HL 83: Transport I

Time: Thursday 15:00–16:30 Location: H16

HL 83.1 Thu 15:00 H16

Electrical properties of InAs nanowires and their interband tunneling across Si heterojunctions for future FET devices — •Pascal Wittlich[1], Stefanie Morkötter[1], Tao Yang[1], Julian Treu[1], Simon Hertenberger[1], Verena Hintermayr[1], Philipp Geselbracht[1], Max Bichler[1], Gerhard Abstreiter[1,2], and Gregor Koblmüller[1] — [1]Walter Schottky Institut and Physik Department, TU München, Garching, Germany — [2]TUM Institute for Advanced Study, Garching, Germany

We present recent results on the electrical transport characteristics of MBE grown InAs nanowires on Si substrate. Several investigations in different NW device geometries are performed, either as vertical free-standing NW devices for all-surround gate NW-FET configurations or as transferred nanowires for fabrication of both back- and top-gated NW-FETs in horizontal geometry. For the latter, we show dependencies of growth parameters, microstructure, contact metal, and surface passivation schemes (high-k dielectrics) on the total NW-FET resistance as well as transconductance and electron mobility. For vertical devices directly integrated on Si, we report a detailed study of inter-band tunneling across p-type Si/n-InAs heterojunctions as a function of substrate doping level and NW diameter. For large doping levels we find the possibility for large tunnel currents and Esaki-type tunneling with explicit negative differential resistance in thin NWs [1]. These results open viable routes for future high-performance III/V-on-Si tunnel-FET devices.

[1] T. Yang et al, Appl. Phys. Lett. 101, 233102 (2012).

HL 83.2 Thu 15:15 H16

Increased Stability of Solution Processed ZnO TFTs by Selectively Bonded Diketones — •Marlis Ortel, Nataliya Kalinovich, Gerd Röschenthaler, and Veit Wagner — Research Center for Functional Materials and Nanomolecular Science, Jacobs University Bremen, Campus Ring 1, 28759 Bremen, Germany

10nm thick nano-crystalline ZnO layers were deposited by spray pyrolysis in TFT configuration in order to investigate the impact of surface states on the TFT performance. Surface trap states are known to have significant influence on mobility, hysteresis and operational stability of transistors. Diketone molecules were applied to the surface, which are known to bind selectively to zinc ions in order to reduce the trap state density. It was found that the electronic structure of the semiconductor was tuned depending on the functional groups attached to the diketone. Transistors coated with 4,4,4-trifluoro-1-phenylbutane-1,2-dione were found to stabilize the TFT performance even under long term gate bias stress. Furthermore the mobility was significantly increased by 30% to 9cm2V-1s-1 after few seconds of exposure to the chemical compound. Hence diketones are concluded to be suitable materials to minimize trapping process in zinc oxide which leads to strongly improved device characteristics.

HL 83.3 Thu 15:30 H16

Influence of boron cluster states on the transport properties of (B,Ga)P — •Steve Petznick[1], Kathleen Klinkmüller[1], Kerstin Volz[2], and Peter J. Klar[1] — [1]Institute of Experimental Physics I, Justus-Liebig University, Giessen, Germany — [2]Structure & Technology Research Laboratory (STRL), Philipps-Universität, Marburg, Germany

The influence of boron incorporation in n-type $B_xGa_{1-x}P$:Y (with $0.9 \leq x \leq 1.9\,\%$ and Y = Te, Si) layers on the transport properties has been studied. The 500 nm thick (B,Ga)P layers were grown by metal-organic vapor phase epitaxy (MOVPE) on semi-insulating (001) GaP substrates. Transport measurements at ambient and hydrostatic pressure were performed at different temperatures between 1.6 and 280 K in Van der Pauw geometry and in applied magnetic fields up to 10 T.

Boron is an isovalent impurity in GaP yielding to a density of localized states in the vicinity of the conduction band edge. These localized states act as scattering centers and have a severe impact on the transport behavior of this n-type material.

Hydrostatic pressure allows one to tune the band structure while the composition stays exactly the same. Therefore measurements under hydrostatic pressure were performed to examine the interplay of boron cluster states and the conduction band edge states. The impact on magneto-resistance, resistivity, carrier mobility and concentration, and their temperature and pressure dependence will be discussed.

