HL 13: Poster 1

Time: Monday 15:00–17:30 Location: Poster A

HL 13.1 Mon 15:00 Poster A

Anomalously localized electronic states in three-dimensional disordered systems — •Philipp Cain and Michael Schreiber — Institut für Physik, Technische Universität, D-09107 Chemnitz

We study the Anderson model of localization at the metal-insulator transition in the band centre of three-dimensional disordered samples. For the critical disorder we determine a large number of wave functions of the model and study the distribution of the wave function amplitudes. Deviations from the scaling of multifractal correlation functions allow us to discriminate anomalously localized states from the usual critical states. The thus identified anomalously localized states lead to deviations of the critical properties and have to be eliminated from the ensemble average for a characterization of criticality.

HL 13.2 Mon 15:00 Poster A

The application of multigrid methods to the Helmholtz/Anderson problem — •Rudolf Roemer and Sarah Mallion — Centre for Scientific Computing, University of Warwick, Coventry, UK

The similarities of the Helmholtz equation to the Schrödinger equation make it an ideal testing ground for programs designed to solve the latter. Multigrid methods are one way of solving the superficially similar Laplace equation and they can be highly efficient and easily adaptable to the specifics of an individual problem. The very nature of the multigrid process however, with its repeated interpolation and smoothing steps prevents it from converging to rapidly oscillating solutions such as those occurring with the Helmholtz equation. This is particularly problematic when the diagonal term includes randomness - the Anderson model. We propose the use of the comparatively slower varying WKB ansatz as an assumed form for the solution to the Helmholtz equation. This, with appropriately set of re-derived discrete differential operators, has the potential to negate the inherent problems of the Laplacian multigrid solver and allows convergence even to the highly oscillating solutions of the Helmholtz equation.

HL 13.3 Mon 15:00 Poster A

Interface influence on optical properties of Si-SiO_2 structures — •Kaori Seino, Jan-Martin Wagner, and Friedhelm Bechstedt — Institut für Festkörpertheorie und -optik, Friedrich-Schiller-Universität, Max-Wien-Platz 1, 07743 Jena, Germany

Prototypical Si-based systems to study quantum-size effects are short-period Si-SiO_2 multiple quantum wells (MQWs). The application of Si-SiO_2 layered system in multi-junction solar cells for future photovoltaics requires an optimum band structure design. Their fabrication as nm-scale superlattice allows a band-gap tuning. The understanding of optical properties in Si-SiO_2 multilayer structures is essential for their application.

Here we present results for optical properties of Si-SiO_2 MQWs obtained by means of first-principles calculations. The calculations for optical properties have been widely performed within the independent-particle approximation. We investigate the dependence on the thickness of the silicon layer, varying in the range from 1 to 4 nm, for several structural interface elements ensuring dangling-bond passivation at the interface. Our results demonstrate vertical confinement effects on the optical properties for both the fundamental gap and the oscillator strength of Si-SiO_2 superlattices with nm-sized layers.

HL 13.4 Mon 15:00 Poster A

Einfluss akustischer Oberflächenwellen auf die Leitfähigkeit von Graphen — •Jörg Kinzel, Jens Ebbecke, Markus Regler und Achim Wixforth — Universität Augsburg

Monolagige Graphitschichten, die als Graphen bezeichnet werden, eröffnen einen neuen Weg zu einem zweidimensionalen Elektronengas (2DEG), wobei vor allem die lineare Energiedispersion der Leitungselektronen besondere Eigenschaften hervorruft.
Je nach Anzahl der a-b Gitterebenen zeigt Graphen halbleitende oder halbmetallische Eigenschaften, wobei sich im Falle eines 2DEG auch die erwartenden Shubnikov-de Haas Oszillationen bzw. der Quanten Hall Effekt beobachten lassen, bei letzterem sind die Plateaus der Hallspannung jedoch um $\frac{1}{2}\frac{h}{4e^2}$ verschoben. [1]

In dieser Arbeit wird der Einfluss eines mittels akustischer Oberflächenwellen induzierten Hochfrequenzfeldes auf den Ladungstransport in Graphenschichten untersucht, die aus einem makroskopischen Graphitstück hergestellt wurden.

[1] K. S. Novoselov et. al., Nature 438, 197 (2005)

HL 13.5 Mon 15:00 Poster A

Investigating the properties of ternary chalcogenide alloys with Density Functional Theory employing PAW potentials — •Pascal Rausch, Stephan Kremers, and Matthias Wuttig — I. Physikalisches Institut (1A), RWTH Aachen, 52056 Aachen

For modern data storage applications like PC-RAMs, phase change alloys play a crucial role. In order to understand physical properties of suitable materials, e.g. the electronic band structures, first principles calculations have proven to yield valuable insight. The ultimate goal is to deduce design rules for phase change alloys with superior properties. To perform density functional calculations, the use of pseudopotentials is necessary. Trouiller-Martins/Hamann type pseudopotentials are well established, but to refine the methods, so called Plane Augmented Wave (PAW) pseudopotentials are an interesting option. They provide the same numerical efficiency while keeping the correct physical information in the core region. PAW were used to perform calculations on materials such as $Ge_1Sb_2Te_4$ or GeTe to validate their effectiveness. In addition new ternary chalcogenide materials, which show slow converging behaviour using Trouiller-Martins/Hamann type pseudopotentials, were investigated with respect to their electronic structure.

HL 13.6 Mon 15:00 Poster A

Ionenstrahlgestützte Molekularstrahlepitaxie von Gadoliniumnitrid-Schichten — •Julius Mennig, Jürgen Gerlach, Thomas Höche und Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung e.V., Permoserstr. 15, 04318 Leipzig

Seit einigen Jahren sind Seltenerd-Nitride in den Blickpunkt verschiedener Forschungsgruppen gerückt, insbesondere Gadoliniumnitrid (GdN)[1]. Die elektronischen Eigenschaften dieses ferromagnetischen Materials (Curie-Temperatur: 60 K) sind noch nicht vollständig geklärt. Theoretische Modelle variieren von halbmetallisch über halbleitend bis zu isolierend, experimentelle Daten sind aufgrund der geringen kristallinen Qualität der bisher hergestellten Schichten mehrdeutig.

In diesem Beitrag werden Herstellung und Charakterisierung von epitaktischen GdN-Schichten auf MgO präsentiert. Sie wurden mittels Ionenstrahlgestützter Molekularstrahlepitaxie unter Variation der Substrattemperatur zwischen 150 °C und 750 °C abgeschieden. Aufgrund der hohen Affinität des GdN zu Sauerstoff waren Schutzschichten (hier GaN) nötig. Kombinierte SIMS- und ERDA-Analysen weisen auf einen geringen Sauerstoffgehalt in den Schichten hin. *In situ* RHEED- und *ex situ* XRD-Messungen zeigen epitaktisches Wachstum und eine hohe kristalline Qualität der Schichten mit starker Abhängigkeit von der Substrattemperatur. Jedoch tendieren diese (100)-orientierten Schichten zu Verzwillingung.

[1] F. Leuenberger, A. Parge, W. Felsch, K. Fauth, and M. Hessler, Phys. Rev. B 72 (2005) 014427.

HL 13.7 Mon 15:00 Poster A

Effect of hydrogen an silicon co-doping on the magnetic properties of GaGdN grown by MBE — •Martin Roever, Dong-Du Mai, Amilcar Bedoya Pinto, Henning Schuhmann, Tore Niermann, Joerg Malindretos, Michael Seibt, and Angela Rizzi — IV. Physikalisches Institut and Virtual Institute of Spin Electronics (VISel), Georg-August-Universität Göttingen, D-37077 Göttingen, Germany

With the aim of understanding the observed room-temperature giant magnetic moment of highly diluted GaGdN we report on the growth and characterisation of hydrogen and silicon co-doped GaGdN as well as of GaGdN without co-doping. The layers were grown by plasma assisted MBE on MOCVD GaN templates grown on sapphire. Growth was performed at optimised conditions for GaN in the slightly metal rich regime at a substrate temperature of $760°C$. All samples have been doped with Gd and SIMS measurements reveal a Gd concentration between $10^{17}cm^{-3}$ and $10^{21}cm^{-3}$. Not intentionally co-doped samples show ferromagnetism at room temperature with weak coercivity. Another series of samples, co-doped with activated hydrogen, shows ferromagnetic behaviour at room temperature, too. The coerciv-

ity is enhanced, but the overall magnetisation is weaker compared with the non co-doped samples. Because the ferromagnetism in GaGdN is believed to be mediated by electrons the doping with silicon, a n-type dopant in GaN, should increase the magnetisation in this system. Electrical and optical characterisation of all samples are in progress.

HL 13.8 Mon 15:00 Poster A

Preparation, characterization and measurements of graphene layers on SiO_2 substrates — •Ulrich Stöberl, Tobias Feil, Michael Huber, and Dieter Weiss — Institut für Experimentelle und Angewandte Physik, Universität Regensburg, 93040 Regensburg, Germany

In the last two years quite a number of fundamental experimental results on graphene were published and sparked a lot of interest in this new material. Graphene is a monolayer of graphite and comes up with some new characteristics such as a linear dispersion relation or its field effect which allows to tune via a gate voltage from an electron to a hole system. Furthermore graphene is theoretically well understood; although it was not available for experiments yet. We present the preparation of graphene layers of different thicknesses. Starting materials are highly ordered pyrolytic graphite (HOPG) and graphite flakes. Different techniques are used to superimpose the graphene layers to the SiO_2. We show first gate voltage dependent measurements in van-der-Pauw geometry. Additionally the roughness of multi layer graphene surfaces with different thicknesses was determined by means of AFM.

HL 13.9 Mon 15:00 Poster A

All-electron implementation of the *GW* approximation within the FLAPW method — •Christoph Friedrich, Arno Schindlmayr, and Stefan Blügel — Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich, Germany

The *GW* approximation for the electronic self-energy yields quasiparticle band structures in very good agreement with experiment, but almost all implementations so far are based on the pseudopotential approach, which limits their range of applicability. We develop an implementation within the full-potential linearised augmented plane-wave (FLAPW) method, which treats core and valence electrons on the same footing. Furthermore, there is no artificial partitioning of core and valence densities. Within this method a large variety of materials can be treated, including d- and f-electron systems, oxides and magnetic systems. Our implementation uses a mixed basis set for the representation of basis-function products. The expansion of the wave function around the Γ point employing $\mathbf{k}\cdot\mathbf{p}$ perturbation theory allows to treat the divergence of the Coulomb interaction analytically. Here the anisotropy of the dielectric matrix is fully taken into account. As a demonstration we show convergence tests and first results. Financial support from the Deutsche Forschungsgemeinschaft through the Priority Program 1145 is gratefully acknowledged.

HL 13.10 Mon 15:00 Poster A

Adiabatic-Connection Fluctuation-Dissipation Theorem for rare-gas crystals — •Judith Harl and Georg Kresse — Sensengasse 8/12 , 1090 Wien, Österreich

Kohn-Sham density functional theory (DFT) has shown to be an efficient and adequate method to describe a wide range of materials properties. Nevertheless, absolute energies are not within chemical accuracy and the Van-der-Waals interaction is not reproduced correctly due to the inaccurate representation of the long range part of the correlation energy. Improvements can be achieved by the adiabatic-connection fluctuation-dissipation theorem (ACFDT), which links the dielectric response of the non-interacting Kohn-Sham system to the correlation energy. Since calculations of the dynamical response function became tractable, first ACFDT calculations, mostly in the random-phase approximation (RPA), have been undertaken [1,2]. In the present work we focus on the rare gas crystals (Ne,Ar,Kr), representative for weakly bonded Van-der-Waals systems. In the local density approximation (LDA) the DFT lattice constants and cohesive energies show large deviations from experiment and the generalised gradient approximation (GGA) fails completely. Applying the ACFDT-RPA, we found that the error in the lattice constant is decreased from 10% for Ne and 6% for Ar (LDA) to under 1%. For Kr the lattice constant is within 3.5% of experiment. The error in the cohesive energy becomes 4 times smaller than in the LDA.

[1] F. Furche, Phys. Rev. B 64 (2001) 195120.
[3] A. Marini et al., Phys. Rev. Lett. 96 (2006) 136404.

HL 13.11 Mon 15:00 Poster A

Efficient implementation of the exact nonlocal exchange potential within the FLAPW method — •Markus Betzinger, Christoph Friedrich, Gustav Bihlmayer, and Stefan Blügel — Institut für Festkörperphysik, Forschungszentrum Jülich, 52425 Jülich, Germany

The exact nonlocal exchange potential is an important ingredient in Hartree-Fock and density-functional calculations employing hybrid functionals (PBE0, B3LYP, etc.) as well as the optimized effective potential (OEP) (exact exchange) method. Hybrid functionals have been shown to be superior to local-density and generalized gradient-type functionals for clusters and molecules, while the OEP exchange-only approach is known to improve on the electronic band structure of semiconductors. In all methods the evaluation of the exchange potential is the most time-consuming step. While straightforward in Gaussian and plane-wave basis sets, its efficient implementation in the highly accurate full-potential linearized augmented plane-wave method (FLAPW) is still a challenge. Our approach uses a mixed basis which is specifically designed for basis-function products. After representing the Coulomb interaction in this basis, the exchange matrix elements can be written as Brillouin-zone (BZ) integrals over vector-matrix-vector products. The Coulomb interaction goes to infinity in the center of the BZ leading to a divergency in the integrand. The divergent part can be separated from the numerical integral and treated analytically. We show first results. Financial support from the Deutsche Forschungsgemeinschaft through the Priority Program 1145 is gratefully acknowledged.

