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(54) **DISPLAY APPARATUS AND METHOD OF MANUFACTURING DISPLAY APPARATUS THEREOF**

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(57) **ABSTRACT**

Provided is a method of manufacturing display apparatus including processing side surfaces of a plurality of display modules, each of the plurality of display modules including a plurality of micro light emitting diodes (LEDs) provided in pixels on an upper surface of each of the plurality of display modules, and providing the plurality of processed display modules such that the pixels of the plurality of processed display modules are provided at a same interval, respectively, wherein each of the plurality of display modules has a rectangular shape, and wherein the processing the side surfaces of the plurality of display modules includes processing a first side surface of each of the plurality of display modules and a second side surface of each of the plurality of display modules that are adjacent to the first side surface.

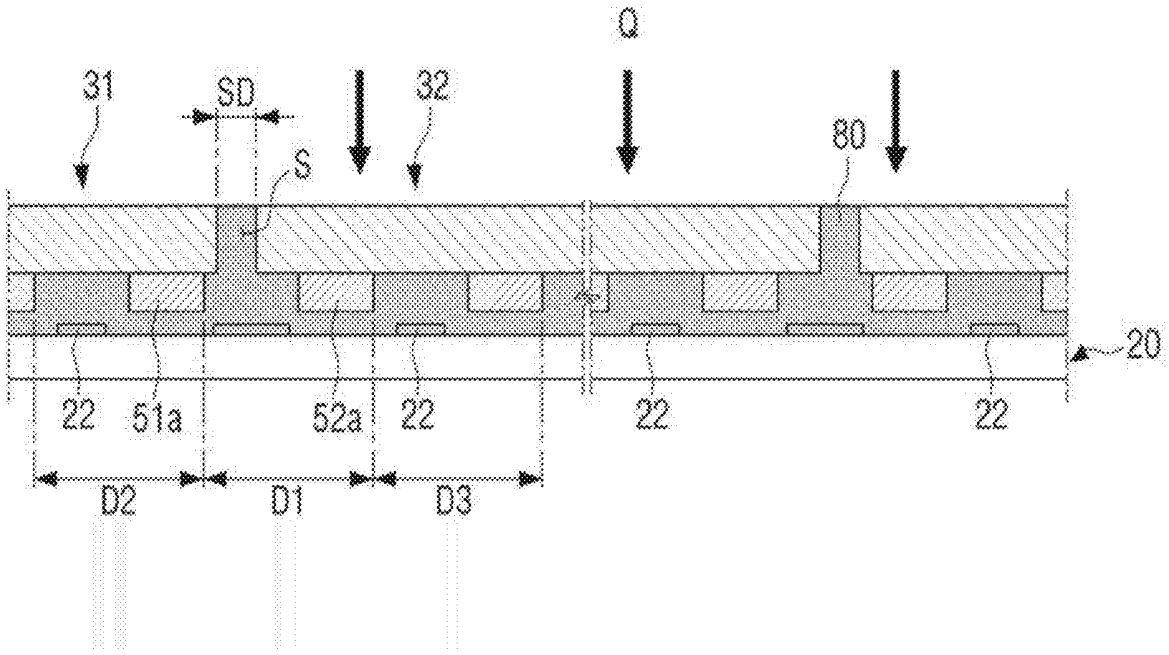


FIG. 1

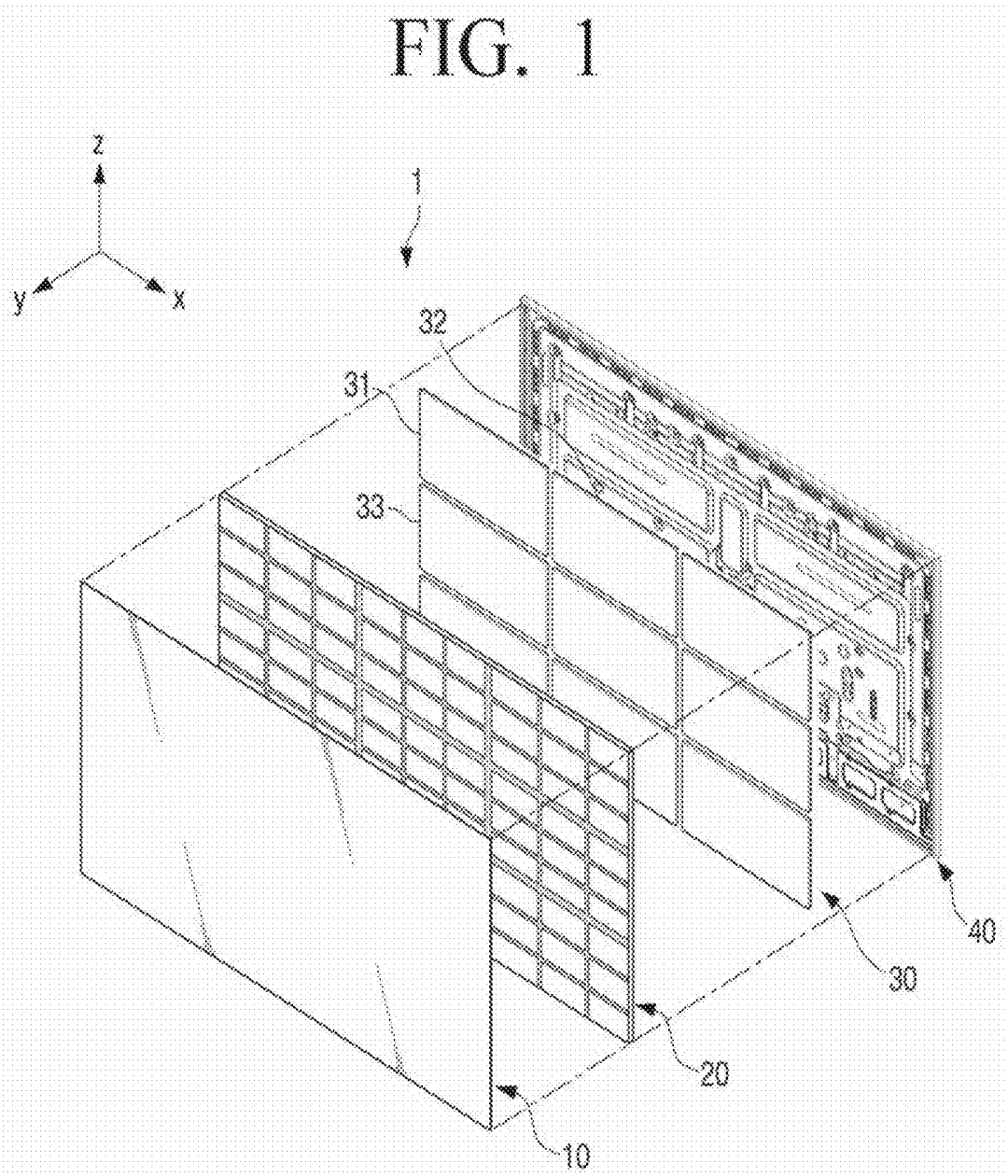


FIG. 2

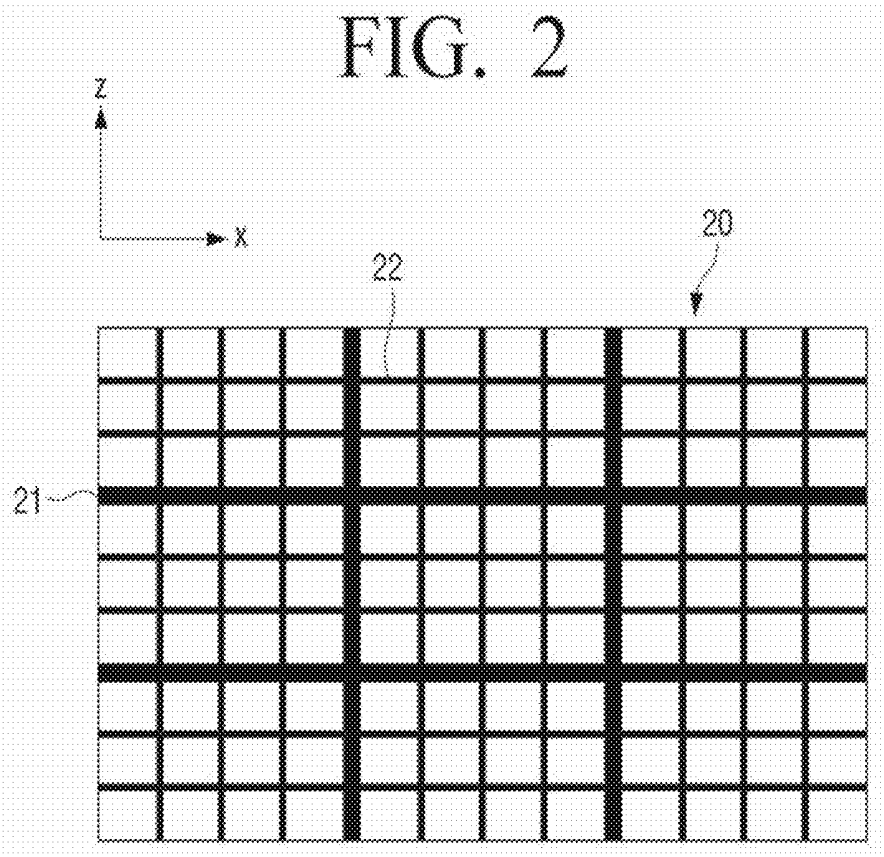


FIG. 3

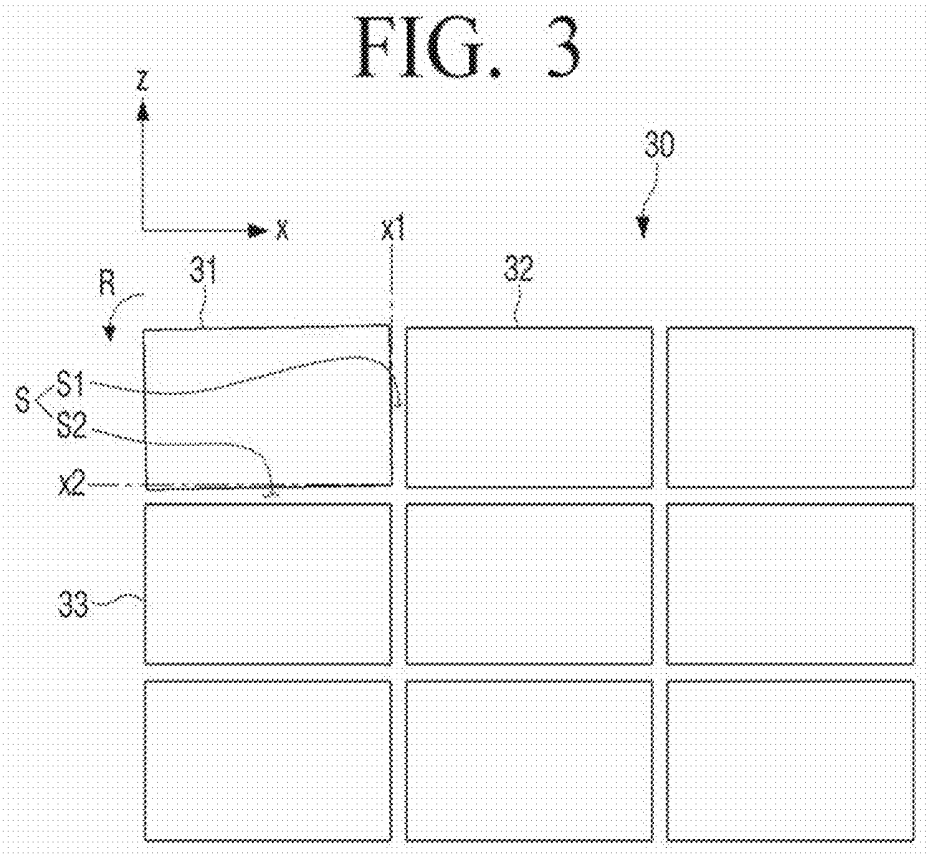


FIG. 4A

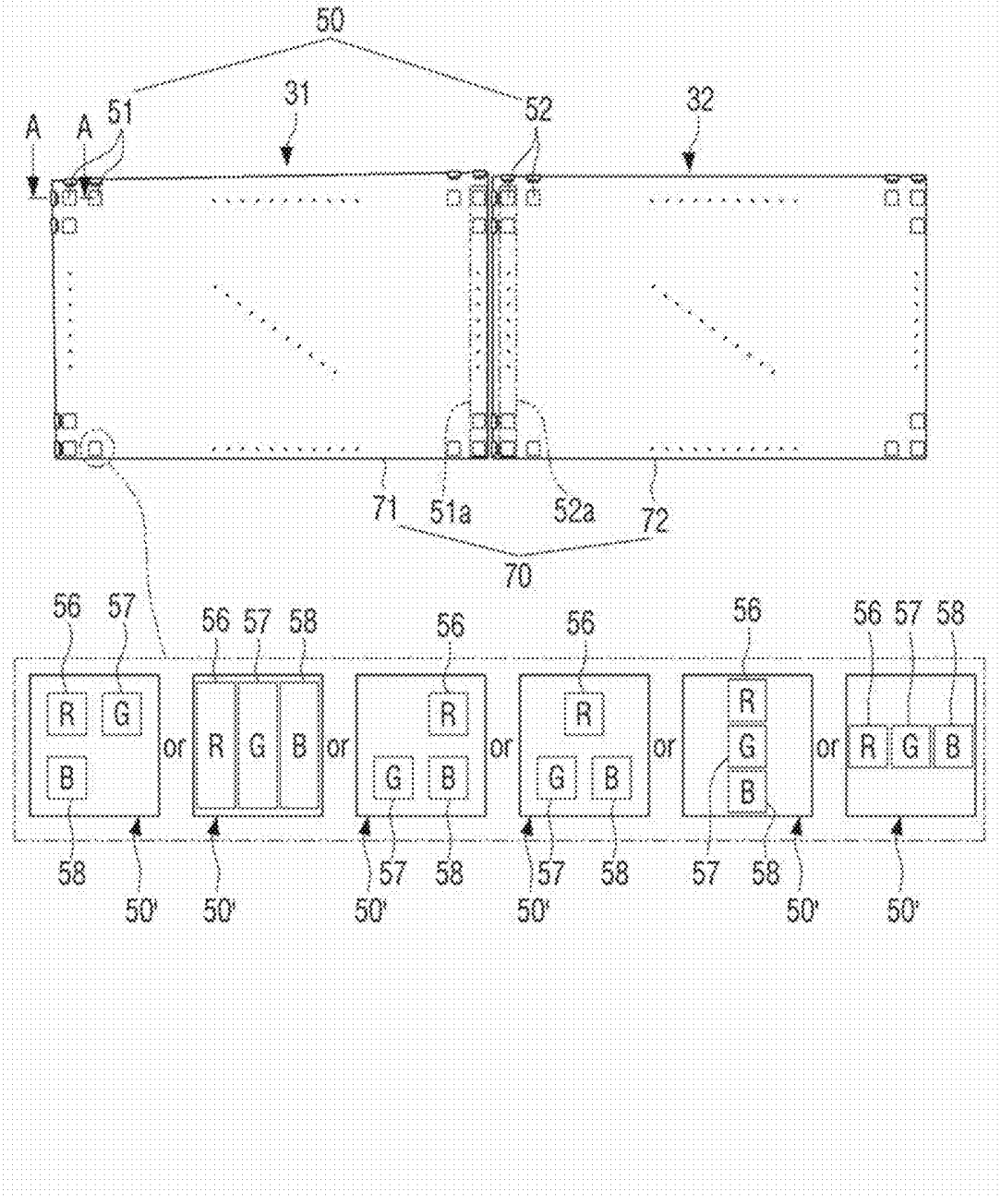


FIG. 4B

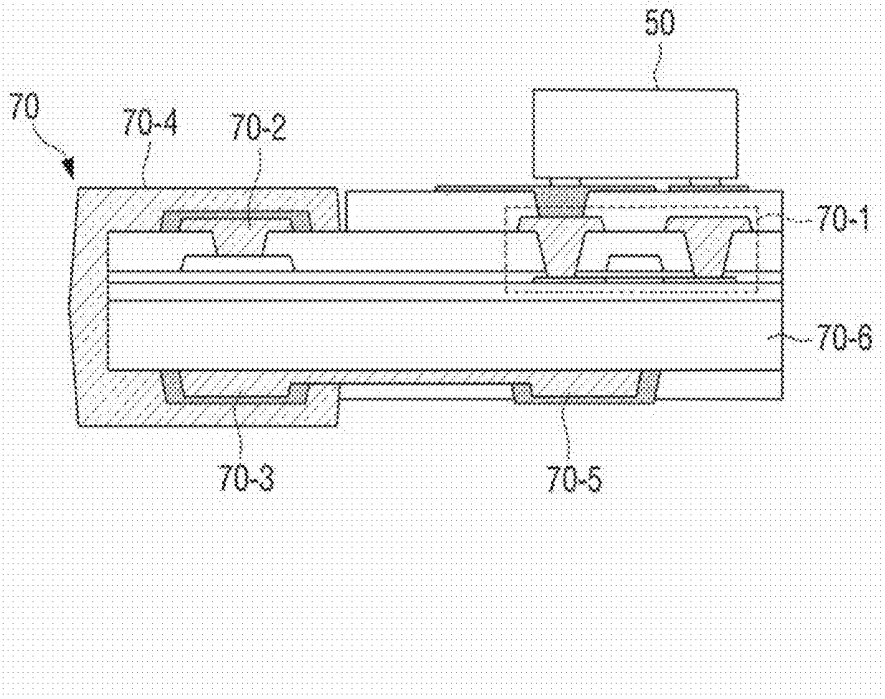


FIG. 4C

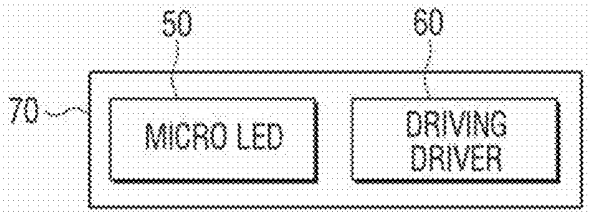


FIG. 5

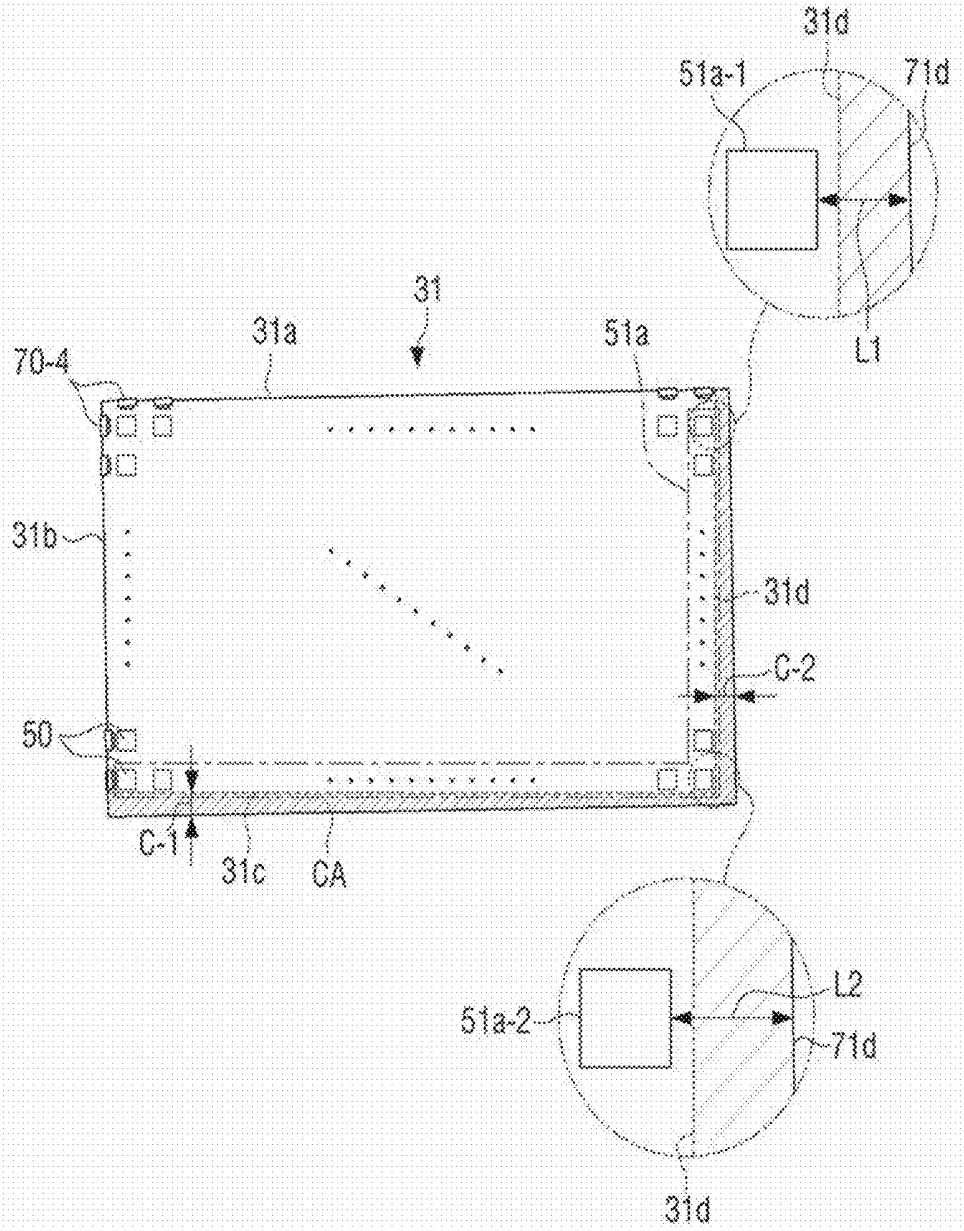

31d
51a-1
71d
L1
31
31a
51a
70-4
31b
31d
C-2
50
C-1
31c
CA
L2
51a-2
71d
31d

FIG. 6

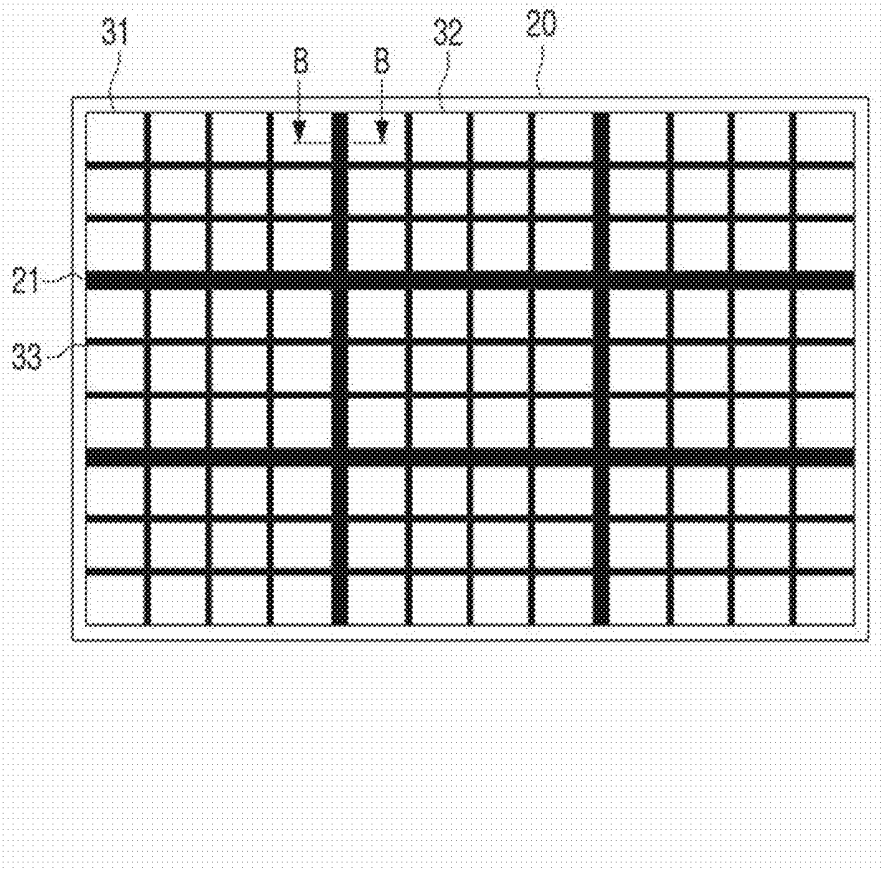


FIG. 7

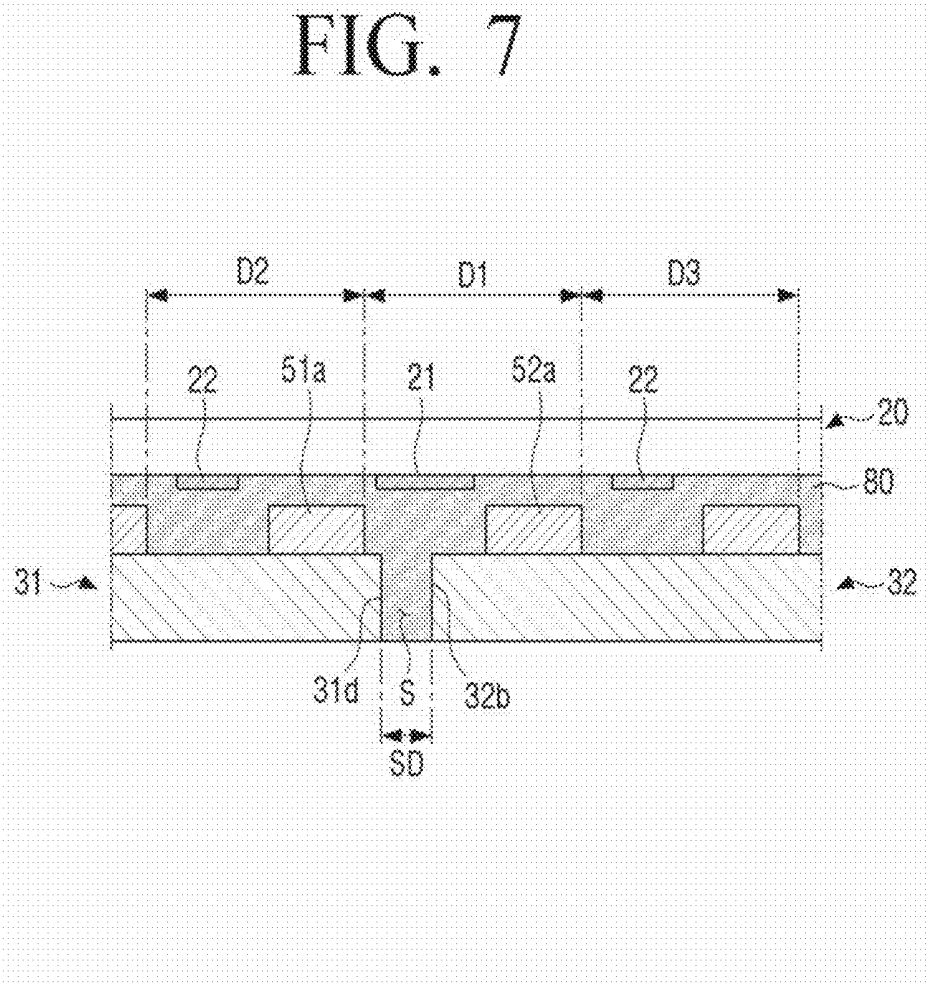


FIG. 8A

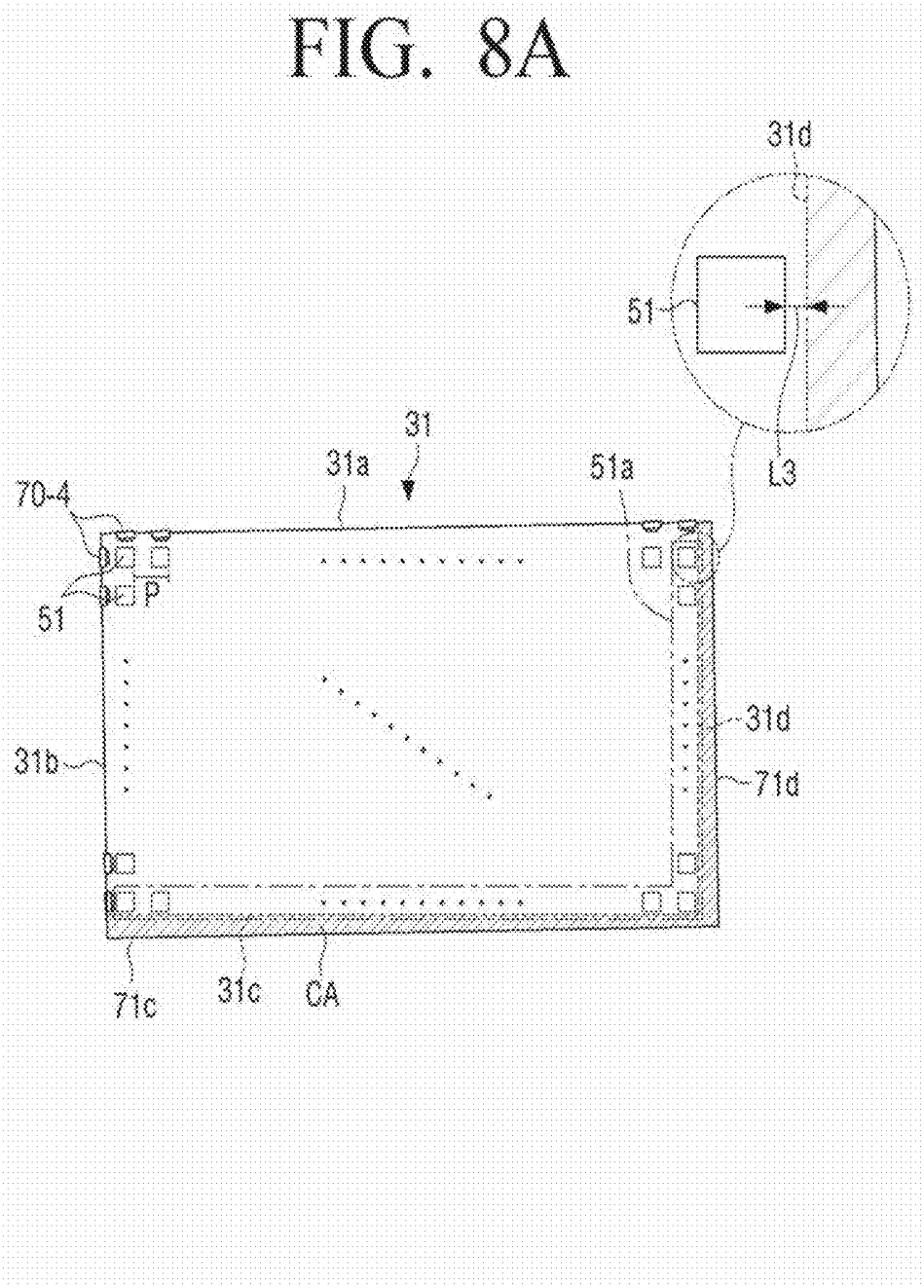


FIG. 8B

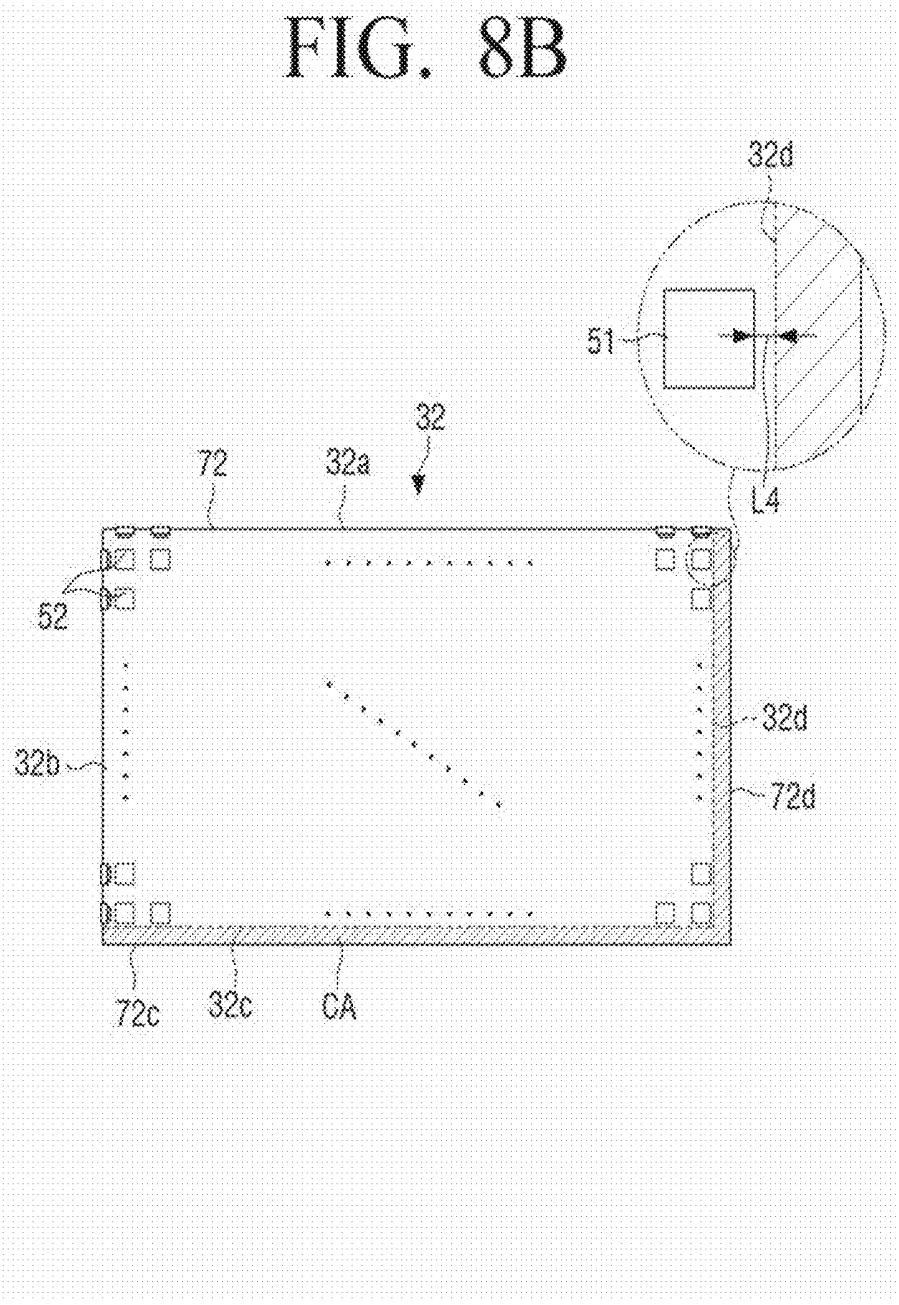


FIG. 9A

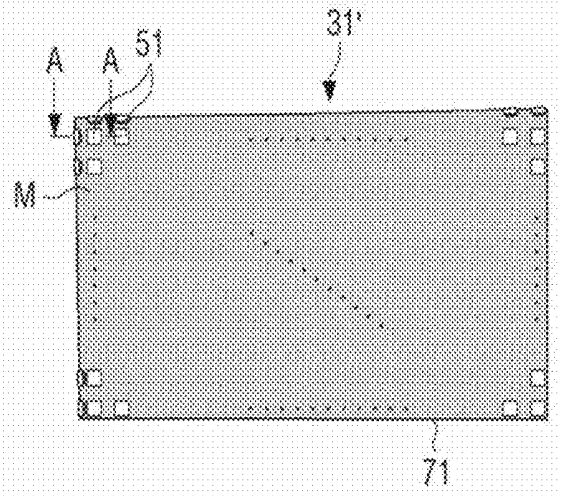


FIG. 9B

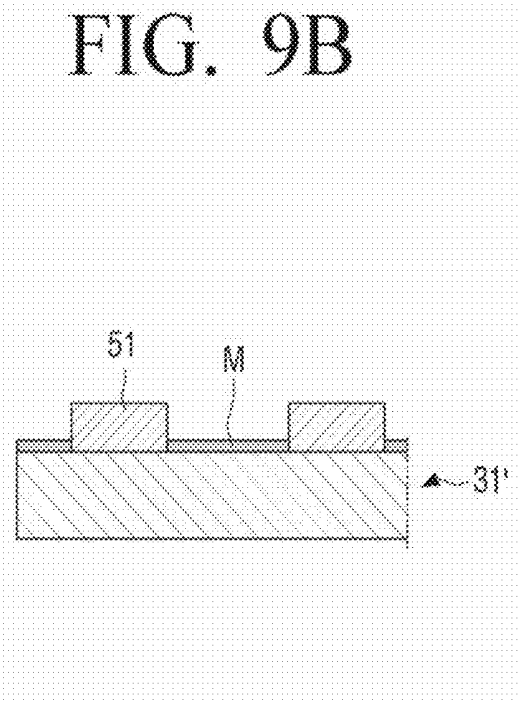


FIG. 10

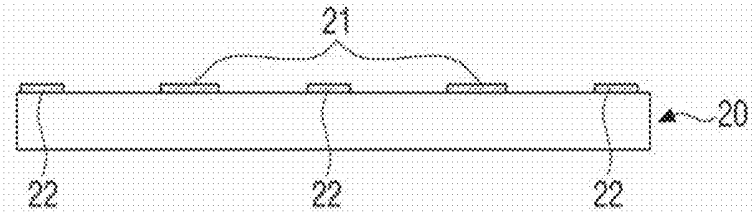


FIG. 11

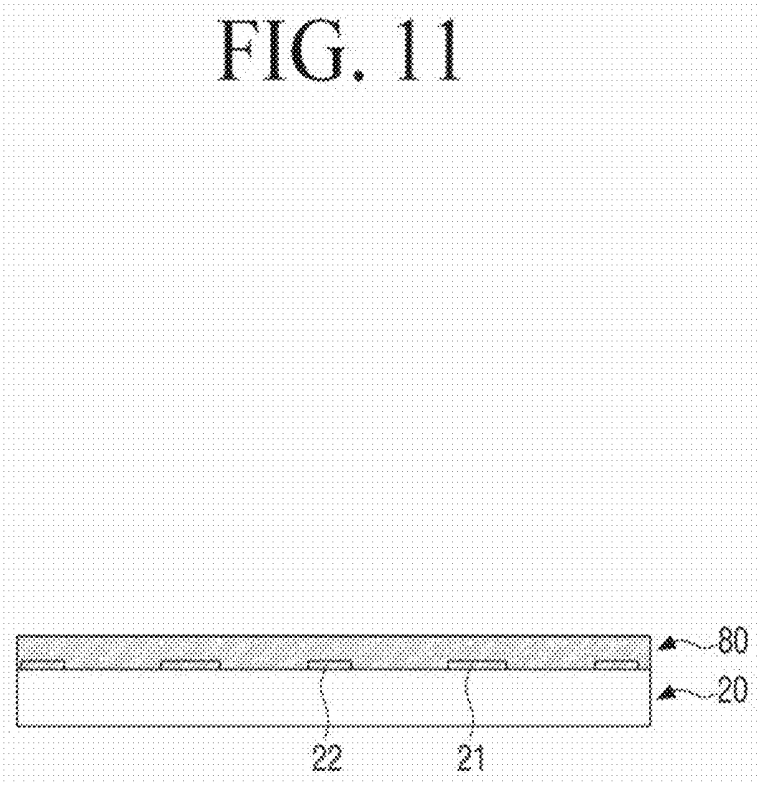


FIG. 12

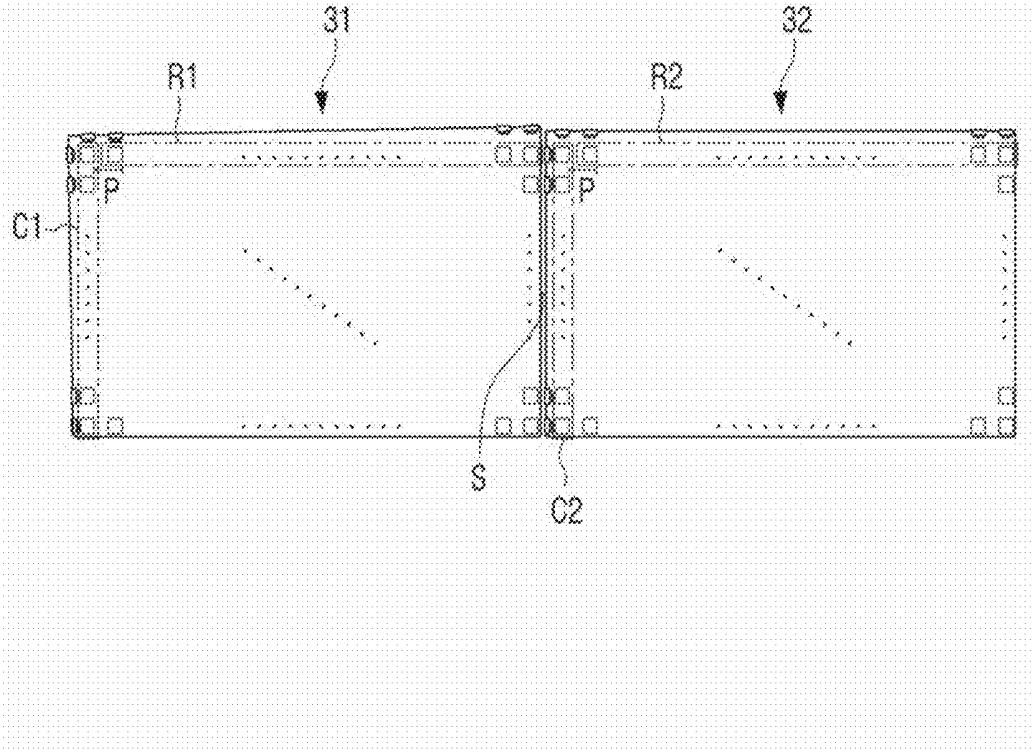


FIG. 13

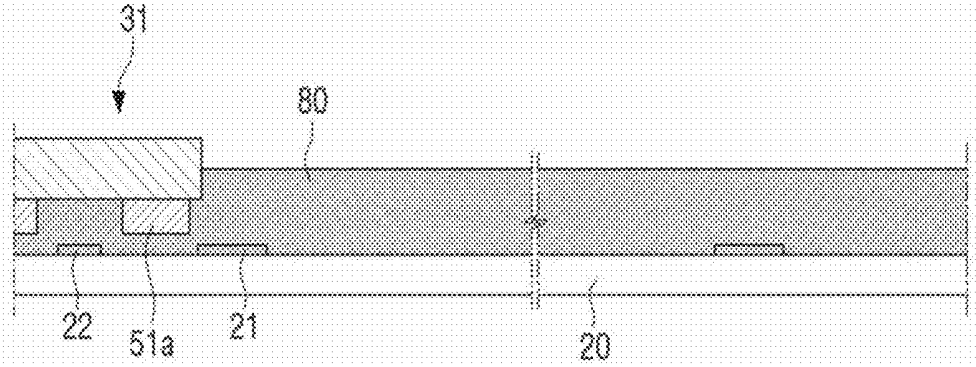
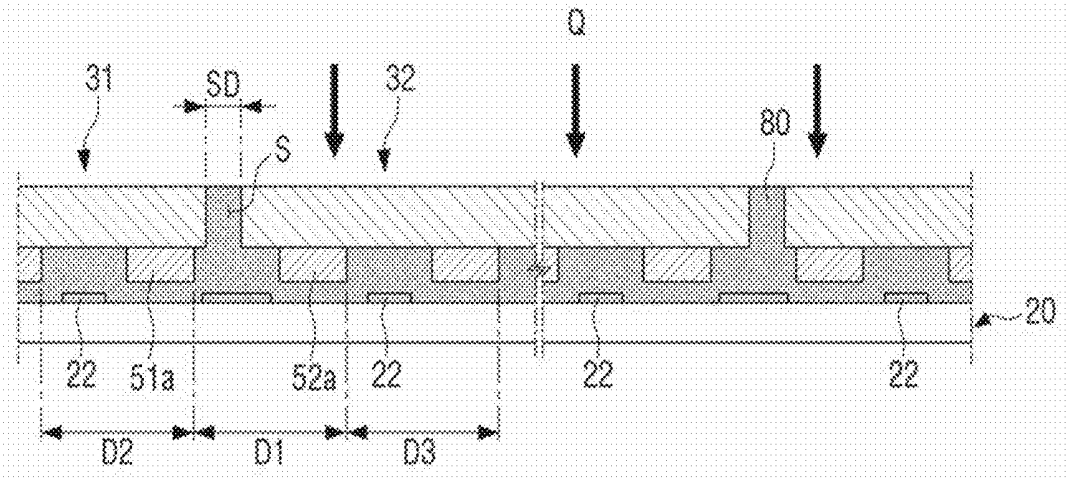


FIG. 14



DISPLAY APPARATUS AND METHOD OF MANUFACTURING DISPLAY APPARATUS THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is based on and claims priority under 35 U.S.C. § 119 to Korean Patent Application No. 10-2019-0001769, filed on Jan. 7, 2019 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

1. Field

