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(54) **DISPLAY UNIT, DISPLAY SUBSTRATE AND METHOD OF MANUFACTURING THE SAME, DISPLAY DEVICE**

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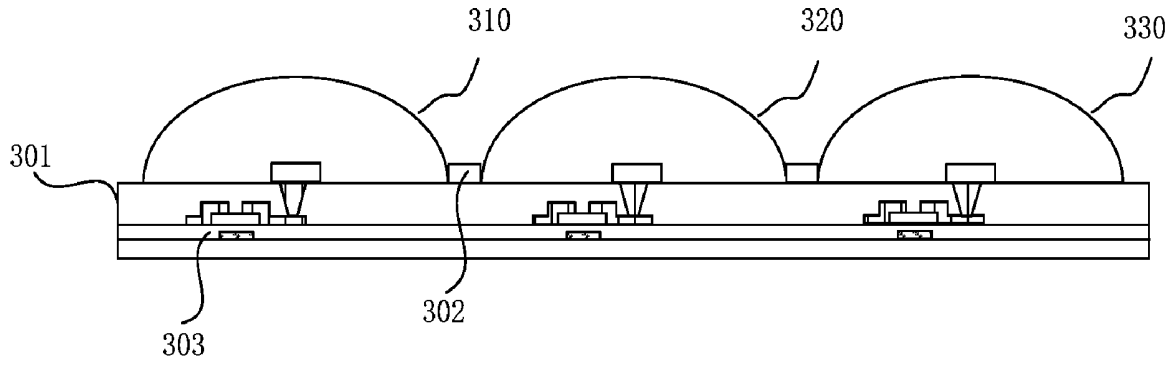
(57) **ABSTRACT**

A display unit, a display substrate and a method of manufacturing the same and a display device. The display unit includes: a Micro-LED chip arranged on a base substrate and a color filter. The Micro-LED chip is configured for emitting light in a first color. The color filter is arranged on the Micro-LED chip, configured for packaging the Micro-LED chip and converting the light in the first color into an outgoing light in a second color, and includes a convex structure in a light outgoing path of the Micro-LED chip.



