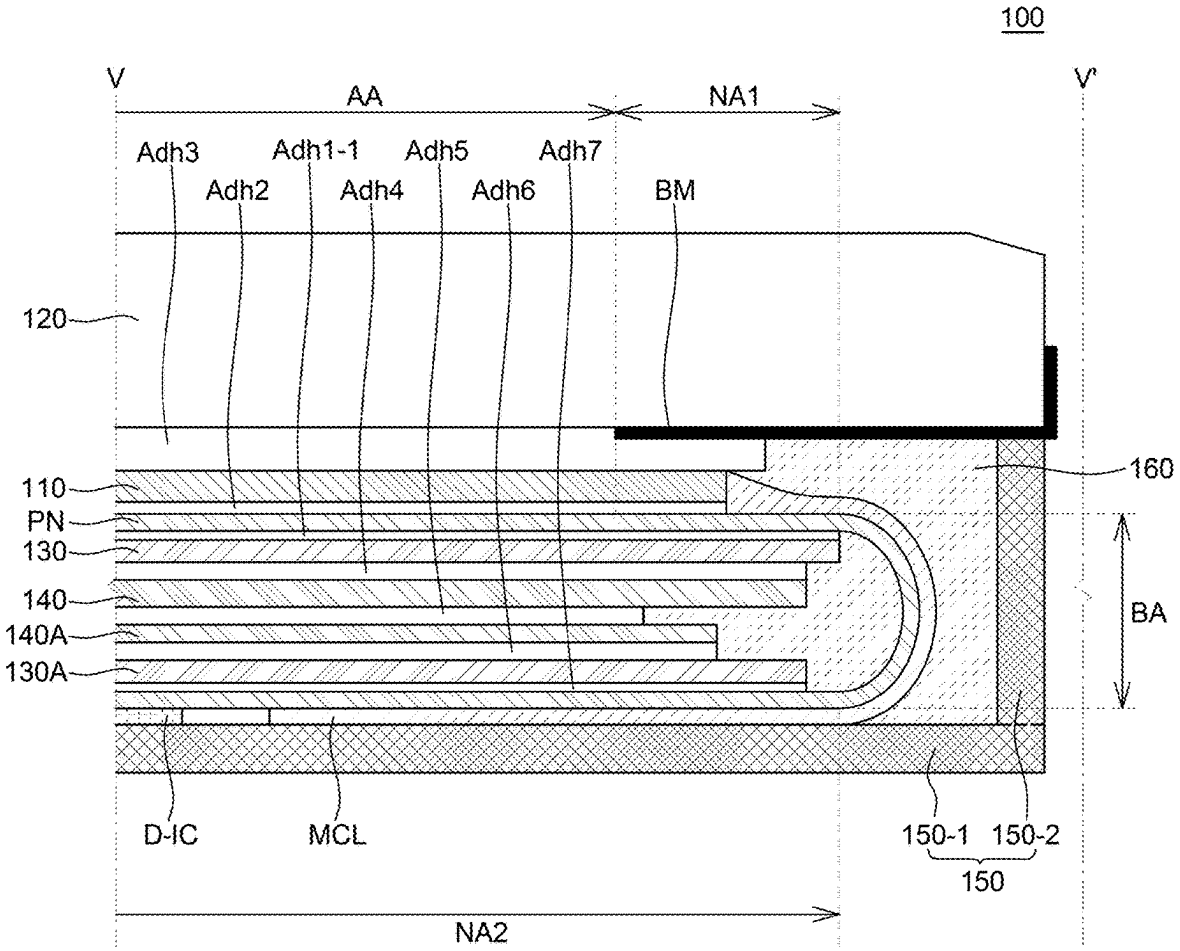

100
V
V'
AA
NA1
Adh3
Adh2
Adh1-1
Adh4
Adh5
Adh6
Adh7
BM
120
110
PN
130
140
140A
130A
160
BA
D-IC
MCL
150-1
150-2
150
NA2

FIG. 5

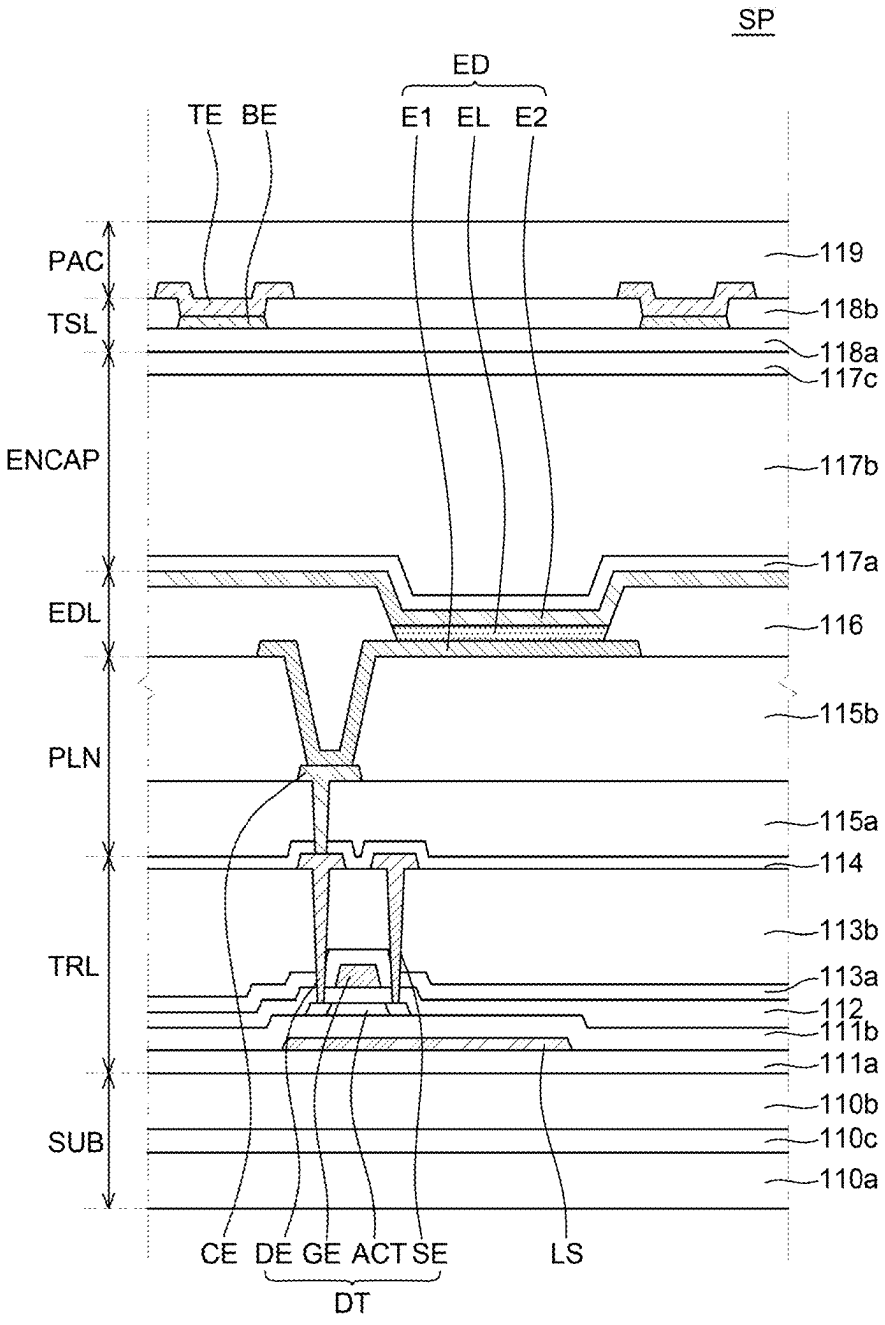

SP
ED
TE
BE
E1
EL
E2
PAC
TSL
ENCAP
EDL
PLN
TRL
SUB
119
118b
118a
117c
117b
117a
116
115b
115a
114
113b
113a
112
111b
111a
110b
110c
110a
CE
DE
GE
ACT
SE
LS
DT