HL 13.12 Mon 15:00 Poster A

FIR spectroscopy of nanostructured meandering conducting stripes fabricated by AFM nanolithography — •Steffen Groth, Kevin Rachor, Carsten Graf von Westarp, Tobias Krohn, Nikolai Mecking, and Detlef Heitmann — Institut für angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstrasse 11, 20355 Hamburg, Germany

We perform far infrared (FIR) photoconductivity spectroscopy on nanostructured meandering conducting stripes fabricated by atomic force microscope (AFM) nanolithography. For this purpose we have established the technique of anodic oxidation to pattern an oxide barrier directly on a GaAs/AlGaAs shallow high electron mobility transistor heterostructure with a two dimensional electron system (2 DES) confined 35 nm below the surface. This technique enables us to prepare barriers with a geometrical thickness of less than 200 nm and lateral structures of different geometry and size down to 300 nm width and up to 180 μm long. The conducting stripe width is furthermore tuneable by sweeping the applied gate voltage. The measurements on the nano Hall bars were performed in a He^3 cryostat at a sample temperature of 300 mK in a magnetic field up to 8 T. Transport measurements in the conducting stripes show typical behaviour of 1D subbands. In FIR spectroscopy we observe confined plasmon modes. We have also patterned a line of resonators with accurately defined geometry. Resonances depending on the size of the resonators are predicted for exitation by FIR radiation.

The Authors thank the DFG for support through the SFB 508.

HL 13.13 Mon 15:00 Poster A

Optical Modes in Semiconductor Microtube Resonators — •Christoph Matthias Schultz, Hagen Rehberg, Christian Strelow, Holger Welsch, Christian Heyn, Detlef Heitmann, and Tobias Kipp — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg

In our recent work we demonstrate that microtubes can act as optical ring resonators [1]. These microtubes are prepared by optical lithography and wet-etching techniques using the self-rolling mechanism of strained bilayers. We observe sharp modes which were probed by the photoluminescence of either InAs quantum dots or InGaAs quantum wells embedded in the tube's wall. The modes show a specific fine structure. We analyze the mode energies regarding the localization along the tube's axis and other typical tube parameters. Our previous theoretical model [1] was expanded by an approximation taking into account the actual tube geometry. The modes show anisotropic radiation behavior. We discuss the possibility of unidirectional emission of light.

We acknowledge financial support from the Deutsche Forschungsgesellschaft via SFB 508 and the Graduiertenkolleg 1286.

[1]: T.Kipp *et al.*, Phys. Rev. Lett. **96**, 077403 (2006)

HL 13.14 Mon 15:00 Poster A

FIR Spectroscopy on Carbon-doped Two-Dimensional Hole Systems — •Kevin Rachor[1], Carsten Graf von Westarp[1], Detlef Heitmann[1], Dirk Reuter[2], and Andreas Wieck[2] — [1]Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstr. 11, 20355 Hamburg — [2]Ruhr-Universität Bochum, Universitätsstraße 150, 44801 Bochum

The recent development of Carbon-doped AlGaAs heterostructures on (100) substrates permits an experimental access to two-dimensional hole systems (2DHS) with high mobilities and no anisotropy [1]. Using a Fourier transform spectrometer we perform broadband far infrared transmission experiments on such samples. Cyclotron resonances measured in perpendicular magnetic fields up to 14 T at 1.6 K are presented here revealing the complicated band structure of hole systems. The dispersion is non-linear yielding an increasing effective mass form $m^* = 0.40\,m_e$ to $0.42\,m_e$ for increasing magnetic fields. For B smaller than 11 T the cyclotron resonances splits into two resonances. Tilting the sample increases this splitting. A possible explication is a coupling between the cyclotron (intraband) and the heavy hole-light hole intersubband resonance. Surprisingly, additional broadenings of the cyclotron resonance for magnetic fields higher than 12 T are observed.

The authors are grateful to the DFG for support through SFB 508.
[1] B. Grbić, C. Ellenberger, T. Ihn, K. Ensslin, D. Reuter, and A. D. Wieck. *Magnetotransport in C-doped AlGaAs heterostructures.* Appl. Phys. Lett. **85**, 2277 (2004).

HL 13.15 Mon 15:00 Poster A

Frequenzaufgelöste Spektroskopie an GaAs/(AlGa)As-Heterostrukturen — •Jonas Haunschild[1], Sangam Chatterjee[1], Peter Thomas[1], Wolfgang W. Rühle[1], Andreas D. Wieck[2], Galina Khitrova[3] und Hyatt M. Gibbs[3] — [1]Fachbereich Physik und Wissenschaftliches Zentrum für Materialwissenschaften, Philipps-Universität Marburg, Renthof 5, D-35032 Marburg, Germany — [2]Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum, D-44780 Bochum, Germany — [3]College of Optical Sciences, The University of Arizona, Tucson, Arizona 85721, USA

Die frequenzaufgelöste Spektroskopie bietet die Möglichkeit, die Lebensdauerverteilung photogenerierter Ladungsträger über viele Dekaden hinweg mittels Photolumineszenz (PL) zu untersuchen. Aus der um 90° phasenverschobenen Komponente des modulierten PL-Signals kann dabei auf die Lebensdauer der angeregten Zustände geschlossen werden. Im Experiment wird ein HeNe-Laser bei 632,8 nm eingesetzt. Der Laser wird von 10 Hz bis 10 MHz moduliert. Somit können Lebensdauern von 100 ms bis 100 ns erfasst werden. An einer Probe mit 60x8,2 nm GaAs-Quantenfilmen zwischen 10 nm AlAs-Barrieren wurde eine Doppelstruktur der Lebensdauerverteilung mit Maxima bei 1 ms und 1 μs gefunden. An einer Probe mit zwölf unterschiedlichen GaAs-Quantenfilmen von Schichtdicken zwischen 3,3 nm bis 19,8 nm wird der Einfluss von Unordnungseffekten auf die Lebensdauerverteilung der Ladungsträger untersucht. Die quantenmechanischen Rechnungen mit Unordnungspotentialen deuten auf eine Verbreiterung der Lebensdauerverteilung mit zunehmender Unordnung hin.

HL 13.16 Mon 15:00 Poster A

The band structure of indium oxide: indirect vs. direct band gap — Paul Erhart, •Péter Ágoston, Andreas Klein, and Karsten Albe — Technische Universität Darmstadt, Institut für Materialwissenschaft, Petersenstraße 23, 64287 Darmstadt

The nature of the band gap of indium oxide is still a matter of debate. Based on optical measurements the presence of an indirect band gap has been suggested, which is 0.9 to 1.1 eV smaller than the direct band gap at the Γ-point. This could be caused by strong mixing of O-2p and In-4d orbitals off Γ. We have performed extensive density functional theory calculations using the LDA+U and GGA+U method to elucidate the contribution of the In-4d states and the effect of spin-orbit coupling on the valence band structure. Although an indirect band gap is obtained the energy difference between the overall valence band maximum and the highest occupied level at the Γ-point is less than 50 meV. It is concluded that the experimental observation cannot be related to the electronic structure of the bulk material.

HL 13.17 Mon 15:00 Poster A

Light absorption of silicon nanoparticles — •Andreas Gondorf[1], Cedrik Meier[1], Stephan Lüttjohann[1], Matthias Offer[1], Axel Lorke[1], and Hartmut Wiggers[2] — [1]Experimental Physics, University of Duisburg-Essen, Lotharstrasse 1, D-47048 Duisburg, Germany — [2]Combustion and Gas Dynamics, University of Duisburg-Essen, Lotharstrasse 1, D-47048 Duisburg, Germany

We have studied silicon nanoparticles fabricated by gas-phase condensation and in-flight sintering using absorption and photoluminescence (PL) spectroscopy. We observe a quantum size effect in PL as well as in absorption spectroscopy. From an analysis of the absorption spectra we are able to identify the character of the band gap of the nanoparticles as indirect. This result is supported by measurements of the decay time of the photoluminescence of excitons. The decay time is four orders of magnitude larger than in direct semiconductors. Moreover, we are able to observe the influence of the particle size distribution in the absorption spectra. The size distribution follows the lognormal distribution. In order to explain the surprisingly small dependence of the absorption edge on the mean particle diameter, we discuss a model which takes into acount the lognormal size distribution.

HL 13.18 Mon 15:00 Poster A

Anisotropic optical properties and excitonic structure of ZnO between 2.5 and 32eV — •Christoph Cobet[1], Munise Rakel[1,2], Christoph Werner[1], Wolfgang Richter[2,3], and Norbert Esser[1,2] — [1]ISAS - Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, D-12489 Berlin — [2]Institut für Festkörperphysik, TU-Berlin, Hardenbergstr. 36, D-10623 Berlin — [3]Dipartimento di Fisica, C139 Roma II (Tor Vergata), Via della Ricerca Scientifica 1, I-00133 Rome

The dielectric response functions of bulk ZnO for polarisations parallel and perpendicular to the c-axis are obtained in the spectral range from 2.5 to 32 eV by analysis of ellipsometric data. The optical absorption of ZnO in the direct band gap region is highly complex and cannot be explained only in terms of interband or pure excitonic absorption. The main peaks can be divided into two classes, which also differ in their temperature dependence: The dominant exciton absorptions and the so called exciton-phonon complexes. It is shown that the ordering of valence band maxima at k=0 is $\Gamma_9 - \Gamma_7 - \Gamma_7$ analog to the most wurtzite compounds. At higher energies electronic transitions involving Zn-3d and O-2s bands are detected. Although the O2s-levels are core-like, they show a residual anisotropy. Finally, the plasmon frequency was recorded to be $\hbar\omega_p$=18.95 eV for $E \perp c$ and 18.12 eV for $E \parallel c$, respectively.

HL 13.19 Mon 15:00 Poster A

Ta_2O_5/SiO_2 dielectric DBR mirrors for ZnO based microcavities and VCSEL structures — •Alexander Franke, Björn Diez, Thomas Hempel, Jürgen Christen, Annett Diez, Sören Heinze, and Alois Krost — Institute of Experimental Physics, Otto-von-Guericke-University Magdeburg, Germany

For the realization of polariton lasers in ZnO and ZnO-based microcavities the fabrication of high quality Distributed Bragg Reflectors (DBRs) is essential. Epitaxial growth e.g. of MgZnO-based DBR has not been reported so far. We produce suitable DBRs operating resonantly at the bound exciton luminescence in ZnO (E = 3.36 eV) using electron beam (EB) evaporation and sputter technique. The DBRs are made of ten $\lambda/4$ multilayers of SiO_2 and Ta_2O_5 dielectric films yielding a high reflectivity of larger than 99 % and a wide stop band of about 720 meV FWHM. This assembly exhibit a high transmission at the spectral position of the E = 3.81 eV line of a HeCd laser allowing efficient optical pumping of the active region without losses. As the active region we use a $3\lambda/2$ thick ZnO layer. The ZnO was reactively sputtered using a Zn target in an Ar and O_2 atmosphere. To further improve the quality of the active ZnO layer and in particular its surface morphology MOCVD growth of polycrystalline ZnO is used replacing the sputtering step in a second sample set.

HL 13.20 Mon 15:00 Poster A

Magnetotransport measurements on GaMnAs and on GaMnAs/MnAs hybrid structures — •Matthias Elm[1], Jörg Teubert[1], Wolfram Heimbrodt[1], Peter Jens Klar[2], Matthias Reinwald[3], and Werner Wegscheider[3] — [1]Department of Physics and Material Science Center, Philipps-University of Marburg, Germany — [2]1. Physics Institute Justus Liebig University of Giessen, Germany — [3]Institute of Applied and Experimental Physics II, University of Regensburg, Germany

GaMnAs alloys on (311)A substrate grown by LT-MBE and corresponding GaAs:Mn/MnAs hybrid structures obtained by thermal

annealing have been investigated. A controlled thermal annealing of highly Mn doped GaAs layers leads to the formation of MnAs nanocrystals by segregation effects. Increasing annealing temperature leads to increasing cluster size. GaMnAs layers and GaAs:Mn/MnAs hybrids have been studied by magnetotransport for different orientations of the applied external magnetic field. The measurements were performed on Hall-bars with a length of 650 μm and a width of 200 μm in a temperature range from 2 to 280 K in magnetic fields up to 10 Tesla. The transport behaviour of the alloy samples and the hybrids show distinct differences. In contrast to the hybrid structures the alloys show also a clear angle dependence in the transport behaviour. The results were used in order to determine the anisotropic parameters.