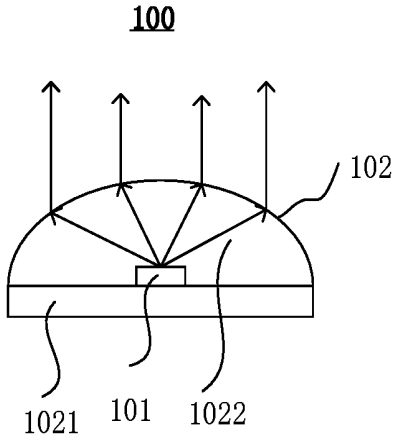


FIG. 1

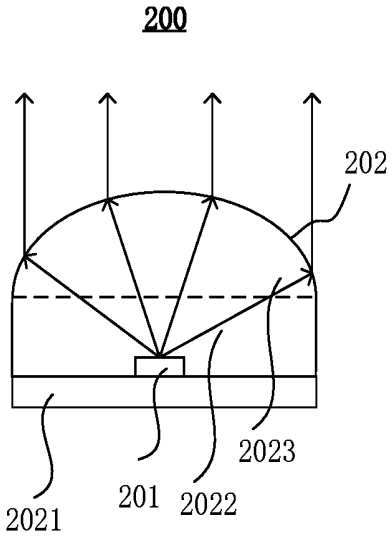


FIG. 2

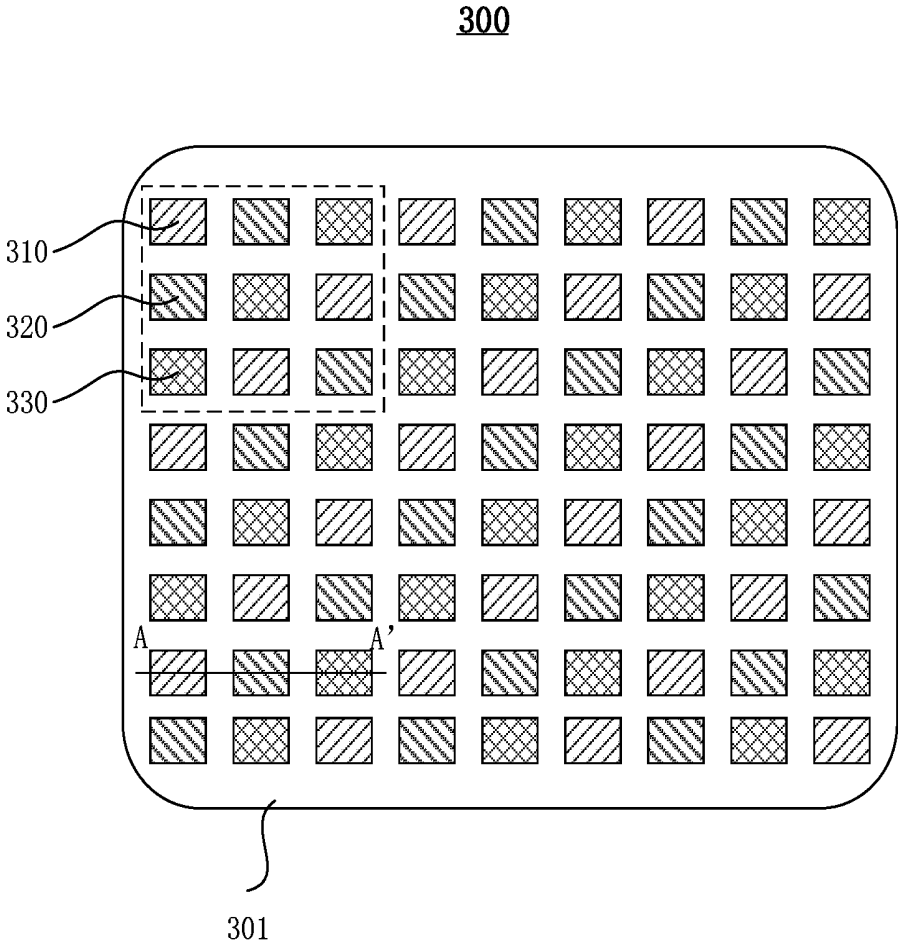


FIG. 3

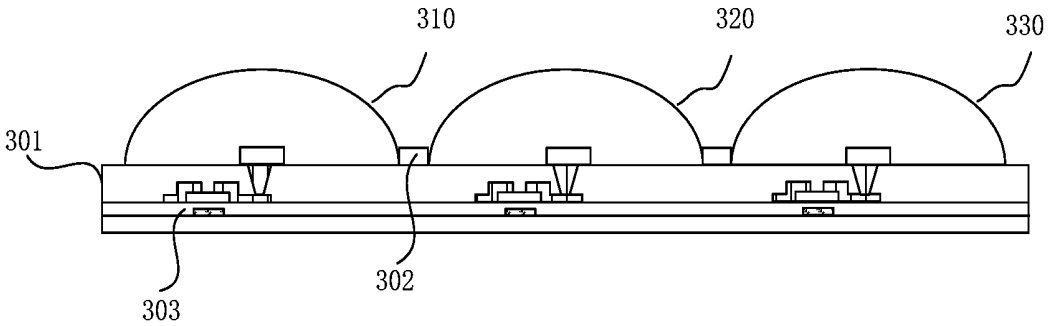


FIG. 4

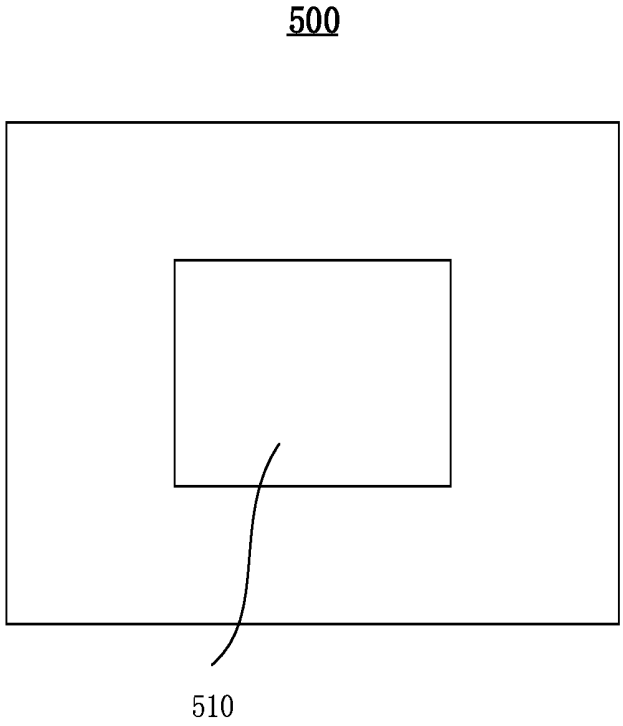

500
510

FIG. 5

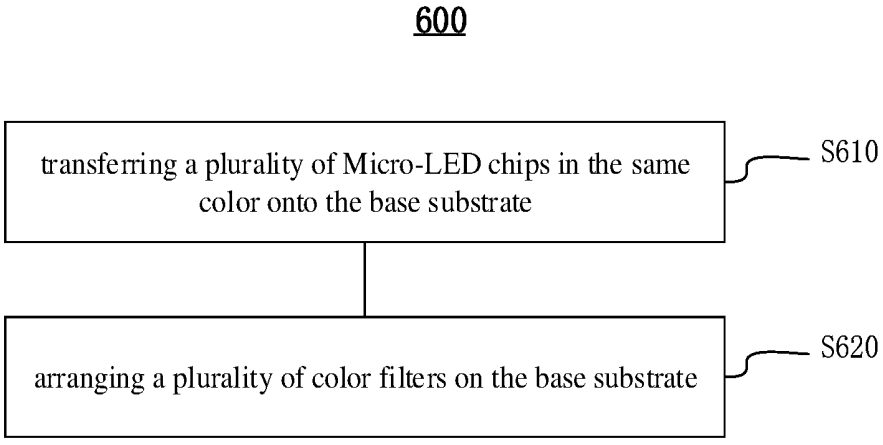

600
transferring a plurality of Micro-LED chips in the same color onto the base substrate
S610
arranging a plurality of color filters on the base substrate
S620

FIG. 6

DISPLAY UNIT, DISPLAY SUBSTRATE AND METHOD OF MANUFACTURING THE SAME, DISPLAY DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Chinese Patent Application No. 201811191001.3, filed on Oct. 12, 2018, the disclosure of which is incorporated herein by reference in its entirety as part of the present application.

