Abstract

Cubic GaN and AlGaN layers are grown by radio frequency plasma assisted molecular beam epitaxy on freestanding 3C-SiC (001) substrates. Detailed analysis reveal a strong influence of the substrate quality on the quality of cubic GaN layers. Several buffer layers were grown at different temperatures to improve the structural properties of the c-GaN buffer. Best values are obtained for AlN buffers deposited at $T_{Subs} = 720°C$. Optimized results for the growth of GaN are found for $T_{Subs} = 720°C$ under a Ga coverage of one monolayer. On top of the GaN buffer, AlGaN films ($0 < x < 0.74$) are grown using Ga coverages of one monolayer and much greater than one monolayer. Investigation of the growth front using reflection high energy electron diffraction as a probe, show a predominant two-dimensional growth mode. With increasing Al mole fraction, a change in the resistivity of the AlGaN layer is observed due to the gettering of oxygen by aluminum. A strong deviation of the current voltage characterisitics of Ni/c-GaN diodes from thermionic emission theory is found, measuring anormal high leakage current, caused by the presence of oxygen donors near the surface. It is investigated, that thermal annealing in air reduces the reverse current by three orders of magnitude. AlGaN/GaN are used to fabricate heterojunction field effect transistor structures. Analysis of the capacitance-voltage characteristics at T=150K revealed clear evidence for the existence of a two-dimensional electron gas with a sheet carrier concentration of about $1.6x10^{12}cm^{-2}$. The source-drain current source-drain voltage characteristics measured at 155K exhibit a clear field effect of source-drain current induced by the gate voltage and a current transport via the two-dimensional electron gas.