HL 46: Nitrides: mostly structural characterization

Time: Tuesday 11:45–12:45 Location: POT 051

HL 46.1 Tue 11:45 POT 051

Aberration-corrected STEM investigation of epitaxial GaN thin films — •David Poppitz, Andriy Lotnyk, Jürgen W. Gerlach, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung e. V., Permoserstr. 15, D-04318 Leipzig

The semiconductor material GaN is widely used in photonics applications. To improve emission efficiency it is necessary to minimize density of defects in GaN thin films. In this study epitaxial GaN thin films with different thicknesses and a high crystalline quality were produced by ion-beam assisted molecular-beam epitaxy (IBA-MBE) on 6H-SiC substrates. These thin films were characterized by advanced transmission electron microscopy at the atomic scale. A FEI Titan G2 60-300 probe aberration corrected scanning transmission electron microscope (S/TEM) was used to perform the experiments. Annular bright field (ABF) STEM imaging was applied for imaging of carbon and nitrogen elements at the GaN-SiC interface. To identify strain in the thin films nano-beam diffraction (NBD) experiments were done.

High-resolution STEM investigations showed a high density of defects in regions close to the GaN-SiC interface. The defects were identified as grain and antiphase boundaries, stacking faults as well as dislocations at the boundaries. It was also found that the thin films consist of hexagonal and cubic GaN. ABF-STEM studies of the GaN-SiC interface revealed local polarity of GaN structure at the interface as Ga-polar. Above a certain thickness, the thin films grow as hexagonal GaN and with highly reduced defect densities.

HL 46.2 Tue 12:00 POT 051

Emission properties of coupled asymmetric cubic AlGaN/GaN quantum wells — •Florian Hörich[1], Marcus Prier[1], Jürgen Bläsing[1], Tobias Wecker[2], Donat J. As[2], Martin Feneberg[1], and Rüdiger Goldhahn[1] — [1]Otto-von-Guericke University, Magdeburg, Germany — [2]University of Paderborn, Germany

Cubic AlGaN/GaN double QWs with different quantum well thicknesses and barrier compositions were grown by plasma-assisted MBE. HRXRD and ellipsometry were performed to determine the composition and barrier heights. The coupling between the QWs was studied by temperature depended photoluminescence spectroscopy. Measured transition energies were compared to theoretical values obtained by transfermatrix method taking the varying exciton binding energy for single QWs into account. Current results suggest a conduction band offset of 64% of the band-gap differences between GaN and AlGaN.

HL 46.3 Tue 12:15 POT 051

Influence of substrate material on InN island nucleation during double-pulsed PAMBE — •Andreas Kraus, Christopher Hein, Heiko Bremers, Uwe Rossow, and Andreas Hangleiter — Institut für Angewandte Physik, Technische Universität Braunschweig

Using pulsed and alternating source fluxes with In pulses less than one monolayer, we are able to grow huge and atomically flat InN islands. However, after a critical island diameter only partial coalescence takes place and In droplet formation occurs. In this contribution we present our investigations on InN island growth on different substrates. The influence of strain, sticking coefficient and surface morphology was studied by growing InN on pure c-oriented sapphire, nitridated sapphire (AlN/Al_2O_3) and MOVPE grown (0001) GaN/Al_2O_3 templates. Furthermore, the influence of dislocation densities was investigated by comparing growth on MOVPE GaN templates with dislocation densities of approximately $10^9\,cm^{-2}$ and pseudo-bulk GaN with only $10^7\,cm^{-2}$. The samples were characterized by AFM, SEM, RHEED and HRXRD. The results show the largest island aspect ratio for growth on Al_2O_3 a smaller one on AlN/Al_2O_3 and the smallest on GaN/Al_2O_3. The island density follows an opposite trend. Growth on (0001) GaN/Al_2O_3 templates leads to two different kinds of island shapes which are very smooth islands and spiral hillocks. The density of the latter one is much less on pseudo-bulk GaN substrates. Spiral hillocks and dendritic features at their rims are correlated with the hindered coalescence with adjoining islands. Therefore, using pseudo-bulk GaN is promising to achieve coalesced InN layers.

HL 46.4 Tue 12:30 POT 051

Structural and optical properties of MBE grown asymmetric cubic AlGaN/GaN double quantum well structures — •Tobias Wecker[1], Florian Hörich[2], Martin Feneberg[2], Rüdiger Goldhahn[2], Dirk Reuter[1], and Donat J. As[1] — [1]University of Paderborn, Germany — [2]Otto-von-Guericke University, Magdeburg

Asymmetric double quantum wells based on group III nitrides are in the focus of interest for the design of quantum cascade lasers and fountain lasers, which emit in the 1.55 μm infrared spectral region. Thus they are important for future devices in the telecommunication. The design of low dimensional optoelectronic devices in hexagonal group III nitrides is complicated by spontaneous polarization fields along the c-axis. By growing cubic group III nitrides in the (001) direction this harmful effect could be avoided. Asymmetric cubic $Al_xGa_{1-x}N/GaN$ double hetero-structures with different Al content were grown on 3C-SiC(001) substrates by radio-frequency plasma-assisted molecular beam epitaxy. For in-situ monitoring of the growth process reflection high energy electron diffraction (RHEED) was used. Clear RHEED oscillations were observed permitting an adjustment of the growth parameters to achieve good sample qualities. Furthermore ex-situ characterization was done by high resolution X-Ray diffraction and inter-band photoluminescence measurements taken at low temperature. The photoluminescence spectra provide four spectral separated emission bands, which clearly could be assigned to the specific layers. A partial stress in the barriers was measured, employing X-Ray diffraction reciprocal space maps (RSM) in the (113) direction.