HL 40: II-VI semiconductors

Time: Thursday 11:00–12:15 Location: EW 201

HL 40.1 Thu 11:00 EW 201

High Resolution Second Harmonic Spectroscopy with Femtosecond Laser Pulses — •Johannes Mund, Dietmar Fröhlich, Dmitri R. Yakovlev, and Manfred Bayer — Experimentelle Physik 2, Technische Universität Dortmund, Germany

We present a new method of high resolution second-harmonic spectroscopy (SHS) by use of broad band femtosecond laser pulses. We show, that in a system with inversion symmetry (Cu_2O, point group O_h) wherein second-harmonic generation (SHG) is forbidden in electric-dipole approximation one can detect resonances of even as well as odd parity exciton states. SHG is allowed if one of the odd parity dipole operators is replaced by the even parity quadrupole operator. We also investigate exciton transitions in crystals without a center of inversion (CuCl, ZnSe, point group T_d), where parity is not a good quantum number and thus even and odd parity excitons can be excited by dipole transitions. Detailed polarization diagrams for linearly as well as circularly polarized light are derived and show good agreement with the experimental results. We discuss the implications of exciton-polariton effects, which result in a spectral shift of resonances in SHG spectra in respect to the ones measured by one-photon absorption.

HL 40.2 Thu 11:15 EW 201

DFT assisted tailoring of fluorine-containing molecules for passivation of zinc oxide layers in thin film transistors — •Jonas Köhling[1], Nataliya Kalinovich[2], Gerd-Volker Röschenthaler[2], and Veit Wagner[1] — [1]Department of Physics & Earth Sciences, Jacobs University Bremen, 28759 Bremen, Germany — [2]Department of Life Sciences & Chemistry, Jacobs University Bremen, 28759 Bremen, Germany

In this work thin film transistors were fabricated by depositing ZnO thin films with a thickness of 12 nm by spray pyrolysis on substrates with predefined electrodes. Because of their instability against oxygen and moisture the thin film transistors were passivated using for this purpose tailor made β-diketones with trifluormethyl and benzene-derivatives as substituents. These molecules were characterized by DFT calculations in order to correlate their properties to electrical results. After passivation of the ZnO surface transistors exhibit reduced hysteresis, increased mobility and better stability against electrical bias stress. The improvement of ZnO thin film transistors depends on the used passivation molecule. UV-Vis, AFM, XPS and IV measurements were used to characterize optical, morphological and electrical properties, respectively. We conclude that functionalized β-diketones passivate surface traps on solution processed ZnO thin films achieving better stability against oxygen and moisture under electrical operation. Best electrical performance is found for thin film transistors passivated with molecules containing toluene and chlorobenzene side groups.

HL 40.3 Thu 11:30 EW 201

Electrical transport characteristics of implanted and epitaxially doped n-type ZnSe — •Johanna Janssen[1], Torsten Rieger[1], Arne Hollmann[2], Felix Hartz[2], Christian Kamphausen[2], Lars Schreiber[2], Detlev Grützmacher[1], and Alexander Pawlis[1] — [1]Peter Grünberg Institute 9 and JARA - FIT, Forschungszentrum Jülich GmbH, Germany — [2]JARA - Institute for Quantum Information, RWTH Aachen University, Germany

The reduced electron-nuclear interaction in isotopically purified ZnSe favorites this material towards the realization of electrostatically defined electron spin qubits with advanced coherence features. A prerequisite for such devices is the preparation of a 2D electron gas (2DEG) by fabricating ZnSe/(Zn,Mg)Se QW structures. To electrically contact the 2DEG, localized n-type doping of the (Zn,Mg)Se layer beneath the metal contacts is required. This is achieved either via ion implantation or by local epitaxial doping. While implantation causes defects, local epitaxial doping involves complex selective growth techniques. Consequently, fabrication of metal contacts on n-ZnSe with low contact resistance and ohmic behavior still remains a major challenge, especially at low temperatures. Here, we compare the transport characteristics of implanted and epitaxially doped ZnSe/(Zn,Mg)Se heterostructures. Different donor species and contact metals were investigated to identify the most promising device properties. Finally, we studied the gate-controlled transport characteristics at low temperatures. Our developed device structure represents a major step towards the realization of electrically controlled ZnSe based electron spin qubits.

HL 40.4 Thu 11:45 EW 201

Second Harmonic Generation in ZnSe/BeTe Multiple Quantum Wells — •Andreas Farenbruch[1], Johannes Mund[1], Walter Warkentin[1], Dmitri Yakovlev[1], Manfred Bayer[1], and Andreas Waag[2] — [1]Experimentelle Physik 2a, Technische Universität Dortmund, 44221 Dortmund, Germany — [2]Institute of Semiconductor Technology, University of Braunschweig, 38106 Braunschweig, Germany

ZnSe/BeTe multiple quantum wells with a type-II band alignment are studied by the nonlinear optical technique of second-harmonic generation (SHG). The sample has ten periods of 20 nm thick ZnSe well layers and 10 nm thick BeTe barriers grown on a GaAs substrate by molecular-beam epitaxy.

Resonances of quantum well exciton states are detected and identified. Application of a magnetic field in Voigt geometry up to 10 T reveals several resonances of magneto-excitons. These are identified by comparison with measurements on ZnSe bulk samples. The exciton signals show quadratic dependence of SHG intensity on magnetic field strength and the diamagnetic shift. Rotational diagrams of the SHG polarisation dependence are measured and compared to model calculations.

HL 40.5 Thu 12:00 EW 201

Full characterization of nuclear spin dynamics in CdTe quantum wells — •Eiko Evers[1], Tomasz Kazimierczuk[1,2], Alex Greilich[1], Dmitri Yakovlev[1,3], Grzegorz Karczewski[4], Tomasz Wojtowicz[4], Jacek Kossut[4], and Manfred Bayer[1,3] — [1]Experimentelle Physik 2, Technische Universität Dortmund, 44221 Dortmund, Germany — [2]Institute of Experimental Physics, Faculty of Physics, University of Warsaw, 02-093 Warsaw, Poland — [3]Ioffe Institute, Russian Academy of Sciences, 194021 St. Petersburg, Russia — [4]Institute of Physics, Polish Academy of Sciences, 02668 Warsaw, Poland

In an n-doped CdTe quantum well structure, we studied the nuclear spin coherent and relaxation dynamics in the presence of coherently spin-polarized electrons by optically detected nuclear magnetic resonance (NMR). The pulsed, optical excitation leads to a partial transfer of the electron polarization to the nuclear spin bath. Thus, a considerable Overhauser field is induced which changes the electron spin precession frequency, detected by time-resolved Faraday rotation. We employed pulsed NMR techniques to selectively study the dynamics of all constituent nuclei separately, both the longitudinal and the transverse dynamics in an external magnetic field.