HL 16 Poster Ia

Zeit: Freitag 16:30–19:00 Raum: Poster TU E

HL 16.1 Fr 16:30 Poster TU E

Weak Localization and Spin Splitting in Inversion Layers on p-type InAs — •Christopher Schierholz, Toru Matsuyama, Ulrich Merkt, and Guido Meier — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstrasse 11c, 20355 Hamburg, Germany

We have examined the magnetoconductivity of quasi two-dimensional electron systems in inversion layers on p-type InAs single crystals. Pronounced features of weak localization and antilocalization at low and beating patterns in SdH oscillations at high magnetic fields are observed. The low field data is almost perfectly described by the theory of Iordanskii, Lyanda-Geller and Pikus [1]. With this we obtain the spin splitting and the Rashba parameter of the ground electric subband as a function of the electron density [2]. In addition we determine the spin splitting and the Rashba parameter from the high field data by FFT analysis. The dependence of the Rashba parameter on the total carrier density is found to differ for low and high fields: the low field results agree well with band-structure calculations by Lamari [3]. The high field results are of the same order of magnitude but show a quite different dependence on the electron density and thus a strong deviation from the theoretical predictions.

[1] S. Iordanskii, Y. Lyanda-Geller, and G. Pikus, JETP Lett. **60**, 206 (1994).
[2] C. Schierholz, T. Matsuyama, U. Merkt, and G. Meier, Phys. Rev. B **70**, (December 15th, 2004).
[3] S. Lamari, Phys. Rev. B **67**, 165329 (2003).

HL 16.2 Fr 16:30 Poster TU E

Spin-Orbit Interaction in two- and one-dimensional InAs Heterostructures — •Sebastian von Oehsen, Christopher Schierholz, Guido Meyer, Toru Matsuyama, and Ulrich Merkt — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Germany

In spintronic devices like the spin transistor [1] the spin of the electron is controlled within a one-dimensional channel by the Rashba effect [2]. InAs heterostructures have a strong and tunable spin-orbit interaction and are thus an interesting material for such a device.

We investigate spin-orbit interaction in modulation-doped InAs heterostructures with two-dimensional electron systems by two transport experiments. First, the tunability of spin-orbit interaction is investigated in a two-dimensional channel: in low fields weak antilocalization is observed and analyzed according to Ref.[3], in high fields beating patterns of Shubnikov-de Haas oscillations are recorded. For the second experiment the heterostructures are laterally confined. With these quantum point-contacts we aim at the determination of the influence of spin-orbit interaction on the quantized conductance of a one dimensional channel.

[1] S. Datta and B. Das, Appl. Phys. Lett. **56**, 665 (1990)
[2] M. Governale and U. Zülicke, Phys. Rev. B **66**, 073311 (2002)
[3] S. Iordanskii, Y. Lyanda-Geller, and G. Pikus, JETP Lett. **60**, 206 (1994)

HL 16.3 Fr 16:30 Poster TU E

GaAs-based multi-terminal devices in lateral spin-valve geometry — •T. Last[1], M. Wahle[1], S.F. Fischer[1], U. Kunze[1], D. Reuter[2], and A.D. Wieck[2] — [1]Werkstoffe und Nanoelektronik, Ruhr-Universität Bochum, D-44780 Bochum — [2]Angewandte Festkörperphysik, Ruhr-Universität Bochum, D-44780 Bochum

Essential for the detection of spin accumulation in a lateral ferromagnet(FM)-semiconductor(SC) spin-valve structure is the resistance-matching between the FM/SC contact resistance and the resistance of the semiconductor channel. We present a multi-terminal lateral FM/SC tunnelling device based on a GaAs-heterostructure. A 50 nm moderately n-doped ($1x10^{16}/cm^3$) GaAs layer is grown on semi-insulating undoped GaAs. On top of the n-doped GaAs layer a 10.5 nm thick δ-doped ($1x10^{18}/cm^3$) layer is introduced to reduce the width of the Schottky-barrier and to provide tunnelling as the major spin injection mechanism at low voltages. Permalloy electrodes are optimized in terms of uniform magnetization at the FM/SC contact and suitable switching behaviour: widths 2.0 μm and 0.4 μm (length: 150 μm, thickness: 30 nm) separated by 0.2 μm. Up to now no spin blockade is observed. Further experiments are in progress towards optimization of the matching of the contact and channel resistances.

