United States Patent Application Publication	20250268029
Kind Code	A1
Publication Date	August 21, 2025
Inventor(s)	SON; Hyesun et al.

DISPLAY DEVICE

Abstract

A flexible or foldable display device is disclosed that is capable of increasing the reliability of the folding area by including a first adhesive member positioned on the color filter layer, disposed in the folding area, and including an ultraviolet absorbing material of a first mole percent, and a second adhesive member disposed on the first adhesive member in the folding area and including an ultraviolet absorbing material of a second mole percent smaller than the first mole percent.

Inventors: **SON; Hyesun (Paju-si, KR), JANG; Sejin (Paju-si, KR), HWANG; JunHa (Paju-si, KR), PARK; SoJung (Paju-si, KR)**

Applicant: **LG Display Co., Ltd.** (Seoul, KR)

Family ID: **1000008270873**

Appl. No.: **18/934936**

Filed: **November 01, 2024**

Foreign Application Priority Data

KR	10-2024-0025229	Feb. 21, 2024

Publication Classification

Int. Cl.: **H10K59/126** (20230101); **H10K59/38** (20230101); **H10K59/80** (20230101); **H10K102/00** (20230101)

U.S. Cl.:

CPC **H10K59/126** (20230201); **H10K59/38** (20230201); **H10K59/873** (20230201); H10K2102/311 (20230201); H10K2102/351 (20230201)

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority from Korean Patent Application No. 10-2024-0025229, filed on Feb. 21, 2024, which is hereby incorporated by reference for all purposes as if fully set forth herein.

BACKGROUND

Technical Field

[0002] Embodiments of the disclosure relate to a display device.

Description of Related Art

[0003] The importance of display devices is increasing with the development of multimedia. In response to this, various types of display devices, such as organic light emitting display devices, liquid crystal display devices, etc., are being used.

[0004] As display technology advances, research and development on display devices with flexible displays are actively underway.

[0005] Flexible displays may extend or shorten the display screen by folding, bending, or sliding, contributing greatly to reducing the size of the display device or changing the design.

BRIEF SUMMARY

[0006] A stacked structure that uses a color filter layer instead of a polarizer has been developed for organic light emitting display devices, but when applied to flexible displays, suffers from poor folding reliability. Accordingly, the inventors of the disclosure have invented a display device that may enhance the reliability of the folding area through UV exposure.

[0007] Embodiments of the disclosure may provide a display device capable of increasing the reliability of the folding area.

[0008] Embodiments of the disclosure may provide a display device capable of increasing the reliability of a flexible display to which a color filter layer is applied.

[0009] Embodiments of the disclosure may provide a display device, comprising a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area, a plurality of light emitting elements disposed on the substrate, an encapsulation layer disposed on the plurality of light emitting elements, a color filter layer disposed on the encapsulation layer, a first adhesive member positioned on the color filter layer, disposed in the folding area, and including an ultraviolet absorbing material of a first mole percent, and a second adhesive member disposed on the first adhesive member in the folding area and including the ultraviolet absorbing material of a second mole percent smaller than the first mole percent.

[0010] Embodiments of the disclosure may provide a display device comprising a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area, a plurality of light emitting elements disposed on the substrate, an encapsulation layer disposed on the plurality of light emitting elements, a color filter layer disposed on the encapsulation layer, a first adhesive member positioned on the color filter layer, including a concave portion including a flat portion and an inclined portion surrounding the flat portion and overlapping the folding area, and including an ultraviolet absorbing material of a first mole percent, and a second adhesive member positioned in the concave portion of the first adhesive member, and including the ultraviolet absorbing material of a second mole percent smaller than the first mole percent.

[0011] Embodiments of the disclosure may provide a display device comprising a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area, a plurality of light emitting elements

disposed on the substrate, an encapsulation layer disposed on the plurality of light emitting elements, a color filter layer disposed on the encapsulation layer, and an adhesive member disposed on the color filter layer, disposed in the folding area, and including a first portion adjacent to the color filter layer and a second portion on the first portion, wherein an ultraviolet absorption rate of the first portion is larger than an ultraviolet absorption rate of the second portion.

[0012] According to embodiments of the disclosure, there may be provided a display device capable of increasing the reliability of the folding area.

[0013] According to embodiments of the disclosure, there may be provided a display device capable of low-power driving by increasing the reliability of a color filter layer-applied flexible display.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[0014] The above and other objects, features, and advantages of the disclosure will be more clearly understood from the following detailed description, taken in conjunction with the accompanying drawings, in which:

[0015] FIGS. **1**A and **1**B are perspective views illustrating a display device according to embodiments of the disclosure;

[0016] FIG. **2** is a view illustrating a configuration of a system of a display device according to embodiments of the disclosure;

[0017] FIG. **3** is an equivalent circuit diagram illustrating a subpixel in a display panel according to embodiments of the disclosure;

[0018] FIG. **4** is a cross-sectional view illustrating a display panel according to embodiments of the disclosure;

[0019] FIGS. **5**A, **5**B, **5**C, and **5**D are views illustrating an example of a cross-sectional structure taken along A-A′ of FIG. **1**A;

[0020] FIG. **6** is a graph illustrating changes in value depending on the presence or absence of a UV absorbing material of an adhesive member in a display device according to embodiments of the disclosure; and

[0021] FIGS. **7**A, **7**B, and **7**C are views schematically illustrating a process of forming a structure of a display device according to embodiments of the disclosure.

DETAILED DESCRIPTION

[0022] In the following description of examples or embodiments of the disclosure, reference will be made to the accompanying drawings in which it is shown by way of illustration specific examples or embodiments that can be implemented, and in which the same reference numerals and signs can be used to designate the same or like components even when they are shown in different accompanying drawings from one another. Further, in the following description of examples or embodiments of the disclosure, detailed descriptions of well-known functions and components incorporated herein will be omitted when it is determined that the description may make the subject matter in some embodiments of the disclosure rather unclear. The terms such as “including”, “having”, “containing”, “constituting” “make up of”, and “formed of” used herein are generally intended to allow other components to be added unless the terms are used with the term “only”. As used herein, singular forms are intended to include plural forms unless the context clearly indicates otherwise.

[0023] Terms, such as “first”, “second”, “A”, “B”, “(A)”, or “(B)” may be used herein to describe elements of the disclosure. Each of these terms is not used to define essence, order, sequence, or number of elements, etc., but is used merely to distinguish the corresponding element from other elements.

[0024] When it is mentioned that a first element “is connected or coupled to”, “contacts or overlaps”, etc., a second element, it should be interpreted that, not only can the first element “be directly connected or coupled to” or “directly contact or overlap” the second element, but a third element can also be “interposed” between the first and second elements, or the first and second elements can “be connected or coupled to”, “contact or overlap”, etc., each other via a fourth element. Here, the second element may be included in at least one of two or more elements that “are connected or coupled to”, “contact or overlap”, etc., each other.
[0025] When time relative terms, such as “after,” “subsequent to,” “next,” “before,” and the like, are used to describe processes or operations of elements or configurations, or flows or steps in operating, processing, manufacturing methods, these terms may be used to describe non-consecutive or non-sequential processes or operations unless the term “directly” or “immediately” is used together.
[0026] In addition, when any dimensions, relative sizes, etc., are mentioned, it should be considered that numerical values for an elements or features, or corresponding information (e.g., level, range, etc.) include a tolerance or error range that may be caused by various factors (e.g., process factors, internal or external impact, noise, etc.) even when a relevant description is not specified. Further, the term “may” fully encompasses all the meanings of the term “can”.
[0027] Hereinafter, various embodiments of the disclosure are described in detail with reference to the accompanying drawings.
[0028] FIGS. **1**A and **1**B are perspective views illustrating a display device according to embodiments of the disclosure.
[0029] Hereinafter, the first direction FD, the second direction SD, and the third direction TD cross each other in different directions.
[0030] For example, the first direction FD may be a length direction, the second direction SD may be a width direction, and the third direction TD may be a thickness direction.
[0031] Referring to FIGS. **1**A and **1**B, a display device **100** according to embodiments of the disclosure may include various devices for displaying a screen or an image.
[0032] The display device **100** may include, but is not limited to, e.g., a smartphone, a mobile phone, a tablet personal computer (PC), a personal digital assistant (PDA), a portable multimedia player (PMP), a television, a game console, a wristwatch-type electronic device, a head mounted display, a monitor of a personal computer, a notebook computer, a car navigation system, a car dashboard, a digital camera, a camcorder, an external sign board, an electronic display, various medical devices, various inspection devices, various home appliances including a display such as a refrigerator or a washing machine, an Internet of things device, or the like.
[0033] Referring to FIG. **1**A, the display device **100** may have a rectangular shape on a plane.
[0034] In an embodiment, the display device **100** may have two opposite long sides extending in the first direction FD and two opposite short sides extending in the second direction SD crossing the first direction FD on a plane.
[0035] However, the disclosure is not limited thereto, and the display device **100** may have various shapes.
[0036] The display device **100** may include a display area DA and a non-display area NDA.
[0037] The display area DA may display an image or video.
[0038] A plurality of pixels may be disposed in the display area DA.
[0039] As illustrated in FIG. **1**A, the display area DA may be disposed on an upper surface of the display device **100**, but is not limited thereto, and the display area DA may be also disposed on at least one of a lower surface and a side surface of the display device **100**.
[0040] The non-display area NDA may not display an image or video.
[0041] The non-display area NDA may be disposed around the display area DA.
[0042] The non-display area NDA may surround the display area DA.
[0043] The non-display area NDA may be, e.g., an area in which a light blocking member such as a

