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Micro light emitting device structure and display apparatus

Abstract

A micro light emitting device structure includes a substrate, a connecting layer, a micro light emitting device and a covering layer. The connecting layer is connected to the substrate. The micro light emitting device is removably connected to the connecting layer, and includes a semiconductor epitaxial structure and two electrodes. The semiconductor epitaxial structure has an outer surface. The electrodes are disposed on a first surface of the outer surface of the semiconductor epitaxial structure, or disposed on the first surface of the outer surface of the semiconductor epitaxial structure and a second surface of the semiconductor epitaxial structure away from the first surface, respectively. The covering layer is disposed on the outer surface of the semiconductor epitaxial structure.

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Background/Summary

RELATED APPLICATIONS
(1) This application claims priority to Taiwan Application Serial Number 110111808, filed Mar. 31, 2021, which is herein incorporated by reference.
BACKGROUND
Technical Field
(2) The present disclosure relates to a micro light emitting device structure and a display apparatus. More particularly, the present disclosure relates to a micro light emitting device structure and a display apparatus, which can be configured to enhance the yield rate and improve the process.
Description of Related Art
(3) In the conventional art, when micro light emitting devices are disposed on a substrate, a covering layer (such as silicon oxide, SiO.sub.2) is sputtered on an upper surface of each of the micro light emitting devices before removing a connecting layer (such as adhesive layer) between the micro light emitting devices, and the connecting layer between the micro light emitting devices are then removed. However, the aforementioned process is limited to the spacing between the micro light emitting device and the characteristic of the connecting layer, and the connecting layer between the micro light emitting devices is easily remained.
(4) Hence, a micro light emitting device structure and a display apparatus, which are not limited to the spacing between micro light emitting devices and the characteristic of a connecting layer, need to be developed.
SUMMARY
(5) According to one aspect of the present disclosure, a micro light emitting device structure includes a substrate, a connecting layer, a micro light emitting device and a covering layer. The connecting layer is connected to the substrate. The micro light emitting device is removably connected to the connecting layer, and includes a semiconductor epitaxial structure and two electrodes. The semiconductor epitaxial structure has an outer surface. The electrodes are disposed on a first surface of the outer surface of the semiconductor epitaxial structure, or disposed on the first surface of the outer surface of the semiconductor epitaxial structure and a second surface of the semiconductor epitaxial structure away from the first surface, respectively. The covering layer is disposed on the outer surface of the semiconductor epitaxial structure.
(6) According to another aspect of the present disclosure, a display apparatus includes a circuit substrate, a plurality of micro light emitting devices, a covering layer and an isolation layer. The circuit substrate includes a pad layer. The micro light emitting devices are electrically connected to the circuit substrate via the pad layer, and each of the micro light emitting devices includes a semiconductor epitaxial structure and two electrodes. The semiconductor epitaxial structure has an outer surface. The electrodes are disposed on the semiconductor epitaxial structure, and electrically connected to the pad layer. The covering layer is disposed on the outer surface of the

semiconductor epitaxial structure. The isolation layer is disposed on the outer surface of the semiconductor epitaxial structure, and the covering layer is contacted with the isolation layer.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) FIG. **1** is a schematic view of a micro light emitting device structure according to an embodiment of the present disclosure.

(2) FIG. **2** is a transferring schematic view of the micro light emitting device structure according to the embodiment in FIG. **1**.

(3) FIG. **3** is a breaking schematic view of the micro light emitting device structure according to the embodiment in FIG. **2**.

(4) FIG. **4** is a schematic view of the micro light emitting device structure after transferring according to the embodiment in FIG. **1**.

(5) FIG. **5** is another schematic view of the micro light emitting device structure after transferring according to the embodiment in FIG. **1**.

(6) FIG. **6** is a schematic view of a micro light emitting device structure according to another embodiment of the present disclosure.

(7) FIG. **7** is an assembling schematic view of a substrate, a connecting layer, a semiconductor epitaxial structure and a covering layer according to an embodiment of the present disclosure.

(8) FIG. **8** is a schematic view of disposing electrodes of a micro light emitting device structure according to the embodiment in FIG. **7**.

(9) FIG. **9** is a transferring schematic view of the micro light emitting device structure according to the embodiment in FIG. **7**.

(10) FIG. **10** is a schematic view of the micro light emitting device structure after transferring according to the embodiment in FIG. **7**.

(11) FIG. **11** is another schematic view of the micro light emitting device structure after transferring according to the embodiment in FIG. **7**.

(12) FIG. **12** is an assembling schematic view of a substrate, a connecting layer, a semiconductor epitaxial structure and a covering layer according to another embodiment of the present disclosure.

