HL 29 Spintronik IV

Zeit: Samstag 15:00–16:15 Raum: TU P270

HL 29.1 Sa 15:00 TU P270

Preferred sites and valence states of transition metals in spintronic $ZnGeP_2$ — •Wolfgang Gehlhoff[1], Dmitri Azamat[1], Axel Hoffmann[1], and Nikolaus Dietz[2] — [1]Institute for Solid State Physics, Technical University Berlin, Germany — [2]Department of Physics and Astronomy, Georgia State University, Atlanta, USA

The quest for room-temperature ferromagnetic semiconductors resulted in a recent interest in transition metal (TM) doped ternary pnictides $A^{II}M^{IV}X_2^V$. The site preference and valence states for the different TM and their interaction with native defects play an important role in the discussion of the origin of the ferromagnetism [1, 2]. However, there are only few experimental data for the ternary pnictides [3]. For low Mn-doped samples the characteristic Mn^{2+} EPR spectra for isolated Mn^{2+} on group II site are observed. In higher doped $ZnGeP_2$ we observed the formation of Mn-Mn pairs. In addition, we could detect new TM defects in unintentionally doped $ZnGeP_2$.Without illumination of the samples we observed two iron-related spectra. The first one is identified as the spectrum of Fe^{2+} ($3d^6$) incorporated on the Zn site with S=2 and a large zero-field splitting. The second one arises from Fe^{3+} ($3d^5$) with S=5/2 and substitute for Ge site. Under illumination we observed the spectrum from Fe^+ on Zn site. The strongest Cr-related spectrum is caused by Cr^{4+} on Ge site.

[1] P. Mahadevan and A. Zunger, Phys. Rev. Lett. **88**, 047205 (2002)
[2] T. Kamatani and H. Akai, Phase Transitions **76**, 401 (2003)
[3] W. Gehlhoff, D. Azamat, A. Hoffmann, Materials Science in Semiconductor Processing, Vol.6 (2003) pp. 379-383

HL 29.2 Sa 15:15 TU P270

Spin-orbit coupling parameters for electrons and holes in III-V semiconductors — •R Scholz[1], J.-M. Jancu[2], E.A. de Andrada e Silva[2,3], and G.C. La Rocca[2] — [1]Institut für Physik, Technische Universität Chemnitz, Chemnitz, Germany — [2]Scuola Normale Superiore and INFM, Piazza dei Cavalieri 7, Pisa, Italy — [3]Instituto Nacional de Pesquisas Espaciais, 12201 Sao Jose dos Campos, Sao Paulo, Brasil

Multi-band $\mathbf{k}\cdot\mathbf{p}$ Hamiltonians depend on both momentum and spin-orbit coupling parameters whose values turn out to be crucial for the spin splittings and the anisotropy of both conduction and valence bands. We report on a precise determination of the $\mathbf{k}\cdot\mathbf{p}$ parameters required for an effective 14-band bulk Hamiltonian for III-V semiconductors [1] by using an improved tight-binding (TB) model [2]. The TB calculations are performed in an $sp^3d^5s^*$ nearest neighbor model including spin-orbit coupling, where the optimized parameters reproduce the experimental band energies all around the Brillouin zone. The 14-band model is obtained from a Löwdin renormalization of the 40-band TB Hamiltonian and a subsequent Taylor series expansion around Γ. Our new values for the off-diagonal spin-orbit splitting between the Γ_4 valence and conduction states and for the k^3 Dresselhaus spin splitting of the conduction band are compared to previous results. The differences between the TB band structure and the $\mathbf{k}\cdot\mathbf{p}$ expansion define the range of applicability of the latter, indicating requirements for experimental tests of the theory.

[1] P. Pfeffer and W. Zawadzki, Phys. Rev. B **53**, 12813 (1996).
[2] J.-M. Jancu, R. Scholz, F. Beltram, and F. Bassani, Phys. Rev. B **57**, 6493 (1998).