black matrix is disposed.
[0044] In an embodiment, the display area DA may have a rectangular shape, and the non-display area NDA may be disposed around four sides of the display area DA, but is not limited thereto.
[0045] Referring to FIGS. **1**A and **1**B, the display device **100** may be a foldable display device capable of being folded or unfolded.
[0046] The display device **100** may be divided into a folding area FA and non-folding areas NFA**1** and NFA**2**.
[0047] The folding area FA may be an area that is folded or bent when the display device **100** is folded.
[0048] The non-folding areas NFA**1** and NFA**2** may be areas that maintain flatness without folding or bending when the display device **100** is folded.
[0049] The non-folding areas NFA**1** and NFA**2** may include a first non-folding area NFA**1** and a second non-folding area NFA**2**.
[0050] The first non-folding area NFA**1** and the second non-folding area NFA**2** may be arranged in the first direction FD, and the folding area FA may be disposed between the first non-folding area NFA**1** and the second non-folding area NFA**2**.
[0051] The display device **100** may be folded so that the first non-folding area NFA**1** overlaps the second non-folding area NFA**2**, or may be bent so that the first non-folding area NFA**1** is inclined with respect to the second non-folding area NFA**2** or unfolded flat.
[0052] For example, the display device **100** may be folded so that the first non-folding area NFA**1** forms an angle of 0 degrees or more and less than 180 degrees with respect to the second non-folding area NFA**2**, or may be unfolded so that the first non-folding area NFA**1** forms an angle of 180 degrees with respect to the second non-folding area NFA**2**.
[0053] Referring to FIG. **1**A, when the display device **100** is unfolded, the first non-folding area NFA**1**, the folding area FA, and the second non-folding area NFA**2** may be flatly unfolded so as not to overlap each other in the third direction TD.
[0054] Referring to FIG. **1**B, when the display device **100** is folded, the first non-folding area NFA**1** and the second non-folding area NFA**2** may overlap each other in the third direction TD.
[0055] Further, although not illustrated, when the display device **100** is folded, the first non-folding area NFA**1** and the second non-folding area NFA**2** may be disposed to be inclined with each other.
[0056] In this case, at least a portion of the first non-folding area NFA**1** and at least a portion of the second non-folding area NFA**2** may or may not overlap each other in the third direction TD.
[0057] In an embodiment, one folding area FA and two non-folding areas NFA**1** and NFA**2** are illustrated, but the number and arrangement of the folding area FA and the non-folding area NFA are not limited thereto.
[0058] Referring to FIG. **1**B, the display device **100** may be in-folded.
[0059] In-folding may be folding so that at least a portion of the display area DA is not exposed to the outside during folding.
[0060] For example, when a portion of the display area DA is folded to face another portion of the display area DA and the display device **100** is completely folded, the display area DA may be surrounded by at least one other member forming the exterior of the display device **100** not to be exposed to the outside.
[0061] The display device **100** may have an unfolding state in which the display device **100** is unfolded and a folding state in which the display device **100** is folded.
[0062] The display device **100** may be configured to be freely switchable to the unfolding state and the folding state.
[0063] Referring to FIG. **1**A, the unfolding state may be a state in which the first non-folding area NFA**1** and the second non-folding area NFA**2** are disposed side by side on one plane.
[0064] Referring to FIG. **1**B, the folding state may be a state in which the first non-folding area NFA**1** and the second non-folding area NFA**2** are disposed parallel to each other and completely

overlap each other in the third direction TD.
[0065] Although not shown, the folding state may further include a state in which the first non-folding area NFA**1** and the second non-folding area NFA**2** are half-folded.
[0066] In other words, the first non-folding area NFA**1** may be disposed to be inclined with respect to the second non-folding area NFA**2**.
[0067] In this case, the first non-folding area NFA**1** and the second non-folding area NFA**2** may partially overlap or may not overlap depending on the angle between the first non-folding area NFA**1** and the second non-folding area NFA**2**.
[0068] For example, the unfolding state may be a state in which the angle between the first non-folding area NFA**1** and the second non-folding area NFA**2** of the display device **100** is 180 degrees, and the folding state may be a state in which the angle between the first non-folding area NFA**1** and the second non-folding area NFA**2** of the display device **100** is 0 degrees or more and less than 180 degrees or 180 degrees or more and less than 360 degrees.
[0069] FIG. **2** is a view illustrating a system configuration of a display device **100** according to embodiments of the disclosure.
[0070] Referring to FIG. **2**, a display device **100** may include a display panel **110** and display driving circuits, as components for displaying images.
[0071] The display driving circuits are circuits for driving the display panel **110** and may include a data driving circuit **220**, a gate driving circuit **230**, and a display controller **240**.
[0072] The display panel **110** may include a display area DA in which images are displayed and a non-display area NDA in which no image is displayed.
[0073] The non-display area NDA may be an outer area of the display area DA and be referred to as a bezel area.
[0074] The whole or part of the non-display area NDA may be an area visible from the front surface of the display device **100** or an area that is bent and not visible from the front surface of the display device **100**.
[0075] The display panel **110** may include a substrate SUB and a plurality of subpixels SP disposed on the substrate SUB.
[0076] The display panel **110** may further include various types of signal lines to drive the plurality of subpixels SP.
[0077] The display device **100** according to embodiments of the disclosure may be a liquid crystal display device or a self-emission display device in which the display panel **110** emits light by itself.
[0078] When the display device **100** according to the embodiments of the disclosure is a self-emission display device, each of the plurality of subpixels SP may include a light emitting element.
[0079] For example, the display device **100** according to embodiments of the disclosure may be an organic light emitting diode display device in which the light emitting element is implemented as an organic light emitting diode (OLED).
[0080] As another example, the display device **100** according to embodiments of the disclosure may be an inorganic light emitting display device in which the light emitting element is implemented as an inorganic material-based light emitting diode.
[0081] As another example, the display device **100** according to embodiments of the disclosure may be a quantum dot display device in which the light emitting element is implemented as a quantum dot which is self-emission semiconductor crystal.
[0082] The structure of each of the plurality of subpixels SP may vary according to the type of the display device **100**.
[0083] For example, when the display device **100** is a self-emission display device in which the subpixels SP emit light by themselves, each subpixel SP may include a light emitting element that emits light by itself, one or more transistors, and one or more capacitors.
[0084] For example, various types of signal lines may include a plurality of data lines DL transferring data signals (also referred to as data voltages or image signals) and a plurality of gate