HL 16.4 Fr 16:30 Poster TU E

Optical spin injection from (Zn,Mn)Se into GaAs/(Al,Ga)As quantum wells — •Wolfgang Löffler, Daniel Tröndle, Thorsten Passow, Bruno Daniel, Miriam Kantner, Michael Hetterich, Michael Grün, Claus Klingshirn, and Heinz Kalt — Universität Karlsruhe (TH), Center for Functional Nanostructures (CFN) and Institut für Angewandte Physik, Wolfgang-Gaede-Str. 1, D-76128 Karlsuhe

The efficient injection of spin polarized charge carriers into semiconductor nanostructures is currently a field of intense research.

Using a confocal magneto-P technique we optically excite spin-polarized excitons in a semimagnetic (Zn,Mn)Se layer and detect the photoluminescence signal and its polarization state from a GaAs/(Al,Ga)As quantum well. The MBE-grown samples are placed in a magnetic cryostat at fields up to 14T and temperature T=4K. Comparing the measured circular polarization degrees of the photoluminescence signal in dependence of the excitation polarization we calculate the magneto-polarization, i.e. the degree of circular polarization induced by the magnetic field, which reaches values of up to 0.2. The actual injection efficiency is much higher but is to some extent masked by the fact that only 20% of the exciting light is absorbed within the (Zn,Mn)Se layer.

Currently we extend our work to electrical spin injection from doped (Zn,Mn)Se DMS layers into (In,Ga)As quantum wells.

HL 16.5 Fr 16:30 Poster TU E

Room temperature threshold reduction in vertical-cavity surface-emitting lasers by injection of spin-polarized electrons — J. Rudolph[1], S. Döhrmann[1], •T. Paprotta[1], D. Hägele[1], W. Stolz[2], and M. Oestreich[1] — [1]Institut für Festkörperphysik, Universität Hannover, Appelstraße 2, D-30167 Hannover, Germany — [2]Department of Physics and Material Sciences Center, Philipps University Marburg, Renthof 5, D-35023 Marburg, Germany

We experimentally demonstrate the reduction of the laser threshold of a commercial GaAs/(AlGa)As vertical-cavity surface-emitting laser (VCSEL) by optical injection of spin-polarized electrons at room temperature. A rate-equation model reproduces the measured reduction of 2.5% for injected electrons with 50% spin polarization. The model predicts a threshold reduction of more than 23% for 100% spin polarization in a VCSEL-structure with codoped 7.5 nm quantum wells and a reduction of 50% in otherwise identical VCSEL-structures grown on (110) substrate.

HL 16.6 Fr 16:30 Poster TU E

Electrical Searches of Spin Injection from Fe into GaAs-based Heterostructures — •Fang-Yuh Lo[1], E. Schuster[2], D. Reuter[1], W. Keune[2], J. Yang[1], and A. D. Wieck[1] — [1]Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum, Universitätsstraße 150, 44780 Bochum — [2]Laboratorium für Angewandte Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg

We exploited the cleaved-edge overgrowth(CEO) method to have clean interfaces between Fe and GaAs-based heterostructures. Electrical measurements reveal a Schottky character for the Fe/heterostructures contact. For patterning the Fe film, we use focused ion beam(FIB) milling. We will discuss the fabrication of the spin-valve structure and their electrical characterization.

HL 16.7 Fr 16:30 Poster TU E

Towards Capture of Optically Induced Spin-Currents in Semiconductor Nanostructures — •Sangam Chatterjee[1], Wolfgang Rühle[1], and Klaus Köhler[2] — [1]Department of Physics and Material Science Center, Philipps-University Marburg, Renthof 5, 35032 Marburg, Germany — [2]Fraunhofer Institute for Applied Solid-State Physics, 79108 Freiburg, Germany

Coherent one and two photon excitation of semiconductors leads to spin-polarized currents due to quantum interference. Pure spin-currents without a net electron current are generated if the correct polarization geometry is chosen. The spin orientation and direction of these currents can be controlled by the relative phase of the two exciting fields [1]. Our

goal is to detect these spin currents in an integrated device.

We have designed and grown a semiconductor nanostructure to demonstrate the capture of ballistic electrons in two different GaAs quantum wells. Experimental photoluminescence studies for different excitation and polarization geometries are presented and discussed.