(13) FIG. **13** is a transferring schematic view of the semiconductor epitaxial structure and the covering layer according to the embodiment in FIG. **12**.

(14) FIG. **14** is a schematic view of disposing an electrode of a micro light emitting device structure after transferring according to the embodiment in FIG. **12**.

(15) FIG. **15** is another schematic view of disposing the electrode of the micro light emitting device structure after transferring according to the embodiment in FIG. **12**.

(16) FIG. **16** is a schematic view of a display apparatus according to an embodiment of the present disclosure.

(17) FIG. **17** is a schematic view of a display apparatus according to another embodiment of the present disclosure.

(18) FIG. **18** is another schematic view of the display apparatus according to the embodiment in FIG. **17**.

DETAILED DESCRIPTION

(19) FIG. **1** is a schematic view of a micro light emitting device structure **100** according to an embodiment of the present disclosure. In FIG. **1**, the micro light emitting device structure **100** includes a substrate **111**, a connecting layer **121**, a micro light emitting device **130** and a covering layer **140**.

(20) The connecting layer **121** is connected to the substrate **111**, wherein the substrate **111** can be a temporary substrate (that is, a non-circuit substrate, which is configured to temporarily carry the

micro light emitting devices for the mass transfer), and the substrate **111** can be a sapphire substrate or a glass substrate, which are the non-circuit substrates with high flatness, but the present disclosure is not limited thereto.
(21) The micro light emitting device **130** is removably connected to the connecting layer **121**, and includes a semiconductor epitaxial structure **132** and two electrodes, wherein the semiconductor epitaxial structure **132** has an outer surface, and includes a first semiconductor layer **133**, a light emitting layer **134** and a second semiconductor layer **135**. Furthermore, the light emitting layer **134** is disposed between the first semiconductor layer **133** and the second semiconductor layer **135**, and the electrodes are disposed a first surface **136** of the outer surface of the semiconductor epitaxial structure **132**, wherein the electrodes includes a first electrode **131***a* and a second electrode **131***b*, which have the opposite electrical properties, the first electrode **131***a* is electrically connected to the second semiconductor layer **135**, and the second electrode **131***b* is electrically connected to the first semiconductor layer **133**.
(22) The covering layer **140** is disposed on the outer surface of the semiconductor epitaxial structure **132** and an outer surface of the connecting layer **121**. In detail, the covering layer **140** is disposed on a second surface **137** and a lateral surface **138** of the semiconductor epitaxial structure **132**, wherein the second surface **137** is relative to the first surface **136** of the semiconductor epitaxial structure **132**. In particular, according to the embodiment of FIG. **1**, the micro light emitting device **130** is a flip-chip micro LED.
(23) By the aforementioned disposition of the micro light emitting device structure **100**, when the transferring process is performed, the micro light emitting device **130** is temporarily fixed on the substrate **111** via the connecting layer **121**. The micro light emitting device **130** can be smoothly removed from the substrate **111**, and the micro light emitting device **130** is transferred to a transferring substrate **112** (as shown in FIG. **2**) to proceed the following process. By the disposition of the covering layer **140**, the micro light emitting device structure **100** can be effectively protected during the transferring process to promote the yield rate.
(24) Moreover, a Young's modulus of the covering layer **140** is larger than a Young's modulus of the connecting layer **121**, wherein the Young's modulus of the covering layer **140** is larger than or equal to **15** times of the Young's modulus of the connecting layer **121**. When the Young's modulus of the covering layer **140** is less than **15** times of the Young's modulus of the connecting layer **121**, the covering layer **140** or the connecting layer **121** may be easily remained on the micro light emitting device **130**. Further, the difference of the Young's modulus is favorable for separating the micro light emitting device **130** from the connecting layer **121**.
(25) The micro light emitting device structure **100** further includes an isolation layer **150**, wherein the isolation layer **150** is disposed on the first surface **136**, and the covering layer **140** is contacted with a lateral surface of the isolation layer **150**. The isolation layer **150** is merely disposed on the first surface **136**, and hence the space of the lateral surface is not occupied to obtain the higher space utilization during the process.
(26) A material of the covering layer **140** can be the same as or different from a material of the isolation layer **150**, wherein the Young's modulus of the covering layer **140** is less than or equal to a Young's modulus of the isolation layer **150**, a thickness of the covering layer **140** is less than or equal to a thickness of the isolation layer **150**, and a hardness of the covering layer **140** is less than or equal to a hardness of the isolation layer **150**. Because the Young's modulus of the covering layer **140** is less than or equal to the Young's modulus of the isolation layer **150**, the transferring efficiency can be promoted, and the covering layer **140** can be avoided remaining on the micro light emitting device **130**. Moreover, when at least one of the hardness, the thickness and the Young's modulus of the covering layer **140** is less than the hardness, the thickness and the Young's modulus of the isolation layer **150**, the better transferring efficiency can be obtained. It should be mentioned that both of the isolation layer **150** and the covering layer **140** can be made of an inorganic material, such as isolation materials, which can be silicon dioxide or aluminum nitride,