TECHNICAL FIELD

[0002] Embodiments of the present disclosure relate to a display unit, a display substrate and a method of manufacturing the same, and a display device.

BACKGROUND

[0003] With the rapid development of a wearable display device, micro light emitting diode (Micro-LED, pLED) technology is emerging. The Micro-LED technology (including LED miniaturizing and matrixing technologies) refers to integration of a high-density miniaturized LED array on a chip. A Micro-LED display has a power consumption much less than a liquid crystal display (LCD), and is also self-luminous, like an organic light-emitting diode (OLED) display. It is possible for a Micro-LED display to reduce the magnitude of a distance between pixels from millimeter to micron, the color saturation of the Micro-LED display is close to that of an OLED display, and thus the Micro-LED display is deemed as the next generation of display technology by many manufacturers. The inorganic material-based Micro-LED has the advantages of self-luminous characteristics, a small size, a light weight, a high brightness, a longer service life, lower power consumption, shorter response time and higher controllability, and the Micro-LED technology is to realize the thin film, miniaturization and array design of the structure of LEDs.

SUMMARY

[0004] At least one embodiment of the present disclosure provides a display unit, which includes:

[0005] a micro light emitting diode (Micro-LED) chip, arranged on a base substrate and configured for emitting light in a first color; and

[0006] a color filter, the color filter being arranged on the Micro-LED chip, the color filter being configured for packaging the Micro-LED chip and converting the light in the first color into an outgoing light in a second color, and the color filter comprising a convex structure in a light outgoing path of the Micro-LED chip.

[0007] In the display unit according to some embodiments of the present disclosure, the convex structure is a convex lens structure.

[0008] In the display unit according to some embodiments of the present disclosure, the Micro-LED chip is at a focal point of the convex lens, so as to convert the light in the first color emitted from the Micro-LED chip into the outgoing light in the second color, and the outgoing light in the second color is substantially parallel.

[0009] In the display unit according to some embodiments of the present disclosure, a distance from the micro-LED chip to an optical center of the convex lens is less than a focal length of the convex lens.

[0010] In the display unit according to some embodiments of the present disclosure, in at least one direction, the Micro-LED chip has a dimension in a range of 1 micron~10 microns.

[0011] In the display unit according to some embodiments of the present disclosure, the first color is white, and the second color is one selected from a group consisting of red, blue and green.

[0012] At least one embodiment of the present disclosure provides a display substrate, which includes:

[0013] a base substrate; and

[0014] a plurality of the above-mentioned display units, arranged on the base substrate in an array,

[0015] wherein the plurality of display units are divided into a plurality of subarrays, each of plurality of subarrays comprises a first display unit, a second display unit and a third display unit, the first display unit, the second display unit and the third display unit emit outgoing light in different colors.

[0016] In the display substrate according to some embodiments of the present disclosure, in each of the plurality of subarrays, each of the first display unit, the second display unit and the third display unit is arranged adjacent to a different type of display unit in each of a row direction and a column direction.

[0017] In the display substrate according to some embodiments of the present disclosure, each of the first display unit, the second display unit and the third display unit of each of the plurality of subarrays is arranged adjacent to a different type of display unit of an adjacent subarray in each of the row direction and the column direction.

[0018] In the display substrate according to some embodiments of the present disclosure, the outgoing light emitted from each of the first display unit, the second display unit and the third display unit has a color of one selected from a group consisting of red, green and blue, and the outgoing light emitted from the first display unit, the second display unit and the third display unit has different colors.

[0019] In the display substrate according to some embodiments of the present disclosure, each of the plurality of subarrays comprises:

[0020] the first display unit, the second display unit and the third display unit arranged in sequence in a first direction in a first row;

[0021] the second display unit, the third display unit and the first display unit arranged in sequence in the first direction in a second row; and

[0022] the third display unit, the first display unit and the second display unit arranged in sequence in the first direction in a third row,

[0023] wherein the first display unit emits red outgoing light, the second display unit emits green outgoing light, and the third display unit emits blue outgoing light.

[0024] The display substrate according to some embodiments of the present disclosure further comprises a light blocking layer, wherein the light blocking layer is on the base substrate and between adjacent display units.

[0025] At least one embodiment of the present disclosure provides a display device, which includes the above-mentioned display substrate.

[0026] At least one embodiment of the present disclosure provides a method of manufacturing the above-mentioned display substrate, which includes:

[0027] transferring a plurality of Micro-LED chips in an identical color onto the base substrate; and

[0028] arranging a plurality of color filters on the base substrate, wherein each of the plurality of color filters covers and packages at least one of the plurality of Micro-LED chips to obtain the display substrate.

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] In order to clearly illustrate the technical solution of the embodiments of the present disclosure, the drawings of the embodiments will be briefly described in the following; it is obvious that the described drawings are only related to some embodiments of the present disclosure and thus are not limitative of the present disclosure.

[0030] FIG. **1** is a schematic structural diagram of a display unit according to some embodiments of the present disclosure.

[0031] FIG. **2** is a schematic structural diagram of a display unit according to some embodiments of the present disclosure.

[0032] FIG. **3** is a schematic top view of a display substrate according to some embodiments of the present disclosure.

