HL 35 II-VI semiconductors III

Time: Wednesday 14:30–16:15 Room: POT 151

HL 35.1 Wed 14:30 POT 151

Optical orientation and thermal relaxation of excitons in semimagnetic CdMnSe/ZnSe quantum dots — •Thomas Schmidt[1], Michael Scheibner[1,2], Lukas Worschech[1], Alfred Forchel[1], Taras Slobodskyy[3], and Laurens Molenkamp[3] — [1]Technische Physik, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany — [2]Naval Research Laboratories, Washington, DC 20375 USA — [3]EP III, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany

Polarization dynamics of quantum dots (QDs) represent actually an intensely studied field of research. Of special interest are semimagnetic quantum dots due to their distinct magnetic properties caused by the interaction of carrier spins with the Mn spin system. It is clear that with decreasing Mn content the semimagnetic properties are reduced. We have studied the polarization dynamics of a series of optical orientation and thermal relaxation of excitons in CdMnSe/ZnSe quantum dots for different Mn contents ranging from 0 to 2%. From the dependence of the polarization on the magnetic field strength we determined the exciton g factors of the QDs for different Mn contents and the relevant spin relaxation times. In particular, we have been able to resolve the sign reversal of the g factor. In QDs with negligible g factor the polarization properties are dominated by the optical orientation of the excited light. The spin relaxation times extracted from the thermal relaxation depend sensitively on the Mn concentration in a range of a few picoseconds.

HL 35.2 Wed 14:45 POT 151

Whispering gallery modes in ZnSe/MgZnSSe-microdiscs with CdSe quantum dots at room temperature — •Johannes Renner[1], Lukas Worschech[1], Silke Kuhn[1], Suddho Mahapatra[2], Karl Brunner[2], and Alfred Forchel[1] — [1]Technische Physik, Universität Würzburg, Am Hubland, 97074 Würzburg — [2]Experimentelle Physik III, Universität Würzburg

Several approaches are currently under investigation with the aim to control the coupling between photonic modes in a cavity with three dimensional optical confinement and excited states of quantum dots. We have studied by photoluminescence spectroscopy the emission from II-VI microdiscs with self assembled CdSe quantum dots. The quantum dots were embedded in the centre of a ZnSe/MgZnSSe heterostructure, which was grown by molecular beam epitaxy on top of a GaAs substrate. Electron beam lithography and etching techniques were applied to define microdiscs with diameters ranging from 0.5 to 5 μm. The samples were mounted on glass and the GaAs was removed. Quantum dot emission up to temperatures of 320K was detected. In addition to that we analyzed the dependence of whispering gallery modes on the disc size and for different temperatures. We were able to resolve whispering gallery modes with quality factors exceeding 1000 even at room temperature.

HL 35.3 Wed 15:00 POT 151

Oxygen in sputter-deposited ZnTe thin Films — •Stefan Merita, Thorsten Krämer, Angelika Polity, and Bruno K. Meyer — I. Physikalisches Institut, Justus Liebig Universität, Heinrich Buff Ring 16, 35392 Giessen

Bandgap-bowing has been observed in many of the zinc-group-VI compounds, when the anion is substituted with an isovalent element. Recently new results on the $ZnO_{1-x}S_x$ and $ZnO_{1-x}Se_x$ system have been presented, but so far only one report on $ZnO_{1-x}Te_x$ is known. It is to be expected that the latter system shows a particularly strong bowing behaviour. We examine the possibility of synthesizing $ZnO_{1-x}Te_x$ thinfilms by sputter-deposition. Optical transmission measurements, x-ray diffraction (XRD) and energy-dispersive-x-ray-analysis (EDX) give information about the bandgap-energy, crystal structure and composition of the samples. From this data the bowing-parameter of the $ZnO_{1-x}Te_x$-system can be deduced.

HL 35.4 Wed 15:15 POT 151

Orbital- and Spin Quantization of electronic states as Origins of Second Harmonic Generation in Semiconductors — •Benjamin Kaminski[1], I. Sänger[1], D.R. Yakovlev[1], M. Bayer[1], R.V. Pisarev[2], and V.V. Pavlov[2] — [1]Experimentelle Physik II, Universität Dortmund — [2]A.A.F.Ioffe Physical Technical Institute, Russian

The application of magnetic-fields to semiconductors enables to investigate their magnetic properties and disclose the energy and spin structure. We use the nonlinear optical technique of second-harmonic generation (SHG) to study diluted-magnetic semiconductors. In the case of diamagnetic CdTe we observe an orbital quantization induced contribution to the SHG signal, whereas the SHG intensity depends quadratically on the applied magnetic field. The same mechanism was observed in GaAs (Phys. Rev. Lett. 94, 157404 (2005)). In the case of paramagnetic (Cd, Mn)Te another SHG contribution appears. The origin of this contribution is the spin quantization of the electronic states with low Mn content. It is strongly enhanced due to the giant Zeeman splitting effect (see also J. Opt. Soc. Am. B 22, 168 (2005)). The competition of the two mechanisms is investigated for (Cd, Mn)Te with a Mn concentration of 0.001, where the spin and the orbital quantization contributions are of comparable magnitude.