[0002] The disclosure relates to a display apparatus with improved luminance uniformity and reduced manufacturing costs, and a manufacturing method thereof.

2. Description of the Related Art

[0003] A micro LED is formed of an ultra-small inorganic luminous material, and can emit light by itself to display an image. The micro LED refers to an ultra-small LED having a length of one tenth and an area of one hundredth compared to a general light emitting diode (LED) chip, and a width, length and height of 10 to 100 micrometers (μm).

[0004] A display screen of a display apparatus may be implemented by arranging a plurality of display modules having a plurality of micro LEDs arranged thereon, respectively. However, interval spaces between the plurality of display modules need to be minimized to realize uniform luminance of the display screen and to minimize seams between the plurality of display modules, and the plurality of display modules need to be arranged in order for spacing between the plurality of micro LEDs implementing the display screen to be same.

[0005] However, when the plurality of display modules are arranged based on physical matching, there has been a problem, due to manufacturing tolerances, that the space between the plurality of micro LEDs is not constant so that uniform luminance is not realized and a seam is recognized on the display screen.

SUMMARY

[0006] Provided are a display device with improved luminance uniformity and reduced manufacturing costs, and a manufacturing method thereof.

[0007] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description, or may be learned by practice of the presented embodiments.

[0008] In accordance with an aspect of the disclosure, provided is a method of manufacturing display apparatus including processing side surfaces of a plurality of display modules, each of the plurality of display modules including a plurality of micro light emitting diodes (LEDs) provided in pixels on an upper surface of each of the plurality of display modules, and providing the plurality of processed display modules such that the pixels of the plurality of processed display modules are provided at a same interval, respectively, wherein each of the plurality of display modules has a rectangular shape, and wherein the processing the side surfaces of the plurality of display modules includes processing a first side surface of each of the plurality of display modules and a second side surface of each of the plurality of display modules that are adjacent to the first side surface.