[0033] FIG. **4** is a sectional view along line A-A' in FIG. **3**.

[0034] FIG. **5** is a schematic block diagram of a display device according to some embodiments of the present disclosure.

[0035] FIG. **6** is a flow chart of a method of manufacturing a display substrate according to some embodiments of the present disclosure.

DETAILED DESCRIPTION

[0036] In order to make objects, technical details and advantages of the embodiments of the present disclosure apparent, the technical solutions of the embodiments will be described in a clearly and fully understandable way in connection with the drawings related to the embodiments of the present disclosure. Apparently, the described embodiments are just a part but not all of the embodiments of the present disclosure. Based on the described embodiments herein, those skilled in the art can obtain other embodiment (s), without any inventive work, which should be within the scope of the present disclosure.

[0037] Unless otherwise defined, all the technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which the present disclosure belongs. The terms "first," "second," etc., which are used in the description and the claims of the present application for invention, are not intended to indicate any sequence, amount or importance, but distinguish various components. Also, the terms such as "a," "an," etc., are not intended to limit the amount, but indicate the existence of at least one. The terms "comprise," "comprising," "include," "including," etc., are intended to specify that the elements or the objects stated before these terms encompass the elements or the objects and equivalents thereof listed after these terms, but do not preclude the other elements or objects. The phrases "connect", "connected", etc., are not intended to define a physical connection or mechanical connection, but may include an electrical connection, directly or indirectly. "On," "under," "right," "left" and the like are only used to indicate relative position relationship, and when the position of the object which is described is changed, the relative position relationship may be changed accordingly.

[0038] In order to keep the following description of the embodiments of the present disclosure clear and concise, detailed descriptions of known functions and known components are omitted in the present disclosure.

[0039] Usually, a Micro-LED display module is formed by transferring the Micro-LEDs in batches onto a circuit substrate, then making a protective layer and an electrode and finally performing packaging. A single Micro-LED is usually monochromatic. If the Micro-LED display module is desired to emit colored light, the Micro-LEDs in different colors are required to be transferred in batches onto the circuit substrate for many times to obtain a display array. However, the above-mentioned transferring technology is difficult, and a mounting accuracy is difficult to control, which causes a low product yield and fails to realize real volume production.

[0040] On the other hand, due to its small size, the Micro-LED may realize a high PPI display device, and thus may be applied to scenarios such as virtual display glasses, large screen projection, or the like. These applications have higher demands for display effects of the Micro-LED device, and a problem of visual graininess at the edge due to a pixel arrangement will be serious.

[0041] At least one embodiment of the present disclosure provides a display unit, including a base substrate, a Micro-LED chip and a color filter. The Micro-LED chip is arranged on the base substrate, and configured for emitting light in a first color. The color filter is arranged on the Micro-LED chip, is configured for packaging this Micro-LED chip and converting the light in a first color into an outgoing light in a second color, and includes a convex structure located in a light outgoing path of the Micro-LED chip.

[0042] FIG. **1** is a schematic structural diagram of a display unit **100** according to some embodiments of the present disclosure. As shown in FIG. **1**, the display unit **100** includes a Micro-LED chip **101** and a color filter **102** arranged on the base substrate **1021**.

[0043] For example, the Micro-LED chip **101** includes an unpackaged chip or a bare chip which is partially packaged or bonded, and may emit light in a first color in case of being provided with power. For example, the Micro-LED chip **101** is obtained by being manufactured on a supply base (for example, a sapphire base) through a semiconductor process, being cut and separated from this supply base, and the embodiments of the present disclosure have no limitation on the manufacturing material, process and structure of the Micro-LED chip. In some embodiments, this first color is white. In some other embodiments, this first color is blue, red, green, or the like.

[0044] The color filter **102** is arranged on the Micro-LED chip **101**. In some embodiments, the color filter **102** may cover the whole Micro-LED chip **101**. The color filter **102** is configured for packaging the Micro-LED chip **101**, i.e., sealing the Micro-LED chip **101** to prevent the Micro-LED chip **101** from being exposed to an external environment, prevent water vapor or oxygen gas in the air from entering or penetrating the display unit **100**, thereby avoiding adverse influences on the performance of the Micro-LED chip **101**, and eliminating the need of a separate package or seal structure. In addition, the color filter **102** has a color filtering function, and is further configured for converting the light in

the first color emitted from the Micro-LED chip **101** into the outgoing light in the second color. For example, the second color may be red, blue, green, or the like. In the embodiments of the present disclosure, the color filter **102** not only packages the Micro-LED chip **101**, but also enables the display unit **101** to emit the light in a desired color, thereby achieving, for example, displaying color.

[0045] For example, in an embodiment of the present disclosure, the Micro-LED chip **101** may emit white light, and the color filter **102** may convert the white light emitted from the Micro-LED chip **101** into red, blue or green light, thereby emitting red, blue or green outgoing light through the Micro-LED chip which emits white light.

[0046] In some embodiments of the present disclosure, the color filter **102** may include a convex structure which is convex away from the Micro-LED chip **101**. The convex structure may have any shapes, for example, hemisphere, polyhedron, or the like. In some embodiments of the present disclosure, the convex structure is a convex lens structure, thereby obtaining a microlens corresponding to the Micro-LED chip **101**. For example, in FIG. **1**, the color filter **102** is entirely shown having a planoconvex lens structure.