HL 35.5 Wed 15:30 POT 151

Carrier-density dependence of the exchange coupling between magnetic ions and conduction band electrons in heavily n-type $Zn_{(1-x)}Mn_xSe$ and optically pumped $Cd_{(1-x)}Mn_xTe$ — •M. Lentze[1], P. Grabs[1], J. Geurts[1], K. Rönnburg[2], E. Mohler[2], and H. Roskos[2] — [1]Universität Würzburg, Experimentelle Physik III, Am Hubland, 97074 Würzburg — [2]Johann Wolfgang Goethe-Universität, Physikalisches Institut, Max-von-Laue-Str. 1, 60438 Frankfurt

Diluted magnetic semiconductors (DMS) like (Zn,Mn)Se and (Cd,Mn)Te show giant magneto-optical effects. These effects originate from the strong s/p-d interaction of the magnetic ions with conduction-band electrons and valence-band holes, which induces a pronounced spin-dependent band-splitting in external magnetic fields. For undoped bulk (Zn,Mn)Se the exchange energy for the electrons amounts to $N_0\alpha$ = 260 meV.

We analyzed the doping dependence of the exchange energy $N_0\alpha$ of the conduction band electrons for n-doped bulk-like (Zn,Mn)Se samples with doping levels up to n=$4{\cdot}10^{18}$ cm^{-3} and for optically pumped (Cd,Mn)Te. Our analysis was performed by means of spin-flip Raman spectroscopy and by time-resolved Faraday rotation experiments. Our experiments show a distinct decrease of the conduction band exchange energy with increasing n-doping level. For n=$4{\cdot}10^{18}$ cm^{-3}, the decrease amounts to 30% with respect to undoped samples. The doping-induced decrease of $N_0\alpha$ is explained in terms of the increasing contribution of electronic states with finite q-vector. Their wave functions exhibit an admixture of p-like character.

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Internal Drift Effects on the Diffusion of Ag in CdTe — •H. Wolf[1], F. Wagner[1], Th. Wichert[1], and ISOLDE collaboration[2] — [1]Technische Physik, Universität des Saarlandes, D-66041 Saarbrücken, Germany — [2]CERN, DH-1211 Geneva 23, Switzerland

Unusual concentration profiles have been observed upon diffusion of Ag in CdTe [1]. The diffusion experiments were performed with the radiotracers ^{111}Ag implanted into one side of a typically 800 μm thick CdTe crystal at a depth of about 30 nm. The resulting diffusion profiles of Ag extending over the whole crystal critically depend on the respective external conditions during diffusion and on the sample pre-treatments. After diffusing the Ag dopant into the CdTe crystal at 800 K (60 min) under vacuum or Cd pressure the symmetrical concentration profiles show depletion layers of 100 or 300 μm below the surfaces of the crystal, whereby the depletion layers are much stronger pronounced in case of diffusion under Cd pressure. In contrast, the Ag concentration is increased at the surface and decreased in the interior of the crystal if the diffusion is performed under Te pressure. The Ag profiles are well described within a model based on an interaction of the dopant Ag atoms with the intrinsic defects of the Cd sublattice of CdTe taking into account the charge states of all participating defects. The diffusion of Ag is significantly affected by an internal drift due to the electric field generated by the distribution of the charged defects.

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[1] H. Wolf, F. Wagner, Th. Wichert, and ISOLDE Collaboration, Phys. Rev. Lett. 94, 125901, 2005.

HL 35.7 Wed 16:00 POT 151

DX-Centers in Indium doped CdTe: Electrical characterization and PAC study — •M. Türker, J. Kronenberg, M. Deicher, H. Wolf, and Th. Wichert — Technische Physik, Universität des Saarlandes, D-66041 Saarbrücken

In CdTe, donors like Indium can be electrically compensated by vacancies present in the Cd sublattice (V_{Cd}) either by the formation of A-centers (In-V_{Cd} pairs, [1]) or DX centers. For In concentrations exceeding 10^{18} cm^{-3}, DX centers are created by the relaxation of the In donor towards an interstitial lattice site thereby generating a neighboring Cd vacancy [2]. This relaxation should create an electric field gradient (EFG) observable by perturbed $\gamma\gamma$ angular correlation (PAC) using ^{111}In/^{111}Cd. An EFG assigned to the DX defect (ν_Q=21 MHz, η=0) has been observed earlier [3]. Characteristic for DX centers is a metastable state formed by illumination at low temperatures, where the In donor relaxes back to a substitutional site leading to an increased persistent photoconductivity (PPC) [2]. We performed PAC and conductivity measurements as a function of temperature with and without illumination. Below 150 K, the samples show a PPC effect with about 20% increase of the carrier concentration. This effect is not accompanied by any changes of the PAC spectra recorded with the same samples. Possible explanations of the observed EFG will be discussed.

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[1] Th. Wichert, T. Krings and H. Wolf, Physica B **185** (1993) 297
[2] C.H. Park and D.J. Chadi, Phys. Rev. B **52** (1995) 11884
[3] S.Lany, H.Wolf and Th. Wichert, Phys. Rev. Lett **92** (2004) 225504