HL 89: Transport II

Time: Thursday 16:45–18:00 Location: H16

HL 89.1 Thu 16:45 H16

Non-equilibrium Polaritonics - Non-linear Effects and Optical Switching — •Regine Frank — Institut für Theoretische Physik, Universität Tübingen

A microscopic electronic non-equilibrium effect, highly nonlinear polaritonics, is proposed to mediate an ultrafast all-optical switching. The electronic band structure within the switching material shall be modified by external laser light, namely the Franz-Keldysh effect, and the modified electronic density of states within the Au grains are coupled to a single mode photonic waveguide. Using this microscopic polaritonic coupling without ever including any macroscopic influences due to the geometric arrangement a strong transmission reduction originating from the established quantum interference is derived. The lifetime of the coupled states is heavily dependent on the Fano resonance type binding and the amplitude of the applied electric field. Besides the Fano signatures the microscopic coupling photon-electron-photon leads to a modified gaped electronic density of states within the switching material. On site interaction as well as finite temperature effects are considerd.

HL 89.2 Thu 17:00 H16

Analytical and numerical transistor models for carbon nanotubes under strain — •Christian Wagner[1], Jörg Schuster[2], and Thomas Gessner[1,2] — [1]Center for Microtechnologies, Chemnitz University of Technology, Chemnitz, Germany — [2]Fraunhofer Institute for Electronic Nano Systems (ENAS), Chemnitz, Germany

Carbon nanotubes (CNTs) are objects attracting high interest in research and applications. While the physics of CNTs is understood quite well, the quantitative description of their properties within an application-environment is of huge interest.

Piezoresistive acceleration sensors are first upcoming applications of CNTs, where they are ideal candidates due to their mechanical strength and their outstanding piezoresistive response. In experiments, these kinds of sensors need an applied gate voltage to adjust the working point which may change i.e. due to adsorbed molecules on the CNT.

Therefore, we calculate the resistance of infinite CNTs under strain — with respect to different gate and drain-source voltages, but without regard to contacts. The Landauer approach is used and condensed into an analytical model. This yields a simplified description of the characteristics based on the band gaps of strained CNTs described in [1,2]. The different levels of theory – analytical and numerical – are investigated. This ends up in a fully parametric description of a CNT device. One of the results is that the sensing regime can be adjusted by the gate- and drain-source voltage.

[1] Yang, L. and Han, J., *Phys. Rev. Lett. 85*, p. 154, **2000**
[2] Wagner, C. et al., *Phys. Stat. Sol. C*, **2012**, doi: 10.1002/pssb.201200113

HL 89.3 Thu 17:15 H16

All-electrical measurements of direct spin Hall effect in GaAs with Esaki diodes — •Markus Ehlert[1], Mariusz Ciorga[1], Cheng Song[1,2], Martin Utz[1], Dominique Bougeard[1], and Dieter Weiss[1] — [1]Institute of Experimental and Applied Physics, University of Regensburg, D-93040 Regensburg, Germany — [2]Laboratory of Advanced Materials, Department of Material Science & Engineering, Tsinghua University, Beijing 100084, China

We present measurements of direct spin Hall effect (DSHE) in lightly doped n-GaAs channels (2×10^{16} cm^{-3}) employing ferromagnetic (Ga,Mn)As/GaAs Esaki diode structures as spin detecting contacts. This setup, similar to the one used in [1], allows us to efficiently probe the low level spin polarization generated by DSHE even in channels with low conductivities (below 2000 Ω^{-1}m^{-1}). In our experiments [2] we investigate bias and temperature dependence of the measured spin Hall signal and evaluate the value of total spin Hall conductivity and its dependence on channel conductivity and temperature. From the results, we determine skew scattering and side-jump contribution to the total spin Hall conductivity, which we compare to both theory [3] and experiments performed with higher conductive n-GaAs channels [1]. We conclude that both skewness and side jump contribution cannot be treated as fully independent of the conductivity of the channel. This work was supported by DFG SFB689 and DFG SPP1285.

[1] E. S. Garlid *et al.*, Phys. Rev. Lett. **105**, 156602 (2010).
[2] M. Ehlert, M. Ciorga *et al.*, Phys. Rev. B **86**, 205204 (2012).
[3] H. A. Engel *et al.*, Phys. Rev. Lett. **95**,166605 (2005).

HL 89.4 Thu 17:30 H16

Electron spin dynamics in Gd-implanted GaN — •Jörg Rudolph[1], Jan Heye Buss[1], Stepan Shvarkov[2], Andreas D. Wieck[2], and Daniel Hägele[1] — [1]AG Spektroskopie der kondensierten Materie, Ruhr-Universität Bochum, Bochum, Germany — [2]Angewandte Festkörperphysik, Ruhr-Universität Bochum, Bochum, Germany

Dilute magnetic semiconductors (DMS) are a prerequisite for the development and realization of a spin-based electronics. GaN-based DMS have attracted strong interest in the last years, with a special focus on Gd-doped GaN after reports of ferromagnetism with Curie temperatures far above room-temperature [1]. Experimental evidence for high-temperature ferromagnetism in Gd:GaN was, however, always based on integral measurements of the magnetization by SQUIDs, while complementary methods like x-ray magnetic dichroism or magnetic resonance techniques could not corroborate the claimed ferromagnetism [2]. We measure the electron spin dynamics in GaN implanted with different Gd densities as well as coimplanted with Si by time-resolved magneto-optical Kerr-rotation spectroscopy. We find strongly increased electron spinlifetimes for an intermediate Gd concentration. This strong increase is, however, shown to be a consequence of the high defect density created during the ion implantation, and not a consequence of a magnetic effect of the Gd ions.

[1] S. Dhar *et al.*, Phys. Rev. Lett. **94**, 037205 (2005)
[2] A. Ney *et al.*, J. Magn. Magn. Mat. **322**, 1162 (2010)

HL 89.5 Thu 17:45 H16

Exchange Interaction of Phosphorus Donors and Interface Defects at the Si/SiO$_2$ Interface — •Max Suckert[1], Felix Hoehne[1], Lukas Dreher[1], Hans Huebl[2], Martin Stutzmann[1], and Martin S. Brandt[1] — [1]Walter Schottky Institut, Garching, Germany — [2]Walther-Meißner-Institut, Garching, Germany

Electrically detected magnetic resonance (EDMR) has been established as a versatile tool to investigate the properties of paramagnetic defects. The method involves the formation of spin pairs whose symmetry determines the transport properties resulting in a resonant current change when spins are flipped by microwave irradiation.

We apply the method of electrically detected double electron–electron resonance (EDDEER), recently added to the EDMR toolbox, to determine the coupling between phosphorus donors ^{31}P and dangling bonds P$_{b0}$ at the Si/SiO$_2$ interface quantitatively. This spin pair is of particular interest for the electrical readout mechanism allowing for the detection of coherent spin manipulation of the ^{31}P and decoherence introduced by the P$_{b0}$ to the ^{31}P spins. By modelling the exchange interaction numerically and comparing the result to the EDDEER time evolution, we assign the typical coupling strength of 600 kHz observed to a distribution of ^{31}P–P$_{b0}$ spin pairs with distances in the range from 14 to 20 nm.

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