
In blauen Spektralbereich sind GaN-basierte Heterostrukturen von großer Bedeutung für die Anwendung in Laserdioden (LD) und Leuchtdioden (LED). In diesem Zusammenhang ist ein genaues Verständnis des Einbaus von Mg und Si, die als Dotieratome für p-bzw. n-Dotierung verwendet werden, notwendig. So wurde beobachtet, dass Mg-Dotieratome nicht homogen im GaN-Film verteilt sind, sondern in Abhängigkeit von der Dotierkonzentration unterschiedlich starke Tendenz zur Segregation zeigen. Zur genaueren Charakterisierung des Segregationsverhaltens wurden Experimente mit Photolelektronenspektroskopie (XPS) und Spektromikroskopie (ESCA-Mikroskopie) bei verschiedenen Dotierkonzentrationen durchgeführt. Dabei wurde festgestellt, dass Mg auch bei niedrigen Dotierkonzentrationen deutlich unterhalb der Schwellwinkelbedingung für clusters were ruled out to cause the observed ferromagnetism.

Es werden auch die ersten Ergebnisse der Ausrichtung eines magnetischen Momentes in GaMnN epilayers. Strong Fermi level dependence of the magnetization was observed. Using co-doping (Si, Mg), the RT magnetization were explored in MOCVD-grown n- and p-type diodes (LED). In this context, a detailed understanding of the basic mechanisms of solid phase formation using a newly developed bond-order potential molecular-dynamics simulations in order to study the basic mechanisms of the electric field strength in the AlGaN layer. Another result of the magnetic moments of an AlGaN/GaN HEMT interface. This property is of fundamental interest for the design of high-pressure is a promising way to produce defect free crystallites that can be used as seeds for MBE growth. We have performed atomic scale molecular-dynamics simulations in order to study the basic mechanisms of solid phase formation using a newly developed bond-order potential that realistically describes the nitrogen gas phase, pure gallium as well as various solid structures of GaN. By varying the gas pressure we investigate the process of nitrogen saturation of the gallium melt and the corresponding conditions for GaN crystallization. Moreover, we elucidate the basic mechanisms for dissociation of N2 dimers at the liquid-gas interface.

MD-simulations of high pressure synthesis of single crystalline GaN — Karsten Albe und Paul Erhart — TU Darmstadt, Institut für Materialwissenschaft, Petersenstr. 23, D-64287 Darmstadt

Bulk synthesis of gallium nitride from nitrogen and liquid gallium at high-presures is a promising way to produce defect free crystallites that can be used as seeds for MBE growth. We have performed atomic scale molecular-dynamics simulations in order to study the basic mechanisms of solid phase formation using a newly developed bond-order potential that realistically describes the nitrogen gas phase, pure gallium as well as various solid structures of GaN. By varying the gas pressure we investigate the process of nitrogen saturation of the gallium melt and the corresponding conditions for GaN crystallization. Moreover, we elucidate the basic mechanisms for dissociation of N2 dimers at the liquid-gas interface.


A method for determination of the 2DEG density of an AlGaN/GaN HEMT by electroreflectance spectroscopy was introduced. The technique is based on electroreflectance spectroscopy, i.e. on the analysis of the Franz-Keldysh oscillations and the determination of the electric field strength in the AlGaN layer. Another result of the method is the polarization discontinuity between AlGaN and GaN which represents the polarization charge bound at the AlGaN/GaN interface. This property is of fundamental interest for the design of HEMTs. We have investigated a transistor structure with 2% Al-content in the barrier. Using a Schottky gate contact the 2DEG density was adjusted between 0 and 10¹⁰ cm⁻². Magnetotransport measurements confirm the precision of our method. Furthermore, our findings indicate a 22% lower polarization discontinuity than theory predicts, taking into account the spontaneous and the piezoelectric contribution [Ambacher et al., J. Phys.: Condens. Matter 14, 3399 (2002)]. The results are discussed in terms of a simple plate capacitor model and by self consistent conduction band calculations.
Characterization of epitaxially laterally overgrown GaN structures by micrometer-resolved X-ray Rocking Curve Imaging —

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Epitaxial lateral overgrowth (ELO) of GaN works by growing a nucleation layer on a substrate and covering by a mask with laterally periodic openings. Upon subsequent regrowth of GaN, dislocations from the wetting layer can propagate vertically through these mask windows, but not usually into the lateral GaN wings growing on both sides of the windows. The GaN lattice quality in ELO wings is therefore expected to be superior.

We have performed experimental investigations of the local lattice quality in ELO structures using a technique of spatially resolved X-ray diffraction named Rocking Curve Imaging. It allows to monitor the crystal lattice quality and ELO wing tilt in individual periods of the laterally periodic structure, with spatial resolution down to one micrometer. Results show a highly inhomogeneous lattice tilt distribution across the sample surface. The progressive bending of laterally overgrown areas can be analyzed, showing both concave and convex curvature of ELO wings, depending on growth conditions. Samples grown on different substrates (SiC vs. sapphire) and by different growth sequences (1S- and 2S-ELO) will be compared in view of their crystalline perfection.