Optimizing the efficiency of gallium nitride-based light-emitting diodes from contact area of current spreading to electrode

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Abstract

A nonuniform current spreading in the current spreader layer greatly reduced the internal quantum efficiency (IQE) of the light-emitting diodes (LED). The effects of the current spreading layer on the electrode contact area toward the IQE in a vertical design of gallium nitride (GaN)-based LED chip is analytically analyzed. The contact area was varied by changing the value of the electrode's width from 2 to 12 mu m. Efficiency droop and current density at peak IQE are analyzed based on contact area. The width of 2 mu m requires 1.6 mu Am(-2)current density to achieve peak efficiency and produces a droop of 0.2150. The width of 12 mu m requires 9.6 mu Am(-2)current density to achieve peak efficiency and produces 0.0557 droop. The increase in contact area increases the current density needed to achieve peak IQE while decreases efficiency droop. The optimal spreader contact width of this vertical LED design is 6 mu m.

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