[1] J. Hübner, W.W. Rühle et al., Phys. Rev. Lett. 90, 216601 (2003) and M. Stevens, A. Smirl et al., Phys. Rev. Lett. 90, 136603 (2003)

HL 16.8 Fr 16:30 Poster TU E

Steps towards the realization of ZnMnSe-InGaAs/GaAs SQW electrical spin injection LEDs — •M. Hetterich[1], J. Kvietkova[1], T. Passow[1], J. Lupaca-Schomber[1], B. Daniel[1], C. Klingshirn[1], W. Löffler[1], D. Tröndle[1], H. Kalt[1], D. Litvinov[2], and D. Gerthsen[2] — [1]Institut für Angewandte Physik and Center for Functional Nanostructures (CFN), Universität Karlsruhe, D-76131 Karlsruhe, Germany — [2]Laboratorium für Elektronenmikroskopie and CFN, Universität Karlsruhe, D-76128 Karlsruhe, Germany

Recently, techniques to spin-polarize electrons and inject them into semiconductor structures have attracted large attention as one of the key elements for a future spin-based (opto-) electronics. In the devices we want to study, semimagnetic ZnMnSe is used as a spin aligner and the spin-polarized electrons are injected into an InGaAs/GaAs quantum well (QW) LED. As the first step towards this aim we have fabricated surface-emitting InGaAs/GaAs QW p-i-n diodes using MBE and optical lithography. Bright electroluminescence (EL) could be obtained from these LEDs in the whole temperature range from 5-300 K. We have therefore moved on to add the n-doped ZnMnSe:Cl spin aligner, which is grown in a different system. A thin As layer is used to protect the sample from oxidation during transport to the II-VI chamber. This protective layer can easily be desorbed thermally, before the ZnMnSe growth is initiated. Indeed, TEM investigations prove the III-V/II-VI interface to be of good quality. Bright EL of these spin LEDs could already be obtained for T=5-300 K. Polarization-resolved magneto-EL measurements to determine the spin injection efficiency are currently under way.

HL 16.9 Fr 16:30 Poster TU E

A Spin-Mechanical Device for Detection and Control of Spin Current by Nanomechanical Torque — •Stefan Kettemann[1], Pritiraj Mohanty[2], Guiti Zolfagharkhani[2], and Peter Fulde[3] — [1]1. Institut fuer Theoretische Physik, Uni Hamburg, Jungiusstrase 9, 20355 Hamburg — [2]Department of Condensed Matter Physics, Boston University, Boston — [3]Max Planck-Institut fuer Physik Komplexer Systeme, Dresden

We propose a spin-mechanical device to control and detect spin currents by mechanical torque[1,2]. We show that this spin flip torsion balance effect can be strongly enhanced in a nanomechanical device when a nanowire containing a FM-NM interface is grown on top of a suspended nano-electro-mechanical structure (NEMS). Thereby, the spin transport can be measured by the induced mechanical torque in the NEMS torsion device. The inverse is also true: a torque at the FM-NM interface produces a potential difference between the two metals. Accordingly, a spin current can be generated by applying an external torque. We perform a detailed analysis to show that such a device can be used to detect, control and induce spin current[2]. [1] P. Fulde and S. Kettemann, Ann. Phys. 7, 214 (1998). [2] P. Mohanty, G. Zolfagharkani, S. Kettemann, and P. Fulde, Phys. Rev. B 70, 195301 (2004)

HL 16.10 Fr 16:30 Poster TU E

Tunneling Through Single-Crystal GaAs(001) Barriers With Sputtered Fe-Contacts — •Jürgen Moser, Marcus Zenger, Peifeng Chen, Werner Wegscheider, and Dieter Weiss — Institut für Experimentelle und Angewandte Physik, Universität Regensburg, D-93040 Regensburg

We investigate transport through epitaxial GaAs(001) barriers sandwiched between sputtered Fe-films. To realize a Fe/GaAs(001)/Fe sandwich we use the epoxy-bond-and-stop-etch-technique. To achieve different magnetic switching fields of the two sputtered Fe-layers at room temperature one of the Fe-layers is covered with Co. This layer acts as a pinning layer and leads to a high coercive field of one Fe-layer. Previous experiments have shown that tunneling is the dominant transport mechanism for these samples. A pretreatment of one GaAs surface with hydrogen plasma at RT and a small acceleration voltage to reduce the native oxide layer increases the TMR-Effect from 1.2 % to about 3 % at 4.2 K which corresponds to a spin-polarisation of about 12 % in the Jullière model. Temperature dependent measurements show a reduction of the TMR-Effect to about 0.3 % at 300 K. This reduction is much higher than expected by the temperature dependence of the magnetisation of iron.

