Co and Mn doped ZnO. Two series of samples were prepared for both (Zn,Co)O and (Zn,Mn)O. One series of ZnCoO thin films was grown by UHV-magnetron reactive sputtering and the other consists of ion implanted ZnO wires on a silicon substrate. The Mn doped series were fabricated by diffusion or by ion implantation of Mn in ZnO bulk material. The Mn and Co doped samples exhibit distinct differences in optical properties. In the case of the (Zn,Co)O the intern 3d transitions can be seen in PL as well as in absorption spectra. A broad Mn induced band is observable below the band gap in the absorption of the Mn doped samples. Details will be discussed at the poster.

HL 32.24 Tue 18:30 Poster D1

Photocurrent measurements of *a*- and *c*-plane oriented ZnO layers — •Richard K. Thöt, Thomas Sander, Sebastian Eisermann, Stefan Lautenschläger, Bruno K. Meyer, and Peter J. Klar — I. Physikalisches Institut, Justus-Liebig-Universität Gießen, Heinrich-Buff-Ring 16, 35392 Gießen, Germany

We present in-plane photocurrent measurements of CVD-grown ZnO layers on different substrates. The measurements were performed at temperatures in the range from 80 K to 300 K. The spectra yield information about the influence of strain and crystal orientation on the interband transitions. At liquid nitrogen temperature a finestructure of the photocurrent response is visible due to transitions from multiple valence band energies. In another experiment we recorded photocurrent spectra using linearly polarized probe light varying the polarization angle. For *a*-plane grown ZnO samples the photocurrent confirms the expected anisotropy of the semiconductor layers. The finestructure of the valence band can be studied and the orientation of the *c*-axis within the layer can be determined.

HL 32.25 Tue 18:30 Poster D1

The refractive index of zinc oxide microwire single crystals — Christian Czekalla, Philipp Kühne, Chris Sturm, •Rüdiger Schmidt-Grund, and Marius Grundmann — Universität Leipzig, Fakultät für Physik und Geowissenschaften, Institut für Experimentelle Physik II, Linnéstr. 5, 04103, Leipzig, Germany

Among a large number of applications, zinc oxide (ZnO) single crystals (bulk and micro- and nanowires) are expected to form important building blocks for future optoelectronic devices like light emitting and laser diodes. Optical resonances from ZnO structures have been observed by a number of groups in the past years.

In most of the publications, modeling of the mode structure, especially in the near bandgap spectral region, is difficult because the energy dependent refractive index $n(E)$ is typically not known. Additionally, in case of the self assembled micro- and nanowires, the structures are too small to perform spectroscopic ellipsometry to determine $n(E)$.

We compare $n(E)$ obtained from (a) spectroscopic ellipsometry measurements of ZnO bulk single crystals and (b) spatially resolved photoluminescence measurements of ZnO microwires employing a plane wave whispering gallery mode model for the observed resonances. We discuss the differences between the results obtained from the two methods and their mutual impact, leading to a highly precise determination of $n(E)$ in an energy range between 1.80 eV and 3.25 eV and for temperatures between 10 K and 295 K.

HL 32.26 Tue 18:30 Poster D1

Photolumineszenz- und Transmissionsmessungen an ZnO/MgZnO-Quantengrabenstrukturen — •Johannes Kupper, Alexander Müller, Gabriele Benndorf, Martin Lange, Matthias Brandt, Michael Lorenz und Marius Grundmann — Universität Leipzig, Fakultät für Physik und Geowissenschaften, Institut für Experimentelle Physik II, Linnestr. 5, 04103 Leipzig

Eine Möglichkeit zur Einstellung der Emissionswellenlänge von optischen Bauelementen bieten Quantengrabenstrukturen. Die Confinementenergie lässt sich über die Barrierenhöhe und Grabenbreite einstellen. Für Gräben aus ZnO eignet sich MgZnO als Barrierenmaterial. Mittels gepulster Laserabscheidung wurden einzelne ZnO/MgZnO-Quantengräben (QWs) mit unterschiedlicher Grabenbreite bei verschiedenen Züchtungsbedingungen auf *a*-Saphir abgeschieden. Dabei war es möglich QWs mit und ohne quantenunterstütztem Stark-Effekt (QCSE) darzustellen. Zur besseren Gitteranpassung wurde zwischen Grabenstruktur und Substrat eine MgZnO-Pufferschicht eingebracht.