HL 13.21 Mon 15:00 Poster A

Effect of localized B and N states on the magneto-transport of (B,Ga,In)As and (Ga,In)(N,As) — •Jörg Teubert[1], Peter Klar[2], Wolfram Heimbrodt[1], Volker Gottschalch[3], Andrew Lindsay[4], and Eoin OReilly[4] — [1]Faculty of Physics and Material Sciences Center, Philipps-University of Marburg, Germany — [2]1. Physics Institute Justus Liebig University of Giessen, Germany — [3]Faculty of Chemistry and Mineralogy, University of Leipzig, Germany — [4]Tyndall National Institute, Lee Maltings, Cork, Ireland

The incorporation of both B or N into GaAs is expected to cause the formation of highly localized levels resonant with the conduction band. Whereas in the case of N the interaction between these localized levels and extended band states has considerable effect on the electonic band structure, the effects of B-incorporation on the electronic properties are generally believed to be rather small.

Magneto-transport properties of n- and p-type (B,Ga,In)As and (Ga,In)(N,As) were studied in the temperature range from 2 to 300 K and in magnetic fields up to 10 T and at hydrostatic pressures up to 16 kbar. The magneto-transport in (B,Ga,In)As and (Ga,In)(N,As) is very similar. P-type samples show normal semiconductor behaviour whereas the electron transport in both alloys is strongly affected by the interaction of the free carriers with the density of states of localized B and N impurity states, respectively. A possible transition from band-like transport to hopping-like transport in (B,Ga,In)As at low temperature and low carrier concentration or high pressure will be discussed.

HL 13.22 Mon 15:00 Poster A

A block-tridiagonalization algorithm for quantum transport calculations — •Michael Wimmer and Klaus Richter — Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg

There is a great variety of numerical algorithms for the calculation of coherent quantum transport. Usually, these algorithms have two things in common: They are based on tight-binding Hamiltonians and, in order to work efficiently, the Hamiltonian matrix must be in block-tridiagonal form. In general, this form is optimal - i.e. the algorithm runs most efficiently - if the blocks are as small as possible and equally sized. Even for very symmetric structures it can be difficult to construct the optimal form by hand, for complex structures it is even more difficult.

We present an algorithm based on heuristic graph partitioning techniques that brings a Hamiltonian matrix into an optimal block-tridiagonal form. It can be used as input for serial and parallel transport algorithms. Based upon that algorithm and the recursive Green's function method, we have developed a code for coherent transport calculations that is suited for any tight-binding model and can also deal with multiterminal structures.

HL 13.23 Mon 15:00 Poster A

Design and realization of micromechanical cantilevers for magnetization studies of two-dimensional electron systems in nanostructures — •T. Windisch[1], O. Roesler[1], J. I. Springborn[1], N. Ruhe[1], Ch. Heyn[1], D. Heitmann[1], M. A. Wilde[2], and D. Grundler[2] — [1]Institut für Angewandte Physik, Universität Hamburg, Jungiusstraße 11, D-20355 Hamburg — [2]Physik Department E10, Technische Universität München, James-Franck-Straße 1, D-85748 Garching

We have designed and realized micromechanical cantilever magnetometers (MCMs) which allows us to measure the magnetization M of small arrays of nanostructures incorporating a low-dimensional electron system. According to $M = -(\partial U/\partial B)_{N,T}$ (B is the magnetic field) at low temperature T provides direct information about the magnetic field dependence of the ground state energy U. To get a high signal-to-noise ratio for a small electron number N we first optimized the shape, thickness and width of our MCMs using finite-element simulations (FEM). To test the developed sensor layout we secondly fabricated MCMs from a specifically designed GaAs heterostructure by electron beam lithography and etching of sacrificial layers. The lateral size was about 40 μm × 120 μm. Using interferometric fiber optics we readout the MCMs at T = 300 mK and measured the de Haas-van Alphen effect of an integrated two-dimensional electron system. We report the FEM optimization study and our experimental results. We thank the Deutsche Forschungsgemeinschaft for financial support via SFB 508 and the excellence cluster Nanosystems Initiative Munich.

HL 13.24 Mon 15:00 Poster A

Magnetization measurements of low-dimensional electron systems by static and dynamic cantilever magnetometry — •A. Krohn[1], J. I. Springborn[1], N. Ruhe[1], M. A. Wilde[2], D. Heitmann[1], and D. Grundler[2] — [1]Institut für Angewandte Physik, Universität Hamburg, Jungiusstrasse 11, 20355 Hamburg — [2]Technische Universität München, Department E10, James-Franck-Strasse 1, 85748 Garching

A direct way to achieve information about the ground state of an electron system in semiconductors is to measure the magnetization $M = -\partial F/\partial B$ (F is the free energy). We use a cantilever magnetometer based on a fiber-optics interferometer to study the magnetization of a two-dimensional electron system (2DES) at a temperature down to 0.3 K and a magnetic field B of up to 14.5 T. We apply two different modi simultaneously: The well established static measurement of M and a dynamic technique where we modulate the gate voltage applied to the 2DES. By the latter technique we detect $\partial M/\partial N_s$ (N_s is the carrier density). By the novel set-up we are thus able to compare the static magnetization and the dynamic susceptibility measured on the same 2DES. In our experiment we investigate a 2DES in an inverted high electron mobility transistor structure and monitor the de Haas-van Alphen oscillations by the two different techniques. The 2DES has a maximum carrier density of $6 \cdot 10^{11}$ cm^{-2} and mobility of 45,000 cm^2/Vs at 0.3 K. We find that the magnetic data agree within about 10%. We acknowledge financial support by the Deutsche Forschungsgemeinschaft via SFB508 and GR1640/1.

HL 13.25 Mon 15:00 Poster A

Quantum dot as a thermal rectifier — Ralf Scheibner[1], •Christian Praetorius[1], Ines Hense[1], Markus König[1], Dirk Reuter[2], Andreas Wieck[2], Hartmut Buhmann[1], and Laurens Molenkamp[1] — [1]Physikalisches Institut (EP3), Universität Würzburg, Am Hubland, 97074 Würzburg, Germany — [2]Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum, Universitätsstraße 150, 44780 Bochum, Germany

A magnetic field parallel to the plane of a 2DEG is used to control the energy distribution of states in a gate defined quantum dot. In high magnetic fields, rearrangements in the spin system favor states with a high orbital quantum number and introduce an asymmetry in the coupling of the quantum dot to its leads. We investigate the electric, thermo-electric, and thermal transport properties in this case of an asymmetric quantum dot-lead coupling. Thermovoltage measurements agree well with numerical analysis on the basis of a resonant tunneling model for transport using measurements data from non-linear conductance measurements. Further theoretical model investigations reveal that the quantum dot intrinsically acts as a thermal rectifier.

HL 13.26 Mon 15:00 Poster A

Spectrally resolved far-infrared photoresponse in quasi-Corbino quantum Hall systems — •Christian Notthoff and Axel Lorke — Festkörperphysik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg

We present far-infrared (FIR) photoresponse measurements on different quasi-Corbino-shaped GaAs/AlGaAs heterostructures in the integer quantum Hall regime. We use a FT-FIR-Spectrometer as source and the sample it self as well as a Si-bolometer(for transmission measurements) as a detector. Contrary to the classical Hallbar-geometry, which exhibits their maximum sensitivity just below and above an integer filling factor [1,2], our samples show their max sensitivity at the integer filling factor. We find a sharp photoresponse-signal centred at the cyclotron-frequency with a nearly Lorenzian shape, which rapidly decreases in amplitude by varying the magnetic field away from an integer filling factor. Both observations show that the observed photoresponse is clearly not a bolometric effect but rather a direct result from resonat inter-Landau-level transition.

[1] J. Appl. Phys., Vol89, No 7 (April 2001) [2] PRB 63, 085320

(Oktober 2004)

HL 13.27 Mon 15:00 Poster A

Wigner-Crystalline Order of Two-Dimensional Electron Systems in High Magnetic Fields — •Guenther Meissner and Uwe Schmitt — Theoretische Physik, Universitaet des Saarlandes, Postfach 15 11 50, D-66041 Saarbruecken

A unified many-body approach which has been shown to allow for studying the nature of novel liquid and solid phases of interacting two-dimensional electrons in high magnetic fields is reexamined. Effects on collective excitations from including weak random disorder and from considering various quasi particles of composites of electrons and magnetic flux quanta are discussed in view of recent microwave resonance and inelastic light scattering experiments on high quality two-dimensional electron systems. The insulator terminating the series of fractional quantum Hall liquids at high magnetic fields is identified with the electron quantum solid being related to the Wigner crystal.

HL 13.28 Mon 15:00 Poster A

Doping efficiency and donor binding energy in high mobility AlAs quantum wells — Claudius Knaak, •Shivaji Dasgupta, Max Bichler, Anna Fontcuberta i Morral, Gerhard Abstreiter, and Matthew Grayson — Walter Schottky Institute, Technische Universität München, Am Coulombwall 3, Garching

We present a quantitative study of the energy band diagram for the X-point conduction band E_X for high mobility (001) oriented AlAs quantum wells (QW). Saturation of the dark electron density of the two dimensional electron system (2DES) was observed at $2\times10^{11}/\mathrm{cm}^2$ for an incrementally doped series of the samples, allowing the doping efficiency of the Si delta doping layers in $Al_xGa_1 - xAs$ (x =0.45) to be calibrated. In addition, we report the binding energy of the donors to be an essential factor in analyzing the conduction band diagram to explain the saturation density. In a double-sided doped AlAs QWs charging effects from dilute charge traps in the substrate [1] can be neglected because they will be screened by the bottom Si-delta doping layer. Our model is further complemented by a detailed study of the persistent photoconductivity. After a cold 4 K illumination, a peculiar rise in density to $4 \times 10^{11}/\mathrm{cm}^2$ is seen upon thermally annealing the samples in the dark at 40 K. Similar studies are also reported for high mobility (110) oriented AlAs QW substrates.

[1] De Poortere, et al. Phys. Rev. B 67, 153303 (2003).

HL 13.29 Mon 15:00 Poster A

Formation of Bloch-oscillations and plasma frequency in femtosecond excited semiconductors — •Klaus Morawetz[1,2], Pavel Lipavsky[3], and Michael Schreiber[1] — [1]Institute of Physics, Chemnitz University of Technology, *09107 Chemnitz, Germany — [2]Max Planck Institute for the Physics of Complex*Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany — [3]Faculty of Mathematics and Physics, Charles University, *Ke Karlovu 3, 12116 Prague 2, Czech Republic

Starting from a quantum kinetic equation including the mean field and a conserving relaxation-time approximation we derive an analytic formula which describes the time dependence of the dielectric function in a plasma created by a short intense laser pulse with an additional external electric field bias. This formula reproduces universal features of the formation of collective modes seen in recent experimental data of femtosecond spectroscopy, [Phys. Rev. B 72 (2005) 233203-1-5], and describes the appearance of additional Bloch oscillations due to the finite bias. The long-time limit of the response function coincides with the field-dependent dielectric function derived earlier. [Phys. Rev. E 50 (1994) 474-479]

HL 13.30 Mon 15:00 Poster A

Nonequilibrium Green's functions approach to artificial atoms: Nonequilibrium behavior — •Karsten Balzer[1], Michael Bonitz[1], Nils-Erik Dahlen[2], and Robert van Leeuwen[2] — [1]ITAP, Christian-Albrechts-Universität Kiel, Leibnizstr. 15, 24098 Kiel, Germany — [2]Theoretical Chemistry, Materials Science Center, Rijksuniversiteit Groningen, Nijenborgh 4, 9747 AG Groningen, The Netherlands

Using a nonequilibrium Green's functions (NEGF) approach, we compute the temporal behavior of quantum confined particles, which is of relevance for quantum dots, metal clusters or ions in traps. In the framework of applications to e.g. strong laser fields these systems are known to show interesting nonequilibrium behavior as well as nonlinear effects.

The dynamical properties are obtained by numerically solving the Keldysh-Kadanoff-Baym equations (KKBE) for the two-time NEGF, where initial correlations [1,2] are included self-consistently starting from a correlated thermal equilibrium Green's function for a confined system of N charged fermions. This method is shown to conserve density, momentum and total energy. In addition, we use an appropriate basis representation of the NEGF, which successfully worked to examine small molecules [2]. The results include the intra- and interband response of the system to a strong time-dependent electric field.

[1] Introduction to Computational Methods in Many-Body Physics, M. Bonitz and D. Semkat, Rinton Press (2006). [2] N. E. Dahlen, R. van Leeuwen and A. Stan, J. Phys.: Conf. Ser. 35 (2006).