FIG. 6

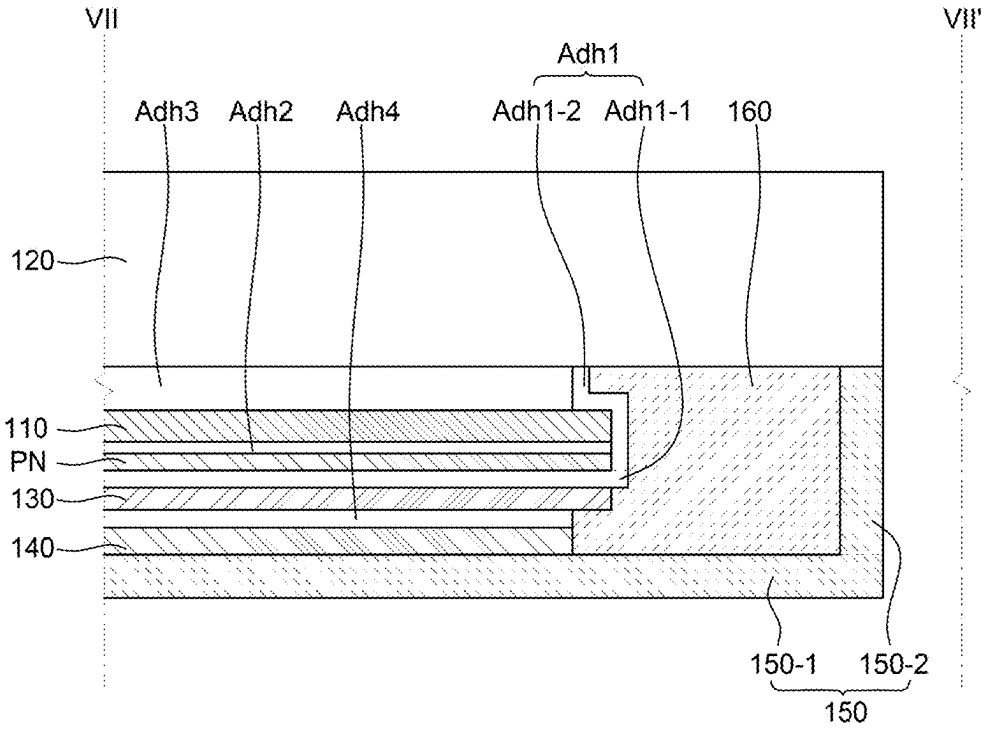

VII
VII'
Adh1
Adh3
Adh2
Adh4
Adh1-2
Adh1-1
160
120
110
PN
130
140
150-1
150-2
150

FIG. 7

DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to Korean Patent Application No. 10-2024-0019686 filed on Feb. 8, 2024, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND

Technical Field

[0002] The present disclosure relates to a display device, and more particularly, to a display device capable of reducing stress to be applied to a display panel.

Description of the Related Art

[0003] Display devices, which visually display electrical information signals, are being rapidly developed with the entry into the information era. Various studies are being continuously conducted to develop a variety of display devices which are thin and lightweight, consume low power, and have improved performance.

[0004] As the representative display devices, there may be a liquid crystal display (LCD) device, a field emission display (FED) device, an electrowetting display (EWD) device, an organic light-emitting display (OLED) device, and the like.

[0005] An electroluminescent display device, as the representative organic light-emitting display device, refers to a display device that autonomously emits light. Unlike a liquid crystal display device, the electroluminescent display device does not require a separate light source and thus may be manufactured as a lightweight, thin display device. In addition, the electroluminescent display device is advantageous in terms of power consumption because the electroluminescent display device operates at a low voltage. Further, the electroluminescent display device is expected to be adopted in various fields because the electroluminescent display device is also excellent in terms of colors, response speeds, viewing angles, and contrast ratios (CRs).

SUMMARY

[0006] An object to be achieved by an embodiment of the present disclosure is to provide a display device capable of reducing stress to be applied to a display panel.

[0007] An object to be achieved by another embodiment of the present disclosure is to provide a display device capable of minimizing the occurrence of cracks caused by thermal deformation in a high-temperature or low-temperature environment.

[0008] Objects of the present disclosure are not limited to the above-mentioned objects, and other objects, which are not mentioned above, can be clearly understood by those skilled in the art from the following descriptions.

[0009] To achieve these and other advantages and in accordance with objects of the disclosure, as embodied and broadly described herein, a display device includes a display panel including a display area, an optical area disposed in the display area and including a through-hole, and a non-display area configured to surround the display area, a support member disposed below the display panel, a first bonding layer disposed between the display panel and the support member, a frame including a lower frame disposed below the support member, and a lateral frame disposed on side surfaces of the display panel, the support member, and the first bonding layer, and a molding member disposed between the display panel, the support member, and the frame, wherein the first bonding layer extends from one side of the display panel adjacent to the optical area and is disposed between the display panel and the molding member.

[0010] Other detailed matters of the exemplary embodiments are included in the detailed description and the drawings.

[0011] In the display device according to the embodiment of the present disclosure, the bonding layer is disposed between the display panel and the molding member at one side of the display panel adjacent to the optical area, such that the bonding layer may serve as a buffer between the display panel and the molding member, which may reduce damage to the display panel.

[0012] In the display device according to the embodiment of the present disclosure, the bonding layer with a relatively low modulus is disposed between the display panel and the molding member at one side of the display panel adjacent to the optical area, which may reduce the occurrence of thermal stress caused by a difference in thermal strain rate between the display panel and the molding member in a high-temperature or low-temperature environment.

[0013] The effects according to the present disclosure are not limited to the contents exemplified above, and more various effects are included in the present disclosure.

[0014] It is to be understood that both the foregoing general description and the following detailed description of the present disclosure are merely by way of example and are intended to provide further explanation of the inventive concepts as claimed.

BRIEF DESCRIPTION OF DRAWINGS

[0015] The accompanying drawings, which are included to provide a further understanding of the disclosure and are incorporated in and constitute a part of this application, illustrate embodiments of the disclosure and together with the description serve to explain the principles of the disclosure. In the drawings:

[0016] FIG. **1** is a block diagram for explaining a display device according to an embodiment of the present disclosure;

[0017] FIG. **2** is a view schematically illustrating a circuit configuration of a subpixel according to the embodiment of the present disclosure;

[0018] FIG. **3** is a top plan view of the display device according to the embodiment of the present disclosure;

[0019] FIG. **4** is a cross-sectional view taken along line IV-IV' in FIG. **3**;

[0020] FIG. **5** is a cross-sectional view taken along line V-V' in FIG. **3**;

[0021] FIG. **6** is a cross-sectional view of the subpixel according to the embodiment of the present disclosure; and

[0022] FIG. **7** is a cross-sectional view taken along line VII-VII' in FIG. **3**.

DETAILED DESCRIPTION

[0023] Advantages and characteristics of the present disclosure and a method of achieving the advantages and

characteristics will be clear by referring to exemplary embodiments described below in detail together with the accompanying drawings. However, the present disclosure is not limited to the exemplary embodiments disclosed herein but will be implemented in various forms. The exemplary embodiments are provided by way of example only so that those skilled in the art can fully understand the disclosures of the present disclosure and the scope of the present disclosure.

[0024] The shapes, sizes, ratios, angles, numbers, and the like illustrated in the accompanying drawings for describing the exemplary embodiments of the present disclosure are merely examples, and the present disclosure is not limited thereto. Like reference numerals generally denote like elements throughout the disclosure. Further, in the following description of the present disclosure, a detailed explanation of known related technologies may be omitted to avoid unnecessarily obscuring the subject matter of the present disclosure. The terms such as "including," "having," and "consisting of" used herein are generally intended to allow other components to be added unless the terms are used with the term "only". Any references to singular may include plural unless expressly stated otherwise.

[0025] Components are interpreted to include an ordinary error range even if not expressly stated.

[0026] When the position relation between two parts is described using the terms such as "on", "above", "below", and "next", one or more parts may be positioned between the two parts unless the terms are used with the term "immediately" or "directly".

[0027] When an element or layer is disposed "on" the other element or layer, another layer or another element may be interposed directly on the other element or therebetween.

