Growth and Structural Characteristics of GGO/GaN(001)

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Rare earth oxides are among a group of oxides, whichearlier were found to grow epitaxially on GaAs and Si. Traditionally the rare earth oxides received interest due to their rich magnetic and chemical properties, and more recently have attracted a lot of attention because of new applications on passivating semiconductor surfaces.4–7 In the area of group III–V compound semiconductors, deposition of Gd2O3 films on clean GaAs surfaces in ultrahigh vacuum (UHV) has produced a low interfacial density of states. III-nitride compound semiconductors are suitable for applications in high-temperature and high-power electronics because of their wide band gaps and high breakdown fields.

GaN films on sapphire (0001) were grown using metalorganic chemical vapor deposition (MOCVD). The growth of rare earth oxide films on GaN took place in an UHV (~1x10^{-10} Torr) system. We haveremoved contaminants of the GaN surface caused by air exposure by annealing the samples (at 650–700 °C) in theUHV system.

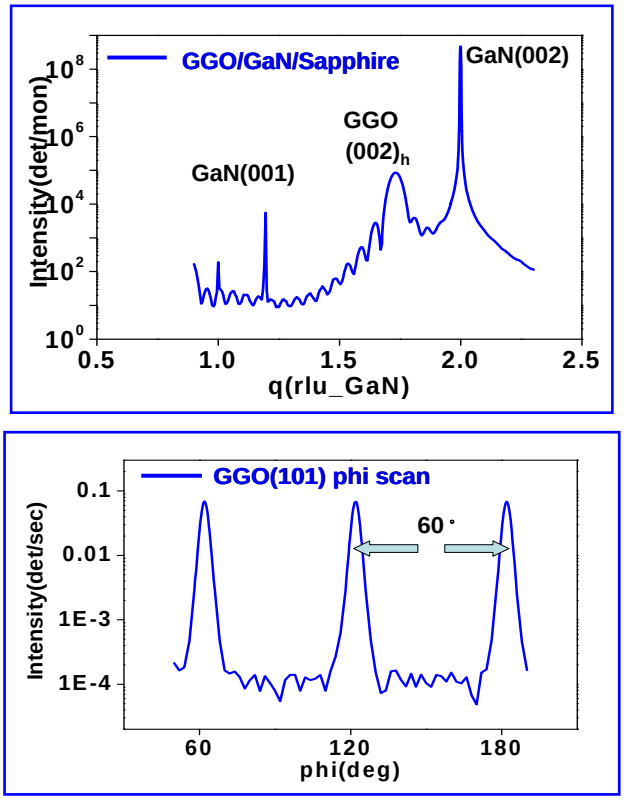

Figure 2. (a) high resolution x-ray diffraction of GGO/GaN/Sapphire(0001). From the peak position and peak intensity, the wurzite GaN (002) and hexagonal GGO(002) peaks were observed. The FWHM of the theta rocking scan is 0.082° (b) phi-cone scans at GGO(101)$_h$ showing an 6-fold symmetry.

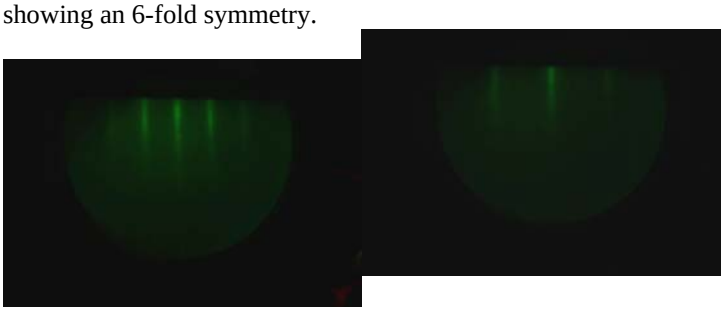

Figure 3. (a) In-situ Reflection high energy electron diffraction (RHEED) patterns of the GGO surface during high temperature growth in UHV. The two major in-plane directions of the oxide are separated by 30° .

In summary, single-crystal rare earth oxide films Gd2O3 were grown epitaxially on single-crystal GaN films. The GaN films grown on sapphire (0001) have a wurtzite hexagonal close-packed (hcp) structure. The Gd2O3 films grown on the GaN were found to have an hcp structure.