[0047] FIG. **2** is a schematic structural diagram of a display unit **200** according to some other embodiments of the present disclosure. As shown in FIG. **2**, the display unit **200** includes a Micro-LED chip **201** and a color filter **202** arranged on a base substrate **2021**, and the color filter **202** has a structure in which the planoconvex lens is combined with a columnar part (such as a cylinder, a square column, or the like). Although it is shown in FIGS. **1** and **2** that a part of the color filter has a planoconvex lens structure, persons skilled in the art should understand that the color filter may have a convex lens structure in other forms, such as a meniscus lens, and the embodiments of the present disclosure are not limited thereto.

[0048] In the embodiments as shown in FIG. **1**, the color filter **102** may include a convex portion **1022**. The convex portion **1022** is an example of the above-mentioned convex structure. The convex portion **1022** may be arranged on the base substrate **1021** through pressing, photoetching, or the like, and may be of the above-mentioned second color, such as red, blue, green, or the like. The convex portion **1022** is located in a light outgoing path of the Micro-LED chip **101**, and the light in the first color emitted from the Micro-LED chip **101** may be converted into light in the second color after passing through the convex portion **1022**. The convex portion **1022** may be made of various appropriate materials, such as glass, resin, photoresist which is at least partially transparent, or the like. In some embodiments, the convex portion **1022** may be made of entirely transparent photoresist.

[0049] In the embodiments as shown in FIG. **2**, the color filter **202** may include a base **2022** and a convex portion **2023**. The convex portion **2023** is an example of the above-mentioned convex structure. The base **2022** and the convex portion **2023** may be arranged on the base substrate **2021** through pressing, photoetching, or the like, and one of the base **2022** and the convex portion **2023** may be of the above-mentioned second color, such as red, blue, green, or the like. The light in the first color emitted from the Micro-LED chip **201** may be converted into light in the second color after passing through the color filter **202**. The convex portion **2023** is formed on the base **2022**, for example, the convex portion **2023** may be integrally formed with the base **2022**, or the convex portion **2023** and the base **2022** may be separately formed. In some embodiments, the base **2022** may be made of glass, resin, photoresist, or the like. For example, the convex portion **2023** may be obtained by coating the photoresist which is at least partially transparent on the base **2022** and exposing, developing the photoresist through a semi-transparent mask. In some embodiments, the convex portion **2023** may be made of entirely transparent photoresist. As mentioned above, the base **2022** and the convex portion **2023** may be made of different materials. However, persons skilled in the art should understand that the base **2022** and the convex portion **2023** may also be made of the same material. For example, the base **2022** and the convex portion **2023** may both be made of glass, resin, or photoresist which is at least partially transparent, and the embodiments of the present disclosure are not limited thereto.

[0050] As shown in FIGS. **1** and **2**, a part (such as the convex portion) of the color filter may have a planoconvex lens structure. The relation between a curvature radius and a focal length of the planoconvex lens is as follows:

$$r=f*(n-1)$$

where r is a curvature radius of the planoconvex lens, f is a focal length of the planoconvex lens, and n is a refractive index of the planoconvex lens.

[0051] In some embodiments, when the Micro-LED chip is located at a focal point of the convex lens, more specifically, a light outgoing position of the Micro-LED chip is located at the focal point of the convex lens, the color filter may convert the light emitted from the Micro-LED chip into parallel light, i.e., the color filter has a collimation function. In the present disclosure, the parallel light may refer to collimated light. In some other embodiments, when a distance from the Micro-LED chip to an optical center of the convex lens is less than a focal length of the convex lens, more specifically, a distance from a light outgoing position of the Micro-LED chip to the optical center of the convex lens is less than the focal length of the convex lens, the color filter may further have a function of diverging light. In different applications, based on actual requirements, the convex portion of the color filter may have different curvature radii so that the color filter implements different functions.

[0052] In the embodiments of the present disclosure, how to determine the curvature radius of the convex portion of the color filter is explained by taking the planoconvex lens as an example. In the case where the convex portion of the color filter has other lens structures, the curvature radius of the convex portion of the color filter may be determined based on the specific lens structure.

[0053] For another example, in addition to the convex portion, the color filter may further include a color layer configured for achieving the color filtering function. This color layer may be arranged in a light emitting path of the Micro-LED chip, for example, at an upper surface of the convex portion, or between the base and convex portion, or the like, and the embodiments of the present disclosure are not limited thereto. Additionally, as mentioned above, the color filter may not include a separately provided color layer. In this case, the convex portion and/or the base of the color filter may have the function of filtering color, for example, a color converting material is mixed in the convex portion and/or the base.

[0054] In the display unit according to some embodiments of the present disclosure, the color filter converts the light emitted from the Micro-LED chip into substantially parallel outgoing light or divergent outgoing light. Therefore, when the display unit is in use, an extra light collimating device or light diverging device is no longer required to be arranged in the light outgoing path of the display unit.

[0055] The Micro-LED chip according to the present disclosure has a dimension of 1 micron~10 microns in at least one direction. For example, the Micro-LED chip has a dimension of 1 micron, 5 microns, 10 microns, or the like in at least one direction. In addition, persons skilled in the art should understand that the display unit according to the embodiments of the present disclosure may include more Micro-LED chips, such as 2, 3, 4 or the like.