[0028] Although the terms "first", "second", and the like are used for describing various components, these components are not confined by these terms. These terms are merely used for distinguishing one component from the other components. Therefore, a first component to be mentioned below may be a second component in a technical concept of the present disclosure.

[0029] Like reference numerals generally denote like elements throughout the disclosure.

[0030] A size and a thickness of each component illustrated in the drawing are illustrated for convenience of description, and the present disclosure is not limited to the size and the thickness of the component illustrated.

[0031] The features of various embodiments of the present disclosure can be partially or entirely adhered to or combined with each other and can be interlocked and operated in technically various ways, and the embodiments can be carried out independently of or in association with each other.

[0032] Hereinafter, various exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[0033] FIG. **1** is a block diagram for explaining a display device of an embodiment of the present disclosure.

[0034] With reference to FIG. **1**, a display device of embodiments of the present disclosure may include an image processing part **151**, a timing control part **152**, a data drive part **153**, a scan drive part **154**, and a display panel PN.

[0035] The image processing part **151** may output a data signal DATA, a data enable signal DE, and the like supplied from the outside.

[0036] In addition, for example, the image processing part **151** may output one or more of a vertical synchronizing signal, a horizontal synchronizing signal, and a clock signal in addition to the data enable signal DE.

[0037] The timing control part **152** may receive the data signal DATA, the data enable signal DE, and the driving signals including the vertical synchronizing signal, the horizontal synchronizing signal, and the clock signal from the image processing part **151**. In addition, on the basis of the driving signal, the timing control part **152** may output a gate timing control signal GDC for controlling an operation timing of the scan drive part **154** and output a data timing control signal DDC for controlling an operation timing of the data drive part **153**.

[0038] In response to the data timing control signal DDC supplied from the timing control part **152**, the data drive part **153** may sample and latch the data signal DATA supplied from the timing control part **152**, convert the data signal DATA into a gamma reference voltage, and output the gamma reference voltage. The data drive part **153** may output the data signal DATA through data lines DL**1** to DLn. The data drive part **153** may be provided in the form of an integrated circuit (IC).

[0039] In addition, the scan drive part **154** may output the scan signal in response to the gate timing control signal GDC supplied from the timing control part **152**. The scan drive part **154** may output the scan signal through gate lines GL**1** to GLm. The scan drive part **154** may be provided in the form of an integrated circuit (IC) or formed on the display panel PN in a gate-in-panel (GIP) manner.

[0040] The display panel PN may display an image in response to the data signal DATA and the scan signal respectively supplied from the data drive part **153** and the scan drive part **154**.

[0041] The display panel PN may include subpixels SP configured to display images.

[0042] For example, the subpixels SP may include a red subpixel, a green subpixel, and a blue subpixel or include a white subpixel, a red subpixel, a green subpixel, and a blue subpixel. The subpixel SP may have one or more different light-emitting areas depending on luminous properties.

[0043] FIG. **2** is a view schematically illustrating a circuit configuration of the subpixel according to the embodiments of the present disclosure.

[0044] With reference to FIG. **2**, one subpixel may include a switching transistor SW, a driving transistor DT, a capacitor Cst, a compensating circuit CC, and an organic light-emitting element ED.

[0045] For example, the switching transistor SW may perform a switching operation so that a data signal supplied through a first data line DL**1** is stored, as a data voltage, in the capacitor Cst in response to a scan signal supplied through a first gate line GL**1**. In addition, for example, the driving transistor DT may operate such that a drive current flows between a first power line EVDD (high-potential voltage) and a second power line EVSS (low-potential voltage) in accordance with the data voltage stored in the capacitor Cst. In addition, the organic light-emitting element ED may operate to emit light in accordance with a drive current produced by the driving transistor DT.

[0046] The compensating circuit CC refers to a circuit added into the subpixel to compensate for a threshold voltage of the driving transistor DT or the like. The compensating circuit CC may include one or more transistors.

The compensating circuit CC may have various configurations depending on an external compensation method.

[0047] The subpixel illustrated in FIG. **2** has a 2T (Transistor) 1C (Capacitor) structure including the switching transistor SW, the driving transistor DT, the capacitor Cst, and the light-emitting element ED. However, in case that the compensating circuit CC is added, the subpixel may have various configurations such as 3T1C, 4T2C, 5T2C, 6T1C, 6T2C, 7T1C, 7T2C, or the like.

[0048] FIG. **3** is a top plan view of the display device according to the embodiment of the present disclosure. For convenience of description, FIG. **3** illustrates only the display panel PN and a data drive part D-IC among various constituent elements of a display device **100**.

[0049] The display panel PN may include a display area AA, an optical area OA disposed in the display area AA and including through-holes TH, and a non-display area NA configured to surround the display area AA.

[0050] The display area AA is an area of the display panel PN in which images are displayed.

[0051] A plurality of subpixels SP and a circuit for operating the plurality of subpixels SP may be disposed in the display area AA. The plurality of subpixels SP may be minimum units that constitute the display area AA. Display elements may be respectively disposed in the plurality of subpixels SP. For example, an organic light-emitting element including an anode, a light-emitting layer, and a cathode may be disposed in each of the plurality of subpixels SP. However, the present disclosure is not limited thereto. In addition, the circuit configured to operate the plurality of subpixels SP may include driving elements, lines, and the like. For example, the circuit may include a thin-film transistor, a storage capacitor, a gate line, a data line, and the like. However, the present disclosure is not limited thereto.

[0052] The optical area OA is an area disposed in the display area AA, and the through-holes TH may be disposed in the optical area OA. The through-hole TH may be disposed in the display area AA of the display panel PN, thereby reducing a bezel area, which is the non-display area NA, and maximizing the display area AA. A design product with the maximized display area AA maximizes a degree of screen immersion of a user, thereby improving an aesthetic appearance.

[0053] The through-hole TH may be formed to correspond to an electronic optical device. The electronic optical device may be a device that receives light having passed through the display panel and performs a predetermined function in response to the received light. Therefore, the electronic optical device may be disposed to overlap the through-hole TH of the display panel PN. For example, the electronic optical device may be configured as a camera or various sensors. However, the present disclosure is not limited thereto. The electronic optical device may include all devices that perform predetermined functions in response to the light. Meanwhile, because the electronic optical device is disposed below the display panel PN, the electronic optical device may not be visually recognized by the user. For example, in case that the electronic optical device is a camera, the camera is disposed on the rear surface of the display panel PN. However, the camera may capture an image of the front surface of the display device **100** instead of the rear surface of the display device **100**.

[0054] FIG. **3** illustrates two through-holes TH. However, the present disclosure is not limited thereto. The number of through-holes TH may be provided variously. For example, one or two holes are disposed in the display area AA. A camera may be disposed in a first hole, and a distance detection sensor, a face recognition sensor, or a wide angle camera may be disposed in a second hole.

[0055] The non-display area NA is an area in which no image is displayed. Various lines, various circuits, and the like for operating the display elements in the display area AA are disposed in the non-display area NA. For example, the non-display area NA may include link lines for transmitting signals to the plurality of subpixels and the circuit in the display area AA. The non-display area NA may include gate-in-panel (GIP) lines or drive ICs such as the gate drive part and the data drive part D-IC.

[0056] The non-display area NA may be an area extending from the display area AA. However, the present disclosure is not limited thereto. The non-display area NA may be an area that surrounds the display area AA. FIG. **3** illustrates that the non-display area NA surrounds the display area AA having a round corner. However, the shapes and arrangements of the display area AA and the non-display area NA are not limited to the example illustrated in FIG. **3**. That is, the display area AA and the non-display area NA may be suitable for the design of an electronic device equipped with the display device **100**. For example, an exemplary shape of the display area AA may also be a quadrangular shape, a pentagonal shape, a hexagonal shape, a circular shape, an elliptical shape, or the like.

[0057] The non-display area NA includes a first non-display area NA**1**, a bending area BA, and a second non-display area NA**2**. The first non-display area NA**1** is an area extending from the display area AA while surrounding the display area AA. The bending area BA may be an area extending from one side of the first non-display area NA**1** and bent. The second non-display area NA**2** may be an area extending from the bending area BA and disposed below the display area.