[0009] The processing the side surfaces of the plurality of display modules may include processing at least two display modules of the plurarlity of display modules such that at least two or more display modules of the plurality of display modules have different surface areas.

[0010] The method may further include forming an adhesive layer on one surface of a transparent cover, wherein the providing the plurality of processed display modules includes providing the first processed display module and the sescond processed display module on the transparent cover, respectively, such that intervals between a plurality of first edge micro LEDs provided on one side surface of the first processed display module among the plurality of processed display module are equal to intervals between a plurality of second edge micro LEDs provided on one side surface of the second processed display module that are provided adjacent to one side surface of the first processed display module, and providing the plurality of processed display modules on a transparent cover formed with the adhesive layer.

[0011] The processing may further include processing a side surface of the first display module such that a distance between the plurality of first edge micro LEDs and one side surface of the first display module is smaller than a distance between each of the plurality of micro LEDs.

[0012] The processing the side surfaces of the plurality of display modules may further include processing the side surface of the first display module such that the processed side surface of the first display module is parallel to at least one of rows and columns of the plurality of first micro LEDs provided on the first display module.

[0013] The providing the plurality of processed display modules may further include providing the first processed display module and the sescond processed display module on the transparent cover such that the first processed display module and the second processed display module are provided with an interval space between the first processed display module and the second processed display module.

[0014] The transparent cover may include a covering formed in the form of a lattice and configured to absorb external light, and the providing the plurality of processed display modules may further include providing the first processed display module and the second processed display module on the transparent cover such that the interval space is covered by the covering.