[0056] The display unit according to embodiments of the present disclosure may achieve displaying color, and may provide parallel light to reduce light loss or provide divergent light to implement magnification.

[0057] Some embodiments of the present disclosure further provide a display substrate which is provided with a plurality of mentioned-above display units arranged in an array. The plurality of display units are divided into a plurality of subarrays, each of which at least includes a first display unit and a second display unit which emit outgoing light in different colors. For example, the first and second display units are arranged adjacent to different types of display units in row and column directions.

[0058] As an example, the description will be made below by taking the subarray which includes three display units emitting outgoing light in three different colors as an example.

[0059] FIG. **3** is a schematic top view of a display substrate **300** according to some embodiments of the present disclosure. As shown in FIG. **3**, the display substrate **300** includes a base substrate **301** and a plurality of the mentioned-above display units according to any one of the embodiments of the present disclosure which are arranged on the base substrate **301** in an array. The plural display units are divided into a plurality of subarrays (one of the subarrays is shown in a dotted block in FIG. **3**).

[0060] In the embodiment shown in FIG. **3**, each subarray includes a first display unit **310**, a second display unit **320** and a third display unit **330**, and in each subarray, the first, second, and third display units **310**, **320** and **330** each are arranged adjacent to different types of display units in each of the row and column directions.

[0061] The first, second, and third display units **310**, **320** and **330** emit outgoing light in different colors. As an example, the first display unit **310** may emit red light, the second display unit **320** may emit green light, the third display unit **330** may emit blue light, and persons skilled in the art should understand that the present disclosure is not limited thereto. For example, the first display unit **310** may also emit blue or green light, the second display unit **320** may also emit red or blue light, and the third display unit **330** may emit red or green light.

[0062] In addition, although FIG. **3** shows that each subarray includes three display units, persons skilled in the art should understand that based on actual requirements, each subarray may further include display units which may emit outgoing light in more colors or less colors. For example, in some embodiments, each subarray may include two display units emitting outgoing light in two colors, or four display units emitting outgoing light in four colors, and the embodiments of the present disclosure are not limited thereto. For example, the four colors of the outgoing light may include red, green, blue and yellow (RGBY), wherein the display unit which emits yellow light includes a yellow color filter, or the four colors of the outgoing light may include includes red, green, blue and white (RGBW), wherein the display unit which emits white light does not include a color filter.

[0063] As shown in FIG. **3**, in some embodiments of the present disclosure, each subarrays has three rows and three columns, and each row and column of each subarray only includes one first display unit **310**, one second display unit **320** and one third display unit **330**. In the case where the subarray includes more or less types of display units, the subarray has more or less rows and columns. For example, in the case where the subarray includes two display units which emit outgoing light in two different colors, the subarray may have two rows and two columns; in the case where the subarray includes four display units which emit outgoing light in four different colors, the subarray may have four rows and four columns

[0064] The above-mentioned subarray is arranged repeatedly so that the first, second and third display units **310**, **320** and **330** of each subarray are arranged adjacent to different types of display units of adjacent subarrays in row and column directions. As shown in FIG. **3**, in the subarray shown by a dotted block, the second display unit **320** in the third row and the third column is adjacent to the third display units **330** of adjacent subarrays in the row and column directions. Since the first, second and third display units **310**, **320** and **330** emit light in three colors, the three colors may be distributed evenly on the display substrate by the above-mentioned arrangement.

[0065] As shown in FIG. **3**, in the first row of each subarray, the first, second and third display units **310**, **320** and **330** are arranged in sequence from left to right; in the second row of each subarray, the second, third and first display units **320**, **330** and **310** are arranged in sequence from left to right; and in the third row of each subarray, the third, first and second display units **330**, **320** and **310** are arranged in sequence from left to right. It should be understood that the above-mentioned left-to-right direction is merely exemplary, and in other embodiments, the display units may be arranged from right to left, and the embodiments of the present disclosure have no limitation in this aspect.

[0066] In some embodiments, the first display unit **310** may emit red light, the second display unit **320** may emit green light, and the third display unit **330** may emit blue light, and thus the first row of the subarray forms an R/G/B arrangement, the second row of the subarray forms a G/B/R arrangement, and the third row of the subarray forms a B/R/G arrangement. In some other embodiments, the first display unit **310** may emit red light, the second display unit **320** may emit blue light, and the third display unit **330** may emit green light, and thus the first row of the subarray forms an R/B/G arrangement, the second row of the subarray forms a B/G/R arrangement, and the third row of the subarray forms a G/R/B arrangement. Similarly, in other embodiments, the first, second and third display units **310**, **320** and **330** emitting one of red, green and blue lights may be arranged in other arrangements to obtain other color arrangements, and the embodiments of the present disclosure have no limitation in this aspect.

[0067] In the embodiments of the present disclosure, the problem of visual graininess at the edge when the display panel is cut into an irregular shape may be solved by arranging the first, second and third display units **310**, **320** and **330** in the subarray in the above-mentioned order.

[0068] FIG. **4** is a sectional view along A-A' line in FIG. **3**. As shown in FIG. **4**, a light blocking layer **302** is arranged on the base substrate **301**. The light blocking layer **302** is located between adjacent display units, and configured for protecting the base substrate **301** and blocking the light rays emitted from a side surface of the color filter, and preventing crosstalk. For example, the light blocking layer **302** for example, may be made of a light blocking material, such as a metal layer, a metal oxide layer, a dark resin layer, or the like.

