# HL 16: II-VI Semiconductors I

Time: Monday 15:00–16:15 Location: EW 202

HL 16.1 Mon 15:00 EW 202

**Geometry effects of nonlinear optical properties in 0D-1D II-VI semiconductor nanocrystals** — •Alexander W. Achtstein[1], Jonas Hennig[1], Anatol Prudnikau[2], Marya Hardzei[2], Mikhail Artemyev[2], and Ulrike Woggon[1] — [1]Institute of Optics and Atomic Physics, Technical University of Berlin, Berlin, Germany — [2]Institute for Physico-Chemical Problems, Belarussian State University, Minsk, Belarus

Semiconductor nanoparticles have unique properties due to spatial confinement and shape control also in the nonlinear optical regime. This work studies the optical nonlinearities in colloidal 0D and 1D zinc-blende- and wurtzite-type II-VI semiconductor nanocrystals. To understand nonlinear effects at a nanoscale, spatial confinement and its influence on the nonlinear optical properties are investigated. The expected strong geometry and size dependence of the two photon absorption (TPA) cross-section has been tested by a size series of colloidal CdS dots and rods starting from a near 0D system to long 1D nanorods in a z-scan setup. A pronounced change of volume normalized TPA cross sections at the transition from dots to elongated rods has been found. While the bulk TPA coefficient of CdS is only 17GM/nm$^3$, it grows in spherical CdS nanocrystals to 140GM/nm$^3$ and becomes $2.3\times10^3$ GM/nm$^3$ in elongated CdS nanorods. The contributions of spatial confinement and local field effects of the dielectric environment are evaluated separately to get a deeper insight in the confinement effect on TPA. Additional Two-Photon Luminescence Excitation measurements reveal the spectral dependence of the TPA coefficients.

HL 16.2 Mon 15:15 EW 202

**New approach towards backthinning and removal of MBE growth substrates** — •Steffen Bieker, Michael Rüth, Tobias Kiessling, Wolfgang Ossau, and Laurens W. Molenkamp — Physikalisches Institut (EP3) der Universität Würzburg, 97074 Würzburg, Germany

Epitaxial lift-off techniques (ELO) have attracted interest since the late 1980s [1]. We report on a new two-step approach towards the removal of MBE growth substrates. Other than established ELO techniques, our process does not rely on a sacrificial release layer. Pure mechanical lapping allows for several micrometer of residual substrate thicknesses. Residue-free removal of the GaAs substrates from II-VI semimagnetic resonant tunnelling diodes (RTD) is demonstrated. HR-XRD analysis indicates that the crystalline integrity of complex RTD heterostructures is preserved if a silicon frame is mounted during the lapping step to decouple shear forces from the active device layers. Smoothing of interfaces due to strain relaxation allows to assess the microscopic origin of long-debatable transport characteristics.

[1] Yablonovitch et al., APL **51**, 2222 (1987)

HL 16.3 Mon 15:30 EW 202

**Li-doping of cubic ZnS grown on GaP (001) by chemical vapour deposition** — •Gunther Haas, Udo Roemer, Stefan Lautenschlaeger, Sebastian Eisermann, Andreas Laufer, Melanie Pinnisch, and Bruno Karl Meyer — 1st Physics Institute, Justus-Liebig-University Giessen, Heinrich-Buff-Ring 16, 35392 Giessen, DE-Germany

Chemical vapour deposition has been used to grow high quality zinc sulfide heteroepitaxial layers on GaP (001). The precursors of the growth process were metallic zinc and dihydrogen sulfide. Zinc sulfide is a wide band gap semiconductor, known to be challenging in terms of Li-doping with the purpose of p-type doping. In our experiments we used lithium amide as a lithium doping source. Our investigations of undoped as well as Li-doped layers show a clear dependence of the structural quality analyzed by X-Ray diffraction (XRD) and the surface morphology observed with atomic force microscopy (AFM) on the layer thickness. The surface morphology of undoped layers switches from nanometer scale crystallites to rough pyramid-like structures for layers thicker than ca. 1.8 $\mu m$, while Li-doped layers exhibit a rippled surface. The incorporation of Li and Na into the layers was confirmed by secondary ion mass spectrometry (SIMS) and correlates with the intensity of acceptor bound excitons found in low temperature photoluminescence measurements.

HL 16.4 Mon 15:45 EW 202

**Optical characterization of CdSe/ZnTe type-II interfaces for photovoltaics** — •Jan-Peter Richters[1], Lionel Gerard[2], Regis Andre[2], and Joel Bleuse[1] — [1]CEA-CNRS group "Nanophysique et semiconducteurs", CEA-Grenoble, INAC, SP2M, 17 rue des Martyrs, 38042 Grenoble, France — [2]CEA-CNRS group "Nanophysique et semiconducteurs", Institut Néel, CNRS, BP 166, 38042 Grenoble Cedex 9, France

Solar cells based on direct bandgap semiconductors (GaAs, CdTe, CdSe...) show an efficient light absorption compared to silicon solar cells. This is an advantage for material savings due to thinner absorbers, but it also comes with the drawback of higher losses due to efficient radiative electron-hole recombination. Such losses could be prevented through the use of type-II interfaces which separate electrons and holes within the active area, similar to a p-n junction. We report a study of CdSe/ZnTe samples showing such an interface. The CdSe bandgap (1.7 eV) is well adapted to the solar spectrum and its lattice parameter mismatch with ZnTe is exceptionally low. We have grown, by MBE, different kinds of samples like CdSe/ZnTe 2D interfaces and superlattices and present time-resolved spectroscopy results which specify the efficiency of the electron-hole separation in these type-II structures. The measured decay time can be above 100 ns for the interface optical transition, i.e. 3 orders of magnitude slower than the typical PL decay time for the constitutive materials taken separately.

HL 16.5 Mon 16:00 EW 202

**A new model for the $O_{Te}$-$V_{Cd}$ complex in CdTe** — •Dirk Bastin[1], Edward Lavrov[1], Jörg Weber[1], Jürgen Schneider[2], Alex Fauler[2], and Michael Fiederle[2] — [1]Technische Universität Dresden, 01062 Dresden, Deutschland — [2]Freiburger Materialforschungszentrum, 79104 Freiburg, Deutschland

CdTe single crystals treated in $CdSO_4$ vapor at 850 °C are investigated by IR absorption. Two local vibrational modes (LVM) at 1096.8 ($\nu_1$) and 1108.4 cm$^{-1}$ ($\nu_2$) appear in the sample as the result of the thermal treatment. The modes were previously identified by Chen *et al.* as vibrations of the $O_{Te}$-$V_{Cd}$ complex [G. Chen *et al.*, Phys. Rev. Lett. **96**, 035508 (2006)]. We detect in our samples additional LVMs with intensities which match the natural abundance of the sulfur isotopes. The reported dependence of the absorption intensities of $\nu_1$ and $\nu_2$ from the oxygen concentration of the samples points to a model of an sulfur-oxygen complex of the vibrating center. From the intensities of the IR absorption involving the $^{18}O$ isotope, we conclude that two oxygen atoms contribute to the LVMs.