HL 13 III-V Halbleiter II

Zeit: Freitag 15:00–16:30 Raum: TU P-N202

HL 13.1 Fr 15:00 TU P-N202

Electronic structure and band alignment of GaIn(N)As/GaAs quantum wells determined by surface photovoltage and electroreflectance measurements — •M. Hetterich[1], A. Grau[1], M. Galluppi[2], L. Geelhaar[2], and H. Riechert[2] — [1]Institut für Angewandte Physik and Center for Functional Nanostructures (CFN), Universität Karlsruhe, D-76131 Karlsruhe, Germany — [2]Infineon Technologies AG, Corporate Research Photonics, D-81730 München, Germany

GaIn(N)As/GaAs is a material system with many applications in near infrared optoelectronics. However, in particular for nitrogen-containing quantum wells (QWs) the exact band alignment and conduction band dispersion are still controversial. In this contribution we combine in a first step contactless electroreflectance (ER) spectroscopy with surface photovoltage (SPV) measurements to determine the unstrained valence band offset of GaInAs/GaAs QW structures. While ER enables sensitive measurements even of weak optical transitions between quantized electron and hole states, the advantage of SPV experiments is, that they provide a more direct access to the band offset than many other techniques. Thus, the number of free fit parameters (and their range) used in the theoretical modelling of our ER spectra can be reduced substantially, leading to better defined results. In a second step we extend our SPV studies to GaInNAs/GaAs QWs. To model the non-parabolic conduction band structure due to the presence of nitrogen we use an effective numerical procedure based on the band anti-crossing (BAC) model. Through a fit to our experimental data the band alignment as well as the BAC model parameters $E_{\rm N}$ and $C_{\rm NM}$ can be determined.

HL 13.2 Fr 15:15 TU P-N202

Unusual Segregation of Antimony into InP in MOVPE — •Martin Leyer[1], Stefan Weeke[1], Frank Brunner[2], Markus Pristovsek[1], Markus Weyers[2], and Wolfgang Richter[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin, 10623 Berlin, Hardenbergstraße 36 — [2]Ferdinand-Braun-institut für Höchstfrequenztechnik, 12489 Berlin, Gustav-Kirchhoff-Str. 4

The GaAsSb/InP material system has promising advantages for an InP based DHBT (Double Heterostructure Bipolar Transistor) regarding bandstructure alignment and base sheet resis-tance. The optimization of the GaAsSb/InP interface is a critical issue since Antimony segregation is observed disturbing the formation of an abrupt interface. In order to investigate Sb segregation using Metalorganic Vapor Phase Epitaxy (MOVPE), InP surfaces where exposed to TMSb and afterwards overgrown with InP. The growth was monitored in situ with RAS (Reflec-tance Anisotropy Spectroscopy) and spectroscopic ellipsometry. Secondary Ion Mass Spec-troscopy (SIMS) was used to analyse the Sb content. The incorporation of Sb showed an unex-pected temperature dependence in the range from 500°C to 600°C. In SIMS a second Sb con-taining layer appeared on top of the Sb exposed layer after a certain thickness. This could be explained by the existence of a quasi-liquid InSb surface phase above the InSb melting tem-perature of 527°C.

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Photoluminescence Measurements on $GaAs_{1-x}N_x$ Quantum Wells — •B. Rähmer, F. Poser, M. Pristovsek, and W. Richter — Technische Universität Berlin, Institut für Festkörperphysik, Hardenbergstr. 36, 10623 Berlin

It is well known that the fundamental bandgap energy of $GaAs_{1-x}N_x$ shifts into the infrared spectral region with increasing nitrogen content x. This makes $GaAs_{1-x}N_x$ an interesting material for light emitting devices with emission wavelengths from 1.3 μm to 1.55 μm . However, the underlying mechanism of the bandgap shift is still not fully understood.

Here we study the temperature dependent photoluminescence (PL) of MOVPE grown 5-fold $GaAs_{1-x}N_x$/GaAs super lattices for samples with x ranging between 1% and 5%. The N content x is determined by XRD and correlated to the PL data.