[0069] A driving circuit **303** for a display unit may also be formed on the base substrate **301**. The Micro-LED chip is electrically connected with the driver circuit **303** through wire bonding, binding, or the like. The driver circuit **303** is configured for providing a driving voltage to the display unit so that the Micro-LED chip in the display unit may emit light. This driver circuit may be for example transistors, capacitors, or the like, and may include a switch transistor, a driver transistor and a storage capacitor (2T1C structure). The switch transistor is connected with a gate line and a data line, receives a data voltage signal from the data line under the control of a scan signal on the gate line, and then stores the data voltage signal in the storage capacitor and controls a conduction current of the driver transistor, thereby controlling a luminous intensity of the Micro-LED in the Micro-LED chip. In FIG. **4**, the driver circuit **303** is shown by taking a thin film transistor as an example, and a gate of the thin film transistor is electrically connected with the gate line, a source of the thin film transistor is connected with the data line, and a source of the thin film transistor may be electrically connected with the Micro-LED chip in the corresponding display unit, thereby providing the data voltage signal provided by the data line to the Micro-LED chip under the control of the scan signal on the gate line, so as to drive the Micro-LED chip to emit light.

[0070] The base substrate **301** may be made of a material such as glass, ceramic, polyimide, silicon, or the like, and may be for example a single-layer substrate or a multi-layer substrate. In the case where the base substrate **301** is a silica-based substrate, the driver circuit **303** may be formed on the base substrate **301** through the semiconductor process conveniently, which simplifies the manufacturing process of the display substrate. In some embodiments, the Micro-LED chip and the color filter of the display unit of the display substrate are formed on the same base substrate. For example, in the embodiments shown in FIGS. **3** to **4**, the base substrate **301** is used as the base substrate of each of the display units **310**-**330**. That is, the display units of the display substrate **300** share the same base substrate **301**. However, in another embodiment, the Micro-LED chips and the color filters of a part of the display units of the display substrate may be arranged on a base substrate, whereas the Micro-LED chips and the color filters of another part of the display units of the display substrate may be arranged on another base substrate, and the embodiments of the present disclosure have no limitation in this aspect.

[0071] Some embodiments of the present disclosure further provide a display device, including the above-mentioned display substrate. As shown in FIG. **5**, the display device **500** according to some embodiments of the present disclosure may include a display substrate **510**. The display device **500**, for example, may be a Micro-LED display, or a liquid crystal display, wherein the display substrate **510** is used as a backlight source of the display device **500**, and the display device **500** may further include other elements, such as a liquid crystal layer. The display device **500** may be a display screen arranged in a virtual reality display device or an augmented reality display device. For example, the display screen has an irregular shape (such as ellipse) which is not rectangular, and is configured for receiving a display signal from a controller in the virtual reality display device or the augmented reality display device so as to display images.

[0072] Some embodiments of the present disclosure further provide a method of manufacturing the above-mentioned display substrate. As shown in FIG. **6**, the method **600** of manufacturing the display substrate according to some embodiments of the present disclosure include steps S**610** and S**620**.

[0073] In step S**610**, a plurality of Micro-LED chips in the same color are transferred onto the base substrate.

[0074] The Micro-LED chip is an unpackaged bare chip. In some embodiments, the Micro-LED chips may be transferred onto the base substrate through a micro-transfer technology. For example, separate Micro-LED chips are obtained by being manufactured and cut on a semiconductor base (such as a silicon base). In the micro-transfer technology, the transfer of the Micro-LED chip is finished by using a patterned transfer head, for example, a Polydimethylsiloxane (PDMS) transfer head with a convex structure to pick up the Micro-LED chip (that is, the bare chip) from the supply substrate through a PDMS transfer layer with adhesiveness, aligning the PDMS transfer head with a reception substrate, attaching the Micro-LED chip picked up by the PDMS transfer head onto a preset position of the reception substrate, and finally peeling the PDMS transfer head from the reception substrate.

[0075] In step S**620**, a plurality of color filters is arranged on the base substrate, wherein each color filter covers and packages at least one Micro-LED chip to obtain the display substrate.

[0076] For example, the color filter may be manufactured in advance, or may be manufactured on the base substrate after the Micro-LED chip is transferred to the base substrate, for example, through pressing, photoetching, or the like, and the embodiments of the present disclosure are not limited thereto. For example, when the color filter is made of colored glass cement or colored resin, the colored glass cement or colored resin which is not cured may be first applied onto the display substrate provided with the display unit, a microlens corresponding to the display unit is obtained by pressing the applied colored glass cement or colored resin, and then curing is performed to obtain the color filter with a required shape. The red, green and blue color filters may be manufactured in sequence. The obtained color filters not only serve to filter color and modulate light, but also achieve the function of packaging (sealing). As required, the color converting material may also be added in the colored glass cement or colored resin, for example, a fluorescent material, a quantum dot material, or the like, thereby converting incident white light into light in a preset color, and improving an optical purity and a luminous intensity of the color filter.

[0077] The descriptions about the Micro-LED chip, color filter, and base substrate mentioned in the method **600** may refer to the above-mentioned description related to FIGS. **1** to **4**, and are not repeated herein.