Die QWs wurden mit Hilfe von Photolumineszenz(PL)- und Transmissions(TM)-Messungen zwischen 2K und 300K untersucht. Neben dem intensiven Hauptpeak der QW-PL zeigen sich mehrere Phononenwiederholungen, wobei die QWs mit QCSE eine zusätzliche Rotverschiebung der PL aufweisen. Die Grabenabsorption zeigt bis zu zwei Maxima. Das niederenergetische Maximum kann dem e1-h1-Übergang zugeschrieben werden. Die Zuordnung des höherenergetischen Maximums wird diskutiert.

HL 33: Poster I: Transport, including Magnetic-Field Effects

Time: Tuesday 18:30–20:30 Location: Poster D1

HL 33.1 Tue 18:30 Poster D1

Atomistic Description of Large Nanostructures based on III-Nitride semiconductors — •Alejandro Molina-Sánchez[1], Alberto García-Cristóbal[1], Andres Cantarero[1], Aleksandrs Terentjevs[2], and Giancarlo Cicero[2] — [1]Instituto de Ciencia de Materiales de la Universidad de Valencia, P.O. Box 22085, E-46071 Valencia, Spain — [2]Physics and Materials Science and Chemical Engineering Departments, Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129 Torino, Italy

Semiconductor nanocolumns exhibiting a growth without dislocatinos and high crystalline quality are of great interest in nanotechnology applications. Specifically, InN-based nanocolumns are good candidates to develop multi-junction solar cells due to their small gap, 0.67 eV, and the posibility of alloying with other nitrides (as GaN and AlN) to cover the entire solar spectrum. A proper description of optical properties of the nanostructures described above can start with an atomistic treatment of the electronic structure in order to keep the essential geometry and symmetry of the objects. Unfortunately, the best description realized with ab initio electronic structure software is strongly limited by the nanocolumn diameter to a few nanometers. By using a combination of ab initio and empirical tight-binding methods, we can connect the quality of the first principles calculations (performed with the Espresso code), with the versatility of an empirical approach. Once we have an ab initio quality parameter set for the empirical tight-binding code, we can study larger nanostructures with this approach, reducing the computation time in orders of magnitud.

HL 33.2 Tue 18:30 Poster D1

Non-linear properties of ballistic electron-focusing devices — •Arkadius Ganczarczyk[1], Martin Geller[1], Axel Lorke[1], Dirk Reuter[2], and Andreas D. Wieck[2] — [1]Experimental Physics and CeNIDE, Universität Duisburg-Essen — [2]Chair of Applied Solid State Physics, Ruhr-Universität Bochum

This poster has been withdrawn.

HL 33.3 Tue 18:30 Poster D1

Transport through a molecular junction within P(E)-theory — •Denis Kast and Joachim Ankerhold — Institut für Theoretische Physik, Universität Ulm

Directed charge transfer in isolated molecular aggregates originates from a fluctuating environment consisting e.g. of internal vibronic modes or solvent degrees of freedom. Corresponding transfer rates can be derived within the P(E)-formalism known from the theory of Coulomb-blockade in single charge transfer. This methodology can be extended to describe incoherent charge transport through molecular junctions including the electromagnetic environment of the actual circuitry. We present first results for simple molecular junctions and for internal vibronic degrees of freedom in and out of thermal equilibrium. Findings are compared with data from real-time Quantum Monte Carlo simulations.

HL 33.4 Tue 18:30 Poster D1

Electrical Properties of Graphene- Carbon Nanotube junction — •Pablo Thomas Robert, Julien Bordaz, Romain Danneau, and Frank Hennrich — Karlsruher Institut für Technologie, Campus Nord, Institut für Nanotechnologie

Since it has been in 2004 first isolated, it has become one of the hottest

research topics in condensed matter physics. The peculiar band structure of this zero-gap semiconductor leads to novel electronics properties and mades it a high promising material for electronic devices. Our aim is to study the electrical transport properties of graphene-nanotube hybrid carbon systems by carrying out 4 point-probe measurements and the graphene/carbon nanotube interface resistance. We want to compare those measurements with the ones obtained when using the metal electrodes standard technique to connect the graphene sheet.