and the connecting layer **121** can be an organic material to more easily separate from the micro light emitting device **130** during the following process.
(27) Furthermore, an angle θ**1** is between the covering layer **140** and the isolation layer **150**, wherein the angle θ**1** can be less than or equal to 90 degrees. Therefore, the connecting layer **121** is more hardly remained during transferring the micro light emitting device structure **100**. Furthermore, when the angle θ**1** is less than or equal to 50 degrees, the micro light emitting device structure **100** can have the better transferring and separating point during transferring under pressing by a transferring device (not shown). Moreover, a cross-sectional view of the covering layer **140** and the isolation layer **150** is trapezoid, convex or inverted trapezoid, but the present disclosure is not limited thereto.
(28) FIG. **2** is a transferring schematic view of the micro light emitting device structure **100** according to the embodiment in FIG. **1**. FIG. **3** is a breaking schematic view of the micro light emitting device structure **100** according to the embodiment in FIG. **2**. In FIGS. **2** and **3**, when the micro light emitting device structure **100** is transferred, the transferring substrate **112** is disposed on the micro light emitting device **130** and the covering layer **140**, wherein a transferring material **122** is contacted with the covering layer **140** on the second surface **137** of the semiconductor epitaxial structure **132**, and the transferring material **122** is disposed between the transferring substrate **112** and the covering layer **140** to connect the transferring substrate **112** and the micro light emitting device **130** of the micro light emitting device structure **100**. Further, the micro light emitting device structure **100** is pressed via the transferring substrate **112**, the connecting layer **121** is squeezed and deformed, and the connecting layer **121** is broken along a breaking line B, wherein the connecting layer **121** can be broken from a breaking beginning point P, but the present disclosure is not limited thereto. It should be mentioned that a material of the transferring substrate **112** and the material of the substrate **111** can be the same to avoid the transferring displacement of the micro light emitting device **130** because of the difference of the pressure and the temperature, and a material of the transferring material **122** and the material of the connecting layer **121** can be the same to be favorable for the micro light emitting device structure **100** to be further transferred to another substrate, but the present disclosure is not limited thereto.
(29) Moreover, both of the Young's modulus of the covering layer **140** and the Young's modulus of the isolation layer **150** are larger than the Young's modulus of the connecting layer **121** and a Young's modulus of the transferring material **122**. By the difference of the Young's modulus, the connecting layer **121** is hardly remained on a surface of the isolation layer **150**.
(30) FIG. **4** is a schematic view of the micro light emitting device structure **100** after transferring according to the embodiment in FIG. **1**. In FIG. **4**, after transferring the micro light emitting device structure **100**, the connecting layer **121** is separated from a surface of the isolation layer **150** and surfaces of the electrodes (that is, the first electrode **131***a* and the second electrode **131***b*), and a residual side (not shown) of the covering layer **140** may be formed on an edge of the first surface **136** of the semiconductor epitaxial structure **132**. Hence, the micro light emitting device structure **100** according to the embodiment of FIG. **4** can be obtained by purging the residual side of the covering layer **140** after transferring to avoid the residual side of the covering layer **140** influencing the following assembling process. Further, according to the embodiment of FIG. **4**, the covering layer **140** is merely disposed on the lateral surface of the isolation layer **150**, and the isolation layer **150** is further disposed on a portion of the lateral surface **138** of the outer surface of the semiconductor epitaxial structure **132**.
(31) FIG. **5** is another schematic view of the micro light emitting device structure **100** after transferring according to the embodiment in FIG. **1**. In FIG. **5**, the covering layer **140** can be further disposed on the isolation layer **150**, and the isolation layer **150** is further disposed on the portion of the lateral surface **138** of the outer surface of the semiconductor epitaxial structure **132**, wherein a disposing distance D of the covering layer **140** is less than or equal to 10 μm. In detail, the disposing distance D of the covering layer **140** is about 3 μm to 4 μm, wherein the covering