lines GL transferring gate signals (also referred to as scan signals).
[0085] The plurality of data lines DL and the plurality of gate lines GL may cross each other.
[0086] Each of the plurality of data lines DL may be disposed while extending in a first direction.
[0087] Each of the plurality of gate lines GL may be disposed while extending in a second direction.
[0088] Here, the first direction may be a column direction and the second direction may be a row direction.
[0089] The first direction may be also the row direction, and the second direction may be also the column direction.
[0090] The data driving circuit **220** is a circuit for driving the plurality of data lines DL, and may output data signals to the plurality of data lines DL.
[0091] The gate driving circuit **230** is a circuit for driving the plurality of gate lines GL, and may output gate signals to the plurality of gate lines GL.
[0092] The display controller **240** is a device for controlling the data driving circuit **220** and the gate driving circuit **230** and may control driving timings for the plurality of data lines DL and driving timings for the plurality of gate lines GL.
[0093] The display controller **240** may supply a data driving control signal DCS to the data driving circuit **220** to control the data driving circuit **220** and may supply a gate driving control signal GCS to the gate driving circuit **230** to control the gate driving circuit **230**.
[0094] The display controller **240** may receive input image data from the host system **250** and supply image data Data to the data driving circuit **220** based on the input image data.
[0095] The data driving circuit **220** may supply data signals to the plurality of data lines DL according to the driving timing control of the display controller **240**.
[0096] The data driving circuit **220** may receive digital image data Data from the display controller **240** and may convert the received image data Data into analog data signals and output the analog data signals to the plurality of data lines DL.
[0097] The gate driving circuit **230** may supply gate signals to the plurality of gate lines GL according to the timing control of the display controller **240**.
[0098] The gate driving circuit **230** may receive a first gate voltage corresponding to a turn-on level voltage and a second gate voltage corresponding to a turn-off level voltage, along with various gate driving control signals GCS, generate gate signals, and supply the generated gate signals to the plurality of gate lines GL.
[0099] For example, the data driving circuit **220** may be connected with the display panel **110** by a tape automated bonding (TAB) method or connected to a bonding pad of the display panel **110** by a chip on glass (COG) or chip on panel (COP) method or may be implemented by a chip on film (COF) method and connected with the display panel **110**.
[0100] The gate driving circuit **230** may be connected with the display panel **110** by TAB method or connected to a bonding pad of the display panel **110** by a COG or COP method or may be connected with the display panel **110** according to a COF method.
[0101] Alternatively, the gate driving circuit **230** may be formed in a gate in panel (GIP) type, in the non-display area NDA of the display panel **110**.
[0102] The gate driving circuit **230** may be disposed on the substrate or may be connected to the substrate.
[0103] In other words, the gate driving circuit **230** that is of a GIP type may be disposed in the non-display area NDA of the substrate.
[0104] The gate driving circuit **230** that is of a chip-on-glass (COG) type or chip-on-film (COF) type may be connected to the substrate.
[0105] Meanwhile, at least one of the data driving circuit **220** and the gate driving circuit **230** may be disposed in the display area DA of the display panel **110**.
[0106] For example, at least one of the data driving circuit **220** and the gate driving circuit **230** may

be disposed not to overlap the subpixels SP or to overlap all or some of the subpixels SP.
[0107] The data driving circuit **220** may be connected to one side (e.g., an upper or lower side) of the display panel **110**.
[0108] Depending on the driving scheme or the panel design scheme, data driving circuits **220** may be connected with both the sides (e.g., both the upper and lower sides) of the display panel **110**, or two or more of the four sides of the display panel **110**.
[0109] The gate driving circuit **230** may be connected to one side (e.g., a left or right side) of the display panel **110**.
[0110] Depending on the driving scheme or the panel design scheme, gate driving circuits **230** may be connected with both the sides (e.g., both the left and right sides) of the display panel **110**, or two or more of the four sides of the display panel **110**.
[0111] The display controller **240** may be implemented as a separate component from the data driving circuit **220**, or the display controller **140** and the data driving circuit **220** may be integrated into an integrated circuit (IC).
[0112] The display controller **240** may be a timing controller used in typical display technology, a control device that may perform other control functions as well as the functions of the timing controller, or a control device other than the timing controller, or may be a circuit in the control device.
[0113] The display controller **240** may be implemented as various circuits or electronic components, such as an integrated circuit (IC), a field programmable gate array (FPGA), an application specific integrated circuit (ASIC), or a processor.
[0114] The display controller **240** may be mounted on a printed circuit board or a flexible printed circuit and may be electrically connected with the data driving circuit **220** and the gate driving circuit **230** through the printed circuit board or the flexible printed circuit.
[0115] The display controller **240** may transmit/receive signals to/from the data driving circuit **220** according to one or more predetermined interfaces.
[0116] The interface may include, e.g., a low voltage differential signaling (LVDS) interface, an EPI interface, and a serial peripheral interface (SP).
[0117] To provide a touch sensing function as well as an image display function, the display device **100** according to embodiments of the disclosure may include a touch sensor and a touch sensing circuit that senses the touch sensor to detect whether a touch occurs by a touch object, such as a finger or pen, or the position of the touch.
[0118] The touch sensing circuit may include a touch driving circuit **260** that drives and senses the touch sensor and generates and outputs touch sensing data and a touch controller **270** that may detect an occurrence of a touch or the position of the touch using touch sensing data.
[0119] The touch sensor may include a plurality of touch electrodes.
[0120] The touch sensor may further include a plurality of touch lines for electrically connecting the plurality of touch electrodes and the touch driving circuit **260**.
[0121] The touch sensor may be present in a touch panel form outside the display panel **110** or may be present inside the display panel **110**.
[0122] When the touch panel, in the form of a touch panel, exists outside the display panel **110**, the touch panel is referred to as an external type.
[0123] When the touch sensor is of the external type, the touch panel and the display panel **110** may be separately manufactured or may be combined during an assembly process.
[0124] The external-type touch panel may include a touch panel substrate and a plurality of touch electrodes on the touch panel substrate.
[0125] When the touch sensor is present inside the display panel **110**, the touch sensor may be formed on the substrate SUB, together with signal lines and electrodes related to display driving, during the manufacturing process of the display panel **110**.
[0126] The touch driving circuit **260** may supply a touch driving signal to at least one of the

plurality of touch electrodes and may sense at least one of the plurality of touch electrodes to generate touch sensing data.
[0127] The touch sensing circuit may perform touch sensing in a self-capacitance sensing scheme or a mutual-capacitance sensing scheme.
[0128] When the touch sensing circuit performs touch sensing in the self-capacitance sensing scheme, the touch sensing circuit may perform touch sensing based on capacitance between each touch electrode and the touch object (e.g., finger or pen).
[0129] According to the self-capacitance sensing scheme, each of the plurality of touch electrodes may serve both as a driving touch electrode and as a sensing touch electrode.
[0130] The touch driving circuit **260** may drive all or some of the plurality of touch electrodes and sense all or some of the plurality of touch electrodes.
[0131] When the touch sensing circuit performs touch sensing in the mutual-capacitance sensing scheme, the touch sensing circuit may perform touch sensing based on capacitance between the touch electrodes.
[0132] According to the mutual-capacitance sensing scheme, the plurality of touch electrodes are divided into driving touch electrodes and sensing touch electrodes.
[0133] The touch driving circuit **260** may drive the driving touch electrodes and sense the sensing touch electrodes.
[0134] The touch driving circuit **260** and the touch controller **270** included in the touch sensing circuit may be implemented as separate devices or as a single device.
[0135] The touch driving circuit **260** and the data driving circuit **220** may be implemented as separate devices or as a single device.
[0136] The display device **100** may further include a power supply circuit for supplying various types of power to the display driver integrated circuit and/or the touch sensing circuit.
[0137] The display device **100** according to embodiments of the disclosure may be a mobile terminal, such as a smart phone or a tablet, or a monitor or television (TV) in various sizes but, without limited thereto, may be a display in various types and various sizes capable of displaying information or images.
[0138] FIG. **3** is an equivalent circuit of a subpixel SP in a display panel **110** according to embodiments of the disclosure.
[0139] Each subpixel SP disposed in the display area DA of the display panel **110** may include an light emitting element ED, a driving transistor DRT for driving the light emitting element ED, a scan transistor SCT for transferring a data voltage Vdata to a first node N**1** of the driving transistor DRT, and a storage capacitor Cst for maintaining a constant voltage during one frame.
[0140] The driving transistor DRT may include the first node N**1** to which the data voltage may be applied, a second node N**2** electrically connected with the light emitting element ED, and a third node N**3** to which a driving voltage ELVDD is applied from a driving voltage line DVL.
[0141] The first node N**1** in the driving transistor DRT may be a gate node, the second node N**2** may be a source node or a drain node, and the third node N**3** may be the drain node or the source node.
[0142] The light emitting element ED may include an anode electrode AE, a light emitting layer EL, and a cathode electrode CE.
[0143] The anode electrode AE may be a pixel electrode disposed in each subpixel SP and be electrically connected to the second node N**2** of the driving transistor DRT of each subpixel SP.
[0144] The cathode electrode CE may be a common electrode commonly disposed in the plurality of subpixels SP, and a base voltage ELVSS may be applied thereto.
[0145] For example, the anode electrode AE may be a pixel electrode, and the cathode electrode CE may be a common electrode.
[0146] Conversely, the anode electrode AE may be a common electrode, and the cathode electrode CE may be a pixel electrode.