The annealing behavior was studied for one $GaAs_{1-x}N_x$/GaAs sample with 4% nitrogen. A blue shift of the PL emission with increasing annealing temperature as described in the literature was not observed but the PL intensity shows a significant increase.

HL 13.4 Fr 15:45 TU P-N202

Exchange reactions of As and N on GaAs surfaces — •R. Ehlert[1], S.J. Simon[1], F. Poser[1], N. Esser[2], P. Vogt[1], and W. Richter[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin, Hardenbergstrasse 36, 10623 Berlin — [2]Institute for Analytical Science, Dept. Berlin, Albert-Einstein Str. 9, 12489 Berlin

$GaAs_{1-x}N_x$ is a promising material for light emitting devices operating in a spectral range from 1.3 -1.55 μm . Understanding the nitrogen incorporation mechanisms in $GaAs_{1-x}N_x$ is crucial for optimization of growth conditions.

We present comparative in-situ RAS studies of $GaAs_{1-x}N_x$ under MOVPE condition and in UHV for samples with a nitrogen content of up to 5 % . Samples are grown in MOVPE by using TMGa, TBAs and TBHy as precursors or prepared by nitridation of GaAs surfaces. Upon nitridation a change of RAS spectra from the GaAs(2×4) to the GaAsN (3×3)-like is observed. After growth the samples are capped with an amorphous As-capping layer, transferred to UHV and decapped by annealing. Alternatively, samples were prepared by nitridation of clean GaAs(001) surfaces using ammonia as a nitrogen source. RHEED, RAS, STM and SXPS are used to measure surface properties.

HL 13.5 Fr 16:00 TU P-N202

Influence of sapphire nitridation of MOVPE growth of InN — •C. Werner, M. Drago, M. Pristovsek, and W. Richter — TU-Berlin, Institut für Festkörperphysik, Hardenbergstr. 36, 10623 Berlin

The growth of InN in MOVPE is a challenging issue. Subsequently, the quality of the available InN layers is poor and fundamental properties of this material (i.e. the value of the bandgap energy) are still under discussion. Therefore, there is a strong demand to improve the InN. Usually our InN epitaxy is a three step process, consisting of nitridation, nucleation layer (commonly low-temperature and defective) and thick InN layer growth. In this work we study the effects of different nitridation procedures on the quality of InN layers. With in-situ spectroscopic ellipsometry (SE) we are able to see the progress of nitridation and get an insight into the nitridation process. We expose sapphire to ammonia in either nitrogen or hydrogen carrier gas. Both, the resulting nitrided substrate and the InN layer grown on top are characterised ex-situ with atomic force microscopy and X-ray diffraction. We found that hydrogen as carrier gas during nitridation has a negative effect on the crystal quality.

HL 13.6 Fr 16:15 TU P-N202

Defect related optical transitions in AlN bulk crystals — •Martin Albrecht[1], Klaus Irmscher[1], Matthias Rossberg[1], Thilo Remmle[1], Jürgen Wollweber[1], and Axel Hoffmann[2] — [1]Institut für Kristallzüchtung, Max-Born-Strasse 2, 12489 Berlin — [2]Institut für Festkörperphysik, TU Berlin, Hardenbergstrasse 36 10623 Berlin

Optical transitions in epitaxial AlN layers and bulk crystals are in general dominated by a broad luminescence band ranging from 4eV - 2eV. This luminescence band has been attributed to a variety of point defects (e.g. N-vacancies, Al vacancies and interstitials, ON) or defect complexes (especially VAl - ON). Youngman and Harris showed, that a red shift of this band could be related to an increasing oxygen content. In this paper we study by means of optical spectroscopy, electro-paramagnetic resonance and transmission electron microscopy AlN bulk crystals grown by the sublimation method. The crystals were grown in the temperature range between 1900°C and 2100°C in BN crucibles. They are either hexagonal platelets or single crystalline boules of 12x3x2mm size grown along the c-axis. We find defect related bands at 3.45 eV, 3.0eV, 2.0 eV and 1.6 eV. A detailed study based on temperature and excitation dependent cathodoluminescence, time resolved photoluminescence and photoluminescence excitation is performed to analyse the physical nature of the defect related optical transitions