HL 13.31 Mon 15:00 Poster A

Laser-induced nonthermal melting in InSb: What is the mechanism? — •Waldemar Töws, Christian Sippel, Christian Gilfert, Jessica Walkenhorst, Eeuwe Sieds Zijlstra, and Martin Garcia — Theoretische Physik, Fachbereich Naturwissenschaften, Universität Kassel, Heinrich-Plett-Str. 40, 34132 Kassel, Germany

A recent experiment [A. M. Lindenberg et al., Science **308**, 392 (2005)] performed on InSb suggests that ultrafast laser-induced nonthermal melting occurs due to a flattening of interatomic potentials. This study was based on Debye-Waller theory, applied in the time-domain and for non-equilibrium processes. We analyzed the nonthermal melting of InSb by using (i) first-principles electronic structure calculations for the interatomic potentials (ii) dynamical models to find the structure factors under different nonequilibrium conditions. Combining the two methods mentioned above we discuss the different possible scenarios for the lattice dynamics during the first 100 fs after the laser excitation.

HL 13.32 Mon 15:00 Poster A

Quantum potential for confined charged particles in nonequilibrium — •Andrea Fromm[1], Michael Bonitz[1], and James Dufty[2] — [1]Institut für Theoretische Physik und Astrophysik, Universität Kiel, Leibnizstr. 15, 24098 Kiel — [2]Physics Department, University of Florida, Gainesville

In thermal equilibrium the idea to describe quantum systems by retaining the classical structure of the equations, but replacing the original potential by an effective potential, that takes into account quantum effects, has been successfully used for external potentials, see e.g. [1], and for pair potentials, see e.g. [2]. From the calculated quantum potential follows a quantum mechanical force, that can be applied in classical simulations like molecular dynamic, see e.g. [3]. Here we extend this concept to systems in nonequilibrium [4]. We consider an electron system in a weakly inhomogeneous confinement potential and a strong electric field. Using the equation of motion for the nonequilibrium Green's functions, an equation for the quantum potential is derived and soluted by iteration. In the classical spectral function the original potential is replaced by the quantum potential and the spectral function is analysed for the special case of a harmonic potential and a constant electric field. The appropriate quantum mechanical density of states is calculated.

[1] D. Bohm, Phys. Rev. 85, 166 and 180 (1986). [2] A.V. Filinov, M. Bonitz, W. Ebeling, J. Phys. A: Math. Gen. 36 (2003). [3] A.V. Filinov, V.O. Golubnychiy, M. Bonitz, W. Ebeling, J.W. Dufty, Phys. Rev. E 70 (1986). [4] M. Bonitz, J.W. Dufty, Cond. Matt. Phys. 7 (2004).

HL 13.33 Mon 15:00 Poster A

Terahertz Emission by Drift and Diffusion — •Guillermo Acuna, Federico Buersgens, Christian Lang, and Roland Kersting — University of Munich, Munich, Germany

Many charge carrier dynamics that follow femtosecond laser excitation can be used to generate terahertz (THz) radiation in semiconductors. Examples are the ultrafast onset of current surges in an electric field or the Dember effect, which arises due to different electron and hole diffusivities. The individual contributions to the emitted THz signal are still under discussion. In this work we present an experiment that gives quantitative insight into the charge carrier dynamics that lead to THz emission. We perform time resolved THz studies on a semi-insulating GaAs structure with periodically poled surface electrodes. The emission processes are distinguished by their dependence on the applied electrical field. Most surprising is that the THz signal depends on the applied electrical field, although the alternating direction of the driving field should lead to a cancellation of the far-field emission. This emission process is explained by electron acceleration in regions

with inhomogeneous fields. Other dynamics that become visible by their specific terahertz emission are the Dember effect, the intervalley transfer of electrons, and the hole current at high field strengths.

HL 13.34 Mon 15:00 Poster A

Semiconductor quantum rings as a source for ultrafast magnetic and chiral light pulses — •Moskalenko A.S.[1], Matos-Abiague A.[2], and Berakdar J.[1] — [1]Max Planck Institute of Microstructure Physics, Weinberg 2, 06120 Halle, Germany — [2]Institute for Theoretical Physics, University of Regensburg, 93040 Regensburg, Germany

We investigate temporal behavior of non-equilibrium electron states in semiconductor quantum rings driven by (sub)picosecond half-cycle electromagnetic pulses and pulse sequences. These states carry time-dependent charge polarization and current [1,2]. We demonstrate how they can be used for generation of ultrafast magnetic [3] and chiral light pulses and sequences of such pulses.

[1] A. Matos-Abiague and J. Berakdar, Phys. Rev. B 70, 195338 (2004).

[2] A. Matos-Abiague and J. Berakdar, Phys. Rev. Lett. 94, 166801 (2005).

[3] A.S. Moskalenko, A. Matos-Abiague, and J. Berakdar, Phys. Rev. B 74, 161303 (2006).

HL 13.35 Mon 15:00 Poster A

Effects of initial spin polarization and external magnetic fields on the electron spin dephasing in a two dimensional electron system — •Dominik Stich[1], Robert Schulz[1], Andreas Maurer[1], Tobias Korn[1], Dieter Schuh[1], Werner Wegscheider[1], Jun Zhou[2], Ming Wei Wu[2], and Christian Schüller[1] — [1]Institut für Experimentelle und Angewandte Physik II, Universität Regensburg, D-93040 Regensburg, Germany — [2]Hefei National Laboratory, University of Science and Technology of China, Hefei, 230026, China

Understanding the properties of electron spin dephasing is a very crucial detail for any future spin-electronic device. We investigated the electron spin dynamics in a high mobility (1.6×10^6 cm^2/Vs) two dimensional electron system in a one side n-doped (2.1×10^{11} cm^2) 20 nm wide GaAs-AlGaAs single quantum well by conducting time-resolved Faraday rotation (TRFR) measurements in the range from zero to high magnetic fields (up to 10T) which are applied in the Voigt configuration. We found that the spin dephasing time T_2* is strongly depending on the initial degree of spin polarization P and on the applied magnetic field. Besides that, we also found that the electron g-factor is increasing with decreasing P. At very low sample temperatures (1.5 K) we also observed zero field spin oscillations [Brand et al. PRL 89, 236601(2002)]. Our measurements are in good accordance with the calculations done by Wu et al. that are based on solving the many body kinetic Bloch equations.

We acknowledge support by the Deutsche Forschungsgemeinschaft via project SCHU1171/1 and SFB 689 TP B4.

HL 13.36 Mon 15:00 Poster A

Photoluminescence and ultrafast spectroscopy on GaAs quantum wells close to a GaMnAs layer — •Robert Schulz, Tobias Korn, Andreas Maurer, Dominik Stich, Ursula Wurstbauer, Dieter Schuh, Werner Wegscheider, and Christian Schüller — Institut für Experimentelle und Angewandte Physik II, Universität Regensburg, 93040 Regensburg, Germany

We study nonmagnetic GaAs quantum wells (QW) embedded in an AlGaAs/GaAs heterostructure close to a ferromagnetic GaMnAs layer. We present photoluminescence (PL) data of two QWs at different distances to the GaMnAs layer measured at 4 K: one QW is close (3 to 10 nm) to the GaMnAs layer, the other one is 120 nm away and used as a reference. The PL signal of the QW close to the Ga(Mn)As layer shows a significant broadening and quenching depending on the barrier width. This may be due to two effects: (i) Backdiffusion of Mn through the barrier into the upper QW during sample growth. (ii) Tunnelling of photoexcited charge carriers through the barrier into the low-bandgap Ga(Mn)As layer.

Additionally, time-resolved pump-probe experiments show that the carrier lifetime in the upper QW in comparison with the reference QW is significantly reduced. In contrast, the spin lifetime is four times larger, which we attribute to the D'Yakonov-Perel mechanism: Mn ions within the upper QW act as momentum scattering centers und thus increase the spin lifetime.

We acknowledge support by the DFG via project SCHU1171/1 and SFB 689 TP B4.

HL 13.37 Mon 15:00 Poster A

Temperature dependent MOVPE growth of InN quantum dots investigated by in-situ spectroscopic ellipsometry — •Simon Ploch, Christian Meissner, Massimo Drago, Markus Pristovsek, and Michael Kneissl — Technische Universität Berlin, Institute of Solid States Physics, Hardenbergstrasse 36, 10623 Berlin, Germany

The band edge of indium nitride is the lowest among the nitride semiconductors. A successful growth of InN quantum dots is promissing for possible applications in infrared LEDs and laser diodes. This work presents in-situ spectroscopic ellipsometry (SE) measurements of non-capped MOVPE grown quantum dots on GaN/sapphire, which allows to control their properties during the formation process.
In a first series we varied the temperature between 540°C and 620°C by a constant V/III ratio of 15.000. SE reveals a strong dependence on the growth rate, dot formation and density by the temperature. In order to an correctly interpretation of the in-situ SE data, the epitaxial structures are characterised ex-situ by atomic force microscopy (AFM) and photoluminescence. The additional influence on the quantum dot size is given by different growth times, between 30 s and 4 min, and verified by the AFM measurements. Finally, we have analyzed the effects of different V/III ratios.

HL 13.38 Mon 15:00 Poster A

Reverse Deep Level Transient Spectroscopy on InAs Quantum Dots — •Christiane Konetzni, Andreas Schramm, Christian Heyn, and Wolfgang Hansen — Institut für Angewandte Physik, Jungiusstraße 11c, 20355 Hamburg

With transient capacitance spectroscopy we study self-assembled InAs quantum dots on (001) GaAs. The quantum dots were grown with solid-source molecular beam epitaxy (MBE) and are embedded in n-doped GaAs Schottky diodes. We apply conventional deep level transient spectroscopy (DLTS) and reverse deep level transient spectroscopy (R-DLTS) to study the s- and p-type quantum-dot levels as well as wettinglayer states. In DLTS experiments the capacitance transients reflect the electron emission rates, whereas in the R-DLTS measurements the transients depend on the electron capture rates. We compare spectra obtained with these methods and point out the advantages of experiments with R-DLTS.

HL 13.39 Mon 15:00 Poster A

Investigation of Heterojunction Sharpness of III-V-Nanowhiskers by Analytical (S)TEM Measurements — •Daniela Sudfeld[1], Jochen Kästner[1], Günter Dumpich[1], Ingo Regolin[2], Werner Prost[2], and Franz Josef Tegude[2] — [1]Department of Physics, Experimental Physics - AG Farle, University of Duisburg-Essen, Lotharstr. 1, 47048 Duisburg — [2]Solid State Electronics Dept., University of Duisburg-Essen, Lotharstr. 55, ZHO, D-47048 Duisburg

High crystal quality single GaAs/InGaAs/GaAs and GaAs/GaP/GaAs nanowhiskers were grown by MOVPE on (111)B GaAs substrates using the VLS growth mode. Energy-dispersive X-ray spectroscopy (EDS) measurements were performed to investigate (1) the interface sharpness of group-III versus group-V transitions, and (2) lateral transitions attributed to a parasitic conventional layer growth forming a core-shell structure perpendicular to the growth direction. The results show that group-III transitions exhibit long tails attributed to a memory effect of the group-III species in the Au droplet, while lateral sharp core-shell GaAs/InGaAs/GaAs heterojunctions were found [1]. In contrast, the transition of the GaAs/GaP/GaAs whisker is much sharper due to a lacking memory effect of group-V species in the seed particle. These results provide important rules for an appropriate design of heterojunction nanowhisker devices. Acknowledgement: This work was supported by the DFG (SFB 445). Reference: [1] I. Regolin et al., Journal of Crystal Growth (2006), in press.

HL 13.40 Mon 15:00 Poster A

Magnetization of tunneling coupled double-layer quantum dots — •J. Topp[1], O. Roesler[1], D. Reuter[2], A.D. Wieck[2], D. Grundler[3], and D. Heitmann[1] — [1]Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstraße 11, D-20355 Hamburg — [2]Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum, Universitätsstraße 150, D-44780 Bochum — [3]Physik-Department E10, Technische Universität München, James-Franck-Straße 1, D-85747 Garching

We have experimentally investigated the magnetization M of large arrays of double-layer quantum dots. The dots were prepared from a modulation-doped AlGaAs/GaAs heterostructure containing two quantum wells separated by a 1 nm thick tunneling barrier. We used electron beam lithography and reactive ion etching to create a hexagonal-closed-packed array of up to $6 \cdot 10^6$ dots with identical diameters of down to 300 nm. To investigate the magnetization $M = -(\partial U/\partial B)_{N,T}$ (U is the inner energy and N the electron number) these dots were integrated to a micromechanical cantilever magnetometer operated at a temperature $T = 20$ mK. Measuring M in magnetic fields B up to 16 T we have thereby monitored the electronic ground state energy U of double-layer quantum dots. From these data we extract the electron-electron interaction and tunneling-gap energy. The authors thank the Deutsche Forschungsgemeinschaft for financial support through SFB 508 and through the excellence cluster "Nanosystems Initiative Munich (NIM)".

