

What is claimed is:

1. A light-emitting diode (LED) chip structure, comprising:
 - a substrate;
 - an isolation element, comprising
 - an upper isolation part and a lower isolation part, wherein the lower isolation part is positioned in the substrate and the upper isolation part protrudes from a surface of the substrate;
 - a reflective layer disposed on a sidewall of the upper isolation part; and
 - a mesa including an LED component surrounded by the isolation element, wherein a bottom portion of the reflective layer does not contact the mesa.
2. The LED chip structure according to claim 1, wherein the reflective layer is disposed on the sidewall and a top surface of the upper isolation part, and the bottom of the reflective layer extends from the isolation element to the mesa.
3. The LED chip structure according to any one of claims 1-2, wherein a dielectric layer is disposed at a bottom of a sidewall of the mesa, and the dielectric layer is covered by the bottom portion of the reflective layer.
4. The LED chip structure according to any one of claims 1-3, wherein a height of the upper isolation part is higher than a height of the lower isolation part.
5. The LED chip structure according to any one of claims 1-4, wherein a bottom width of the upper isolation part is equal to or wider than a top width of the lower isolation part.

6. The LED chip structure according to claim 5, wherein the bottom width of the upper isolation part is longer than the top width of the lower isolation part and shorter than twice the top width of the lower isolation part, two protrusions are formed at each bottom end of the upper isolation part, and a width of each of the two protrusions is less than half of the top width of the lower isolation part.

7. The LED chip structure according to any one of claims 5-6, wherein, in a side view, a cross section of the upper isolation part is a trapezoid and a cross section of the lower isolation part is an inverted trapezoid, the bottom of the upper isolation part covering a top of the lower isolation part.

8. The LED chip structure according to any one of claims 5-7, wherein the upper isolation part and the lower isolation part are axisymmetrical and co-axial.

9. The LED chip structure according to any one of claims 1-8, wherein a height of the upper isolation part is higher than a height of the mesa, relative to a surface of the substrate, and a tilt angle of the sidewall of the upper isolation part is greater than a tilt angle of the sidewall of the mesa, relative to an axis normal to the surface of the substrate.

10. The LED chip structure according to claim 9, wherein the tilt angle of the sidewall of the mesa is smaller than 45° , and the tilt angle of the sidewall of the upper isolation part is greater than 45° .

11. The LED chip structure according to any one of claims 3-10, wherein the dielectric layer covers a top surface and the sidewall of the mesa, the top surface of the mesa including an area free of the dielectric layer.
12. The LED chip structure according to any one of claims 3-11, wherein the dielectric layer is transparent to light emitted from the LED chip structure.
13. The LED chip structure according to any one of claims 3-12, wherein the dielectric layer comprises one or more of silicon-containing dielectric layer, aluminum-containing dielectric layer or titanium-containing dielectric layer.
14. The LED chip structure according to claim 13, wherein the silicon-containing dielectric layer comprises an oxide or nitride of silicon, the aluminum-containing dielectric layer comprises an oxide of aluminum, and the titanium-containing dielectric layer comprises an oxide of titanium.
15. The LED chip structure according to claim 14, wherein the oxide of titanium is Ti_3O_5 .
16. The LED chip structure according to any one of claims 1-15, wherein the reflective layer includes a multi-layered structure.
17. The LED chip structure according to claim 16, wherein the multi-layered structure comprises a stack of one or more reflective material layers and one or more dielectric material layers.

18. The LED chip structure according to any one of claims 1-17, wherein the reflective layer comprises one or more metallic conductive materials with a high reflectance above 80%.

19. The LED chip structure according to claim 18, wherein the one or more metallic conductive materials comprise one or more of aluminum, gold or silver.

20. The LED chip structure according to any one of claims 3-19, wherein a top surface and the sidewall of mesa and the top surface and the sidewall of the upper isolation part are covered by a conductive layer.

21. The LED chip structure according to claim 20, wherein the conductive layer is transparent to light emitted from the LED chip structure.

22. The LED chip structure according to any one of claims 1-21, wherein the isolation element comprises photosensitive dielectric material.

23. The LED chip structure according to claim 22, wherein the photosensitive dielectric material is SU-8 or photosensitive polyimide (PSPI).

24. The LED chip structure according to any one of claims 1-23, wherein the substrate comprises a semiconductor wafer and a bonding metal layer on top of the semiconductor wafer.