layer **140** covers a portion of the isolation layer **150**, and both of the isolation layer **150** and the covering layer **140** cover a lateral surface of the light emitting layer **134**. Therefore, the light emitting layer **134** can be entirely protected by the dual protection of the isolation layer **150** and the covering layer **140**. In particular, if the disposing distance D is larger than 10 μm, that is, the covering layer **140** is too close to a center of the micro light emitting device **130**, the connecting layer **121** is hardly broken along the breaking line B (shown as FIG. **3**) during the transferring process, and the connecting layer **121** is easily remained on the surface of the isolation layer **150**.
(32) In detail, when the covering layer **140** and the isolation layer **150** are disposed on a light emitting surface of the micro light emitting device **130**, the covering layer **140** and the isolation layer **150** are configured to guide the light; when the covering layer **140** and the isolation layer **150** are disposed on the lateral surface **138** of the semiconductor epitaxial structure **132**, the covering layer **140** and the isolation layer **150** are configured to isolate and protect.
(33) FIG. **6** is a schematic view of a micro light emitting device structure **200** according to another embodiment of the present disclosure. In FIG. **6**, the micro light emitting device structure **200** includes a substrate **211**, a connecting layer **221**, a micro light emitting device **230**, a covering layer **240** and an isolation layer **250**.
(34) The micro light emitting device **230** is removably connected to the connecting layer **221**, and the covering layer **240** is disposed on an outer surface of a semiconductor epitaxial structure **232** and an outer surface of the connecting layer **221**. The isolation layer **250** is disposed on a first surface **236** and a lateral surface **238** of the semiconductor epitaxial structure **232**, and the isolation layer **250** disposed on the lateral surface **238** of the semiconductor epitaxial structure **232** entirely overlaps the covering layer **240** disposed on the lateral surface **238** of the semiconductor epitaxial structure **232**. In particular, the covering layer **240** is disposed on the outermost, and the isolation layer **250** is disposed between the covering layer **240** and the semiconductor epitaxial structure **232**. Therefore, the lateral surface **238** of the semiconductor epitaxial structure **232** can be entirely protected by the dual protection of the isolation layer **250** and the covering layer **240**.
(35) Further, all of other structures and dispositions according to the embodiment of FIG. **6** are the same as the structures and the dispositions according to the embodiment of FIG. **1**, and will not be described again herein.
(36) FIG. **7** is an assembling schematic view of a substrate **311**, a connecting layer **321**, a semiconductor epitaxial structure **332** and a covering layer **340** according to an embodiment of the present disclosure. FIG. **8** is a schematic view of disposing electrodes of a micro light emitting device structure **300** according to the embodiment in FIG. **7**. In FIGS. **7** and **8**, the micro light emitting device structure **300** includes the substrate **311**, the connecting layer **321**, a micro light emitting device **330** and the covering layer **340**.
(37) The micro light emitting device **330** is removably connected to the connecting layer **321**, and the covering layer **340** is disposed on an outer surface of the semiconductor epitaxial structure **332** and an outer surface of the connecting layer **321**. In detail, the covering layer **340** is disposed on a first surface **336** and a lateral surface **338** of the semiconductor epitaxial structure **332**. Therefore, the micro light emitting device structure **300** can be effectively protected during the transferring process. Furthermore, the covering layer **340** can be disposed on the outer surface of the semiconductor epitaxial structure **332** and the outer surface of the connecting layer **321**, a portion of the covering layer **340** is then removed to form openings, an insulating layer **360** is disposed on inner walls of the openings, and electrodes (that is, a first electrode **331***a* and a second electrode **331***b*) are disposed on the semiconductor epitaxial structure **332**, but the present disclosure is not limited thereto.
(38) FIG. **9** is a transferring schematic view of the micro light emitting device structure **300** according to the embodiment in FIG. **7**. In FIG. **9**, when the micro light emitting device structure **300** is transferred, a transferring substrate **312** is disposed on the micro light emitting device **330**, wherein a transferring material **322** is contacted with the covering layer **340** on the first surface **336**

of the semiconductor epitaxial structure **332**, and the transferring material **322** is disposed between the transferring substrate **312** and the covering layer **340** to connect the transferring substrate **312** and the micro light emitting device **330** of the micro light emitting device structure **300**. Further, the micro light emitting device structure **300** is pressed via the transferring substrate **312**, and the covering layer **340** and the connecting layer **321** are squeezed and deformed.