HL 16.11 Fr 16:30 Poster TU E

Spin polarization in a T-shape conductor induced by strong Rashba spin-orbit coupling — •Masayuki Yamamoto[1], Tomi Ohtsuki[2], and Bernhard Kramer[1] — [1]I.Institut für Theoretische Physik, Universität Hamburg, Jungiusstraße 9, 20355 Hamburg, Germany — [2]Department of Physics, Sophia University, Kioi-cho 7-1, Chiyoda-ku, Tokyo 102-8554, Japan

We investigate numerically the spin polarization of the current in the presence of Rashba spin-orbit interaction in a T-shaped conductor as proposed by A.A. Kiselev and K.W. Kim (Appl. Phys. Lett. **78** 775 (2001)). The recursive Green function method is used to calculate the three terminal spin dependent transmission probabilities. We focus on single-channel transport and show that the spin polarization becomes nearly 100 % with a conductance close to e^2/h for sufficiently strong spin-orbit coupling. From the quantum dynamics of wave packets, we deduce that this is due to spin separation caused by quantum mechanical scattering at the junction. The influence of the disorder on the predicted effect is discussed.

HL 16.12 Fr 16:30 Poster TU E

Mesoscopic spin filtering effect in the nonuniform spin-orbit interaction — •Jun-ichiro Ohe[1], Masayuki Yamamoto[1], Tomi Ohtsuki[2], Junsaku Nitta[3], and Bernhard Kramer[1] — [1]Hamburg University — [2]Sophia University, Japan — [3]NTT Basic Research Lab. and CREST-JST, Japan

Novel spin filtering in two-dimensional electron systems with nonuniform spin-orbit interactions (SOI) is numerically investigated. The strength of SOI is modulated perpendicular to the charge current. A spatial gradient of effective magnetic field due to the nonuniform SOI causes the Stern-Gerlach type spin separation. The direction of the polarization is perpendicular to the current and parallel to the spatial gradient. Almost 100 % spin polarization can be realized even without any external magnetic field and ferromagnetic contacts. The spin polarization persists even in the presence of randomness.

HL 16.13 Fr 16:30 Poster TU E

Spin-dependent localization effects in GaAs:Mn/MnAs granular paramagnetic-ferromagnetic hybrids at low temperatures — •C. Michel[1], C. Thien[1], S. Ye[1], P.J. Klar[1], W. Heimbrodt[1], S.D. Baranovskii[1], P. Thomas[1], and B. Goldlücke[2] — [1]Department of Physics and Materials Science Center, Philipps-University of Marburg, Germany — [2]MPI for Computer Science, Saarbrücken, Germany

We compare the magneto-transport in paramagnetic-ferromagnetic GaAs:Mn/MnAs granular hybrids and paramagnetic GaAs:Mn reference samples. The differences in the hole transport between the two systems at low temperatures arise due to carrier localization effects at the cluster–matrix interface in the hybrids. The localization is caused by a Schottky barrier formation at the interface as well as spin-dependent shifts of the hole bands caused by the stray field of the ferromagnetic clusters. The application of an external magnetic field leads to a delocalization of the carriers and thus a negative magneto-resistance effect. These effects can be simulated using a network model approach.

HL 16.14 Fr 16:30 Poster TU E

Weak anti-localization in InGaAs/InP quantum wires — •Vitaliy A. Guzenko, Thomas Schäpers, and Jens Knobbe — Institute of Thin Films and Interfaces (ISG1) and CNI - Center of Nanoelectronic Systems for Information Technology, Research Centre Jülich, 52425 Jülich

The Rashba effect is a promising candidate for spin manipulation in future spintronic devices. The strength of the Rashba effect is dependent on the choice of material. Thus determination of the spin-orbit coupling parameter is of importance. Observation of the weak anti-localization allows one to determine the Rashba coupling parameter if other techniques are not applicable.

We report on the magnetotransport properties of the quasi one-dimensional InGaAs/InP structures. 160 wires of the well defined width, connected in parallel, were prepared by etching the heterostructure, containing a two-dimensional electron gas. Gate dependent as well as temperature dependent measurements were performed, in order to determine the Rashba coupling parameter from the enhanced conductance due to

weak anti-localization. The results were compared to the values obtained by analysing the beating pattern of the Shubnikov–de Haas oscillations.