[0015] The providing the plurality of processed display modules may further include providing the first processed display module and the second processed display module on the transparent cover such that rows and columns of the plurality of the first micro LEDs provided on the first processed display module are parallel to rows and columns of the plurality of second micro LEDs provided on the second processed display module, respectively.

[0016] The providing the plurality of processed display modules may further include providing the first processed display module and the second processed display module on the transparent cover such that the rows of the first processed display module and the rows of the second processed display module are collinear.

[0017] The providing the plurality of processed display modules may further include providing the first processed

display module and the second processed display module on the transparent cover such that the columns of the first processed display module and the columns of the second processed display module are collinear.

[0018] The method may further include forming side wirings on two sides of the plurality of processed display modules, respectively, other than the first side surface and the second side surface of the plurality of processed display modules.

[0019] The method may further include compressing thermally the plurality of processed display modules, and filling the adhesive layer in the interval space.

[0020] In accordance with another aspect of the disclosure, provided is a display apparatus including a plurality of display modules in which a plurality of a micro light emitting diodes (LEDs) are provided in pixels, respectively, and a transparent cover provided to face the plurality of micro LEDs on an upper part of the plurality of display modules, wherein each of the plurality of display modules include a thin film transistor substrate electrically connected to the plurality of micro LEDs, each of the plurality of display modules including a glass substrate and a plurality of thin film transistors provided on an upper surface of the glass substrate, and a driving driver provided on a surface of the glass substrate and configured to drive the plurality of micro LEDs, and wherein at least two or more display modules of the plurality of display modules have different surface areas.