HL 13.41 Mon 15:00 Poster A

From a gate voltage scale to an energy scale in capacitance voltage spectroscopy of InAs quantum dots — •Arne Ludwig, Dirk Reuter, and Andreas D. Wieck — Lehrstuhl für angewandte Festkörperphysik, Ruhr-Universität Bochum, D-44780 Bochum

Self-assembled InAs quantum dots can be investigated by capacitance voltage (C-V) spectroscopy to obtain an addition spectra of bound states. To extract quantization and interaction energies from the measurement, the gate voltage scales have to be converted to an energy scale. In literature, different approaches are used, mainly based on a simple geometric lever arm law.

In this contribution, we will apply different methods to C-V measurements on high quality n- as well as p-type samples and compare the results. Especially, for the first time we try to take the band bending due to the charge on the quantum dots into account. By doing so, we find -compared to lever arm method- smaller values for the relevant energies.

HL 13.42 Mon 15:00 Poster A

Entanglement decay in semiconductor quantum dots — •Katarzyna Roszak[1,2], Pawel Machnikowski[2], and Tilmann Kuhn[1] — [1]Institut für Festkörpertheorie, Universität Münster, Wilhelm-Klemm-Str. 10, 48149 Münster, Germany — [2]Institute of Physics, Wroclaw University of Technology, Wybrzerze Wyspianskiego 27, 50-370 Wroclaw, Poland

Entanglement is a vital component in all quantum computing schemes; for maintaining entanglement coherence must be sustained in multipartite systems. We study the evolution of entanglement in initially completely entangled states of two excitons confined in one or two semiconductor quantum dots under partial pure dephasing induced by a phonon bath. The decay of entanglement (measured by the entanglement of formation) shows two qualitatively different scenarios for different initial states; in some cases the state may become separable (completely disentangled) at a finite time (the pure dephasing is still only partial). It turns out that these states can be easily characterized. The appearance of the effect additionally depends on the coupling strength (as does pure dephasing) and subsequently on temperature. The effect of separation between the dots is also studied; it reflects the crossover from a common-reservoir regime (a biexciton state in one quantum dot) to separate reservoirs (two, well separated dots).

HL 13.43 Mon 15:00 Poster A

Temperature dependent photocurrent spectroscopy of a single InGaAs quantum dot — •Marc C. Hübner[1], Stefan Stufler[1], Patrick Ester[1], Steffen Michaelis de Vasconcellos[1], Artur Zrenner[1], and Max Bichler[2] — [1]Universität Paderborn, Fakultät Naturwissenschaften, Department Physik, Warburger Straße 100, 33098 Paderborn, Germany — [2]Walter Schottky Institut, TU München, Am Coulombwall, 85748 Garching, Germany

Semiconductor quantum dots (QDs) exhibit discrete energy levels which can be described as two-level systems if resonant excitation within spectrally narrow regions is applied. Here we present cw excitation-experiments, carried out in a variable temperature setup up to 70 K allowing for investigations of coupling mechanisms to acoustic phonons.

We have measured the photocurrent (PC) of a single InGaAs QD using a tuneable TiSa laser for resonant excitation. If a sufficiently high reverse bias voltage is applied, photogenerated carriers tunnel out of the QD. By tuning the excitation wavelength the spectral absorption of a single QD can be monitored via the PC. Within a limited range, a PC spectrum can be obtained by a sweep of the bias voltage at fixed laser wavelength. Tuning the applied voltage allows us to vary the linewidth, due to changing tunnelling probabilities. Increasing the temperature significantly shifts the transition energies of the QD to the red, extends the boundaries of the PC regime due to enhanced thermionic emission and also shows effect on the Rabi oscillations of the system.

HL 13.44 Mon 15:00 Poster A

Preparation of silicon nanoparticle films for single particle spectroscopy — •Matthias Offer[1], Cedrik Meier[1], Stephan Lüttjohann[1], Andreas Gondorf[1], Axel Lorke[1], and Hartmut Wiggers[2] — [1]Experimental Physics and CeNIDE, University of Duisburg-Essen, Lotharstrasse 1, D-47048 Duisburg, Germany — [2]Institute of Combustion and Gas Dynamics, University of Duisburg-Essen, Lotharstrasse 1, D-47048 Duisburg, Germany

A major obstacle for spectroscopy of single nanoparticles, obtained by chemical synthesis is the difficulty to deposit dilute layers of isolated nanoparticles on a suitable substrate. In the case of silicon nanoparticles, which are synthesized from the gas-phase without, e.g., organic surface functionalization or modification, there is also a strong tendency towards agglomeration. By dispersing the nanoparticles in different solutions, we have been able to deposit films of isolated particles. We use different organic and aqueous solvents. In the latter case, we find that by varying the pH value we can modify the zeta-potential and reach a stabilized solution. After deposition, we find ring-like structures with a particle-size gradient that leads to a position-dependent energy shift in the PL signal. This can be explained in the framework of the DLVO theory. We compare the deposition results for silicon nanoparticles to results obtained using commercially available PbS nanoparticles with functionalized surfaces.

HL 13.45 Mon 15:00 Poster A

Optical size effects in ultra fine ZnO nanowires — Daniel Stichtenoth[1], Tore Niermann[2], Pai-Chun Chang[3], Chung-Jen Chien[3], Jia Grace Lu[4], and •Carsten Ronning[1] — [1]II. Institute of Physics, University of Göttingen — [2]IV. Institute of Physics, University of Göttingen — [3]Department of Chemical Engineering, UC Irvine — [4]Department of Physics, University of South California

ZnO nanowires as one-dimensional materials are expected to display novel and unique physical properties. For the optical properties the origin of these can be (1) the large surface to volume ratio, (2) the waveguiding property of nanowires, and (3) the reduced dimensionality, which results in a quantum confinement. Due to the rather small exciton bohr radius in ZnO the latter effect is expected just for wires with a diameter of less than 5 nm. Here, we present luminescence studies of ZnO nanowires with diameters in the expected range of confinement effects. The nanowires were synthesized using two different techniques and TEM studies show beside excellent crystal quality, diameters between 4 nm and 40 nm. Temperature dependent photoluminescence measurements were carried out on the as grown samples. At low temperatures a feature at 3.366 eV, which can be attributed to surface-bound excitons, dominates the spectra. With increasing temperature we observed emerging of up to four phonon replica of the free excitonic transition which are blue shifted in the case of the ultra fine nanowires. An intense green luminescence as found by other groups could even at room temperature not be observed. We will discuss the obtained results with respect to literature.

HL 13.46 Mon 15:00 Poster A

Photoluminescence Spectroscopy of CdSe/CdS(/ZnS) Quantum Dots — •Torben Menke[1], Gerwin Chilla[1], Marija Nikolic[3], Andreas Frömsdorf[2], Tobias Kipp[1], Detlef Heitmann[1], Horst Weller[2], and Sephan Förster[2] — [1]Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstraße 11, 20355 Hamburg — [2]Institut für Physikalische Chemie, Universität Hamburg, Grindelallee 117, 20146 Hamburg — [3]Faculty of Technology and Metallurgy, University of Belgrade, Karnegijeva 4, 11000 Belgrade, Serbia

We investigate chemically synthesized nanocrystal quantum dots by photoluminescence (PL) spectroscopy. Our CdSe-core nanocrystals, fabricated as core-shell and core-shell-shell variants, are embedded in a thin polymer matrix on silicon substrates or spin coated directly on sapphire substrates. The nanocrystal density on the substrate is chosen to be so low, that both, ensemble and single nanocrystal PL experiments are possible. In our ensemble measurements, we have

in particular studied the photostability of the photoluminescence signal for temperatures T=4-300K and for different excitation densities. We found the expected red-shift of the photoluminescence with increasing temperature and indication for a high stability of the photon efficiency. In microscopic photoluminescence measurements on single nanocrystals we found crystals with an impressive stability concerning photobleaching. The blinking behavior shows that these nanocrystals are predominantly in the on-state. We acknowledge financial support by the Deutsche Forschungsgemeinschaft via the SFB 508.

HL 13.47 Mon 15:00 Poster A

Resonant micro-Raman spectroscopy on few InAs quantum dots — •Tim Köppen, Thomas Brocke, Tobias Kipp, Andreas Schramm, Christian Heyn, and Detlef Heitmann — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung der Universität Hamburg, Jungiusstraße 11, 20355 Hamburg, Germany

We investigate the electronic excitations in InAs quantum dots under the exploitation of resonant inelastic light scattering. In contrast to earlier measurements at the $E_0 + \Delta$ gap ($\sim$1.65 eV) [1], we now excite resonantly at the E_0 gap ($\sim$1.2 eV) using a TiSa-laser in the near-infrared regime. Furthermore we now use a microscope setup focussing the exciting laser to a diameter of about 1.8 μm. Although there are still about 250 quantum dots under the laser spot, we observe very few sharp lines of individual quantum dots which arise due to resonant excitation. We can distinguish between Raman signals of electronic excitations and photoluminescense signals which reside in the same energy range.

This project is supported by the Deutsche Forschungsgemeinschaft via SFB 508 "Quantenmaterialien".

[1] T. Brocke et al., *Phys. Rev. Lett.* **91**, 257401 (2003)

HL 13.48 Mon 15:00 Poster A

Optical properties of Mn-doped ZnS nanowires — Daniel Stichtenoth[1], Sebastian Geburt[1], Tobias Niebling[2], Peter J Klar[2], and •Carsten Ronning[1] — [1]II. Institute of Physics, University of Göttingen — [2]Dept. of Physics, University of Marburg

Doping of semiconductor nanostructures via ion implantation offers the advantage of precise control of the doping concentration in both lateral and depth direction beyond any solubility limit. In this study, single crystal ZnS nanowires with varying diameter were synthesized according to the VLS mechanism and subsequently dispersed on top of Si substrates. The nanowires were implanted with 55Mn choosing varying ion fluences over 6 orders of magnitude. The range of the ions, set by the implantation energy, matched the diameter of the nanowires, and post-implantation annealing procedures were done under vacuum conditions in order to remove the introduced damage. Electron spin resonance measurements showed that after these procedures the Mn substitute Zn sites in the lattice. The treated nanowires were investigated by time resolved PL measurements, where the well-known long-living 4T1 - 6A1 intra 3d transition of Mn+2 was observed. Correlations between the lifetime of this intra 3d transition and the Mn concentration as well as the diameter of the wires will be discussed in detail.

HL 13.49 Mon 15:00 Poster A

Raman studies of surface phonons in CdSe and CdS quantum dots embedded in dielectric media — •Yuriy Azhniuk[1], Volodymyr Dzhagan[2], Stepan Kuchmii[3], Alexandra Raevskaya[3], Alexandr Stroyuk[3], Mykhailo Valakh[2], and Dietrich Zahn[4] — [1]Institute of Electron Physics, Uzhhorod, Ukraine — [2]Institute of Semiconductor Physics, Kyiv, Ukraine — [3]Institute of Physical Chemistry, Kyiv, Ukraine — [4]Chemnitz University of Technology, Chemnitz, Germany

Contribution of surface phonons strongly affects Raman spectra of quantum dots (QDs). In spite of a number of studies for CdSe and CdS, there is still no unique opinion on the behaviour of surface phonon parameters on the QD size. Moreover, since surface phonons are localized near the QD / host matrix interface, they can be sensitive to the type of host media as well as to the shell type for capped QDs.

Here we present resonant micro-Raman studies of surface phonons of bare and capped colloidal CdSe and CdS QDs in different organic media (gelatine, polyvinyl alcohol, polyacrylamide) as well as those grown in silicate glass. Measurements were performed using a Dilor XY 800 spectrometer and different Ar laser lines for excitation.

The dependences obtained for the surface phonon frequency, halfwidth as well as surface-to-LO phonon intensity ratio on the QD size, excitation wavelength, type of host media, passivating shell are analyzed. The results are compared with the calculations in the framework of a dielectric continuum model. The differences observed can be related to the QD surface reconstruction.

HL 13.50 Mon 15:00 Poster A

Tunable quantum dots in InAs nanowires — •Marc Scheffler[1], Stevan Nadj-Perge[1], Leo P. Kouwenhoven[1], Magnus T. Borgström[2], and Erik P. A. M. Bakkers[2] — [1]Kavli Institute of NanoScience, Delft University of Technology, POB 5046, 2600GA Delft, The Netherlands — [2]Philips Research Laboratories, High Tech Campus 4, 5656 AE Eindhoven, The Netherlands

Semiconductor nanowires are a versatile system to study electronic transport at mesoscopic length scales. Here InAs nanowires are particularly interesting due to the large spin-orbit coupling and furthermore promising for devices due to the comparably easy processing for Ohmic contacts.

We study the electronic transport in of individual InAs nanowire devices at low temperatures. Here we use different gate geometries to tune the charge carrier density either globally (for the complete wire) or locally. In particular, we use local top gates to create barriers that define tunable quantum dots. Towards our final goal of spin manipulation of single electrons, we focus on a tunable double dot. We present stability diagrams and discuss the influence of different quantum dot geometries.