HL 16.15 Fr 16:30 Poster TU E

Magnetotransport through nanoscale constrictions in ferromagnetic (001)-(Ga,Mn)As — •Markus Schlapps, Matthias Döppe, Tobias Feil, Matthias Reinwald, Werner Wegscheider, and Dieter Weiss — Universität Regensburg

Transport through small GaMnAs islands, separated by nanoscale constrictions from wider GaMnAs contacts, have recently shown interesting transport behaviour [1]. These constrictions act as pinning sites for domain walls and have so far shown spin-valve like effects with resistance changes $\Delta R/R \approx 1\%$ for constrictions on the order of 100 nm.

Here we show that $\Delta R/R$ is strongly temperature and current dependent and can be as high as 100% for 100 nm wide constrictions. The dependence on current, temperature and constriction width will be discussed.

[1] C. Rüster et al: PRL **91**, 216602 (2003)

HL 16.16 Fr 16:30 Poster TU E

Spin-orbit induced spin-polarized conductances in Y-shaped devices — •Kai Dittmer, Jun-Ichiro Ohe, and Bernhard Kramer — I.Institut für Theoretische Physik, Universität Hamburg, Jungiusstr. 9, 20355 Hamburg, Germany

One of the most important open questions in spintronics is the effective injection of spins into certain devices, e.g. the spin-transistor of Datta and Das [1]. The most simple appearing way is the injection via a ferromagnetic contact. One of the major obstacles in this approach is the current mismatch at the interfaces between the metallic contact and the semiconducting device. Using semiconducting ferromagnets is one way to circumvent this problem, but another problem with ferromagnets is the direct control of the ferromagnetic domains at the interface regions, and a third problem might be the influence of the magnetic stray fields penetrating the device.

As is well known in mesoscopics, spin-orbit interaction together with uncontrolled(impurity-) scattering results in the spin-dephasing of Dyakonov and Perel. Now, can spin-orbit interaction be used to produce spin-polarized currents, just like an inverse Dyakonov-Perel effect? The answer is yes [2], and we would like to propose with the Y-shaped spin-filter a possible device.

[1] S. Datta and B. Dat, Appl. Phys. Lett. **56**, 665 (1990)
[2] A. A. Kiselev and K. W. Kim, J. Appl. Phys **94**, 4001 (2003)

HL 16.17 Fr 16:30 Poster TU E

novel type of commensurability oscillations in haxagonal superlattices — •Stefan Meckler[1], Thomas Heinzel[1], Ulf Gennser[2], and Giancarlo Faini[2] — [1]IPkM, Heinrich-Heine-Universität, Univesitätsstr. 1, 40225 Düsseldorf, Germany — [2]LPN-CNRS, Route de Nozay, 91460 Marcoussis, France

Transport experiments on latteral superlattices in two-dimensional electron gases that show pronounced magneto-oscillations are reported. They originate from stable orbits around one or several antidots. In hexagonal lattice structures, we observe a novel type of classical commensurability peaks at high magnetic fields. These peaks are most prominent for large antidot diameters of about 70-90% of the lattice period. Using semiclassical simulations based on a billiard model, the observed oscillations can be attributed to stable orbits bouncing between neighboring antidots. This interpretation is backed by the observation of Aharonov-Bohm type oscillations with a correspondingly large period at the observed resonances.

HL 16.18 Fr 16:30 Poster TU E

Ab initio impact ionization rate in GaAs, GaN, and ZnS — •Angelika Kuligk, Niels Fitzer, and Ronald Redmer — Universität Rostock, Institut für Physik, 18051 Rostock

We have performed ab initio band structure calculations for GaAs, GaN, and ZnS within density functional theory (DFT) using an exact exchange formalism with a local density approximation (EXX-LDA) for correlations. The wave-vector dependent microscopic impact ionization rate (IIR) is determined for these materials. A strong asymmetry of the IIR as well as a pronounced influence of the band structure is found. We compare these results with scattering rates obtained from band structures calculated with the empirical pseudopotential method (EPM). We present also energy-averaged impact ionization rates which can be applied in Monte Carlo simulations of high field electron transport.