HL 83.4 Thu 15:45 H16

Magnetotransport measurements on nanostructured $Bi_{1-x}Sb_x$ alloys — •Matthias T. Elm[1], Christian H. Will[1], Bernadette Landschreiber[2], Ekrem Güneş[2], Sabine Schlecht[2], and Peter J. Klar[1] — [1]I. Physikalisches Institut, Justus-Liebig-Universität, Heinrich-Buff Ring 16, 35392 Gießen — [2]Institut für Anorganische und Analytische Chemie, Heinrich-Buff-Ring 58, 35392 Gießen

A series of nanostructured $Bi_{1-x}Sb_x$ alloy samples were prepared by cold pressing of Bi and Sb nanoparticles, which were synthesized by mechanical alloying. The Sb content in the alloys varied between 0% to 50%. Increasing the Sb content strongly influences the band structure resulting in a change of the transport behavior from semi-metallic to semiconducting behavior with a maximum band gap of 41.5 meV at a Sb concentration of around 14% determined from temperature-dependent resistivity measurements. At even higher Sb concentrations the transport behavior becomes semi-metallic again. The change of the band structure was investigated by magnetotransport measurements at a temperature of 30 K in magnetic fields up to 10 T. Using a three band model and taking into account the influence of the magnetic field on the band structure it was possible to describe the magnetic-field induced changes of the magnetoresistance as well as the Hall-constant of the different samples.

HL 83.5 Thu 16:00 H16

Resonant cavity enhanced telecommunication wavelength light detection by resonant tunneling — •Andreas Pfenning, Fabian Hartmann, Fabian Langer, Dirk Bisping, Sven Höfling, Martin Kamp, Alfred Forchel, and Lukas Worschech — Technische Physik, Physikalisches Insitut, Universität Würzburg and Wilhelm Conrad Röntgen Research Center for Complex Material Systems, Am Hubland, D-97074 Würzburg, Germany

We have fabricated GaAs based resonant tunneling diodes (RTD) with a nearby and lattice matched quaternary GaInNAs absorption layer for light detection at the telecommunication wavelength $\lambda = 1.3\ \mu$m. The RTD photodetector was embedded in an optical cavity consisting of alternating GaAs/AlAs distributed Bragg reflectors (DBR) with a resonance wavelength at $\lambda = 1.29\ \mu$m. RTD mesas with ring shaped contacts and an aperture for optical excitation of charge carriers were fabricated with diameters from 12 μm down to 1 μm. At room temperature resonant tunneling was found with a peak-to-valley ratio of 1.3. Photocurrent measurements of the RTD photodetector showed sensitivities of 31 kA/W for resonant optical excitation and a quantum efficiency enhancement of 10 compared to off resonance excitation. The photodetector shows a resolution down to single photons.

HL 83.6 Thu 16:15 H16

Effects of defects near source or drain contacts of carbon nanotube transistors — •Neng-Ping Wang[1] and Xiao-Jun Xu[2] — [1]Physics Department, Science Faculty, Ningbo University, Fenghua Road 818, Ningbo 315211, P.R. China — [2]Information Faculty, Ningbo City College of Vocational Technology, Xuefu Road 9, Ningbo 315100, P.R. China

In field-effect transistors, charge trapping in the gate oxide is known to cause random telegraph signals (RTSs) in the drain current. We calculate the amplitude of the RTS due to a single charged defect in a long-channel p-type carbon nanotube field-effect transistor, using the nonequilibrium Greens function method in a tight-binding approximation. We find that in the turn-on regime, the amplitude of the RTS due to a positive charge increases with the distance of the charge from the source (or drain) contact, and in the middle of the channel the RTS amplitude reaches about 100%. The amplitude of the RTS caused by a positive charge close to the source (or drain) contact increases with the applied gate voltage and drain voltage. In the on-state, a positive charge located at the nanotube-oxide interface and close to the source (or drain) contact may cause large RTSs about 50%. Similar amplitudes of RTSs have been observed in recent experiments [F. Liu, etal, Appl. Phys. Lett., 86 (2005) 163102].