HL 66: Transport Properties III (Experiments)

Time: Wednesday 18:15–19:30 Location: ER 164

HL 66.1 Wed 18:15 ER 164

Picosecond time-resolved photocurrents in GaAs nanowires — •Nadine Erhard[1], Leonhard Prechtel[1], Milan Padilla[1], Helmut Karl[2], Gerhard Abstreiter[1], Anna Fontcuberta[3], and Alexander Holleitner[1] — [1]Walter Schottky Institut and Physik-Department, TU München, Am Coulombwall 4a, D-85748 Garching, Germany — [2]Institute of Physics, University of Augsburg, D-86135 Augsburg, Germany — [3]Laboratoire des Materiaux Semiconducteurs, Ecole Polytechnique Federale de Lausanne, 1015 Lausanne, Switzerland

Conventional scanning photocurrent microscopy (SPCM) experiments on semiconductor nanowires are typically limited to timescales exceeding 10 ps. Yet, it is known from optical experiments that carrier relaxation and transport processes can occur on much faster timescales in semiconducting nanowires. We therefore apply a recently developed pump-probe photocurrent spectroscopy to investigate the photocurrent dynamics of p-doped GaAs nanowires with a picosecond time-resolution. Hereby, the ultrafast photocurrent response of the nanowire is sampled at a field probe in a stripline circuit. We discuss ultrafast thermoelectric, displacement, and carrier lifetime limited currents as well as the time-resolved transport of photogenerated holes.

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Transporteigenschaften von (BGa)((As)P)-Kontaktschichten für monolithisch integrierte Ga(NAsP)-Laser auf Si-(001)-Substraten — •Christian Lück[1], Martin Zimprich[1], Sven Liebich[1], Andreas Arndt[1], Andreas Beyer[1], Bernardette Kunert[2], Kerstin Volz[1] und Wolfgang Stolz[1] — [1]Struktur- und Technologieforschungslabor (STRL) und Fachbereich Physik, Philipps-Universität Marburg, Hans-Meerwein-Straße, 35032 Marburg — [2]NAsP III/V GmbH, Am Knechtacker 19, 35041 Marburg

Die monolithische Integration von aktiven optischen Komponenten in die Silizium-Nanoelektronik führt zu neuartigen integrierten Schaltkreisen. Der hier vorgestellte Lösungsansatz für die Laserkomponente ist das verdünnt-stickstoffhaltige Materialsystem Ga(NAsP), das eine direkte Energielücke aufweist und gitterangepaßt auf Si-(001)-Substrat mittels der metall-organischer Gasphasenepitaxie abgeschieden werden kann. Erste Breitstreifenlaserstrukturen zeigen Laseremission bis 165 K mit einem Schwellstrom von 1,5 kA/cm^2 [1]. In diesen gitterangepassten Laserstrukturen werden (BGa)P-Kontaktschichten sowie (BGa)(AsP)-Wellenleiterschichten eingesetzt. Die elektrischen Transporteigenschaften dieser Schichtstrukturen wurden eingehend mittels temperatur-abhängiger Magnetotransportmessungen als Funktion der Dotierung und der Zusammensetzung aufgeklärt und im Hinblick auf den möglichen Einsatz in effizienten elektrischen Injektionslaserstrukturen auf Si (001)-Substrat optimiert.

[1] Liebich et al., Appl. Phys. Lett. 99, 071109 (2011).

HL 66.3 Wed 18:45 ER 164

Ballistic and thermoelectric contributions to transverse rectification in density-modulated 2D-systems — •Arkadius Ganczarczyk[1], Andy Quindeau[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

We investigate tunable transverse rectification in a density-modulated two-dimensinal electron gas (2DEG) from $T = 1.8$ K to 300 K. The 2DEG is patterned into a hall bar geometry. Using gate electrodes we induce two stripes of different charge carrier densities along the channel. The resulting density gradient perpendicular to the channel induces a transverse voltage, which - due to the symmetry of the device - does not change polarity when the current direction is reversed [1, 2].

To acquire a deeper insight into the physics behind this rectification effect, we investigate its dependence on modulation strength, temperature and the width of the stripes. The results are discussed using a billiard model, which describes the propagation of ballistic electrons in density-modulated 2D-systems. Also possible thermoelectric effects in the structure are considered. In order to calculate the expected thermoelectric voltage in such a system, the electron temperatures in the heated electron gas are determined experimentally. Both models are compared in order to obtain a deeper insight into this novel rectification effect.

[1] A. Ganczarczyk *et al.*, preprint:arXiv:0804.0689v3 (2009).
[2] A. Ganczarczyk *et al.*, AIP Conf. Proc. 1199, 143 (2009).

HL 66.4 Wed 19:00 ER 164

GaAs/AlGaAs resonant tunneling diodes with a GaInNAs absorption layer for telecommunication light sensing — •Fabian Hartmann, Fabian Langer, Dirk Bisping, Sven Höfling, Martin Kamp, Alfred Forchel, and Lukas Worschech — Technische Physik, Physikalisches Institut, Universität Würzburg and Wilhelm Conrad Röntgen Research Center for Complex Material Systems, Am Hubland, D-97074 Würzburg, Germany

GaAs based double AlGaAs barrier resonant tunneling diodes (RTD) were grown by molecular beam epitaxy with a nearby, lattice-matched GaInNAs absorption layer. The electrical and optical properties of the RTDs were investigated for different thicknesses of a thin GaAs buffer layer incorporated between the AlGaAs barrier and the GaInNAs absorption layer. RTD mesas with ring contacts and an aperture for optical excitation of charge carriers were fabricated with diameters from 12 down to 1 micrometer. A resonant current peak was observed for all samples at room temperature with a maximum peak-to-valley ratio of 3.9. Under illumination with laser light of 1300 nm wavelength, a pronounced photo-effect is found with sensitivities of about 1000 A/W.

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Bistable swichting in double electron layer Y branch switches — •Stefan Kremling, Sven Höfling, Lukas Worschech, Martin Kamp, and Alfred Forchel — Technische Physik, Wilhelm Conrad Röntgen Research Center for Complex Material Systems, Physikalisches Institut, Universität Würzburg, Am Hubland, Bavaria, D-97074 Würzburg, Germany

Nanoelectronics with III-V compound semiconductors have attracted considerable attention due to their outstanding electron transport properties. Y-branch switches (YBSs) which consist of a drain split along a branching section into two branches have been proposed as efficient switching devices. Recently, selfgating of YBSs has been observed in the nonlinear regime at bias voltages of a few Volts, where one branch serves as gate to control the conductance of the other branch. In order to enhance the selfgating for small bias voltages, the couplings between the branches have to be maximized, e.g. by closely spaced electron layers. By means of electron beam lithography, YBSs were defined in double electron layers based on GaAs quantum wells embedded in AlGaAs barriers. The transfer characteristics of the YBSs were tested and maximum transconductances values of e/kT were observed at the transition to bistable switching. A model for a dynamic gate operation is proposed and compared with the measurements.