HL 45: Optical properties II

Time: Tuesday 11:15–12:30 Location: POT 006

HL 45.1 Tue 11:15 POT 006

Photon Echoes from CdTe Quantum Wells in a Magnetic-Field — •Matthias Salewski[1], Lukas Langer[1], Sergey V. Poltavtsev[1,2], Irina A. Yugova[2], Dmitri R. Yakovlev[1,3], Grzegorz Karczewski[4], Tomasz Wojtowicz[4], Ilya A. Akimov[1,3], and Manfred Bayer[1] — [1]Experimentelle Physik 2, Technische Universität Dortmund, 44221 Dortmund, Germany — [2]Spin Optics Laboratory, St. Petersburg State University, 198504 St. Petersburg, Russia — [3]A.F. Ioffe Physical-Technical Institute, Russian Academy of Sciences, 194021 St. Petersburg, Russia — [4]Institute of Physics, Polish Academy of Sciences, PL-02668 Warsaw, Poland

The interaction with a short laser-pulse excites negatively charged excitons (trions) from an ensemble of localized electrons in a n-type CdTe/(Cd,Mg)Te semiconductor quantum well. The resulting polarization undergoes a fast dephasing due to inhomogeneous broadening in the sample. It can be reversed by a delayed laser-pulse that creates a photon echo at exactly twice the delay-time. It is possible to split the second pulse into two single pulses to create a stimulated photon echo. With the different methods one can determine the optical T_1 and T_2 times of the system.

The application of a transverse magnetic-field allows to control the amplitude of the photon echo. Exploiting the Larmor precession of electron spins about the transverse magnetic field we demonstrate transfer of coherence between optically accessible and inaccessible pairs of states. The results are explained in terms of the optical Bloch equations accounting for the spin level structure of electrons and trions.

HL 45.2 Tue 11:30 POT 006

Optical characterization of germanium nanostructures — •Anna-Sophie Pawlik, Jan Beyer, Peter Seidel, Maximilian Geyer, and Johannes Heitmann — Technische Universität Bergakademie Freiberg, Institut für Angewandte Physik

The optical properties of Germanium nanostructures (Ge ns) embedded in a ZrO_2 Matrix were investigated. The samples have been prepared by a co-sputtering-process, at which superlattices consisting of ZrO_2 and Ge/ZrO_2 mixed layers have been deposited on a silicon substrate with and without a silicon nitride (SiN_x) layer. SiN_x was used to prevent a reaction of the ZrO_2 with the native silicon oxide. During rapid thermal processing the formation of Ge ns takes place through a decomposition of the mixed layer. Photoluminescence (PL) measurements have been carried out at temperatures variing from 13 to 300 K. For the visible spectral region, two PL peaks were observed at room temperature, centred at around 2.2 eV and 2.9 eV. These peaks do not correlate with the crystallinity and concentration of the Ge ns. It has been concluded, that these peaks are defect related. Only for samples with a SiN_x layer underneath the superlattices, PL in the infrared wavelength at around 0.83 eV could be observed at low temperatures. Temperature dependent measurements showed a redshift of the PL peak position and a decreasing intensity with increasing temperature. Further investigations indicate that this PL Signal is attributed to the band to band recombination in the Ge ns. This assumption is confirmed by Raman measurements, which show a peak for crystalline Ge at around 300 cm^{-1} for the samples which show PL in the IR region.

HL 45.3 Tue 11:45 POT 006

Investigation of the effective mass in GaAsN — •Faina Esser[1,2], Oleksiy Drachenko[1], Harald Schneider[1], Amalia Patanè[3], Mark Hopkinson[4], and Manfred Helm[1,2] — [1]Institute of Ion Beam Physics and Material Research, Helmholtz-Zentrum Dresden-Rossendorf, 01314 Dresden, Germany — [2]Technische Universität Dresden, 01062 Dresden, Germany — [3]The University of Nottingham, Nottingham, United Kingdom — [4]The University of Sheffield, Sheffield, United Kingdom

As a member of diluted nitrides, GaAsN is a highly interesting material system for many application purposes such as LEDs, lasers, solar cells, and infrared photodetectors because of the tuning possibility of these devices by the variation of the nitrogen content. For an accurate description of this material system, a profound knowledge of the band structure and in particular the effective mass (EM) is crucial. Because of the inconsistency of previous results, which can be traced down to the particular investigation method, we apply several methods on one sample series of GaAsN containing samples with 0.1 - 1 percent of nitrogen. Cyclotron resonance spectroscopy, beeing the most direct method, reveals that the EM is not significantly affected by the nitrogen doping. Photoluminescence, on the other hand, stems from several transitions, which are not resolved spectrally, but identified in time-resolved measurements. We discuss the different behaviour of the involved transitions in magnetic fields up to 7 T (static) and 41 T (pulsed).

HL 45.4 Tue 12:00 POT 006

Determination of Raman tensor components in α-GaN — •Christian Röder, Gert Irmer, Cameliu Himcinschi, and Jens Kortus — TU Bergakademie Freiberg, Institute of Theoretical Physics, Leipziger Str. 23, D-09599 Freiberg, Germany

In order to specify charge carrier concentration and mobility in GaN by Raman spectroscopy the value of the Faust-Henry coefficient is required but it is still debated. According to the symmetry of wurtzite-type GaN three different Faust-Henry coefficients are implied which can be related to the peak ratios of LO- and TO-phonon of the corresponding polar Raman active modes and the Raman scattering efficiency of phonon-polaritons [1]. In this work the Raman tensor components of α-GaN single crystals were determined by Raman intensity measurements using various scattering geometries. The obtained values of the Faust-Henry coefficients are compared with Raman scattering efficiency results on phonon-polaritons in wurtzite-type GaN.
The authors would like to thank the European Union (EFRE) as well as the Free State of Saxony for financial support within the ADDE project.

[1] Irmer, G. *et al.*: Phys. Rev. B **88**, 104303 (2013)

HL 45.5 Tue 12:15 POT 006

Optimizing the optical properties of elliptically-shaped micropillars — •Tim Schönfeld[1], Stephan Figge[1], Kathrin Sebald[2], Thorsten Klein[1], Elahe Zakizadeh[1], and Detlef Hommel[1] — [1]Institute of Solid State Physics, Semiconductor Epitaxy, University of Bremen, P.O. Box 330440, 28334 Bremen, Germany — [2]Institute of Solid State Physics, Semiconductor Optics, University of Bremen, P.O. Box 330440, 28334 Bremen, Germnay

The optical confinement in microcavities of different geometries opens new possibilities to control the light-matter interaction. Structures like photonic molecules, waveguides and elliptically shaped micropillars can be realized by focused ion-beam etching.

The quality of these structures, especially the smoothness of the sidewalls strongly depends on the etching parameters but also on the software structuring routine. Conventionally, bitmap files are used to define the pattern. In this case the fixed line or column scanning direction of the ion beam leads to shiftings at the sidewalls and consequently to a deteriorated quality. In order to overcome this problem we used stream files to be able to control the beam direction along the contour of pattern. In this contribution we comparatively study the properties of elliptically shaped micropillars generated by conventional bitmap and stream file routines. The sidewall quality of these structures is investigated by scanning electron microscopy as well as micro photoluminescence in order to compare the deduced quality factors of both microcavities.