HL 16.19 Fr 16:30 Poster TU E

In-plane tunneling spectroscopy of low-dimensional electron systems in a GaAs/AlGaAs heterostructure — •J.-L. Deborde[1], S. F. Fischer[1], U. Kunze[1], D. Reuter[2], and A. D. Wieck[2] — [1]Werkstoffe and Nanoelektronik, Ruhr-Universität Bochum — [2]Angewandte Festkörperphysik, Ruhr-Universität Bochum

The use of tunneling spectroscopy between low-dimensional electron systems is of great interest to observe spectral features such as bandstructure effects or electron mode coupling. Using atomic force microscope (AFM) lithography, we produced a smooth potential barrier in a GaAs/AlGaAs heterostructure allowing in-plane tunneling in a two-dimensional electron gas (2DEG) as electrodes. The application of a bias across the barrier revealed Fermi-edge effects in the tunneling spectrum. Considering this AFM fabricated tunneling barrier, we aim to implement an in-plane electron directional coupler. Devices consisting of two parallel quantum wires (QWs) separated by a tunneling barrier were prepared by means of a combination of electron beam lithography and AFM lithography techniques. The electron density inside each one-dimensional electron waveguide (1DEWG) is controlled by in-plane gates whereas the height of the potential barrier is tuned by an electron-beam evaporated Schottky top gate. The conductance of the 1DEWGs show steps quantized with $2e^2/h$ as characteristic of one-dimensional transport. Experiments are expected to reveal tunnel coupling between the two 1DEWGs.

HL 16.20 Fr 16:30 Poster TU E

Ballistic rectification processes in crossed electron-waveguide devices — •Michael Knop[1], Ulrich Wieser[1], Ulrich Kunze[1], Dirk Reuter[2], and Andreas D. Wieck[2] — [1]Lehrstuhl für Werkstoffe und Nanoelektronik, Ruhr-Universität Bochum, Germany — [2]Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum, Germany

We investigate ballistic rectification processes in nanoscale four-terminal field effect devices with broken symmetry. The electron-waveguide injection leads are oppositely attached to a 200-400 nm wide and 2.5 μm long central channel which provides voltage probes. The angle between the injection leads and the central channel is varied between 30° and 90°. The devices are fabricated by a mix-and-match process combining high-resolution electron-beam and conventional photo lithography from a GaAs/AlGaAs heterostructure. The conductance characteristics of the injection leads show quantized conductance. Dc measurements in three-terminal configuration, one voltage probe remains unused, show ballistic rectification due to different mode population in the injection leads. In the four-terminal configuration we observe a rectification signal arising from the inertia ballistic motion of the injected electrons.

HL 16.21 Fr 16:30 Poster TU E

Ballistic transport in nanoscale Si/SiGe cross-bars — •Sorin Poenariu[1], Ulrich Wieser[1], Ulrich Kunze[1], and Thomas Hackbarth[2] — [1]Lehrstuhl für Werkstoffe und Nanoelektronik, Ruhr-Universität Bochum, D-44780 Bochum — [2]DaimlerChrysler Forschungszentrum Ulm, Wilhelm-Runge-Strasse 11, D-89081 Ulm

Starting from a high-mobility modulation-doped Si/SiGe heterostructure we prepare nanoscale field effect devices in order to study ballistic transport phenomena at $T = 4.2$ K. The transport channel is defined by a four-terminal ballistic cross-bar. Different symmetric and asymmetric geometries are realized with respect to the width and length of the current leads. We use a mix-and-match process which combines high resolution electron-beam lithography with calixarene and optical lithography with standard photoresist. The resulting resist pattern is transferred into the heterostructure by a low-damage CF_4/O_2 plasma process. For small current injection the four-terminal I-V-characteristic shows a negative bend resistance due to the ballistic motion of electrons. The influence of a top gate voltage on the I-V-characteristic is analyzed for different geometries. A second evidence of ballistic transport is a pronounced negative differential conductance (NDC) which is found in two-terminal I-V-characteristics of cross-bars and quasi one-dimensional wires. This NDC is attributed to phonon emission of electrons in the hot-electron regime.

HL 16.22 Fr 16:30 Poster TU E

Herstellung und Charakterisierung von vertikal geschichteten, niedrig-dimensionalen Ladungsträgersystemen — •C. Werner, D. Reuter und A.D. Wieck — Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum

Wir haben durch einen kombinierten Wachstums- und Implantationsprozess vertikal geschichtete, niedrig-dimensionale Ladungsträgersysteme in einer $Al_{0,33}Ga_{0,67}As/GaAs/Al_{0,33}Ga_{0,67}As/GaAs/Al_{0,33}Ga_{0,67}As$-Quantentopfstruktur hergestellt. Dabei wird mit Molekularstrahlepitaxie (MBE) zunächst ein Teil der Probe gewachsen und nach einem Ultrahochvakuum (UHV) Transfer in eine fokussierte Ionenstrahl (FIB) Anlage der Dotierstoff für das untere Ladungsträgersystem durch FIB eingebracht, bevor der Wafer nach UHV-Rücktransfer in der MBE-Anlage mit der Quantentopfstruktur fertig gestellt wird. Dies bietet - durch Wahl eines geschickten Implantationslayouts in Verbindung mit einer Strukturierung durch nasschemisches Ätzen - die Möglichkeit, die Ladungsträgersysteme getrennt zu kontaktieren. Bisher wurden zwei relativ weit voneinander entfernte Elektronengase erzeugt. Diese wurden zunächst getrennt vermessen und im Anschluss ihre Wechselwirkung untereinander untersucht.

HL 16.23 Fr 16:30 Poster TU E

Mikroskopische Transportmodelle für die Ladungsträgerdynamik in ZNS:Mn MISIM-Strukturen — •Karsten Meyer, Thomas Raker und Tilmann Kuhn — Institut für Festkörpertheorie, Wilhelm-Klemm-Str. 10, 48149 Münster

Wir untersuchen im Rahmen eindimensionaler mikroskopischer Modelle wie dem Drift-Diffusions und dem hydrodynamischen Transportmodell die Bistabilität der Ladungsübertragung in Wechselspannungsbetriebenen ZnS:Mn MISIM-Strukturen als Funktion von Amplitude und Frequenz der Treiberspannung. Es zeigt sich, dass dieses Phänomen in der Struktur der Gleichungen begründet ist und damit nicht kritisch vom funktionalen Verlauf des Stoßionisationskoeffizienten abhängt. So werden sowohl bei der Verwendung des üblichen, von Howard, Sahni und Alt vorgeschlagenen Verlaufs, als auch bei einer an experimentellen Ergebnissen angepassten Form breite bistabile Bereiche gefunden. Eine Erweiterung des Drift-Diffusions Modells auf zwei räumliche Dimensionen liefert Strukturbildungsphänomene wie sie auch im Experiment beobachtet werden.

HL 16.24 Fr 16:30 Poster TU E

Magnetic Focusing in Ballistic Hall-Bar Geometries — •Tobias Feil, Werner Wegscheider, and Dieter Weiss — Universität Regensburg

We investigate magnetotransport in Hall-bar geometries with dimensions much smaller than the electron mean free path at low temperatures. For the experiments we used GaAs/AlGaAs heterojunctions with low-temperature mobilities of 600 m^2/Vs and a corresponding mean free path of 45 μm.

Hall-bars with typically 4 μm wide mesas and potential probe separation of 4 μm were defined by electron beam lithography and dry etching. By driving a constant current along the Hall-bar we observe, as a function of a perpendicular magnetic field, pronounced oscillations in the longitudinal voltage drop, with a periodicity given by the magnetic focus condition:

$2nR_C = L \quad , \quad n = 1, 2, 3, ...$

with the cyclotron radius R_C and the contact separation L.

The resistance minima of the oscillations are well below the Drude resistance at low temperatures.

HL 16.25 Fr 16:30 Poster TU E

New approach to resonant transmission in nanostructures — •Oleg Kidun[1], Jamal Berakdar[1], and Natasha Fominykh[2] — [1]MPI für Mikrostrukturphysik, Halle, Germany — [2]Institute of Physics, St. Petersburg State University, St. Petersburg, Russia

We explore the resonant transmission probability in artificially fabricated nanosystems such as semiconductor quantum wells or quantum dots. We introduce the concept of spatially varying conductance and provide determining equations for this quantity. The theory resembles the well-known variable phase method [1-2], applied for 3D systems. Application of the suggested approach for particular nanostructures and a comparison of the theoretical results with experimental measurements are presented and discussed.

[1] F. Calogero, Variable Phase Approach in Potential Scattering, AP, NY (1967)

[2] O. Kidun, N. Fominykh, J. Berakdar, J. Phys. A 35, 9413 (2001)

HL 16.26 Fr 16:30 Poster TU E

Beam splitter Design using mixed phase space cavities — •Oliver Bendix, Antonio Mendez-Bermudez, and Ragnar Fleischmann — MPI für Strömungsforschung und Fakultät Physik der Universität Göttingen

We propose the construction of electronic/electromagnetic beam splitters using two-dimensional multi-lead waveguides. A prototype two-lead waveguide is locally deformed in order to produce a ternary incomplete horseshoe (proper of mixed phase space). Due to dynamical tunneling to phase space resonant islands the appearance of quasibound states (QBS) is induced. Then, we attach transversal leads to the waveguide on the deformation region in positions *along* the QBS, where the horseshoe is only slightly perturbed. We show that such QBS pump into the transversal leads giving rise to beam splitters. This assumption is based on the investigations due to classical Poincarè Maps [1] and quantum-mechanical Scattering Wave Functions (its Husimi Representation).