[0078] In the method of manufacturing the display substrate according to the embodiments of the present disclosure, the Micro-LEDs emitting light in different colors may be prevented from being transferred to the base substrate in batches for many times, the difficulty and the accuracy requirement are reduced, and the product yield is improved.

[0079] The foregoing are merely exemplary embodiments of the disclosure, and not intended to define the scope of the disclosure, and the scope of the disclosure is determined by the appended claims.

What is claimed is:

1. A display unit, comprising:

a micro light emitting diode (Micro-LED) chip, arranged on a base substrate and configured for emitting light in a first color; and

a color filter, the color filter being arranged on the Micro-LED chip, the color filter being configured for packaging the Micro-LED chip and converting the light in the first color into an outgoing light in a second color, and the color filter comprising a convex structure in a light outgoing path of the Micro-LED chip.

2. The display unit according to claim **1**, wherein the convex structure is a convex lens structure.

3. The display unit according to claim **2**, wherein the Micro-LED chip is at a focal point of the convex lens, so as to convert the light in the first color emitted from the Micro-LED chip into the outgoing light in the second color, and the outgoing light in the second color is substantially parallel.

4. The display unit according to claim **2**, wherein a distance from the micro-LED chip to an optical center of the convex lens is less than a focal length of the convex lens.

5. The display unit according to claim **1**, wherein in at least one direction, the Micro-LED chip has a dimension in a range of 1 micron~10 microns.

6. The display unit according to claim **1**, wherein the first color is white, and the second color is one selected from a group consisting of red, blue and green.

7. A display substrate, comprising:

a base substrate; and

a plurality of display units, arranged on the base substrate in an array,

wherein each of the plurality of display units comprises:

a micro light emitting diode (Micro-LED) chip, arranged on a base substrate and configured for emitting light in a first color; and

a color filter, the color filter being arranged on the Micro-LED chip, the color filter being configured for packaging the Micro-LED chip and converting the light in the first color into an outgoing light in a second color, and the color filter comprising a convex structure in a light outgoing path of the Micro-LED chip, and

the plurality of display units are divided into a plurality of subarrays, each of the plurality of subarrays comprises a first display unit, a second display unit and a third display unit, the first display unit, the second display unit and the third display unit emit outgoing light in different colors.

8. The display substrate according to claim **7**, wherein in each of the plurality of subarrays, each of the first display unit, the second display unit and the third display unit is arranged adjacent to a different type of display unit in each of a row direction and a column direction.

9. The display substrate according to claim **8**, wherein each of the first display unit, the second display unit and the third display unit of each of the plurality of subarrays is arranged adjacent to a different type of display unit of an adjacent subarray in each of the row direction and the column direction.

10. The display substrate according to claim **9**, wherein

the outgoing light emitted from each of the first display unit, the second display unit and the third display unit has a color of one selected from a group consisting of red, green and blue, and the outgoing light emitted from the first display unit, the second display unit and the third display unit has different colors.

11. The display substrate according to claim **10**, wherein each of the plurality of subarrays comprises:

the first display unit, the second display unit and the third display unit arranged in sequence in a first direction in a first row;

the second display unit, the third display unit and the first display unit arranged in sequence in the first direction in a second row; and

the third display unit, the first display unit and the second display unit arranged in sequence in the first direction in a third row,

wherein the first display unit emits red outgoing light, the second display unit emits green outgoing light, and the third display unit emits blue outgoing light.

12. The display substrate according to claim **7**, further comprising a light blocking layer, wherein the light blocking layer is on the base substrate and between adjacent display units.

13. A display device, comprising the display substrate according to claim **7**.

14. A method of manufacturing the display substrate according to claim **7**, comprising:

transferring a plurality of Micro-LED chips in an identical color onto the base substrate; and

arranging a plurality of color filters on the base substrate, wherein each of the plurality of color filters covers and packages at least one of the plurality of Micro-LED chips to obtain the display substrate.

15. The display unit according to claim **2**, wherein the first color is white, and the second color is one selected from a group consisting of red, blue and green.

16. The display unit according to claim **3**, wherein the first color is white, and the second color is one selected from a group consisting of red, blue and green.

17. The display unit according to claim **4**, wherein the first color is white, and the second color is one selected from a group consisting of red, blue and green.

18. The display unit according to claim **5**, wherein the first color is white, and the second color is one selected from a group consisting of red, blue and green.

19. The display substrate according to claim **7**, wherein the convex structure is a convex lens structure.

20. The display substrate according to claim **7**, wherein the Micro-LED chip is at a focal point of the convex lens,

so as to convert the light in the first color emitted from the Micro-LED chip into the outgoing light in the second color, and

the outgoing light in the second color is substantially parallel.

* * * * *

专利名称(译)	显示单元，显示基板及其制造方法，显示装置		
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[标]申请(专利权)人(译)	北京京东方显示技术有限公司 京东方科技集团股份有限公司		
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摘要(译)

显示单元，显示基板及其制造方法和显示装置。 显示单元包括：布置在基础基板上的Micro-LED芯片和滤色器。 微型LED芯片被配置用于发射第一颜色的光。 彩色滤光片设置在Micro-LED芯片上，用于封装Micro-LED芯片并将第一颜色的光转换为第二颜色的出射光，并且在Micro的光出射路径中包括凸结构。 -LED芯片。