HL 13.51 Mon 15:00 Poster A

Noise at a Fermi edge singularity — •N. Maire[1], F. Hohls[1], T. Lüdtke[1], K. Pierz[2], and R. J. Haug[1] — [1]Institut für Festkörperphysik, Universität Hannover, D-30167 Hannover — [2]Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116 Braunschweig

We investigate self-assembled InAs quantum dots embedded in a GaAs-AlAs-GaAs heterostructure. We observe distinct steps in the I-V characteristic corresponding to resonant tunneling through individual quantum dots. At high magnetic fields (B > 12 T) we measure an additional peak like current overshoot at these steps. The overshoot increases with increasing magnetic field and decreasing temperature. We find that this feature stems from an electron-electron interaction effect between the electron on the dot and the electrons in the lead, a so called Fermi Edge Singularity (FES) effect.

We investigate the noise characteristic at the FES at a magnetic field of 15 T and and at a temperature of 0.4 K. We observe a 1/f and a frequency independent noise, the so called shot noise. The shot noise power is suppressed compared to the noise power of a single tunneling barrier as it is indeed expected for a double barrier resonant tunneling structure. The striking feature is an additional strong suppression of the shot noise power in parallel to the current overshoot induced by the FES effect. We find that this suppression is too strong to be explained by typical theoretical models which do not include the interaction between the lead and the dot.

[1] N. Maire et al., cond-mat/0609738

HL 13.52 Mon 15:00 Poster A

Einfluss der Elektronen-Injektion auf den trägheitsballistischen Transport in nanoskaligen Si/SiGe-Wellenleiterstrukturen — •Gang Qiao[1], Ulrich Wieser[1], Ulrich Kunze[1] und Thomas Hackbarth[2] — [1]Werkstoffe und Nanoelektronik, — [2]DaimlerCrysler Forschungszentrum Ulm, D-89081 Ulm

Ausgehend von einer modulationsdotierten Si/SiGe-Heterostruktur mit hoher Elektronenbeweglichkeit werden nanoskalige mehrfach verzweigte elektronische Wellenleiter präpariert, um daran trägheitsballistische Effekte im Elektronentransport zu untersuchen. Die Wellenleiterstrukturen sind aus einem zentralen orthogonalen Kreuz und zwei zusätzlichen Verzweigungen zusammengesetzt, die längs der vertikalen Kreuz-Achse auf beiden Seiten der Kreuzungsstelle angebracht sind. In beide Verzweigungen mündet je ein parallel zur horizontalen Kreuz-Achse orientierter, geradliniger Wellenleiter. Zwischen der zentralen Kreuzungsstelle und einem dieser Wellenleiter wird eine lokale Barriere erzeugt. Die Barriere soll eine effiziente Injektion ballistischer Elektronen ermöglichen und kann durch eine nanoskalige Gate-Elektrode quer zur vertikalen Kreuz-Achse oder durch eine Engstelle in dieser Achse erzeugt werden. Mit 2- und 4-Punkt Messungen der lokalen und nichtlokalen I-U-Kennlinien wird bei $T = 4.2$ K der Einfluss der Injektionsbedingungen auf trägheitsballistische Effekte untersucht. Im Regime heißer Elektronen findet sich in den lokalen I-U-Kennlinien ein negativ differenzieller Leitwert, der auf die Emission eines Intervalley-Phonons zurückgeführt wird.

HL 13.53 Mon 15:00 Poster A

Mode spectroscopy of tunnel-coupled asymmetric quantum point contacts — •S. S. Buchholz[1], S. F. Fischer[1], U. Kunze[1], D. Schuh[2] und Gerhard Abstreiter[2] — [1]Werkstoffe und Nanoelektronik, Ruhr-Universität Bochum — [2]Walter Schottky Institut, Technische Universität München

Semiconductor electron waveguides separated by a tunneling barrier show interesting coupling phenomena based on coherent electron transport. Vertically stacked quantum point contacts (QPCs) of equal width (symmetric configuration) have recently been investigated [1], [2]. Atomic force microscope lithography and wet chemical etching [3] allow the preparation of large one-dimensional (1D) subband separations (> 10 meV). Here, we present in analogy tunnel-coupled QPCs of unequal width (asymmetric configuration). A top gate voltage (V_{tg}) controls the occupation of 1D subbands in both QPCs, a back gate voltage (V_{bg}) influences the occupation of mainly the bottom QPC, and cooling under back gate voltage allows the tuning of the bottom QPC confining potential. We record the conductance and transconductance with respect to V_{tg}, V_{bg} and magnetic field, and observe a lift of subband degeneracy for modes with equal parity in high perpendicular magnetic fields (> 3 T). In longitudinal magnetic fields the coupling induced energy splittings indicate an oscillatory behavior.[1] S.F. Fischer *et al.*, Nature Physics **2**, 91 (2006). [2] S.F. Fischer *et al.*, Phys. Rev. B **74**, 115324 (2006). [3] U. Kunze, Supperlatt. Microstruct. **31**, 3 (2002).

HL 13.54 Mon 15:00 Poster A

Quantum Thermal Conductance of Electrons in a One-Dimensional Wire — •O. Chiatti[1], J. T. Nicholls[2], Y. Y. Proskuryakov[3], N. Lumpkin[4], I. Farrer[4], and D. A. Ritchie[4] — [1]Forschungszentrum Dresden-Rossendorf, Hochfeld-Magnetlabor Dresden (HLD), 01328 Dresden, Germany — [2]Department of Physics, Royal Holloway, University of London, Egham, Surrey TW20 0EX, UK — [3]Department of Physics, Durham University, Durham DH1 3LE, UK — [4]Department of Physics, Cavendish Laboratory, Cambridge CB3 0HE, UK

An electron thermometer is used to measure the temperature rise of approximately 2×10^5 electrons in a two-dimensional box, due to heat flow into the box through a ballistic one-dimensional (1D) constriction. Using a simple model we deduce the thermal conductance $\kappa(V_g)$ of the 1D constriction, which we compare to its electrical conductance characteristics. For the first four 1D subbands the heat carried by the electrons passing through the wire is proportional to its electrical conductance $G(V_g)$. In the vicinity of the *0.7 structure* this proportionality breaks down, and a plateau at the thermal-conductance quantum, $\pi^2 k_B^2 T/3h$, is observed. [*Phys. Rev. Lett.* **97**, 056601 (2006)]

HL 13.55 Mon 15:00 Poster A

Einzelelektronentransport durch Kohlenstoffnanoröhren mittels akustischer Oberflächenwellen — •Markus Regler, Jens Ebbecke und Achim Wixforth — Institut für Physik, Experimentalphysik 1, Universität Augsburg, Universitätsstr.1, 86159 Augsburg

Kohlenstoffnanoröhren (KNR) stellen seit ihrer Entdeckung ein breites Forschungsgebiet dar. KNR bilden ideale eindimensionale Leiter und zeigen abhängig vom Umfang metallische oder halbleitende Eigenschaften. Sie bieten so Anwendungen etwa als Transistoren an.

Eine weitere Anwendungsmöglichkeit ist der Transport einzelner Elektronen mit Hilfe von akustischen Oberflächenwellen (AOW) durch eine solche Röhre. Dazu werden die KNR auf einem piezoelektrischen Substrat ($LiNbO_3$) mit Metallelektroden (Au/Ti, Pd/Ti) kontaktiert. Dabei bilden sich zwischen den Röhren und den Elektroden Tunnelbarrieren, so dass für genügend kleine Kontaktabstände ($\approx 1\mu m$) in der KNR ein Quantenpunkt (QP) entsteht. Mit zusätzlich angebrachten Gateelektroden können die Zustände im QP beeinflusst werden.

Wird eine AOW angeregt, deren Wellenlänge dem doppelten Kontaktabstand entspricht, führt dies zu einer Modulation der Barrieren. Bei verminderter Barrierenhöhe wird den Elektronen das Tunneln in den bzw. aus dem QP erleichtert, so dass pro Wellenzyklus ein Elektron durch den QP transportiert wird. Für den resultierenden Strom gilt: $I = e \cdot f$ (e: Elementarladung, f: Frequenz der AOW). Die verwendeten Frequenzen liegen im Bereich von wenigen GHz, der Strom daher in der Größenordnung von Nanoampere. Eine Anwendung solcher Bauteile wäre beispielsweise ein zukünftiger Stromstandard.

HL 13.56 Mon 15:00 Poster A

SAW-induced current in ratchets on GaAs/AlGaAs heterostructures as function of dimensionality and temperature. — •Marcin Malecha, Jens Ebbecke, and Achim Wixforth — Universität Augsburg, Institut für Physik, Lehrstuhl für Experimentalphysik I, Universitätsstr. 1, D-86159 Augsburg

Ratchets are basically non-symmetrical systems. In quantum regime, the most important feature of a ratchet structure is its asymmetric tunnelling barrier. Because the particle tunnelling depends not only on the height but also the shape of the barrier (unlike the classical regime) a net current flow will adjust and its direction strongly depends on the energy distribution of considered particles at given temperature. We are investigating current transport through ratchet structures on GaAs/AlGaAs heterostructures using surface acoustic waves at different temperatures. We examine the behaviour of the driven electrons due to changing the dimensionality of the 2-dimensional electron gas to 1D (nanowires) or 0D (quantum dots) by applying potential on in-plane gates. Because of the built-in broken centrosymmetry of ratchet structures the change of dimensionality has a pronounced effect on the induced net current. We present our initial results and current status of our research.

HL 13.57 Mon 15:00 Poster A

Excitonic Aharonov-Bohm effect in the presence of an electric field — •Andrea Fischer and Rudolf Römer — Department of Physics and Centre for Scientific Computing, University of Warwick, Coventry CV4 7AL, UK

We theoretically study exciton absorption on a ring threaded by a magnetic flux and in the presence of a lateral electric field. For the case when the attraction between an electron and a hole is short ranged, we use a self-consistent Ansatz to obtain a solution to the problem. We demonstrate that despite the electrical neutrality of the exciton, for a fixed electric field, both the spectral position of the exciton peak in the absorption and the corresponding oscillator strength oscillate with magnetic flux. We show that for a fixed magnetic flux, the amplitude of oscillation first increases slightly but later decreases strongly with increasing electric field.

HL 13.58 Mon 15:00 Poster A

Spectroscopy of quantum dots with ballistic electrons — •Ines Hense[1], Christian Praetorius[1], Ralf Scheibner[1], Markus König[1], Carsten Danz[1], Dirk Reuter[2], Andreas Wieck[2], Hartmut Buhmann[1], and Laurens Molenkamp[1] — [1]Physikalisches Institut, Lehrstuhl für Experimentelle Physik 3, Universität Würzburg, Am Hubland, 97074 Würzburg, Germany. — [2]Lehrstuhl für angewandte Festkörperphysik, Ruhr-Universität Bochum, Universitätsstraße 150, 44780 Bochum, Germany.

In contrast to conventional methods ballistic electron injection via quantum point contacts (QPC) assures that the quantum dot (QD) system remains in undisturbed thermal equilibrium with its leads throughout the measurement. This is important especially if hybridisation effects between QD states and the leads are expected.

Here, we present data on gate defined GaAs QDs with opposed QPC injectors in a distance of 2 μm, which is well below the elastic mean free path. Using an ac+dc electron injection and lock-in detection the energy selective QD transmission spectra can be explored in a wide parameter range. The non-local resistance and the transmission clearly reflect the energy spectrum of the QD under investigation. Special attention is paid to the regime where spin correlations (e.g. Kondo effect) dominate the transport properties of the QD system.

HL 13.59 Mon 15:00 Poster A

Preparation and Characterization of spin filters on InAs — •Jan Jacob, Sebastian von Oehsen, Guido Meier, Toru Matsuyama, and Ulrich Merkt — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstrasse 11, 20355 Hamburg, Germany

Highly spin-polarized currents are needed for spintronic devices. The injection rate of polarized currents in ferromagnet-semiconductor hybrid devices is poor. Several all-semiconductor three-terminal devices are proposed for semiconductors with a strong and tunable spin-orbit interaction [1,2]. We investigate Y-shaped devices on InAs heterostructures. We prepare sidegates to decrease the number of conductance channels in the two-dimensional electron system. In such a geometry the spin-orbit interaction is supposed to cause currents with opposite spin polarizations in the outgoing leads of the Y-shaped device. We employ electron-beam lithography and reactive-ion etching to obtain structures with minimal channel width of 100 nm and channel length from 500 nm to 1500 nm. These lengths are comparable

to the elastic mean free path of the electrons. With two spin filters in series we aim at the detection of a spin-polarized current within a conductivity measurement.