To fabricate our probes, we first deposit on highly doped silicon substrates some graphene by mechanical exfoliation of graphite. After spin-coating a multi-walled carbon nanotube solution on the probe, the nanotubes are then dragged on the graphene sheet using an atomic force microscope in non-contact mode. We also pattern metal contacts on the graphene sheet using standard electron beam lithography followed by ultra-high vacuum metal evaporation.

HL 33.5 Tue 18:30 Poster D1

Pure orbital photocurrents in (111) Si-MOSFETs — •J. Kamann[1], J. Karch[1], P. Olbrich[1], S.A. Tarasenko[2], E.L. Ivchenko[2], T. Schönberger[1], Z.D. Kvon[3], and S.D. Ganichev[1] — [1]THz Center, University of Regensburg, Regensburg, Germany — [2]Ioffe Institute, St. Petersburg, Russia — [3]Institute of Semiconductor Physics, Russian Academy of Sciences, Novosibirsk, Russia

We report on pure orbital photocurrents in (111) grown Si-MOSFET structures. Photocurrents are generated by illumination with a pulsed high power THz laser of several wavelengths. We obtain photon-helicity dependant currents, changing sign when we switch the circular polarization of the incident pulse from left- to righthanded. Furthermore we were able to measure currents that vary with the orientation of linear polarized radiation. In addition to the spin, free carriers in solid states can be characterized by other internal properties, e.g., a valley index in manyvalley semiconductors. In this case, one can consider pure orbit-valley currents, where partial electron fluxes in valleys are nonzero but the net electric current $\sum I_\nu$ vanishes. Here, the role of spin-up and spin-down states is replaced by the valley index: there is no net charge current, but the electrons in different valleys travel in different directions. Si-MOSFETs grown in (111) direction belong to the symmetry group C_{3v}, denying currents that are sensitive to unpolarized or circular polarized radiation under normal incidence. However, a net electric current induced by linearly polarized light is allowed. In this case, the partial fluxes become nonequal and do not compensate each other. This is demonstrated in our experimental results.

HL 33.6 Tue 18:30 Poster D1

Magnetoconductance switching in arrays of oval quantum dots — •Christian Morfonios — PCI Heidelberg

Employing oval shaped quantum billiards connected by quantum wires as the building blocks of a linear quantum dot array, we calculate the ballistic magnetoconductance in the linear response regime. Optimizing the geometry of the billiards, we aim at a maximal finite- over zero-field ratio of the magnetoconductance. This switching effect arises from a relative phase change of scattering states in the oval quantum dot through the applied magnetic field, which lifts a suppression of the transmission characteristic for a certain range of geometry parameters. It is shown that a sustainable switching ratio is reached for a very low field strength, which is multiplied by connecting only a second dot to the single one. The impact of disorder is addressed in the form of remote impurity scattering, which poses a temperature dependent lower bound for the switching ratio, showing that this effect should be readily observable in experiments.

HL 33.7 Tue 18:30 Poster D1

Magneto-Transport Studies on Evenly Curved Two-Dimensional Electron Systems in Semiconductor-Microtubes with Hall Bar Contact-Geometry — •David Sonnenberg, Karen Peters, Stefan Mendach, Andrea Stemmann, and Wolfgang Hansen — Institut für Angewandte Physik und Zentrum für Mikrostrukturforschung, Universität Hamburg, Jungiusstrasse 11, 20355 Hamburg, Germany

We present magneto-transport studies on evenly curved two-dimensional electron systems (2DES) in InGaAs-microtubes. The microtubes are fabricated from epitaxial films, by releasing thin strained semiconductor layers from the substrate. Strain relaxation causes the film hosting the 2DES to roll-up into tubes with micrometer sized diameters. The rolled-up 2DES are prepared in a Hall-bar contact-geometry along the curvature of the microtube. Low-temperature magneto-transport measurements are performed with current direction parallel to the modulation of the perpendicular magnetic-field component. An asymmetric behaviour of the Hall resistance in dependence of the magnetic field orientation will be discussed.