[0021] A shortest distance between a first edge micro LED provided on one side surface of a plurality of first micro LEDs provided on a first processed display module among the plurality of processed display modules and a side surface of the first processed display module adjacent to the first edge micro LED may be different, and wherein the first processed display module and the second processed display module provided adjacent to the first processed display module may be provided such that an interval between the first edge micro LED of the first processed display module and the second edge micro LED provided one side surface of a plurality of second micro LEDs of the second processed display module is regular.

[0022] The plurality of processed display modules have a rectangular shape, respectively, wherein the first processed display module may include a first side surface, a second side surface adjacent to the first side surface, a first processed surface facing the first side surface, and a second processed surface facing the second side surface and adjacent to the first processed surface, and wherein the first processed surface and the second processed surface are covered by a covering.

[0023] The first processed surface may be parallel to rows of the plurality of first micro LEDs.

[0024] The first processed surface may be parallel to columns of the plurality of first micro LEDs.

[0025] The plurality of micro LEDs may include a red micro LED configured to emit red light, a green micro LED configured to emit green light, and a blue micro LED configured to emit blue light, and wherein the red micro LED, the green micro LED and the blue micro LED are included in one pixel.

[0026] The display apparatus may further include an adhesive layer provided between the plurality of display modules and the transparent cover, and configured to fix the plurality of display modules on the transparent cover.

[0027] The transparent cover may further include an additional covering that covers space between the plurality of micro LEDs

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above and other aspects, features, and advantages of certain embodiments of the present disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

[0029] FIG. **1** is an exploded perspective view illustrating a display apparatus according to an embodiment;

[0030] FIG. **2** is a top view illustrating a transparent cover according to an embodiment;

[0031] FIG. **3** is a top view illustrating a plurality of display modules according to an embodiment;

[0032] FIG. **4**A is a top view illustrating a first and second processed display modules according an embodiment;

[0033] FIG. **4**B is a cross section view taken along line A-A of FIG. **4**;

[0034] FIG. **4**C is a block diagram illustrating an operation of a display module according to an embodiment;

[0035] FIG. **5** is a top view illustrating a processing area of a first processed display module according to an embodiment;

[0036] FIG. **6** is a top view illustrating that a plurality of display modules are disposed on a transparent cover according to an embodiment;

[0037] FIG. **7** is a cross section view taken along line B-B of FIG. **6**;

[0038] FIG. **8**A is a top view illustrating a process of processing of a first display module according to an embodiment;

[0039] FIG. **8**B is a top view illustrating a process of processing of a second display module according to an embodiment;

[0040] FIG. **9**A is a top view illustrating a first processed display module according to a modified embodiment;

[0041] FIG. **9**B is a cross section view taken along line F-F of FIG. **9**A; and

[0042] FIGS. **10** to **14** are schematic diagrams illustrating a process of arranging a plurality of processed display modules.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0043] Exemplary embodiments of the present disclosure will now be described in greater detail with reference to the accompanying drawings. However, the disclosure is not limited to embodiments disclosed below and may be implemented in various forms, and various changes may be made. However, descriptions of the embodiments are provided to make the disclosure complete, and to fully inform the scope of the disclosure to those skilled in the art. Components in the accompanying drawings are described to be larger than actual sizes for convenience of description, and the ratio of each component may be exaggerated or reduced.

[0044] When a component is described as being "on" or "adjacent to" another component, it may be directly in contact with or connected to another component, but it should be understood that there may be another component in between them. On the other hand, when a component is described as being "directly on" or "directly adjacent to" another component, it may be understood that there may not

be another component in between them. Other expressions describing relationship between the components, such as "between" and "directly between", and the like, may be interpreted in the same way.

[0045] When components are described as provided at a "same interval/height", it may be understood that the components are provided with similar interval/height within the tolerance range.

[0046] The terms such as "first," "second," and so on may be used to describe a variety of elements, but the elements should not be limited by these terms. The terms are only used to differentiate one component from other components. For example, the "first" component may be named the "second" component, and vice versa, without departing from the scope of the present disclosure.

[0047] The expression such as "comprise" or "have" as used herein is intended to designate existence of a characteristic, number, step, operation, element, part or a combination thereof as specified in the description, and should not be construed as foreclosing possible existence or addition of one or more of the other characteristics, numbers, steps, operations, elements, parts or a combination thereof.

[0048] Unless terms used in the embodiments of the disclosure are defined differently, it may be interpreted as meanings commonly known to those skilled in the art. For example, the terms such as "space" or "interval" may be used to describe a distance between two objects. On the other hand, the term "interval space" as used herein is intended to describe an interval between the plurality of processed display modules **30**.

[0049] Hereinafter, a configuration of a display apparatus **1** according to an embodiment will be described in detail with reference to FIGS. **1** to **3**.

[0050] FIG. **1** is an exploded perspective view illustrating a display apparatus **1** according to an embodiment, FIG. **2** is a top view illustrating a transparent cover **20** according to an embodiment, and FIG. **3** is a top view illustrating a plurality of display modules **30** according to an embodiment.

[0051] FIG. **1** is an exploded perspective view illustrating the display apparatus **1** according to an embodiment.

[0052] A display apparatus **1** described below is a device capable of processing an image signal received from the outside and visually displaying the processed image, and may be implemented in various forms such as a television, a monitor, a portable multimedia device, a portable communication device, and the like, and if it is a device displaying an image visually, the form thereof is not limited.

[0053] As shown in FIG. **1**, the display apparatus **1** may include a protective plate **10**, a transparent cover **20**, a plurality of processed display modules **30**, and a housing **40**.

[0054] The display module according to an embodiment of the disclosure may be applied to an electronic product or an electronic device that requires a wearable device, a portable device, a handheld device, or various displays, in a single unit. The display module can also be applied to a display device such as a monitor for a personal computer, a TV and digital signage, an electronic display through a plurality of assembly arrangements.

[0055] Herein, processing may include various mechanical and chemical processes such as cutting, polishing, etching, or the like.

[0056] In addition, a processed display module **30** may refer to a display module that has been processed. A protection plate **10** may be disposed on a front surface (Y-axis direction) of the display apparatus **1** and configured to protect a transparent cover **20** and the plurality of display modules **30** disposed behind the protection plate **10** from the outside.

[0057] The protective plate **10** may be made of a thin glass material and may be made of various materials as necessary.

[0058] The transparent cover **20** is a plate on which the plurality of processed display modules **30** may be disposed, and is disposed in front of the plurality of processed display modules **30**. In other words, the transparent cover **20** may be disposed to face a plurality of micro LEDs **50** on top of the plurality of display modules **30**. The transparent cover **20** may be formed of a flat plate, or may be formed of various shapes and sizes to fit various shapes and sizes of the plurality of display modules **30**.

[0059] Accordingly, the transparent cover **20** may support the plurality of processed display modules **30** in order that the plurality of processed display modules **30** are arranged in parallel on the same plate, and the transparent cover **20** may implement the same height between the plurality of processed display modules **30** to implement uniform luminance of a display screen.

[0060] In addition, as illustrated in FIG. **3**, the transparent cover **20** may be disposed with the plurality of processed display modules **30** with a space S formed in-between. The space formed between the plurality of micro LEDs **50** to be disposed in each of the plurality of processed display modules **30** may be the same.

[0061] In other words, a width of an interval space S may be an interval between the plurality of processed display modules **30**.

[0062] In addition, an adhesive layer **80** (refer to FIG. **7**) is formed on one surface of the transparent cover **20**. Accordingly, the plurality of processed display modules **30** may adhere to one surface of the transparent cover **20** to be fixed to the transparent cover **20**.

[0063] In addition, the transparent cover **20** is made of a transparent material, light generated by the plurality of processed display module **30** may be transmitted through the transparent cover **20**. For example, the transparent cover **20** may be made of glass.

[0064] Referring to FIG. **2**, a covering **21** covering the interval space S may be formed on one surface of the transparent cover **20**. The covering **21** may be made of a material that absorbs light, and may be formed on one surface of the transparent cover **20**. For example, the covering **21** may be formed in a lattice form on one surface of the transparent cover **20**.

[0065] The covering **21** may cover the interval space S formed between the plurality of processed display modules **30**. Accordingly, when external light is introduced from the front surface (Y-axis direction) of the display apparatus **1**, the external light may be absorbed such that a user may not recognize the interval space S between the plurality of processed display modules **30**. Thus, a seamless display apparatus **1** may be implemented.

[0066] The covering **21** may be composed of a black matrix photosensitive resin composition for a liquid crystal display containing a binder resin, a photopolymerization initiator, a black pigment and a solvent, or a resin composition containing a black pigment for shielding.

[0067] The plurality of display modules **30** may implement light to display an image in front (Y-axis direction) according to an image signal input from the outside.

[0068] In addition, the plurality of display modules **30** may be arranged in accordance with a size of a display to be implemented by each display module **30** manufactured in a module form to form a display screen.

[0069] For example, when the first display module **31** and the second display module **32** are arranged side by side in a horizontal direction (X-axis direction), the display screen may be longer in the horizontal direction (X-axis direction) than a vertical direction (Z-axis direction).

[0070] In addition, when the first display module **31** and the third display module **33** are arranged side by side in the vertical direction (Z-axis direction), the display screen may be longer in the vertical direction (Z-axis direction) than the horizontal direction (X-axis direction).

[0071] Accordingly, display screens of various sizes and shapes may be implemented according to the number and shape of arranging the plurality of display modules **30**.

[0072] After the plurality of display modules **30** have been collectively processed, the plurality of display modules **30** may be arranged with a space S formed in-between as illustrated in FIG. **3**.

[0073] For example, on the basis of a first processed display module **31**, a second processed display module **32** may be arranged in parallel with the first processed display module **31** with a first interval space S**1** provided between the first processed display module **31** and the second processed display module **32**.

[0074] In addition, on the basis of the first processed display module **31**, a third processed display module **33** may be arranged in parallel with the first processed display module **31** with a second interval space S**2** provided between the first processed display module **31** and the third processed display module **33**.

[0075] The interval space S including the first interval space S**1** and the second interval space S**2** may be equally spaced between the plurality of micro LEDs **50** of each of the plurality of processed display modules **30**, such that a width of the interval space S of each of the plurality of processed display modules **30** may be varied.

[0076] As illustrated in FIG. **4**A, the plurality of micro LEDs **50** may include red micro LED **56**, a green micro LED **57**, and a blue micro LED **58** as one-pixel unit. In addition, the micro LED **50** may be a pixel **50'**.

[0077] For example, a width of the first interval space S**1** and a width of the second interval space S**2** may be different.

[0078] In addition, some of the plurality of processed display modules **30** may be rotated and disposed in a predetermined direction to equalize space between all the plurality of micro LEDs **50** included in the plurality of processed display modules **30**.

[0079] For example, as illustrated in FIG. **3**, the first processed display module **31** may be partially rotated and arranged in an R direction.

[0080] Accordingly, a vertical side surface of the first processed display module **31** may not coincide with an extension line X**1** of the vertical side surface of the third processed display module **33** disposed in a vertical direction of the first processed display module **31**.

[0081] Similarly, a horizontal side surface of the first processed display module **31** may not coincide with an extension line X**2** of a horizontal side surface of the second processed display module **32** disposed in the horizontal direction of the first processed display module **31**.

[0082] Thus, spaces between the first plurality of micro LEDs **51** disposed on the first processed display module **31** and the second plurality of micro LEDs **52** disposed on the second processed display module **32** may be the same. Accordingly, a display screen of the display apparatus **1** may implement uniform luminance.

[0083] Although the first processed display module **31** may be partially rotated and arranged, embodiments are not limited thereto, and some of the plurality of processed display modules **30** may be rotated and arranged in one direction to maintain the same space between the plurality of micro LEDs **50**.

[0084] A detailed structure of the plurality of processed display modules **30** will be described in detail with reference to FIG. **4**A.

[0085] A housing **40** may form an exterior of the display apparatus **1**, and be disposed behind the transparent cover **20**, and stably fix the plurality of processed display modules **30** and the transparent cover **20**.

[0086] In addition, the housing **40** may stably fix an edge region of a protective plate **10**.

[0087] Accordingly, the housing **40** may prevent various components included in the display apparatus **1** from being exposed to the outside, and may protect various components included in the display apparatus **1** from external shock.

[0088] Hereinafter, a specific structure of the plurality of processed display apparatuses **1** will be described with reference to FIGS. **4**A to **5**.

[0089] FIG. **4**A is a top view illustrating a first and second processed display modules **31** and **32** according an embodiment, FIG. **4**B is a cross section view taken along line A-A of FIG. **4**, FIG. **4**C is a block diagram illustrating an operation of a display module according to an embodiment, and FIG. **5** is a top view illustrating a processed area CA of a first processed display module **31** according to an embodiment.

[0090] Although it is described based on the first and second processed display modules **31** and **32** of the plurality of processed display modules **30**, a structure of the first and second processed display modules **31** and **32** may be the same as a structure of the processed display module **30**, respectively.