[1] M. Yamamoto, T. Ohtsuki, and B. Kramer, Phys. Rev. B **72**, 115321 (2005)

[2] J.I. Ohe, M. Yamamoto, T. Ohtsuki, and J. Nitta, Phys. Rev. B **72**, 041308 (2005)

HL 13.60 Mon 15:00 Poster A

Surface acoustic wave mediated lateral electron spin transport with ferromagnetic tunnel contact spin injection — •Jens Ebbecke and Achim Wixforth — Lehrstuhl für Experimentalphysik I, Universitätsstr. 1, 86159 Augsburg, Germany

The motivation is to develop a spintronics device with electric spin injection, lateral electron spin transport by surface acoustic wave and optical or electrical readout. Also surface gates are possible for spin state manipulation. We present a detailed description of the idea and results of initial experiments.

HL 13.61 Mon 15:00 Poster A

Geometric spin transformation in quantum dot loops — •Burkhard Scharfenberger, Pablo San-Jose, and Gerd Schön — Institut für Theoretische Festkörperphysik, Universität Karlsruhe, 76128 Karlsruhe

Upon adiabatic variation of control parameters, the wave function of a quantum mechanical system, starting initially in an a non-degenerate eigenstate, acquires a Berry-phase purely dependending on the geometry of the choosen path in parameter-space [1]. In the case of k-fold degeneracies this Berry-phase is extended to a general U(k) transformation [2].
The inherent stability of such a geometric effect against dynamic perturbations has lead to proposals to employ it in the encoding and manipulation of quantum information [3]. We investigate the transformation of an electron spin when it is pumped adiabatically around a loop of N quantum dots in a 2 dimensional electron gas with finite spin-orbit interaction. In the absence of magnetic fields, the two (pseudo-)spin states form a degenerate subspace and the resulting rotation of the electron spin within this subspace depend on the ratio of loop-radius/spin orbit length. Thus, if the loop is comparable in size to the spin-orbit-length, arbitrary rotations become possible controlled by shape and size of the loop.
[1] M.V. Berry, Proc. R. Soc. Lond. A 392, 45 (1984)
[2] F. Wilczek and A. Zee, Phys. Rev. Lett. 52, 2111 (1984)
[3] J.J Jones et al., Nature 403, 869 (2000)

HL 13.62 Mon 15:00 Poster A

Spin relaxation in narrow wires of a two-dimensional electron gas — Peter Schwab[1], Michael Dzierzawa[1], •Cosimo Gorini[1], and Roberto Raimondi[2] — [1]Universität Augsburg, Augsburg, Germany — [2]Universita' degli Studi Roma Tre, Rome, Italy

How does an initially homogeneous spin-polarization in a confined two-dimensional electron gas with Rashba spin-orbit coupling evolve in time? How does the relaxation time depend on system size? Motivated by a recent experiment [1], we study these questions for systems of a size much larger than the Fermi wavelength but comparable and even shorter than the spin-relaxation length [2]. We approach the problem relying on the quasiclassical Green's function method [3]. The confinement causes the appearance of boundary modes, whose influence on the overall spin relaxation becomes crucial when decreasing the wire width below the spin relaxation length. Depending on the boundary conditions spin relaxation may become faster or slower than in a bulk system.
[1] A. W. Holleitner, V. Sih, R. C. Myers, A. C. Gossard and D. Awschalom, Phys. Rev. Lett. **97**, 036805 (2006).
[2] P. Schwab, M. Dzierzawa, C. Gorini and R. Raimondi, Phys. Rev. B **74**, 155316 (2006).
[3] P. Schwab and R. Raimondi, Ann. Phys. (Leipzig) **12**, 471 (2003).

HL 13.63 Mon 15:00 Poster A

GaMnAs on patterned GaAs(001) substrates: Growth and magnetotransport — •Joachim Daeubler, Michael Glunk, Thomas Hummel, Wladimir Schoch, Wolfgang Limmer, and Rolf Sauer — Institut für Halbleiterphysik, Universität Ulm, 89069 Ulm, Germany

A new type of GaMnAs microstructures with laterally confined electronic and magnetic properties has been realized in a bottom-up procedure by growing GaMnAs films on $[1\bar{1}0]$-oriented ridge structures with (113)A sidewalls and (001) top layers prepared on GaAs(001) substrates [1]. Previous studies on planar GaMnAs samples have revealed different incorporation of Mn and excess As in (001) and (113)A layers [2]. Accordingly, temperature- and field-dependent magnetotransport measurements on the overgrown ridge structures clearly demonstrate the coexistence of electronic and magnetic properties specific for (001) and (113)A GaMnAs in one single sample. This introduces an additional degree of freedom in the development of new functional structures.

[1] W. Limmer, J. Daeubler, M. Glunk, T. Hummel, W. Schoch, and R. Sauer, Microelectron. J. 37, 1535 (2006).
[2] J. Daeubler, M. Glunck, W. Schoch, W. Limmer, R. Sauer, Appl. Phys. Lett. 88, 051904 (2006).

HL 13.64 Mon 15:00 Poster A

Tunneling anisotropic magnetoresistance effect in a p+-(Ga,Mn)As/n+-GaAs Esaki diode — •Mariusz Ciorga[1], Andreas Einwanger[1], Janusz Sadowski[1,2], Werner Wegscheider[1], and Dieter Weiss[1] — [1]Experimentelle und Angewandte Physik, Universität Regensburg, Universitätsstrasse 31, D-93040 Regensburg, Germany — [2]MAX-Lab, Lund University, SE-221 00, Lund, Sweden

We report on the investigation of Tunneling Anisotropic Magnetoresistance effect in single Esaki diode p+-(Ga,Mn)As/n+-GaAs devices in an in-plane magnetic field configuration We performed two types of measurement scans. In the angle scan the value of an external magnetic field H was kept constant while the sample was rotated i.e. the angle between H and the chosen crystallographic axis of (Ga,Mn)As was being changed. This type of scans gave us information about underlying magnetic anisotropy of measured devices. In the field scans the above angle was fixed and the magnetic field was swept from the saturation at one field direction to saturation at the opposite direction. We observed the spin-valve-like signal with the amplitude of ˜0.5%. The pattern of the observed magnetic reversal process strongly depends on the observed magnetic anisotropy of the (Ga,Mn)As layer. For samples with an uniaxial anisotropy along [100] directions the sign of the spin-valve-like signal can be changed by a simple rotation of the magnetic field by 90°. This is not the case when device shows an uniaxial anisotropy along [110] directions. The type of the anisotropy is found to be strongly shaped, in a random way, during processing of the wafer.

HL 13.65 Mon 15:00 Poster A

Non-local spin-valve signal in magnetotransport measurements on p+-(Ga,Mn)As/n+-GaAs Esaki diode devices. — •Andreas Einwanger[1], Mariusz Ciorga[1], Janusz Sadowski[1,2], Dieter Schuh[1], Werner Wegscheider[1], and Dieter Weiss[1] — [1]Experimentelle und Angewandte Physik, Universität Regensburg, Universitätsstrasse 31, D-93040 Regensburg, Germany — [2]Present address: MAX-Lab, Lund University, SE-221 00, Lund, Sweden

We have fabricated devices to investigate all-electrical injection/detection of spin-polarized carriers from ferromagnetic (Ga,Mn)As layer into the non-magnetic GaAs layer in a lateral transport geometry. The Esaki diode structures p+-(Ga,Mn)As/n+-GaAs are used as injector/detector contacts to circumvent the problem of fast spin relaxation of holes injected from a p-type ferromagnet into GaAs. Under a reverse bias applied to such a structure spin-polarized electrons, with longer spin relaxation times than holes, tunnel from (Ga,Mn)As valence band through the depletion layer into GaAs conduction band [1]. We report on the first results of our magnetotransport experiments in a non-local lateral spin valve geometry.

[1]. M. Kohda et al., Jpn. J. Appl. Phys 40, L1274 (2001).

HL 13.66 Mon 15:00 Poster A

Transiente Störstellenspektroskopie an Cu(In,Ga)Se2-Dünnschichtsolarzellen — •Martin Knipper und Jürgen Parisi — Abteilung Energie- und Halbleiterforschung, Institut für Physik, Universität Oldenburg, 26111 Oldenburg

Dünnschichtsolarzellen auf Basis von Cu(In,Ga)Se2 (CIGS) haben auf Grund ihrer günstigen Eigenschaften (z.B. hohes Absorptionsvermögen) die Serienreife erreicht. Wir untersuchen diese Solarzellen mit Hilfe der transienten Störstellenspektroskopie (DLTS) und Admittanzspektroskopie für ein tiefergehendes Verständnis der bulk-Effekte. Durch die Messung der Kapazitätstransiente bei verschiedenen Temperaturen kann die Aktivierungsenergie bestimmt werden. Ein energetisches Tiefenprofil der Defekte konnte durch die Variation der Sperrspannung und Pulshöhe bestimmt werden. Weiter wird der Einfluss

der Bulkdefekte auf die Solarzellenparameter insbesondere auf die Effizienz der Solarzelle untersucht.

HL 13.67 Mon 15:00 Poster A

Polymer-Fullerene Bulk-Heterojunction Solar Cells With Additional ZnO:Al Layer — •Daniel Rauh[1,2], Volker Lorrmann[1,2], Carsten Deibel[2], Vladimir Dyakonov[1,2], and Ingo Riedel[1] — [1]Div. Functional Materials for Energy Technology, ZAE Bayern e.V., Am Hubland, D-97074 Würzburg, Germany — [2]Experimental Physics VI (Energy Research), Faculty of Physics and Astronomy, Julius-Maximilians University of Würzburg, Am Hubland, D-97074 Würzburg, Germany

We investigated novel functional layers of ZnO:Al serving as a buffer layer between the absorber and the light reflecting metal electrode of organic bulk heterojunction solar cells. The reason for introducing such a layer is twofold: 1. The ZnO:Al layer serves as an optical spacer readjusting the electric field distribution throughout the device, thus causing improved light absorption within the absorber. 2. n-type ZnO:Al is expected to enhance the selectivity of the metal electrode serving as a hole blocking layer. Our optical simulations clearly demonstrate that the gain in absorption do not exceed 20 % upon introduction of an optical spacer. We synthesized nanoparticular ZnO:Al and produced thin films for devices with the aforementioned cell structure and compared the photovoltaic performance with reference devices. To discriminate between the effects of improved light absorption and enhanced selectivity of the metal electrode we combined optical simulations and electrical interface characterization.

HL 13.68 Mon 15:00 Poster A

Identification and Quantification of Local Absorber Properties of Cu(In,Ga)Se2 from Sub-Micron Resolved PL and Optical Transmission — •Levent Gütay and Gottfried Bauer — Institute for Physics, University of Oldenburg, 26111 Oldenburg, Germany

We have analyzed Cu(In,Ga)Se2 absorber layers with a confocal microscope setup designed for photoluminescence (PL) and optical transmission experiments with lateral resolution in the 1-micron scale and below. We present results for inhomogeneities of optoelectronic properties of Cu(In1-xGax)Se2-absorbers in terms of fluctuations of the local band gap and of splitting of quasi-Fermi-levels which can be extracted from spectrally resolved PL data. From optical transmission spectra we get additional data for local band gaps and their fluctuations. The optical threshold for photon absorption/emission in Cu(In1-xGax)Se2 is a complicated function of wavelength/photon energy that cannot be reduced to a single parameter band gap, we plot photon energies for different degrees of absorption (e.g. $\alpha = 10\hat{}n$ 1/cm, with n = 2,3,4) as pseudo-band gap energy. We summarize fluctuations in Fermi level splitting and optical pseudo band gap energies in histograms and discuss their local interdependence in terms of correlation factors.

HL 13.69 Mon 15:00 Poster A

Optical and electrical properties of sputtered copper oxide thin films — •Swen Graubner, Stefan Merita, and Bruno Meyer — I. Physikalisches Institut, Justus-Liebig-Universität Giessen, Heinrich-Buff-Ring 16, 35392 Giessen

In order to promote the understanding of CuxO sputtering, we deposited several series of thin-films under various conditions. Substrate temperature was changed, ranging from room temperature to 700 K. Argon and oxygen flow were varied in the region of up to 5 sccm. The morphology of the deposited CuxO thin-films was investigated by x-ray diffraction, EDX and REM. It could be shown that the oxygen flow directly influences whether Cu(II)O or CuO is formed. Electrical measurements were done to gain information about specific resistivity, carrier concentration and mobility. Optical absorption and transmission experiments gave information about the band-edge properties of the investigated CuxO thin films.

HL 13.70 Mon 15:00 Poster A

Turn-on dynamics and modulation response in semiconductor quantum dot lasers — •Ermin Malić, Moritz Bormann, Philipp Hövel, Matthias Kuntz, Dieter Bimberg, Andreas Knorr, and Eckehard Schöll — Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We present a theoretical simulation of the turn-on dynamics of InAs/GaAs quantum dot semiconductor lasers driven by an electrical current pulse. Our approach goes beyond standard phenomenological rate equations. It contains microscopically calculated Coulomb scattering rates describing Auger transitions between quantum dots and the wetting layer. In agreement with experimental results, we predict a strong damping of relaxation oscillations on a nanosecond time scale. Our simulations explicitly take the strongly nonlinear dependence of the Coulomb scattering rates on the wetting layer charge carrier densities, and we show their crucial importance for the understanding of the turn-on dynamics of quantum dot lasers.