HL 33.8 Tue 18:30 Poster D1

Serial arrays of square Quantum Hall devices for resistance standards — •Jens Könemann, Franz-Josef Ahlers, Klaus Pierz, and Hans Werner Schumacher — Physikalisch-Technische Bundesanstalt, Bundesallee 100, D-38116 Braunschweig

Combining several Hall bars in series or in parallel with the help of the multiple series connection technique [1] allow to realize quantum resistance standards for resistance values from, e.g., 100 Ω to 1 MΩ. One of the necessary checks for verifying such a device as a resistance standard comprises the reversal of the magnetic field orientation. However, for serial arrays such a reversal intrinsically results in different resistance values for the two field orientations. Here, we propose a scheme to circumvent this restriction. It relies on interchanging the voltage and current probes together with the magnetic field inversion using a totally symmetric design based on square Hall bars. First device realizations are presented.

[1] F. Delahaye, J. Appl. Phys., Vol. 73, 7914 (1993).

HL 33.9 Tue 18:30 Poster D1

Anomalous magnetotransport of magnetic 2DHGs in the quantum-Hall regime — •Stefan Knott[1], Ursula Wurstbauer[1], Thomas Hirschmann[1], Werner Wegscheider[2,3], and Wolfgang Hansen[1] — [1]Institut für Angewandte Physik, Universität Hamburg, Germany — [2]Institut für Experimentelle und Angewandte Physik, Universität Regensburg, Germany — [3]Solid State Physics Laboratory, ETH Zürich, Switzerland

The interaction of localized magnetic moments with a two-dimensional hole gas is studied with low-temperature magnetotransport measurements. The hole gas is confined in manganese modulation-doped InAlAs/InGaAs/InAs quantum wells grown by molecular beam epitaxy. If Mn ions are inside the quantum well the holes are strongly localized at zero field, while it shows quantized transport at high field featuring Shubnikov-de Haas oscillations and the quantum-Hall effect. Here we present high-field data that show pronounced deviation from the behavior of samples with no Mn ions in the quantum well: The Hall voltage is neither linear nor monotonous and the 1/B-periodicity is not given anymore. Moreover, a significant weak anti-localization signature is present still at 4.2K in samples without Mn ions in the channel, indicating strong spin orbit coupling. The observed temperature dependency of both types of samples and possible explanations will be discussed.

HL 33.10 Tue 18:30 Poster D1

Collective Excitations of Interacting Two-Dimensional Electrons in High Magnetic Fields — •Guenther Meissner and Uwe Schmitt — Theoretische Physik, Universitaet des Saarlandes, Postfach 151150, D-66041 Saarbruecken

A hierarchy of fractional quantum Hall states at odd-denominator rational filling factors of the lowest Landau level is associated with a correspoding hierarchy of liquid phases. At sufficiently high magnetic fields such liquid phases are terminated by an insulating phase which could be identified as being a quantum solid phase related to the Wigner crystal. Therefore, we have explored, in as far, as a many-body approach for interacting two-dimensional electrons in high magnetic fields [1] is suitable for investigating collective excitations of these states. Composites of 1, 2, and 3 electron charges (e), with 3, 5, and 7 magnetic flux quanta (ch/e), respectively, are considered in view of recent experimental invastigations of magneto-rotons [2]. The anyonic statistics of the resulting fractionally charged quasiparticles of charge e/3, e/5, and e/7 is of importance for studying topological order and might find application for building a topological quantum computer.

[1] G. Meissner, Physica B 184, 66 (1993). [2] I.V. Kukushkin, J.H. Smet, V.W. Scarola, V. Umansky, and K. von Klitzing, Science, 324, 1044 (2009).

HL 33.11 Tue 18:30 Poster D1

Spin photocurrents in diluted magnetic semiconductors — •M. Schmalzbauer[1], P. Olbrich[1], S.D. Ganichev[1], S.A. Tarasenko[2], V.V. Bel'kov[2], Ch. Brinsteiner[1], W. Eder[1], D.R. Yakovlev[2,3], V. Kolkovsky[4], W. Zaleszczyk[4], G. Karczewski[4], T. Wojtowicz[4], and D. Weiss[1] — [1]THz Center, University of Regensburg, Germany — [2]Ioffe Physico-Technical Institute, Rus.