HL 7: II-VI semiconductors

Time: Monday 11:30–13:00 Location: EW 201

HL 7.1 Mon 11:30 EW 201

Gate induced transition from n to p conduction in HgTe quantum wells — •Christoph Brüne, Markus König, Steffen Wiedmann, Andreas Roth, Hartmut Buhmann, and Laurens W. Molenkamp — Physikalisches Institut, Lehrstuhl für Experimentelle Physik 3, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

HgTe/HgCdTe quantum well (QW) structures became very interesting for electronical applications due the good electrical properties and the unique band structure (which e.g. enabled the observation of the quantum spin hall effect [1]). In low density n-type QWs and as a consequence of the narrow bandgap it becomes possible to deplete the conduction band completely and introduce p-type conduction. The depletion can be realised by using a gate electrode to lower the fermi level in the QW. The n-to-p transition is observed in magneto transport measurements on hallbar structures. Clear SdH oscillations and hall plateus are observed in the p-type regime even though the contact regions are n-type, which leads to an additional p-n junction resistance. This Esaki-type tunnel resistance is deduced from the measurements. It turned out that the resistance and mobility changes are mainly due to a change of the effective band mass of the carriers.

[1] M. König *et al.* Science 318, 766 (2007).

HL 7.2 Mon 11:45 EW 201

First principles calculations of CdSe nanowires — •Marcel Mohr and Christian Thomsen — Institut für Festkörperphysik, TU Berlin

We present first principles calculations of CdSe nanowires with diameters of up to 25 Å. Their atomic structure and their electronic and vibrational properties are investigated. We verify the strong band gap dependence on nanowire diameter. In addition, passivating the surface dangling bonds increases the band gap. The phonon modes that correspond to bulk modes show a redshift with smaller diameter. A shortening of the bond lengths of surface atoms gives rise to high-energy surface modes. Surface termination induces lattice contraction and a shift of the phonon frequencies.

HL 7.3 Mon 12:00 EW 201

Lithographical fabrication of HgTe quantum well structures for spin Hall effect measurements — •Andreas Roth, Moritz Leberecht, Markus König, Christoph Brüne, Hartmut Buhmann, and Laurens W. Molenkamp — Physikalisches Institut, Lehrstuhl für Experimentelle Physik 3, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

Large Rashba energies and high carrier mobilities make HgTe quantum wells structures an interesting material for spintronics applications. The electric detection of the spin Hall current without an external magnetic field requires structures with a special geometry [1]. Due to the low growth temperature standard nano fabrication processes can not be used. It was necessary to develop specific low temperature lithographic processes. Here we present measurements on structures which are fabricated with different geometries and various contact configurations. The Rashba-coupling strength was controlled separately for injector and detector in a non-local measurement configuration. The results provide an all-electronic detection of spin-currents.

[1] E. M. Hankiewicz *et al.*, Phys. Rev. B 70, 241301(R) (2004).

HL 7.4 Mon 12:15 EW 201

Diffusion von Co und Au in CdZnTe — •Jörg Kronenberg[1], Frank Wagner[1], Herbert Wolf[1], Thomas Wichert[1] und CERN ISOLDE collaboration[2] — [1]Technische Physik, Universität des Saarlandes, D-66123 Saarbrücken, Germany — [2]CERN, PH Department, CH-1211 Geneva 23, Switzerland

Nach Implantation der Gruppe-IB-Metalle ^{111}Ag und ^{67}Cu in die II-VI Halbleiter CdTe, CdZnTe und ZnTe mit 60 keV und nachfolgender Diffusion bei ca. 800 K unter dem Dampfdruck der Metallkomponente werden symmetrische Profilformen beobachtet, die in der Mitte des Kristalls eine hohe und in den bis zu 250 μm tiefen Randzonen eine niedrige Ag bzw. Cu Konzentration zeigen [1]. Ähnlich ist auch das Diffusionsverhalten von Na in CdZnTe. Die Diffusionsprofile unterscheiden sich drastisch von gewöhnlichen Diffusionsprofilen, welche sich in einer monotonen Abnahme der Konzentration äußern. In den hier vorgestellten Experimenten wurde untersucht, ob in CdZnTe auch das Edelmetall Au oder das ferromagnetische Dotieratom Co ungewöhnliche Diffusionseigenschaften zeigen. Hierfür wurden an ISOLDE/CERN ^{191}Au und ^{61}Co mit 60 keV in 500 μm dicke CdZnTe Einkristalle implantiert und diese anschließend zwischen 700 K und 900 K getempert. Während die ^{61}Co Diffusion ebenfalls ungewöhnlich, dabei aber deutlich unterschiedlich zur Ag oder Cu Diffusion verläuft, wurden für ^{191}Au keine ungewöhnlichen Diffusionsprofile beobachtet.
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[1]H. Wolf *et al.*, Phys. Rev. Lett. 94 (2005) 125901

HL 7.5 Mon 12:30 EW 201

Radiation induced coupling of semimagnetic quantum dots — •Thomas Schmidt[1], Fabian Spielberger[1], Lukas Worschech[1], Alfred Forchel[1], Taras Slobodskyy[2], and Laurens Molenkamp[2] — [1]Technische Physik, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany — [2]Experimentelle Physik III, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

In 1954 R. H. Dicke pointed out that the particles of a spontaneously radiating gas can not be regarded as independent as long as they interact with a common radiation field [1]. Here we present optical studies performed with CdMnSe quantum dots (QDs), which indicates that due to Mn not only the nonradiative decay because of the internal Mn transition is altered but also the radiative decay undergoes a change associated with a Mn enhanced coupling of quantum dots by their radiation field [2]. The range of such a radiant coupling is in the order of the emission wavelength. By analyzing the photoluminescence intensity and the decay rate of quantum dots for differently sized mesas, it was observed that the quantum yield is larger for quantum dots embedded in large mesas with many quantum dots. Removing QDs slows down the PL decay associated with a cooperative radiation of the QDs. Interestingly, by comparison of different excitation conditions it was found that incorporation of Mn into the samples enhances the far-field coupling.

[1] R. H. Dicke, Physical Review 93, 99 (1954)
[2] M. Scheibner, et al., Nature Physics 3, 106 (2007).

HL 7.6 Mon 12:45 EW 201

Interface phonons in CdSe/Zns core/shell-nanorods — •Holger Lange[1], Maria Machon[1], Mikhail Artemyev[2], Ulrike Woggon[3], and Christian Thomsen[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin — [2]Fachbereich Physik, Universität Dortmund — [3]Institute for Physico-Chemical Problems of Belorusian State University, Minsk

We discuss surface optical phonon modes and interface optical phonons in plain CdSe nanorods of different sizes and CdSe nanorods with an epitaxial grown ZnS shell. The related Raman bands are not only influenced by the geometry of the nanorod, but also by the presence and structure of the shell.