HL 13.71 Mon 15:00 Poster A

DC-transport characteristics of Silicon-on-Insulator FET with 55nm thick silicon films at low doping levels — •Pagra Truman, Petra Uhlmann, and Manfred Stamm — Leibniz Institute of Polymer Research Dresden, Hohe Str. 6, Germany

Silicon-on-Insulator (SOI) FET with nanoscale silicon films at low doping levels have potential for (bio-)sensing applications but still the device properties are not fully understood yet: With decreasing film thickness the energy band structure of the silicon film becomes strongly affected by the existence of interfacial states. Furthermore for film thicknesses below the maximum depletion length the device properties can no longer be described by a semiclassical approach. We investigate n-channel normally-on SOIFET devices and observe for positive gate bias close to ideal MOSFET device characteristics whereas for negative gate bias the transistor does not turn to the off-state but instead becomes insensitive to the gate. Additonally the impact of the W/Ti and Ti/Au metal contacts on the device properties is studied: Exceeding a certain gate voltage level device characteristics become similar to the ones of a Schottky-barrier MOSFET. It is worth mentioning that the W/Ti and Ti/Au contacts have not been annealed.

HL 13.72 Mon 15:00 Poster A

Laterale, zweidimensionale npn-Übergänge: Eine neue Methode für Positionsdetektoren — •C. Werner, D. Reuter und A.D. Wieck — Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum

Wir haben auf Basis von $Al_{0,33}Ga_{0,67}As/In_{0,11}Ga_{0,89}As/GaAs$-Heterostrukturen laterale, zweidimensionale npn-Übergänge erzeugt, indem wir eine in der MBE gewachsene p-modulationsdotierte Heterostruktur durch lokale Implantation von Siliziumionen überkompensiert und so lokal ein zweidimensionales Elektronengas erzeugt haben.

Verbindet man die beiden n-dotierten Bereiche mit einem Widerstand und strahlt mit einem fokussierten Laserstrahl auf den p-dotierten Bereich, so ist der Spannungsabfall über dem Widerstand proportional zu der Position des Laserstrahls senkrecht zu den beiden p-n-Übergängen, wobei die Empfindlichkeit 1 mV/μm beträgt. Damit ist es möglich, die Positionsveränderungen des Laserstrahls im Nanometerbereich zu bestimmen.

Zusätzlich ist es uns durch eine andere Implantationsgeometrie gelungen, die Position auch in zwei Raumrichtungen bestimmen zu können, wobei sich die Messungen der beiden Raumrichtungen nicht beeinflussen.

HL 13.73 Mon 15:00 Poster A

Influence of thermal annealing on the memory effect in MIS structures containing crystalline Si nanoparticles — Nicola Nedev[1], Diana Nesheva[2], Emil Manolov[2], Rudolf Brüggemann[3], •Sebastian Meier[3], Kiril Kirilov[4], and Zelma Levi[2] — [1]Instituto de Ingenieria Universidad Autónoma de Baja California, Benito Juárez Blvd., s/n, C.P. 21280, Mexicali, Baja California, México. — [2]Institute of Solid State Physics, Bulgarian Academy of Sciences, 72 Tzarigradsko Chaussee Blvd., 1784 Sofia, Bulgaria. — [3]Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg, Germany. — [4]Department of Solid State Physics and Microelectronics, Sofia University "St. Kliment Ohridski", 5 James Bourchier, 1164 Sofia, Bulgaria.

Silicon nanocrystals embedded in a SiO_2 matrix are fabricated by thermal annealing of Metal/SiO_2/SiO_x/c-Si structures (x=1.15) at 1000 °C in N_2 atmosphere for 30 or 60 min. High frequency C-V measurements demonstrate that both types of sample can be charged negatively or positively by applying a positive or negative bias voltage to the gate. The clockwise hysteresis windows of 30 and 60 min annealed samples are about 7 and 5.5 V for the ± 12 V scanning range ($E_{ox} = \pm$ 2.4 MV/cm), respectively. Although the samples annealed for 60 min have a smaller hysteresis window, they have two important advantages compared to the 30 min annealed ones: a lower defect density at the c-Si wafer/SiO_2 interface and a smaller value of the fixed oxide charge

close to this interface.

HL 13.74 Mon 15:00 Poster A

The design and fabrication of an electron pump with in-plane gate transistors by focused ion beam implantation — •M. Draghici, D. Salloch, A. Melnikov, D. Reuter, and A. D. Wieck — Lehrstuhl für Angewandte Festkörperphysik, Ruhr-Universität Bochum, Universitätsstr. 150, 44780 Bochum

In the last decade, there has been a considerable interest especially in the metrological community to design and develop a device capable to deliver a current with an extremely high accuracy. The Coulomb blockade and single electron tunneling effects in small junctions made possible devices, which manipulate individual electrons [1]. A drawback is the very sophisticated routine for tuning and operating the pump. Another approach was to fabricate devices for which the charge transport through an 1D-channel formed in an $Al_xGa_{1-x}As$ heterostructure is done using surface acoustic waves of few GHz [2]. The advantage is that the current extends to the nanoampere range. We present an electron pump with in-plane gate (IPG) transistors [3] fabricated by focused ion beam implantation. Although, the device is operating at low frequencies (tens of kHz), it is capable to produce a current more than one order of magnitude higher than the electron pumps based on Coulomb blockade and single electron tunneling effects. The maskless fabrication process does not require any alignment between the sources, the drains and the gates of the IPG transistors.

[1] L. J. Geerligs *et al.*, Phys. Rev. Lett. **64**, 2691 (1990).
[2] V. I. Talyanskii *et al.*, Phys. Rev. B **56**, 15180 (1997).
[3] A. D. Wieck, K. Ploog, Appl. Phys. Lett. **56**, 928 (1990).

HL 13.75 Mon 15:00 Poster A

Functionalized macroporous silicon structures for ir-radiation and chemical sensing applications — •Benjamin Gesemann and Ralf Wehrspohn — Microstructure based material design group, MLU Halle-Wittenberg, Heinrich-Damerow-Strasse 4, D-06120 Halle

In recent years ordered macroporous silicon structures have been used for photonic crystal studies. Beside that they also offer a huge potential for ir-radiation and chemical sensing applications.

We enhanced processes to fabricate high aspect ratio ordered membrane structures with complex shapes for functional devices. The μm-sized porosity as well as mm- and cm-sized outer and inner shapes for a functional chip-design can be etched in a single process. We will show measurements and calculations for thermal emission- as well as gas sensing properties of functionalized coated macroporous silicon devices.

HL 13.76 Mon 15:00 Poster A

***In situ* spectroscopy and characterisation of organic solar cells** — •F. Holch, J. Pernpeintner, A. Schöll, and E. Umbach — Universität Würzburg, Experimentelle Physik II, 97074 Würzburg

Electronic devices based on organic semiconductors belong to a field of growing interest in fundamental and application related research. The different experimental methods and preparation techniques often complicate a comprehensive understanding of fundamental properties and their impact on device performance. We present first results from a new project focussing on organic solar cells using relatively small organic molecules. For a better understanding of the limiting parameters basic questions such as the determination of energy levels in the active layer as well as the bandoffsets/–alignment at the organic hetero–interface and contacts will be addressed using photoelectron spectroscopy (UPS) and inverse photoelectron spectroscopy (IPES). *In situ* electrical measurements (IV) help to associate fundamental results with device characteristics such as efficiency and fill factor. In order to avoid uncontrolled contamination, the complete fabrication (active layer and contacts) and characterisation is performed under clean and well defined conditions in UHV. As a benefit of this approach the influence of contamination occurring, e.g., during the fabrication process or device operation can be analysed systematically. Moreover, metal deposition methods are optimised in order to reduce damage to the sensitive organic layer. The interplay between interface morphology and interaction will be investigated by XPS using a peeling technique, which has already been successfully applied to Au/DIP contacts.

HL 13.77 Mon 15:00 Poster A

Open circuit voltage of organic solar cells - experiment and simulation — •Matthias Roosz[1], Carsten Deibel[1], Ingo Riedel[2], Vladimir Dyakonov[1,2], David Cheyns[3], Jan Genoe[3], and Paul Heremans[3] — [1]Experimental Physics VI, Physical Institute, Julius-Maximilians-University of Würzburg, Am Hubland, D-97074 Würzburg, Germany — [2]Div. Functional Materials for Energy Technology, ZAE Bayern e.V., Am Hubland, D-97074 Würzburg, Germany — [3]IMEC, Polymer & Molecular Electronics, Kapeldreef 75, B-3001 Leuven, Belgium

Polymer photovoltaic devices are promising alternatives to inorganic solar cells due to their low-cost fabrication of large areas. However, as the power conversion efficiency of organic solar cells needs to be further increased, investigations of the basic principles are indispensible.

The open-circuit voltage as a key parameter of organic solar cells is studied by both simulation and device characterization. We present an analytic model for bilayer devices employing Poisson-equation and the balance between drift/diffusion-current which is compared to bilayer polymer-fullerene solar cells. Light intensity and temperature dependance will be discussed.

HL 13.78 Mon 15:00 Poster A

Investigation of electronic traps in organic transport layers via thermally stimulated current measurements — •Julia Schafferhans[1], Carsten Deibel[1], and Vladimir Dyakonov[1,2] — [1]Experimental Physics VI, Physical Institute, Julius-Maximilians-University of Würzburg, Am Hubland, 97074 Würzburg, Germany — [2]Div. Functional Materials for Energy Technology, ZAE Bayern e.V., Am Hubland, 97074 Würzburg, Germany

Charge transport in disordered organic semiconductors is generally described as thermally activated hopping in a gaussian distribution of localized states. The presence of charge traps is critical to the performance of organic electronic devices, since trapped charge carriers do no longer contribute to current flow. We investigate the depth and the density of trap states in the polymer poly(3-hexylthiophene) (P3HT) by applying the thermally stimulated current (TSC) technique. In particular, we present experimental data on the influence of doping the polymer with fullerene derivatives, which are relevant for the application in organic photovoltaics.

HL 13.79 Mon 15:00 Poster A

Photoinduced polarons in conjugated polymer-fullerene composites studied with light-induced electron-spin resonance — •Andreas Sperlich[1], Moritz Liedtke[1,2], Johannes Sieger[1], Carsten Deibel[1], Ingo Riedel[1,2], Vladimir Dyakonov[1,2], and Nazario Martin[3] — [1]Experimental Physics VI, Physical Institute, Julius-Maximilians University of Würzburg, Am Hubland, D-97074 Würzburg — [2]ZAE Bayern, Div. Functional Materials for Energy Technology, Am Hubland, D97074 Würzburg, Germany — [3]Departamento de Quimica Organica, Facultad de Quimica, Universidad Complutense, E-28040 Madrid

Electron-spin resonance (ESR) and light induced electron spin resonance (LESR) studies of photogenerated polarons in films of polymer and of polymer-fullerene composites were performed. Investigated materials are regio-regular and regio-random poly(3-hexylthiophene) (RR-P3HT / RRa-P3HT), [6,6] phenyl-C61-butyric acid methyl ester (PCBM) and a novel C70-derivate. In pure polymer-films a single polaron-signal is detected with ESR; it is significantly enhanced under illumination. Polymer-fullerene composites show two distinct polaron signals below 200K. The efficiency of the charge carrier generation in these polymer-fullerene-composites is relevant for applications in organic solar cell devices.

HL 13.80 Mon 15:00 Poster A

Injection studies on the guest-host system: terrylene in para-terphenyl — •Bernhard Grotz, Fedor Jelezko, Jörg Wrachtrup, and Jens Pflaum — 3. Physikalisches Institut, Universität Stuttgart, Germany

Efficient charge carrier injection accompanied by recombination on individual lattice sites are the substantial requirements to detect single molecule electroluminescence in organic host-guest systems, the latter defining key elements for quantum cryptographic application. But comparing the positions of the contributing energy levels as well as the properties of metal-organic interfaces the injection often is restricted by the substantial level-offset and by the formation of interface dipoles, etc.

We address this problem by injection studies on the terrylene doped para-terphenyl guest-host system, a prominent candidate for single photon sources [1] and widely studied by optical techniques. The crystalline samples were prepared either by Lipsett-growth or by spin casting on glass. In a first attempt, direct electron injection in PPX

capped and uncapped Lipsett-grown crystals was provided at energies between 10-1000eV in UHV. From spectral measurements of the luminescence we conclude the possibility of electron injection and subsequent transport to and recombination on the terrylene dopant in the para-terphenyl matrix. We will discuss further extensions to this approach, to achieve higher recombination efficiencies as well as higher local resolutions.

[1] B. Lounis, W.E. Moerner, Nature, 407, 491 (2000)