[0058] The first non-display area NA**1** and the second non-display area NA**2** may be areas disposed on the same plane as the display area AA or disposed in parallel with the display area AA and kept in a flat state. For example, the first non-display area NA**1** may be disposed in the flat state on the same plane as the display area AA, and the second non-display area NA**2** may be disposed in the flat state below the display area AA and disposed in parallel with the display area AA. Therefore, for example, the display area AA, the first non-display area NA**1**, and the second non-display area NA**2** may be referred to as non-bending areas. However, the present disclosure is not limited thereto.

[0059] A drive IC D-IC may be disposed in the second non-display area NA**2**. The drive IC D-IC may provide data signals to the plurality of subpixels SP. For example, in response to the data timing control signal supplied from a timing controller, the drive IC D-IC may sample and latch a data signal supplied from the timing controller, convert the data signal into a gamma reference voltage, and output the gamma reference voltage. The drive IC D-IC may output the data signals through a plurality of data lines. For example, a pad part may be disposed in the second non-display area NA**2** in which the drive IC D-IC is disposed, and a printed circuit board electrically connected to the pad part may be further disposed and provide a signal to the drive IC D-IC. However, the present disclosure is not limited thereto.

[0060] Meanwhile, the drive IC D-IC may be disposed in the form of a chip-on panel (COP) at one side of the display panel PN and connected to a display panel PN. Alternatively, the drive IC D-IC may be provided in the form of a chip-on film (COF) disposed on a separate flexible film and connected to the display panel PN. However, the present disclosure is not limited thereto.

[0061] As the display panel PN is bent, the drive IC D-IC disposed in the second non-display area NA**2** is disposed below the display area AA. For example, the drive IC D-IC and the printed circuit board, which is connected to the pad part of the display panel PN, may move to a rear surface side of the display panel PN and overlap the display area AA. Therefore, the circuit elements, such as the drive IC D-IC and the printed circuit board, may not be visually recognized when viewed from above the display panel PN. Therefore, a size of the non-display area NA, which is visually recognized from above the display panel PN, may be reduced, such that a narrow bezel may be implemented.

[0062] The display device **100** may further include various additional elements configured to generate various signals or operate a pixel in the display area AA. The additional elements for operating the pixel may include an inverter circuit, a multiplexer, an electrostatic discharge (ESD) circuit, and the like. The display device **100** may also include additional elements related to functions other than the function of operating the pixel. For example, the display device **100** may further include additional elements that provide a touch detection function, a user certification function (e.g., fingerprint recognition), a multi-level pressure detection function, a tactile feedback function, and the like. The above-mentioned additional elements may be positioned in the non-display area NA and/or an external circuit connected to a connection interface.

[0063] Hereinafter, the constituent elements of the display device **100** will be described in more detail with reference to FIGS. **4** and **5**.

[0064] FIG. **4** is a cross-sectional view taken along line IV-IV'

[0065] in FIG. **3**. FIG. **5** is a cross-sectional view taken along line V-V' in FIG. **3**.

[0066] With reference to FIGS. **4** and **5**, the display device **100** may include a cover member **120**, a third bonding layer Adh**3**, a polarizing layer **110**, a second bonding layer Adh**2**, a display panel PN, a first-first bonding layer Adh**1-1**, a support member **130**, a fourth bonding layer Adh**4**, a metal plate **140**, a black matrix BM, a frame **150**, and a molding member **160**.

[0067] First, the display panel PN may include a substrate and light-emitting elements.

[0068] The substrate may be a support member for supporting other constituent elements disposed on the substrate of the display device **100**, and the substrate may be made of an insulating material. For example, the substrate may be made of glass, resin, or the like. In addition, the substrate may include plastic such as polymer or polyimide (PI) and be made of a material having flexibility.

[0069] The light-emitting elements may be disposed on the substrate. The light-emitting elements may be differently defined depending on the type of display panel PN. For example, in case that the display panel PN is an organic light-emitting display panel, the light-emitting element may be an organic light-emitting diode (OLED).

[0070] A driving transistor for operating the light-emitting element may be disposed between the substrate and the light-emitting element. The driving transistors may be respectively disposed in a plurality of subpixel areas. For example, the driving transistor may include a gate electrode, an active layer, a source electrode, and a drain electrode. In addition, the driving transistor may further include a gate insulation layer that insulates the gate electrode from the active layer, and the driving transistor may further include an interlayer insulation layer that insulates the gate electrode from the source electrode and the drain electrode. The display panel PN will be described in detail with reference to FIG. **6** to be described below.

[0071] The polarizing layer **110** may be disposed above the display panel PN. The polarizing layer **110** may be a layer for polarizing incident light. The polarizing layer **110** may be a film having light transmittance at a predetermined level and absorb external light and reflected light thereof to suppress a decrease in contrast ratio. Specifically, the display panel PN includes various metallic materials applied to semiconductor elements, lines, organic light-emitting elements, and the like. Therefore, the external light entering the display panel PN may be reflected by the metallic material. The reflection of external light may decrease visibility of the display device **100**. Therefore, the polarizing layer **110** may be disposed to suppress the reflection of external light, thereby improving outdoor visibility of the display device **100**.

[0072] The second bonding layer Adh**2** may be disposed between the display panel PN and the polarizing layer **110**. The second bonding layer Adh**2** may fix the display panel PN and the polarizing layer **110**. The second bonding layer Adh**2** may minimize the occurrence of foreign substances or bubbles between the display panel PN and the polarizing layer **110**, and an optically transparent bonding agent, such as an optically clear adhesive (OCA) or an optical clear resin (OCR), may be used. However, the present disclosure is not limited thereto.

[0073] The cover member **120** may be disposed on the polarizing layer **110**. The cover member **120** may have a shape corresponding to the display panel PN and be disposed to cover the display panel PN. The cover member **120** may protect the display panel PN from an external impact, moisture, heat, or the like. For example, the cover member **120** may be a tempered glass. However, the present disclosure is not limited thereto.

[0074] With reference to FIG. **5**, the black matrix BM may be disposed below the cover member **120**. The black matrix BM may be disposed at an outer periphery of the cover member **120** and disposed along a periphery of the cover member **120**. In this case, an area in which the black matrix BM is disposed may correspond to the first non-display area NA**1**. The black matrix BM may be made of a material with low permeability. Therefore, the black matrix BM may inhibit various constituent elements, which are disposed below the first non-display area NA**1**, from being visually recognized from the outside. In addition, the black matrix BM may be made of a material with conductivity and discharge static electricity of the cover member **120**.

[0075] The black matrix BM may be made of resin containing chromium (Cr), graphite, or conductive particles. In this case, the resin may be one or more materials among acrylic resin, epoxy resin, phenolic resin, polyamide-based resin, polyimide-based resin, unsaturated polyester-based

resin, polyphenylene-based resin, polyphenylene sulfide-based resin, and benzocyclobutene. However, the present disclosure is not limited thereto. In addition, the conductive particle may be made of any one of molybdenum (Mo), chromium (Cr), titanium (Ti), nickel (Ni), neodymium (Nd), copper (Cu), silver (Ag), and magnesium (Mg) or alloys thereof. However, the present disclosure is not limited thereto.

[0076] The third bonding layer Adh**3** may be disposed between the polarizing layer **110** and the cover member **120**. The third bonding layer Adh**3** may fix the polarizing layer **110** and the cover member **120**. The third bonding layer Adh**3** may minimize the occurrence of foreign substances or bubbles between the polarizing layer **110** and the cover member **120**, and an optically transparent bonding agent, such as an optically clear adhesive (OCA) or an optical clear resin (OCR), may be used. However, the present disclosure is not limited thereto.

[0077] Meanwhile, the support member **130** may be disposed below the display panel PN. The support member **130** may support the display panel PN and protect the display panel PN from external moisture, heat, impact, or the like. For example, the support member **130** may also be referred to as a backplate. The support member **130** may be made of a transparent organic insulating material to suppress curl and static electricity of the display device **100**, and inspect an external appearance of the rear surface of the display device **100**. For example, the support member **130** may be made of a plastic material such as polymethyl methacrylate (PMMA), polycarbonate (PC), polyvinyl alcohol (PVA), acrylonitrile-butadiene-styrene (ABS), polyethylene terephthalate (PET), silicone, and polyurethane (PU). However, the present disclosure is not limited thereto.