[0147] Hereinafter, for convenience of description, it is assumed that the anode electrode AE is a pixel electrode and the cathode electrode CE is a common electrode.
[0148] The light emitting element ED may be an organic light emitting diode (OLED), an inorganic light emitting diode, or a quantum dot light emitting element.
[0149] In this case, when the light emitting element ED is an organic light emitting diode, the light emitting layer EL of the light emitting element ED may include an organic light emitting layer including an organic material.
[0150] The scan transistor SCT may be on/off controlled by a scan signal SCAN, which is a gate signal, applied via the gate line GL and be electrically connected between the first node N**1** of the driving transistor DRT and the data line DL.
[0151] The storage capacitor Cst may be electrically connected between the first node N**1** and second node N**2** of the driving transistor DRT.
[0152] Each subpixel SP may have a 2T (transistor) 1C (capacitor) structure which includes two transistors DRT and SCT and one capacitor Cst as shown in FIG. **3** and, in some cases, each subpixel SP may further include one or more transistors or one or more capacitors.
[0153] The storage capacitor Cst may be an external capacitor intentionally designed to be outside the driving transistor DRT, but not a parasite capacitor (e.g., Cgs or Cgd) which is an internal capacitor that may be present between the first node N**1** and the second node N**2** of the driving transistor DRT.
[0154] Each of the driving transistor DRT and the scan transistor SCT may be an n-type transistor or a p-type transistor.
[0155] Further, each of the driving transistor DRT and the scan transistor SCT may be composed of a low-temperature polycrystalline silicon transistor.
[0156] However, without limitations thereto, at least one may be composed of an oxide thin film transistor.
[0157] Since the circuit elements (particularly, the light emitting element ED) in each subpixel SP are vulnerable to external moisture or oxygen, an encapsulation layer ENCAP may be disposed to cover the light emitting elements ED to prevent penetration of external moisture or oxygen into the circuit elements (particularly, the light emitting element ED).
[0158] Further, referring to FIG. **3**, a touch electrode layer TSL may be disposed on the encapsulation layer ENCAP.
[0159] A color filter layer CF may be disposed on the touch electrode layer TSL.
[0160] The color filter layer CF may include a plurality of color filters.
[0161] The touch electrode layer TSL and the plurality of color filters are described below.
[0162] FIG. **4** is a cross-sectional view illustrating a display panel according to embodiments of the disclosure.
[0163] Referring to FIG. **4**, a display panel **110** according to embodiments of the disclosure includes a substrate **4100**, an insulation layer **4210** positioned on the substrate, an anode electrode **4310** positioned on the insulation layer **4210**, a bank layer **4330** positioned on the anode electrode **4310** and the insulation layer **4210**, a light emitting layer **4320** positioned on the anode electrode **4310**, a cathode electrode **4340** positioned on the light emitting layer **4320** and the bank layer **4330**, an encapsulation layer **4350** positioned on the cathode electrode **4340**, a touch buffer layer **4360** positioned on the encapsulation layer **4350**, a touch interlayer insulation layer **4370** positioned on the touch buffer layer **4360**, and a passivation layer **4380** positioned on the touch interlayer insulation layer **4370**.
[0164] The display panel **110** may include a first transistor positioned on the substrate **4100** and an organic light emitting element electrically connected to the first transistor.
[0165] The first transistor may include a first active layer **4121**, a first gate electrode layer **4122**, a first source electrode layer **4123**, and a first drain electrode layer **4124**.
[0166] The organic light emitting element includes an anode electrode **4310**, a light emitting layer

4320, and a cathode electrode **4340**.
[0167] Referring to FIG. **4**, a light blocking layer **4127** may be disposed on the substrate **4100**.
[0168] A first buffer layer **4110** may be disposed on the substrate **4100** and the light blocking layer **4127**, and a second buffer layer **4111** may be disposed on the first buffer layer **4110**.
[0169] The first active layer **4121** of the first transistor may be disposed on the second buffer layer **4111**.
[0170] The first gate insulation layer **4112** may be disposed on the first active layer **4121**, and the first gate electrode layer **4122** may be disposed on the first gate insulation layer **4112**.
[0171] A first interlayer insulation layer **4113** may be disposed on the first gate electrode layer **4122**, a third buffer layer **4114** may be disposed on the first interlayer insulation layer **4113**, a second gate insulation layer **4115** may be disposed on the third buffer layer **4114**, and a second interlayer insulation layer **4116** may be disposed on the second gate insulation layer **4115**.
[0172] The light blocking electrode layer **4128**, the first source electrode layer **4123**, and the first drain electrode layer **4124** may be disposed on the second interlayer insulation layer **4116**.
[0173] The first source electrode layer **4123** and the first drain electrode layer **4124** may be disposed to be spaced apart from each other on the second interlayer insulation layer **4116**.
[0174] Each of the first source electrode layer **4123** and the first drain electrode layer **4124** may contact the first active layer **4121** through holes formed in the first gate insulation layer **4112**, the first interlayer insulation layer **4113**, the third buffer layer **4114**, the second gate insulation layer **4115**, and the second interlayer insulation layer **4116**.
[0175] As described above, the first transistor may be disposed on the substrate **4100**, but the structure of the first transistor according to embodiments of the disclosure is not limited thereto.
[0176] As another example, the first gate electrode layer **4122** may be disposed on the substrate **4100**, the first active layer **4121** may be disposed on the first gate electrode layer **4122**, the first source electrode layer **4123** may be disposed on the first active layer **4121** to overlap one end of the first active layer **4121**, and the first drain electrode layer **4124** may be disposed to overlap the other end of the first active layer **4121**.
[0177] An insulation layer **4210** may be disposed to cover the first transistor.
[0178] The insulation layer **4210** may be formed of an organic material, but embodiments of the disclosure are not limited thereto.
[0179] The insulation layer **4210** may include a first insulation layer **4211**, a second insulation layer **4212**, and a third insulation layer **4213**.
[0180] Specifically, the first insulation layer **4211** covering the first transistor may be disposed, the second insulation layer **4212** may be disposed on the first insulation layer **4121**, and the third insulation layer **4213** may be disposed on the second insulation layer **4212**.
[0181] However, the disclosure is not necessarily limited thereto, and the insulation layer **4210** may be a single insulation layer, and is not limited to a multilayer film.
[0182] Meanwhile, the light emitting layer **4320** of the organic light emitting element may be disposed on the anode electrode **4310** that does not overlap the bank layer **4330**.
[0183] The bank layer **4330** may cover at least a portion of the light emitting layer **4320**.
[0184] The cathode electrode **4340** of an organic light emitting element may be disposed on the light emitting layer **4320**.
[0185] Meanwhile, the light emitting layer **4320** of the organic light emitting element may be formed by a deposition or coating method having straightness.
[0186] For example, the light emitting layer **4320** may be formed by physical vapor deposition (PVD).
[0187] The light emitting layer **4320** formed in this way may have a thickness in an area having a predetermined angle with respect to the substrate **4100** that is thinner than a thickness in an area parallel to the substrate **4100**.
[0188] The light emitting layer **4320** may include a red organic light emitting layer disposed in the