(39) Moreover, both of a Young's modulus of the covering layer **340** and a Young's modulus of the semiconductor epitaxial structure **332** are larger than a Young's modulus of the connecting layer **321**, wherein the Young's modulus of the semiconductor epitaxial structure **332** is larger than 15 times of the Young's modulus of the connecting layer **321** and the Young's modulus of the transferring material **322**, but the present disclosure is not limited thereto. The difference of the Young's modulus is favorable for separating the micro light emitting device **330** from the connecting layer **321**, and the connecting layer **321** is hardly remained on a second surface **337** of the semiconductor epitaxial structure **332**, wherein the second surface **337** is away from the first surface **336** of the semiconductor epitaxial structure **332**. Moreover, the connecting layer **321** and the transferring material **322** can be configured to cushion to protect the micro light emitting device **330**. It should be mentioned that a projecting area of the connecting layer **321** on the substrate **311** is less than a projecting area of the second surface **337** on the substrate **311**, hence the connecting layer **321** is contracted under the semiconductor epitaxial structure **332**, and the covering layer **340** is also contracted under the semiconductor epitaxial structure **332**. When a contracting distance of the covering layer **340** contracted under the semiconductor epitaxial structure **332** is d, the covering layer **340** has a contracting angle θ**2**, which is on a connecting area between the semiconductor epitaxial structure **332** and the connecting layer **321**, and the contracting angle θ**2** can be less than or equal to 90 degrees. Hence, the connecting layer **321** is easily squeezed to deform and break in the following process by the contracting angle θ**2**.

(40) FIG. **10** is a schematic view of the micro light emitting device structure **300** after transferring according to the embodiment in FIG. **7**. FIG. **11** is another schematic view of the micro light emitting device structure **300** after transferring according to the embodiment in FIG. **7**. In FIGS. **10** and **11**, the covering layer **340** is contacted with the transferring material **322**, and the connecting layer **321** is removed after transferring.

(41) According to the embodiment of FIG. **11**, the covering layer **340** can be further disposed on the second surface **337** of the semiconductor epitaxial structure **332** by the contracting disposition. Further, when the covering layer **340** is disposed on the second surface **337** of the semiconductor epitaxial structure **332**, a projecting area of the covering layer **340** on the second surface **337** is A**1**, and a surface area of the second surface **337** is A**2**, the following condition can be satisfied: 0.8 A**2**≤A**1**≤A**2**. Therefore, a light emitting area of the micro light emitting device **330** can be increased, and the light guiding efficiency can be promoted.

(42) In detail, when the covering layer **340** is disposed on a light emitting surface of the micro light emitting device **330**, the covering layer **340** is configured to guide the light. Moreover, the covering layer **340** may not be contracted before transferring, hence the covering layer **340** is merely disposed on the lateral surface **338** of the semiconductor epitaxial structure **332**, and the covering layer **340** is configured to isolate, reflect and protect.

(43) It should be mentioned that the micro light emitting device structure **300** according to the embodiments of FIGS. **7** to **11** can be further transferred after transferring, and the transferring number can be determined under the real situation. Furthermore, an area of the covering layer **340**, which is configured to isolate a lateral surface to be an insulating layer, is the same as an area of the semiconductor epitaxial structure **332**, and the covering layer **340** can be obtained without the yellow-light process. In general, the insulating layer of the conventional art obtained by the yellow-light process is likely to obtain a structure similar to the eave because of the window, and the aforementioned structure is not favorable for the transferring process of the wafer. Therefore, according to the embodiment of FIGS. **7** to **11**, the process cost can be reduced, and the micro light

emitting device structure **300**, which is favorable for the transferring process of the wafer, can be obtained.

(44) Further, all of other structures and dispositions according to the embodiment of FIG. **7** are the same as the structures and the dispositions according to the embodiment of FIG. **1**, and will not be described again herein.

(45) FIG. **12** is an assembling schematic view of a substrate **411**, a connecting layer **421**, a semiconductor epitaxial structure **432** and a covering layer **440** according to another embodiment of the present disclosure. FIG. **13** is a transferring schematic view of the semiconductor epitaxial structure **432** and the covering layer **440** according to the embodiment in FIG. **12**. FIG. **14** is a schematic view of disposing an electrode **431** of a micro light emitting device structure **400** after transferring according to the embodiment in FIG. **12**. FIG. **15** is another schematic view of disposing the electrode **431** of the micro light emitting device structure **400** after transferring according to the embodiment in FIG. **12**. In FIGS. **12** to **15**, the micro light emitting device structure **400** includes the substrate **411**, the connecting layer **421**, a micro light emitting device **430** and the covering layer **440**.

(46) The micro light emitting device **430** is removably connected to the connecting layer **421**, and includes the electrodes and the semiconductor epitaxial structure **432**. The covering layer **440** is disposed on an outer surface of the semiconductor epitaxial structure **432** and an outer surface of the connecting layer **421**. In detail, the covering layer **440** is disposed on a first surface **435** and a lateral surface **438** of the semiconductor epitaxial structure **432**. Therefore, the micro light emitting device structure **400** can be effectively protected during the transferring process. Furthermore, the electrodes can be disposed on the first surface **435** of the semiconductor epitaxial structure **432** and a second surface **436** of the semiconductor epitaxial structure **432** away from the first surface **435**, respectively, after transferring. The electrode **431** disposed on the first surface **435** is disposed after the covering layer **440** removed a portion to form an opening, and the electrode **431** can be disposed before transferring or after transferring, but the present disclosure is not limited thereto. In particular, according to the embodiment of FIG. **12**, the micro light emitting device **430** can be a vertical micro LED, wherein the electrode **431** and another one electrode (not shown), which have the opposite electrical properties, are disposed on two relative surfaces (that is, the second surface **436** and the first surface **435**) of the semiconductor epitaxial structure **432**, respectively.