[0078] The first-first bonding layer Adh**1-1** may be disposed between the support member **130** and the display panel PN. The first-first bonding layer Adh**1-1** may fix the support member **130** and the display panel PN. The first-first bonding layer Adh**1-1** may be a pressure sensitive adhesive that minimizes the occurrence of foreign substances or bubbles between the support member **130** and the display panel PN. However, the present disclosure is not limited thereto. For example, the display device may further include a first-second bonding layer Adh**1-2** (not shown in FIGS. **4-5**) extending from the first-first bonding layer Adh**1-1**. The first-second bonding layer Adh**1-2** will be described below with reference to FIG. **7**.

[0079] The metal plate **140** may be disposed below the support member **130**. The metal plate **140** may protect the support member **130** from an external impact that may be applied during the process of manufacturing the display device. In addition, the metal plate **140** may serve as a heat dissipation plate for dissipating heat, which is generated from the display panel PN, to the outside. The metal plate **140** may be made of a metallic material such as stainless steel (SUS), stainless steel (SUS) containing different metals such as nickel (Ni), iron (Fe), aluminum (Al), and magnesium (Mg). Particularly, stainless steel (SUS) may be applied to the metal plate **140**. For example, because stainless steel (SUS) has high restoring force and rigidity, the metal plate **140** may maintain high rigidity even though a thickness of the metal plate **140** decreases.

[0080] The fourth bonding layer Adh**4** may be disposed between the support member **130** and the metal plate **140**. The fourth bonding layer Adh**4** may fix the support member **130** and the metal plate **140**. The fourth bonding layer Adh**4** may be a pressure sensitive adhesive (PSA) that minimizes the occurrence of foreign substances or bubbles between the support member **130** and the metal plate **140**. However, the present disclosure is not limited thereto.

[0081] With reference to FIGS. **3** and **5** together, an additional backplate **130**A and an additional metal plate **140**A may be disposed below the metal plate **140** corresponding to the bending area BA.

[0082] The additional backplate **130**A and the additional metal plate **140**A may complement the rigidity of the second non-display area NA**2** of the display panel PN. Meanwhile, the additional backplate **130**A and the additional metal plate **140**A may be disposed so as not to overlap the bending area BA. Therefore, thicknesses of the components disposed in the bending area BA may be minimized, and the flexibility of the bending area may be ensured by easily controlling a neutral surface of the bending area BA.

[0083] With reference to FIG. **5**, a fifth bonding layer Adh**5** is disposed between the metal plate **140** and the additional metal plate **140**A, and a sixth bonding layer Adh**6** is disposed between the additional metal plate **140**A and the additional backplate **130**A. The fifth bonding layer Adh**5** may bond the metal plate **140** and the additional metal plate **140**A, and the sixth bonding layer Adh**6** may bond the additional metal plate **140**A and the additional backplate **130**A. For example, the fifth bonding layer Adh**5** and the sixth bonding layer Adh**6** may be configured as a pressure sensitive adhesive (PSA). However, the present disclosure is not limited thereto.

[0084] The second non-display area NA**2** of the display panel PN is disposed below the additional backplate **130**A. Further, a seventh bonding layer Adh**7** is disposed between the additional backplate **130**A and the second non-display area NA**2** of the display panel PN. The seventh bonding layer Adh**7** may bond the additional backplate **130**A and the second non-display area NA**2** of the display panel PN. For example, the seventh bonding layer Adh**7** may be configured as a pressure sensitive adhesive (PSA). However, the present disclosure is not limited thereto.

[0085] The frame **150** is disposed below the metal plate **140**. The frame **150** may be disposed below the metal plate **140** and disposed along the outer periphery of the display device **100**. That is, the frame **150** may not only include a lower frame **150-1** disposed below the metal plate **140**, but also include a lateral frame **150- 2** connected to the lower frame **150-1** and configured to surround the side surface of the display device **100**. Therefore, the frame **150** may reinforce the rigidity of the outer periphery of the display device **100**.

[0086] For example, the frame **150** may be made of plastic, such as polyimide (PI), polyethylene naphthalate (PEN), polyethylene terephthalate (PET), or a combination of these polymer, or metal, such as copper (Cu) or stainless steel (SUS), to reinforce the rigidity of the outer periphery of the display device **100**. However, the present disclosure is not limited thereto.

[0087] In addition, the molding member **160**, which fills a space provided by the frame **150**, may be included. The molding member **160** will be described in detail with reference to FIG. **7** to be described below.

[0088] With reference to FIGS. **3** and **5**, a coating layer MCL may be disposed in the bending area BA of the display panel PN. For example, the coating layer MCL may be

disposed to adjoin one side of the polarizing layer **110** disposed on the display panel PN. The display panel PN may be finely cracked because a tensile force is applied to the display panel PN when the display panel PN is bent. Therefore, the coating layer MCL may be formed by coating the bending area with resin with a small thickness, thereby protecting the display panel PN.

[0089] For example, the coating layer MCL may be disposed to adjoin one end of the polarizing layer **110** disposed in the first non-display area NA**1**, and the coating layer MCL may extend to the bending area BA and the second non-display area NA**2**. For example, an area between the polarizing layer **110** in the first non-display area NA**1** and the drive IC D-IC disposed in the second non-display area NA**2** may be coated with the coating layer MCL. For example, one end of the coating layer MCL may adjoin the polarizing layer **110** of the first non-display area NA**1**, and the other end of the coating layer MCL may adjoin the drive IC D-IC disposed in the second non-display area NA**2**. However, the present disclosure is not limited thereto. The other end of the coating layer MCL may be spaced apart from the drive IC D-IC disposed in the second non-display area NA**2**.

[0090] Hereinafter, the constituent elements of the display panel PN will be described in more detail with reference to FIG. **6**.

[0091] FIG. **6** is a cross-sectional view illustrating a cross-sectional structure of one subpixel disposed in the display area according to the embodiment of the present disclosure. Specifically, FIG. **6** illustrates only the constituent elements included in the display panel PN in one subpixel SP disposed in the display area AA.

[0092] With reference to FIG. **6**, in the subpixel SP disposed in the display area AA, a transistor layer TRL may be disposed above a substrate SUB, and a planarization layer PLN may be disposed above the transistor layer TRL. In addition, a light-emitting element layer EDL may be disposed above the planarization layer PLN, an encapsulation layer ENCAP may be disposed above the light-emitting element layer EDL, a touch sensing layer TSL may be disposed above the encapsulation layer ENCAP, and a protective layer PAC may be disposed above the touch sensing layer TSL. In addition, a polarizing layer (not shown in FIG. **6**) may be disposed above the protective layer PAC.

[0093] The substrate SUB is a component for supporting various constituent elements included in the display device **100** and may be made of an insulating material. The substrate SUB may include a first substrate **110***a*, a second substrate **110***b*, and an interlayer insulation layer **110***c*. The interlayer insulation layer **110***c* may be disposed between the first substrate **110***a* and the second substrate **110***b*. As described above, the substrate SUB may include the first substrate **110***a*, the second substrate **110***b*, and the interlayer insulation layer **110***c*, which may suppress moisture penetration. For example, the first substrate **110***a* and the second substrate **110***b* may each be a substrate made of polyimide (PI).

[0094] Various types of patterns GE, DE, SE, and ACT for forming a transistor such as the driving transistor DT, various types of insulation layers **111***a*, **111***b*, **112**, **113***a*, **113***b*, and **114**, and various types of metal patterns LS may be disposed on the transistor layer TRL in the display area AA.

[0095] Hereinafter, a layered structure of the transistor layer TRL will be described in more detail.

[0096] A multi-buffer layer **111***a* may be disposed on the second substrate **110***b*, and an active buffer layer **111***b* may be disposed on the multi-buffer layer **111***a*.

[0097] A light-blocking layer LS, which serves as a light shield, may be disposed on the multi-buffer layer **111***a*.

[0098] The active buffer layer **111***b* may be disposed on the light-blocking layer LS.

