N-TYPE DOPING OF HIGH ALUMINIUM CONCENTRATION ALGAN BASED MATERIALS FOR OPTOELECTRONIC APPLICATIONS

Shiping Guo,[1] Milan Pophristic,[1] Boris Peres[1] and Ian Ferguson[2]

[1]EMCORE Corporation
145 Belmont Drive
Somerset, NJ 08873

[2]Georgia Institute of Technology
The School of Electrical and Computer Engineering
Atlanta, GA 30332

There has recently been interest in AlGaN-based materials (x¡0.30) for field effect transistors and higher aluminum concentration materials (x¿0.30) for emitters and detectors that operate in the solar-blind region (260-280nm). In this paper, the development of a growth technology and the associated growth processes for AlGaN materials with high aluminum composition (x¿0.60) on sapphire substrates are reported. The vapor-solid distribution coefficient for a growth chamber optimized for AlGaN growth was approximately unity. Crack-free AlGaN (x=0.40-0.60) films with high crystalline quality and good composition uniformity were achieved using a low temperature AlN and AlGaN superlattice nucleation layers. The understanding of the doping properties of AlGaN is critical for devices. Si-doped AlGaN epilayers with x 0.40 have been grown with carrier concentrations of 1x1018 cm-3 and mobilities of 35 cm2/V-s without the need for pulsed epitaxy techniques. However, n-type doping of high aluminum concentration AlGaN (x¿0.60) has proved difficult to achieve as these layers are typically highly resistive. A secondary ion mass spectroscopy study has been completed on GaN and AlGaN layers to study this issue. This work shows that O and C are not major compensating centers in AlGaN.