[1] J. A. Méndez-Bermúdez, G. A. Luna-Acosta, P. Šeba, and K. N. Pichugin, Phys. Rev. B **67**, 161104(R) (2003).

HL 16.27 Fr 16:30 Poster TU E

Bindungsspezifität von Peptiden auf Halbleiteroberflächen — •Karsten Goede[1], Michael Bachmann[2], Wolfhard Janke[2] und Marius Grundmann[1] — [1]Institut für Experimentelle Physik II — [2]Institut für Theoretische Physik, Universität Leipzig, Deutschland

Hybride Systeme aus anorganischen Halbleitern und Bio-Molekülen bilden einerseits ein gut zugängliches Modellsystem für das Studium des fundamental wichtigen Prozesses der molekularen Selbstanordnung, andererseits könnten sie vielfältige praktische Anwendungen finden als Bio-Sensoren oder in einer zukünftigen Nano-Bio-Elektronik. In diesem Beitrag zeigen wir, daß der mittels AFM-Messungen bestimmte Adhäsionskoeffizient von Clustern verschiedener Peptide mit ähnlicher Sequenz auf diversen Halbleiteroberflächen sowohl abhängig ist von der Elektronegativität der Oberflächenatome und ihrer räumlichen Anordnung als auch von der Art und Abfolge der Seitenketten in den Aminosäuren des Peptids [1]. Weiterhin können wir zeigen, daß eine geringe Adhäsion einhergeht mit der Ausbildung besonders großer und besonders weicher Cluster. Ausgehend von diesen empirischen Befunden werden Simulationen der Peptidfaltung vorgestellt, und der Weg zu einer theoretischen Modellierung der Peptid-Adhäsion auf Oberflächen wird diskutiert.

[1] K. Goede, P. Busch, M. Grundmann, Nano Lett., im Druck, Jahrgang 4, Ausgabe 11 (2004).

HL 16.28 Fr 16:30 Poster TU E

Die elektrische Aktiverung von Dotieratomen in SiC — •A. Mattausch, M. Bockstedte und O. Pankratov — Lst. für Theoretische Festkörperphysik, Universität Erlangen-Nürnberg, Staudtstr. 7, 91058 Erlangen

Die elektrische Aktivierung und Löslichkeit von Dotieratomen ist der limitierende Faktoren auf dem Weg zu hochdotierem SiC. In Stickstoffdotierten Proben konnte eine vollständige elektrische Aktivierung nur für eine Dotierung unterhalb einer Grenzkonzentration von $2\text{-}5{\cdot}10^{19}\,\mathrm{cm}^{-3}$ erreicht werden [1,2]. Dagegen konnte Phosphor bis zu Konzentrationen von $10^{20}\,\mathrm{cm}^{-3}$ bei nahezu vollständiger Aktivierung implantiert werden [1]. Um das Verhalten dieser Dotieratome zu verstehen haben wir ihre elektrische Aktivierung und ihre Löslichkeit mittels *ab initio* Methoden untersucht. Wir finden, dass Phosphor als flacher Donator hauptsächlich auf dem Silizium-Untergitter eingebaut wird, während Stickstoff ausschließlich Kohlenstoff-Plätze besetzt. Die elektrische Aktivierung beider Donatoren wird im thermodynamischen Gleichgewicht nicht durch Kompensation begrenzt, sondern durch die Bildung von Präzipitaten beim Phosphor und durch Passivierung beim Stickstoff. Für die Stickstoffpassivierung ist die oberhalb einer kritischen Stickstoffkonzentration von $2{\cdot}10^{19}\,\mathrm{cm}^{-3}$ dominierende Bildung von Stickstoff-Leerstellen-Komplexen verantwortlich.

[1] M. Laube *et al.*, J. Appl. Phys **92**, 549 (2002).

[2] D. Schulz *et al.*, Mater. Sci. Forum **338-342**, 87 (2000).