(47) In detail, when the micro light emitting device structure **400** is transferred, a transferring substrate **412** is disposed on the semiconductor epitaxial structure **432**, wherein a transferring material **422** is contacted with the covering layer **440** on the first surface **435** of the semiconductor epitaxial structure **432**, and the transferring material **422** is disposed between the transferring substrate **412** and the covering layer **440** to connect the transferring substrate **412** and the micro light emitting device **430** of the micro light emitting device structure **400**. Then, the micro light emitting device structure **400** is pressed via the transferring substrate **412**, the connecting layer **421** is squeezed and deformed, and the connecting layer **421** is broken.

(48) Moreover, both of a Young's modulus of the covering layer **440** and a Young's modulus of the semiconductor epitaxial structure **432** are larger than a Young's modulus of the connecting layer **421**.

(49) In FIG. **15**, the covering layer **440** can be further disposed on the second surface **436** of the semiconductor epitaxial structure **432**, and a disposing distance D of the covering layer **440** is larger than or equal to 0.5 μm, and the disposing distance D is less than or equal to 1 μm. At least one of the electrodes is connected to the covering layer **440**. According to the embodiment of FIG. **15**, the electrode **431** disposed on the second surface **436** is connected to the covering layer **440**. In particular, a disposing area of the electrode **431** can be controlled by controlling the covering layer **440** disposed on the second surface **436** of the semiconductor epitaxial structure **432**. Therefore, the enough area, which is configured to accept the electrons, can be provided. Simultaneously, the electrode **431** can be avoided being excessively disposed on the lateral surface **438** of the

semiconductor epitaxial structure **432**, and the situation of the electrical leakage on the side can be prevented.
(50) Further, all of other structures and dispositions according to the embodiment of FIG. **12** are the same as the structures and the dispositions according to the embodiment of FIG. **1**, and will not be described again herein.
(51) FIG. **16** is a schematic view of a display apparatus **500** according to an embodiment of the present disclosure. In FIG. **16**, the display apparatus **500** includes a circuit substrate **510**, a plurality of micro light emitting devices **520**, a covering layer **530** and an isolation layer **540**.
(52) The circuit substrate **510** includes a pad layer **511**, and the micro light emitting devices **520** are electrically connected to the circuit substrate **510** via the pad layer **511**, wherein a number of the micro light emitting devices **520** can at least three, and the micro light emitting devices **520** can be at least separated into a red micro light emitting device, a green micro light emitting device and a blue micro light emitting device according to the light emitting sources of different colors, but the present disclosure is not limited thereto.
(53) Each of the micro light emitting devices includes two electrodes and a semiconductor epitaxial structure **522**, wherein the semiconductor epitaxial structure **522** has an outer surface, and includes a first semiconductor epitaxial layer **523**, a light emitting layer **524** and a second semiconductor epitaxial layer **525**. Furthermore, the light emitting layer **524** is disposed between the first semiconductor epitaxial layer **523** and the second semiconductor epitaxial layer **525**, and the electrodes are disposed on the semiconductor epitaxial structure **522**, and electrically connected to the pad layer **511**, wherein the electrodes includes a first electrode **521***a* and a second electrode **521***b*, which have the opposite electrical properties, the first electrode **521***a* is electrically connected to the second semiconductor layer **525**, and the second electrode **521***b* is electrically connected to the first semiconductor layer **523**.
(54) The covering layer **530** is disposed on the outer surface of the semiconductor epitaxial structure **522**, the isolation layer **540** is disposed on the outer surface of the semiconductor epitaxial structure **522**, and the covering layer **530** is contacted with the isolation layer **540**. In particular, the isolation layer **540** is disposed on a first surface **526** of the outer surface of the semiconductor epitaxial structure **522**, and the covering layer **530** is disposed on a second surface **527** and a lateral surface **528** of the semiconductor epitaxial structure **522**, wherein the second surface **527** is away from the first surface **526** of the semiconductor epitaxial structure **522**.
(55) In detail, when the covering layer **530** and the isolation layer **540** are disposed on a light emitting surface of each of the micro light emitting devices **520**, the covering layer **530** and the isolation layer **540** are configured to guide the light; when the covering layer **530** and the isolation layer **540** are disposed on the lateral surface **528** of the semiconductor epitaxial structure **522**, the covering layer **530** and the isolation layer **540** are configured to isolate and protect.
(56) FIG. **17** is a schematic view of a display apparatus **600** according to another embodiment of the present disclosure. FIG. **18** is another schematic view of the display apparatus **600** according to the embodiment in FIG. **17**. In FIGS. **17** and **18**, the display apparatus **600** includes a circuit substrate **610**, a plurality of micro light emitting devices **620**, a covering layer **630** and an isolation layer **640**, wherein the circuit substrate **610** includes a pad layer **611**, and the micro light emitting devices **620** are electrically connected to the circuit substrate **610** via the pad layer **611**. The covering layer **630** is disposed on an outer surface of a semiconductor epitaxial structure **622**, the isolation layer **640** is disposed on the outer surface of the semiconductor epitaxial structure **622**, and the covering layer **630** is contacted with the isolation layer **640**, wherein the covering layer **630** is disposed on an outer surface of the isolation layer **640**, and is contacted with at least portions of a lateral surface of each of electrodes (that is, a first electrode **621***a* and a second electrode **621***b*). In particular, the isolation layer **640** is disposed on a first surface **626** of the outer surface of the semiconductor epitaxial structure **622**, and the covering layer **630** is disposed on a second surface **627** and a lateral surface **628** of the semiconductor epitaxial structure **622**, wherein the second