red subpixel, a green organic light emitting layer disposed in the green subpixel, and a blue organic light emitting layer disposed in the blue subpixel.
[0189] FIG. **4** illustrates an example in which the light emitting layer **4320** is a green organic light emitting layer.
[0190] Meanwhile, the anode electrode **4310** may include a reflective metal.
[0191] FIG. **4** illustrates a configuration in which the anode electrode **4310** is a single layer, but embodiments of the disclosure are not limited thereto, and may be formed of multiple layers.
[0192] For example, when the anode electrode **4310** is formed of multiple layers, at least one layer may include a reflective metal.
[0193] For example, the anode electrode **4310** may include at least one of aluminum, neodymium, nickel, titanium, tantalum, copper (Cu), silver (Ag), and an aluminum alloy, but embodiments of the disclosure are not limited thereto.
[0194] The cathode electrode **4340** may contain a conductive material through which light is transmitted or semi-transmitted.
[0195] For example, it may include at least one type of transparent conductive oxide such as indium tin oxide (ITO), indium zinc oxide (IZO), indium tin zinc oxide (ITZO), zinc oxide, tin oxide, or the like, or a transflective metal such as magnesium, silver (Ag), or an alloy of magnesium and silver.
[0196] Here, when the cathode electrode **4340** includes a transflective metal, the thickness of the cathode electrode **4340** may be smaller than the thickness of the anode electrode **4310**.
[0197] Meanwhile, a light blocking layer **4127**, a light blocking electrode layer **4128** electrically connected to the light blocking layer **4127**, and a second metal pattern layer **4129** positioned on the first insulation layer **4211** may be disposed on the substrate **4100**.
[0198] The light blocking layer **4127** may perform a capacitor function or a function of blocking light entering from the rear surface.
[0199] The light blocking electrode layer **4128** may contact the light blocking layer **4127** through holes formed in the first buffer layer **4110**, the second buffer layer **4111**, the first gate insulation layer **4112**, the first interlayer insulation layer **4113**, the third buffer layer **4114**, the second gate insulation layer **4115**, and the second interlayer insulation layer **4116**.
[0200] The second metal pattern layer **4129** may contact the first source electrode layer **4123** through a hole formed in the first insulation layer **4211**, and may contact the anode electrode **4310** through holes formed in the second insulation layer **4212** and the third insulation layer **4213**.
[0201] In other words, the second metal pattern layer **4219** may serve to electrically connect the first source electrode layer **4123** and the anode electrode **4310**.
[0202] Further, as shown in FIG. **4**, a storage capacitor may be disposed in the active area.
[0203] The storage capacitor may include a first storage capacitor electrode layer **4125**, which is disposed on the same layer as the first gate electrode layer **4122**, and a second storage capacitor electrode layer **4126**, which is disposed on the first interlayer insulation layer **4113**, but the structure of the storage capacitor according to embodiments of the disclosure is not limited thereto.
[0204] As illustrated in FIG. **4**, the second storage capacitor electrode layer **4126** may form a capacitor with the first storage capacitor electrode layer **4125**.
[0205] The second active layer **4131** of the second transistor may be disposed on the third buffer layer **4114**.
[0206] The second gate insulation layer **4115** may be disposed on the second active layer **4131**, and the second gate electrode layer **4131** may be disposed on the second gate insulation layer **4115**.
[0207] A second interlayer insulation layer **4116** may be disposed on the second gate electrode layer **4131**, and an insulation layer **4210** may be disposed on the second interlayer insulation layer **4116**.
[0208] The second source electrode layer **4132** and the second drain electrode layer **4133** may be disposed on the second interlayer insulation layer **4116**.

[0209] The second source electrode layer **4132** and the second drain electrode layer **4133** may be disposed to be spaced apart from each other on the second interlayer insulation layer **4116**.
[0210] Each of the second source electrode layer **4132** and the second drain electrode layer **4133** may contact the second active layer **4130** through a hole formed in the second interlayer insulation layer **4116** and the second gate insulation layer **4115**.
[0211] Meanwhile, at least one spacer **4331** may be disposed between the cathode electrode **4340** and the bank layer **4330**.
[0212] The spacer **4331** may be formed of the same material as the bank layer **4330**, but embodiments of the disclosure are not limited thereto.
[0213] The bank layer **4330** and the spacer **4331** may be formed of a transparent insulating material.
[0214] The transmittance of the bank layer **4330** may be higher than the transmittance of the third insulation layer **4213**.
[0215] Meanwhile, at least one or more encapsulation layers **4350** may be disposed on the cathode electrode **4340** of the organic light emitting element.
[0216] The encapsulation layer **4350** may include a first encapsulation layer **4351** disposed on the cathode electrode **4340**, a second encapsulation layer **4352** disposed on the first encapsulation layer **4351**, and a third encapsulation layer **4353** disposed on the second encapsulation layer **4352**.
[0217] As such, when the encapsulation layer **4350** is formed of multiple layers, at least one layer may include an inorganic insulating material, and at least one other layer may include an organic insulating material.
[0218] In an embodiment of the disclosure, the first encapsulation layer **4351** and the third encapsulation layer **4353** may include an inorganic insulating material, and the second encapsulation layer **4352** may include an organic insulating material, but embodiments of the disclosure are not limited thereto.
[0219] The encapsulation layer **4350** may be disposed on the organic light emitting element to prevent moisture, foreign substances, or the like from penetrating into the organic light emitting element.
[0220] A touch buffer layer **4360** may be disposed on the third encapsulation layer **4353**, and a touch interlayer insulation layer **4370** may be disposed on the touch buffer layer **4360**.
[0221] A plurality of touch sensors **4410** may be disposed on the touch interlayer insulation layer **4370**.
[0222] The touch sensors **4410** may be transparent or opaque.
[0223] A passivation layer **4380** may be disposed on the plurality of touch sensors **4410**.
[0224] A plurality of black matrices **4420** may be disposed on the passivation layer **4380**.
[0225] The black matrix **4420** may be formed of a material having low reflectivity.
[0226] For example, the black matrix **4420** may include carbon black, a dye, or a resin.
[0227] It may include color filters CF**1** and CF**2** positioned on the passivation layer **4380** and positioned in an area corresponding to the opening area of the bank layer **4330**.
[0228] In FIG. **4**, a green color filter CF**1** and a blue color filter CF**2** are disposed between a plurality of black matrices **4420**.
[0229] A display device having high luminance efficiency may be provided by including color filters CF**1** and CF**2**.
[0230] The overcoat layer **4390** may be disposed on the passivation layer **4380** to cover the plurality of black matrices **4420** and the color filters CF**1** and CF**2**.
[0231] The overcoat layer **4390** may prevent moisture, foreign substances, or the like from penetrating, thereby preventing a metal or the like from being corroded by reacting with moisture in the air.
[0232] A first connection pattern and a second connection pattern may be contacted by a hole formed in the touch interlayer insulation layer **4370**.

[0233] The cross-sectional view of the display panel **110** has been described above with reference to FIG. **4**.
[0234] Hereinafter, cross-sectional structures positioned on the display panel **510** are described with reference to FIGS. **5**A to **5**D.
[0235] Here, the matters regarding the display panel **510** of FIGS. **5**A to **5**D may be substantially the same as those regarding the display panel **110** described with reference to FIG. **4**.
[0236] In the disclosure, when A is substantially the same as B, it may mean that A and B are regarded as the same considering a tiny difference due to a processing error.
[0237] FIGS. **5**A, **5**B, **5**C, and **5**D are views illustrating an example of a cross-sectional structure taken along A-A′ of FIG. **1**A.
[0238] Referring to FIGS. **5**A to **5**D, a display device may include a first non-folding area NFA**1**, a second non-folding area NFA**2** spaced apart from the first non-folding area NFA**1**, and a folding area FA positioned between the first non-folding area NFA**1** and the second non-folding area NFA**2** with respect to the first direction FD.
[0239] The first non-folding area NFA**1** may be positioned between a first outer area OA**1** and the folding area FA, and the second non-folding area NFA**2** may be positioned between a second outer area OA**2** and the folding area FA.
[0240] In the disclosure, the first outer area OA**1** is not limited to an area other than the first non-folding area NFA**1**. For example, the first outer area OA**1** may be a partial area of the first non-folding area NFA**1**.
[0241] Likewise, in the disclosure, the second outer area OA**2** is not limited to an area other than the second non-folding area NFA**2**. For example, the second outer area OA**2** may be a partial area of the second non-folding area NFA**2**.
[0242] However, in the disclosure, for convenience of description, the first outer area OA**1** and the second outer area OA**2**, and the first non-folding area NFA**1** and the second non-folding area NFA**2** are separately described.
[0243] Referring to FIGS. **5**A to **5**D, a first adhesive member **511** may be positioned on the display panel **510**, may be disposed in the folding area FA, and may include an ultraviolet absorbing material.
[0244] Further, a second adhesive member **512** may be positioned on the first adhesive member **511** in the folding area FA.
[0245] The second adhesive member **512** may include, but is not limited to, an ultraviolet absorbing material.
[0246] For example, when the second adhesive member **512** includes an ultraviolet absorbing material, the mole percent of the ultraviolet absorbing material included in the second adhesive member **512** may be smaller than the mole percent of the ultraviolet absorbing material included in the first adhesive member **511**.
[0247] As another example, the second adhesive member **512** may not include an ultraviolet absorbing material.
[0248] When the second adhesive member **512** does not include an ultraviolet absorbing material or includes less than the first adhesive member **511**, the second adhesive member **512** positioned in the folding area FA is more exposed by ultraviolet rays UV incident from the cover glass **540** to the first adhesive member **511** than the first adhesive member **511** positioned in the first non-folding area NFA**1** and the second non-folding area NFA**2**, so that the adhesive force of the folding area FA is higher than the adhesive force of the first non-folding area NFA**1** and the second non-folding area NFA**2**.
[0249] Accordingly, since the adhesive force of the folding area FA is higher than the adhesive force of the first non-folding area NFA**1** and the second non-folding area NFA**2**, delamination of the folding area FA may be prevented.
[0250] Further, the adhesive members **511** and **512** adjacent to the display panel **510** in the folding

