

III-Nitride based visible and ultra-violet light emitting diodes: Aspects of light extraction from devices

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ABSTRACT

III-nitride semiconductors, especially GaN/InGaN/AlGaIn materials, have drawn much attention in recent years due to their tremendous potential in light-emitting-diode (LED) and laser diode applications in a wide range of wavelength starting from ultraviolet to visible region. These devices cover a wide range of societal as well as strategic applications in the areas of solid state lighting, signaling, sensing, UV-curing, lithography and sterilization including water disinfection. InGaN and AlGaIn based material systems are specifically important for light emission in visible and ultra-violet wavelength respectively. In general, LEDs have various advantages like compact-size, energy-efficient, environment-friendly, highly reliable and long lifetime over conventional light sources such as incandescent and fluorescent lamps. However, light extraction from the LEDs is always an issue for the total internal reflection within the device and it is more critical for ultra-violet emission because of its absorption through GaN layer.

In this article, the overall issues of the light extraction from visible and UV-LED devices would be discussed and subsequently a few remedies would be addressed. These would incorporate the design and fabrication novel structures. The effort of CSIR-CEERI towards development of GaN/InGaN visible (blue and white) LEDs and AlGaIn-based UV-LEDs would be presented. Recent trends for achieving better performance of LEDs in terms of efficiency, lifetime and droop would also be discussed.

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