HL 29.3 Sa 15:30 TU P270

Experimenteller Nachweis von strominduzierter Spinorientierung in Quantentrogstrukturen — •S.D. Ganichev[1], S. N. Danilov[1], S. Giglberger[1], Petra Schneider[1], V. V. Bel'kov[2], L. E. Golub[2], W. Wegscheider[1], D. Weiss[1] und W. Prettl[1] — [1]Institut für Experimentelle und Angewandte Physik, Universität Regensburg, 93040 Regensburg — [2]A. F. Ioffe Physico-Technical Institute, 194021 St. Petersburg, Rußland

Es wurde experimentell nachgewiesen, daß ein elektrischer Strom in niederdimensionalen Systemen zu einer stationären Spinpolarisation der freien Ladungsträger führt [1]. Mikroskopisch betrachtet ist dieser Effekt die Konsequenz aus der Spin-Bahn-Kopplung, die die Spinentartung der Ladungsträger im k-Raum aufhebt, und der spinabhängigen Relaxation. Dieser Effekt wurde bereits vor über 20 Jahren theoretisch von Aronov und Lyanda-Geller vorhergesagt [2]. Direkte Inter-Subband-Übergänge in p-GaAs Multi-Quantentrögen wurden durch Terahertzstrahlung eines optisch gepumpten cw FIR-Lasers mit 118 μm bei Raumtemperatur angeregt. Diese strominduzierte Spinpolarisation führt zu Faradayeffekt und Dichroismus. [1] S.D. Ganichev et.al., cond-mat/0403641. [2] A.G. Aronov and Yu.B. Lyanda-Geller, JETP Lett. **50**, 431 (1989).

HL 29.4 Sa 15:45 TU P270

Experimentelle Bestimmung der Rashba- und Dresselhaus-Beiträge zur Spin-Bahn-Wechselwirkung — •Stephan Giglberger[1], S. D. Ganichev[1], V. V. Bel'kov[2], L. E. Golub[2], E. L. Ivchenko[2], Petra Schneider[1], W. Wegscheider[1], D. Weiss[1] und W. Prettl[1] — [1]Institut für Experimentelle und Angewandte Physik, Universität Regensburg, 93040 Regensburg — [2]A. F. Ioffe Physico-Technical Institute, 194021 St. Petersburg, Rußland

Das relative Verhältnis der Rashba- und Dresselhausterme, durch welche die Spin-Bahn-Wechselwirkung in Halbleiter Quantentrogstrukturen beschrieben wird, konnte zum ersten mal in n-leitenden GaAs Quantentrögen direkt gemessen werden [1]. Mit einem optisch gepumpten, gepulstem FIR - Laser wurden mit 148 μm bei Raumtemperatur indirekte Übergänge durch Drude-Absorption induziert und die Winkelabhängigkeit des spingalvanischen und zirkular photogalvanischen Effektes gemessen. Das Verhältnis der Rashba- und Dresselhaus-Koeffizienten kann direkt aus diesem Experiments bestimmt werden und bedarf keinerlei durch die Theorie berechneten Größen. [1] S.D. Ganichev et.al., Phys.Rev.Lett. **92**, 256601-1 (2004).

HL 29.5 Sa 16:00 TU P270

Spin dynamics of electrons in n-doped InAs quantum dots. — •Alex Greilich, Irina Yugova, Sergej Verbin, Evgenij Zhukov, Matthias Schwab, Dmitrij Yakovlev, and Manfred Bayer — Experimentelle Physik II, Universität Dortmund, D-44221, Germany

We have studied the carrier spin dynamics in n-doped InAs quantum dots (QDs) and have compared it with the one from undoped reference dots. The measurements are time-resolved and was done with mode locked Ti:Sa laser (frequency 76MHz, 1-ps pulse duration) and the signal was detected either by a streak camera or by pump and probe time-resolved Faraday rotation. T_2 and T_1 times in n-doped QDs were considerably longer than in undoped QDs. The dependence of these times on temperature, magnetic field and excitation power was measured and analyzed.