area FA may be divided into two portions, e.g., a portion (i.e., **511**) having a high UV absorption rate and a portion (i.e., **512**) having a low UV absorption rate positioned on the portion having the high UV absorption rate, thereby increasing the reliability of the flexible display to which the color filter layer is applied.

[0251] The ultraviolet absorbing material may be at least one of benzotriazole, triazin, and benzophenone, but is not limited thereto.

[0252] Benzotriazole-based ultraviolet absorbing materials may include, e.g., 2-(2′-hydroxy-5′-methylphenyl)benzotriazole, 2-(2′-hydroxy-3′-tert-butyl-5′-methylphenyl)-5-chlorobenzotriazole, 2-(2′-hydroxy-3′,5′-di-tert-butylphenyl)-5-chlorobenzotriazole, 2-(2′-hydroxy-3′,5′-di-tert-amylphenyl)benzotriazole, 2-(2H-benzotriazole-2-yl)-4-(1,1,3,3-tetramethylbutyl)phenol.

[0253] The triazine-based ultraviolet absorbing materials may include, e.g., 2-(4,6-diphenyl-1,3,5-triazin-2-yl)-5-hexyloxyphenol, 2-[4,6-bis(2,4-dimethylphenyl)-1,3,5-triazin-2-yl]-5-(octyloxy)phenol.

[0254] The benzophenone-based ultraviolet absorbing material may include, e.g., 2-hydroxy-4-n-octoxybenzophenone.

[0255] Meanwhile, the display device may include a first barrier layer **521** overlapping the first outer area OA**1** and a second barrier layer **522** overlapping the second outer area OA**2**.

[0256] By disposing the first barrier layer **521** and the second barrier layer **522** in the first outer area OA**1** and the second outer area OA**2**, respectively, it is possible to prevent moisture from penetrating and prevent whitening of adhesive members.

[0257] Further, since the first barrier layer **521** and the second barrier layer **522** have a higher modulus than the adhesive member, evaporation of adhesives of the first outer area OA**1** and the second outer area OA**2** may be prevented.

[0258] The first barrier layer **521** and the second barrier layer **522** may include rubber or acrylic resin, but are not limited thereto.

[0259] The first barrier layer **521** and the second barrier layer **522** may have a water vapor transmission rate (WVTR) of 4.5 to 60 g/m.sup.3/day, but are not limited thereto.

[0260] In the disclosure, the water vapor transmission rate (WVTR) is a measure of the degree of water vapor passing through the barrier layers **521** and **522**.

[0261] The water vapor transmission rate decreases as the thickness of the barrier layers **521** and **522** increases, and increases as the temperature increases.

[0262] When the first barrier layer **521** and the second barrier layer **522** include rubber or acrylic resins, the water vapor transmission rate (WVTR) may be lowered to delay water penetration.

[0263] The storage modulus of the first barrier layer **521** and the second barrier layer **522** may be 8.43×10.sup.4 to 2.05×10.sup.6 Pa at −20° C., 3.93×10.sup.4 to 2.21×10.sup.5 Pa at 25° C., and 3.03×10.sup.4 to 1.73×10.sup.5 Pa at 60° C., but is not limited thereto.

[0264] In the disclosure, the storage modulus is a parameter indicating how elastically a material reacts to external stress.

[0265] The higher the storage modulus, the stronger resistance to external stress the material has.

[0266] In the first outer area OA**1** and the second outer area OA**2**, the black matrix **530** may be disposed on the first barrier layer **521** and the second barrier layer **522**, respectively.

[0267] When the black matrix **530** is disposed on the first barrier layer **521** and the second barrier layer **522**, ultraviolet rays UV incident from the cover glass **540** toward the display panel **510** may not pass through the black matrix **530**.

[0268] Meanwhile, the cover glass **540** may be positioned over the entire area on the black matrix **530** and the second adhesive member **512**.

[0269] A protective layer **550** may be disposed on the cover glass **540**.

[0270] The configuration commonly applied to FIGS. **5**A to **5**D has been described above.

[0271] Hereinafter, each drawing is described in detail.

[0272] Referring to FIG. **5**A, in the first non-folding area NFA**1**, the folding area FA and the second

non-folding area NFA**2**, the first adhesive member **511** may be disposed on the display panel **510**, and a third adhesive member **513** including an ultraviolet absorbing material may be included on the first adhesive member **511** in the first non-folding area NFA**1** and the second non-folding area NFA**2**.

[0273] In this case, the thickness h**2** of the second adhesive member **512** and the thickness h**3** of the third adhesive member **513** are not particularly limited, but it is preferable that the thickness h**2** of the second adhesive member **512** and the thickness h**3** of the third adhesive member **513** are the same.

[0274] Further, the sum h**1**+h**3** of the thickness of the first adhesive member **511** and the thickness of the third adhesive member **513** may be larger than the thickness hl of the first adhesive member **511**.

[0275] Further, the amounts of ultraviolet absorbing materials of the first adhesive member **511**, the second adhesive member **512**, and the third adhesive member **513** may be different.

[0276] Preferably, the mole percents of the ultraviolet absorbing materials of the first adhesive member **511** and the third adhesive member **513** may be larger than the mole percent of the ultraviolet absorbing material of the second adhesive member **512**. The mole percents of the ultraviolet absorbing materials of the first adhesive member **511** and the third adhesive member **513** may be the same.

[0277] More preferably, only the first adhesive member **511** and the third adhesive member **513** may include an ultraviolet absorbing material, and the second adhesive member **512** may not include an ultraviolet absorbing material.

[0278] In other words, the mole percent of the ultraviolet absorbing material of the second adhesive member **512** may be 0 mol %.

[0279] Meanwhile, referring to FIG. **5**A, the sum h**4** of the thicknesses of at least one of the first barrier layer **521** and the second barrier layer **522** and the black matrix **530** may be equal to or larger than the sum h**1**+h**2** of the thicknesses of the first adhesive member **511** and the second adhesive member **512**, or be preferably the same.

[0280] When the sum h**4** of the thicknesses of at least one of the first barrier layer **521** and the second barrier layer **522** and the black matrix **530** is equal to or larger than the sum h**1**+h**2** of the thicknesses of the first adhesive member **511** and the second adhesive member **512**, moisture penetration from the outside may be effectively blocked and evaporation of adhesives may be prevented.

[0281] FIG. **5**A has been described above in detail, and FIG. **5**B is described in detail below.

[0282] Referring to FIG. **5**B, a third adhesive member **513** may be included that is disposed on the display panel **510** in the first non-folding area NFA**1** and the second non-folding area NFA**2** and includes an ultraviolet absorbing material.

[0283] In this case, the thickness h**3** of the third adhesive member **513** is not particularly limited, but is preferably larger than the thickness hl of the first adhesive member **511**.

[0284] More preferably, the thickness h**3** of the third adhesive member **513** may be equal to the sum h**1**+h**2** of the thickness of the first adhesive member **511** and the thickness of the second adhesive member **512**.

[0285] Matters regarding the first barrier layer **521** and the second barrier layer **522** of FIG. **5**B may be substantially the same as those regarding the first barrier layer **521** and the second barrier layer **522** described with reference to FIG. **5**A.

[0286] Further, the amounts of ultraviolet absorbing materials of the first adhesive member **511**, the second adhesive member **512**, and the third adhesive member **513** may be different.

