N-Type GaN Thinning for Enhancing Light Extraction Efficiency in GaN-Based Thin-Film Flip-Chip Ultraviolet (UV) Light Emitting Diodes (LED)

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Abstract : GaN-based 365 nm wavelength ultraviolet (UV) light emitting diodes (LED) have various applications: curing, molding, purification, deodorization, and disinfection etc. However, their usage is limited by very low output power, because of the light absorption in the GaN layers. In this study, we demonstrate a method utilizing removal of 365 nm absorption layer buffer GaN and thinning the n-type GaN so as to improve the light extraction efficiency of the GaN-based 365 nm UV LED. The UV flip chip LEDs of chip size 1.3 mm x 1.3 mm were fabricated using GaN epilayers on a sapphire substrate. Via-hole n-type contacts and highly reflective Ag metal were used for efficient light extraction. LED wafer was aligned and bonded to AlN carrier wafer. To improve the extraction efficiency of the flip chip LED, sapphire substrate and absorption layer buffer GaN were removed by using laser lift-off and dry etching, respectively. To further increase the extraction efficiency of the LED, exposed n-type GaN thickness was reduced by using inductively coupled plasma etching.

Keywords : extraction efficiency, light emitting diodes, n-GaN thinning, ultraviolet
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