HL 53: Transport properties

Time: Friday 10:15–11:45 Location: POT 151

HL 53.1 Fri 10:15 POT 151

Electronic properties of crystalline phase change materials — •Michael Woda, Peter Jost, Stephan Kremers, Philipp Merkelbach, Theo Siegrist, and Matthias Wuttig — I. Physikalisches Institut (1A), RWTH Aachen, 52056 Aachen, Germany

In phase change materials (PCM) the pronounced contrast between the amorphous and crystalline state in form of optical and electrical properties is combined with a fast phase transition on a ns timescale. This combination opens the possibility of memory applications. PCM are already employed in rewritable optical data storage and are used for the Phase change RAM (PCRAM). This is a promising candidate to become the next generation non-volatile solid state electronic memory. In PCRAMs it is important to have stable and well defined resistance levels. Here we present a comparative study of different PCM alloys in order to determine the origin of different crystalline resistivities upon thermal annealing, which seem not to be governed by grain properties. We investigate different degrees of crystallinity with various techniques including van der Pauw, Hall, ellipsometry, FTIR and XRD measurements.

HL 53.2 Fri 10:30 POT 151

A time dependent approach to obtain transmission coefficients of multi-terminal devices — •Christoph Kreisbeck[1], Viktor Krückl[1], and Tobias Kramer[1,2] — [1]Institute for Theoretical Physics, University of Regensburg, 93040 Regensburg, Germany — [2]Department of Physics, Harvard University, Cambridge, MA 02138, USA

We are interested in transport behavior of semiconductor nanostructures, where we particularly focus on multi-terminal devices. The conductivity through these devices can be described theoretically within the Landauer-Büttiker formalism, which connects conductance-voltage characteristics with scattering matrices. To obtain the latter we introduce a time dependent approach, which proves to be a very efficient way to calculate transmission coefficients numerically. Moreover this method can go beyond Landauer-Büttiger. This means that we do not have to restrict ourself to asymptotic channels anymore, but we can study localised electron sources as well.

HL 53.3 Fri 10:45 POT 151

Tuning of decoupled graphene layers by front and backgate — •Thomas Lüdtke, Hennrik Schmidt, Patrick Barthold, and Rolf J. Haug — Institut für Festkörperphysik, Leibniz Universität Hannover, Appelstr. 2, 30167 Hannover

We present transport measurements through a heterojunction of decoupled layers of graphene as a function of backgate and topgate voltage as well as magnetic field at temperatures down to 300mK [1]. Folded monolayers on a SiO2 substrate are structured and contacted by using electron beam lithography. A PMMA layer is deposited onto the structured part to be able to fabricate an additional local gate afterwards.

In a four terminal measurement the resistance of the device was obtained by tuning the potential of the backgate and the topgate independently. Charge neutrality points of both regions are clearly visible, separating the different charge configurations (e.g. p-n-p, n-n-n) of the graphene field effect transistor. The magnetic field dependence of the localy gated sample shows four different oscillations in the Shubnikov-de Haas (SdH) measurement. Two of these oscillations are dependent on the potential of the applied backgate, whereas the other two oscillations changes when tuning the local topgate. Calculations of the carrier concentrations from SdH measurements as well as a Berry phase of Pi shows the existence of two decoupled monolayers of graphene that can be tuned by gates independently.

[1] H. Schmidt, T. Lüdtke, P. Barthold, E. McCann, V. I. Fal'ko, and R. J. Haug; Appl. Phys. Lett. 93, 172108 (2008)

HL 53.4 Fri 11:00 POT 151

A tunable self-switching in-plane diode in a 2D-system — •Simone Vossen[1], Arkadius Ganczarczyk[1], Martin Geller[1], Axel Lorke[1], Dirk Reuter[2], and Andreas Wieck[2] — [1]Experimental Physics and CeNIDE, Universität Duisburg-Essen — [2]Solid State Physics, Ruhr-Universität Bochum

Patterning on the nanometer scale enables to produce devices with new functionalities that are mainly given by the sample geometry. We fabricated a device geometry in a two-dimensional electron gas (2DEG) that uses the so-called self-switching effect to realize a tunable diode-like structure [1]. The sample consists of a 400nm wide channel in a 2DEG confined by etched insulating trenches. An asymmetric potential profile causes the self-switching effect. The working principle is based on lateral pinch off, which modulates the width of the depletion zones of the narrow etched channel. Depending on the direction of the applied voltage along the channel, the channel opens or closes, resulting in diode-like behavior.

