A comparative study of GaN and AlN films grown using a novel UHV MOVPE process employing plasma activated nitrogen, ammonia and a range of metal organic precursors

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We present the results of a comprehensive comparison of epitaxial GaN and AlN films grown using TriEthylGallium (TEG), TriMethylGallium (TMG), Tri-isoPropylGallium (TiPG), TriMethylAluminium (TMA) and TriMethylAmineAlane (TMAA) as group III precursors in a novel UHV MOVPE process with the nitrogen source being either nitrogen gas (activated by a plasma) or ammonia. The films were grown on sapphire, to a thickness of 1.5μm, over a range of temperatures, with each of the above precursors and with each of the nitrogen sources. The films showed good crystallinity, but possessed a brownish colouration. The colouration of individual films varied from almost black to almost transparent. We conclude that this latter effect is due to varying degrees of contamination by a common species.

For each film we present a detailed X-ray profile which shows a surprising lack of any features arising from the contamination mentioned above, even where the contaminant levels are obviously high - indicating that the contaminant neither occupies a consistent site in the host crystal nor does it phase separate. We also present Photoluminescence (PL), ellipsometric and photoabsorption data, together with Secondary Ion Mass Spectrometric (SIMS) analysis - the latter giving an indication of the abundance of impurities in the films. On the basis of this study, our preliminary conclusion is that the dominant source of contamination is carbon. We discuss mass spectrometric measurements of the ambient atmosphere in the growth chamber, which enable us to draw conclusions about the possible nature of the processes giving rise to the contamination.

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