surface **627** is away from the first surface **626** of the semiconductor epitaxial structure **622**. Moreover, a lateral surface of a light emitting layer **624** is covered via the isolation layer **640** and the covering layer **630**. Therefore, the light emitting layer **624** can be entirely protected by the dual protection of the isolation layer **640** and the covering layer **630**.

(57) According to the embodiment of FIG. **18**, it should be mentioned that the covering layer **630** can be further and entirely disposed on an outer lateral surface of each of the electrodes (that is, the first electrode **621***a* and the second electrode **621***b*). Hence, the electrodes can have the better protection and the higher support during being connected to the pad layer **611**, and the electrodes are not influenced by the high pressure and the high temperature.

(58) Further, all of other structures and dispositions according to the embodiments of FIGS. **17** and **18** are the same as the structures and the dispositions according to the embodiment of FIG. **16**, and will not be described again herein.

(59) In summary, by the micro light emitting device structure and the display apparatus of the present disclosure, not only can the manufacturing cost be reduced, but the light guiding efficiency can be simultaneously enhanced. Further, the present disclosure is favorable for the compact size of the micro light emitting device structure and the display apparatus.

(60) The foregoing description, for purpose of explanation, has been described with reference to specific examples. It is to be noted that Tables show different data of the different examples; however, the data of the different examples are obtained from experiments. The examples were chosen and described in order to best explain the principles of the disclosure and its practical applications, to thereby enable others skilled in the art to best utilize the disclosure and various examples with various modifications as are suited to the particular use contemplated. The examples depicted above and the appended drawings are exemplary and are not intended to be exhaustive or to limit the scope of the present disclosure to the precise forms disclosed. Many modifications and variations are possible in view of the above teachings.

Claims

1. A micro light emitting device structure, comprising: a substrate; a connecting layer connected to the substrate; a micro light emitting device connected to the connecting layer, and comprising: a semiconductor epitaxial structure having an outer surface, wherein the outer surface of the semiconductor epitaxial structure comprises a first surface, a second surface closer to the substrate than the first surface and farthest away from the first surface, and a lateral surface between the first surface and the second surface; and two electrodes disposed on the first surface of the outer surface of the semiconductor epitaxial structure, or disposed on the first surface of the outer surface of the semiconductor epitaxial structure and the second surface of the outer surface of the semiconductor epitaxial structure farthest away from the first surface of the outer surface of the semiconductor epitaxial structure, respectively; a covering layer disposed on the outer surface of the semiconductor epitaxial structure; and an isolation layer disposed on the first surface of the outer surface of the semiconductor epitaxial structure, wherein the isolation layer is disposed between a lateral surface of a light emitting layer of the semiconductor epitaxial structure and the covering layer, wherein the covering layer comprises a first portion disposed on an outer surface of the isolation layer farthest away from the semiconductor epitaxial structure and a second portion directly physically contacted with the lateral surface and the second surface of the outer surface of the semiconductor epitaxial structure, wherein the first portion of the covering layer is disposed directly above the first surface of the outer surface of the semiconductor epitaxial structure, and wherein the covering layer is a single layer structure and disposed on the first surface of the outer surface of the semiconductor epitaxial structure, on the lateral surface of the outer surface of the semiconductor epitaxial structure, and on a portion of the isolation layer.

