Improved Efficiency of InGaN Based Blue and Green Light Emitting Diodes Using Corrugated Interface Substrates

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The use of a corrugated interface substrate (CIS) to improve the efficiency of InGaN based blue and green light emitting diodes has been investigated. The CIS acts to minimise total internal reflection at the Sapphire/GaN interface and hence improve light extraction efficiency [1]. To create the CIS, photolithgraphy was used to form a hexagonal array of circles in a photoresist etch mask. Four different combinations of circle diameter and lattice constant were used. Inductivley coupled plasma (ICP) etching was then used to transfer the resist pattern into the sapphire. The etch process creates hemisperical features in the sapphire due to lateral resist erosion. (Fig 1). Growth of the GaN/InGaN LED epi layers was then carried out by metal organic vapour phase epitaxy (MOVPE) (fig 2). Preliminary wafer level measurements using indium contacts show external quantum efficiency (EQE) improvements over un patterned substrates of up to 30 % for the green LED (550 nm) and up to 20 % for the blue LED (460 nm). Further work is underway to determine the optimal CIS geometries for maximum efficiency improvements at each wavelength.

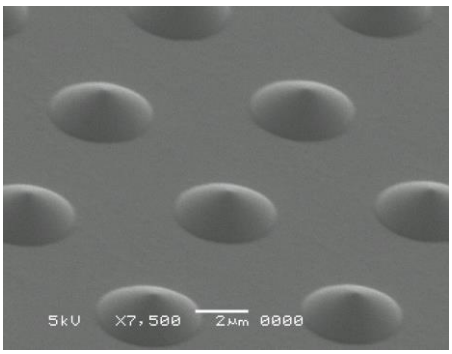

Fig. 1. SEM image of CIS post-etch

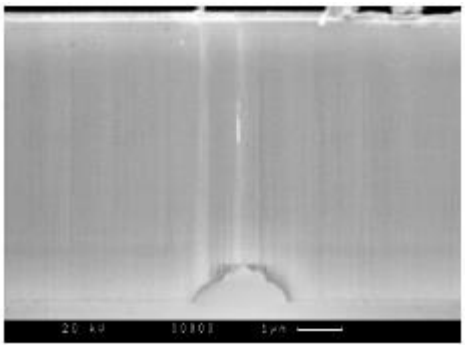

Fig. 2. SEM cross section of CIS feature post-growth

[1] Lee, J.H., Oh, J.T., Park, J.S., Kim, J.W., Kim, Y.C., Lee, J.W. and Cho, H.K. (2006), Improvement of luminous intensity of InGaN light emitting diodes grown on hemispherical patterned sapphire. Phys. Status Solidi C, 3: 2169–2173. doi: 10.1002/pssc.200565308

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