The tunability of the self-switching device (SSD) is achieved by two in-plane side gates, which modulate the depletion zones of the electron channel. We are able to tune the characteristics of the SSD for instance the on-voltage of the diode from 0 V up to 0.7 V in comparison to the fixed on-voltage of a standard p-n diode.

Additionally we examine the frequency operations of the SSD and analyze its behavior in a magnetic field.

[1] A.M. Song, M. Missous, P. Omling, A.R. Peaker, L. Samuelson, and W. Seifert, Appl. Phys. Lett. 83, 1881-1883 (2003)

HL 53.5 Fri 11:15 POT 151

Nonlinear mesoscopic transport in asymmetric quantum wires — •Bettina Brandenstein-Köth, Lukas Worschech, Stefan Lang, Jan Heinrich, Sven Höfling, and Alfred Forchel — Technische Physik, Universität Würzburg, 97074 Würzburg

The nonlinear transport of asymmetric quantum wires has been studied under the influence of an external magnetic field. The investigated structures were based on a modulation doped GaAs/AlGaAs heterostructures with a two-dimensional electron gas approximately 80nm below the surface. The inplane asymmetry of the quantum wire was realized by two different side walls, one defined via an etched channel and the other by a metal-surface depletion gate. Magnetic fields were applied perpendicular to the sample surface. The conductance of the quantum wires was studied at a temperature of 4.2K. It was found that such asymmetric quantum wires show a pronounced magnetic-field asymmetry, defined as the change in the conductance induced by a change in the magnetic-field sign. The asymmetric conductance increases linearly with the bias voltage up to several hundred millivolts. We explain our findings by a recently proposed magnetic-field asymmetry of nonlinear mesoscopic transport.[1]

[1] D. Sánchez and M. Büttiker, Phys. Rev. Lett. 93, 106802 (2004); B. Spivak and A. Zyuzin, Phys. Rev. Lett. 93, 226801 (2004).

HL 53.6 Fri 11:30 POT 151

Tunable Graphene System with Two Decoupled Monolayers — •Hennrik Schmidt, Thomas Lüdtke, Patrick Barthold, and Rolf J. Haug — Institut für Festkörperphysik, Leibniz Universität Hannover, D-30167 Hannover, Germany

Atomically thin sheets of carbon, graphene, can be used as current-carrying components in field-effect transistors. Using micromechanical cleavage of natural graphite, flakes of different thickness are deposited on top of a silicon wafer with a 330 nm thick silicon oxide, including also folded samples. This folding leads to a misorientation and thereby to decoupling of the two stacked layers.

We present measurements on such two layer systems consisting of decoupled monolayers [1]. To distinguish this sample from monolayer and single cystal bilayer graphene, magnetotransport measurements are carried out with temperatures down to 1.5 Kelvin. A backgate voltage between -70 V and 70 V is used to tune the carrier concentration and type. Applying magnetic fields up to 13 Tesla, the longitudinal resistance shows two sets of Shubnikov-de Haas oscillations with a Berry's phase of π for both oscillations, verifying a system of stacked monolayers. From the period of theses oscillations, the charge carrier densities are obtained, showing different values for each layer due to screening effects.

[1] H. Schmidt, T. Lüdtke, P. Barthold, E. McCann, V. I. Fal'ko, and R. J. Haug, Appl. Phys. Lett. 93, 172108 (2008)