[0091] Surface areas of at least two display modules of the plurality of display modules **30** may be different from each other. To be specific, surface areas of the plurality of processed display modules **30** that have been processed may be different from each other.

[0092] The surface area may refer to an area of an upper surface of one display module of the display module **30**.

[0093] For example, the surface area of the processed first display module **31** and the processed second display module **32** illustrated in FIG. **4**A may be different from each other. However, embodiments are not limited thereto, and surface areas of some of the processed plurality of display modules among the plurality of processed display modules may be the same.

[0094] The plurality of processed display modules **30** may include a thin film transistor substrate **70** and a plurality of micro LEDs **50** disposed on the thin film transistor substrate **70**, respectively.

[0095] For example, the first processed display module **31** may include a first thin film transistor substrate **71** and a first plurality of micro LEDs **51** disposed on the first thin film transistor substrate **71**.

[0096] Similarly, the second processed display module **32** may include a second thin film transistor substrate **72** and a second plurality of micro LEDs **52** disposed on the second thin film transistor substrate **72**.

[0097] The thin film transistor substrate **70** may have a quadrangular shape and may stably fix the plurality of micro LEDs **50** disposed on one flat surface.

[0098] For example, the thin film transistor substrate **70** may be coupled to an electrode layer (or TFT layer) including a plurality of thin film transistors on a glass substrate.

[0099] Accordingly, a driving driver **60** (refer to FIG. **4**C) for driving the thin film transistor substrate **70** may be disposed on the thin film transistor substrate **70** formed of a glass substrate **70-6** and an electrode layer to be operated. In other words, a chip-shaped driving driver **60** may be implemented in the form of a chip on glass (COG) on the thin film transistor substrate **70**.

[0100] Accordingly, the driving driver **60** for driving the thin film transistor substrate **70** may be disposed and operated on the thin film transistor substrate **70** formed of a circuit board. In other words, the chip-shaped driving driver **60** may be implemented in the form of a chip on board (COB) on the thin film transistor substrate **70**. For example, the driving driver **60** may be disposed behind the glass substrate **70-6**. In this case, the thin film transistor substrate **70** may be made of a transparent material having a predetermined light penetrability. For example, the thin film transistor substrate **70** may include the glass substrate **70-6**.

[0101] As shown in FIG. **4**B, the thin film transistor substrate **70** may include a plurality of thin film transistors **70-1** for controlling and driving the plurality of micro LEDs **50** disposed on one surface thereof.

[0102] The thin film transistor **70-1** may be formed inside the thin film transistor substrate **70** and electrically connected to one micro LED **50** disposed on an upper surface of the thin film transistor substrate **70**. In addition, the plurality of thin film transistors **70-1** may be disposed on an upper surface of the glass substrate **70-6**.

[0103] Accordingly, the thin film transistor **70-1** may selectively drive the micro LED **50** by controlling a current flowing in the micro LED **50**. In other words, the thin film transistor substrate **70** may serve as a switch for controlling a pixel, which is a basic unit of a display.

[0104] In addition, the thin film transistor substrate **70** may include a first connection pad **70-2** electrically connected to the thin film transistor **70-1** on an edge of one surface of the thin film transistor substrate **70**, a second connection pad **70-3** formed on an edge of the other surface of the thin film transistor substrate **70**, a side wiring **70-4** which electrically connects the first connection pad **70-2** and the second connection pad **70-3**, and a driving pad **70-5** electrically connected to the second connection pad **70-3** and electrically connected to a driving driver **60** disposed on the other surface of the thin film transistor substrate **70**.

[0105] Accordingly, an electrical signal for driving the plurality of micro LEDs **50** in the driving driver **60** may be transmitted to a driving pad **70-5**, a second connection pad **70-4**, a side wiring **70-4**, the first connection pad **70-2**, and the thin film transistors **70-1**, and drive the plurality of micro LEDs **50**, respectively.

[0106] In addition, the driving driver **60** for driving the plurality of micro LEDs **50** disposed on one thin film transistor substrate **70** may be disposed behind the thin film transistor substrate **70**, and connected to the side wiring **70-4**, such that the edge areas of the plurality of processed display modules **30** may be reduced or minimized and the plurality of processed display modules **30** may be disposed adjacent to each other.

[0107] Accordingly, a bezelless and seamless display apparatus **1** may be realized by minimizing space between the plurality of processed display modules **30**.

[0108] In addition, the processed display module **30** according to the disclosure may be applied to a structure of a through glass via (TGV). For example, the plurality of micro LEDs **50**, a via hole for connecting the driving driver **60** disposed behind the thin film transistor **70-1** and the first thin film transistor substrate **71**, and a conductive material filled in the via hole may be formed on the first thin film transistor substrate **71**.

[0109] In other words, processed display modules **31** and **32** may be arranged, respectively, through the structure of the through glass via (TGV) in a state in which the plurality of micro LEDs **50** and the thin film transistor **70-1**, and the driving driver **60** are electrically connected.

[0110] Accordingly, the bezelless and seamless display apparatus **1** may be realized while minimizing the space between the plurality of processed display modules **30** including the TGV structure.

[0111] The micro LED **50** is made of an inorganic light emitting material having a size of 100 μm or less in width, length, and height, and is disposed on the thin film transistor substrate **70** to irradiate light by itself

[0112] The micro LED **50** may be composed of one pixel **50'**, and a red micro LED **55** emitting red light, a green micro LED **56** emitting green light, and a blue micro LED **57** emitting blue light, which are sub-pixels, may be arranged in one pixel.

[0113] The sub pixels **55**, **56**, and **57** may be arranged in a matrix form, or may be sequentially arranged in one pixel **50'**. However, the arrangement of the subpixels **55**, **56**, and **57** is an example, and the subpixels **55**, **56**, and **57** may be arranged in various forms in one pixel **50'**, respectively.

[0114] In other words, the micro LED **50** may include the red micro LED **56**, the green micro LED **57**, and the blue micro LED **58**, and the red micro LED **56**, the green micro LED **57**, and the blue micro LED **58** may be composed in one pixel **50**. The micro LED **50** has a relatively fast response speed, low power, and high luminance, and thus is being used as a light emitting device of a next generation display. Specifically, the micro LED **50** has a higher efficiency in converting electricity into photons compared to conventional liquid crystal displays (LCDs) or organic LEDs (OLEDs).

[0115] The micro LED **50** may have a higher brightness per watt than that of conventional LCD or OLED displays. This allows the micro LED **50** to achieve the same brightness with about half energy of the conventional LEDs or OLEDs.

[0116] In addition, the micro LED **50** may realize high resolution, excellent color, contrast and brightness, may accurately express a wide range of colors, and may realize a clear screen even in the outdoors under the bright sunlight. In addition, the micro LED **50** may be strong in burn-in phenomenon and generates less heat, thereby ensuring a longer life without deformation.

[0117] In addition, the micro LED **50** may be a flip chip.

[0118] The plurality of micro LEDs **50** may be disposed on the processed display module **30** at equal space. In other

words, the plurality of micro LEDs **50** disposed on one processed display module **30** may be arranged at regular intervals in a matrix form.

[0119] For example, a first plurality of micro LEDs **51** disposed on the first processed display module **31** may be arranged at equal intervals, and may be arranged in a plurality of columns and rows that are parallel to each other

[0120] Similarly, the second plurality of micro LEDs **52** disposed on the second processed display module **32** may be arranged at equal intervals, and may be arranged in a plurality of columns and rows that are parallel to each other.

[0121] In addition, as shown in FIG. **5**, the shortest distance from a first edge micro LED MA disposed on one side portion of the first plurality of micro LEDs **51** disposed on the first display module to a side surface of the first display module **31** adjacent to the first edge micro LED **51** may be different.

[0122] The processed display module may be a display module in which a side is processed through a processing process, and the display module may be a display module in a state before the processing process.

[0123] For example, a distance L**1** from a top-first edge micro LED **51**A-**1** disposed at the upper end of the first display module among the first plurality of edge micro LEDs **51**A to a third side surface of the first display module before being processed **71**D may be smaller than a distance L**2** from a bottom-first edge micro LED **51**A-**2** disposed at the lower end of the first display module among the first plurality of edge micro LEDs **51**A.

[0124] In other words, when the first plurality of micro LEDs **51** are arranged on the first display module **31** non-parallel to the horizontal side surface and the vertical side surface of the first display module **31**, a distance between the first edge micro LEDs **51**A and one side of the first display module **31** may be different.

[0125] When the first plurality of micro LEDs **51** are arranged on the first display module **31** non-parallel to the horizontal side surface and the vertical side surface of the first display module **31**, when the first display module **31** and the second display module **32** are not processed, and space between the first plurality of micro LEDs **51** and the second plurality of micro LEDs **52** is regularly arranged to be constant, the edges of side surfaces of the first display module **31** and the second display module **32** are physically in contact with each other, such that space between the first plurality of micro LEDs **51** and the second plurality of micro LEDs **52** may not be regularly arranged.

[0126] However, even when the first plurality of micro LEDs **51** are arranged on the first display module **31** non-parallel to the horizontal side surface and the vertical side surface of the first display module **31**, space between the first processed display module **31** and the second processed display module **32** may be minimized by processing the processed area CA of the first display module **31**, thereby regularly arranging the interval between the first plurality of micro LEDs **51** and the second plurality of micro LEDs **52**.

[0127] In other words, the first processed display module **31** and the second processed display module **32** disposed adjacent to the first processed display module **31** may be arranged in order for space between the first edge micro LED MA of the first processed display module **31** and the second edge micro LED **52**A disposed on one side of the second plurality of micro LEDs **52** of the processed display module **32** to be regular.

[0128] Accordingly, it may be possible to implement uniform luminance of the display screen in the display apparatus **1** and a seamless display between the plurality of display modules by maintaining the same space between the first plurality of edge micro LEDs MA and the second plurality of edge micro LEDs **52**B.

[0129] In addition, even if the plurality of micro LEDs **50** are arranged not parallel to a horizontal side surface and a vertical side surface of the display module **30**, a yield of a manufacturing process may be increased by processing the side surfaces of the display module **30**.

[0130] The first processed display module **31** may be a rectangular shape and have a first side surface **31**A, a second side surface **31**B adjacent to the first side surface **31**A, a first processed surface **31**C facing the first side surface **31**A, and a second processed surface **31**D facing the second side surface **31**B and adjacent to the first processed surface **31**C.

[0131] A structure of the first processed display module **31** will be described, but the structure of the first processed display module **31** is the same as that of the plurality of processed display modules **30**.

[0132] Side wires **70-4** may be formed on the first side surface **31**A and the second side surface **31**B.

[0133] In addition, the first processing surface **31**C may be processed to be parallel to a row of the first plurality of micro LEDs **50** disposed on the first processed display module **31**. In addition, the second processing surface **31**D may be processed to be parallel to a row of the plurality of micro LEDs **50** disposed on the first processed display module **31**.

[0134] Accordingly, a distance between the first edge micro LED **51**A disposed on an edge of the first processed display module **31** among the first plurality of micro LED **50** and the first and second processed surfaces **31**C and **31**D may be decreased.

[0135] Therefore, when the second processed display module **32** is arranged adjacent to the first processed display module **31**, a distance between the first edge micro LED **51**A and the second edge micro LED **52**B may be regularly arranged. In other words, the first processed display **31** and the second processed display module **21** may be arranged such that the distance between the first edge micro LED MA and the second edge micro LED **52**B may equal to the distance between the first plurality of micro LEDs **51** and the second plurality of micro LEDs **52**.

[0136] Accordingly, it is possible to implement uniform luminance of the display screen implemented in the display apparatus **1** and to implement seamless display among the plurality of display modules.

[0137] Meanwhile, referring back to FIG. **5**, the processed area CA processed in the plurality of display modules **30** may be processed to have the same first processed width C-**1** and the same second processed width C-**2**.

[0138] For example, both the first processed display module **31** and the second processed display module **32** may be processed to have the same first machined width C-**1** and the same second machined width C-**2**.

[0139] Accordingly, even when sizes of the plurality of display modules **30** are different due to manufacturing tolerances, edge areas of the plurality of display modules **30** may be reduced by collectively processing with the first machined width C-**1** and the second machined width C-**2**.

[0140] Thus, a plurality of adjacent processed display modules **30** may be arranged in order that the plurality of

micro LEDs **50** have a regular space due to the reduction of edge areas of the plurality of processed display modules **30**.

[0141] In other words, due to manufacturing tolerances, due to a contact of the edge areas of the plurality of display modules **30**, the plurality of micro LEDs **50** may not be arranged to have regular intervals, but through the processing process, the plurality of adjacent processed display modules **30** may be arranged in order that the plurality of micro LEDs **50** have a regular space, by processing a portion of the plurality of display modules **30**.

