HL 56: GaN: Optical characterization

Time: Wednesday 12:00–13:00 Location: H15

HL 56.1 Wed 12:00 H15

Influence of compositional variations of quaternary barrier layers on the optical properties of an InGaN SQW — •Christopher Karbaum[1], Frank Bertram[1], Thomas Hempel[1], Jürgen Christen[1], Jan Wagner[2], Michael Jetter[2], and Peter Michler[2] — [1]Institute of Experimental Physics, Otto-von-Guericke-University Magdeburg, Germany — [2]Institut für Halbleiteroptik und Funktionelle Grenzflächen, University Stuttgart, Germany

The optical properties of c-plane oriented group III-nitride layers were investigated using spatially and spectrally-resolved cathodoluminescence (CL) at liquid helium temperature. The characterized set of samples was grown on sapphire substrates with Si-doped GaN buffer layers. A nominally 3 nm thick InGaN SQW was embedded into quaternary AlGaInN barriers of varying In content due to different TMIn-fluxes ranging from 3 sccm up to 50 sccm during the pulsed MOVPE growth and finally capped by a p-doped GaN layer. In all samples the NBE emission exhibits an inhomogeneous distribution with an emission line shifted to shorter wavelengths (354.4 nm). In absolute contrast to this, with increasing In content the CL from the quaternary layers is shifted from 330 nm to the spectral position of the broad DAP emission band (380 nm). For lower In content distinct luminescence contributions from the InGaN SQW which are evenly distributed between 440 nm and 480 nm were found, whereas with an increase of the In content in the barriers the emission behavior of the InGaN SQW merges into a monomodal distribution with an emission band centered at about 445 nm causing a reduction of FWHM from 333 meV down to 140 meV.

HL 56.2 Wed 12:15 H15

Band-gap renormalization versus Burstein-Moss shift in (0001) GaN investigated by spectroscopic ellipsometry — •Sarah Osterburg[1], Martin Feneberg[1], Eberhard Richter[2], Stephanie Fritze[1], Armin Dadgar[1], Alois Krost[1], and Rüdiger Goldhahn[1] — [1]Institut für Experimentelle Physik, Otto-von-Guericke-Universität Magdeburg — [2]Ferdinand-Braun-Institut, Leibniz-Institut für Höchstfrequenztechnik, Berlin

High free electron concentrations in semiconductors lead to enhanced electron-electron and electron-ion interactions decreasing the fundamental band-gap of the material. On the other hand, the simultaneous filling of the conduction band shifts the Fermi level and thus the absorption onset to higher energies, counteracting the band-gap renormalization. The interplay of both effects is investigated in this study experimentally. Spectroscopic ellipsometry was employed on c-plane free standing HVPE grown GaN:Si samples ($n \leq 1.4 \times 10^{19}\mathrm{cm}^{-3}$) and c-plane GaN:Ge thin films grown on sapphire ($3.8 \times 10^{19}\ \mathrm{cm}^{-3} \leq n < 2 \times 10^{20}\ \mathrm{cm}^{-3}$). When taking into account the strain state, a complete picture is obtained which will be discussed

HL 56.3 Wed 12:30 H15

Temperature-dependent external quantum efficiencies of bulk ZnO and GaN — •Nils Rosemann[1], Melanie Pinnisch[2], Stefan Lautenschläger[2], Martin Eickhoff[2], Bruno K. Meyer[2], and Sangam Chatterjee[1] — [1]Fachbereich Physik, Philipps-Universität Marburg, Renthof 5, D-35032 Marburg, Germany — [2]I. Physikalisches Institut, Justus-Liebig-University Gießen, Heinrich Buff-Ring 16, 35392 Gießen, Germany

The most promising candidates for efficient solid-state UV-emitters today are probably those based on GaN. Nevertheless, ZnO has to be taken into account as an alternative material as these two materials share many physical properties such as large band-gap, exciton binding energies and a wurtzite crystal structure. However, both of them have their respective down-sides. In case of GaN the realization of high power devices remains the largest challenge, whereas ZnO still lacks the possibility of efficient and controllable p-type doping. To quantify the potential of both materials we investigate two series of GaN and ZnO bulk layers by temperature-dependent absolute photoluminescence spectroscopy using an integrating sphere mounted inside a cryostat. All samples show a strong decrease of the overall external quantum efficiency (EQE) with increasing temperature. Their differences only unveil in the spectral dependence of the EQE. For the GaN samples the EQE at room temperature is dominated by PL from deep defects while the ZnO is still dominated by near-edge emission.

HL 56.4 Wed 12:45 H15

Two-electron transition of excitons bound to neutral Si donors in homoepitaxial AlN — •Benjamin Neuschl[1], Martin Feneberg[2], Rüdiger Goldhahn[2], Zhihong Yang[3], Thomas Wunderer[3], Jinqiao Xie[4], Seiji Mita[4], Rafael Dalmau[4], Ramón Collazo[5], Zlatko Sitar[5], and Klaus Thonke[1] — [1]Institute of Quantum Matter / Group Semiconductor Physics, University of Ulm — [2]Department of Experimental Physics / Material Physics, University of Magdeburg — [3]Palo Alto Research Center Inc., Palo Alto, USA — [4]HexaTech Inc., Morrisville, USA — [5]Department of Materials Science and Engineering, North Carolina State University, Raleigh, USA

We successfully detected the contribution of two-electron transitions of excitons bound to neutral silicon donors to the emission spectra of aluminum nitride. The sample under investigation was grown homoepitaxially by MOCVD on PVT grown bulk aluminum nitride substrate. Its outstanding crystal quality allows for a very detailed analysis by low-temperature photoluminescence spectroscopy with excellent spectral resolution. For a multitude of excitation spots, we correlated the emission intensities of all luminescence bands in the bandedge region. We found a clear dependency of one single band on the emission of excitons bound to neutral silicon. Temperature dependent studies on the according emission bands confirmed our interpretation of a two-electron transition. This allows for a direct calculation of the donor binding energy of silicon in aluminum nitride.