Enhancement of light extraction efficiency of GaN-based Light-Emitting Diodes using a BCB-based Graded-Refractive-Index Layer

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The light extraction efficiency of GaN-based LEDs was limited by total internal reflection (TIR), which was caused by the large difference of the refractive index between GaN (n=2.5) and air (n=1). Graded-refractive-index (GRIN) layer was widely used to enhance the light extraction efficiency of LEDs by reducing the Fresnel reflection. Our group employed benzocyclobutene (BCB) as the material of GRIN layer. Firstly, BCB was spin-coated on LEDs. Then, SiO_2 nanospheres were spin-coated on the surface of BCB. The substrate was annealed at 160ºC for 5 seconds. The bottom half of SiO_2 nanospheres was embedded into the BCB layer. Then, SiO_2 nanospheres were wet-etched by HF-based solution. Consequently, porous BCB layer was fabricated on BCB layer, so GRIN BCB layer consisted of two layers as BCB layer (n=1.55) and porous BCB layer (n=1.2). GRIN BCB layer was effective to enhance the light extraction efficiency of LEDs due to the reduction of the Fresnel reflection and the side-wall emission. The light output at injection current of 10mA was increased by 9.2% and 22% after fabricating BCB layer and GRIN BCB layer on ITO layer of LEDs.