2. The micro light emitting device structure of claim 1, wherein a Young's modulus of the covering

layer is larger than a Young's modulus of the connecting layer.
3. The micro light emitting device structure of claim 1, wherein the covering layer is contacted with the connecting layer.
4. The micro light emitting device structure of claim 1, wherein the covering layer is disposed on the second surface of the semiconductor epitaxial structure, a projecting area of the covering layer on the second surface is A**1**, a surface area of the second surface is A**2**, and the following condition is satisfied:
$0.8A2 \leq A1 \leq A2$.
5. The micro light emitting device structure of claim 1, wherein a disposing distance of the covering layer covering the second surface of the outer surface of the semiconductor epitaxial structure is greater than a disposing distance of the covering layer covering the first surface of the outer surface of the semiconductor epitaxial structure.
6. The micro light emitting device structure of claim 1, wherein at least one of the electrodes is connected to the isolation layer.
7. The micro light emitting device structure of claim 1, wherein a Young's modulus of the isolation layer is larger than a Young's modulus of the connecting layer.
8. The micro light emitting device structure of claim 1, wherein the covering layer is contacted with the isolation layer.
9. The micro light emitting device structure of claim 1, wherein a Young's modulus of the covering layer is less than or equal to the Young's modulus of the isolation layer.
10. The micro light emitting device structure of claim 1, wherein a thickness of the covering layer is less than or equal to a thickness of the isolation layer.
11. The micro light emitting device structure of claim 1, wherein a disposing distance of the covering layer covering the outer surface of the isolation layer is less than or equal to 10 μm.
12. The micro light emitting device structure of claim 1, wherein the isolation layer is contacted with the lateral surface of the light emitting layer of the semiconductor epitaxial structure.
13. The micro light emitting device structure of claim 1, wherein a first portion of the first surface of the outer surface of the semiconductor epitaxial structure is covered by the first portion of the covering layer and a second portion of the first surface of the outer surface of the semiconductor epitaxial structure is free from being covered by the first portion of the covering layer.
14. A display apparatus, comprising: a circuit substrate, comprising a pad layer; a plurality of micro light emitting devices electrically connected to the circuit substrate via the pad layer, and each of the micro light emitting devices comprising: a semiconductor epitaxial structure having an outer surface, wherein the outer surface of the semiconductor epitaxial structure comprises a first surface facing the circuit substrate, a second surface farthest away from the first surface, and a lateral surface between the first surface and the second surface; and two electrodes disposed on the first surface of the outer surface of the semiconductor epitaxial structure facing the circuit substrate, and electrically connected to the pad layer; a covering layer disposed on the outer surface of the semiconductor epitaxial structure; and an isolation layer disposed on the first surface of the outer surface of the semiconductor epitaxial structure, wherein the isolation layer is disposed between a lateral surface of a light emitting layer of the semiconductor epitaxial structure and the covering layer, wherein the covering layer comprises a first portion contacted with the isolation layer and disposed on an outer surface of the isolation layer farthest away from the semiconductor epitaxial structure and a second portion directly physically contacted with the lateral surface and the second surface of the outer surface of the semiconductor epitaxial structure, wherein the first portion of the covering layer is disposed directly above the first surface of the outer surface of the semiconductor epitaxial structure, and wherein the covering layer is a single layer structure and disposed on the first surface of the outer surface of the semiconductor epitaxial structure, on the lateral surface of the outer surface of the semiconductor epitaxial structure, and on a portion of the isolation layer.
15. The display apparatus of claim 14, wherein the covering layer is contacted with the electrodes.

16. The micro light emitting device structure of claim 1, wherein the second portion of the covering layer is connected to the first portion of the covering layer.
17. The micro light emitting device structure of claim 1, wherein a portion of the outer surface of the isolation layer is covered by the first portion of the covering layer and other portions of the outer surface of the isolation layer are spaced apart from the covering layer.
18. The display apparatus of claim 15, wherein the covering layer is disposed on a portion of a lateral surface of each of the electrodes.
19. The micro light emitting device structure of claim 1, wherein each of the electrodes comprises a first surface and a second surface farthest away from the first surface, and wherein the first surface of each of the electrodes is contacted with the semiconductor epitaxial structure and the second surface of each of the electrodes is spaced apart from the covering layer.
20. The micro light emitting device structure of claim 19, wherein each of the electrodes further comprises a lateral surface between the first surface and the second surface, and wherein the lateral surface of each of the electrodes has a portion covered by the isolation layer and remaining portions spaced apart from the isolation layer.