[0142] Accordingly, manufacturing costs for implementing a uniform display screen can be reduced, yields can be improved, and uniformity of the luminance of the display screen can be realized.

[0143] Hereinafter, a structure in which the transparent cover **20** and the plurality of processed display modules **30** are combined will be described in detail with reference to FIGS. **6** and **7**.

[0144] FIG. **6** is a top view illustrating that a plurality of display modules are disposed on a transparent cover according to an embodiment, and FIG. **7** is a cross section view taken along line B-B of FIG. **6**.

[0145] As shown in FIG. **6**, the plurality of processed display modules **31** may be fixed behind the transparent cover **20**.

[0146] For example, as illustrated in FIG. **7**, the plurality of processed display modules **30** may be arranged with a space in-between, and the space S may be covered by the covering **21**.

[0147] For example, the first processed display module **31** and the second processed display module **32** may be arranged with a space in-between.

[0148] The interval space distance (SD) of the interval space (S) may be adjusted such that a first distance D**1** between the first edge micro LED **51**A and the second edge micro LED **52**A is the same as a second distance D**2**, which is a regular interval between the first plurality of micro LEDs **51**, and a third distance D**3**, which is a regular interval between the second plurality of micro LEDs **52**.

[0149] The first processed display module **31** and the second processed display module **32** may be disposed in order for the first interval D**1** between the first edge micro LED **51**A and the second edge micro LED **52**A to be the same as the second interval D**2**, which is a regular interval between the plurality of micro LEDs **51**, and the third interval D**3**, which is a regular interval between the plurality of micro LEDs **52**.

[0150] Therefore, the second interval D**2** and the third interval D**3** are the same as arrangement intervals P between the plurality of micro LEDs **50**.

[0151] Accordingly, it is possible to implement uniform luminance of the display screen implemented in the display apparatus **1** and to implement seamless display among the plurality of display modules.

[0152] In addition, the first processed display module **31** and the second processed display module **32** may be disposed on the transparent cover **20** so that the interval space S is covered by the covering **21** of the transparent cover **20**.

[0153] Therefore, the first processed surface **31**C and the second processed surface **31**D of the first processed display module **31** may be covered by the covering **21**.

[0154] Accordingly, when external light flows into the first processed surface **31**C and the second processed surface **31**D on which the side surfaces of the plurality of display modules are processed, the covering **21** may absorb the external light so as to prevent the external light from being diffusely reflected by contacting the first processed surface **31**C and the second processed surface **31**D.

[0155] In particular, when the thin film transistor substrate **70** of the plurality of processed display modules **30** is formed of a glass substrate, the user may recognize a seam due to diffused reflection caused by external light, but the covering **21** may implement the seamless display by absorbing external light that flows into the display apparatus **1**.

[0156] In other words, the plurality of processed display modules **30** have the same interval between the plurality of micro LEDs **50**, and the interval space S between the plurality of processed display modules **30** may be disposed to be covered by the covering **21**.

[0157] In addition, the transparent cover **20** may include an additional covering **22** to cover space between the plurality of micro LEDs **50**.

[0158] For example, when the plurality of micro LEDs **50** are arranged in a matrix form on the first thin film transistor substrate **71**, a constant interval may be formed between the plurality of micro LEDs **50**. In this case, the transparent cover **20** may cover the space between the plurality of micro LEDs **50** by having the additional covering **22** in addition to the covering **21**.

[0159] Accordingly, the additional covering **22** may absorb external light flowing into the display apparatus **1** similar to the covering **21**, thereby realizing the seamless display of the display apparatus **1**.

[0160] In addition, the additional covering **22** may be made of the same material as the covering **21**, and the covering **21** and the additional covering **22** may be simultaneously formed on one surface of the transparent cover **20**.

[0161] In addition, a width of the additional covering **22** may be equal to or smaller than a width of the covering **21**.

[0162] In addition, an adhesive layer **80** may be formed between the plurality of processed display modules **30** and the transparent cover **20** to fix the plurality of processed display modules **30** to the transparent cover **20**.

[0163] In this case, the adhesive layer **80** is formed to cover side surfaces of the plurality of processed display modules **30** by filling the interval spaces S, thereby stably fixing the plurality of processed display modules **30** to the transparent cover **20**.

[0164] Hereinafter, a manufacturing process of the display apparatus **1** will be described in detail with reference to FIGS. **8**A to **14**.

[0165] FIG. **8**A is a top view illustrating a process of processing a first display module according to an embodiment, FIG. **8**B is a top view illustrating a process of processing a second display module according to an embodiment, FIG. **9**A is a top view illustrating a first processed display module according to another embodiment, FIG. **9**B is a cross section view taken along line F-F of FIG. **9**A, and FIGS. **10** to **14** are schematic diagrams illustrating a process of arranging a plurality of processed display modules.

[0166] The processed display module may be a display module in which a side is processed through a processing process, and the display module may be a display module in a state before the processing process.

[0167] First, as illustrated in FIG. **8**A, the first plurality of micro LEDs **51** are mounted on a manufactured first display module **31** at regular intervals in a matrix form. For example, the plurality of micro LEDs **50** may be arranged by

units of pixels on the upper surfaces of the plurality of display modules **30**, respectively.

[0168] In this case, due to manufacturing tolerances, rows and columns of the first plurality of micro LEDs **51** that are not parallel to a horizontal side surface and the vertical side surface of the first display module may be provided. In addition, due to manufacturing tolerances, sizes between the plurality of processed display modules **30** may be different.

[0169] In other words, the shortest interval between a first plurality of edge micro LEDs **51**A disposed on one side of the first plurality of micro LEDs **51** and the horizontal side surface **71**C and the vertical side surface **71**D of the first display module before processing may be different.

[0170] Next, the first display module may process a side of the first display module to make the shortest interval L**3** between the first plurality of edge micro LEDs **51**A and one side surface of the first processed display module smaller than intervals P between the plurality of micro LEDs **50**.

[0171] Here, the arrangement intervals P between the plurality of micro LEDs **50** may refer to an interval between the first plurality of micro LEDs **51**.

[0172] For example, as shown in FIG. **8**A, the shortest interval L**3** between the first edge micro LED **51**A and the second processed surface **31**D formed after processing the processed area CA of the first display module **31** may be smaller than intervals between the first plurality of micro LEDs **51**.

[0173] Accordingly, when the first processed display module **31** and the second processed display module **32** are arranged side by side, the first processed display module **31** and the second processed display module **32** may be arranged on the transparent cover **20** in order for an interval between the first edge micro LED **51**A and the second edge micro LED **51**B of the second processed display module disposed closest to the first edge micro LED **51**A to be the same.

[0174] Here, the interval between the first edge micro LED **51**A and the second edge micro LED **52**A may be equal to the arrangement intervals P between the plurality of micro LEDs **50**.

[0175] In addition, side surfaces of the plurality of display modules **30** may be processed. For example, processing may collectively process the first side surface and the second side surface adjacent to the first side surface of the plurality of display modules **30** having a rectangular shape, respectively.

[0176] In addition, the processed side surface of the first display module **31** may process the side surface of the first display module **31** to be parallel to at least one of the rows and columns of the first plurality of micro LEDs **51** disposed on the first display module **31**.

[0177] For example, as shown in FIG. **8**A, the first display module **31** may be processed such that the first processed surface **31**A formed after processing the processed area CA is parallel to a row of the first plurality of micro LED **51**.

[0178] The first display module **31** may be processed such that the second processed surface **31**D formed after processing the processed area CA is parallel to a row of the first plurality of micro LEDs **51**.

[0179] Accordingly, even when the rows and columns of a first plurality of micro LEDs **51** are disposed non-parallel to the horizontal side and the vertical side of the first display module due to manufacturing tolerances, the first and second processed surfaces **31**C and **31**D of the first processed display module **31** may be parallel to the rows and columns of the first plurality of micro LEDs **51** through the process of processing.

[0180] Accordingly, when the first processed display module **31** and the second processed display module **32** are arranged side by side, adjacent and opposing side surfaces of each other may be arranged in parallel, thereby improving an accuracy of the arrangement process.

[0181] In addition, the plurality of display modules **30** may process two adjacent side surfaces among the plurality of side surfaces of the plurality of display modules, respectively. In addition, side wirings may be formed on the remaining two sides of the plurality of processed display modules, respectively, in addition to the two processed side surfaces.

[0182] For example, as shown in FIG. **8**A, side wirings **70-4** may be formed at the first processed surface **31** C of the first processed display module **31**, the first side surface **31**A of the first processed display module **31** in addition to the second processed surface **32**D and the second side surface **31**B.

[0183] Similarly, as shown in FIG. **8**B, side wirings **70-4** may be formed at the first processed surface **32**C of the second processed display module **32**, the first side surface **31**A of the second processed display module **32** in addition to the second processed surface **32**D and the second side surface **32**B.

[0184] The side wiring **70-4** may be formed after the plurality of display modules **30** are processed, or may be formed before the plurality of display modules **30** are processed, as needed.

[0185] In addition, the process of processing the plurality of display modules **30** may be processed through laser cutting, or through a mechanical processing process.

[0186] Meanwhile, as shown in FIG. **8**B, rows and columns of the second plurality of micro LEDs **52** disposed on the second display module **32** may be mounted to be parallel to the horizontal side and the vertical side of the second display module **32**, respectively.

[0187] In other words, the rows and columns of the first plurality of micro LEDs **51** described above are not disposed parallel to the horizontal side and the vertical side of the first display module **31**, while the rows and columns of the second plurality of micro LEDs **52** may be disposed to be parallel to the horizontal side and the vertical side of the second display module **32**.

[0188] However, even in this case, the second display module **32** may be processed in the same manner as the first display module **31**.

[0189] For example, the second display module **32** may be processed such that the side surfaces of the second display has the shortest interval between the second plurality of edge micro LEDs **52**A and one side of the second processed display module **32** that is smaller than the arrangement intervals P between thee plurality of micro LEDs **50**.

[0190] The arrangement intervals P between the plurality of micro LEDs **50** may refer to an interval between the second plurality of micro LEDs **52**. In addition, the arrangement intervals P may refer to an interval between the first and second plurality of micro LEDs **51** and **52**.

[0191] For example, as shown in FIG. **8**B, the shortest interval L to the second processed surface **32**D formed after processing the processed area CA of the second edge micro

LED **52**A and the second display module **32** may be smaller than the interval between the second plurality of micro LEDs **52**.

[0192] In addition, the processed side surface of the second display module **32** may process the second display module **32** to be parallel to at least one of the rows and columns of the second plurality of micro LEDs **52** disposed on the second display module **32**.

[0193] For example, as shown in FIG. **8**B, the second display module **32** may be processed such that a first processed surface **32**C formed after the processed area CA is processed to be parallel to the row of the second plurality of micro LEDs **52**.

[0194] Similarly, the second display module **32** may be processed such that the second processed surface **32**D formed after the processed area CA is processed to be parallel to the row of the second plurality of micro LEDs **52**.

[0195] Accordingly, as the plurality of display modules **30** are collectively processed, the shortest interval between the plurality of edge micro LEDs disposed on the edges of the plurality of display modules **30** and the plurality of processed display modules **30** may be reduced.

[0196] Therefore, when the plurality of display modules **30** are disposed on the transparent cover **20**, space between the plurality of micro LEDs **50** disposed on each of the plurality of display modules **30** may be the same.

[0197] In other words, even when some of the plurality of display modules are disposed by rotating or moving in an X and Z axes, it may prevent or reduce the edges of the adjacent plurality of display modules **30** from being contacted in order to dispose intervals between the plurality of micro LEDs **50** to be the same.

[0198] In addition, as shown in **9**A and **9**B, light absorbing layer M may be formed on a first thin film transistor substrate **71** in a processed first display module **31**'.

[0199] The light absorbing layer M may be composed of a black matrix photosensitive resin composition for a liquid crystal display containing a black pigment and a solvent or a resin composition containing a black pigment for shielding.

[0200] Specifically, the light absorbing layer M may be applied to a region where the plurality of micro LEDs **51** are not mounted on the first thin film transistor substrate **71**.

[0201] For example, the light absorbing layer M may be formed after the plurality of micro LEDs **51** are mounted on the first thin film transistor substrate **71** or may be formed the first thin film transistor substrate **71** before the plurality of micro LEDs are mounted on the first thin film transistor substrate **71**.

[0202] Accordingly, the light absorbing layer M may absorb external light flowing from the outside of the display apparatus **1** to implement a seamless display of the display apparatus **1**.

[0203] In addition, the light absorbing layer M may be composed of the same material as the covering **21** and the additional covering **22**. For example, a color of the light absorbing layer M may be the same as a color of the covering **21** and the additional covering **22**.