[0287] Preferably, the mole percents of the ultraviolet absorbing materials of the first adhesive member **511** and the third adhesive member **513** may be larger than the mole percent of the ultraviolet absorbing material of the second adhesive member **512**. The mole percents of the ultraviolet absorbing materials of the first adhesive member **511** and the third adhesive member **513**

may be the same.
[0288] More preferably, only the first adhesive member **511** and the third adhesive member **513** may include an ultraviolet absorbing material, and the second adhesive member **512** may not include an ultraviolet absorbing material.
[0289] In other words, the mole percent of the ultraviolet absorbing material of the second adhesive member **512** may be 0 mol %.
[0290] FIG. **5**B has been described above in detail, and FIGS. **5**C and **5**D are described below in detail.
[0291] Referring to FIGS. **5**C and **5**D, a first adhesive member **511** including a concave portion **560** overlapping the folding area FA and including an ultraviolet absorbing material may be positioned on the display panel **510**.
[0292] The concave portion **560** may include a flat portion FLT and an inclined portion SLO surrounding the flat portion FLT.
[0293] A second adhesive member **512** may be disposed in the concave portion **560** of the first adhesive member **511**.
[0294] Matters regarding the first barrier layer **521** and the second barrier layer **522** of FIGS. **5**C and **5**D may be substantially the same as those regarding the first barrier layer **521** and the second barrier layer **522** described with reference to FIG. **5**A.
[0295] The amounts of ultraviolet absorbing materials of the first adhesive member **511** and the second adhesive member **512** may be different.
[0296] Preferably, the mole percent of the ultraviolet absorbing material of the first adhesive member **511** may be larger than the mole percent of the ultraviolet absorbing material of the second adhesive member **512**.
[0297] More preferably, only the first adhesive member **511** may include an ultraviolet absorbing material, and the second adhesive member **512** may not include an ultraviolet absorbing material.
[0298] In other words, the mole percent of the ultraviolet absorbing material of the second adhesive member **512** may be 0 mol %.
[0299] The thickness h**2** of the second adhesive member **512** may be equal to a value obtained by subtracting the thickness h**1** of the first adhesive member **511** of the folding area FA from the thickness h**3** of the first adhesive member **511** of the area other than the folding area FA.
[0300] In other words, the depth of the concave portion **560** may be substantially the same as the thickness h**2** of the second adhesive member **512**.
[0301] The angle formed by the flat portion FLT and the inclined portion SLO is not particularly limited, but it is preferable that the angle formed by the flat portion FLT and the inclined portion SLO is a right angle as shown in FIG. **5**D.
[0302] Meanwhile, referring to FIGS. **5**C and **5**D, the sum h**4** of the thicknesses of at least one of the first barrier layer **521** and the second barrier layer **522** and the black matrix **530** may be equal to or larger than the sum h**1**+h**2** of the thicknesses of the first adhesive member **511** and the second adhesive member **512**, and be preferably the same. That is, the sum h**4** of thicknesses of at least one of the first barrier layer **521** and the second barrier layer **522** and the black matrix **530** may be equal to a thickness h**3** of the first adhesive member **511** in an area other than the folding area FA.
[0303] When the sum h**4** of the thicknesses of at least one of the first barrier layer **521** and the second barrier layer **522** and the black matrix **530** is equal to or larger than the sum h**1**+h**2** of the thicknesses of the first adhesive member **511** and the second adhesive member **512**, moisture penetration from the outside may be effectively blocked and evaporation of adhesives may be prevented.
[0304] FIG. **6** is a graph illustrating changes in value depending on the presence or absence of a UV absorbing material of an adhesive member in a display device according to embodiments of the disclosure.
[0305] Referring to FIG. **6**, the graph differs between when the adhesive member does not include

an ultraviolet absorbing material (X) and when the adhesive member includes an ultraviolet absorbing material (Y).
[0306] Specifically, at less than −20° C., it is shown that the storage modulus is higher when the ultraviolet absorbing material is included (Y) than when the ultraviolet absorbing material is not included (X).
[0307] On the other hand, at −20° C. or higher, the storage modulus is higher when the ultraviolet absorbing material is not included (X) than when the ultraviolet absorbing material is included (Y).
[0308] Therefore, when the ultraviolet absorbing material is included (Y), folding is not easy because the storage modulus is high at −20° C. or lower, whereas folding is easy because the storage modulus is low at −20° C. or higher.
[0309] From FIG. **6**, it is possible to increase the reliability of the folding area in low-temperature and high-temperature environments by adjusting the thickness or content of the adhesive member including the ultraviolet absorbing material and the adhesive member not including the ultraviolet absorbing material.
[0310] FIGS. **7**A, **7**B, and **7**C are views schematically illustrating a process of forming a structure of a display device according to embodiments of the disclosure.
[0311] The display panel **510**, the first adhesive member **511**, the second adhesive member **512**, the third adhesive member **513**, the cover glass **540**, the first barrier layer **521**, the second barrier layer **522**, the black matrix **530**, and the protective layer **550** of FIGS. **7**A to **7**C may be substantially the same as the display panel **510**, the first adhesive member **511**, the second adhesive member **512**, the third adhesive member **513**, the cover glass **540**, the first barrier layer **521**, the second barrier layer **522**, the black matrix **530**, and the protective layer **550** described with reference to FIGS. **5**A to **5**D.
[0312] Referring to FIG. **7**A, the first adhesive member **511**, the second adhesive member **512**, the third adhesive member **513**, the first barrier layer **521**, the second barrier layer **522**, and the black matrix **530** may be positioned on the protective film **700**.
[0313] Then, referring to FIG. **7**B, the cover glass **540** may be disposed on the black matrix **530**, the second adhesive member **512**, and the third adhesive member **513**, and the protective layer **550** may be disposed on the cover glass **540**.
[0314] The adhesive force between the second adhesive member **512** and the third adhesive member **513** and the cover glass **540** may be increased by exposure ultraviolet rays UV incident from the cover glass **540** to the first adhesive member **511**.
[0315] In this case, the second adhesive member **512** has a lower mole percent of the ultraviolet absorbing material than the third adhesive member **513**, and thus the adhesive force between the second adhesive member **512** and the cover glass **540** may be higher than the adhesive force between the third adhesive member **513** and the cover glass **540** due to UV exposure.
[0316] Then, referring to FIG. **7**C, after removing the protective film **700** of FIG. **7**B, the display panel **510** may be disposed at the place where the protective film **700** was positioned.
[0317] Embodiments of the disclosure described above are briefly described below.
[0318] A display device according to embodiments of the disclosure may comprise a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area, a plurality of light emitting elements disposed on the substrate, an encapsulation layer disposed on the plurality of light emitting elements, a color filter layer disposed on the encapsulation layer, a first adhesive member positioned on the color filter layer, disposed in the folding area, and including an ultraviolet absorbing material of a first mole percent, and a second adhesive member disposed on the first adhesive member in the folding area and including the ultraviolet absorbing material of a second mole percent smaller than the first mole percent.
[0319] In the display device according to embodiments of the disclosure, the second mol percent may be 0 mol %.

