HL 20 Spin controlled transport II

Time: Tuesday 15:15–16:30 Room: BEY 118

HL 20.1 Tue 15:15 BEY 118

Vertical cavity surface emitting lasers for amplification of spin information at room temperature — •Stephan Hövel[1], Nils C. Gerhardt[1], Martin Hofmann[1], Junling Yang[2], Dirk Reuter[2], and Andreas D. Wieck[2] — [1]AG Optoelektronische Bauelemente und Werkstoffe, Ruhr-Universität Bochum, IC2/152, 44780 Bochum — [2]Angewandte Festkörperphysik, Ruhr-Universität Bochum, NB 03, 44780 Bochum

Spin injection into semiconductor light emitting diodes at room temperature usually results in effects much too small for applications. This is due to low injection efficiencies and, in particular, to strong spin relaxation in the semiconductor. We show experimentally and theoretically that spin information can be amplified using the nonlinearity of vertical cavity surface emitting lasers at threshold. By polarized optical excitation of a GaInAs VCSEL we can achieve an output polarization which is higher than that of the excitation [1]. For further improvement, we analyse the spin relaxation in different semiconductor materials to determine the optimal active material for a spin-VCSEL. Finally, we discuss electrical injection schemes for room temperature and low external magnetic fields [2].We thank the DFG for providing support in the SFB 491.

[1] S. Hövel, N. Gerhardt, M. Hofmann, J. Yang, D. Reuter and A. Wieck, Electronics Letters 41, 251 (2005)

[2] N. C. Gerhardt, S. Hövel, C. Brenner, M. R. Hofmann, F.-Y. Lo, D. Reuter, A. D. Wieck, E. Schuster W. Keune and K. Westerholt, Appl. Phys. Lett. 87, 032502 (2005)

HL 20.2 Tue 15:30 BEY 118

Spin Dynamics During Transport Via Dynamic Quantum Dots — •James AH Stotz, Rudolph Hey, Paulo V Santos, and Klaus H Ploog — Paul-Drude-Institut für Festkörperelektronik, Hausvogteiplatz 5-7, 10117 Berlin, Germany

Quantum information processing using electron spins in semiconductor structures requires the coherent transport and manipulation of spin polarized carriers. Previous studies have typically focussed on either the transport of spins with little control of their microscopic movement or the use of quantum dots to manipulate spins locally without microscopic transport. Recent work [1] using the unique system of dynamic quantum dots (DQDs) shows that electron spins can be transported over long distances and manipulated while retaining their microscopic confinement. The DQDs are produced by the superposition of piezoelectric potentials from surface acoustic waves propagating along orthogonal directions on a GaAs/(Al,Ga)As quantum well sample. While it is clear that the confinement potential of the DQDs reduces D'yakonov-Perel' spin dephasing during transport, the effects of the strain and magnetic fields on spin dephasing are much more complicated. We will discuss the underlying mechanisms behind the ability to transport spins over long distances including the impact of confinement on spin coherence. In addition, the strong dephasing of the spin coherence in an external magnetic field will be addressed, and the influence of the acoustic strain field on the transport will be introduced.

[1] J.A.H. Stotz *et al.*, Nature Materials **4**, 585-588 (2005)

[2] Financial support from the BMBF Nanoquit project is appreciated.

HL 20.3 Tue 15:45 BEY 118

Entanglement distillation by adiabatic passage in coupled quantum dots — •jaroslav fabian[1] and ulrich hohenester[2] — [1]Institute for Theoretical Physics, University Regensburg — [2]Institute of Physics, University of Graz

Adiabatic passage of two correlated electrons in three coupled quantum dots is shown to provide a robust and controlled way of distilling, transporting and detecting spin entanglement, as well as of measuring the rate of spin disentanglement. Employing tunable interdot coupling the scheme creates, from an unentangled two-electron state, a superposition of spatially separated singlet and triplet states. A single measurement of a dot population (charge) collapses the wave function to either of these states, realizing entanglement to charge conversion. The scheme is robust, with the efficiency close to 100\%, for a large range of realistic spectral parameters.

HL 20.4 Tue 16:00 BEY 118

Conductance Quantization in Quantum Point Contacts with Spin-Orbit Interaction — •Sebastian von Oehsen, Guido Meier, Toru Matsuyama, and Ulrich Merkt — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Germany

InAs has a strong and tunable spin-orbit interaction [1] and is thus an interesting material for spintronic devices. We present measurements on quantum point-contacts on InAs/InGaAs heterostructures.

Hallbars are predefined on the samples by wet etching. To achieve lateral electrostatic confinement we use either split gates on a SiO_2 layer or side gates. With the latter technique peripheral charging effects can be avoided because of the absence of an isolator. The measurements are performed at 250 mK and in magnetic fields up to 5 Tesla. Quantization steps in the conductance are measured. The transition from electrostatic to magnetic confinement is examined and compared with recent theoretical results [2].

[1] Ch. Schierholz, T. Matsuyama, U. Merkt, and G. Meier. Phys. Rev. B **70**, 233311 (2004)

[2] S. Debald and B. Kramer, Phys. Rev. B **71**, 115322 (2005)

HL 20.5 Tue 16:15 BEY 118

Current Assisted Magnetization Switching in (Ga,Mn)As Nanodevices — •K. Pappert, C. Gould, C. Rüster, R. Giraud, T. Borzenko, G. M. Schott, K. Brunner, G. Schmidt, and L. W. Molenkamp — Physikalisches Institut (EP3), Universität Würzburg, Am Hubland, D-97074 Würzburg, Germany

Current induced magnetization switching of metallic nanometer-sized magnets has attracted much attention over the past years. It is viewed as an attractive alternative technique for magnetic information storage. However, the current densities presently needed highly exceed the limits tolerated by today's integrated circuits.

Ferromagnetic semiconductors on the other hand are anticipated to react to much smaller current densities. Yamanouchi et al.[1] observed current assisted magnetization switching in a (Ga,Mn)As Hall bar close to its Curie temperature using the magnetooptical Kerr and Hall effect. Here we present current assisted switching of the island of a (Ga,Mn)As double constriction device at 4.2 K. We adapt a read-out scheme demonstrated by Rüster et al.[2]. They used the resistance of domain walls pinned by nanoconstrictions to determine the magnetic configuration in a similar structure. Combining current assisted switching and the pinned domain wall resistance read-out in a single device constitutes a significant step forward towards a spintronic storage device, which may use domain walls to realize information storage, transport, manipulation and readout.

[1] M. Yamanouchi et al., Nature **428**, 539 (2004).

[2] C. Rüster et al., Phys. Rev. Lett. **91**, 216602 (2003).