[0099] An active layer ACT of the driving transistor DT may be disposed on the active buffer layer **111***b*. For example, the active layer ACT may be made of polysilicon (p-Si), amorphous silicon (a-Si), or oxide semiconductor. However, the present disclosure is not limited thereto.

[0100] A gate insulation layer **112** may be disposed on the active layer ACT. The gate insulation layer **112** may be made of silicon oxide (SiO_x), silicon nitride (SiN_x), or a multilayer thereof.

[0101] In addition, a gate electrode GE of the driving transistor DT may be disposed on the gate insulation layer **112**. The gate electrode GE is disposed on the gate insulation layer **112** and overlaps the active layer ACT. The gate electrode GE may be made of various electrically conductive materials, for example, magnesium (Mg), aluminum (Al), nickel (Ni), chromium (Cr), molybdenum (Mo), tungsten (W), gold (Au), or an alloy thereof. However, the present disclosure is not limited thereto.

[0102] A first interlayer insulation layer **113***a* may be disposed to cover the gate electrode GE. A second interlayer insulation layer **113***b* may be disposed on the first interlayer insulation layer **113***a*.

[0103] A source electrode SE and a drain electrode DE of the driving transistor DT may be disposed on the second interlayer insulation layer **113***b*.

[0104] The source electrode SE and the drain electrode DE may be respectively connected to one side and the other side of the active layer ACT through contact holes provided in the second interlayer insulation layer **113***b*, the first interlayer insulation layer **113***a*, and the gate insulation layer **112**. The source electrode SE and the drain electrode DE may each be made of various electrically conductive materials, for example, magnesium (Mg), aluminum (Al), nickel (Ni), chromium (Cr), molybdenum (Mo), tungsten (W), gold (Au), or an alloy thereof. However, the present disclosure is not limited thereto.

[0105] A portion of the active layer ACT, which overlaps the gate electrode GE, may be a channel area. One of the source electrode SE and the drain electrode DE is connected to one side of the channel area of the active layer ACT, and the other of the source electrode SE and the drain electrode DE is connected to the other side of the channel area of the active layer ACT.

[0106] A passivation layer **114** may be disposed on the source electrode SE and the drain electrode DE. The passivation layer **114** may serve to protect the driving transistor DT and be configured as an inorganic layer, for example, silicon oxide (SiO_x), silicon nitride (SiN_x), or a multilayer thereof.

[0107] The planarization layer PLN may be positioned above the transistor layer TRL.

[0108] The planarization layer PLN may include a first planarization layer **115***a* and a second planarization layer **115***b*. The planarization layer PLN protects the driving transistor DT and planarizes the upper portion of the driving transistor DT.

[0109] The first planarization layer **115***a* may be disposed on the passivation layer **114**.

[0110] A connection electrode CE may be disposed on the first planarization layer **115***a*.

[0111] The connection electrode CE may be connected to one of the source electrode SE and the drain electrode DE through a contact hole provided in the first planarization layer **115***a*.

[0112] The second planarization layer **115***b* may be disposed on the connection electrode CE.

[0113] The light-emitting element layer EDL may be positioned above the second planarization layer **115***b*.

[0114] Hereinafter, a layered structure of the light-emitting element layer EDL will be described in detail.

[0115] An anode E**1** may be disposed on the second planarization layer **115***b*. In this case, the anode E**1** may be electrically connected to the connection electrode CE through a contact hole provided in the second planarization layer **115***b*. The anode E**1** may be made of a metallic material.

[0116] In case that the display device **100** is a top-emission type display device in which light emitted from the light-emitting element ED propagates toward an upper side of the substrate SUB on which the light-emitting element ED is disposed, the anode E**1** may further include a transparent conductive layer and a reflective layer disposed below the transparent conductive layer. For example, the transparent conductive layer may be made of transparent conductive oxide such as ITO or IZO. For example, the reflective layer may be made of silver (Ag), aluminum (Al), gold (Au), molybdenum (Mo), tungsten (W), chromium (Cr), or an alloy thereof.

[0117] A bank **116** may be disposed to cover the anode E**1**. A portion of the bank **116**, which corresponds to the light-emitting area of the subpixel, may be opened. A part of the anode E**1** may be exposed through the opened portion (hereinafter, referred to as an open area) of the bank **116**. In this case, the bank **116** may be made of an inorganic insulating material such as silicon nitride (SiN_x) or silicon oxide (SiO_x), or an organic insulating material such as benzocyclobutene-based resin, acrylic resin, or imide-based resin. However, the present disclosure is not limited thereto.

[0118] A light-emitting layer EL may be disposed in the open area of the bank **116**. Therefore, the light-emitting layer EL may be disposed on the anode E**1** exposed through the open area of the bank **116**.

[0119] A cathode E**2** may be disposed on the light-emitting layer EL.

[0120] The light-emitting element ED may be formed by the anode E**1**, the light-emitting layer EL, and the cathode E**2**. The light-emitting layer EL may include a plurality of organic layers.

[0121] The encapsulation layer ENCAP may be positioned above the light-emitting element layer EDL.

[0122] The encapsulation layer ENCAP may have a single-layer or multilayer structure. For example, the encapsulation layer ENCAP may include a first encapsulation layer **117***a*, a second encapsulation layer **117***b*, and a third encapsulation layer **117***c*.

[0123] In this case, the first encapsulation layer **117***a* and the third encapsulation layer **117***c* may each be configured as an inorganic layer, and the second encapsulation layer **117***b* may each be configured as an organic layer. Among the first encapsulation layer **117***a*, the second encapsulation layer **117***b*, and the third encapsulation layer **117***c*, the second encapsulation layer **117***b* may be thickest and serve as a planarization layer.

[0124] The first encapsulation layer **117***a* may be disposed on the cathode E**2** and closest to the light-emitting element ED. The first encapsulation layer **117***a* may be made of an inorganic insulating material that may be deposited at a low temperature. For example, the first encapsulation layer **117***a* may be made of silicon nitride (SiN_x), silicon oxide (SiO_x), silicon oxynitride (SiON), aluminum oxide (Al_2O_3), or the like. Because the first encapsulation layer **117***a* is deposited in a low-temperature ambience, it is possible to suppress damage to the light-emitting layer EL made of an organic material vulnerable to a high-temperature ambience during a deposition process.

[0125] The second encapsulation layer **117***b* may have a smaller area than the first encapsulation layer **117***a*. In this case, the second encapsulation layer **117***b* may be formed to expose two opposite ends of the first encapsulation layer **117***a*. The second encapsulation layer **117***b* may serve as a buffer for mitigating stress between the layers. The second encapsulation layer **117***b* may serve to improve the planarization performance.

[0126] For example, the second encapsulation layer **117***b* may be made of an organic insulating material such as acrylic resin, epoxy resin, polyimide, polyethylene, or silicon oxycarbon (SiOC). For example, the second encapsulation layer **117***b* may also be formed in an inkjet manner. However, the present disclosure is not limited thereto.

[0127] The third encapsulation layer **117***c* may be formed above the second encapsulation layer **117***b* to cover a top surface and a side surface of each of the second encapsulation layer **117***b* and the first encapsulation layer **117***a*. In this case, the third encapsulation layer **117***c* may minimize or block the penetration of outside moisture or oxygen into the first encapsulation layer **117***a* and the second encapsulation layer **117***b*. For example, the third encapsulation layer **117***c* may be made of an inorganic insulating material such as silicon nitride (SiN_x), silicon oxide (SiO_x), silicon oxynitride (SiON), or aluminum oxide (Al_2O_3).

[0128] The touch sensing layer TSL may be disposed above the encapsulation layer ENCAP.

[0129] Specifically, the touch sensing layer TSL may include a touch buffer layer **118***a* disposed on the encapsulation layer ENCAP, a bridge electrode BE disposed on the touch buffer layer **118***a*, a touch interlayer insulation layer **118***b* disposed on the touch buffer layer **118***a* and the bridge electrode BE, and a plurality of touch electrodes TE disposed on the touch interlayer insulation layer **118***b*.