[0204] Accordingly, the light absorbing layer M may absorb, similar to the covering **21**, external light flowing into the display apparatus **1** and some of light of the plurality of micro LEDs **50** that are not necessary in implementing the display screen, thereby enhancing the effect of implementing the seamless display of the display apparatus **1**.

[0205] In addition, the light absorbing layer M may cover a processed side surface of the first thin film transistor substrate **71**. Accordingly, when the first thin film transistor substrate **71** is formed of glass, the light absorbing layer M may absorb light introduced from the outside to prevent or reduce diffuse reflection of external light from the processed side surface.

[0206] Next, as illustrated in FIGS. **10** and **11**, an adhesive layer **80** may be formed on one surface of the transparent cover **20** on which the covering **21** is formed.

[0207] The adhesive layer **80** is to fix the plurality of processed display modules **30** to the transparent cover **20**, and may be composed of a transparent material having adhesiveness. Accordingly, when light is irradiated from the plurality of processed display modules **30**, the adhesive layer **80** may be transmitted.

[0208] Then, as shown in FIG. **12**, the plurality of processed display modules **30** may be disposed on the transparent cover **20** on which the adhesive layers **80** is formed in order for the plurality of micro LEDs **50** of the plurality of processed display modules **30** have the same LED space, respectively.

[0209] For example, an interval P between the first plurality of micro LEDs **51** of the first processed display module **31** and the second plurality of micro LEDs **52** of the second processed display module **32** may be equal to the arrangement intervals P between the first plurality of micro LEDs **51** and the arrangement intervals P between the second plurality of micro LEDs **52**.

[0210] Specifically, the first processed display module **31** and the second processed display module **32** may be disposed on the transparent cover **20** in order to make a regular space between the first plurality of edge micro LEDs MA disposed on one side of the first processed display module **31** among the plurality of processed display modules **30** and the second plurality of edge micro LEDs **52**A disposed on one side of the second processed display module **32** disposed adjacent to one side of the processed display module **31**.

[0211] Similarly, the plurality of processed display modules **30** may arrange the plurality of processed display modules **30** such that the pixels **50**' have the same space.

[0212] Therefore, since the space between the plurality of micro LEDs **50** including the first and second plurality of micro LEDs **51** and **52** for implementing the display screen is the same, it is possible to implement uniform luminance of the display screen and seamless display between the plurality of processed display modules **30**.

[0213] In addition, the first processed display module **31** and the second processed display module **32** may be arranged with the interval space S between the first processed display module **31** and the second processed display module **32**.

[0214] The interval space S is a space formed between side surfaces of the first processed display module **31** and the second processed display module **32** facing each other, and may be adjusted in order for a first interval D**1** between the first edge micro LED MA and the second edge micro LED **52**A to be the same as a second interval D**2** which is a constant interval between the first plurality of micro LEDs **51** and a third interval D**3** which is a constant interval between the second plurality of micro LEDs **52** by adjusting an interval space distance SD of the interval space S.

[0215] In addition, the first processed display module **31** and the second processed display module **32** may be dis-

posed so that the interval space S is covered by the covering **21** of the transparent cover **20**.

[0216] Accordingly, even when external light is introduced into the display apparatus **1**, the user may be prevented from recognizing the seam due to the interval space between the first processed display module **31** and the second processed display modules **32** as the covering **21** absorbs external light.

[0217] In addition, when the first processed display module **31** and the second processed display module **32** are arranged sequentially in a horizontal direction, the first processed display module **31** and the second processed display module **32** may be disposed on the transparent cover **20** in order for the row R1 of the first processed display module **31** and the row R2 of the second processed display module **32** to be disposed on the same line.

[0218] Meanwhile, when the first processed display module **31** and the second processed display module **32** are sequentially arranged in a vertical direction, the first processed display module **31** and the second processed display module **32** may be disposed on the transparent cover **20** in order the column Cl of the first processed display module **31** and the column C2 of the second processed display module **32** to be disposed on the same line.

[0219] Accordingly, since the arrangement intervals P between the plurality of micro LEDs **50** are all the same, uniform luminance of the display screen may be realized.

[0220] The first processed display module **31** and the second processed display module **32** are not limited to those described in the horizontal direction or the vertical direction, and are not limited to the horizontal direction of the first processed display module **31**, and. The second processed display module **32** may be arranged in the horizontal direction of the first processed display module **31**, and the third processed display module **33** may be arranged in the vertical direction of the first processed display module **31**. In this case, the columns and the rows may be arranged on the same line, respectively.

[0221] In addition, when arranging the plurality of processed display modules **30**, sizes of the plurality of processed display modules **30** may be measured, and based on the measured sizes, the plurality of processed display module **31** disposed on the transparent cover **20** may be selectively disposed.

[0222] For example, when considering the plurality of processed display modules **30** have the same space between the plurality of micro LEDs **50**, and the interval space S between the plurality of processed display modules **30** should be disposed to be covered by the covering **21**, it is possible to determine the arrangement of the plurality of display modules based on the measured size data of the processed display module.

[0223] In addition, as shown in FIGS. **13** and **14**, the first processed display module **31** and the second processed display module **32** may be attached sequentially to one surface of the transparent cover **20** on which the adhesive layer **80** is formed.

[0224] Next, as shown in FIG. **14**, the plurality of processed display modules **30** may be thermally compressed. Accordingly, as the adhesive layer **80** is solidified, the plurality of processed display modules **30** may be stably fixed to one surface of the transparent cover **20**.

[0225] In addition, the plurality of processed display modules **30** may be thermally compressed in a Q direction to have the same height with respect to the transparent cover **20**. For example, the plurality of processed display modules **30** with respect to the transparent cover **20** may have the same height by pressing the plurality of processed display modules **30** with a flat plate and transferring heat at the same time.

[0226] Accordingly, the luminance for implementing the display screen may be maintained uniformly through the structure in which the plurality of processed display modules **30** are arranged to have parallel and uniform heights.

[0227] The various example embodiments aforementioned were explained separately, but each of the example embodiments may not necessarily be realized separately, and the configuration and operation of each of the example embodiments may be realized in combinations with at least one other example embodiment.

[0228] The foregoing exemplary embodiments are merely exemplary and are not to be construed as limiting the present disclosure. The present disclosure can be readily applied to other types of apparatuses. Also, the description of exemplary embodiments is intended to be illustrative, and not to limit the scope of the claims and their equivalents, and many alternatives, modifications, and variations will be apparent to those skilled in the art.

What is claimed is:

1. A method of manufacturing display apparatus comprising:

processing side surfaces of a plurality of display modules, each of the plurality of display modules comprising a plurality of micro light emitting diodes (LEDs) provided in pixels on an upper surface of each of the plurality of display modules; and

providing the plurality of processed display modules such that the pixels of the plurality of processed display modules are provided at a same interval, respectively,

wherein each of the plurality of display modules has a rectangular shape, and

wherein the processing the side surfaces of the plurality of display modules comprises processing a first side surface of each of the plurality of display modules and a second side surface of each of the plurality of display modules that are adjacent to the first side surface.

2. The method as claimed in claim **1**, wherein the processing the side surfaces of the plurality of display modules comprises processing at least two display modules of the plurarlity of display modules such that at least two or more display modules of the plurality of display modules have different surface areas.

3. The method as claimed in claim **1** further comprising forming an adhesive layer on one surface of a transparent cover,

wherein the providing the plurality of processed display modules comprises providing the first processed display module and the sescond processed display module on the transparent cover, respectively, such that intervals between a plurality of first edge micro LEDs provided on one side surface of the first processed display module among the plurality of processed display module are equal to intervals between a plurality of second edge micro LEDs provided on one side surface of the second processed display module that are provided adjacent to one side surface of the first processed display module, and

providing the plurality of processed display modules on a transparent cover formed with the adhesive layer.

4. The method as claimed in claim **3**, wherein the processing comprises processing a side surface of the first display module such that a distance between the plurality of first edge micro LEDs and one side surface of the first display module is smaller than a distance between each of the plurality of micro LEDs.

5. The method as claimed in claim **1**, wherein the processing the side surfaces of the plurality of display modules further comprises processing the side surface of the first display module such that the processed side surface of the first display module is parallel to at least one of rows and columns of the plurality of first micro LEDs provided on the first display module.

6. The method as claimed in claim **3**, wherein the providing the plurality of processed display modules further comprises providing the first processed display module and the sescond processed display module on the transparent cover such that the first processed display module and the second processed display module are provided with an interval space between the first processed display module and the second processed display module.

7. The method as claimed in claim **6**, wherein the transparent cover comprises a covering formed in the form of a lattice and configured to absorb external light, and

wherein the providing the plurality of processed display modules further comprises providing the first processed display module and the second processed display module on the transparent cover such that the interval space is covered by the covering.

8. The method as claimed in claim **3**, wherein the providing the plurality of processed display modules further comprises providing the first processed display module and the second processed display module on the transparent cover such that rows and columns of the plurality of the first micro LEDs provided on the first processed display module are parallel to rows and columns of the plurality of second micro LEDs provided on the second processed display module, respectively.

9. The method as claimed in claim **8**, wherein the providing the plurality of processed display modules further comprises providing the first processed display module and the second processed display module on the transparent cover such that the rows of the first processed display module and the rows of the second processed display module are collinear.

10. The method as claimed in claim **8**, wherein the providing the plurality of processed display modules further comprises providing the first processed display module and the second processed display module on the transparent cover such that the columns of the first processed display module and the columns of the second processed display module are collinear.

11. The method as claimed in claim **1** further comprising forming side wirings on two sides of the plurality of processed display modules, respectively, other than the first side surface and the second side surface of the plurality of processed display modules.

12. The method as claimed in claim **6** further comprising compressing thermally the plurality of processed display modules, and filling the adhesive layer in the interval space.

13. A display apparatus comprising:

a plurality of display modules in which a plurality of a micro light emitting diodes (LEDs) are provided in pixels, respectively; and

a transparent cover provided to face the plurality of micro LEDs on an upper part of the plurality of display modules,

wherein each of the plurality of display modules comprises a thin film transistor substrate electrically connected to the plurality of micro LEDs, each of the plurality of display modules comprising a glass substrate and a plurality of thin film transistors provided on an upper surface of the glass substrate; and

a driving driver provided on a surface of the glass substrate and configured to drive the plurality of micro LEDs, and

wherein at least two or more display modules of the plurality of display modules have different surface areas.

14. The display apparatus as claimed in claim **13**, wherein a shortest distance between a first edge micro LED provided on one side surface of a plurality of first micro LEDs provided on a first processed display module among the plurality of processed display modules and a side surface of the first processed display module adjacent to the first edge micro LED is different, and

wherein the first processed display module and the second processed display module provided adjacent to the first processed display module are provided such that an interval between the first edge micro LED of the first processed display module and the second edge micro LED provided one side surface of a plurality of second micro LEDs of the second processed display module is regular.

15. The display apparatus as claimed in claim **14**, wherein the plurality of processed display modules have a rectangular shape, respectively,

wherein the first processed display module comprises:

a first side surface;

a second side surface adjacent to the first side surface;

a first processed surface facing the first side surface; and

a second processed surface facing the second side surface and adjacent to the first processed surface, and

wherein the first processed surface and the second processed surface are covered by a covering.

16. The display apparatus as claimed in claim **15**, wherein the first processed surface is parallel to rows of the plurality of first micro LEDs.

17. The display apparatus as claimed in claim **15**, wherein the first processed surface is parallel to columns of the plurality of first micro LEDs.

18. The display apparatus as claimed in claim **13**, wherein the plurality of micro LEDs comprises:

a red micro LED configured to emit red light;

a green micro LED configured to emit green light; and

a blue micro LED configured to emit blue light, and

wherein the red micro LED, the green micro LED and the blue micro LED are included in one pixel.

19. The display apparatus as claimed in claim **13**, further comprising an adhesive layer provided between the plurality of display modules and the transparent cover, and configured to fix the plurality of display modules on the transparent cover.

20. The display apparatus as claimed in claim **13**, wherein the transparent cover further comprises an additional covering that covers space between the plurality of micro LEDs.

* * * * *

专利名称(译)	显示设备及其制造方法		
公开(公告)号	US20200219862A1	公开(公告)日	2020-07-09
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摘要(译)

提供一种制造包括处理多个显示模块的侧表面的显示装置的方法,该多个显示模块中的每个包括在多个像素中的每个的上表面上的像素中提供的多个微发光二极管(LED)。 显示模块,并提供多个处理后的显示模块,使得分别以相同的间隔提供多个处理后的显示模块的像素,其中多个显示模块中的每个具有矩形形状,并且其中处理侧面 多个显示模块的表面包括处理多个显示模块中的每个的第一侧面和与第一侧面相邻的多个显示模块中的每个的第二侧面。