[0320] In the display device according to embodiments of the disclosure, the first adhesive member may be further disposed on the color filter layer in the first non-folding area and the second non-folding area. A third adhesive member including an ultraviolet absorbing material of a third mole percent may be further included on the first adhesive member in the first non-folding area and the second non-folding area.
[0321] In the display device according to embodiments of the disclosure, a thickness of the second adhesive member may be identical to a thickness of the third adhesive member.
[0322] The display device according to embodiments of the disclosure may further comprise a third adhesive member positioned on the color filter layer, disposed in the first non-folding area and the second non-folding area, and including an ultraviolet absorbing material of a third mole percent.
[0323] In the display device according to embodiments of the disclosure, a thickness of the third adhesive member may be larger than a thickness of the first adhesive member.
[0324] In the display device according to embodiments of the disclosure, the thickness of the third adhesive member may be equal to a sum of the thickness of the first adhesive member and the thickness of the second adhesive member.
[0325] In the display device according to embodiments of the disclosure, the third mole percent may be larger than the second mole percent.
[0326] In the display device according to embodiments of the disclosure, the first mole percent and the third mole percent may be the same.
[0327] In the display device according to embodiments of the disclosure, the ultraviolet absorbing material may include at least one of benzotriazole, triazin, and benzophenone.
[0328] In the display device according to embodiments of the disclosure, the substrate may further include a first outer area adjacent to the first non-folding area and a second outer area adjacent to the second non-folding area. The display device may further comprise a first barrier layer overlapping the first outer area and a second barrier layer overlapping the second outer area.
[0329] In the display device according to embodiments of the disclosure, a black matrix may be positioned on the first barrier layer and the second barrier layer. A sum of thicknesses of at least one of the first barrier layer and the second barrier layer and the black matrix may be equal to a sum of thicknesses of the first adhesive member and the second adhesive member.
[0330] A display device according to embodiments of the disclosure may comprise a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area, a plurality of light emitting elements disposed on the substrate, an encapsulation layer disposed on the plurality of light emitting elements, a color filter layer disposed on the encapsulation layer, a first adhesive member positioned on the color filter layer, including a concave portion including a flat portion and an inclined portion surrounding the flat portion and overlapping the folding area, and including an ultraviolet absorbing material of a first mole percent, and a second adhesive member positioned in the concave portion of the first adhesive member, and including the ultraviolet absorbing material of a second mole percent smaller than the first mole percent.
[0331] In the display device according to embodiments of the disclosure, the second mol percent may be 0 mol %.
[0332] In the display device according to embodiments of the disclosure, a depth of the concave portion may be equal to a thickness of the second adhesive member.
[0333] In the display device according to embodiments of the disclosure, the ultraviolet absorbing material may include at least one of benzotriazole, triazin, and benzophenone.
[0334] In the display device according to embodiments of the disclosure, a thickness of the second adhesive member may be equal to a value obtained by subtracting a thickness of the first adhesive member of the folding area from a thickness of the first adhesive member of an area other than the folding area.
[0335] In the display device according to embodiments of the disclosure, a right angle may be

formed by the inclined portion and the flat portion.
[0336] In the display device according to embodiments of the disclosure, the substrate may further include a first outer area adjacent to the first non-folding area and a second outer area adjacent to the second non-folding area. The display device may further comprise a first barrier layer overlapping the first outer area and a second barrier layer overlapping the second outer area.
[0337] In the display device according to embodiments of the disclosure, a black matrix may be positioned on the first barrier layer and the second barrier layer. A sum of thicknesses of at least one of the first barrier layer and the second barrier layer and the black matrix may be equal to a thickness of the first adhesive member in an area other than the folding area.
[0338] A display device according to embodiments of the disclosure may comprise a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area, a plurality of light emitting elements disposed on the substrate, an encapsulation layer disposed on the plurality of light emitting elements, a color filter layer disposed on the encapsulation layer, and an adhesive member disposed on the color filter layer, disposed in the folding area, and including a first portion adjacent to the color filter layer and a second portion on the first portion, wherein an ultraviolet absorption rate of the first portion is larger than an ultraviolet absorption rate of the second portion.
[0339] The above description has been presented to enable any person skilled in the art to make and use the technical idea of the disclosure, and has been provided in the context of a particular application and its requirements. Various modifications, additions and substitutions to the described embodiments will be readily apparent to those skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the disclosure. The above description and the accompanying drawings provide an example of the technical idea of the disclosure for illustrative purposes only. That is, the disclosed embodiments are intended to illustrate the scope of the technical idea of the disclosure.
[0340] The various embodiments described above can be combined to provide further embodiments. Aspects of the embodiments can be modified, if necessary to employ concepts of the various patents, applications and publications to provide yet further embodiments.
[0341] These and other changes can be made to the embodiments in light of the above-detailed description. In general, in the following claims, the terms used should not be construed to limit the claims to the specific embodiments disclosed in the specification and the claims, but should be construed to include all possible embodiments along with the full scope of equivalents to which such claims are entitled. Accordingly, the claims are not limited by the disclosure.

Claims

1. A display device, comprising: a substrate including a first non-folding area, a second non-folding area, and a folding area between the first non-folding area and the second non-folding area; a plurality of light emitting elements disposed on the substrate; an encapsulation layer disposed on the plurality of light emitting elements; a color filter layer disposed on the encapsulation layer; a first adhesive member positioned on the color filter layer, the first adhesive member disposed in the folding area and including a first ultraviolet absorbing material of a first mole percent; and a second adhesive member disposed on the first adhesive member, the second adhesive member disposed in the folding area and including a second ultraviolet absorbing material of a second mole percent less than the first mole percent.
2. The display device of claim 1, wherein the second mole percent is 0 mol %.
3. The display device of claim 1, wherein the first adhesive member is further disposed on the color filter layer in the first non-folding area and the second non-folding area, the display device further comprising: a third adhesive member including a third ultraviolet absorbing material of a third mole percent, the third adhesive member disposed on the first adhesive member in the first non-

folding area and the second non-folding area.
4. The display device of claim 3, wherein a thickness of the second adhesive member is equal to a thickness of the third adhesive member.
5. The display device of claim 1, further comprising: a third adhesive member positioned on the color filter layer, the third adhesive member disposed in the first non-folding area and the second non-folding area, and the third adhesive member including a third ultraviolet absorbing material of a third mole percent.
6. The display device of claim 5, wherein a thickness of the third adhesive member is greater than a thickness of the first adhesive member.
7. The display device of claim 6, wherein the thickness of the third adhesive member is equal to a sum of the thickness of the first adhesive member and a thickness of the second adhesive member.
8. The display device of claim 3, wherein the third mole percent is larger than the second mole percent.
9. The display device of claim 8, wherein the first mole percent and the third mole percent are equal.
10. The display device of claim 1, wherein at least one of the first ultraviolet absorbing material and the second ultraviolet absorbing material includes one or more of benzotriazole, triazin, and benzophenone.
11. The display device of claim 1, wherein the substrate further includes a first outer area adjacent to the first non-folding area and a second outer area adjacent to the second non-folding area, the display device further comprising: a first barrier layer overlapping the first outer area; and a second barrier layer overlapping the second outer area.
12. The display device of claim 11, further comprising: a black matrix positioned on the first barrier layer and the second barrier layer, wherein a sum of a thickness of at least one of the first barrier layer and the second barrier layer and a thickness of the black matrix is equal to a sum of a thickness of the first adhesive member and a thickness of the second adhesive member.
13. A display device, comprising: a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area; a plurality of light emitting elements disposed on the substrate; an encapsulation layer disposed on the plurality of light emitting elements; a color filter layer disposed on the encapsulation layer; a first adhesive member positioned on the color filter layer, the first adhesive member including a concave portion overlapping the folding area and a first ultraviolet absorbing material of a first mole percent, wherein the concave portion includes a flat portion and an inclined portion surrounding the flat portion; and a second adhesive member positioned in the concave portion of the first adhesive member, the second adhesive member including a second ultraviolet absorbing material of a second mole percent less than the first mole percent.
14. The display device of claim 13, wherein the second mole percent is 0 mol %.
15. The display device of claim 13, wherein a depth of the concave portion is equal to a thickness of the second adhesive member.
16. The display device of claim 13, wherein the first ultraviolet absorbing material or the second ultraviolet absorbing material includes at least one of benzotriazole, triazin, and benzophenone.
17. The display device of claim 13, wherein a thickness of the second adhesive member is equal to a value obtained by subtracting a thickness of the first adhesive member in the folding area from a thickness of the first adhesive member of an area excluding the folding area.
18. The display device of claim 13, wherein the inclined portion is perpendicular to the flat portion.
19. The display device of claim 13, wherein the substrate further includes a first outer area adjacent to the first non-folding area and a second outer area adjacent to the second non-folding area, the display device further comprising: a first barrier layer overlapping the first outer area; and a second barrier layer overlapping the second outer area.
20. The display device of claim 19, further comprising: a black matrix positioned on the first

barrier layer and the second barrier layer, wherein a sum of thicknesses of at least one of the first barrier layer and the second barrier layer and the black matrix is equal to a thickness of the first adhesive member in an area other than the folding area.

21. A display device, comprising: a substrate including a first non-folding area, a second non-folding area, and a folding area positioned between the first non-folding area and the second non-folding area; a plurality of light emitting elements disposed on the substrate; an encapsulation layer disposed on the plurality of light emitting elements; a color filter layer disposed on the encapsulation layer; and an adhesive member disposed on the color filter layer in the folding area, the adhesive member including a first portion adjacent to the color filter layer and a second portion on the first portion, wherein an ultraviolet absorption rate of the first portion is greater than an ultraviolet absorption rate of the second portion.