[0130] The touch buffer layer **118***a* may inhibit outside moisture, foreign substances, or a liquid chemical such as a developer or an etching liquid, which is used during a process of manufacturing the touch electrodes formed on the touch buffer layer **118***a*, from penetrating into the light-emitting element.

[0131] The plurality of touch electrodes TE may include a plurality of first touch electrodes extending in a first direction, and a plurality of second touch electrodes extending in a second direction intersecting the first direction.

[0132] For example, the plurality of first touch electrodes and the plurality of second touch electrodes may be disposed on the same layer. However, the plurality of second touch electrodes may be disposed to be separated from one another in the area in which the plurality of first touch electrodes and

the plurality of second touch electrodes intersect. The plurality of second touch electrodes, which are separated from one another, may be connected by the bridge electrodes BE. The touch interlayer insulation layers **118***b* may be disposed between the plurality of second touch electrodes and the bridge electrodes BE.

[0133] A protective layer PAC **119** may be disposed to cover the touch sensing layer TSL. The protective layer **119** may be configured as an organic insulation layer. The protective layer **119** may suppress a level difference on the uppermost layer of the display device **100**, thereby improving the visibility of the display device **100**.

[0134] Hereinafter, one side of the display device **100** adjacent to the optical area OA will be described in more detail with reference to FIG. **7**.

[0135] FIG. **7** is a cross-sectional view taken along line VII-VII' in FIG. **3**. A repeated description of the constituent elements substantially identical to the constituent elements illustrated in FIGS. **4** and **5** will be omitted. The same reference numerals are used for the same components.

[0136] With reference to FIG. **7**, in the display device **100** according to the embodiment of the present disclosure, one side of the display device **100** adjacent to the optical area OA may include the cover member **120**, the third bonding layer Adh**3**, the polarizing layer **110**, the second bonding layer Adh**2**, the display panel PN, a first bonding layer Adh**1**, the support member **130**, the fourth bonding layer Adh**4**, the metal plate **140**, and the frame **150**, like the display area AA of the display device **100**.

[0137] In the display device **100** according to the embodiment of the present disclosure, the frame **150** may be disposed below the metal plate **140** and disposed along the outer periphery of the display device **100**. That is, the frame **150** may not only include a lower frame **150-1** disposed below the metal plate **140**, but also include a lateral frame **150-2** connected to the lower frame **150- 1** and configured to surround the side surface of the display device **100**.

[0138] The display device **100** according to the embodiment of the present disclosure may include the molding member **160** configured to fill a space provided by the frame **150**. For example, the molding member **160** may be disposed between the frame **150** and the cover member **120**, the polarizing layer **110**, the display panel PN, the support member **130**, and the metal plate **140**. The molding member **160** may be formed to seal a lower portion of the cover member **120**, a side surface of the polarizing layer **110**, a side surface of the display panel PN, a side surface of the support member **130**, and a side surface of the metal plate **140**. Because the molding member **160** seals the lower portion of the cover member **120**, the side surface of the polarizing layer **110**, the side surface of the display panel PN, the side surface of the support member **130**, and the side surface of the metal plate **140**, it is possible to suppress the penetration of moisture, oxygen, or foreign substances into the display device **100**. In addition, the molding member **160** may protect the constituent elements of the display device **100** and mitigate an impact to be applied to the display device **100**.

[0139] For example, the molding member **160** may be formed by filling the inside of the frame **150** with the material, which constitutes the molding member **160**, and curing the material. However, the method of forming the molding member **160** is not limited thereto.

[0140] The molding member **160** may include curable resin. For example, the molding member **160** may be made of one or more materials among acrylic resin, epoxy resin, phenolic resin, polyamide-based resin, polyimide-based resin, unsaturated polyester-based resin, polyphenylene-based resin, polyphenylene sulfide-based resin, and benzocyclobutene. However, the present disclosure is not limited thereto.

[0141] In the display device according to the embodiment of the present disclosure, the first bonding layer Adh**1** disposed between the display panel PN and the support member **130** may include the first-first bonding layer Adh**1-1** disposed between the display panel PN and the support member **130**, and the first-second bonding layer Adh**1-2** extending from the first-first bonding layer Adh**1-1** at one side of the display device **100** adjacent to the optical area OA and disposed between the display panel PN and the molding member **160**. For example, the first-second bonding layer Adh**1-2** may be disposed between the display panel PN and the molding member **160** and covers the side surface of the display panel PN. The first bonding layer Adh**1** may serve as a buffer between the display panel PN and the molding member **160**, thereby inhibiting the display panel PN from cracking. In addition, the structure, which is formed by extending the first bonding layer Adh**1**, is used as a buffer between the display panel PN and the molding member **160**, such that a separate process of adding a buffer structure is not required, which may reduce the process costs and time.

[0142] In addition, the first bonding layer Adh**1** may not only cover the side surface of the display panel PN, but also cover side surfaces of the constituent elements disposed on the display panel PN. For example, the first-second bonding layer Adh**1-2** extending from the first-first bonding layer Adh**1-1** may be disposed to extend to a bottom surface of the cover member **120** and cover the side surfaces of the constituent elements disposed between the first-first bonding layer Adh**1-1** and the bottom surface of the cover member **120**. For example, the first-second bonding layer Adh**1-2** may cover the side surface of the display panel PN, the side surface of the second bonding layer Adh**2**, the side surface of the polarizing layer **110**, and the side surface of the third bonding layer Adh**3**.

[0143] In the display device **100** according to the embodiment of the present disclosure, a material with a low modulus may be applied to the first bonding layer Adh**1**. For example, the first bonding layer Adh**1** may be a pressure sensitive adhesive, i.e., a pressure sensitive adhesive with a modulus about 30% lower than a modulus of a general pressure sensitive adhesive. For example, a modulus of the first bonding layer Adh**1** may be lower than a modulus of the fourth bonding layer Adh**4**. The modulus of the first bonding layer Adh**1** may be 1.0×10^4 Pa to 9.9×10^4 Pa, and the modulus of the fourth bonding layer Adh**4** may be 1.0×10^5 Pa to 9.9×10^5 Pa. However, the present disclosure is not limited thereto. Because the first bonding layer Adh**1** has a relatively low modulus, the first bonding layer Adh**1** may serve as a buffer that mitigates stress.

[0144] In addition, in the display device **100** according to the embodiment of the present disclosure, the side surfaces of the constituent elements disposed below the first bonding layer Adh**1**, i.e., the side surface of the support member **130**, the side surface of fourth bonding layer Adh**4**, and the side surface of the metal plate **140** may be sealed by the molding

member **160**. That is, the first bonding layer may not be disposed on nor extend to the side surface of the fourth bonding layer Adh**4** and the side surface of the metal plate **140**.

[0145] A material with high rigidity against an external impact may be applied to the metal plate **140**, such that the metal plate **140** may not be damaged even though a separate buffer structure is not disposed between the metal plate **140** and the molding member **160**.

[0146] After the display device is manufactured, a reliability evaluation process, in which a high temperature and a low temperature are repeatedly provided, may be performed to identify stability of a product. In the related art, because there is no gap between a display panel and a molding member, there is a problem in that thermal stress, which is caused by a difference in thermal strain rate between the display panel and the molding member, accumulates between the display panel and the molding member during the reliability evaluation process. When the thermal stress accumulates on an edge of the through-hole, a dark spot is formed at the edge of the through-hole, and a growing dark spot (GDS) defect, in which the dark spot becomes gradually larger, is caused. In order to solve the problem in the related art, there has been an attempt to mitigate deformation between the display panel and the molding member by applying ink between the display panel and the molding member. However, the application of the ink causes a problem of an increase in costs. In addition, because the ink is applied after the display device is manufactured, the ink, which serves as a buffer between the display panel and the molding member, is not present during a trimming process for forming the through-hole in the optical area, which causes a problem of moisture penetration.

[0147] Therefore, in the display device **100** according to the embodiment of the present disclosure, the bonding layer Adh**1** with a relatively low modulus is disposed between the display panel PN and the molding member **160**. Therefore, the bonding layer Adh**1** with a relatively low modulus may act as a buffer layer and reduce the occurrence of thermal stress caused by a difference in thermal strain rate between the display panel PN and the molding member **160** in a high-temperature or low-temperature environment.

