Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Improvement of AlGaN-based deep-ultraviolet light emitting diodes performance with a nano-textured/roughened sapphire substrate MUHAMMAD KHIZAR, YASIN RAJA, Department of Physics & Optical Sciences, University of North Carolina at Charlotte, NC 28223 — Performance improvement of the fabricated AlGaN-based deep-ultraviolet light emitting diode (DUV LEDs) on sapphire with nano-textured/roughned substrate is reported. The output optical powers as well as the current-voltage characteristics of the processed devices with and without textured/roughened substrate are compared. Lapping/polishing and dry-etching techniques were employed for nano-texturing/roughening of the substrate. Magnetron dry etching was performed using a mixed CF_2Cl_2/Ar feed gases followed by an inductively coupled plasma (ICP) etching in BCl_3/Cl_2 plasma chemistry. An etching rate of ∼145 nm/min for the sapphire was easily obtained. The result show that the optical emission power of the fabricated devices with textured/roughened sapphire substrate is higher as compared to similar un-textured/roughened devices. Based on the analysis, it is concluded that a textured/roughened substrate surface with an RMS $\sim$ 15 – 25 nm shows improved light extraction efficiency, which is the result of the reduced internal reflection of the light caused by the nano-textured/roughened surface profile thereby causing deviation for critical angle.

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Date submitted: 28 Nov 2005 Electronic form version 1.4