[0148] In addition, the first bonding layer Adh**1** with a relatively low modulus extends and is disposed between the display panel PN and the molding member **160**, which may protect the side surface of the display panel PN and suppress moisture penetration into the side surface of the display panel PN. In addition, the first bonding layer Adh**1** may serve as a buffer between the display panel PN and the molding member **160**.

[0149] Therefore, it is possible to inhibit thermal stress from accumulating on one side of the display panel PN, particularly, the edge of the through-hole TH. Therefore, it is possible to improve the reliability of the display device **100** according to the embodiment of the present disclosure.

[0150] In addition, in the display device **100** according to the embodiment of the present disclosure, the first bonding layer Adh**1** extends to cover the side surface of the display panel PN during the trimming process for forming the through-hole TH in the optical area OA. Therefore, because the first bonding layer protects the side surface of the display panel during the process, the effect of suppressing moisture penetration into the side surface of the display panel PN may be further improved.

[0151] Hereinafter, the effect according to the embodiment of the present disclosure described above will be described in more detail with reference to Embodiment and Comparative Embodiment.

[0152] First, Embodiment shown in Table 1 below is the display device **100** according to the embodiment of the present disclosure. In this case, a pressure sensitive adhesive with a modulus of 1.0×10^4 Pa to 9.9×10^4 Pa, which is about 30% lower than a modulus of a general pressure sensitive adhesive, was applied as the first bonding layer Adh**1**.

[0153] Meanwhile, Comparative Embodiment differs from Embodiment in terms of the structure in which the display panel PN and the molding member **160** are in contact with each other at one side of the display device **100** adjacent to the optical area OA in Embodiment. That is, the display device of Comparative Embodiment has a structure in which no bonding layer is disposed between the display panel PN and the molding member **160** at one side of the display device **100** adjacent to the optical area OA.

[0154] Maximum principal stress at the edges of the through-holes TH was measured while the display devices of Embodiment and Comparative Embodiment were alternately exposed to a high-temperature (65° C.) environment and a low-temperature (−25° C.) environment. The maximum principal stress is shown in Table 1 below. In this case, the maximum principal stress means normal stress when only the normal stress is applied to any surface including any one point in an object, which receives an external force, whereas shear stress is not applied to the surface.

TABLE 1

	Maximum principal stress (MPa)	
Classification	High temperature (65° C.)	Low temperature (−20° C.)
Embodiment	30.5	25.1
Comparative Embodiment	30.5	34

[0155] As shown in Table 1, it can be ascertained that as in Embodiment, in case that the first bonding layer Adh**1** extends and is disposed on the side surface of the display panel PN, the first bonding layer Adh**1** serves as a buffer, such that the maximum principal stress is reduced by about 26%, in comparison with the display device of Comparative Embodiment. Therefore, according to the display device **100** of Embodiment, the occurrence of cracks in the display panel PN at the edge of the through-hole TH may be reduced as the maximum principal stress accumulating on the edge of the through-hole TH decreases in comparison with the display device of Comparative Embodiment. As a result, the reliability of the display device **100** may be improved.

[0156] The exemplary embodiments of the present disclosure can also be described as follows:

[0157] According to an aspect of the present disclosure, a display device includes a display panel comprising a display area, an optical area disposed in the display area and including a through-hole, and a non-display area configured to surround the display area, a support member disposed below the display panel, a first bonding layer disposed between the display panel and the support member, a frame comprising a lower frame disposed below the support member, and a lateral frame disposed on side surfaces of the display panel, the support member, and the first bonding

layer, and a molding member disposed between the display panel, the support member, and the frame, wherein the first bonding layer extends from one side of the display panel adjacent to the optical area and is disposed between the display panel and the molding member.

[0158] The first bonding layer may cover the side surface of the display panel at one side of the display panel adjacent to the optical area.

[0159] The display device may further include a polarizing layer disposed on the display panel, and a second bonding layer disposed between the display panel and the polarizing layer, the first bonding layer may cover the side surface of the polarizing layer and the side surface of the second bonding layer at one side of the display panel adjacent to the optical area.

[0160] The display device may further include a cover member disposed on the polarizing layer, and a third bonding layer disposed between the cover member and the polarizing layer, the first bonding layer may cover a side surface of the third bonding layer at one side of the display panel adjacent to the optical area.

[0161] The molding member may include curable resin.

[0162] The display device may further include a metal plate disposed below the support member, and a fourth bonding layer disposed between the support member and the metal plate, the side surface of the metal plate and the side surface of the fourth bonding layer may be sealed by the molding member.

[0163] A modulus of the fourth bonding layer may be larger than a modulus of the first bonding layer.

[0164] The modulus of the first bonding layer may be 1.0×10^4 Pa to 9.9×10^4 Pa, and the modulus of the fourth bonding layer may be 1.0×10^5 Pa to 9.9×10^5 Pa.

[0165] The display panel may be bent in a bending area extending and bent from one side of the non-display area at the other side of the display panel opposite to one side of the display panel adjacent to the optical area.

[0166] The display device may further include an electronic optical device disposed to overlap the optical area.

[0167] The first bonding layer is disposed to extend to a bottom surface of the cover member.

[0168] Although the exemplary embodiments of the present disclosure have been described in detail with reference to the accompanying drawings, the present disclosure is not limited thereto and may be embodied in many different forms without departing from the technical concept of the present disclosure. Therefore, the exemplary embodiments of the present disclosure are provided for illustrative purposes only but not intended to limit the technical concept of the present disclosure. The scope of the technical concept of the present disclosure is not limited thereto. Therefore, it should be understood that the above-described exemplary embodiments are illustrative in all aspects and do not limit the present disclosure. The protective scope of the present disclosure should be construed based on the following claims, and all the technical concepts in the equivalent scope thereof should be construed as falling within the scope of the present disclosure.

What is claimed is:

1. A display device, comprising:
a display panel comprising a display area, an optical area disposed in the display area and including a through-hole, and a non-display area configured to surround the display area;
a support member disposed below the display panel;
a first bonding layer disposed between the display panel and the support member;
a frame comprising a lower frame disposed below the support member, and a lateral frame disposed on side surfaces of the display panel, the support member, and the first bonding layer; and
a molding member disposed between the display panel, the support member, and the frame,
wherein the first bonding layer extends from one side of the display panel adjacent to the optical area and is disposed between the display panel and the molding member.

2. The display device of claim **1**, wherein the first bonding layer covers the side surface of the display panel at one side of the display panel adjacent to the optical area.

3. The display device of claim **1**, further comprising:
a polarizing layer disposed on the display panel; and
a second bonding layer disposed between the display panel and the polarizing layer,
wherein the first bonding layer covers the side surface of the polarizing layer and the side surface of the second bonding layer at one side of the display panel adjacent to the optical area.

4. The display device of claim **3**, further comprising:
a cover member disposed on the polarizing layer; and
a third bonding layer disposed between the cover member and the polarizing layer,
wherein the first bonding layer covers a side surface of the third bonding layer at one side of the display panel adjacent to the optical area.

5. The display device of claim **1**, wherein the molding member includes curable resin.

6. The display device of claim **1**, further comprising:
a metal plate disposed below the support member; and
a fourth bonding layer disposed between the support member and the metal plate,
wherein the side surface of the metal plate and the side surface of the fourth bonding layer are sealed by the molding member.

7. The display device of claim **6**, wherein a modulus of the fourth bonding layer is larger than a modulus of the first bonding layer.

8. The display device of claim **7**, wherein the modulus of the first bonding layer is 1.0×10^4 Pa to 9.9×10^4 Pa, and the modulus of the fourth bonding layer is 1.0×10^5 Pa to 9.9×10^5 Pa.

9. The display device of claim **1**, wherein the display panel is bent in a bending area extending and bent from one side of the non-display area at the other side of the display panel opposite to one side of the display panel adjacent to the optical area.

10. The display device of claim **1**, further comprising:
an electronic optical device disposed to overlap the optical area.

11. The display device of claim **4**, wherein the first bonding layer is disposed to extend to a bottom surface of the cover member.

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